SFI SYSTEM

PRECAUTION

1. INITIALIZATION

NOTICE:

- **Perform the RESET MEMORY (AT initialization) when replacing the automatic transmission assembly, engine assembly or ECM (See page AT-17).**
- **Perform the REGISTRATION (VIN registration) when replacing the ECM (See page ES-14).**
- **If the ECM has been replaced or RESET MEMORY (AT initialization) has been performed, set up the function of the ATF (Automatic Transmission Fluid) temperature warning light (See page AT-17).**

HINT:

Initialization can not be completed by only removing the battery.

2. FOR USING INTELLIGENT TESTER

CAUTION:

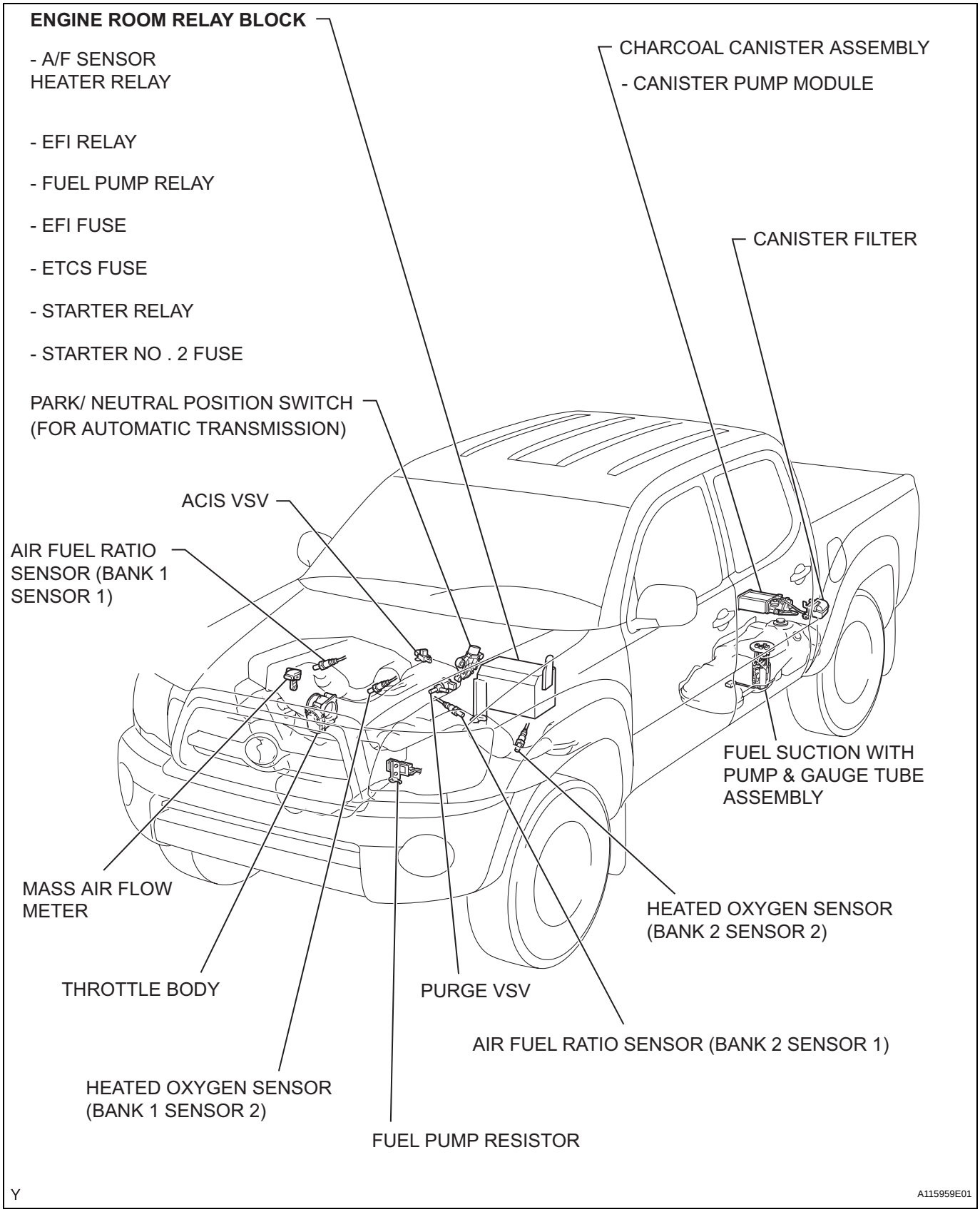
Observe the following items for safety reasons:

- Read its instruction books before using the tester.
- Prevent the tester cable from being caught on the pedals, shift lever and steering wheel when driving with the tester connected to the vehicle.
- When driving the vehicle for testing purposes using the tester, two persons are required. One is for driving the vehicle, and the other operates the tester.

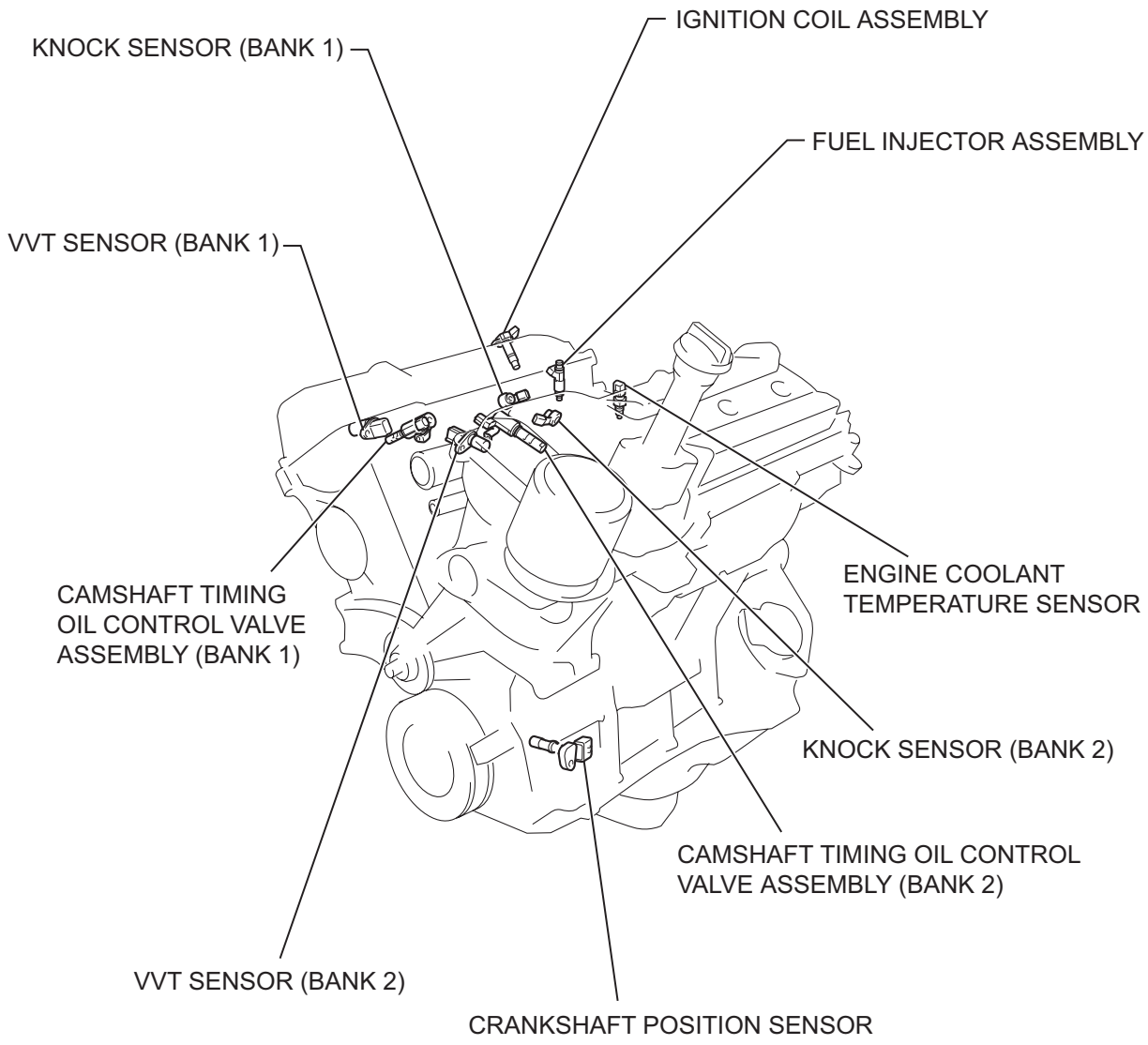
DEFINITION OF TERMS

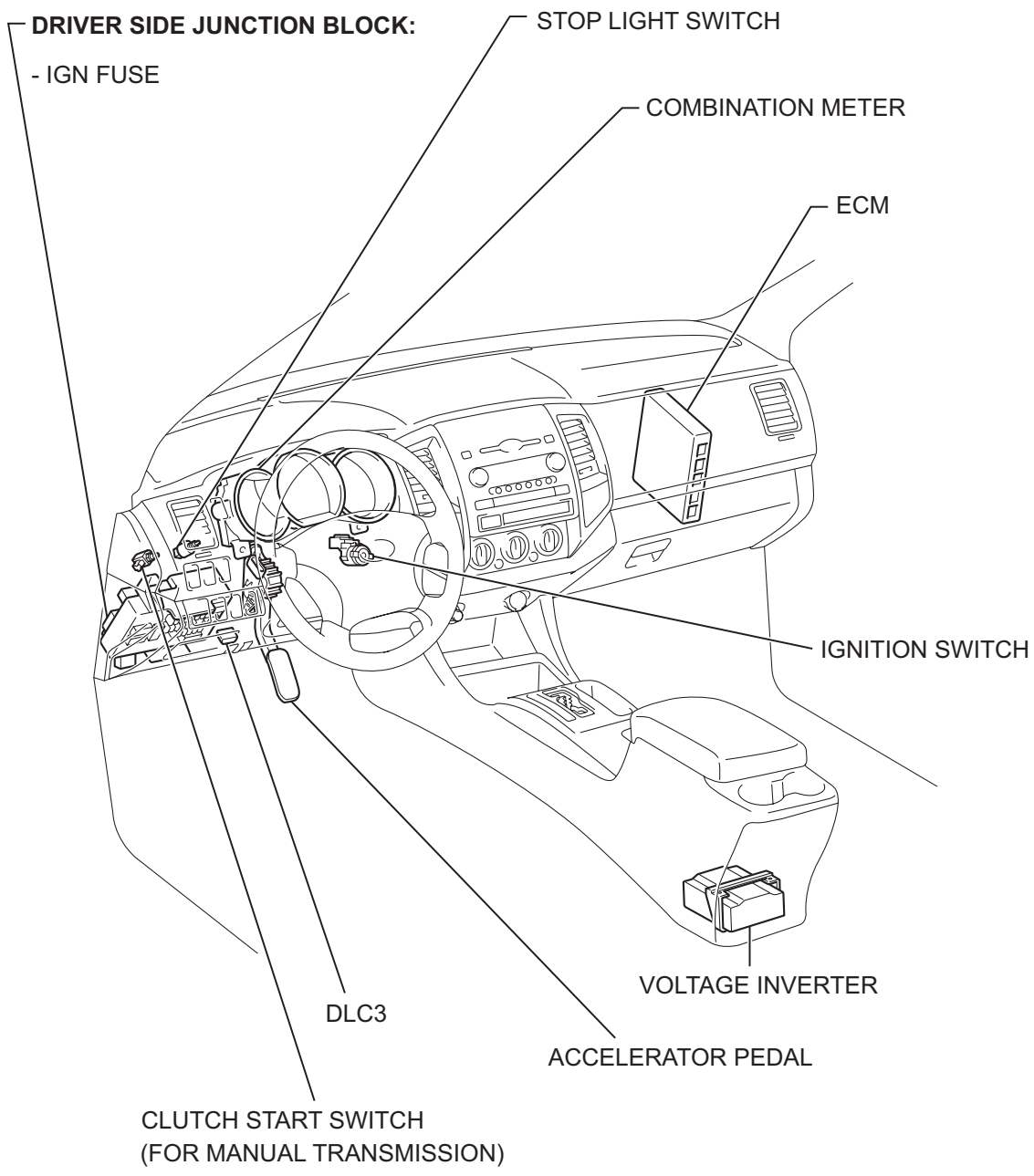
Terms	Definitions
Monitor Description	Description of what ECM monitors and how detects malfunctions (monitoring purpose and details)
Related DTCs	A group of diagnostic trouble codes that are output by ECM based on same malfunction detection logic.
Typical Enabling Conditions	Preconditions that allow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

PARTS LOCATION



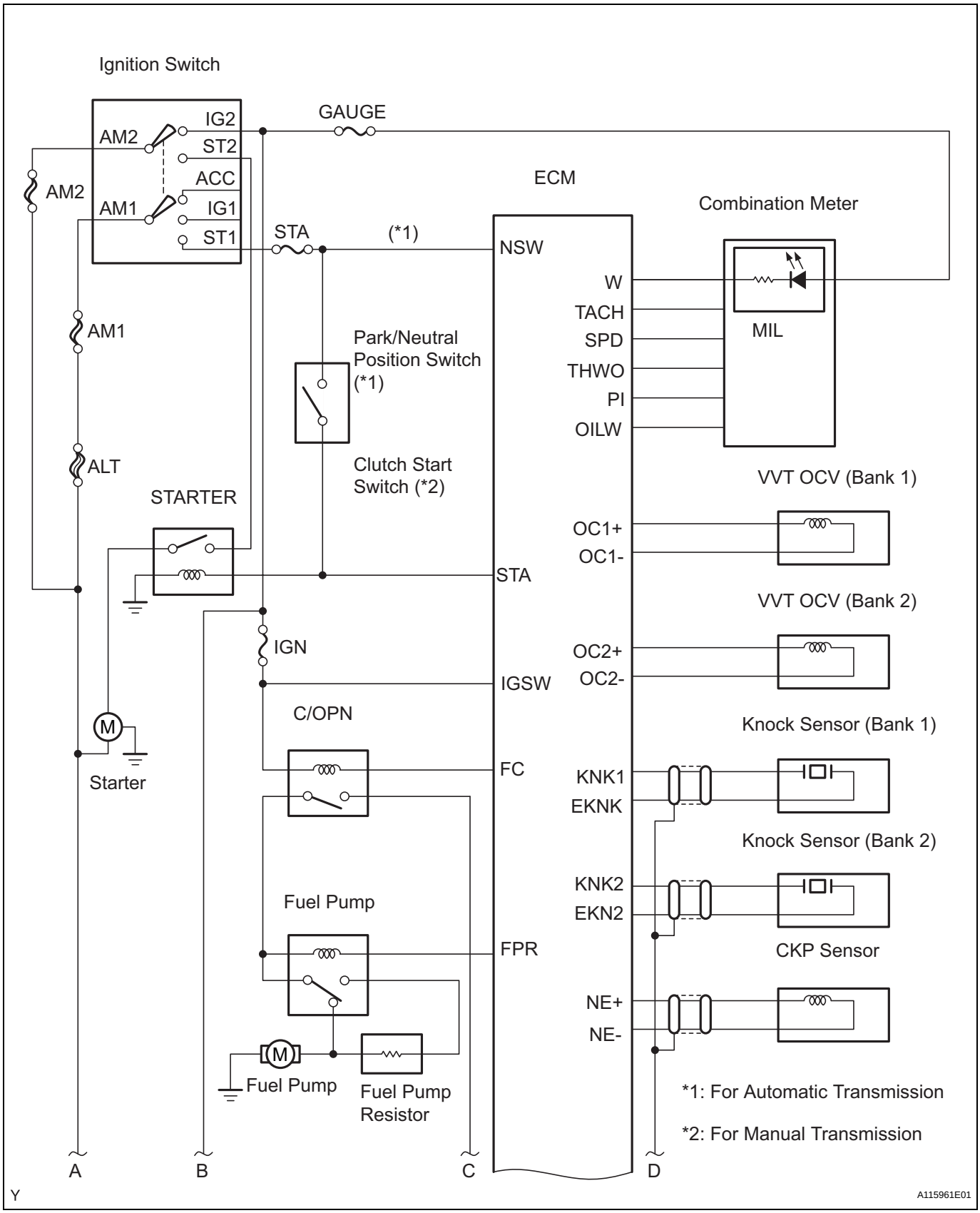
ES

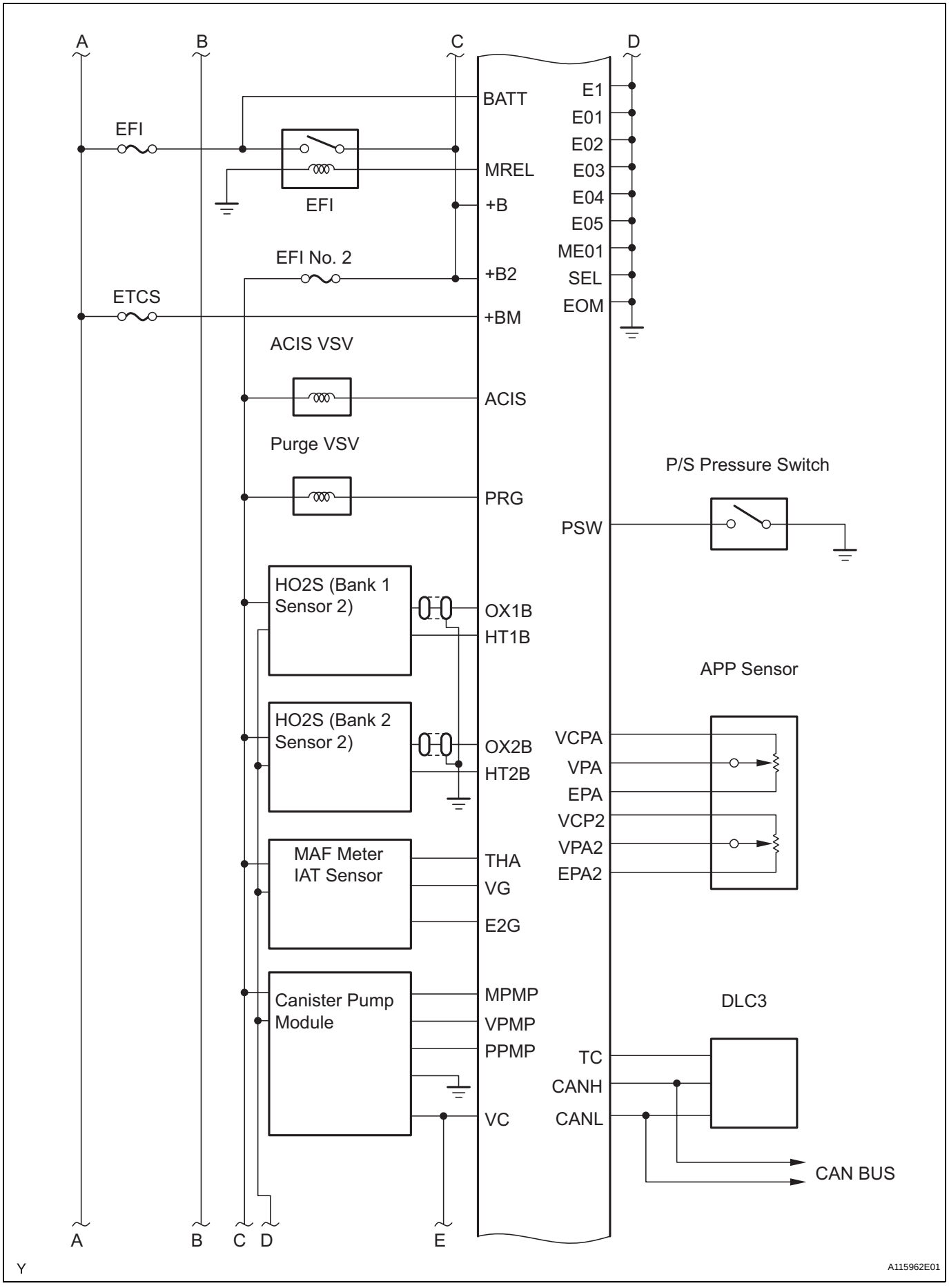

KNOCK SENSOR (BANK 1)
IGNITION COIL ASSEMBLY
FUEL INJECTOR ASSEMBLY
VVT SENSOR (BANK 1)
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (BANK 1)
ENGINE COOLANT TEMPERATURE SENSOR
KNOCK SENSOR (BANK 2)
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (BANK 2)
VVT SENSOR (BANK 2)
CRANKSHAFT POSITION SENSOR
Y
A115960E01

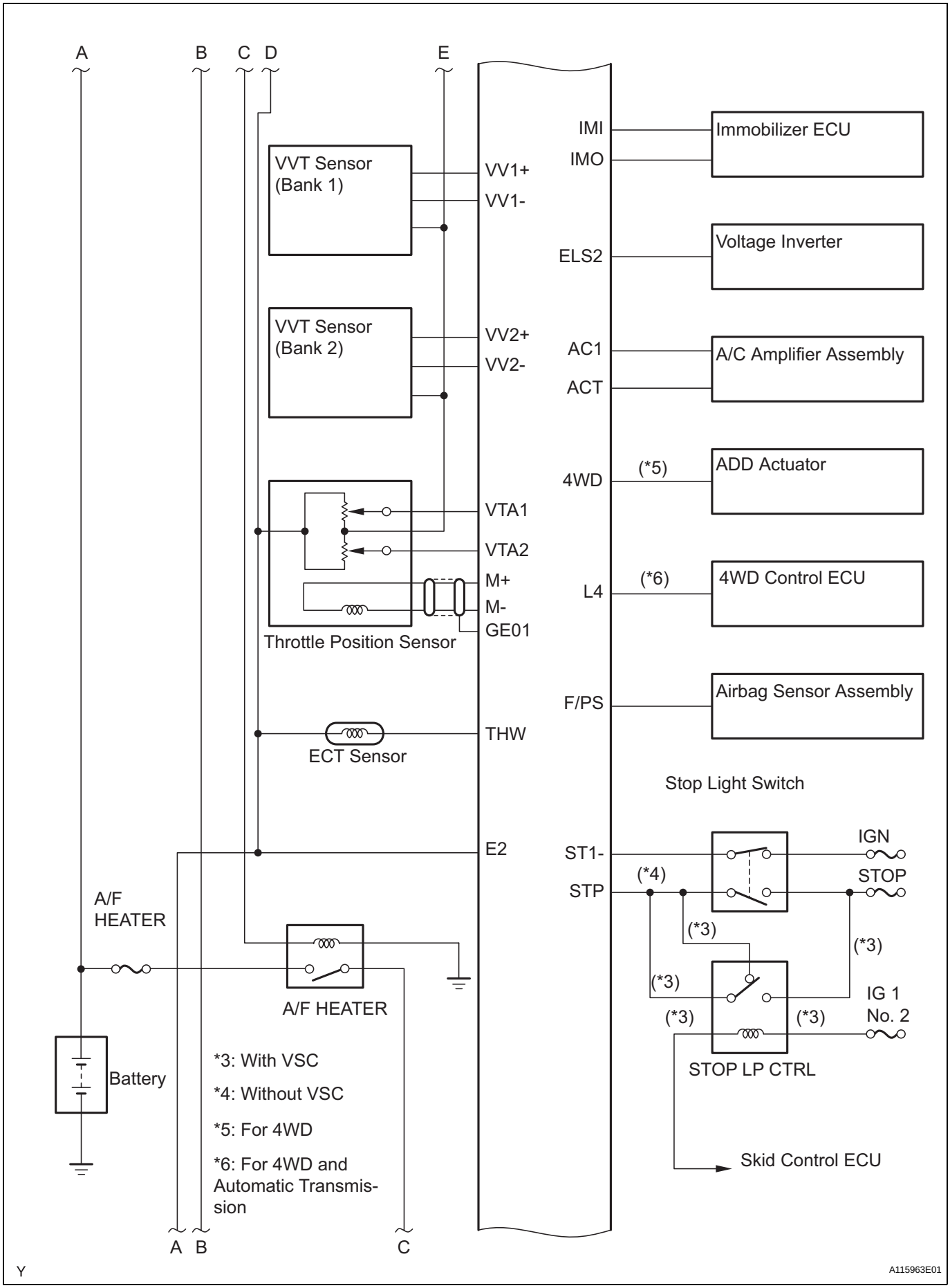

DRIVER SIDE JUNCTION BLOCK:
- IGN FUSE
STOP LIGHT SWITCH
COMBINATION METER
ECM
IGNITION SWITCH
VOLTAGE INVERTER
DLC3
ACCELERATOR PEDAL
CLUTCH START SWITCH
(FOR MANUAL TRANSMISSION)
Y
G034987E04

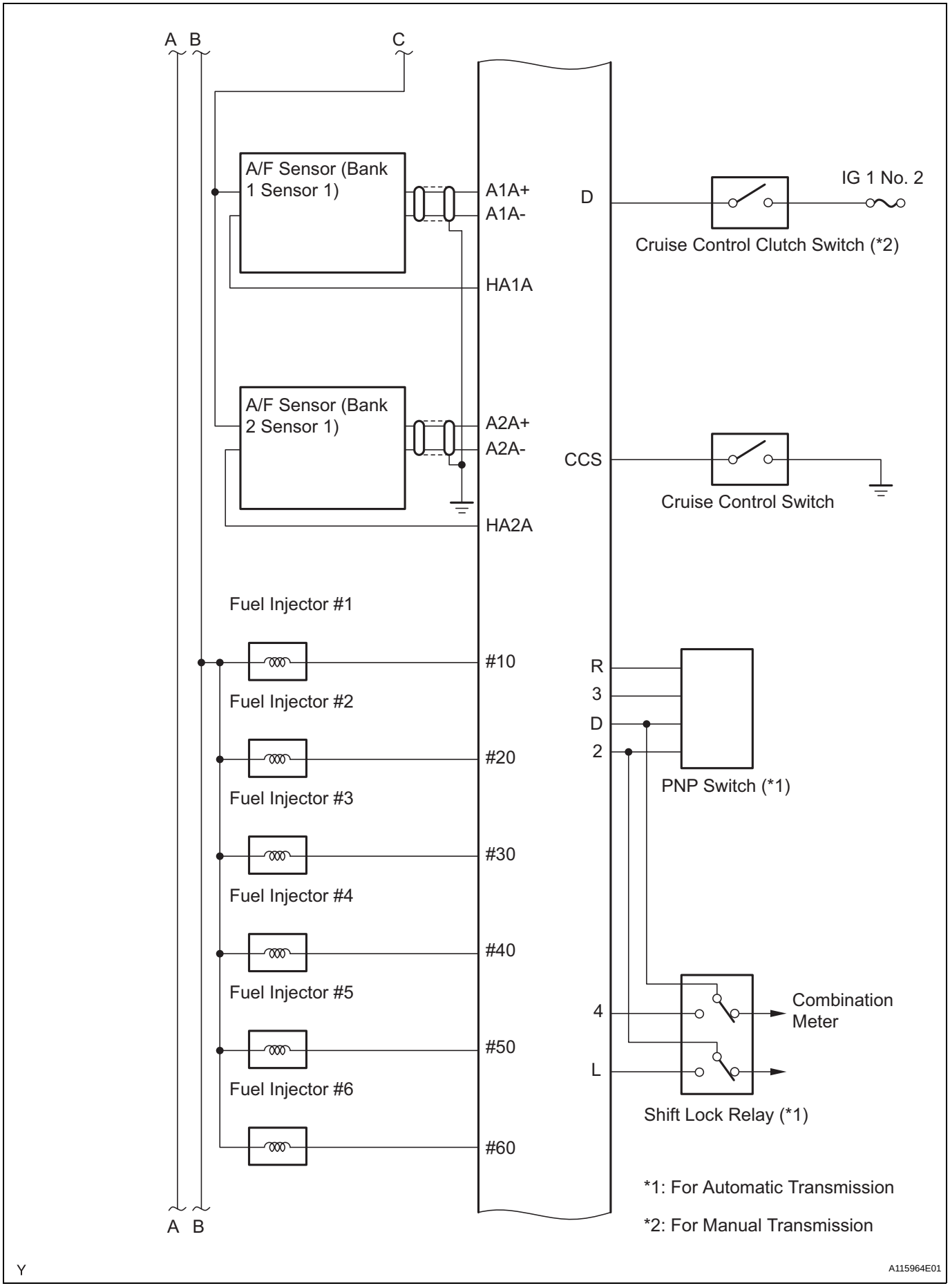
ES

SYSTEM DIAGRAM



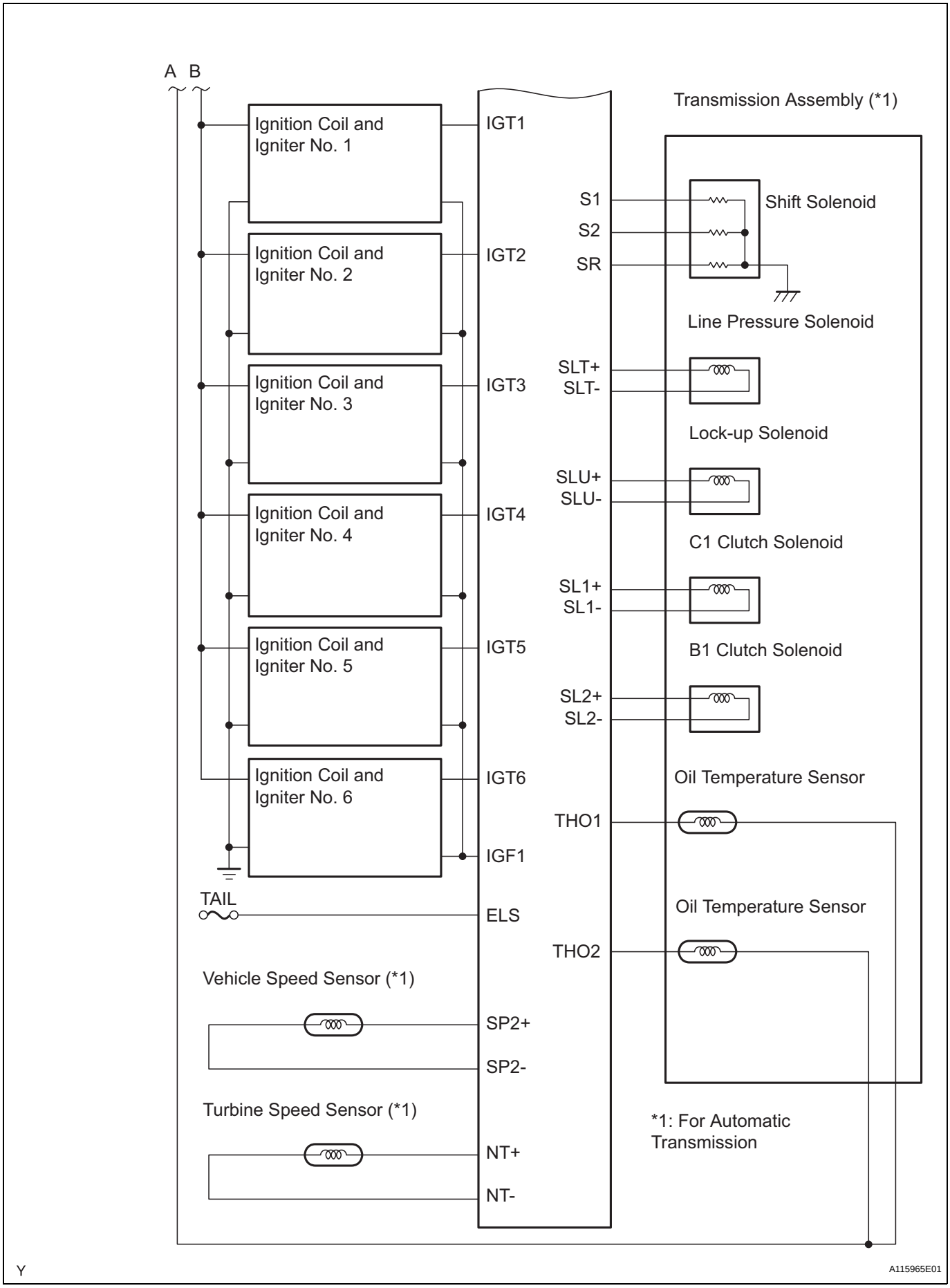

A
B
C
D
EFI
EFI
BATT
MREL
+B
E1
E01
E02
E03
E04
E05
ME01
SEL
EOM
EFI No. 2
+B2
ETCS
+BM
ACIS VSV
ACIS
Purge VSV
PRG
P/S Pressure Switch
PSW
HO2S (Bank 1 Sensor 2)
OX1B
HT1B
APP Sensor
HO2S (Bank 2 Sensor 2)
OX2B
HT2B
VCPA
VPA
EPA
VCP2
VPA2
EPA2
MAF Meter IAT Sensor
THA
VG
E2G
Canister Pump Module
MPMP
VPMP
PPMP
VC
DLC3
TC
CANH
CANL
CAN BUS
A
B
C
D
E
Y
A115962E01


A
B
C
D
E
VVT Sensor (Bank 1)
VV1+
VV1-
VVT Sensor (Bank 2)
VV2+
VV2-
VTA1
VTA2
M+
M-
GE01
Throttle Position Sensor
THW
ECT Sensor
E2
A/F HEATER
A/F HEATER
Battery
*3: With VSC
*4: Without VSC
*5: For 4WD
*6: For 4WD and Automatic Transmission
A B
C
IMI
IMO
Immobilizer ECU
ELS2
Voltage Inverter
AC1
ACT
A/C Amplifier Assembly
4WD
(*5)
ADD Actuator
L4
(*6)
4WD Control ECU
F/PS
Airbag Sensor Assembly
Stop Light Switch
ST1-
STP
(*4)
IGN
STOP
(*3)
(*3)
(*3)
(*3)
(*3)
IG 1
No. 2
STOP LP CTRL
Skid Control ECU
Y
A115963E01


A B
C
A/F Sensor (Bank 1 Sensor 1)
A1A+
A1A-
HA1A
A/F Sensor (Bank 2 Sensor 1)
A2A+
A2A-
HA2A
Fuel Injector #1
#10
Fuel Injector #2
#20
Fuel Injector #3
#30
Fuel Injector #4
#40
Fuel Injector #5
#50
Fuel Injector #6
#60
D
IG 1 No. 2
Cruise Control Clutch Switch (*2)
CCS
Cruise Control Switch
R
3
D
2
PNP Switch (*1)
4
L
Combination Meter
Shift Lock Relay (*1)
*1: For Automatic Transmission
*2: For Manual Transmission
A B
Y
A115964E01

ES

ES


A B
Ignition Coil and Igniter No. 1
Ignition Coil and Igniter No. 2
Ignition Coil and Igniter No. 3
Ignition Coil and Igniter No. 4
Ignition Coil and Igniter No. 5
Ignition Coil and Igniter No. 6
IGT1
IGT2
IGT3
IGT4
IGT5
IGT6
IGF1
TAIL
ELS
Vehicle Speed Sensor (*1)
SP2+
SP2-
Turbine Speed Sensor (*1)
NT+
NT-
Transmission Assembly (*1)
S1
S2
SR
Shift Solenoid
Line Pressure Solenoid
SLT+
SLT-
Lock-up Solenoid
SLU+
SLU-
C1 Clutch Solenoid
SL1+
SL1-
B1 Clutch Solenoid
SL2+
SL2-
Oil Temperature Sensor
THO1
Oil Temperature Sensor
THO2
*1: For Automatic Transmission
Y
A115965E01

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, perform steps 10 and 12 first.

Result	Proceed To
Malfunction does not occur	A
Malfunction occurs	B

B → GO TO STEP 10

A

9	SIMULATE SYMPTOMS

NEXT

10	CHECK DTC*

Result	Proceed To
Malfunction code	A
No code	B

B → GO TO STEP 12

A

11	REFER TO DTC CHART

NEXT

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

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

17	CONDUCT PARTS INSPECTION

NEXT

18	IDENTIFY PROBLEM

NEXT

19	ADJUST AND/OR REPAIR

NEXT

20	CONDUCT CONFIRMATION TEST

NEXT

END

ES

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 1trip detection logic, which is more sensitive to malfunctions than normal mode (default), which uses 2trip detection logic.

1. Clear DTCs (See page ES-38).
2. Switch the ECM from normal mode to check mode using an intelligent tester (See page ES-41).
3. Perform a simulation test.
4. Check and wiggle the harness(es), connector(s) and terminal(s).

BASIC INSPECTION

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

1 CHECK BATTERY VOLTAGE

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 WILL CRANK

NG → **PROCEED TO PROBLEM SYMPTOMS TABLE**

OK

3 CHECK WHETHER ENGINE STARTS

NG → **GO TO STEP 6**

OK

4 CHECK AIR FILTER

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

NG → **REPLACE AIR FILTER**

OK

5 CHECK IDLING SPEED

NG → **TROUBLESHOOT IDLING SPEED AND PROCEED TO NEXT STEP**

OK

6	CHECK FUEL PRESSURE

NG → TROUBLESHOOT FUEL PRESSURE AND PROCEED TO NEXT STEP

OK

7	CHECK FOR SPARK

NG → TROUBLESHOOT SPARK AND PROCEED TO NEXT STEP

OK

PROCEED TO PROBLEM SYMPTOMS TABLE

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 resister the VIN.

1. DESCRIPTION

This registration section consists of three parts, Input Instructions, Read VIN and Write VIN.

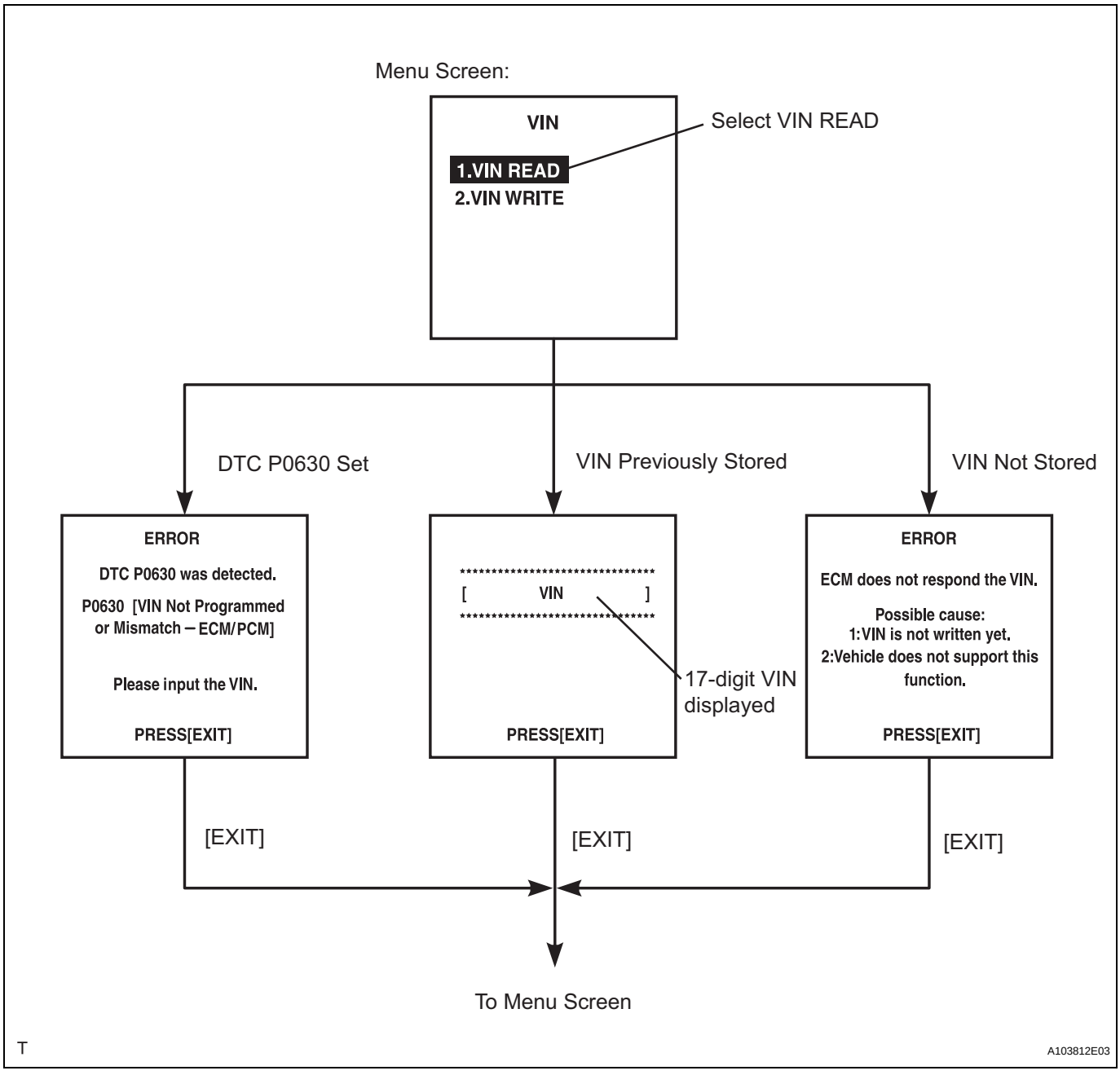
(a) Input Instructions: Explains the general VIN input instructions using an intelligent tester.
(b) Read VIN: Explains the VIN reading process in a flowchart. This process allows the VIN stored in the ECM to be read, in order to confirm that the two VINs, provided with the vehicle and stored in the vehicle's ECM, are the same.
(c) Write VIN: Explains the VIN writing process in a flowchart. This process allows the VIN to be input into the ECM. If the ECM is changed, or the VIN and VIN do not match, the VIN can be registered, or overwritten in the ECM by following this procedure.

2. INPUT INSTRUCTIONS

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

3. READ VIN

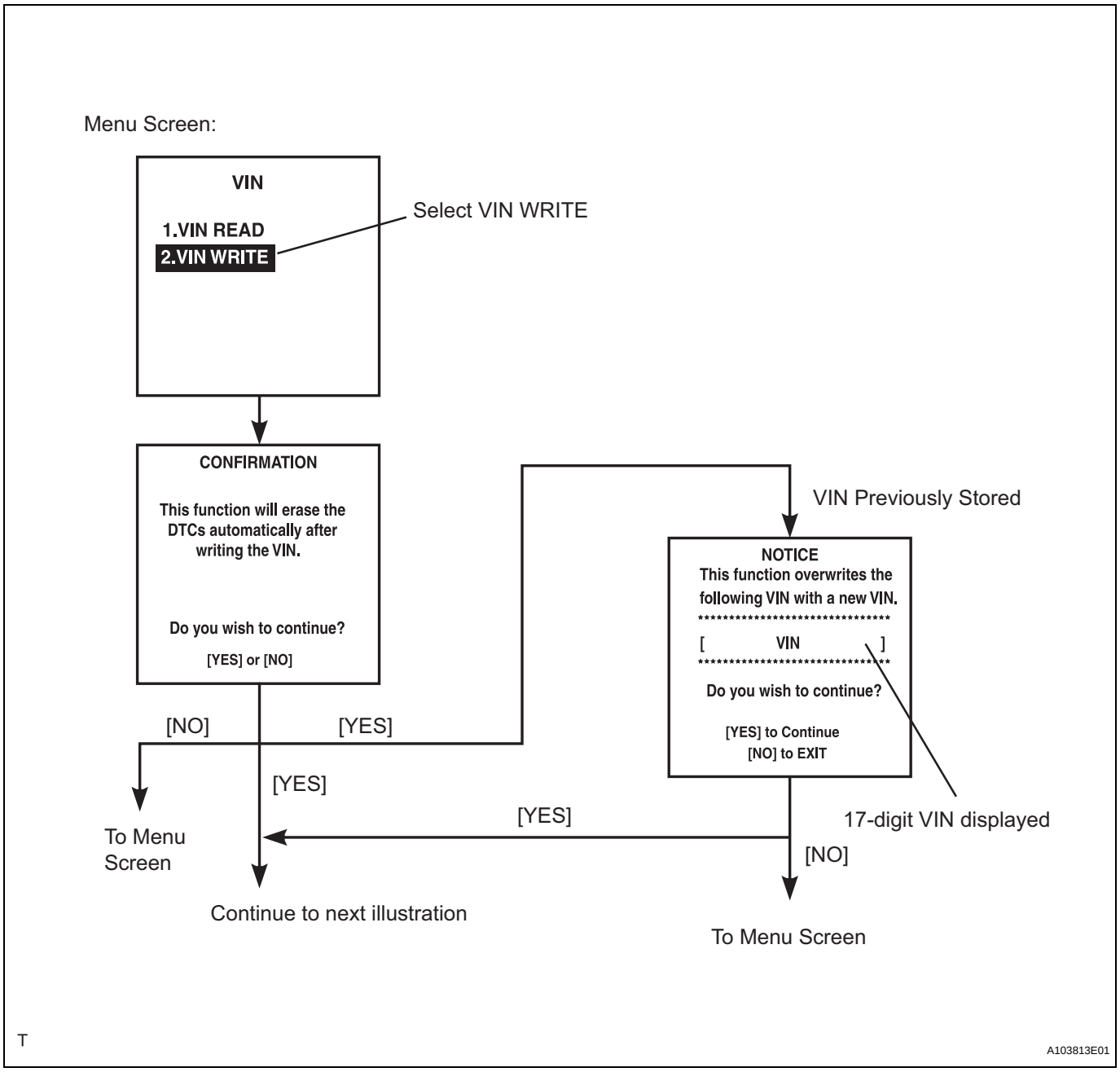
(a) Confirm the vehicle VIN.
(b) Connect an intelligent tester to the DLC3.
(c) Turn the ignition switch ON.
(d) Turn the tester ON.
(e) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / VIN.



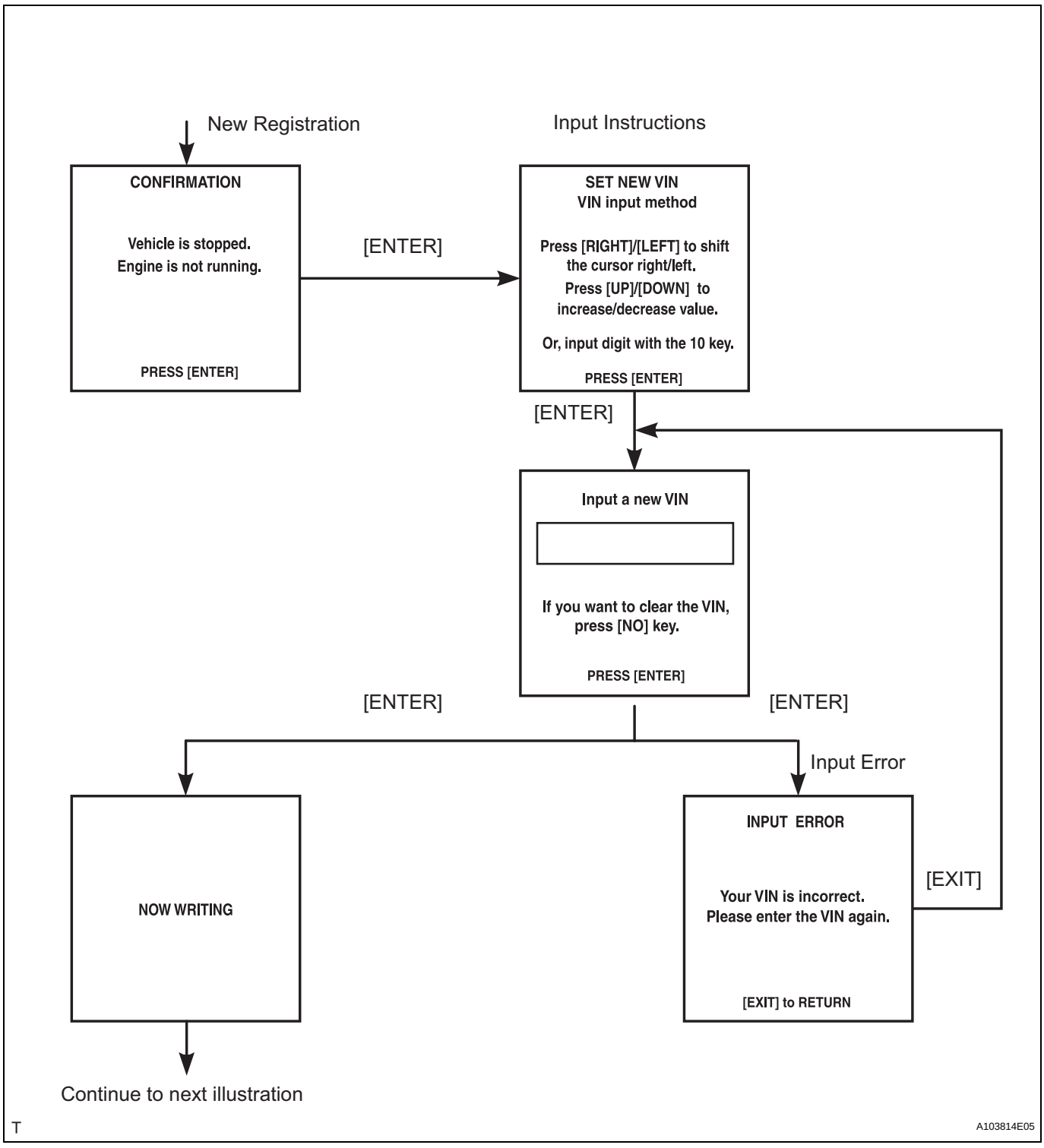
4. WRITE VIN

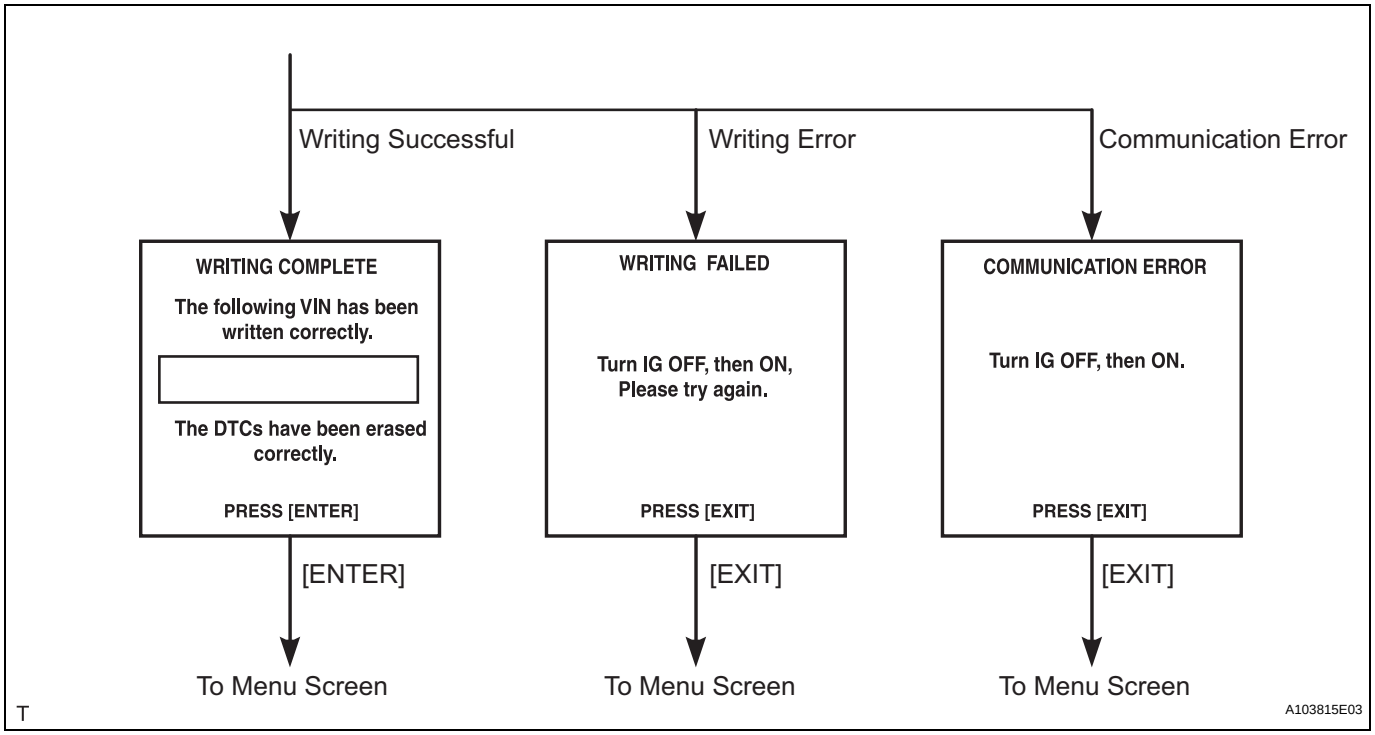
(a) Confirm the vehicle VIN.
(b) Connect an intelligent tester to the DLC3.
(c) Turn the ignition switch ON.
(d) Turn the tester ON.

(e) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / VIN.



ES


New Registration
Input Instructions
CONFIRMATION
Vehicle is stopped.
Engine is not running.
PRESS [ENTER]
[ENTER]
SET NEW VIN
VIN input method
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
A103814E05


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

ES

CHECKING MONITOR STATUS

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

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

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

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

1. PERFORM MONITOR DRIVE PATTERN

(a) Connect an intelligent tester to the DLC3.

(b) Turn the ignition switch ON and the tester ON.

(c) Clear DTCs (See page ES-38).

(d) Run the vehicle in accordance with the applicable drive pattern described in READINESS MONITOR DRIVE PATTERN (See page ES-23). 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 from the intelligent tester menus: DIAGNOSIS, ENHANCED OBDII, 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 test limit and maximum test limit, the component is functioning normally. If not, the component is malfunctioning. The test value is usually significantly higher or lower than the test limit. If the test value is on the borderline of the test limit, the component will malfunction in the near future.
HINT:
The monitor result might on rare occasions be PASS even if the malfunction indicator lamp (MIL) is illuminated. This indicates the system malfunctioned on a previous driving cycle. This might be caused by an intermittent problem.

4. MONITOR RESULT INFORMATION

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

A/F Sensor Bank 1

Monitor ID	Test ID	Scaling	Unit	Description
$01	$8E	Multiply by 0.0003	No dimension	Response rate deterioration level for bank 1 sensor 1
$01	$91	Multiply by 0.004	mA	A/F sensor current

A/F Sensor Bank 2

Monitor ID	Test ID	Scaling	Unit	Description
$05	$8E	Multiply by 0.0003	No dimension	Response rate deterioration level for bank 2
$05	$91	Multiply by 0.004	mA	A/F sensor current for bank 2

HO2S Bank 1 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	Grams	Maximum oxygen storage capacity

HO2S Bank 2 Sensor 2

Monitor ID	Test ID	Scaling	Unit	Description
$06	$07	Multiply by 0.001	V	Minimum sensor voltage
$06	$08	Multiply by 0.001	V	Maximum sensor voltage
$06	$8F	Multiply by 0.0003	Grams	Maximum oxygen storage capacity

Catalyst - Bank 1

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

Catalyst - Bank 2

Monitor ID	Test ID	Scaling	Unit	Description
$22	$A9	Multiply by 0.0003	No dimension	Oxygen storage capacity of catalyst - Bank 2

EVAP

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

Misfire

Monitor ID	Test ID	Scaling	Unit	Description
$A1	$0B	Multiply by 1	Time	Exponential Weighted Moving Average (EWMA) misfire for all cylinders: Misfire counts for last 10 driving cycles - Total
$A1	$0C	Multiply by 1	Time	Misfire rate for all cylinders: Misfire counts for last/ current driving cycles - Total
$A2	$0B	Multiply by 1	Time	EWMA misfire for cylinder 1: Misfire counts for last 10 driving cycles - Total
$A2	$0C	Multiply by 1	Time	Misfire rate for cylinder 1: Misfire counts for last/ current driving cycles - Total
$A3	$0B	Multiply by 1	Time	EWMA misfire for cylinder 2: Misfire counts for last 10 driving cycles - Total

Monitor ID	Test ID	Scaling	Unit	Description
$A3	$0C	Multiply by 1	Time	Misfire rate for cylinder 2: Misfire counts for last/ current driving cycles - Total
$A4	$0B	Multiply by 1	Time	EWMA misfire for cylinder 3: Misfire counts for last 10 driving cycles - Total
$A4	$0C	Multiply by 1	Time	Misfire rate for cylinder 3: Misfire counts for last/ current driving cycles - Total
$A5	$0B	Multiply by 1	Time	EWMA misfire for cylinder 4: Misfire counts for last 10 driving cycles - Total
$A5	$0C	Multiply by 1	Time	Misfire rate for cylinder 4: Misfire counts for last/ current driving cycles - Total
$A6	$0B	Multiply by 1	Time	EWMA misfire for cylinder 5: Misfire counts for last 10 driving cycles - Total
$A6	$0C	Multiply by 1	Time	Misfire rate for cylinder 5: Misfire counts for last/ current driving cycles - Total
$A7	$0B	Multiply by 1	Time	EWMA misfire for cylinder 6: Misfire counts for last 10 driving cycles - Total
$A7	$0C	Multiply by 1	Time	Misfire rate for cylinder 6: Misfire counts for last/ current driving cycles - Total

ES

READINESS MONITOR DRIVE PATTERN

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, select the following menu items: 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 emission 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.

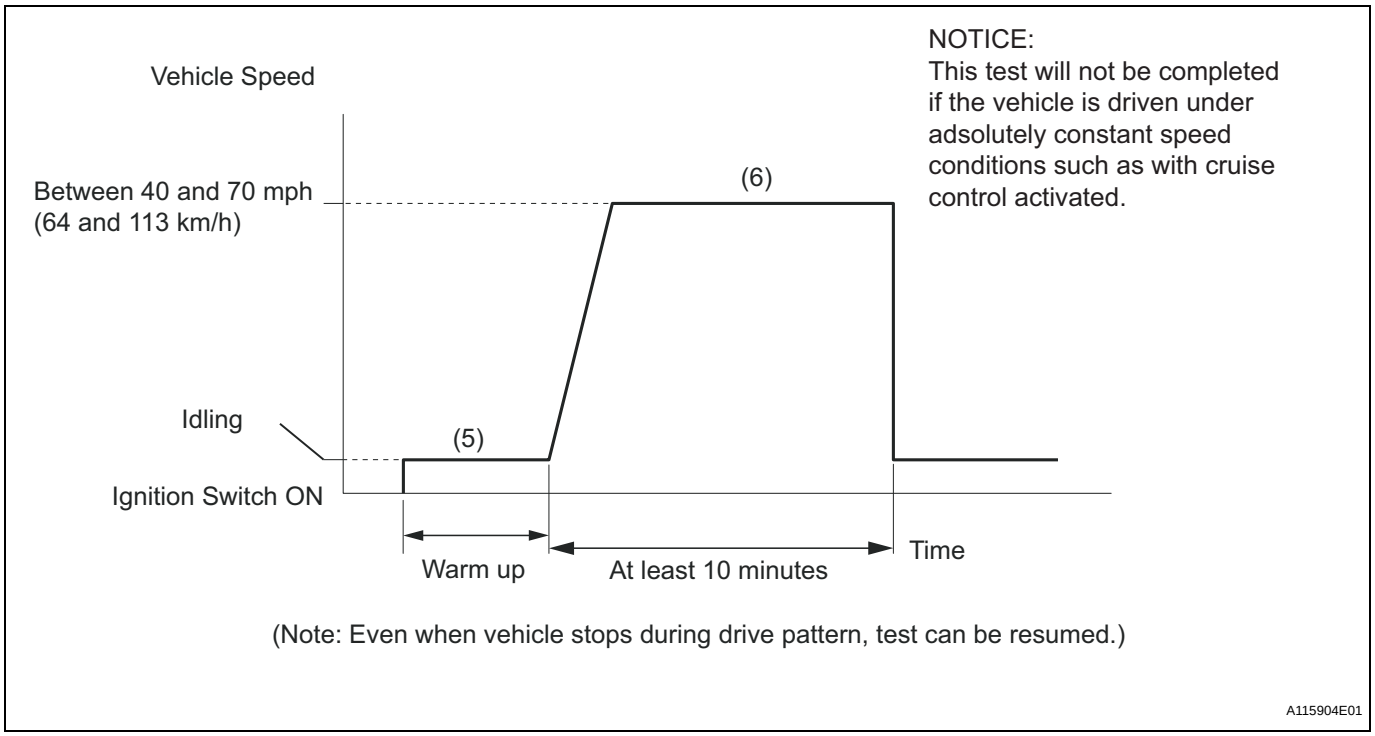
CAUTION:
Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.
NOTICE:
These drive patterns represent the fastest method of satisfying all conditions necessary to achieve complete status for each specific Readiness Monitor.
In the event of a drive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

Contents

Steps	Section Titles
1	Catalyst Monitor (Active Air-Fuel Ratio Control Type)

Steps	Section Titles
2	EVAP System Monitor (Key-Off Type)
3	Air-Fuel Ratio (A/F) and Heated Oxygen (HO2) Sensor Monitors (Active Air-Fuel Ratio Control Type)
4	Air-Fuel Ratio (A/F) and Heated Oxygen (HO2) Sensor Heater Monitors (Front A/F and Rear HO2 Sensor Type)

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



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

(b) Drive Pattern
(1) Connect an intelligent tester or OBDII scan tool to the DLC3.
(2) Turn the ignition switch ON.
(3) Turn the tester or scan tool ON.
(4) Clear DTCs (where set) (See page ES-38).
(5) Start the engine and warm it up.
(6) Drive the vehicle at between 40 mph and 70 mph (64 km/h and 113 km/h) for at least 10 minutes.

(c) Monitor Status
(1) Check the Readiness Monitor status displayed on the tester or scan tool.
(2) If the status does not switch to COMPL (complete), extend the driving time.

2. 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 at stationary.
- The engine coolant temperature is between 4.4°C and 35°C (40°F to 95°F).
- The intake air temperature is between 4.4°C and 35°C (40°F to 95°F).
- Vehicle was driven in the city area (or on free-way) for 10 minutes or more.

(b) Monitor Conditions

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

HINT:

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

(c) Monitor Status

(1) Connect an intelligent tester to the DLC3.

(2) Turn the ignition switch ON.

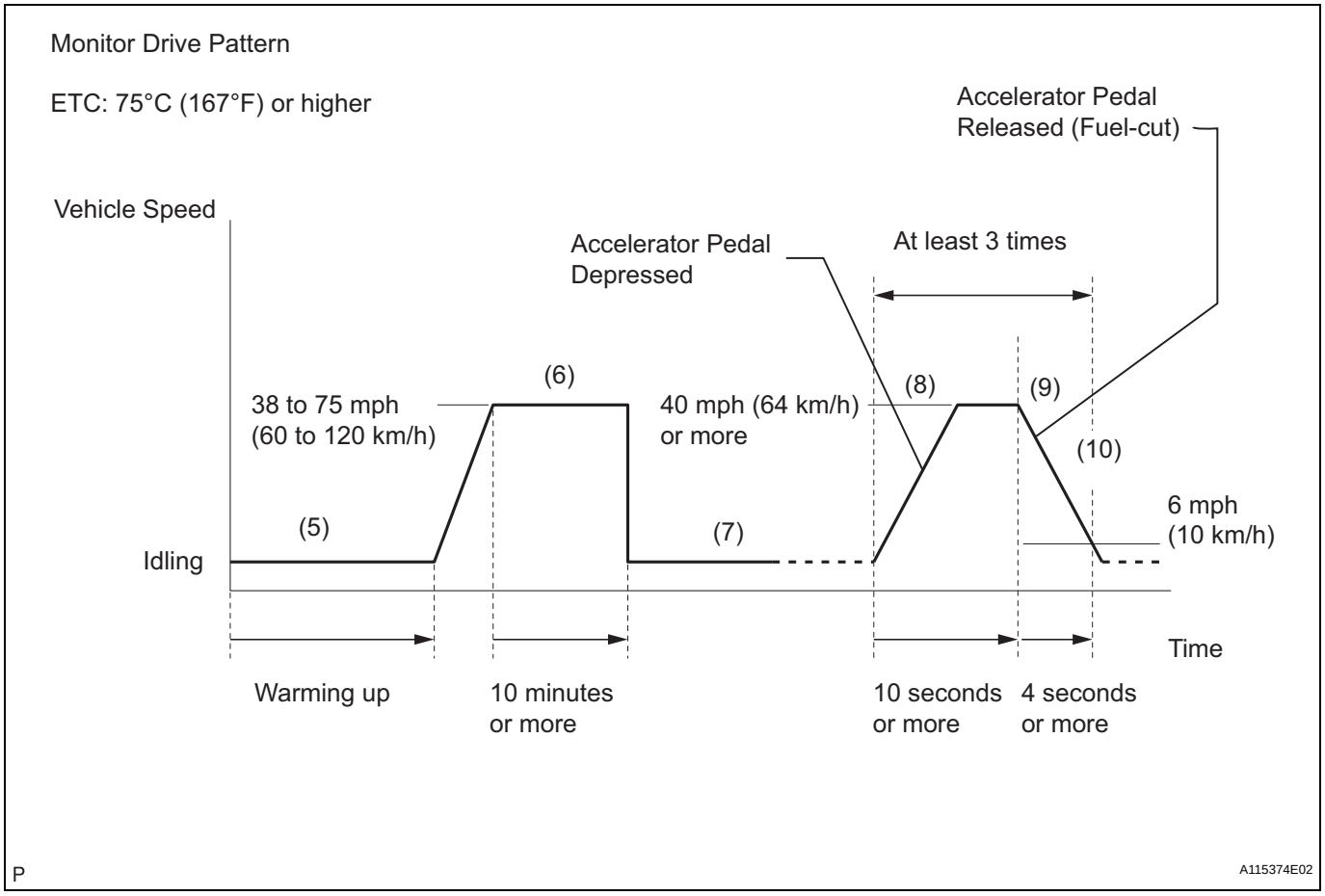
(3) Turn the tester or scan tool ON.

(4) Check the Readiness Monitor status displayed on the tester or scan tool.

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.

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

(a) Preconditions



The monitor will not run unless:

- 2 minutes or more have elapsed since the engine was started.
- The Engine Coolant Temperature (ECT) is 75°C (167°F) or more.
- Cumulative driving time at a vehicle speed of 30 mph (48 km/h) or more exceeds 6 minutes.
- Air-fuel ratio feedback control is performed.
- Fuel-cut control is performed for 8 seconds or more (for the Rear HO2 Sensor Monitor)

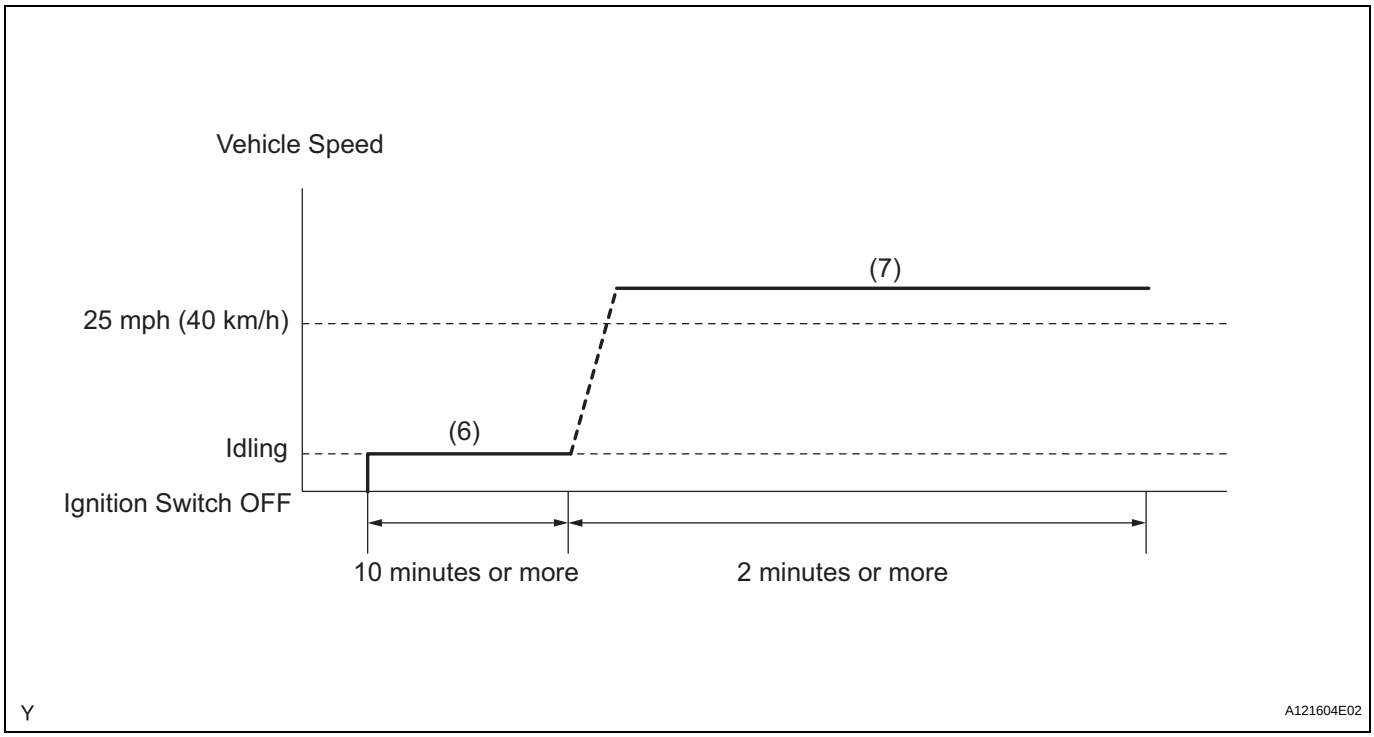
(b) Drive Pattern for front A/F sensor and HO2 sensor

(1) Connect an intelligent tester to the DLC3.
(2) Turn the ignition switch ON.
(3) Turn the tester ON.
(4) Clear DTCs (See page ES-38).
(5) Start the engine, and warm it up until the ECT reaches 75°C (167°F) or higher.
(6) Drive the vehicle at 38 mph (60 km/h) or more for at least 10 minutes.
(7) Change the transmission to 2nd gear.
(8) Accelerate the vehicle to 40 mph (64 km/h) or more by depressing the accelerator pedal for at least 10 seconds.

(9) Soon after performing step (8) above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal, in order to execute fuel-cut control.
(10) Allow the vehicle to decelerate until the vehicle speed declines to less than 6 mph (10 km/h).
(11) Repeat steps from (8) through (10) above at least 3 times in one driving cycle.

(c) Monitor Status
(1) Check the Readiness Monitor status displayed on the tester.
(2) If the status does not switch to COMPL (complete), make sure that the preconditions have been met, and then perform steps from (5) through (11) in Drive Pattern above.

4. 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
(1) Connect an intelligent tester to the DLC3.
(2) Turn the ignition switch ON.
(3) Turn the tester or scan tool ON.
(4) Clear DTCs (See page ES-38).
(5) Start the engine.
(6) Allow the engine to idle for 10 minutes or more.
(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 or scan tool.
If the status does not switch to COMPL (complete), make sure that the preconditions have been met, and repeat steps through (5) to (7) described in the Drive Pattern above.

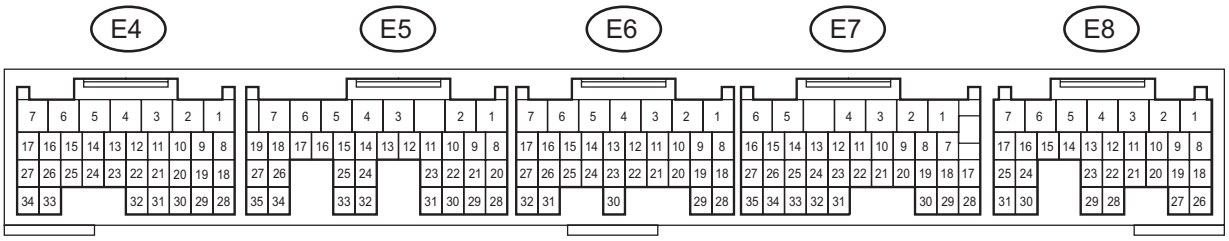
PROBLEM SYMPTOMS TABLE

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.

Symptom	Suspected area	See page
Engine does not crank (Does not start)	1. Immobilizer System	EI-3
	2. Starter	ST-3
	3. STARTER relay	ST-3
No initial combustion (Does not start)	1. ECM power source circuit	ES-383
	2. Fuel pump control circuit	ES-391
	3. VC output circuit	ES-388
	4. ECM	ES-29
Engine cranks normally but difficult to start	1. Fuel pump control circuit	ES-391
	2. Compression	EM-2
Difficult to start with cold engine	1. Starter signal circuit	ES-263
	2. Fuel pump control circuit	ES-263
	3. Spark plug	IG-3
	4. Ignition system	ES-192
	5. Injector	FU-6
Difficult to start with warm engine	1. Starter signal circuit	ES-263
	2. Fuel pump control circuit	ES-391
	3. Spark plug	IG-3
	4. Ignition system	ES-192
	5. Injector	FU-6
High engine idling speed (Poor idling)	1. A/C signal circuit (compressor circuit)	-
	2. ECM power source circuit	ES-383
	3. Electronic throttle control system	ES-283
	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-391
	3. Electronic throttle control system	ES-283
	4. Air induction system	-
	5. PCV hose	-
Rough idling (Poor idling)	1. Compression	EM-2
	2. Fuel pump control circuit	ES-391
	3. Electronic throttle control system	ES-283
	4. Air induction system	-
	5. PCV hose	-
Hunting (Poor idling)	1. ECM power source circuit	ES-383
	2. Fuel pump control circuit	ES-391
	3. Spark plug	IG-3
	4. Ignition system	ES-192
	5. Injector	FU-6
	6. Electronic throttle control system	ES-283
	7. Air induction system	-
	8. PCV hose	-

Symptom	Suspected area	See page
Hesitation/ Poor acceleration (Poor driveability)	1. Fuel pump control circuit	ES-391
	2. A/T faulty* (A750E)	-
	3. A/T faulty* (A750F)	AT-8
	4. Spark plug	IG-3
	5. Ignition system	ES-192
	6. Injector	FU-6
Surging (Poor driveability)	1. Fuel pump control circuit	ES-391
	2. Spark plug	IG-3
	3. Ignition system	ES-192
	4. Injector	FU-6
Engine stalls soon after starting	1. Fuel pump control circuit	ES-391
	2. Spark plug	IG-3
	3. Ignition system	ES-192
	4. Injector	FU-6
Engine stalls during A/C operation	1. A/C signal circuit (Compressor circuit)	-
	2. ECM	ES-29
Unable/difficult to refuel	Refueling valve (canister)	-

TERMINALS OF ECM



Y

A121603E02

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

Symbols (Terminal No.)	Wiring Colors	Terminal Descriptions	Conditions	STD Voltages
BATT (E8-3) - E1 (E6-1)	L - BR	Battery (for measuring the battery voltage and for the ECM memory)	Always	9 to 14 V
+BM (E8-7) - E1 (E6-1)	LG - BR	Power source of throttle motor	Always	9 to 14 V
IGSW (E8-9) - E1 (E6-1)	O - BR	Ignition switch	Ignition switch ON	9 to 14 V
+B (E8-1) - E1 (E6-1)	B - BR	Power source of ECM	Ignition switch ON	9 to 14 V
+B2 (E8-2) - E1 (E6-1)	B - BR	Power source of ECM	Ignition switch ON	9 to 14 V
OC1+ (E6-17) - OC1- (E6-16)	G-Y - L-B	Camshaft timing oil control valve (OCV)	Ignition switch ON	Pulse generation (see waveform 1)
OC2+ (E6-15) - OC2- (E6-14)	L-W - L-R	Camshaft timing oil control valve (OCV)	Ignition switch ON	Pulse generation (see waveform 1)
MREL (E8-8) - E1 (E6-1)	G-W - BR	EFI relay	Ignition switch ON	9 to 14 V
VC (E4-23) - E2 (E4-28)	L - BR	Power source of sensor (specific voltage)	Ignition switch ON	4.5 to 5.0 V
VG (E4-30) - E2G (E4-29)	R-Y - R-W	Mass air flow meter	Idling, Shift lever position P or N, A/C switch OFF	0.5 to 3.0 V
THA (E4-22) - E2 (E4-28)	R-L - BR	Intake air temperature sensor	Idling, Intake air temperature 20°C (68°F)	0.5 to 3.4 V
THW (E4-21) - E2 (E4-28)	Y-B - BR	Engine coolant temperature sensor	Idling, Engine coolant temperature 80°C (176°F)	0.2 to 1.0 V
VTA1 (E4-20) - E2 (E4-28)	G-B - BR	Throttle position sensor (for engine control)	Ignition switch ON, Throttle valve fully closed	0.5 to 1.2 V
VTA1 (E4-20) - E2 (E4-28)	G-B - BR	Throttle position sensor (for engine control)	Ignition switch ON, Throttle valve fully open	3.2 to 4.8 V

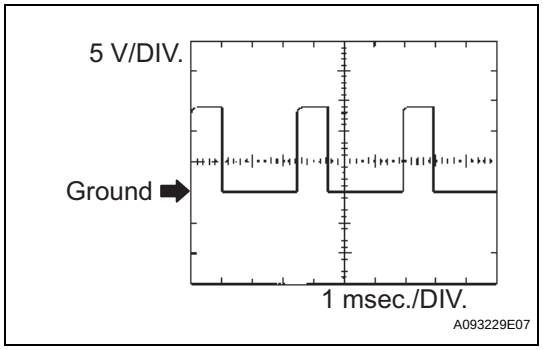
Symbols (Terminal No.)	Wiring Colors	Terminal Descriptions	Conditions	STD Voltages
VTA2 (E4-19) - E2 (E4-28)	G-W - BR	Throttle position sensor (for sensor malfunction detection)	Ignition switch ON, Accelerator pedal fully released	2.1 to 3.1 V
VTA2 (E4-19) - E2 (E4-28)	G-W - BR	Throttle position sensor (for sensor malfunction detection)	Ignition switch ON, Accelerator pedal fully depressed	4.5 to 5.0 V
VPA (E8-18) - EPA (E8-20)	R-Y - LG-B	Accelerator pedal position sensor (for engine control)	Ignition switch ON, Accelerator pedal fully released	0.5 to 1.1 V
VPA (E8-18) - EPA (E8-20)	R-Y - LG-B	Accelerator pedal position sensor (for engine control)	Ignition switch ON, Accelerator pedal fully depressed	2.6 to 4.5 V
VPA2 (E8-19) - EPA2 (E8-21)	GR-B - R-B	Accelerator pedal position sensor (for sensor malfunction detection)	Ignition switch ON, Accelerator pedal fully released	1.2 to 2.0 V
VPA2 (E8-19) - EPA2 (E8-21)	GR-B - R-B	Accelerator pedal position sensor (for sensor malfunction detection)	Ignition switch ON, Accelerator pedal fully depressed	3.4 to 5.0 V
VCPA (E8-26) - EPA (E8-20)	R - LG-B	Power source of accelerator pedal position sensor (for VPA)	Ignition switch ON	4.5 to 5.0 V
VCP2 (E8-27) - EPA2 (E8-21)	L-W - R-B	Power source of accelerator pedal position sensor (for VPA2)	Ignition switch ON	4.5 to 5.0 V
HA1A (E5-2) - E04 (E5-7) HA2A (E5-1) - E05 (E5-6)	R - W-B B-W - W-B	A/F sensor heater	Idling	Below 3.0 V
HA1A (E5-2) - E04 (E5-7) HA2A (E5-1) - E05 (E5-6)	R - W-B B-W - W-B	A/F sensor heater	Ignition switch ON	9 to 14 V
A1A+ (E5-22) - E1 (E6-1)	P - BR	A/F sensor	Ignition switch ON	3.3 V*1
A2A+ (E5-23) - E1 (E6-1)	W - BR	A/F sensor	Ignition switch ON	3.3 V*1
A1A- (E5-30) - E1 (E6-1)	L - BR	A/F sensor	Ignition switch ON	2.9 V*1
A2A- (E5-31) - E1 (E6-1)	R - BR	A/F sensor	Ignition switch ON	2.9 V*1
HT1B (E4-1) - E1 (E6-1) HT2B (E5-5) - E1 (E6-1)	G - BR L - BR	Heated oxygen sensor heater	Idling	Below 3.0 V
HT1B (E4-1) - E1 (E6-1) HT2B (E5-5) - E1 (E6-1)	G - BR L - BR	Heated oxygen sensor heater	Ignition switch ON	9 to 14 V
OX1B (E4-18) - E2 (E4-28) OX2B (E5-33) - E2 (E4-28)	W - BR B - BR	Heated oxygen sensor	Maintain engine speed at 2,500 rpm for 2 minutes after warming up	Pulse generation (see waveform 2)
#10 (E6-2) - E01 (E4-7) #20 (E6-3) - E01 (E4-7) #30 (E6-4) - E01 (E4-7) #40 (E6-5) - E01 (E4-7) #50 (E6-6) - E01 (E4-7) #60 (E6-7) - E01 (E4-7)	R-L - W-B B - W-B R - W-B G - W-B Y - W-B L - W-B	Injector	Ignition switch ON	9 to 14 V
#10 (E6-2) - E01 (E4-7) #20 (E6-3) - E01 (E4-7) #30 (E6-4) - E01 (E4-7) #40 (E6-5) - E01 (E4-7) #50 (E6-6) - E01 (E4-7) #60 (E6-7) - E01 (E4-7)	R-L - W-B B - W-B R - W-B G - W-B Y - W-B L - W-B	Injector	Idling	Pulse generation (see waveform 3)
KNK1 (E5-29) - EKNK (E5-28)	B - W	Knock sensor	Maintain engine speed at 4,000 rpm after warming up	Pulse generation (see waveform 4)
KNK2 (E5-21) - EKN2 (E5-20)	G - R	Knock sensor	Maintain engine speed at 4,000 rpm after warming up	Pulse generation (see waveform 4)
VV1+ (E6-19) - VV1- (E6-29)	R - G	Variable valve timing (VVT) sensor	Idling	Pulse generation (see waveform 5)

Symbols (Terminal No.)	Wiring Colors	Terminal Descriptions	Conditions	STD Voltages
VV2+ (E6-18) - VV2- (E6-28)	Y - L	Variable valve timing (VVT) sensor	Idling	Pulse generation (see waveform 5)
NE+ (E6-21) - NE- (E6-20)	B - W	Crankshaft position sensor	Idling	Pulse generation (see waveform 5)
IGT1 (E4-8) - E1 (E6-1) IGT2 (E4-9) - E1 (E6-1) IGT3 (E4-10) - E1 (E6-1) IGT4 (E4-11) - E1 (E6-1) IGT5 (E4-12) - E1 (E6-1) IGT6 (E4-13) - E1 (E6-1)	P - BR P-L - BR LG - BR LG-B - BR GR - BR G - BR	Ignition coil with igniter (ignition signal)	Idling	Pulse generation (see waveform 6)
IGF1 (E4-24) - E1 (E6-1)	W-R - BR	Ignition coil with igniter (ignition confirmation signal)	Ignition switch ON	4.5 to 5.0 V
IGF1 (E4-24) - E1 (E6-1)	W-R - BR	Ignition coil with igniter (ignition confirmation signal)	Idling	Pulse generation (see waveform 6)
PRG (E4-34) - E1 (E6-1)	Y - BR	Purge VSV	Ignition switch ON	9 to 14 V
PRG (E4-34) - E1 (E6-1)	Y - BR	Purge VSV	Idling	Pulse generation (see waveform 7)
SPD (E7-8) - E1 (E6-1)	V-W - BR	Speed signal from combination meter	Ignition switch ON, Rotate driving wheel slowly	Pulse generation (see waveform 8)
STA (E6-11) - E1 (E6-1)	B-Y - BR	Starter signal	Cranking	9 to 14 V
STP (E8-15) - E1 (E6-1)	L - BR	Stop light switch	Brake pedal depressed	7.5 to 14 V
STP (E8-15) - E1 (E6-1)	L - BR	Stop light switch	Brake pedal released	Below 1.5 V
ST1- (E8-16) - E1 (E6-1)	V-W - BR	Stop light switch (opposite to STP terminal)	Ignition switch ON, Brake pedal depressed	Below 1.5 V
ST1- (E8-16) - E1 (E6-1)	V-W - BR	Stop light switch (opposite to STP terminal)	Ignition switch ON, Brake pedal released	7.5 to 14 V
NSW (E5-8) - E1 (E6-1)	V - BR	Park/Neutral position switch	Ignition switch ON, Shift lever position in P or N	Below 3.0 V
NSW (E5-8) - E1 (E6-1)	V - BR	Park/Neutral position switch	Ignition switch ON, Shift lever position other than P and N	9 to 14 V
M+ (E4-5) - ME01 (E5-3)	P - W-B	Throttle motor	Idling with warm engine	Pulse generation (see waveform 9)
M- (E4-4) - ME01 (E5-3)	L - W-B	Throttle motor	Idling with warm engine	Pulse generation (see waveform 10)
FC (E8-10) - E1 (E6-1)	L-B - BR	Fuel pump control	Ignition switch ON	9 to 14 V
FPR (E6-30) - E1 (E6-1)	Y-R - BR	Fuel pump control	Ignition switch ON	9 to 14 V
W (E7-30) - E1 (E6-1)	BR - BR	MIL	Ignition switch ON	Below 3.0 V
W (E7-30) - E1 (E6-1)	BR - BR	MIL	Idling	9 to 14 V
ELS (E7-13) - E1 (E6-1)	G - BR	Electric load	Defogger switch OFF	0 to 1.5 V
ELS (E7-13) - E1 (E6-1)	G - BR	Electric load	Defogger switch ON	7.5 to 14 V
ELS2 (E7-12) - E1 (E6-1)	B-W - BR	Electric load	Taillight switch OFF	0 to 1.5 V
ELS2 (E7-12) - E1 (E6-1)	B-W - BR	Electric load	Taillight switch ON	7.5 to 14 V
TC (E8-23) - E1 (E6-1)	P-B - BR	Terminal TC of DLC 3	Ignition switch ON	9 to 14 V
TACH (E7-1) - E1 (E6-1)	B-W - BR	Engine speed	Idling	Pulse generation (see waveform 11)
ACIS (E4-33) - E1 (E6-1)	W-L - BR	VSV for ACIS	Ignition switch ON	9 to 14 V
PSW (E6-10) - E1 (E6-1)	G-W - BR	P/S pressure switch	Ignition switch ON	9 to 14 V
VPMP (E8-5) - E1 (E6-1)	V-W - BR	Vent valve (built into canister pump module)	Ignition switch ON	9 to 14 V
MPMP (E8-6) - E1 (E6-1)	G - BR	Leak detection pump (built into canister pump module)	Leak detection pump OFF	0 to 3 V

Symbols (Terminal No.)	Wiring Colors	Terminal Descriptions	Conditions	STD Voltages
MPMP (E8-6) - E1 (E6-1)	G - BR	Leak detection pump (built into canister pump module)	Leak detection pump ON	9 to 14 V
PPMP (E8-22) - E2 (E4-28)	GR - BR	Canister pressure sensor (built into canister pump module)	Ignition switch ON	3 to 3.6 V
F/PS (E7-32) - E1 (E6-1)	R - BR	Airbag sensor assembly	Idling with warm engine	Pulse generation (see waveform 12)
CANH (E7-33) - E1 (E6-1)	B - BR	CAN communication line	Ignition switch ON	Pulse generation (see waveform 13)
CANL (E7-34) - E1 (E6-1)	W - BR	CAN communication line	Ignition switch ON	Pulse generation (see waveform 14)

*1: The ECM terminal voltage is constant regardless of the output voltage from the sensor.

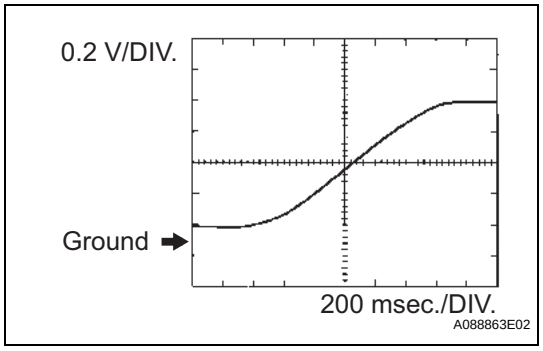
ES



1. WAVEFORM 1
Camshaft timing oil control valve (OCV)

ECM Terminal Names	Between OC1+ and OC1- or OC2+ and OC2-
Tester Ranges	5 V/DIV, 1 msec./DIV
Conditions	Idling

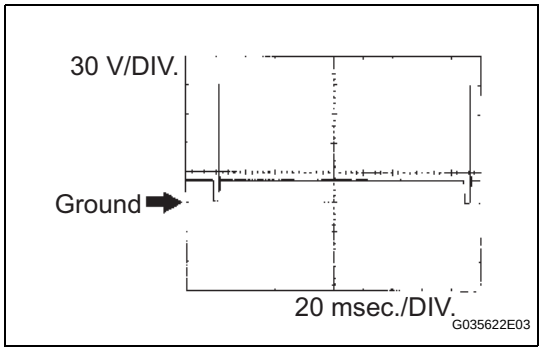
HINT:
The wavelength becomes shorter as the engine rpm increases.



2. WAVEFORM 2
Heated oxygen sensor

ECM Terminal Names	Between OX1B and E2 or OX2B and E2
Tester Ranges	0.2 V/DIV, 200 msec./DIV
Conditions	Engine speed maintained at 2,500 rpm for 2 minutes after warming up sensor

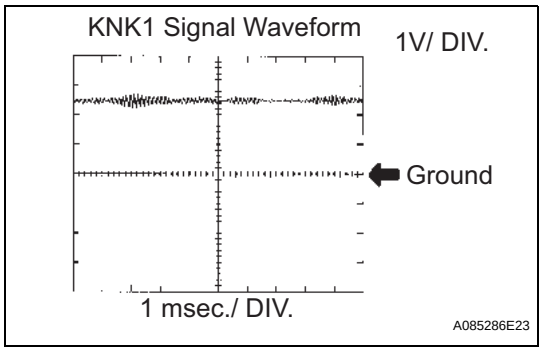
HINT:
In the DATA LIST, item O2S B1S2 or O2S B2S2 shows the ECM input values from the heated oxygen sensor.

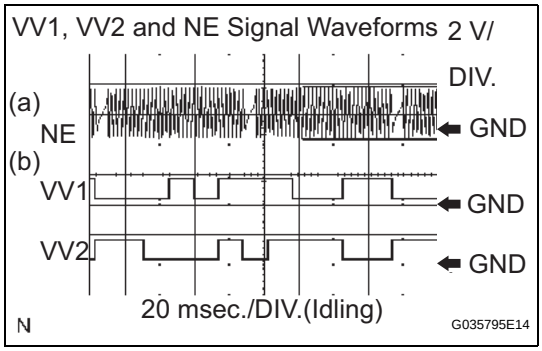


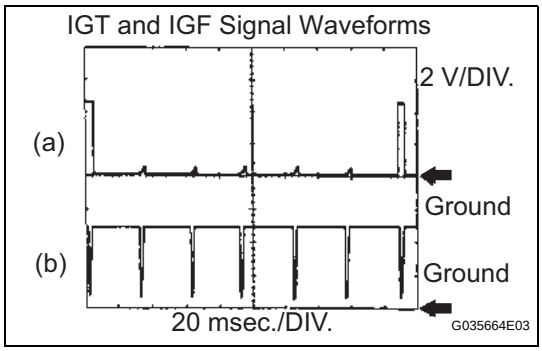
3. WAVEFORM 3
Fuel injector

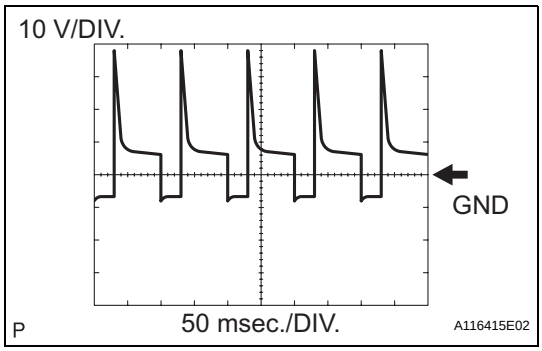
ECM Terminal Names	Between #10 (to 60) and E01
Tester Ranges	30 V/DIV, 20 msec./DIV
Conditions	Idling

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









4. WAVEFORM 4
Knock sensor

ECM Terminal Names	Between KNK1 and EKNK or KNK2 and EKN2
Tester Ranges	0.01 to 10 V/DIV, 0.01 to 10 msec./DIV
Conditions	Engine speed maintained at 4,000 rpm after warming up engine

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

5. WAVEFORM 5
(a) VVT sensor
(b) Crankshaft position sensor

ECM Terminal Names	(a) Between NE+ and NE- (b) Between VV1+ and VV1- or VV2+ and VV2-
Tester Ranges	2 V/DIV, 20 msec./DIV
Conditions	Idling

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

6. WAVEFORM 6
(a) Igniter IGT signal (from ECM to igniter)
(b) Igniter IGF signal (from igniter to ECM)

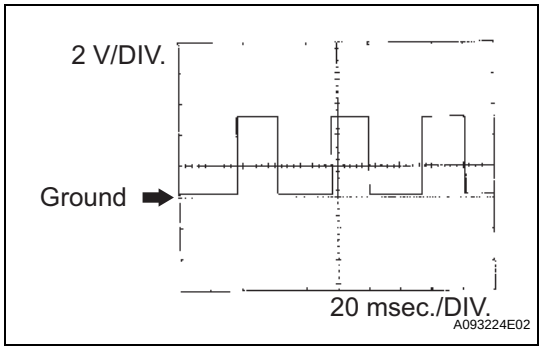
ECM Terminal Names	(a) Between IGT (1 to 6) and E1 (b) Between IGF1 and E1
Tester Ranges 2	2 V/DIV, 20 msec./DIV
Conditions	Idling

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

7. WAVEFORM 7
Purge VSV

ECM Terminal Names	Between PRG and E01
Tester Ranges	10 V/DIV, 50 msec./DIV
Conditions	Idling

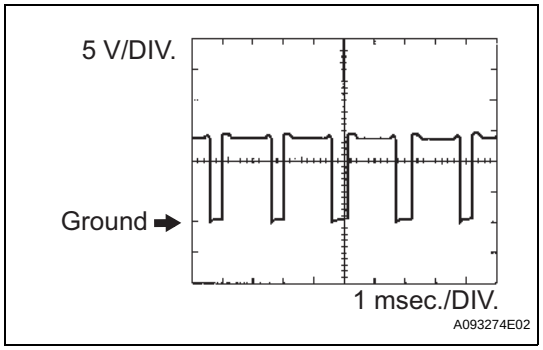
HINT:
If the waveform is not similar to the illustration, check the waveform again after idling for 10 minutes or more.



8. WAVEFORM 8
Vehicle speed signal

ECM Terminal Names	Between SPD and E1
Tester Ranges	2 V/DIV, 20 msec./DIV
Conditions	Driving at 12 mph (20 km/h)

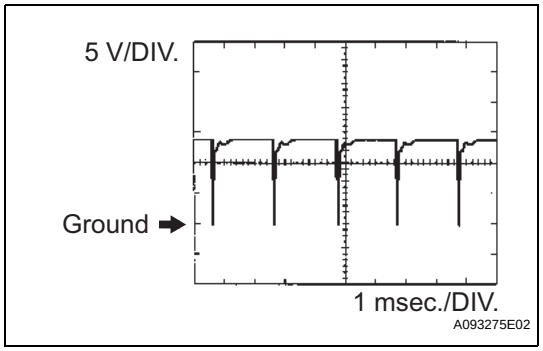
HINT:
The wavelength becomes shorter as the vehicle speed increases.



9. WAVEFORM 9
Throttle actuator positive terminal

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

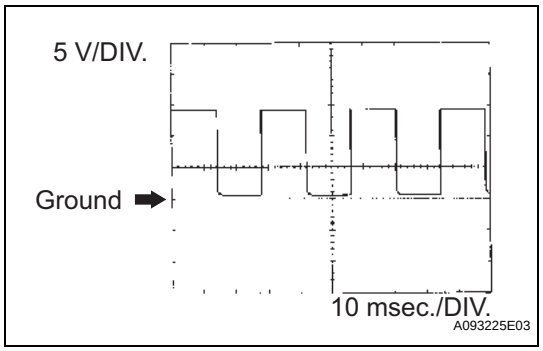
HINT:
The duty ratio varies depending on the throttle actuator operation.



10. WAVEFORM 10
Throttle actuator negative terminal

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

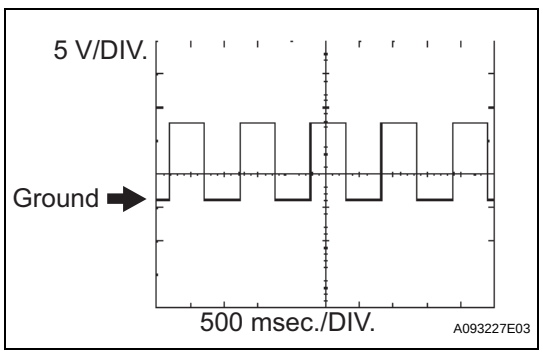
HINT:
The duty ratio varies depending on the throttle actuator operation.



11. WAVEFORM 11
Engine speed signal

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

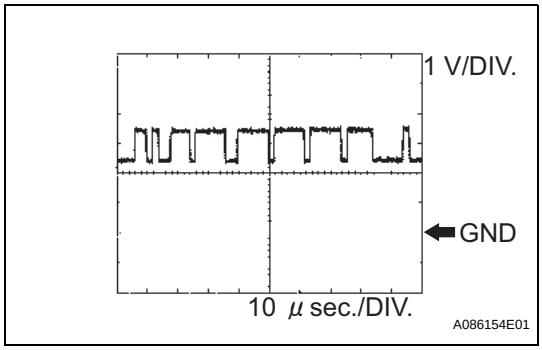
HINT:
The wavelength becomes shorter as the engine rpm increases.



12. WAVEFORM 12
Airbag sensor assembly

ECM Terminal Names	Between F/PS and E1
Tester Ranges	5 V/DIV, 500 msec./DIV
Conditions	Idling with warm engine

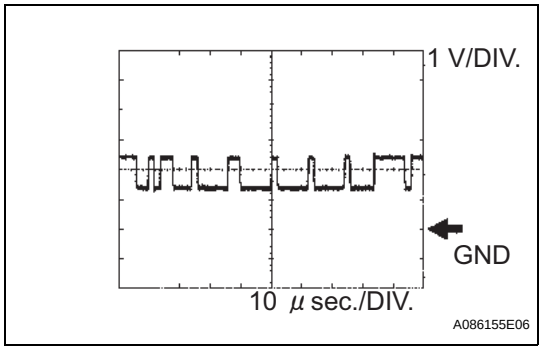
ES



13. WAVEFORM 13
CAN communication signal

ECM Terminal Names	Between CANH and E1
Tester Ranges	1 V/DIV, 10μsec./DIV
Conditions	Stop engine and ignition switch ON

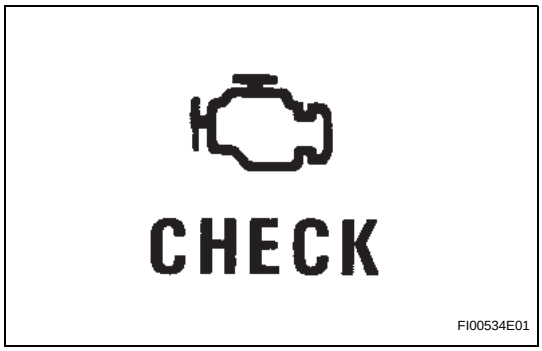
HINT:
The wavelength varies depending on the CAN communication signal.



14. WAVEFORM 14
CAN communication signal

ECM Terminal Names	Between CANL and E1
Tester Ranges	1 V/DIV, 10μsec./DIV
Conditions	Stop engine and ignition switch ON

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

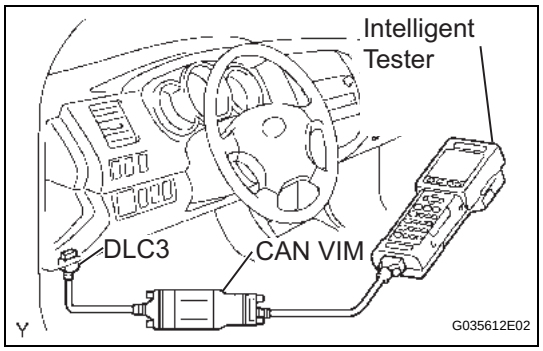


DIAGNOSIS SYSTEM

1. DESCRIPTION

When troubleshooting OBD II (On-Board Diagnostics) vehicles, an 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 illuminates the MIL (Malfunction Indicator Lamp) on the instrument panel when the computer detects a malfunction in:

(a) The emission control systems and components
(b) The power train control components (which affect vehicle emissions)



(c) The computer itself
In addition, the applicable DTCs (Diagnostic Trouble Codes) prescribed by SAE J2012 are recorded on 3 consecutive trips, the MIL turns off automatically but the DTCs remain recorded in the ECM memory.
To check DTCs, connect an intelligent tester to the DLC3. The tester displays DTCs, freeze frame data, and a variety of engine data. The DTCs and freeze frame data can be erased with the tester (See page ES-38).
In order to enhance OBD function on vehicles and develop the Off-Board diagnosis system, CAN communication is introduced in this system (CAN: Controller Area Network). It minimizes a 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 a high speed communication between the systems and to simplify the wire harness connection.
Since this system is equipped with the CAN communication, connecting the CAN VIM (VIM: Vehicle Interface Module) with an intelligent tester is necessary to display any information from the ECM. (Also the communication between an 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 an intelligent tester.

2. NORMAL MODE AND CHECK MODE

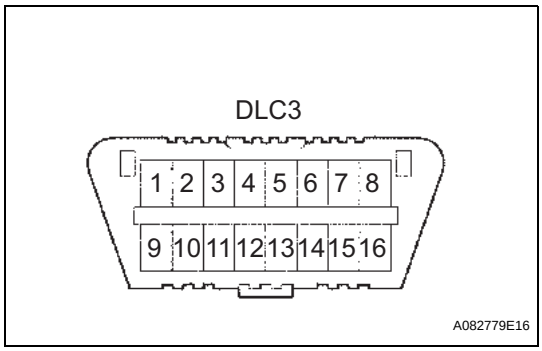
The diagnosis system operates in normal mode during normal vehicle use. In normal mode, 2 trip detection logic is used to ensure accurate detection of malfunctions. Check mode is also available as an option for technicians. In check mode, 1 trip detection logic is used for simulating malfunction symptoms and increasing the system's ability to detect malfunctions, including intermittent problems (intelligent tester only) (See page ES-12).

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

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



5. DLC3 (Data Link Connector 3)

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

Symbols	Terminal No.	Names	Reference terminals	Results	Conditions
SIL	7	Bus "+" line	5 - Signal ground	Pulse generation	During transmission
CG	4	Chassis ground	Body ground	1 Ω or less	Always
SG	5	Signal ground	Body ground	1 Ω or less	Always
BAT	16	Battery positive	Body ground	9 to 14 V	Always
CANH	6	CAN "High" line	CANL	54 to 69 Ω	Ignition switch OFF
CANH	6	CAN "High" line	Battery positive	1 MΩ or higher	Ignition switch OFF
CANH	6	CAN "High" line	CG	1 kΩ or higher	Ignition switch OFF
CANL	14	CAN "Low" line	Battery positive	1 MΩ or higher	Ignition switch OFF
CANL	14	CAN "Low" line	CG	1 kΩ or higher	Ignition switch OFF

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 ON 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 impossible: The problem is probably with 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 the battery before proceeding.

7. MIL (Malfunction Indicator Lamp)

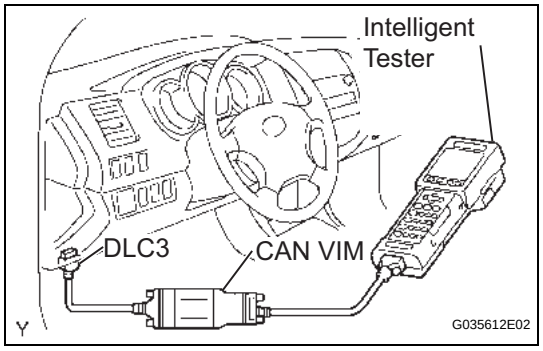
(a) The MIL is illuminated when the ignition switch is first turned ON (the engine is not running).

(b) The MIL should turn off when the engine is started. If the MIL remains illuminated, the diagnosis system has detected a malfunction or abnormality in the system.
HINT:
If the MIL is not illuminated when the ignition switch is first turned ON, check the MIL circuit (See page ES-402).

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:

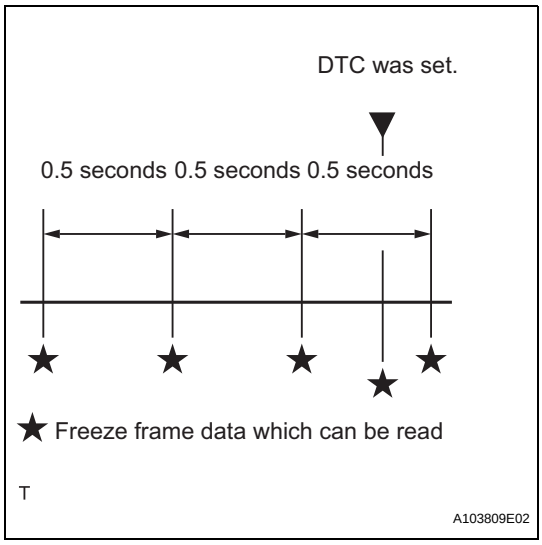
- DTCs which are stored in the ECM can be displayed on an intelligent tester. An intelligent tester can display current and pending DTCs.
- Some DTCs are not set if the ECM does not detect the same malfunction again during a second consecutive driving cycle. However, such malfunctions, detected on only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



1. CHECK DTC (Using an intelligent tester)
(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Select the following menu items: 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-54).

2. CLEAR DTC (Using an intelligent tester)
(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CLEAR CODES.
(e) Press the YES button.

3. CLEAR DTC (Without using an 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 (R/B) located inside the engine compartment for more than 1 minute.



ES

FREEZE FRAME DATA

1. DESCRIPTION

Freeze frame data record 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 replicate the problem even though a DTC is detected, confirm the freeze frame data.

The ECM records engine conditions in the form of freeze frame data every 0.5 seconds. Using an intelligent tester, five separate sets of freeze frame data, including the data values at the time when the DTC was set, can be checked.

- 3 data sets before the DTC was set
- 1 data set when the DTC was set
- 1 data set after the DTC was set

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

2. LIST OF FREEZE FRAME DATA

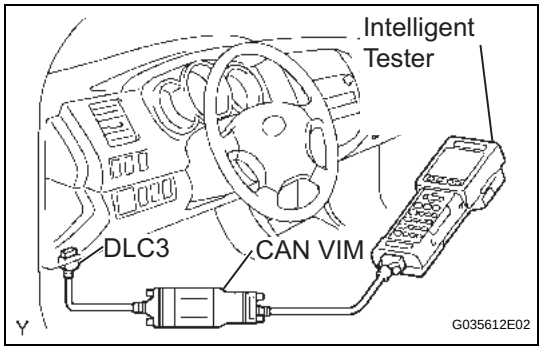
LABEL (Intelligent Tester Display)	Measure Item/Range	Diagnostic Note
INJECTOR	Injector	-
IGN ADVANCE	Ignition advance	-
CALC LOAD	Calculate load	Calculated load by ECM
VEHICLE LOAD	Vehicle load	-
MAF	Mass air flow volume	If value approximately 0.0 g/sec: • Mass air flow meter power source circuit open or short • VG circuit open or short If value 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 value -40°C, sensor circuit open If value 140°C or more, sensor circuit shorted
INTAKE AIR	Intake air temperature	If value -40°C, sensor circuit open If value 140°C or more, sensor circuit shorted
AIR-FUEL RATIO	Air-fuel ratio	-
PURGE DENSITY	Learning value of purge density	-
PURGE FLOW	Purge flow	-
EVAP PURGE VSV	EVAP purge VSV duty ratio	-
EVAP VAPOR PRES	EVAP vapor pressure	-
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	-

LABEL (Intelligent Tester Display)	Measure Item/Range	Diagnostic Note
ACCEL POS #2	Absolute APP No. 2	-
THROTTLE POS	Throttle position	Read value with ignition switch ON (Do not start engine)
THROTTLE POS	Throttle sensor positioning	Read value with ignition switch ON (Do not start engine)
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 voltage output of sensor
O2S B2 S2	Heated oxygen sensor output	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check voltage output of sensor
AFS B1 S1	A/F sensor output	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check voltage output of sensor
AFS B2 S1	A/F sensor output	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check voltage output 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 (Bank1)	• OL (Open Loop): Has not yet satisfied conditions to go closed loop • CL (Closed Loop): Using heated oxygen sensor as feedback for fuel control • OL DRIVE: Open loop due to driving conditions (fuel enrichment) • OL FAULT: Open loop due to detected system fault • CL FAULT: Closed loop but heated oxygen sensor, which used for fuel control, malfunctioning
O2FT B1 S2	Fuel trim at heated oxygen sensor	Same as SHORT FT #1
O2FT B2 S2	Fuel trim at heated oxygen sensor	Same as SHORT FT #1
AF FT B1 S1	Fuel trim at A/F sensor	-
AF FT B2 S1	Fuel trim at A/F sensor	-
CAT TEMP B1 S1	Catalyst temperature	-
CAT TEMP B2 S1	Catalyst temperature	-
CAT TEMP B1 S2	Catalyst temperature	-
CAT TEMP B2 S2	Catalyst temperature	-
INI COOL TEMP	Initial engine coolant temperature	-
INI INTAKE TEMP	Initial intake air temperature	-
INJ VOL	Injection volume	-
STARTER SIG	Starter signal	-
PS SW	Power steering signal	-
PS SIGNAL	Power steering signal (history)	This signal status usually ON until battery terminals disconnected
CTP SW	Closed throttle position switch	-
A/C SIG	A/C signal	-
ELECT LOAD SIG	Electrical load signal	-
STOP LIGHT SW	Stop light switch	-

LABEL (Intelligent Tester Display)	Measure Item/Range	Diagnostic Note
BATTERY VOLTAGE	Battery voltage	-
ATM PRESSURE	Atmospheric pressure	-
ACT VSV	A/C cut status for Active Test	-
EVAP VSV	EVAP purge VSV	VSV for EVAP controlled by ECM (ground side duty control)
FUEL PUMP / SPD	Fuel pump speed status	-
VVT CTRL B1	VVT control status	-
VACUUM PUMP	Key-off EVAP system pump status	-
EVAP VENT VAL	Key-off EVAP system vent valve status	-
TC/TE1	TC and TE1 terminals of DLC3	-
VVTL AIM ANGL #1	VVT aim angle	-
VVT CHNG ANGL #1	VVT change angle	-
VVT OCV DUTY B1	VVT OCV operation duty	-
FC IDL	Idle fuel cut	ON: when throttle valve fully closed and engine speed over 2,800 rpm
FC TAU	FC TAU	Fuel cut being performed under very light load to prevent engine combustion from becoming incomplete
IGNITION	Ignition	-
CYL #1	Cylinder #1 misfire rate	Displayed in only idling
CYL #2	Cylinder #2 misfire rate	Displayed in only idling
CYL #3	Cylinder #3 misfire rate	Displayed in only idling
CYL #4	Cylinder #4 misfire rate	Displayed in only idling
CYL #5	Cylinder #5 misfire rate	Displayed in only idling
CYL #6	Cylinder #6 misfire rate	Displayed in only idling
CYL ALL	All cylinder misfire rate	Displayed in only idling
MISFIRE RPM	Misfire RPM	-
MISFIRE LOAD	Misfire load	-
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	-
MODEL CODE	Identifying the model code	GRN2###
FAN MOTOR	Electric fan motor	-
VAPOR PRESS	Vapor pressure	EVAP system pressure as read by canister pressure sensor
ENG OIL PRES SW	Engine oil pressure switch signal	Always ON while engine is running
ENGINE TYPE	Identifying the engine type	1GR
CYLINDER NUMBER	Identifying the cylinder number	6
DESTINATION	Identifying the destination	A (America)
MODEL YEAR	Identifying the model year	200#
SYSTEM	Identifying the engine system	GASLIN (gasoline engine)

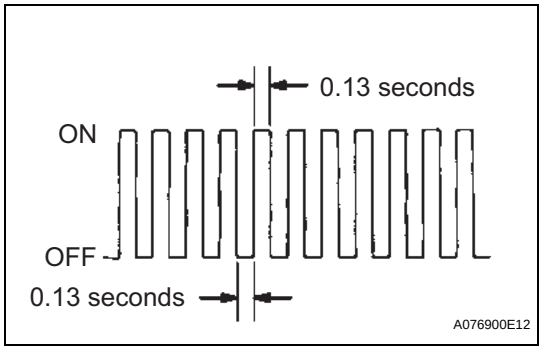
CHECK MODE PROCEDURE

HINT:
Intelligent tester only:
Compared to 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 to ACC 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 (Using an intelligent tester)

(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 positions
  (4) A/C switched OFF
(b) Turn the ignition switch OFF.
(c) Connect an intelligent tester to the DLC3.
(d) Turn the ignition switch ON.
(e) Turn the tester ON.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / CHECK MODE.
(g) Switch the ECM from normal mode to check mode.
(h) Make sure the MIL flashes as shown in the illustration.
(i) Start the engine.
(j) Make sure the MIL turns off.
(k) Simulate the conditions of the malfunction described by the customer.
(l) Check DTCs and freeze frame data using the tester.



FAIL-SAFE CHART

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

DTCs	Components	Fail-Safe Operations	Fail-Safe Deactivation Conditions
P0031, P0032, P0051 and P0052	Air-Fuel Ratio (A/F) Sensor Heater	ECM turns off A/F sensor heater.	Ignition switch OFF
P0037, P0038, P0057 and P0058	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° 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
P0327, P0328, P0332 and P0333	Knock Sensor	ECM sets ignition timing to maximum retard.	Ignition switch OFF
P0351 to P0356	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

NOTICE:

*** 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 an 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 of troubleshooting is one method of shortening diagnostic time.

NOTICE:

In the table below, the values listed under Normal Condition 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 an intelligent tester to the DLC3.
(d) Turn the ignition switch ON.
(e) Turn the tester ON.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST.
(g) Check the values by referring to the table below.

Intelligent Tester Display	Measurement Item:Range (Display)	Normal Condition *	Diagnostic Note
INJECTOR	Injection period of No. 1 cylinder: Min.: 0 ms, Max.: 32.64 ms	1.6 to 2.4 ms: Idling	-
IGN ADVANCE	Ignition timing advance for No. 1 cylinder/ Min.: -64 deg., Max.: 63.5 deg.	BTDC 7 to 24°: Idling	-
CALC LOAD	Calculated load by ECM: Min.: 0 %, Max.: 100 %	• 11.4 to 16.4 %: Idling • 13.1 to 18.9 %: Running without load (2,500 rpm)	-
VEHICLE LOAD	Vehicle load: Min.: 0 %, Max.: 25,700 %	Actual vehicle load	-
MAF	Air flow rate from MAF meter: Min.: 0 g/sec, Max.: 655 g/sec	3.2 to 4.7 g/sec: Idling 13.1 to 18.9 g/sec: 2,500 rpm	If value approximately 0.0 g/sec: • Mass air flow meter power source circuit open • VG circuit open or short If value 160.0 g/sec or more: • E2G circuit open
ENGINE SPD	Engine speed: Min.: 0 rpm, Max.: 16,383 rpm	650 to 750 rpm: Idling	-
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 value -40°C (-40°F): sensor circuit open • If value 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 value -40°C (-40°F): sensor circuit open • If value 140°C (284°F) or more: sensor circuit shorted
AIR-FUEL RATIO	Air-fuel ratio: Min.: 0, Max.: 1.999	0.8 to 1.2: During idling	-
PURGE DENSITY	Learning value of purge density/ Min.: -50 %, Max.: 350 %	-40 to 0 %: Idling	Service data
PURGE FLOW	Purge flow: Min.: 0 %, Max.: 102.4 %	0 to 100 %: Idling	-

Intelligent Tester Display	Measurement Item:Range (Display)	Normal Condition *	Diagnostic Note
EVAP PURGE VSV	EVAP (Purge) VSV control duty: Min.: 0 %, Max.: 100 %	0 to 100 %: During idling	Order signal from ECM
VAPOR PRESS PUMP	Vapor pressure: Min.: 33.853 kPa, Max.: 125.596 kPa	Approximately 100 kPa: Ignition switch ON	EVAP system pressure monitored by canister pressure sensor
VAPOR PRESS CALC	Vapor pressure: (calculated) Min.: -5.632 kPa, Max.: 7,153,264 kPa	Approximately 100 kPa: Ignition switch ON	EVAP system pressure monitored by canister pressure sensor
KNOCK CRRT VAL	Correction learning value of knocking: Min.: -64° CA, Max.: 1,984° CA	0 to 22 °CA: Driving, 44 mph (70 km/h)	Service data
KNOCK FB VAL	Feedback value of knocking: Min.: -64° CA, Max.: 1,984° CA	-22 to 0 °CA Driving, 44 mph (70 km/h)	Service data
CLUTCH	Clutch current Min.: 0 A, Max.: 2.49 A	-	-
ETCS MAG CLUTCH	Electromagnetic clutch: ON or OFF	-	-
EVAP VAPOR PRES	EVAP vapor pressure: Min.: 0 kPa, Max.: 327.675 kPa	Approximately 100 kPa: Ignition switch ON	-
ACCEL POS #1	Absolute Accelerator Pedal Position (APP) No. 1: Min.: 0 %, Max.: 100 %	10 to 22 %: Accelerator pedal released 54 to 86 %: Accelerator pedal fully depressed	-
ACCEL POS #2	Absolute APP No. 2: Min.: 0 %, Max.: 100 %	12 to 42 %: Accelerator pedal released 66 to 98 %: Accelerator pedal fully depressed	-
ACCEL POS #1	APP sensor No. 1 voltage: Min.: 0 V, Max.: 4.98 V	-	ETCS freeze data
ACCEL POS #2	APP sensor No. 2 voltage: Min.: 0 V, Max.: 4.98 V	-	ETCS freeze data
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 4.5t V: Accelerator pedal fully depressed.	-
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.	-
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	Accelerator fully closed value No.1 (AD): Min.: 0, Max.: 4.98 V	-	ETCS service data
ACCEL LRN VAL#1	Accelerator fully closed learning value No.1: Min.: 0, Max.: 124.512	-	ETCS service data
ACCEL LRN VAL#2	Accelerator fully closed learning value No.2: Min.: 0, Max.: 124.512	-	ETCS service data
FAIL #1	Whether or not fail safe function executed: ON or OFF	ON: ETCS has failed	-
FAIL #2	Whether or not fail safe function executed: ON or OFF	ON: ETCS has failed	-

Intelligent Tester Display	Measurement Item:Range (Display)	Normal Condition *	Diagnostic Note
ST1	Starter signal: ON or OFF	ON: Cranking	-
SYS GUARD JUDGE	System guard: ON or OFF	-	ETCS service data
OPN MALFUNCTION	Open side malfunction: ON or OFF	-	ETCS service data
THROTTLE POS	Absolute throttle position sensor: Min.: 0 %, Max.: 100 %	• 10 to 24 %: Throttle fully closed • 64 to 96 %: Throttle fully open	Read value with intrusive operation (active test)
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 sensor positioning: Min.: 0 %, Max.: 100 %	0 to 10 %: Idling	Calculated value based on VTA1
THROTTLE POS #2	Throttle sensor positioning #2: Min.: 0 %, Max.: 100 %	-	Calculated value based on VTA2
THROTTLE POS #1	Throttle position sensor No. 1 output voltage: Min.: 0 V, Max.: 4.9 V	-	ETCS freeze data
THROTTLE POS #2	Throttle position sensor No.2 output voltage: Min.: 0 V, Max.: 4.9 V	-	ETCS freeze data
THROTTLE POS #1	Throttle position No. 1: Min.: 0 V, Max.: 5 V	• 0.5 to 1.2 V: Throttle fully closed • 3.2 to 4.8 V: Throttle fully opened	-
THROTTLE POS #2	Throttle position No. 2: Min.: 0 V, Max.: 5 V	• 2.0 to 2.9 V: Throttle fully closed • 4.6 to 5.0 V: Throttle fully open	Read value with intrusive operation (active test)
THRTL COMND VAL	Throttle position command value: Min.: 0 V, Max.: 4.98 V	0.5 to 4.8 V	ETCS service data
THROTTLE SSR #1	Throttle sensor opener position No. 1: Min.: 0 V, Max.: 4.98 V	0.6 to 1.0 V	ETCS service data
THROTTLE SSR #2	Throttle sensor opener position No. 2: Min.: 0 V, Max.: 4.98 V	2.0 to 2.6 V	ETCS service data
THRTL SSR #1 AD	Throttle sensor opener position No.1 (AD): Min.: 0 V, Max.: 4.98 V	0.6 to 0.9 V	ETCS service data
THROTTLE MOT	Throttle motor current: Min.: 0 A, Max.: 80 A	0 to 3.0 A: Idling	-
THROTTLE MOT	Whether or not throttle motor control permitted: ON or OFF	ON: Idling	Read value with ignition switch ON (Do not start engine)
THROTTLE MOT	Throttle motor: Min.: 0 %, Max.: 100 %	0.5 to 40 %: Idling	-
THROTTLE MOT	Throttle motor current: Min.: 0 A, Max.: 19.92 A	0 to 3.0 A: Idling	-
THROTL OPN DUTY	Throttle motor opening duty ratio: Min.: 0 %, Max.: 100 %	0 to 40 %: During idling	When accelerator pedal depressed, duty ratio increased
THROTL CLS DUTY	Throttle motor closed duty ratio: Min.: 0 %, Max.: 100 %	0 to 40 %: During idling	When accelerator pedal released quickly, duty ratio increased
THRTL MOT (OPN)	Throttle motor duty ratio (open): Min.: 0 %, Max.: 100 %	-	ETCS service data

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Intelligent Tester Display	Measurement Item:Range (Display)	Normal Condition *	Diagnostic Note
THRTL MOT (CLS)	Throttle motor duty ratio (close): Min.: 0 %, Max.: 100 %	-	ETCS service data
O2S B1 S2	Heated oxygen sensor output voltage for bank 1 sensor 2: Min.: 0 V, Max.: 1.275 V	0.1 to 0.9 V: Driving 44 mph (70 km/h)	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check voltage output of sensor
O2S B2 S2	Heated oxygen sensor output voltage for bank 2 sensor 2: Min.: 0 V, Max.: 1.275 V	0.1 to 0.9 V: Driving 44 mph (70 km/h)	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check voltage output of sensor
AFS B1 S1	A/F sensor output voltage for bank 1 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 voltage output of sensor
AFS B2 S1	A/F sensor output voltage for bank 2 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 voltage output of sensor
TOTAL FT #1	Total fuel trim of bank 1 Average value for fuel trim system of bank 1: Min.: -0.5, Max.: 0.496	-0.2 to 0.2: Idling	-
TOTAL FT #2	Total fuel trim of bank 2 Average value for fuel trim system of bank 2: Min.: -0.5, Max.: 0.496	-0.2 to 0.2: Idling	-
SHORT FT #1	Short-term fuel trim of bank 1: Min.: -100 %, Max.: 99.2%	0 +- 20 %	Short-term fuel compensation used to maintain air-fuel ratio at stoichiometric air-fuel ratio
LONG FT #1	Long-term fuel trim of bank 1: Min.: -100 %, Max.: 99.2 %	0 +- 20 %	Overall fuel compensation carried out in long-term to compensate continual deviation of short-term fuel trim from central value
SHORT FT #2	Short-term fuel trim of bank 2: Min.: -100 %, Max.: 99.2%	0 +- 20 %	Short-term fuel compensation used to maintain air-fuel ratio at stoichiometric air-fuel ratio
LONG FT #2	Long-term fuel trim of bank 2: Min.: -100 %, Max.: 99.2 %	0 +- 20 %	Overall fuel compensation carried out in long-term to compensate continual deviation of short-term fuel trim from central value
FUEL SYS #1	Fuel system status (Bank1): 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 heated oxygen sensor as feedback for fuel control • OL DRIVE: Open loop due to driving conditions (fuel enrichment) • OL FAULT: Open loop due to detected system fault • CL FAULT: Closed loop but heated oxygen sensor, which used for fuel control, malfunctioning

Intelligent Tester Display	Measurement Item:Range (Display)	Normal Condition *	Diagnostic Note
FUEL SYS #2	Fuel system status (Bank2): 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 heated oxygen sensor as feedback for fuel control. • OL DRIVE: Open loop due to driving conditions (fuel enrichment) • OL FAULT: Open loop due to detected system fault • CL FAULT: Closed loop but heated oxygen sensor, which used for fuel control, malfunctioning
O2FT B1 S2	Short-term fuel trim associated with bank 1 sensor 2: Min.: -100 %, Max.: 99.2 %	-	Same as SHORT FT #1
O2FT B2 S2	Short-term fuel trim associated with bank 2 sensor 2: Min.: -100 %, Max.: 99.2 %	-	Same as SHORT FT #2
AF FT B1 S1	Short-term fuel trim associated with bank 1 sensor 1: Min.: 0, Max.: 1.999	• Value less than 1 (0.000 to 0.999) = Lean • Stoichiometric air-fuel ratio=1 • Value greater than 1 (1.001 to 1.999) = RICH	-
AF FT B2 S1	Short-term fuel trim associated with bank 2 sensor 1: Min.: 0, Max.: 1.999	• Value less than 1 (0.000 to 0.999) = Lean • Stoichiometric air-fuel ratio=1 • Value greater than 1 (1.001 to 1.999) = RICH	-
CAT TEMP B1S1	Catalyst temperature (Bank 1, Sensor 1): Min.: -40, Max.: 6,513.5 °C	-	-
CAT TEMP B2S1	Catalyst temperature (Bank 2, Sensor 1): Min.: -40, Max.: 6,513.5 °C	-	-
CAT TEMP B1S2	Catalyst temperature (Bank 1, Sensor 2): Min.: -40, Max.: 6,513.5 °C	-	-
CAT TEMP B2S2	Catalyst temperature (Bank 2, Sensor 2): Min.: -40, Max.: 6,513.5 °C	-	-
INI COOL TEMP	Initial engine coolant temperature: Min.: -40°C, Max.: 140°C	Coolant temperature when engine started	Service data
INI INTAKE TEMP	Initial intake air temperature: Min.: -40°C, Max.: 140°C	Intake air temperature when engine started	Service data
INJ VOL	Injection volume (cylinder 1): Min.: 0 ml, Max.: 2.048 ml	0 to 0.5 ml	Quantity of fuel injection volume for 10 times
STARTER SIG	Starter 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	This 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 SIG	A/C signal: ON or OFF	ON: A/C ON	-

Intelligent Tester Display	Measurement Item:Range (Display)	Normal Condition *	Diagnostic Note
PNP SW [NSW]	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: Idling	-
+BM VOLTAGE	+BM voltage: Min.: 0, Max.: 19.92	10 to 15 V: Idling	ETCS service data
BATTERY VOLTAGE	Battery voltage: Min.: 0 V, Max.: 65.535 V	9 to 14 V: Idling	-
ACTUATOR POWER	Actuator power supply: ON or OFF	ON: Idling	ETCS service data
ATM PRESSURE	Atmospheric pressure: Min.: 0 kPa, Max.: 150 kPa	Equivalent to atmospheric pressure (absolute pressure)	-
FUEL PMP SP CTL	Fuel pump speed control status: ON/H or OFF/L	Idling: ON	-
ACIS VSV	ACIS VSV: ON or OFF	-	ON: Open OFF: Closed
ACT VSV	A/C cut status for Active Test: ON or OFF	-	Active Test support data
VVT CTRL B2	VVT control (bank 2) status: ON or OFF	-	Active Test support data
EVAP (Purge) VSV	VSV status for EVAP control: ON or OFF	-	Active Test support data
FUEL PUMP / SPD	Fuel pump/status: ON or OFF	-	Active Test support data
VVT CTRL B1	VVT control (bank 1) status: ON or OFF	-	Active Test support data
VACUUM PUMP	Key-off EVAP system pump status: ON or OFF	-	Active Test support data
FAN MOTOR	Electric fan motor ON or OFF	-	Active Test support data
EVAP VENT VAL	Key-off EVAP system vent valve status: ON or OFF	-	Active Test support data
TC/TE1	TC and TE1 terminal of DLC3: ON or OFF	-	-
VVTL AIM ANGL #1	VVT aim angle (bank 1): Min.: 0 %, Max.: 100 %	0 %: Idling	VVT duty signal value during intrusive operation
VVT CHNG ANGL #1	VVT change angle: Min.: 0°FR, Max.: 60°FR	0 to 5 °FR: Idling	Displacement angle during intrusive operation
VVT OCV DUTY B1	VVT OCV operation duty: Min.: 0 %, Max.: 100 %	0 %: Idling	Requested duty value for intrusive operation
VVTL AIM ANGL #2	VVT aim angle (bank 2): Min.: 0 %, Max.: 100 %	0 %: Idling	VVT duty signal value during intrusive operation
VVT CHNG ANGL #2	VVT change angle (bank 2): Min.: 0°FR, Max.: 60°FR	0 to 5 °FR: Idling	Displacement angle during intrusive operation
VVT OCV DUTY B2	VVT OCV (bank 2) operation duty: Min.: 0 %, Max.: 100 %	0 %: Idling	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 2,800 rpm

Intelligent Tester Display	Measurement Item:Range (Display)	Normal Condition *	Diagnostic Note
FC TAU	Fuel cut TAU: Fuel cut during very light load: ON or OFF	ON: Fuel cut operating	Fuel cut being performed under very light load to prevent engine combustion from becoming incomplete
IGNITION	Ignition counter: Min.: 0, Max.: 600	0 to 600	-
CYL #1, #2, #3, #4, #5, #6	Misfire ratio of cylinders 1 to 6: Min.: 0, Max.: 255	0 %	This item displayed in only idling
CYL ALL	All cylinders misfire rate: Min.: 0, Max.: 255	0 to 35	-
MISFIRE RPM	Engine RPM for first misfire range: Min.: 0 rpm, Max.: 6,375 rpm	0 rpm: Misfire 0	-
MISFIRE LOAD	Engine load for first misfire range: Min.: 0 g/rev, Max.: 3.98 g/rev	0 g/rev: Misfire 0	-
MISFIRE MARGIN	Margin to detect engine misfire: Min.: -100 %, Max.: 99.22 %	-100 to 99.2 %	Misfire detecting margin
#CODES	#Codes: Min.: 0, Max.: 255	-	Number of detected DTCs
CHECK MODE	Check mode: ON or OFF	ON: Check mode ON	See page ES-41
SPD TEST	Check mode result for vehicle speed sensor: COMPL or INCMPL	-	-
MISFIRE TEST	Check mode result for misfire monitor: COMPL or INCMPL	-	-
OXS2 TEST	Check mode result for HO2 sensor (bank 2) : COMPL or INCMPL	-	-
OXS1 TEST	Check mode result for HO2 sensor (bank 1) : COMPL or INCMPL	-	-
A/F SSR TEST B2	Check mode result for air-fuel ratio sensor (bank 2) : COMPL or INCMPL	-	-
A/F SSR TEST B1	Check mode result for air-fuel ratio sensor (bank 1) : COMPL or INCMPL	-	-
MIL	MIL status: ON or OFF	ON: MIL ON	-
MIL ON RUN DIST	MIL ON Run Distance: Min.: 0 second, Max.: 65,535 seconds	Drive distance after DTC detected	-
MIL ON RUN TIME	Running time from MIL ON: Min.: 0 minute, Max.: 65,535 minutes	Equivalent to running time after MIL ON	-
ENG RUN TIME	Engine run time: Min.: 0 second, Max.: 65,535 seconds	Time after engine start	Service data
TIME DTC CLEAR	Time after DTC cleared: Min.: 0 minute, Max.: 65,535 minutes	Equivalent to time after DTCs erased	-
DIST DTC CLEAR	Distance after DTC cleared: Min.: 0 km/h, Max.: 65,535 km/h	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

Intelligent Tester Display	Measurement Item:Range (Display)	Normal Condition *	Diagnostic Note
OBD CERT	OBD requirement	OBD2	-
#CARB CODES	Emission related DTCs	-	Number of emission related DTCs
COMP MON	Comprehensive component monitor: NOT AVL or AVAIL	-	-
FUEL MON	Fuel system monitor: NOT AVL or AVAIL	-	-
MISFIRE MON	Misfire monitor: NOT AVL or AVAIL	-	-
O2S (A/FS) MON	O2S (A/FS) monitor: NOT AVL or AVAIL	-	-
O2S (A/FS) MON	O2S (A/FS) monitor: COMPL or INCMPL	-	-
EVAP MON	EVAP monitor: NOT AVL or AVAIL	-	-
EVAP MON	EVAP monitor: COMPL or INCMPL	-	-
CAT MON	Catalyst monitor: COMPL or INCMPL	-	-
CAT MON	Comprehensive component monitor: UNABLE or ENABLE	-	-
CCM ENA	Comprehensive component monitor: UNABLE or ENABLE	-	-
CCM CMPL	Comprehensive component monitor: COMPL or INCMPL	-	-
FUEL ENA	Fuel system monitor: UNABLE or ENABLE	-	-
FUEL CMPL	Fuel system monitor: COMPL or INCMPL	-	-
MISFIRE ENA	Misfire monitor: UNABLE or ENABLE	-	-
MISFIRE CMPL	Misfire monitor: COMPL or INCMPL	-	-
EGR ENA	EGR monitor: UNABLE or ENABLE	-	-
EGR CMPL	EGR monitor: COMPL or INCMPL	-	-
HTR ENA	O2S (A/FS) heater monitor: UNABLE or ENABLE	-	-
HTR CMPL	O2S (A/FS) heater monitor: COMPL or INCMPL	-	-
O2S (A/FS) ENA	O2S (A/FS) monitor: UNABLE or ENABLE	-	-
O2S (A/FS) CMPL	O2S (A/FS) monitor: COMPL or INCMPL	-	-
ACRF ENA	A/C monitor: UNABLE or ENABLE	-	-
ACRF CMPL	A/C monitor: COMPL or INCMPL	-	-
AIR ENA	2nd Air monitor: UNABLE or ENABLE	-	-
AIR CMPL	2nd Air monitor: COMPL or INCMPL	-	-

Intelligent Tester Display	Measurement Item:Range (Display)	Normal Condition *	Diagnostic Note
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	Model code:	-	Identifying model code: GRN2###
ENGINE TYPE	Engine type:	-	Identifying engine type: 1GR
CYLINDER NUMBER	Cylinder number: Min.: 0, Max.: 255	-	Identifying cylinder number: 6
TRANSMISSION	Transmission type:	-	Identifying transmission type: MT, ECT(5AT) or ECT(4AT)
DESTINATION	Destination	-	Identifying destination: A (America)
MODEL YEAR	Model year: Min.: 1900, Max.: 2155	-	Identifying model year: 200#
SYSTEM	System identification	-	Identifying engine system: GASLIN (gasoline engine)

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

2. ACTIVE TEST

HINT:

Performing 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 an intelligent tester. Performing an ACTIVE TEST as the first step of troubleshooting is one method of shortening diagnostic time.

DATA LIST can be displayed during ACTIVE TESTs.

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

Intelligent Tester Displays	Test Details	Control Ranges	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

Intelligent Tester Displays	Test Details	Control Ranges	Diagnostic Notes
A/F CONTROL	Change injection volume	Lower by 12.5 % or increase by 25 %	• 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, and press YES and ENTER followed by F4
FUEL PMP SP CTL	Fuel pump speed control	ON (low speed)/OFF (high speed)	-
INTAKE CTL VSV1	ACIS VSV	ON/OFF	-
EVAP VSV (ALONE)	Activate EVAP VSV control	ON/OFF	-
VVT CTRL B1	Turn on and off OCV (Oil Control Valve)	ON/OFF	• Engine stalls or idles roughly when OCV turned ON • Normal engine running or idling when OCV off
VVT CTRL B2	Turn on and off OCV (Oil Control Valve)	ON/OFF	• Engine stalls or idles roughly when OCV turned ON • Normal engine running or idling when OCV off
A/C CUT SIG	Control A/C cut signal	ON/OFF	-
FUEL PUMP/SPD	Activate fuel pump (C/OPN Relay)	ON/OFF	-
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	-
ETCS OPEN SLOW	Throttle actuator	ON: throttle valve opens slowly	Test possible when following conditions met: • Ignition switch ON • Engine does not start • Fully depressing accelerator pedal (APP: 58 degrees or more)
ETCS CLOSE SLOW	Throttle actuator	ON: throttle valve closes slowly	Same as above
ETCS OPEN FAST	Throttle actuator	ON: throttle valve opens fast	Same as above
ETCS CLOSE FAST	Throttle actuator	ON: throttle valve closes fast	Same as above
FUEL CUT #1	Cylinder #1 injector fuel cut	ON/OFF	Test possible during vehicle stopping and engine idling.
FUEL CUT #2	Cylinder #2 injector fuel cut	ON/OFF	Same as above
FUEL CUT #3	Cylinder #3 injector fuel cut	ON/OFF	Same as above
FUEL CUT #4	Cylinder #4 injector fuel cut	ON/OFF	Same as above
FUEL CUT #5	Cylinder #5 injector fuel cut	ON/OFF	Same as above
FUEL CUT #6	Cylinder #6 injector fuel cut	ON/OFF	Same as above
VVT B1	Control the 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 possible during idle.
VVT B2	Control the VVT (bank 2)	Between -128 % and 127 %	Same as above
VACUUM PUMP	Leak detection pump	ON/OFF	-
VENT VALVE	Vent valve	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 an intelligent tester.

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

Intelligent Tester Displays	Test Details	Recommended Fuel Temperatures	Diagnostic Notes
EVAP SYS CHECK (AUTO OPERATION)	Perform 5 steps in order to operate EVAP key-off monitor automatically	35°C (95°F) or less	• If no DTCs in PENDING CODE after performing this test, system functioning normally • Refer to EVAP Inspection Procedure (See page ES-351)
EVAP SYS CHECK (MANUAL OPERATION)	Perform 5 steps in order to operate EVAP key-off monitor manually	35°C (95°F) or less	• Used to detect malfunctioning parts • Refer to EVAP Inspection Procedure (See page ES-351)

DIAGNOSTIC TROUBLE CODE CHART

HINT:
Factors such as instrument type may cause readings to differ slightly from stated values. If any DTCs are displayed during a check mode DTC check, check the circuit for the DTCs listed in the table below. For details of each DTC, refer to the page indicated.
*: MIL flashes when a catalyst damaged misfire is detected.

DTC No.	Detection Item	Trouble Areas	MIL	Memory	See page
P0010	Camshaft Position "A" Actuator Circuit (Bank 1)	- Open or short in OCV (bank 1) circuit - OCV (bank 1) - ECM	Comes on	DTC stored	ES-66
P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)	- Valve timing - Oil control valve (OCV) - OCV filter - Camshaft timing gear assembly - ECM	Comes on	DTC stored	ES-71
P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)	- Same as DTC P0011	Comes on	DTC stored	ES-71
P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)	- Mechanical system (Timing chain has jumped tooth or chain stretched) - ECM	Comes on	DTC stored	ES-76
P0018	Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)	- Same as DTC P0016	Comes on	DTC stored	ES-76
P0020	Camshaft Position "A" Actuator Circuit (Bank 2)	- Open or short in OCV (bank 2) circuit - OCV (bank 2) - ECM	Comes on	DTC stored	ES-66
P0021	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)	- Same as DTC P0011	Comes on	DTC stored	ES-71
P0022	Camshaft Position "A" - Timing Over-Retarded (Bank 2)	- Same as DTC P0011	Comes on	DTC stored	ES-71
P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)	- Open in A/F sensor heater circuit - A/F sensor heater - A/F sensor heater relay - ECM	Comes on	DTC stored	ES-78
P0032	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)	- Short in A/F sensor heater circuit - A/F sensor heater - A/F sensor heater relay - ECM	Comes on	DTC stored	ES-78
P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)	- Open in HO2 sensor heater circuit - HO2 sensor heater - EFI relay - ECM	Comes on	DTC stored	ES-83

DTC No.	Detection Item	Trouble Areas	MIL	Memory	See page
P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	- Short in HO2 sensor heater circuit - HO2 sensor heater - EFI relay - ECM	Comes on	DTC stored	ES-83
P0051	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)	- Same as DTC P0031	Comes on	DTC stored	ES-78
P0052	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)	- Same as DTC P0032	Comes on	DTC stored	ES-78
P0057	Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)	- Same as DTC P0037	Comes on	DTC stored	ES-83
P0058	Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)	- Same as DTC P0038	Comes on	DTC stored	ES-83
P0100	Mass or Volume Air Flow Circuit	- Open or short in MAF meter circuit - MAF meter - ECM	Comes on	DTC stored	ES-89
P0101	Mass or Volume Air Flow Circuit Range / Performance Problem	- MAF meter	Comes on	DTC stored	ES-96
P0102	Mass or Volume Air Flow Circuit Low Input	- Open in MAF meter circuit - Short in ground circuit - MAF meter - ECM	Comes on	DTC stored	ES-89
P0103	Mass or Volume Air Flow Circuit High Input	- Short in MAF meter circuit (+B circuit) - MAF meter - ECM	Comes on	DTC stored	ES-89
P0110	Intake Air Temperature Circuit	- Open or short in IAT sensor circuit - IAT sensor (built into MAF meter) - ECM	Comes on	DTC stored	ES-98
P0112	Intake Air Temperature Circuit Low Input	- Short in IAT sensor circuit - IAT sensor (built into MAF meter) - ECM	Comes on	DTC stored	ES-98
P0113	Intake Air Temperature Circuit High Input	- Open in IAT sensor circuit - IAT sensor (built into MAF meter) - ECM	Comes on	DTC stored	ES-98
P0115	Engine Coolant Temperature Circuit	- Open or short in ECT sensor circuit - ECT sensor - ECM	Comes on	DTC stored	ES-104
P0116	Engine Coolant Temperature Circuit Range / Performance Problem	- ECT sensor	Comes on	DTC stored	ES-109

DTC No.	Detection Item	Trouble Areas	MIL	Memory	See page
P0117	Engine Coolant Temperature Circuit Low Input	- Short in ECT sensor circuit - ECT sensor - ECM	Comes on	DTC stored	ES-104
P0118	Engine Coolant Temperature Circuit High Input	- Open in ECT sensor circuit - ECT sensor - ECM	Comes on	DTC stored	ES-104
P0120	Throttle / Pedal Position Sensor / Switch "A" Circuit	- Throttle Position (TP) sensor (built into throttle body) - ECM	Comes on	DTC stored	ES-112
P0121	Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem	- TP sensor (built into throttle body)	Comes on	DTC stored	ES-120
P0122	Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input	- TP sensor (built into throttle body) - Short in VTA1 circuit - Open in VC circuit - ECM	Comes on	DTC stored	ES-112
P0123	Throttle / Pedal Position Sensor / Switch "A" Circuit High Input	- TP sensor (built into throttle body) - Open in VTA1 circuit - Open in E2 circuit - Short between VC and VTA1 circuits - ECM	Comes on	DTC stored	ES-112
P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control	- Cooling system - Engine coolant temperature sensor - Thermostat	Comes on	DTC stored	ES-122
P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	- Thermostat - Cooling system - ECT sensor - ECM	Comes on	DTC stored	ES-125
P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	- Open or short in HO2 sensor (bank 1, 2 sensor 2) circuit - HO2 sensor (bank 1, 2 sensor 2) - HO2 sensor heater (bank 1, 2 sensor 2) - Air-Fuel Ratio (A/F) sensor (bank 1, 2 sensor 1) - EFI relay - Gas leakage from exhaust system	Comes on	DTC stored	ES-128
P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	- Open in HO2 sensor (bank 1, 2 sensor 2) circuit - HO2 sensor (bank 1, 2 sensor 2) - HO2 sensor heater (bank 1, 2 sensor 2) - EFI relay - Gas leakage from exhaust system	Comes on	DTC stored	ES-128

DTC No.	Detection Item	Trouble Areas	MIL	Memory	See page
P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)	- Short in HO2 sensor (bank 1, 2 sensor 2) circuit - HO2 sensor (bank 1, 2 sensor 2) - ECM internal circuit malfunction	Comes on	DTC stored	ES-128
P0156	Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)	- Same as DTC P0136	Comes on	DTC stored	ES-128
P0157	Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)	- Same as DTC P0137	Comes on	DTC stored	ES-128
P0158	Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)	- Same as DTC P0138	Comes on	DTC stored	ES-128
P0171	System Too Lean (Bank 1)	- Air induction system - Injector blockage - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Fuel pressure - Gas leakage from exhaust system - Open or short in A/F sensor (bank 1, 2 sensor 1) circuit - A/F sensor (bank 1, 2 sensor 1) - A/F sensor heater (bank 1, 2 sensor 1) - A/F sensor heater relay - A/F sensor heater and A/F sensor heater relay circuits - PCV hose connections - PCV valve and hose - ECM	Comes on	DTC stored	ES-146
P0172	System Too Rich (Bank 1)	- Injector leakage or blockage - MAF meter - ECT sensor - Ignition system - Fuel pressure - Gas leakage from exhaust system - Open or short in A/F sensor (bank 1, 2 sensor 1) circuit - A/F sensor (bank 1, 2 sensor 1) - A/F sensor heater (bank 1, 2 sensor 1) - A/F sensor heater relay - A/F sensor heater and A/F sensor heater relay circuits - ECM	Comes on	DTC stored	ES-146
P0174	System Too Lean (Bank 2)	- Same as DTC P0171	Comes on	DTC stored	ES-146

DTC No.	Detection Item	Trouble Areas	MIL	Memory	See page
P0175	System Too Rich (Bank 2)	- Same as DTC P0172	Comes on	DTC stored	ES-146
P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit	- TP sensor (built into throttle body) - ECM	Comes on	DTC stored	ES-112
P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input	- TP sensor (built into throttle body) - Short in VTA2 circuit - Open in VC circuit - ECM	Comes on	DTC stored	ES-112
P0223	Throttle / Pedal Position Sensor / Switch "B" Circuit High Input	- TP sensor (built into throttle body) - Open in VTA2 circuit - Open in E2 circuit - Short between VC and VTA2 circuits - ECM	Comes on	DTC stored	ES-112
P0230	Fuel Pump Primary Circuit	- Open or short in fuel pump relay circuit - Fuel pump relay - ECM	-	DTC stored	ES-158
P0300	Random / Multiple Cylinder Misfire Detected	- Open or short in engine wire harness - Connector connection - Vacuum hose connection - Ignition system - Injector - Fuel pressure - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve clearance - Valve timing - PCV hose connections - PCV valve and hose - ECM	Comes on/ Blinks	DTC stored	ES-163
P0301	Cylinder 1 Misfire Detected	- Same as DTC P0300	Comes on/ Blinks	DTC stored	ES-163
P0302	Cylinder 2 Misfire Detected	- Same as DTC P0300	Comes on/ Blinks	DTC stored	ES-163
P0303	Cylinder 3 Misfire Detected	- Same as DTC P0300	Comes on/ Blinks	DTC stored	ES-163
P0304	Cylinder 4 Misfire Detected	- Same as DTC P0300	Comes on/ Blinks	DTC stored	ES-163
P0305	Cylinder 5 Misfire Detected	- Same as DTC P0300	Comes on/ Blinks	DTC stored	ES-163
P0306	Cylinder 6 Misfire Detected	- Same as DTC P0300	Comes on/ Blinks	DTC stored	ES-163
P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	- Short in knock sensor 1 or 2 circuit - Knock sensor 1 or 2 - ECM	Comes on	DTC stored	ES-176
P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	- Open in knock sensor 1 or 2 circuit - Knock sensor 1 or 2 - ECM	Comes on	DTC stored	ES-176

DTC No.	Detection Item	Trouble Areas	MIL	Memory	See page
P0332	Knock Sensor 2 Circuit Low Input (Bank 2)	- Same as DTC P0327	Comes on	DTC stored	ES-176
P0333	Knock Sensor 2 Circuit High Input (Bank 2)	- Same as DTC P0328	Comes on	DTC stored	ES-176
P0335	Crankshaft Position Sensor "A" Circuit	- Open or short in CKP sensor circuit - CKP sensor - Sensor plate (CKP sensor plate) - ECM	Comes on	DTC stored	ES-182
P0339	Crankshaft Position Sensor "A" Circuit Intermittent	- Same as DTC P0335	-	DTC stored	ES-182
P0340	Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)	- Open or short in VVT sensor circuit - VVT sensor - Camshaft timing pulley - Jumped tooth of timing chain - ECM	Comes on	DTC stored	ES-187
P0342	Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)	- Same as DTC P0340	Comes on	DTC stored	ES-187
P0343	Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)	- Same as DTC P0340	Comes on	DTC stored	ES-187
P0345	Camshaft Position Sensor "A" Circuit (Bank 2)	- Same as DTC P0340	Comes on	DTC stored	ES-187
P0347	Camshaft Position Sensor "A" Circuit Low Input (Bank 2)	- Same as DTC P0340	Comes on	DTC stored	ES-187
P0348	Camshaft Position Sensor "A" Circuit High Input (Bank 2)	- Same as DTC P0340	Comes on	DTC stored	ES-187
P0351	Ignition Coil "A" Primary / Secondary Circuit	- Ignition system - Open or short in IGF1 or IGT circuit (1 to 6) between ignition coil with igniter and ECM - No. 1 to No. 6 ignition coils with igniters - ECM	Comes on	DTC stored	ES-192
P0352	Ignition Coil "B" Primary / Secondary Circuit	- Same as DTC P0351	Comes on	DTC stored	ES-192
P0353	Ignition Coil "C" Primary / Secondary Circuit	- Same as DTC P0351	Comes on	DTC stored	ES-192
P0354	Ignition Coil "D" Primary / Secondary Circuit	- Same as DTC P0351	Comes on	DTC stored	ES-192
P0355	Ignition Coil "E" Primary / Secondary Circuit	- Same as DTC P0351	Comes on	DTC stored	ES-192

DTC No.	Detection Item	Trouble Areas	MIL	Memory	See page
P0356	Ignition Coil "F" Primary / Secondary Circuit	- Same as DTC P0351	Comes on	DTC stored	ES-192
P0420	Catalyst System Efficiency Below Threshold (Bank 1)	- Gas leakage from exhaust system - A/F sensor (bank 1 sensor 1) - HO2 sensor (bank 1 sensor 2) - Exhaust manifold (TWC)	Comes on	DTC stored	ES-203
P0430	Catalyst System Efficiency Below Threshold (Bank 2)	- Gas leakage from exhaust system - A/F sensor (bank 2 sensor 1) - HO2 sensor (bank 2 sensor 2) - Exhaust manifold (TWC)	Comes on	DTC stored	ES-203
P043E	Evaporative Emission System Reference Orifice Clog Up	- Canister pump module - Connector/wire harness (Canister pump module - ECM) - ECM - Leakage from EVAP system	Comes on	DTC stored	ES-210
P043F	Evaporative Emission System Reference Orifice High Flow	- Canister pump module - Connector/wire harness (Canister pump module - ECM) - ECM Leakage from EVAP system	Comes on	DTC stored	ES-210
P0441	Evaporative Emission Control System Incorrect Purge Flow	- Purge VSV - Connector/wire harness (Purge VSV - ECM) - ECM - Canister pump medule - Leakage from EVAP system - Leakage from EVAP line (Purge VSV - Intake manifold)	Comes on	DTC stored	ES-216
P0450	Evaporative Emission Control System Pressure Sensor / Switch	- Canister pump module - ECM	Comes on	DTC stored	ES-223
P0451	Evaporative Emission Control System Pressure Sensor Range / Performance	- Canister pump module - Connector/wire harness (Canister pump module - ECM) - ECM	Comes on	DTC stored	ES-223
P0452	Evaporative Emission Control System Pressure Sensor / Switch Low Input	- Canister pump module - Connector/wire harness (Canister pump module - ECM) - ECM	Comes on	DTC stored	ES-223

DTC No.	Detection Item	Trouble Areas	MIL	Memory	See page
P0453	Evaporative Emission Control System Pressure Sensor / Switch High Input	- Canister pump module - Connector/wire harness (Canister pump module - ECM) - ECM	Comes on	DTC stored	ES-223
P0455	Evaporative Emission Control System Leak Detected (Gross Leak)	- Fuel cap (loose) - Leakage from EVAP line (Canister - Fuel tank) - Leakage from EVAP line (Purge VSV - Canister) - Canister pump module - Leakage from fuel tank - Leakage from canister	Comes on	DTC stored	ES-233
P0456	Evaporative Emission Control System Leak Detected (Very Small Leak)	- Same as DTC P0455	Comes on	DTC stored	ES-233
P0500	Vehicle Speed Sensor "A"	- Open or short in speed signal circuit - Combination meter - ECM - Skid control ECU	Comes on	DTC stored	ES-238
P0504	Brake Switch "A" / "B" Correlation	- Short in stop light switch signal circuit - STOP fuse - Stop light switch - ECM	-	DTC stored	ES-242
P0505	Idle Control System Malfunction	- ETCS - Air induction system - PCV hose connections - ECM	Comes on	DTC stored	ES-246
P050A	Cold Start Idle Air Control System Performance	- Throttle body assembly - Mass air flow meter - Air induction system - PCV hose connections - VVT system - Air cleaner filter element - ECM	Comes on	DTC stored	ES-250
P050B	Cold Start Ignition Timing Performance	- Same as DTC P050A	Comes on	DTC stored	ES-250
P0560	System Voltage	- Open in back up power source circuit - EFI fuse - ECM	Comes on	DTC stored	ES-257
P0604	Internal Control Module Random Access Memory (RAM) Error	- ECM	Comes on	DTC stored	ES-261
P0606	ECM / PCM Processor	- ECM	Comes on	DTC stored	ES-261
P0607	Control Module Performance	- ECM	Comes on	DTC stored	ES-261

DTC No.	Detection Item	Trouble Areas	MIL	Memory	See page
P0617	Starter Relay Circuit High	- Park/Neutral Position (PNP) switch (For automatic transmission) - Clutch start switch (For manual transmission) - Starter relay circuit - Ignition switch - ECM	Comes on	DTC stored	ES-263
P0630	VIN not Programmed or Mismatch - ECM / PCM	- ECM	Comes on	DTC stored	ES-270
P0657	Actuator Supply Voltage Circuit / Open	- ECM	Comes on	DTC stored	ES-261
P0724	Brake Switch "B" Circuit High	- Short in stop light switch signal circuit - Stop light switch - ECM	Comes on	DTC stored	ES-272
P1500	AC Inverter Malfunction	- Open or short in speed signal circuit - Short between idle-up signal and +B circuits - Voltage Inverter - ECM	Comes on	DTC stored	ES-275
P2102	Throttle Actuator Control Motor Circuit Low	- Open in throttle actuator circuit - Throttle actuator - ECM	Comes on	DTC stored	ES-279
P2103	Throttle Actuator Control Motor Circuit High	- Short in throttle actuator circuit - Throttle actuator - Throttle valve - Throttle body assembly - ECM	Comes on	DTC stored	ES-279
P2111	Throttle Actuator Control System - Stuck Open	- Throttle actuator - Throttle body assembly - Throttle valve	Comes on	DTC stored	ES-283
P2112	Throttle Actuator Control System - Stuck Closed	- Same as DTC P2111	Comes on	DTC stored	ES-283
P2118	Throttle Actuator Control Motor Current Range / Performance	- Open in ETCS power source circuit - ETCS fuse - ECM	Comes on	DTC stored	ES-286
P2119	Throttle Actuator Control Throttle Body Range / Performance	- ETCS - ECM	Comes on	DTC stored	ES-290
P2120	Throttle / Pedal Position Sensor / Switch "D" Circuit	- Accelerator Pedal Position (APP) sensor - ECM	Comes on	DTC stored	ES-293
P2121	Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance	- Accelerator position sensor - ECM	Comes on	DTC stored	ES-301

DTC No.	Detection Item	Trouble Areas	MIL	Memory	See page
P2122	Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input	- APP sensor - Open in VCP1 circuit - Open or ground short in VPA circuit - ECM	Comes on	DTC stored	ES-293
P2123	Throttle / Pedal Position Sensor / Switch "D" Circuit High Input	- APP sensor - Open in EPA circuit - ECM	Comes on	DTC stored	ES-293
P2125	Throttle / Pedal Position Sensor / Switch "E" Circuit	- APP sensor - ECM	Comes on	DTC stored	ES-293
P2127	Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input	- APP sensor - Open in VCP2 circuit - Open or ground short in VPA2 circuit - ECM	Comes on	DTC stored	ES-293
P2128	Throttle / Pedal Position Sensor / Switch "E" Circuit High Input	- APP sensor - Open in EPA2 circuit - ECM	Comes on	DTC stored	ES-293
P2135	Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation	- Short between VTA1 and VTA2 circuits - TP sensor (built into throttle body) - ECM	Comes on	DTC stored	ES-112
P2138	Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation	- Short between VPA and VPA2 circuits - APP sensor - ECM	Comes on	DTC stored	ES-293
P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)	- Open or short in A/F sensor (bank 1, 2 sensor 1) circuit - A/F sensor (bank 1, 2 sensor 1) - A/F sensor heater (bank 1, 2 sensor 1) - A/F sensor heater relay - A/F sensor heater and relay circuits - Air induction system - Fuel pressure - Injector - ECM	Comes on	DTC stored	ES-304
P2196	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)	- Same as DTC P2195	Comes on	DTC stored	ES-304
P2197	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)	- Same as DTC P2195	Comes on	DTC stored	ES-304
P2198	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)	- Same as DTC P2195	Comes on	DTC stored	ES-304

DTC No.	Detection Item	Trouble Areas	MIL	Memory	See page
P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)	- Open or short in A/F sensor (bank 1, 2 sensor 1) circuit - A/F sensor (bank 1, 2 sensor 1) - A/F sensor heater - A/F sensor heater relay - A/F sensor heater and relay circuits - ECM	Comes on	DTC stored	ES-322
P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)	- Same as DTC P2238	Comes on	DTC stored	ES-322
P2241	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)	- Same as DTC P2238	Comes on	DTC stored	ES-322
P2242	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)	- Same as DTC P2238	Comes on	DTC stored	ES-322
P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)	- Same as DTC P2238	Comes on	DTC stored	ES-322
P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)	- Same as DTC P2238	Comes on	DTC stored	ES-322
P2255	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)	- Same as DTC P2241	Comes on	DTC stored	ES-322
P2256	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)	- Same as DTC P2241	Comes on	DTC stored	ES-322
P2401	Evaporative Emission System Leak Detection Pump Control Circuit Low	- Canister pump module - Connector/wire harness (Canister pump module - ECM) - ECM - Leakage from EVAP system	Comes on	DTC stored	ES-328
P2402	Evaporative Emission System Leak Detection Pump Control Circuit High	- Canister pump module - Connector/wire harness (Canister pump module - ECM) - ECM	Comes on	DTC stored	ES-328
P2419	Evaporative Emission System Switching Valve Control Circuit Low	- Canister pump module - Connector/wire harness (Canister pump module - ECM) - ECM	Comes on	DTC stored	ES-334

DTC No.	Detection Item	Trouble Areas	MIL	Memory	See page
P2420	Evaporative Emission System Switching Valve Control Circuit High	- Canister pump module - Connector/wire harness (Canister pump module - ECM) - ECM - Leakage from EVAP system	Comes on	DTC stored	ES-334
P2610	ECM / PCM Internal Engine Off Timer Performance	- ECM	Comes on	DTC stored	ES-340
P2A00	A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)	- Open or short in A/F sensor (bank 1, 2 sensor 1) circuit - A/F sensor - ECM	Comes on	DTC stored	ES-342
P2A03	A/F Sensor Circuit Slow Response (Bank 2 Sensor 1)	- Same as DTC P2A00	Comes on	DTC stored	ES-342

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

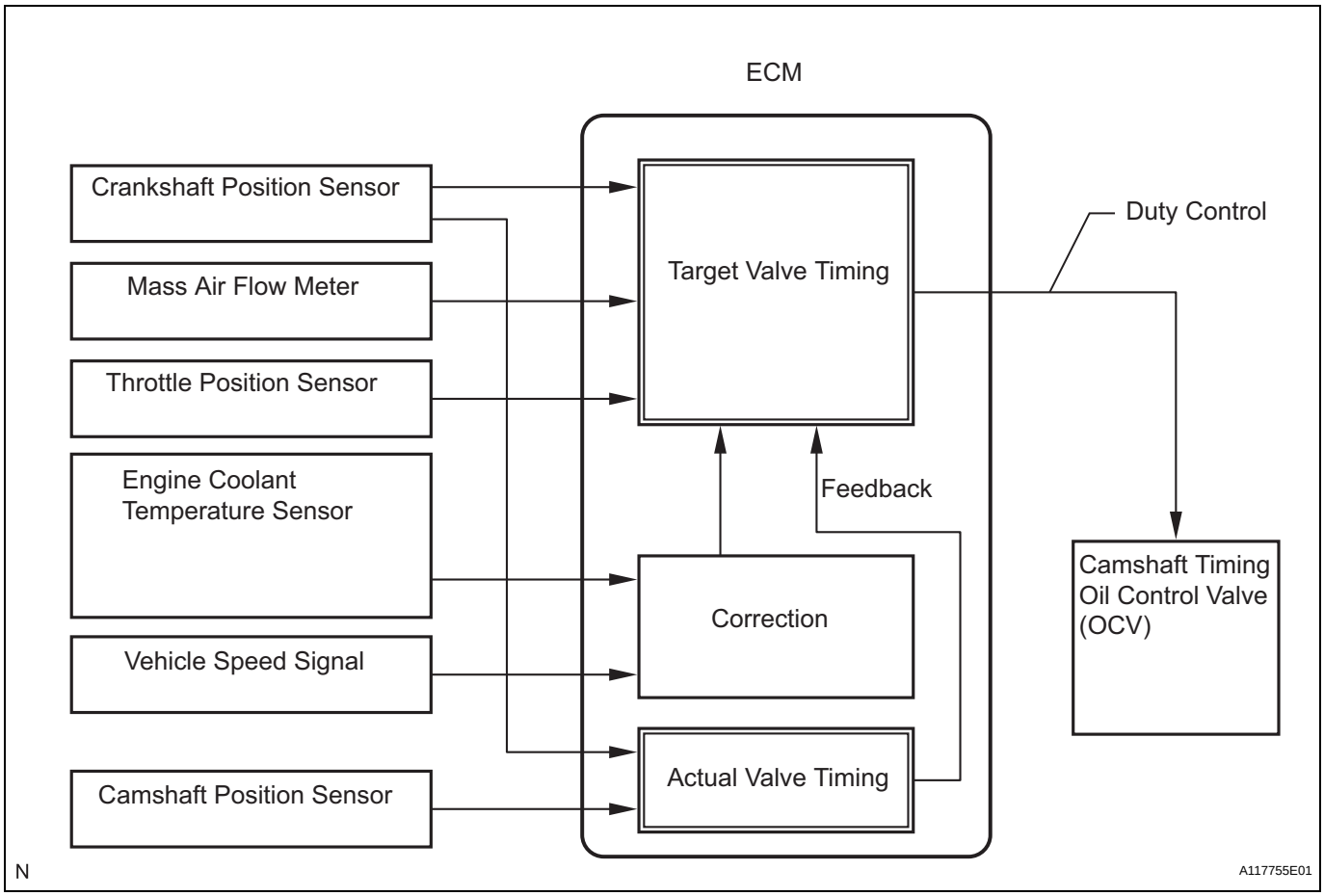
DTC	P0020	Camshaft Position "A" Actuator Circuit (Bank 2)

HINT:
This DTC relates to the Oil Control Valve (OCV).

DESCRIPTION

ES

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.



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

DTC No.	DTC Detection Conditions	Trouble Areas
P0020	Open or short in OCV (bank 2) circuit (1 trip detection logic)	• Open or short in OCV (bank 2) circuit • OCV (bank 2) • 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 (bank 1) open/short P0020: VVT OCV (bank 2) open/short
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 following DTCs not present	None
All of the following conditions are met	-
Ignition switch	ON
Starter	OFF
Time after ignition switch OFF to ON	0.5 seconds or more

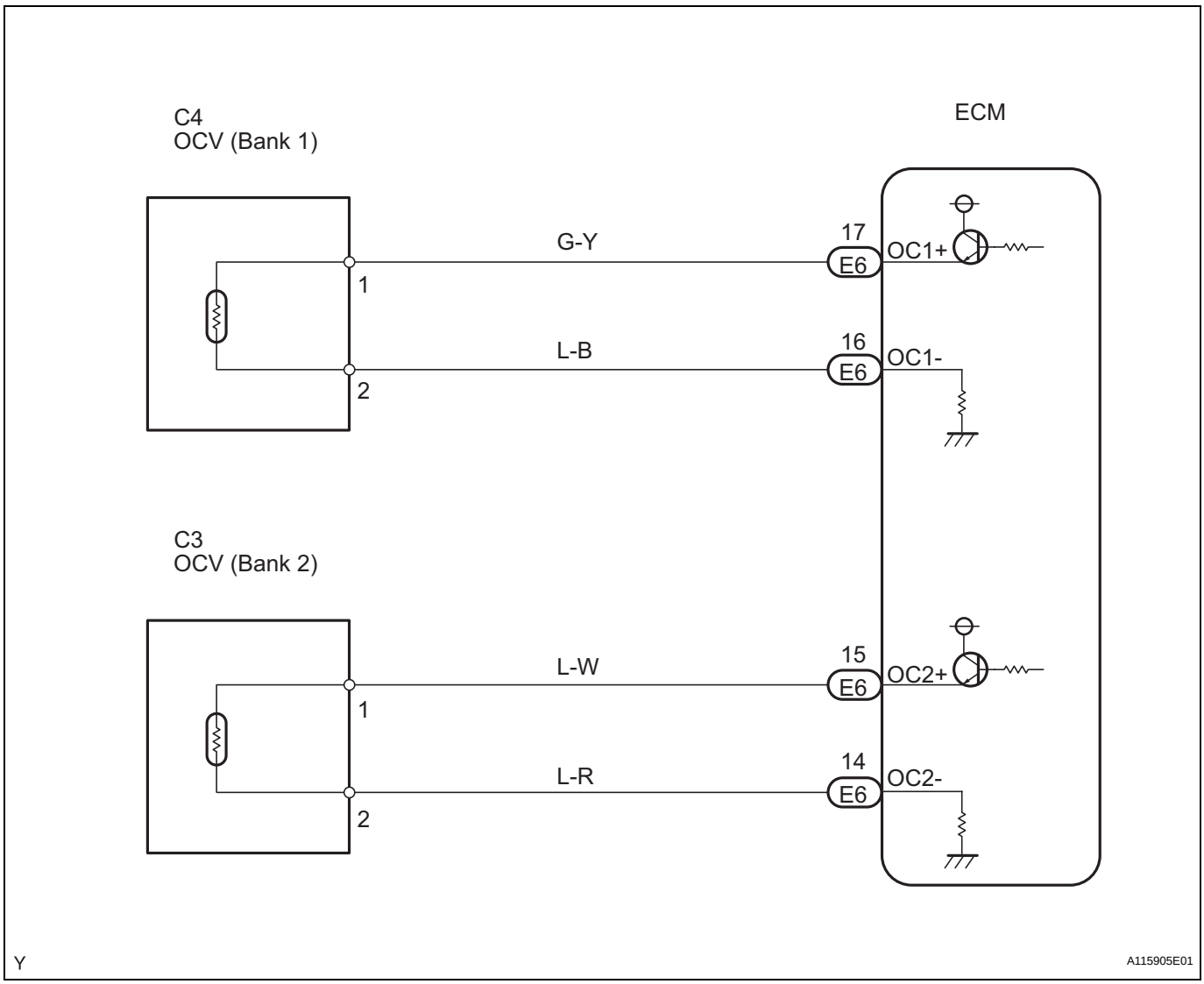
TYPICAL MALFUNCTION THRESHOLDS

One of the following conditions is met	-
A. All of the following conditions are met	-
a. Battery voltage	11 V or more, and less than 13 V
b. Target duty ratio	Less than 70 %
c. Output signal duty ratio	100 % or more
B. All of the following conditions are met	-
a. Battery voltage	13 V or more
b. Target duty ratio	Less than 80 %
c. Output signal duty ratio	100 % or more
C. All of the following conditions are met	-
a. Current cut status	Not cut
b. Output signal duty ratio	3 % or less

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM



HINT:
- If DTC P0010 is displayed, check the bank 1 VVT system circuit.
- Bank 1 refers to the bank that include cylinder No. 1.
- If DTC P0020 is displayed, check the bank 2 VVT system circuit.
- Bank 2 refers to the bank that does not includes cylinder No. 1.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

(a) Connect an 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 or VVT CTRL B2.

(e) Check the engine speed while operating the Oil Control Valve (OCV) using the tester.

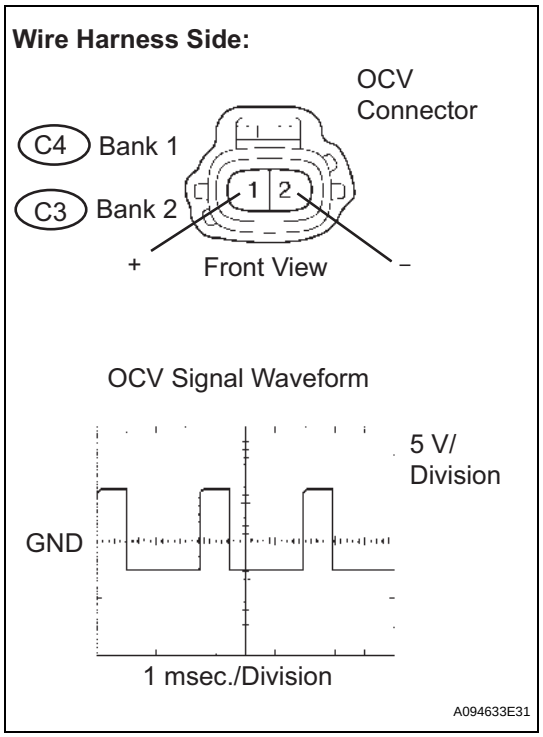
OK

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

OK → **CHECK FOR INTERMITTENT PROBLEMS**

NG

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



(a) Disconnect the C4 or C3 OCV connector.
(b) While idling, check the waveform between the terminals of the C4 or C3 OCV connector using an oscilloscope.
Standard

Tester Connections	Specified Conditions
+ (C4-1) - - (C4-2)	Correct waveform shown
+ (C3-1) - - (C3-2)	

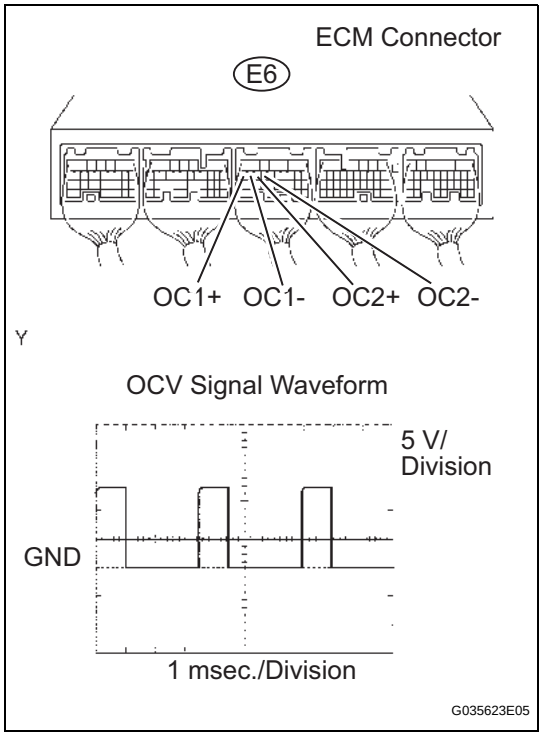
(c) Reconnect the OCV connector.

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

NG

ES

3	INSPECT ECM (OCV SIGNAL)



(a) Inspect the ECM using an oscilloscope.
(b) While idling, check the waveform between the terminals of the E6 ECM connector.

Standard

Tester Connections	Specified Conditions
OC1+ (E6-17) - OC1- (E6-16)	Correct waveform as shown in illustration
OC2+ (E6-15) - OC2- (E6-14)	

NG → **REPLACE ECM**

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

ES

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

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

DTC	P0021	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)

DTC	P0022	Camshaft Position "A" - Timing Over-Retarded (Bank 2)

HINT:
If DTC P0011, P0012, P0021 or P0022 is present, check the VVT (Variable Valve Timing) system.

DESCRIPTION

Refer to DTC P0010 (See page ES-66).

DTC No.	DTC Detection Conditions	Trouble Areas
P0011 P0021	Advanced cam timing: With warm engine and engine speed of between 500 rpm and 4,000 rpm, all conditions (a), (b) and (c) met (1 trip detection logic) (a) Difference between target and actual intake valve timings more than 5°CA (Crankshaft Angle) for 4.5 seconds (b) Current intake valve timing fixed (timing changes less than 5°CA in 5 seconds) (c) Variations in VVT controller timing more than 19°CA of maximum delayed timing (advanced)	• Valve timing • Oil control valve (OCV) • OCV filter • Camshaft timing gear assembly • ECM
P0012 P0022	Retarded cam timing: With warm engine and engine speed of between 500 rpm and 4,000 rpm, all conditions (a), (b) and (c) met (2 trip detection logic) (a) Difference between target and actual intake valve timings more than 5°CA (Crankshaft Angle) for 4.5 seconds (b) Current intake valve timing fixed (timing changes less than 5°CA in 5 seconds) (c) Variations in VVT controller timing 19°CA or less of maximum delayed timing (retarded)	

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, the 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 is set when the following conditions 1), 2) and 3) are met:
1) The difference between the target and actual intake valve timings is more than 5°CA (Crankshaft Angle) and the condition continues for more than 4.5 seconds.
2) It takes 5 seconds or more to change the valve timing by 5°CA.
3) After above conditions 1) and 2) are met, the OCV is forcibly activated 63 times or more.
DTCs P0011 and P0021 (Advanced Cam Timing) are subject to 1 trip detection logic.

DTCs P0012 and P0022 (Retarded Cam Timing) are subject to 2 trip detection logic.
These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.
The monitor will not run unless the following conditions are met:

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

MONITOR STRATEGY

Related DTCs	P0011: Advanced camshaft timing (bank 1) P0012: Retard camshaft timing (bank 1) P0021: Advanced camshaft timing (bank 2) P0022: Retard camshaft timing (bank 2)
Required Sensors/Components (Main)	VVT OCV and 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	P0011 and P0021: Immediate P0012 and P0022: 2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0100 - P0103 (MAF sensor) P0115 - P0118 (ECT sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor) P0340 (CMP sensor) P0351 - P0356 (igniter)
Battery voltage	11 V or more
Throttle position learning	Completed
Engine RPM	500 to 4,000 rpm
Engine coolant temperature	75 to 100°C (167 to 212°F)

TYPICAL MALFUNCTION THRESHOLDS

OCV activation	9.5 seconds or more
Response of valve timing	1 sec/°CA or more (valve timing does not change)

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-68).

HINT:

Abnormal bank	Advanced timing over (Valve timing is out of specified range)	Retarded timing over (Valve timing is out of specified range)
Bank 1	P0011	P0012
Bank 2	P0021	P0022

- If DTC P0011 or P0012 is displayed, check the bank 1 VVT system circuit.
- Bank 1 refers to the bank that includes cylinder No. 1.

- If DTC P0021 or P0022 is displayed, check the bank 2 VVT system circuit.
- Bank 2 refers to the bank that does not include cylinder No. 1.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)

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

Result

Display (DTC Output)	Proceed to
P0011, P0012, P0021 or P0022	A
P0011, P0012, P0021 or P0022 and other DTCs	B

HINT:
If any DTCs other than P0011, P0012, P0021 or P0022 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART

A

2	PREFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

(a) Connect an 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 4

OK

3	CHECK WHETHER DTC OUTPUT RECURS (DTC P0011, P0012, P0021 OR P0022)

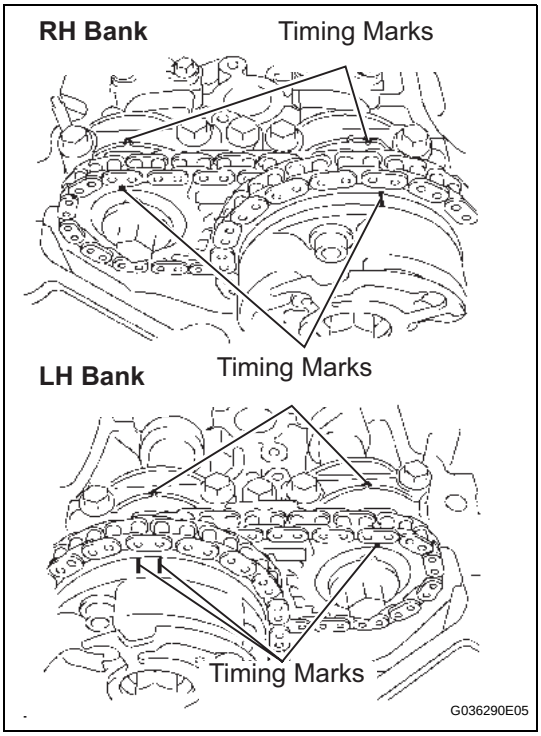
(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Clear DTCs (See page ES-38).
(d) Start the engine and warm it up.

(e) Switch the ECM from normal mode to check mode using the tester (See page ES-41).
(f) Drive the vehicle for more than 10 minutes.
(g) Read DTCs using the tester.
OK:
No DTC output.

OK → **END**

NG

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

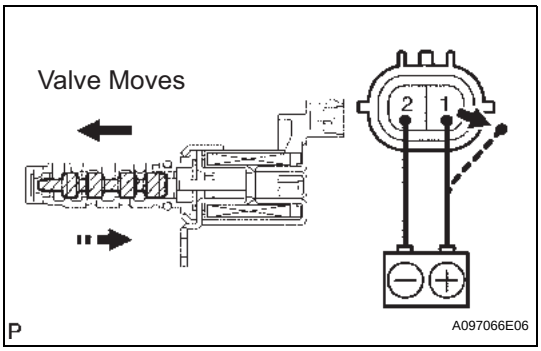


(a) Remove the cylinder head cover (See page EM-57 or EM-74).
(b) Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.
(c) Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.
OK:
Timing marks on camshaft timing gears are aligned as shown in the illustration.
(d) Reinstall the cylinder head cover (See page EM-57 or EM-74).

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:
Valve moves quickly.
(d) Reinstall the OCV.

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

OK

6	INSPECT OIL CONTROL VALVE FILTER

OK:
Filter is not clogged.

NG → **CLEAN OIL CONTROL VALVE FILTER**

OK

7	REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

ES

NEXT

8	CHECK IF DTC OUTPUT RECURS

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Clear DTCs (See page ES-38).
(d) Start the engine and warm it up.
(e) Switch the ECM from normal mode to check mode using the tester (See page ES-41).
(f) Drive the vehicle for more than 10 minutes.
(g) Confirm that no DTC is set using the tester.
Standard:
No DTC output.
HINT:
DTC P0011, P0012, P0021 or P0022 is output when foreign objects in engine oil are caught in some parts of the system. These codes will stay registered even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

OK → **SYSTEM OK**

NG

REPLACE ECM

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

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

DESCRIPTION

Refer to DTC P0335 (See page ES-182).

DTC No.	DTC Detection Conditions	Trouble Areas
P0016	Deviations in crankshaft and camshaft position sensor1 signals (2 trip detection logic)	• Mechanical system (Timing chain has jumped tooth or chain stretched) • ECM
P0018	Deviations in crankshaft and camshaft position sensor2 signals (2 trip detection logic)	

ES

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 22.5°CA, or more than 45.2°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 jumped a 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 following DTCs not present	P0011 (VVT system 1 - advance) P0012 (VVT system 1 - retard) P0021 (VVT system 2 - advance) P0022 (VVT system 2 - retard) P0115 - P0118 (ECT sensor)
Engine RPM	500 to 1,000 rpm

TYPICAL MALFUNCTION THRESHOLDS

Duration of following condition	18 seconds or more
Valve timing when camshaft retarded maximum	Less than 22.5 CA°, or more than 45.2 CA°

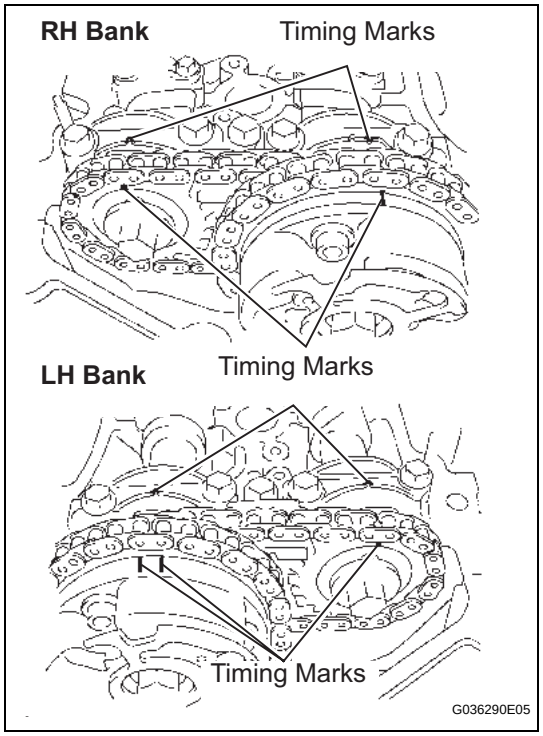
WIRING DIAGRAM

Refer to DTC P0335 (See page ES-184).

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

ES

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



(a) Remove the cylinder head cover (See page EM-25(For 2WD), EM-46(For 4WD)).
(b) Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.
(c) Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°) and align the marks as above.
OK:
Timing marks on camshaft timing gears are aligned as shown in illustration.
(d) Reinstall the cylinder head cover.

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

OK

REPLACE ECM

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

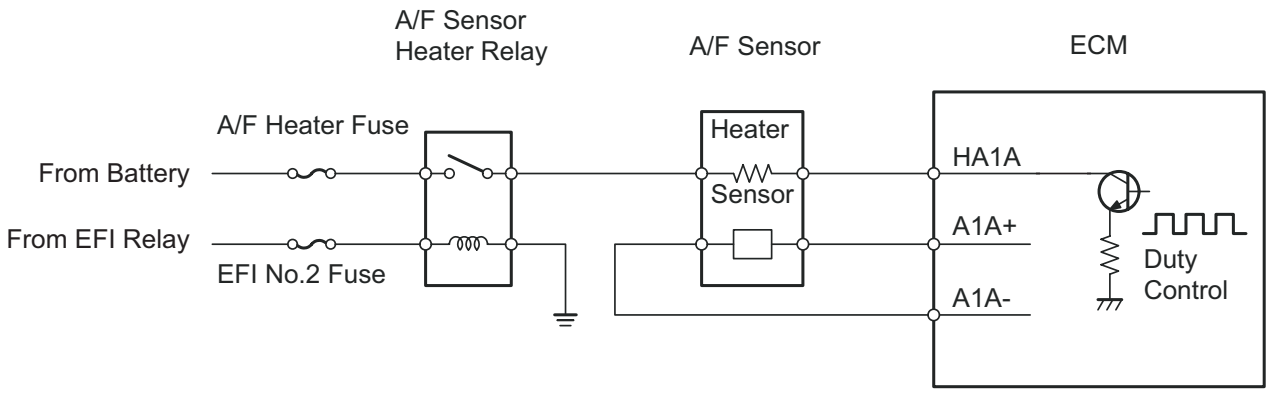
ES

HINT:
- Although the DTC titles say the 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

Refer to DTC P2195 (See page ES-304).
HINT:
- 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 (Bank 1 Sensor 1 System Diagram)



A115897E02

DTC No.	DTC Detection Conditions	Trouble Areas
P0031 P0051	Air-Fuel Ratio (A/F) sensor heater current less than 0.8 A (1 trip detection logic)	• Open in A/F sensor heater circuit • A/F sensor heater • A/F sensor heater relay • ECM

DTC No.	DTC Detection Conditions	Trouble Areas
P0032 P0052	Air-Fuel Ratio (A/F) sensor heater current more than 10 A (1 trip detection logic)	• Short in A/F sensor heater circuit • A/F sensor heater • A/F sensor heater relay • ECM

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

MONITOR 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 or P0052 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 or P0051 is set.

MONITOR STRATEGY

Related DTCs	P0031: A/F sensor heater (bank 1) open/short (Low electrical current) P0032: A/F sensor heater (bank 1) open/short (High electrical current) P0051: A/F sensor heater (bank 2) open/short (Low electrical current) P0052: A/F sensor heater (bank 2) open/short (High electrical current)
Required Sensors/Components (Main)	A/F sensor heater (bank 1 and 2)
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	10 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs not present	None

P0031 and P0051:

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 and P0052:

Time after engine start	10 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

P0031 and P0051:

A/F sensor heater current	Less than 0.8 A

P0032 and P0052:

A/F sensor heater current	More than 10 A

COMPONENT OPERATING RANGE

ES

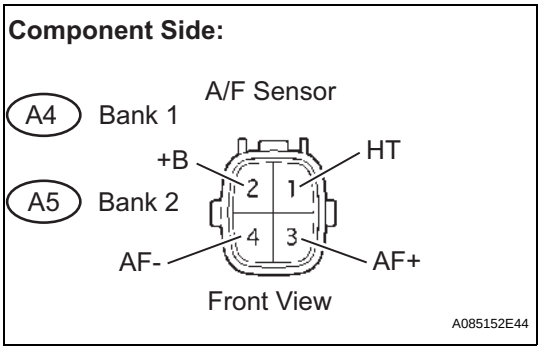
A/F sensor heater current	1.8 to 3.4 A at 20°C (68°F)

WIRING DIAGRAM

Refer to DTC P2195 (See page ES-309).

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

1 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the A4 or A5 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor connector.
Standard Resistance

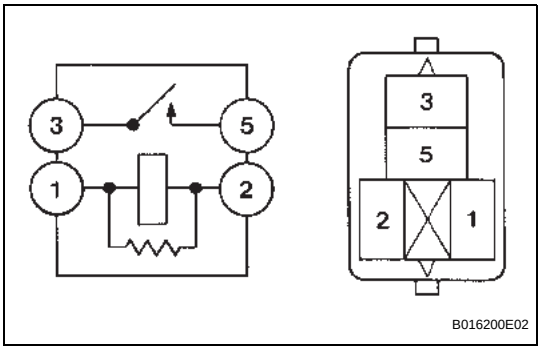
Tester Connections	Specified Conditions
HT (1) - +B (2)	1.8 to 3.4 Ω at 20°C (68°F)
HT (1) - AF- (4)	10 kΩ or higher

(c) Reconnect the A/F sensor connector.

NG → REPLACE AIR FUEL RATIO SENSOR

OK

2 INSPECT AIR FUEL RATIO SENSOR HEATER RELAY



(a) Remove the A/F sensor heater relay from the engine room relay block.
(b) Check the A/F sensor heater relay resistance.
Standard Resistance

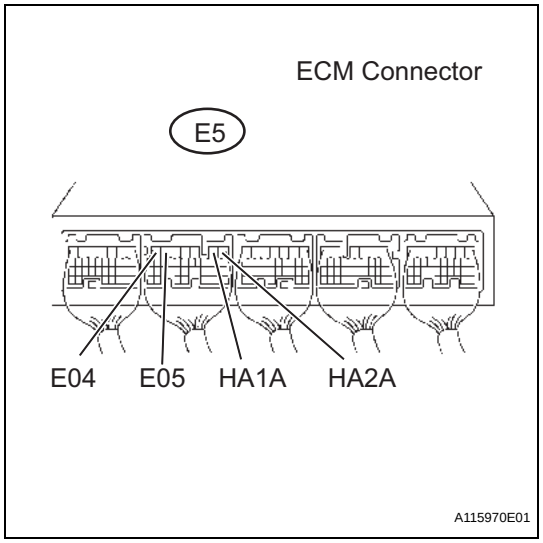
Tester Connections	Specified Conditions
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the A/F sensor heater relay.

NG → REPLACE AIR FUEL RATIO SENSOR HEATER RELAY

OK

3 INSPECT ECM (HA1A OR HA2A VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage between the terminals of the E5 ECM connector.

Standard Voltage

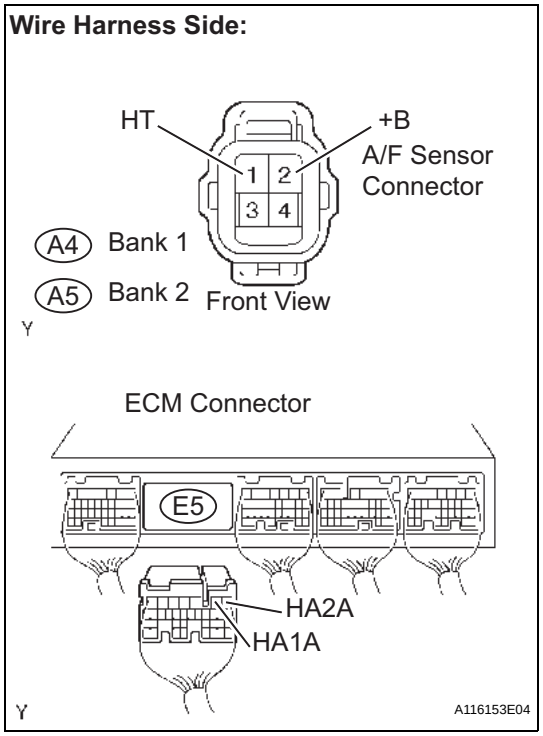
Tester Connections	Specified Conditions
HA1A (E5-2) - E04 (E5-7)	9 to 14 V
HA2A (E5-1) - E05 (E5-6)	

HINT:
- The HA1A means the A/F sensor bank 1 sensor 1.
- The HA2A means the A/F sensor bank 2 sensor 1.

OK → REPLACE ECM

NG

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



(a) Check the harness and the connector between the ECM and the A/F sensor.
  (1) Disconnect the A4 or A5 A/F sensor connector.
  (2) Disconnect the E5 ECM connector.
  (3) Check the resistance.

Standard Resistance (Check for open)

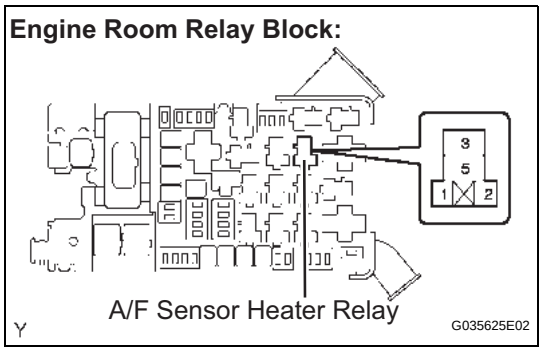
Tester Connections	Specified Conditions
HT (A4-1) - HA1A (E5-2)	Below 1 Ω
HT (A5-1) - HA2A (E5-1)	

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
HT (A4-1) or HA1A (E5-2) - Body ground	10 kΩ or higher
HT (A5-1) or HA2A (E5-1) - Body ground	

  (4) Reconnect the A/F sensor connector.
  (5) Reconnect the ECM connector.

(b) Check the harness and the connector between the A/F sensor and A/F sensor heater relay.
  (1) Disconnect the A4 or A5 A/F sensor connector.
  (2) Remove the A/F sensor heater relay from the engine room relay block.



(3) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
+B (A4-2) - A/F sensor heater relay (3)	Below 1 Ω
+B (A5-2) - A/F sensor heater relay (3)	

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
+B (A4-2) or A/F sensor heater relay (3) - Body ground	10 kΩ or higher
+B (A5-2) or A/F sensor heater relay (3) - Body ground	

(4) Reconnect the A/F sensor connector.
(5) Reinstall the A/F sensor heater relay.

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

OK

REPLACE ECM

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

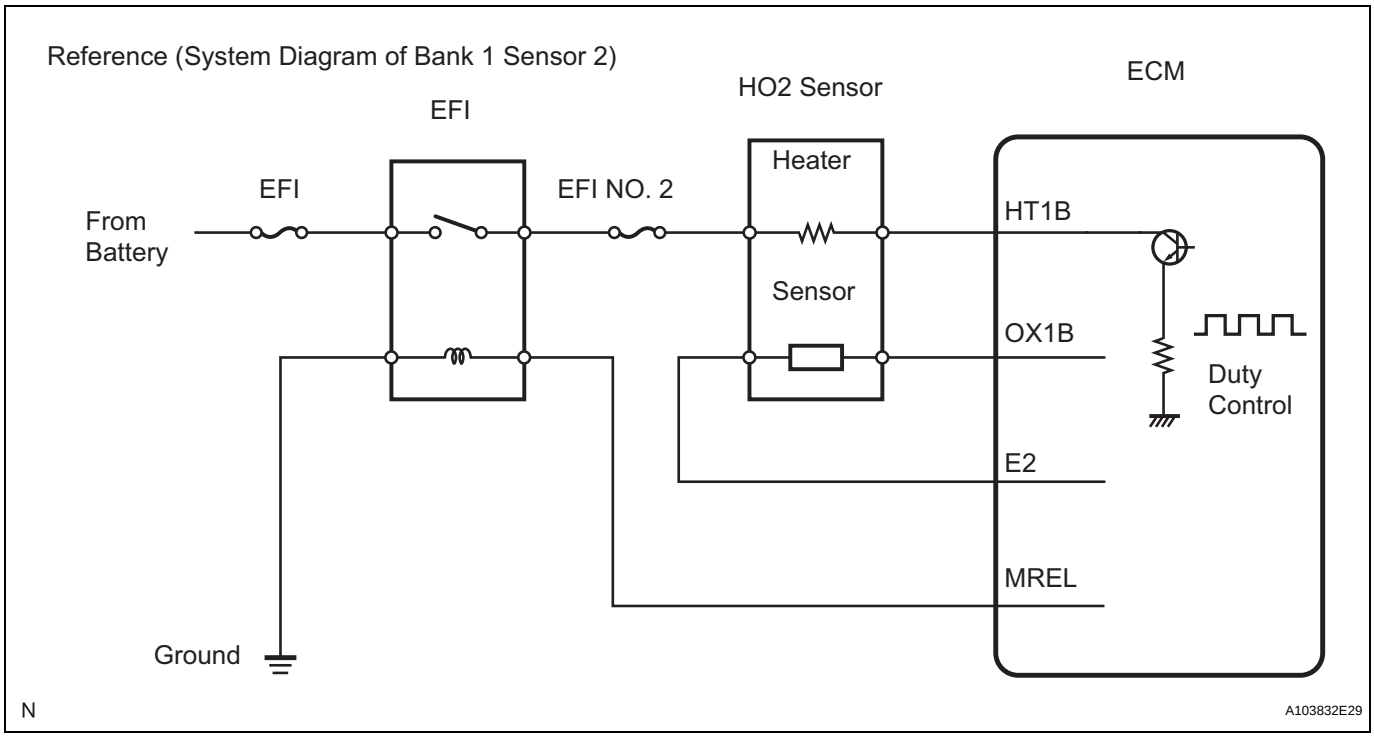
ES

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

DESCRIPTION

Refer to DTC P0136 (See page ES-128).
HINT:

- When any of these DTCs are set, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned OFF.
- The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the B+ side of the circuit.



DTC No.	DTC Detection Conditions	Trouble Areas
P0037 P0057	Heated Oxygen (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

DTC No.	DTC Detection Conditions	Trouble Areas
P0038 P0058	Heated Oxygen (HO2) sensor heater current more than 2 A (1 trip detection logic)	• Short in HO2 sensor heater circuit • HO2 sensor heater • EFI relay • ECM

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

MONITOR DESCRIPTION

ES

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 or P0058 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 or P0057 is set.

MONITOR STRATEGY

Related DTCs	P0037: Heated oxygen sensor heater (bank 1) open/short (Low electrical current) P0038: Heated oxygen sensor heater (bank 1) open/short (High electrical current) P0057: Heated oxygen sensor heater (bank 2) open/short (Low electrical current) P0058: Heated oxygen sensor heater (bank 2) open/short (High electrical current)
Required Sensors/ Components (Main)	Heated oxygen sensor heater (bank 1 and 2)
Required Sensors/ Components (Related)	Vehicle speed sensor
Frequency of Operation	Continuous
Duration	P0037 and P0057: 0.5 seconds P0038 and P0058: 0.3 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

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

P0037 and P0057 (Low current):

When the following conditions are met	0.5 seconds or more
(a) Following conditions are met	-
Learned heater current during heater OFF	Completed
Intrusive heating	Not operating
Heating is OFF	Less than 0.1 seconds
Heater current	Less than 0.3 A
Intrusive heating for high current monitor	Not operating

(b) Following condition are met	-
Time after heaters are OFF	1 seconds or more

P0038 and P0058 (High current):

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

TYPICAL MALFUNCTION THRESHOLDS

P0037 and P0057 (Low current):

Following conditions are met	-
Heater	ON
Heater current	Less than 0.3 A
Intrusive heating	Operating

P0038 and P0058 (High current):

Either A or B is met	-
A. Following conditions are met	With intrusive heating
Heater	ON
Heater current	2 A or more
B. Following conditions are met	Without intrusive heating
Intrusive heating of learned heater current	Operating
Learned heater current during heater OFF	Operating
Heater current	More than 2 A

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)

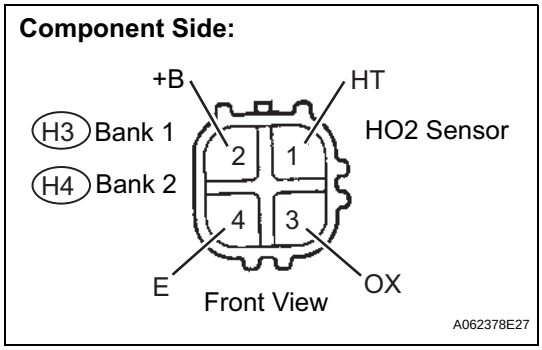
WIRING DIAGRAM

Refer to DTC P0136 (See page ES-135).

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 an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1 INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)



(a) Disconnect the H3 or H4 Heated Oxygen (HO2) sensor connector.
(b) Measure the resistance between the terminals of the HO2 sensor connector.
Standard Resistance (Bank 1, 2 sensor 2)

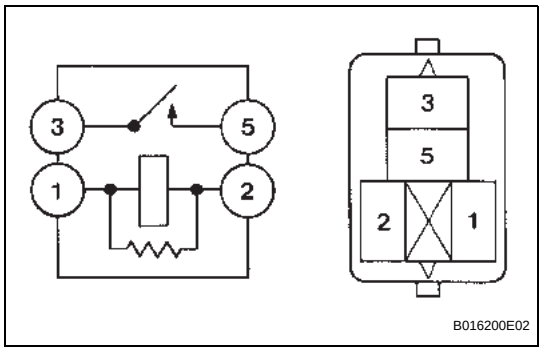
Tester Connections	Specified Conditions
HT (1) - +B (2)	11 to 16 Ω at 20°C (68°F)
HT (1) - E (4)	10 kΩ or higher

(c) Reconnect the HO2 sensor connector.

NG → REPLACE HEATED OXYGEN SENSOR

OK

2 INSPECT EFI RELAY



(a) Remove the EFI relay from the engine room relay block.
(b) Check the EFI relay resistance.
Standard Resistance

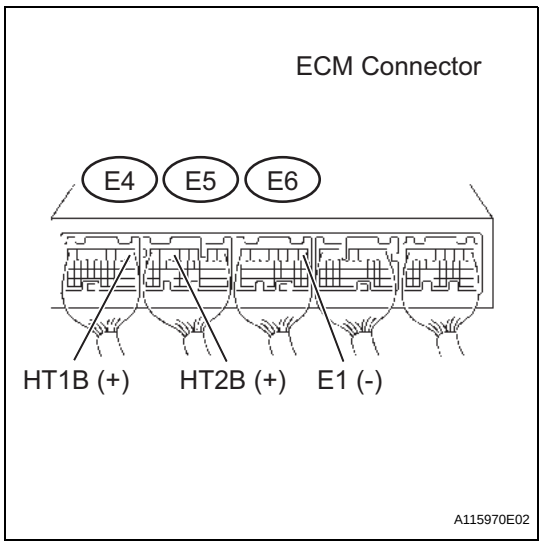
Terminal Connections	Specified Conditions
3-5	10 kΩ or higher
3-5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the EFI relay.

NG → REPLACE EFI RELAY

OK

3 INSPECT ECM (HT1B OR HT2B VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage between the terminals of the E4, E5 and E6 ECM connectors.
Standard Voltage

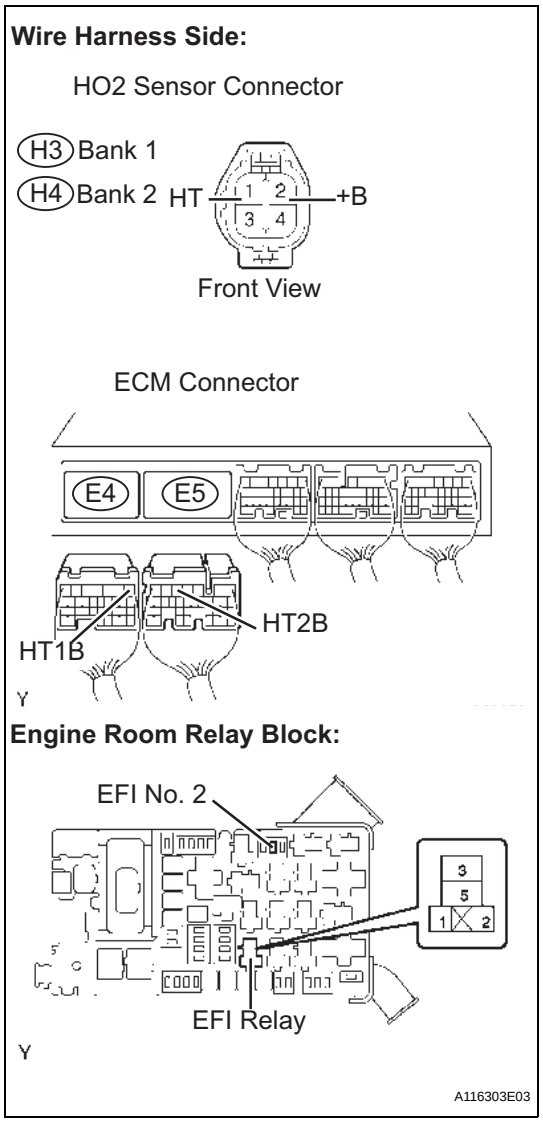
Terminal Connections	Specified Conditions
HT1B (E4-1) - E1 (E6-1)	9 to 14 V
HT2B (E5-5) - E1 (E6-1)	

HINT:
- The HT1B means the heated oxygen sensor bank 1 sensor 2.
- The HT2B means the heated oxygen sensor bank 2 sensor 2.

OK → REPLACE ECM

NG

4	CHECK HARNESS AND CONNECTOR (HO2 SENSOR - ECM, HO2 SENSOR - EFI RELAY)



(a) Check the harness and connector between the ECM and HO2 sensor.
  (1) Disconnect the H3 or H4 HO2 sensor connector.
  (2) Disconnect the E4 or E5 ECM connector.
  (3) Check the resistance.

Standard Resistance (Check for open)

Terminal Connections	Specified Conditions
HT (H3-1) - HT1B (E4-1)	Below 1 Ω
HT (H4-1) - HT2B (E5-5)	

Standard Resistance (Check for short)

Terminal Connections	Specified Conditions
HT (H3-1) or HT1B (E4-1) - Body ground	10 kΩ or higher
HT (H4-1) or HT2B (E5-5) - Body ground	

  (4) Reconnect the HO2 sensor connector.
  (5) Reconnect the ECM connector.

(b) Check the harness and connector between the HO2 sensor and EFI relay.
  (1) Inspect the EFI No. 2 fuse.
    • Remove the EFI No. 2 fuse from the engine room relay block.
    • Check the EFI No. 2 fuse resistance.

Standard Resistance:
Below 1 Ω

    • Reinstall the EFI No. 2 fuse.
  (2) Disconnect the H3 or H4 HO2 sensor connector.
  (3) Remove the EFI relay from the engine room relay block.
  (4) Check the resistance.

Standard Resistance (Check for open)

Terminal Connections	Specified Conditions
+B (H3-2) - EFI relay (3)	Below 1 Ω
+B (H4-2) - EFI relay (3)	

Standard Resistance (Check for short)

Terminal Connections	Specified Conditions
+B (H3-2) or EFI relay (3) - Body ground	10 kΩ or higher
+B (H4-2) or EFI relay (3) - Body ground	

  (5) Reconnect the HO2 sensor connector.
  (6) Reinstall the EFI relay.

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.

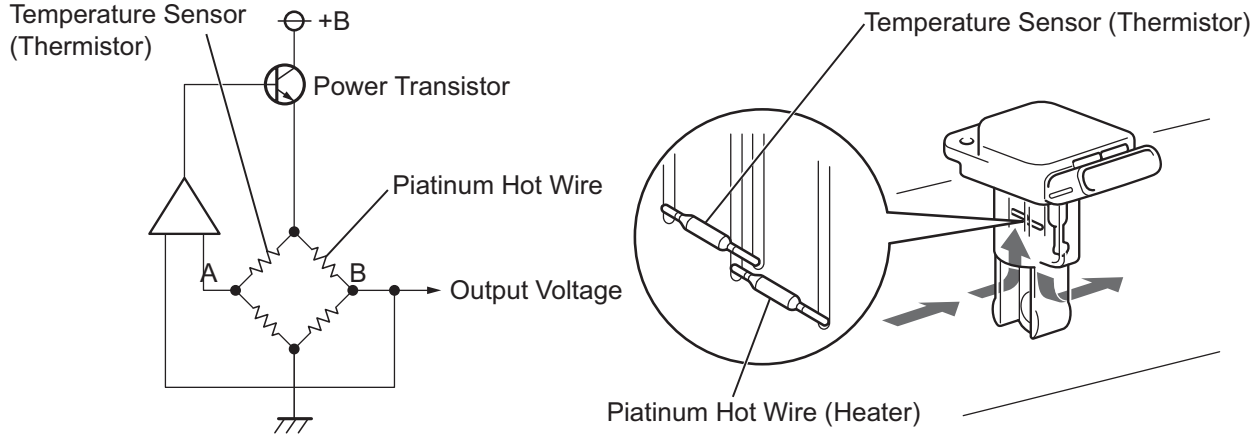
Inside the MAF meter, there is a heated platinum wire which is exposed to the flow of intake air.

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 Conditions	Trouble Areas
P0100	Open or short in Mass Air Flow (MAF) meter circuit for 3 seconds (1 trip detection logic)	• Open or short in MAF meter circuit • MAF meter • ECM
P0102	Open in Mass Air Flow (MAF) meter circuit for 3 seconds (1 trip detection logic)	• Open in MAF meter circuit • Short in ground circuit • MAF meter • ECM
P0103	Short in Mass Air Flow (MAF) meter circuit for 3 seconds (1 trip detection logic)	• Short in MAF meter circuit (+B circuit) • MAF meter • ECM

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

Mass Air Flow Rate (g/sec)	Malfunctions
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 following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0100:

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

P0102:

Mass air flow meter voltage	Less than 0.2 V

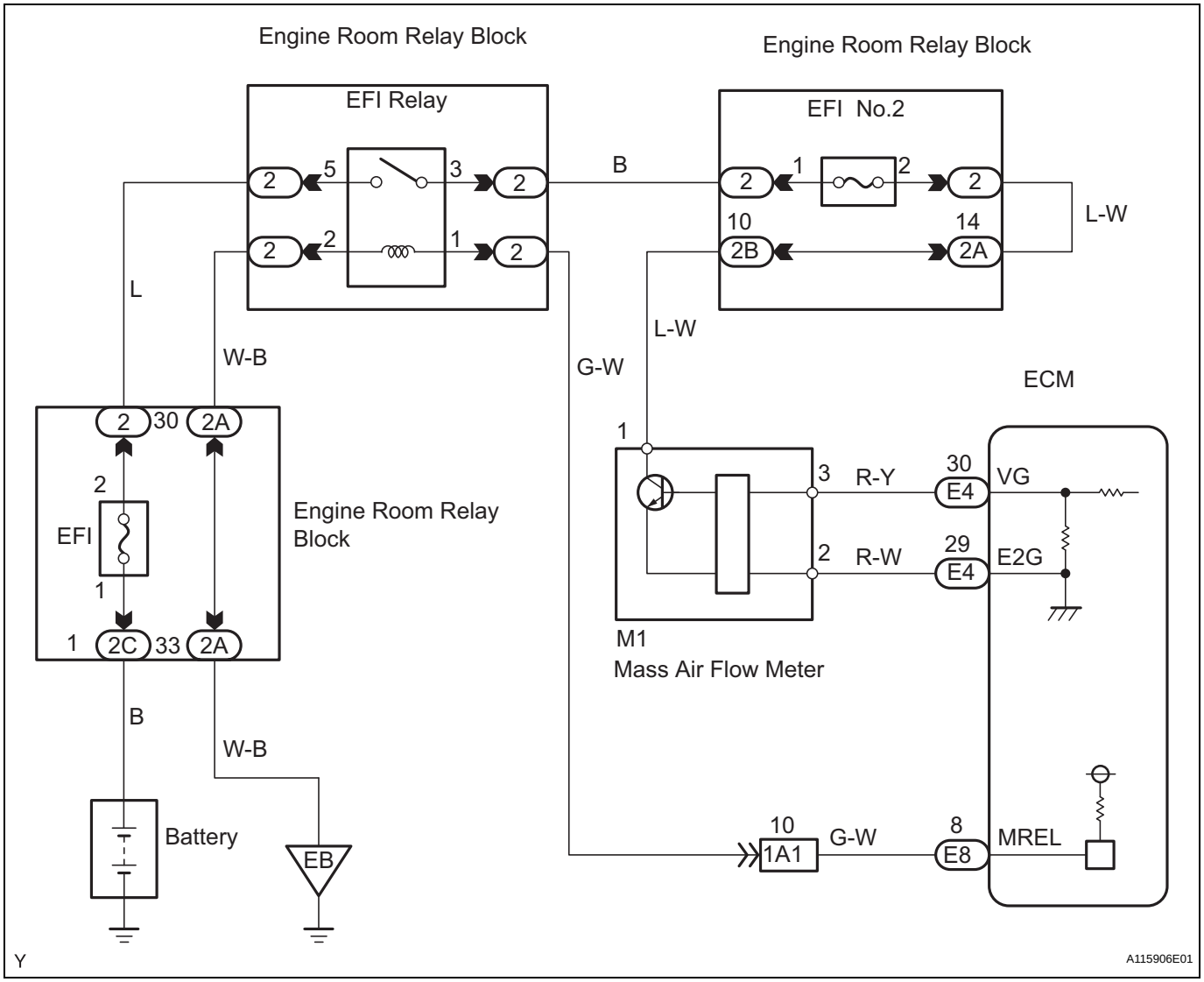
P0103:

Mass air flow meter voltage	More than 4.9 V

COMPONENT OPERATING RANGE

Mass air flow meter voltage	Between 0.4 V and 2.2 V

WIRING DIAGRAM



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

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

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

Result

Mass Air Flow Rate (g/sec)	Proceed to
0.0	A
271.0 or more	B

Mass Air Flow Rate (g/sec)	Proceed to
Between 1.0 and 270.0 (*1)	C

*1: The value must be changed when the throttle valve is open or closed.

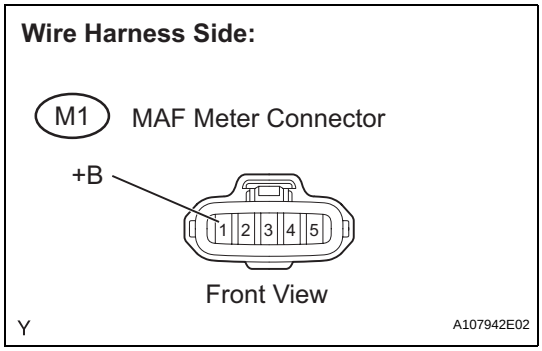
B → Go to step 6

C → CHECK FOR INTERMITTENT PROBLEMS

A

ES

2 INSPECT MASS AIR FLOW METER (POWER SOURCE VOLTAGE)



(a) Disconnect the M1 Mass Air Flow (MAF) meter connector.
(b) Turn the ignition switch ON.
(c) Measure the voltage between the terminal of the wire harness side connector and body ground.
Standard Voltage

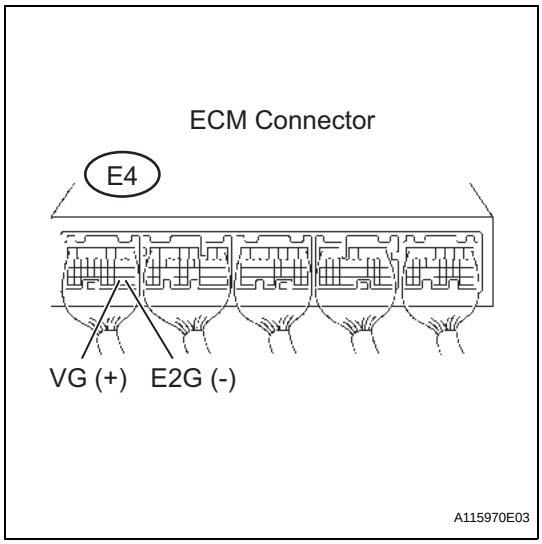
Tester Connections	Specified Conditions
+B (M1-1) - Body ground	9 to 14 V

(d) Reconnect the MAF meter connector.

NG → Go to step 5

OK

3 INSPECT ECM (VG VOLTAGE)



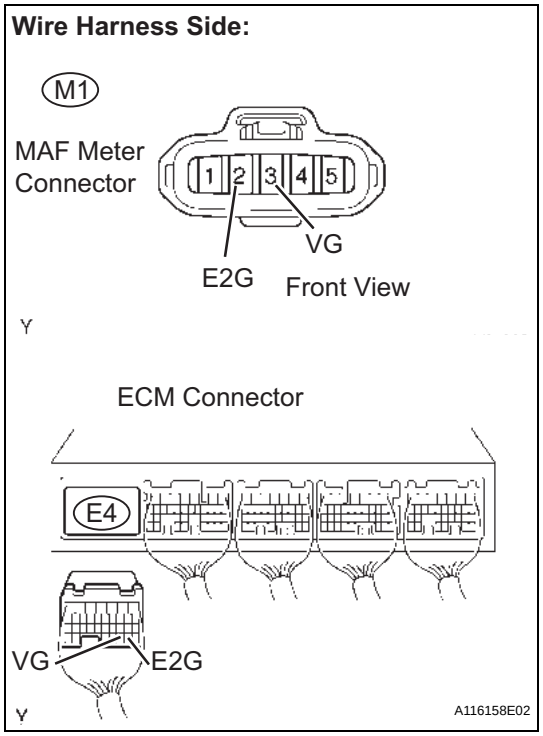
(a) Start the engine.
(b) Measure the voltage between the terminals of the E4 ECM connector.
HINT:
The transmission gear selector lever should be in the P or N position and the A/C switch should be turned OFF.
Standard Voltage

Tester Connections	Conditions	Specified Conditions
VG (E4-30) - E2G (E4-29)	Engine idling	0.5 to 3.0 V

OK → REPLACE ECM

NG

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



(a) Disconnect the M1 MAF meter connector.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
VG (M1-3) - VG (E4-30)	Below 1 Ω
E2G (M1-2) - E2G (E4-29)	

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
VG (M1-3) or VG (E4-30) - Body ground	10 kΩ or higher

(d) Reconnect the MAF meter connector.
(e) Reconnect the ECM connector.

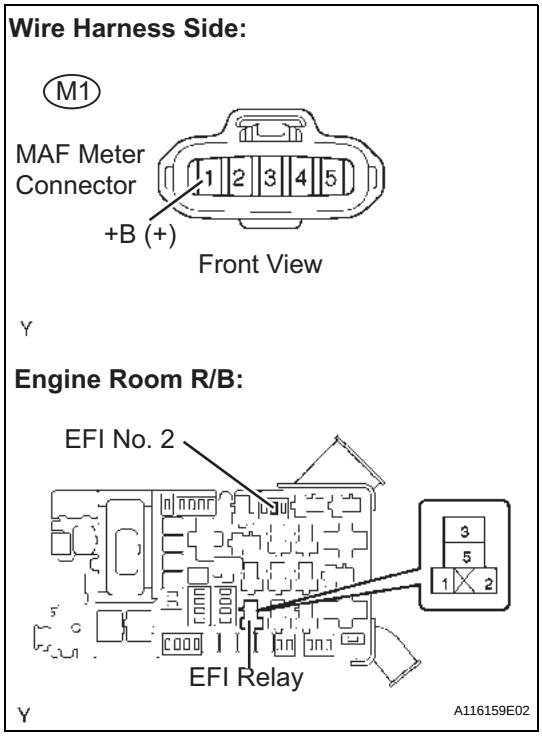
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

REPLACE MASS AIR FLOW METER

ES

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



(a) Inspect the EFI NO. 2 fuse.
  (1) Remove the EFI NO. 2 fuse from the engine room relay block.
  (2) Check the EFI NO. 2 fuse resistance.
    Standard Resistance:
    Below 1 Ω
  (3) Reinstall the EFI NO. 2 fuse.
(b) Disconnect the M1 MAF meter connector.
(c) Remove the EFI relay from the engine room relay block.
(d) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
+B (M1-1) - EFI relay (3)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
+B (M1-1) or EFI relay (3) - Body ground	10 kΩ or higher

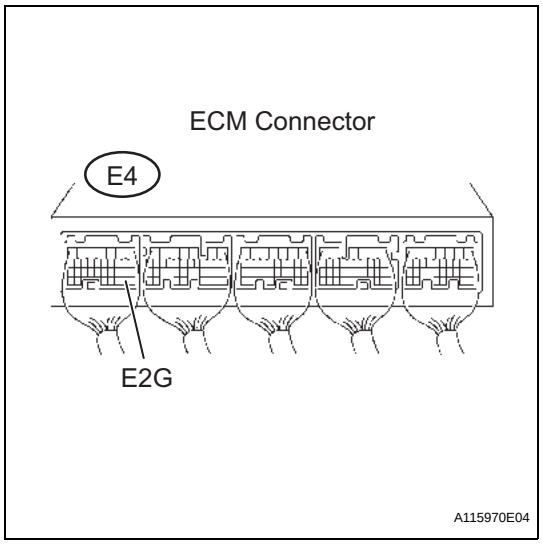
(e) Reconnect the MAF meter connector.
(f) Reinstall the EFI relay.

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

OK

CHECK ECM POWER SOURCE CIRCUIT

6	INSPECT ECM (SENSOR GROUND)



(a) Check the resistance.

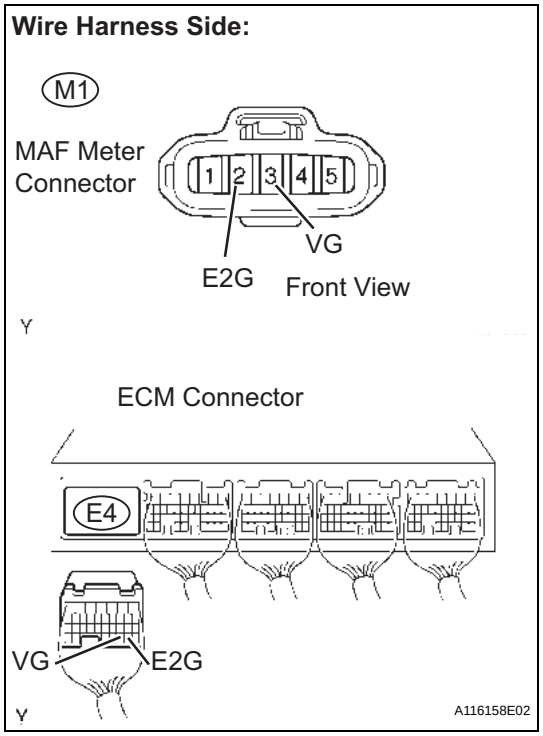
Standard Resistance

Tester Connections	Specified Conditions
E2G (E4-29) - Body ground	Below 1 Ω

NG → **REPLACE ECM**

OK

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



(a) Disconnect the M1 MAF meter connector.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
VG (M1-3) - VG (E4-30)	Below 1 Ω
E2G (M1-2) - E2G (E4-29)	

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
VG (M1-3) or VG (E4-30) - Body ground	10 kΩ or higher

(d) Reconnect the MAF meter connector.
(e) Reconnect the ECM connector.

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

OK

REPLACE MASS AIR FLOW METER

ES

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

DESCRIPTION

Refer to DTC P0100 (See page ES-89).

DTC No.	DTC Detection Conditions	Trouble Areas
P0101	• High voltage: Conditions (a), (b) and (c) continue for more than 10 seconds (2 trip detection logic) (a) Engine speed less than 2,000 rpm (b) Engine coolant temperature 70°C (158°F) or higher (c) Voltage output of Mass Air Flow (MAF) meter more than 2.2 V (varies with Throttle Position [TP] sensor voltage) • Low voltage: Conditions (a) and (b) continue for more than 10 seconds (2 trip detection logic) (a) Engine speed more than 300 rpm (b) Voltage output of MAF meter less than 0.83 V (varies with TP sensor voltage)	• MAF meter

MONITOR DESCRIPTION

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

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

Example:

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

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 following DTCs not present	P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (insufficient ECT for closed loop) P0335 (CKP sensor) P0340 (CMP sensor)

Mass Air Flow Meter Rationality (High Voltage):

Engine speed	Less than 2,000 rpm
Engine coolant temperature	70°C (158°F) or more
Mass air flow meter voltage	4.9 V or less

Mass Air Flow Meter Rationality (Low Voltage):

Engine speed	More than 300 rpm
Mass air flow meter voltage	0.2 V or more
Fuel cut	OFF

TYPICAL MALFUNCTION THRESHOLDS

Mass Air Flow Meter Rationality (High Voltage):

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

Mass Air Flow Meter Rationality (Low Voltage):

Mass air flow meter voltage	Less than 0.83 V (varies with throttle position sensor voltage)

WIRING DIAGRAM

Refer to DTC P0100 (See page ES-91).

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

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

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

Result

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

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

B → REPLACE MASS AIR FLOW METER

A → GO TO DTC CHART

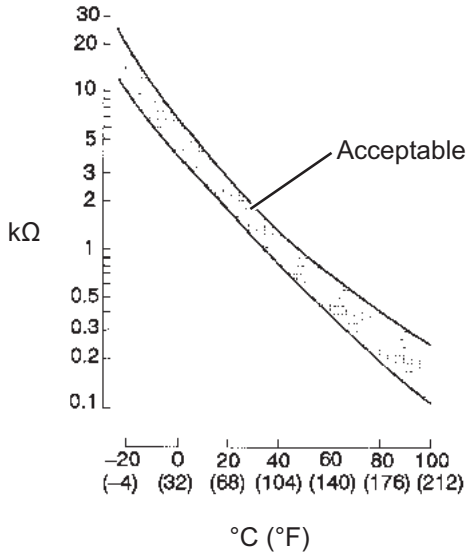
DTC	P0110	Intake Air Temperature Circuit

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 drivability.

HINT:

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

DTC No.	Proceed To	DTC Detection Conditions	Trouble Areas
P0110	Step 1	Open or short in Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic)	• Open or short in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM
P0112	Step 4	Short in Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic)	• Short in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM
P0113	Step 2	Open in Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic)	• Open in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM

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

Temperature Displayed	Malfunctions
-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 voltage output is more than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the IAT sensor circuit, and sets DTC P0113. Conversely, if the voltage output is less than 0.18 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and sets DTC P0112.
If the malfunction is not repaired successfully, a DTC is set 0.5 seconds after the engine is next started.

ES

MONITOR STRATEGY

Related DTCs	P0110: Intake air temperature sensor open/short (Fluctuating) P0112: Intake air temperature sensor short (Low electrical resistance) P0113: Intake air temperature sensor open (High electrical 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 following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0110:

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

P0112:

Intake air temperature sensor voltage	Less than 0.18 V

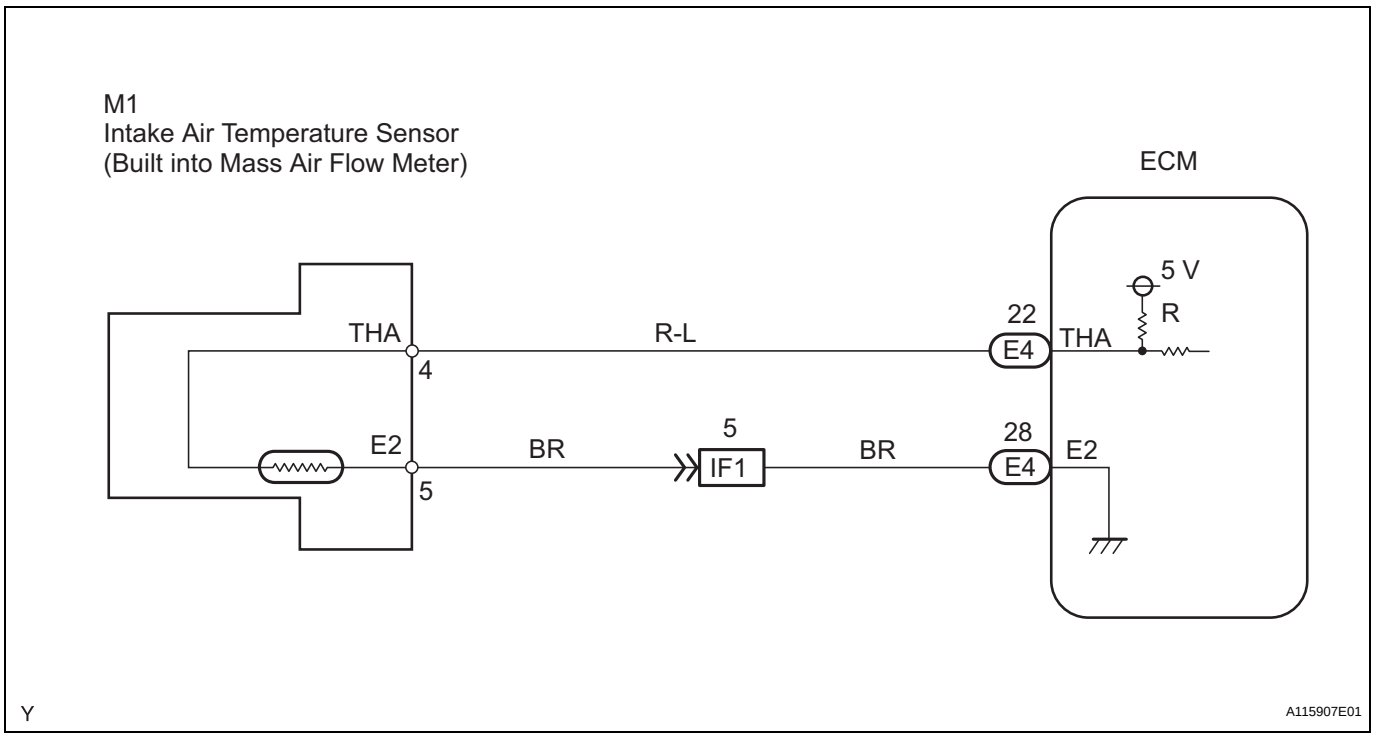
P0113:

Intake air temperature sensor voltage	More than 4.91 V

COMPONENT OPERATING RANGE

Intake air temperature sensor voltage	0.18 V to 4.91 V

WIRING DIAGRAM



ES

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 an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	READ VALUE OF INTELLIGENT TESTER (INTAKE AIR TEMPERATURE)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(e) Read the value displayed on the tester.
Standard:
Same as actual Intake Air Temperature (IAT).

Result

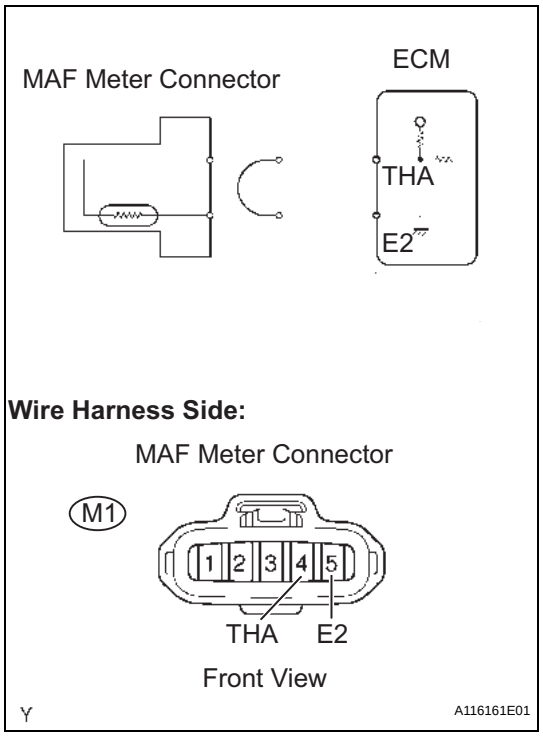
Temperature Displayed	Proceed To
-40°C (-40°F)	A
140°C (284°F) or higher	B
Same as actual IAT	C

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

B	Go to step 4
C	CHECK FOR INTERMITTENT PROBLEMS

A

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



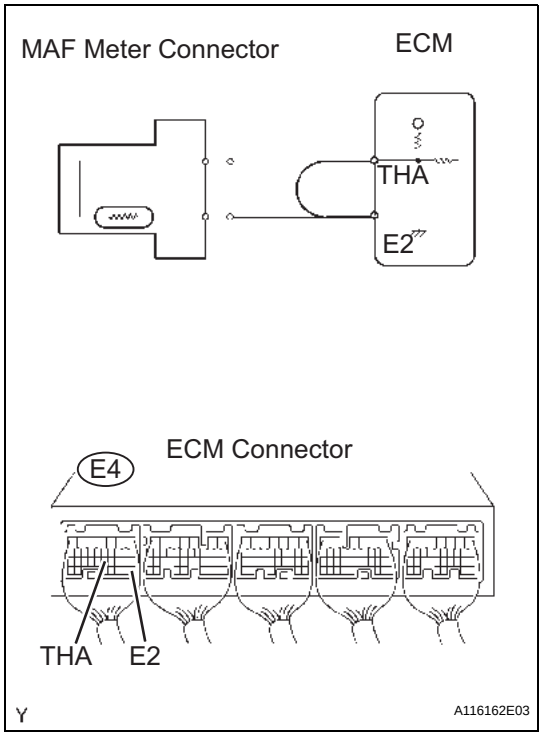
(a) Disconnect the M1 Mass Air Flow (MAF) meter connector.
(b) Connect terminals THA and E2 of the MAF meter wire harness side connector.
(c) Connect an intelligent tester to the DLC3.
(d) Turn the ignition switch ON.
(e) Turn the tester ON.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(g) Read the value displayed on the tester.
Standard:
140°C (284°F) or higher
(h) Reconnect the MAF meter connector.

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

NG

ES

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



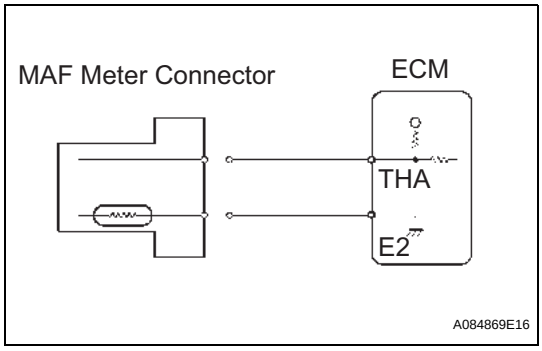
(a) Disconnect the M1 MAF meter connector.
(b) Connect terminals THA and E2 of the E4 ECM connector.
HINT:
Before checking, do visual and contact pressure checks on the ECM connector.
(c) Connect an intelligent tester to the DLC3.
(d) Turn the ignition switch ON.
(e) Turn the tester ON.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(g) Read the value displayed on the tester.
Standard:
140°C (284°F) or higher.
(h) Reconnect the MAF meter connector.

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

NG

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM

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

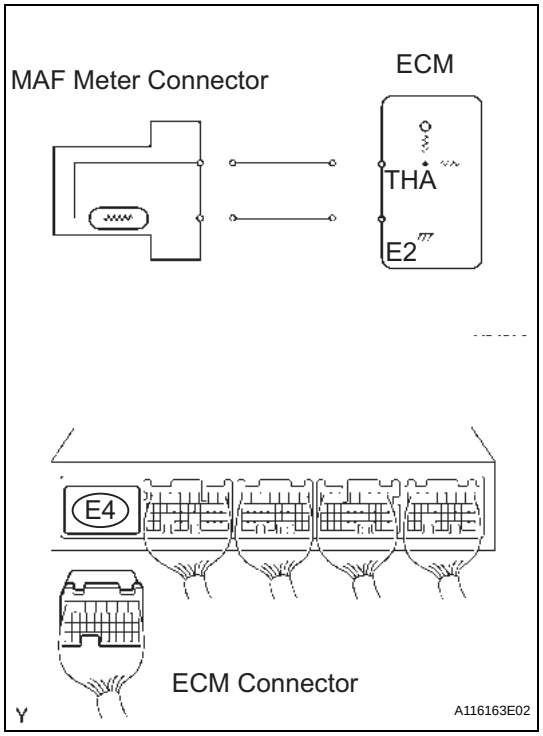


(a) Disconnect the M1 MAF meter connector.
(b) Connect an intelligent tester to the DLC3.
(c) Turn the ignition switch ON.
(d) Turn the tester ON.
(e) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(f) Read the value displayed on the tester.
Standard: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

OK → **REPLACE MASS AIR FLOW METER**

NG

5	READ VALUE OF INTELLIGENT TESTER (CHECK FOR SHORT ECM)



(a) Disconnect the E4 ECM connector.
(b) Connect an intelligent tester to the DLC3.
(c) Turn the ignition switch ON.
(d) Turn the tester ON.
(e) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(f) Read the value displayed on the tester.
Standard:
-40°C (-40°F)
(g) Reconnect the ECM connector.

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

NG

REPLACE ECM

ES

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.

ES

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

DTC No.	Proceed To	DTC Detection Conditions	Trouble Areas
P0115	Step 1	Open or short in Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic)	• Open or short in ECT sensor circuit • ECT sensor • ECM
P0117	Step 4	Short in Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic)	• Short in ECT sensor circuit • ECT sensor • ECM
P0118	Step 2	Open in Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic)	• Open in ECT sensor circuit • ECT sensor • ECM

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

Temperature Displayed	Malfunctions
-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 more than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the ECT sensor circuit, and sets DTC P0118. Conversely, if the voltage output is less than 0.14 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and sets DTC P0117.
If the malfunction is not repaired successfully, a DTC is set 0.5 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0115: Engine coolant temperature sensor open/short (Fluctuating) P0117: Engine coolant temperature sensor short (Low electrical resistance) P0118: Engine coolant temperature sensor open (High electrical resistance)

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0115:

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

P0117:

Engine coolant temperature sensor voltage	Less than 0.14 V

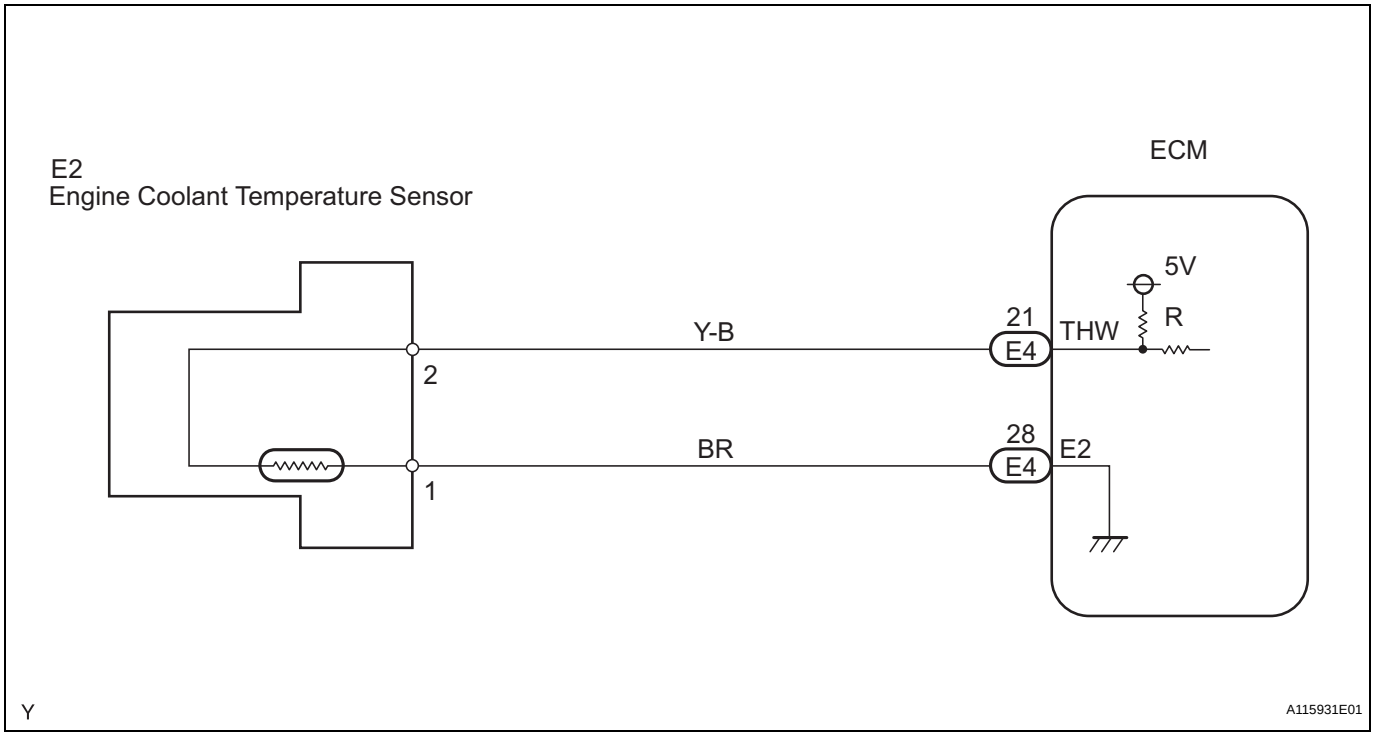
P0118:

Engine coolant temperature sensor voltage	More than 4.91 V

COMPONENT OPERATING RANGE

Engine coolant temperature sensor voltage	0.14 V to 4.91 V

WIRING DIAGRAM



HINT:

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

- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	READ VALUE OF INTELLIGENT TESTER (ENGINE COOLANT TEMPERATURE)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(e) Read the value displayed on the tester.
Standard:
Between 80°C and 97°C (176°F and 207°F) with warm engine.

ES

Result

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

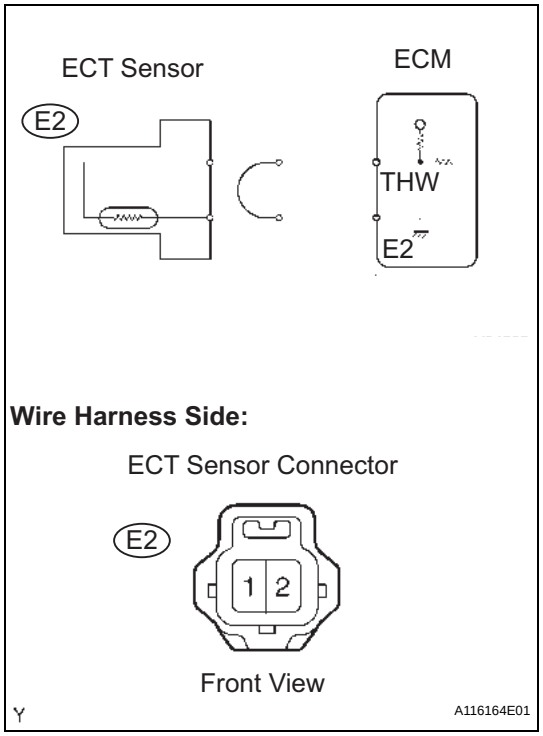
HINT:
- If there is an open circuit, the intelligent tester indicates -40°C (-40°F).
- If there is a short circuit, the intelligent tester indicates 140°C (284°F) or higher.

B → **Go to step 4**

C → **CHECK FOR INTERMITTENT PROBLEMS**

A

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

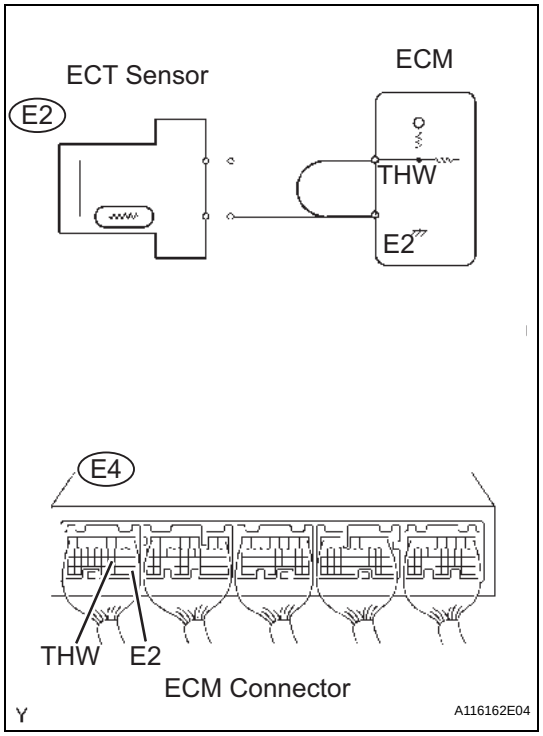


(a) Disconnect the E2 Engine Coolant Temperature (ECT) sensor connector.
(b) Connect terminals 1 and 2 of the ECT sensor connector on the wire harness side.
(c) Connect an intelligent tester to the DLC3.
(d) Turn the ignition switch ON.
(e) Turn the tester ON.
(f) Select the following menu items: DIAGNOSIS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

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

NG

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



(a) Disconnect the E2 ECT sensor connector.
(b) Connect terminals THW and E2 of the E4 ECM connector.
HINT:
Before checking, do visual and contact pressure checks on the ECM connector.
(c) Connect an intelligent tester to the DLC3.
(d) Turn the ignition switch ON.
(e) Turn the tester ON.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(g) Read the value displayed on the tester.
Standard:
140°C (284°F) or higher
(h) Reconnect the ECT sensor connector.

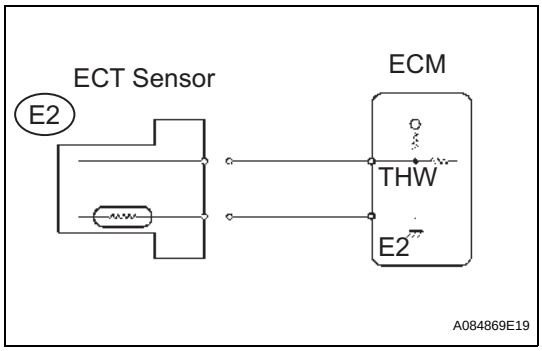
OK → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

ES

NG

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM

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

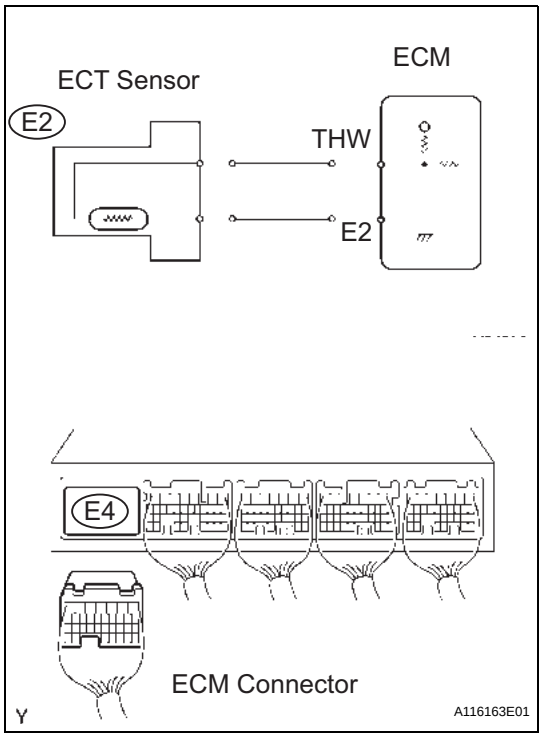


(a) Disconnect the E2 ECT sensor connector.
(b) Connect an intelligent tester to the DLC3.
(c) Turn the ignition switch ON.
(d) Turn the tester ON.
(e) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(f) Read the value displayed on the tester.
Standard: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

OK → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

NG

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



(a) Disconnect the E4 ECM connector.
(b) Connect an intelligent tester to the DLC3.
(c) Turn the ignition switch ON.
(d) Turn the tester ON.
(e) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(f) Read the value displayed on the tester.
Standard:
-40°C (-40°F)
(g) Reconnect the ECM connector.

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

NG

REPLACE ECM

DTC	P0116	Engine Coolant Temperature Circuit Range / Performance Problem

DESCRIPTION

Refer to DTC P0115 (See page ES-104).

DTC No.	DTC Detection Conditions	Trouble Areas
P0116	Case 1: Engine Coolant Temperature (ECT) between 35°C and 60°C (95°F and 140°F) when engine started, and conditions (a) and (b) met (2 trip detection logic) (a) Vehicle driven at varying speeds (accelerated and decelerated) (b) ECT remains within 3°C (5.4°F) of initial ECT Case 2: ECT more than 60°C (140°F) when engine started, and conditions (a) and (b) met (6 trip detection logic) (a) Vehicle driven at varying speeds (accelerated and decelerated) (b) ECT measurements remain within 1°C (1.8°F) of initial ECT on 6 successive occasions	• 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 after driving for 250 seconds, the ECT remains within 3°C (5.4°F) of the starting temperature, the DTC is set (2 trip detection logic).
- Upon starting the engine, the ECT is over 60°C (140°F). If after driving for 250 seconds, the ECM remains within 1°C (1.8°F) of the starting temperature, the DTC is set (6 trip detection logic).

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

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

Monitor runs whenever following DTCs not present	P0100 to P0103: Mass air flow meter
Cumulative idle off period	250 seconds or more
Speed increase by 18.6 mph (30 km/h) or more	10 times or more
Engine coolant temperature at engine start	35 to 60°C (95 to 140°F)
Intake air temperature at engine start	-6.7°C (20°F) or more

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

Monitor runs whenever following DTCs not present	P0100 to P0103: Mass air flow meter
Engine coolant temperature at engine start	60°C (140°F) or more
Intake air temperature at engine start	-6.7°C (20°F) or more
Stop and go*1	Once or more
Steady driving and stop*2	Once or more
Engine running time after engine start	0.3 seconds or more

*1: The vehicle is stopped for 20 seconds or more and accelerated to more than 43.5 mph (70 km/h) within 40 seconds.

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

ES

TYPICAL MALFUNCTION THRESHOLDS

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

Variation of engine coolant temperature	Less than 3°C (5.4°F)

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

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

COMPONENT OPERATING RANGE

Engine coolant temperature	Varies with actual engine coolant temperature

WIRING DIAGRAM

Refer to DTC P0115 (See page ES-105).

HINT:

- If any of DTCs P0115, P0117, P0118 or P0125 are set simultaneously with DTC P0116, the ECT sensor may have an open or a short circuit. Troubleshoot those DTCs first.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the airfuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0116)**

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

Result

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

B → **GO TO DTC CHART**

A

2	INSPECT THERMOSTAT (WATER INLET WITH THERMOSTAT)

(a) Remove the thermostat (See page CO-9).
(b) Check the valve opening temperature of the thermostat.
Standard:
80 to 84°C (176 to 183°F)
HINT:
In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.
(c) Reinstall the thermostat (See page CO-9).

NG → **REPLACE THERMOSTAT**

OK

REPLACE ENGINE COOLANT TEMPERATURE SENSOR

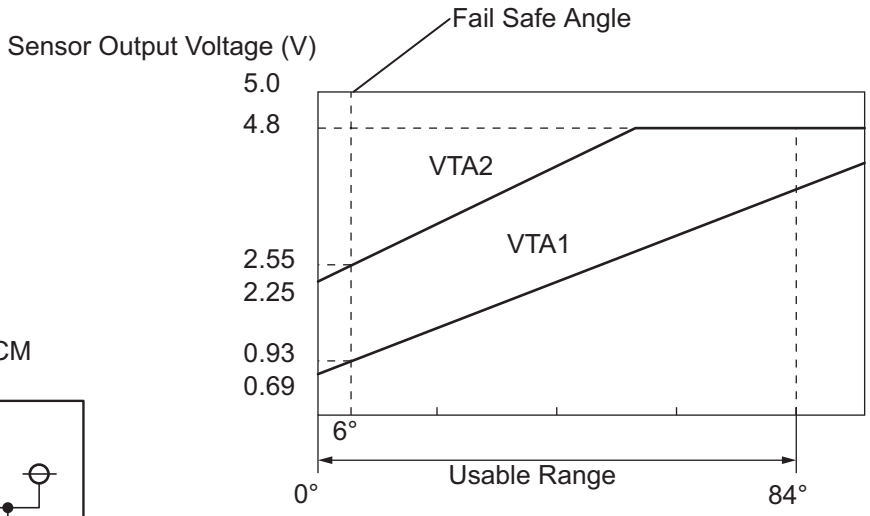
DTC	P0120	Throttle / Pedal Position Sensor / Switch "A" Circuit
DTC	P0122	Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input
DTC	P0123	Throttle / Pedal Position Sensor / Switch "A" Circuit High Input
DTC	P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit
DTC	P0222	Throttle / Pedal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

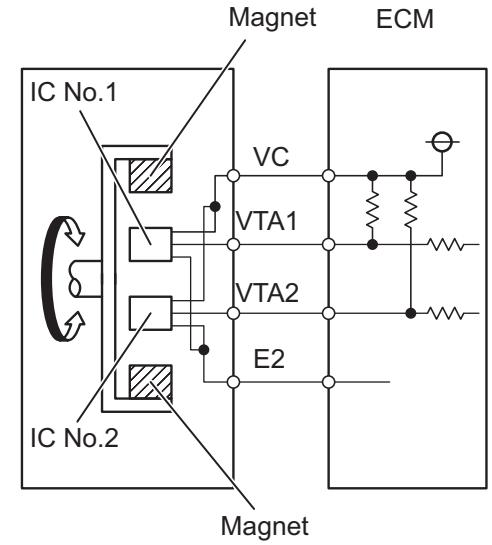
ES

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

DESCRIPTION

This ETCS (Electronic Throttle Control System) does not use a throttle cable. The Throttle Position (TP) sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type, and uses Hall-effect elements, in order to yield accurate signals, even in extreme driving conditions, such as at high speeds as well as very low speeds.
The TP sensor has two sensor circuits which each transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel-cut control.





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

Between 10 % and 24 %: Throttle valve fully closed

Between 66 % and 96 %: Throttle valve fully open

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

Y

A115896E01

DTC No.	DTC Detection Conditions	Trouble Areas
P0120	Output voltage of VTA1 quickly fluctuates beyond lower and upper malfunction thresholds for 2 seconds (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 (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 (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 (1 trip detection logic)	• TP sensor (built into throttle body) • ECM

DTC No.	DTC Detection Conditions	Trouble Areas
P0222	Output voltage of VTA2 1.75 V or less for 2 seconds (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 (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) 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 an intelligent tester: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ETCS / THROTTLE POS AND THROTTLE POS #2.
- THROTTLE POS denotes the VTA1 signal (expressed in percentages), and THROTTLE POS #2 denotes the VTA2 signal (expressed in voltages).

Reference (Normal Condition)

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
THROTTLE POS	**10 to 24 %**	**64 to 96 %**
THROTTLE POS #2	**2.1 to 3.1 V**	**4.5 to 5.0 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 have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and sets a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and sets a DTC.

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) Within 0.5 seconds: P2135
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0120:

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

P0122:

VTA1 voltage	0.2 V or less

P0123:

VTA1 voltage	4.8 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	4.8 V or more

P2135:

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

COMPONENT OPERATING RANGE

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

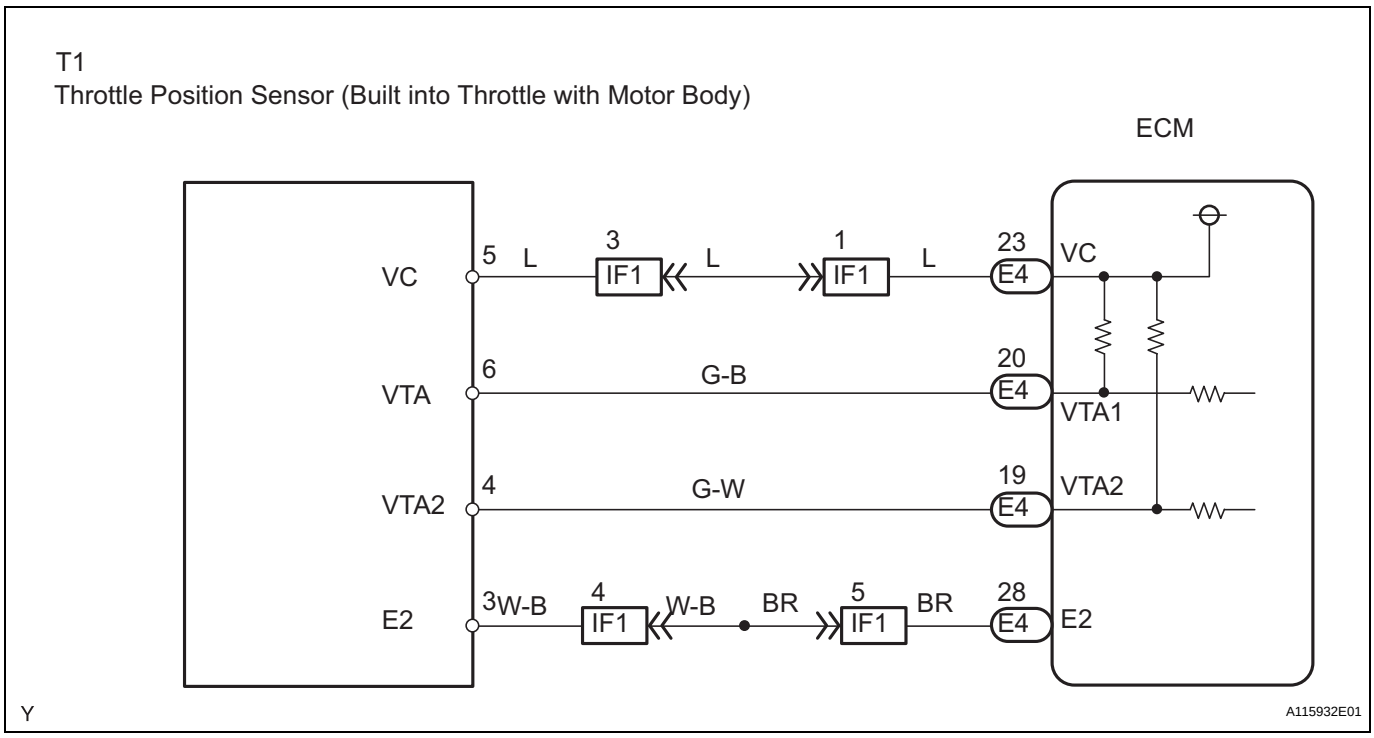
FAIL-SAFE

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° 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



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 an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

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

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON 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 Areas	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
Approx 19 % (Fail-safe)	Between 0 V and 0.2 V or 4.5 V and 5.0 V	Between 10 % and 24 % (Fail-safe)	Between 0 V and 0.2 V or 4.5 V and 5.0 V	VTA2 circuit open or ground short	A

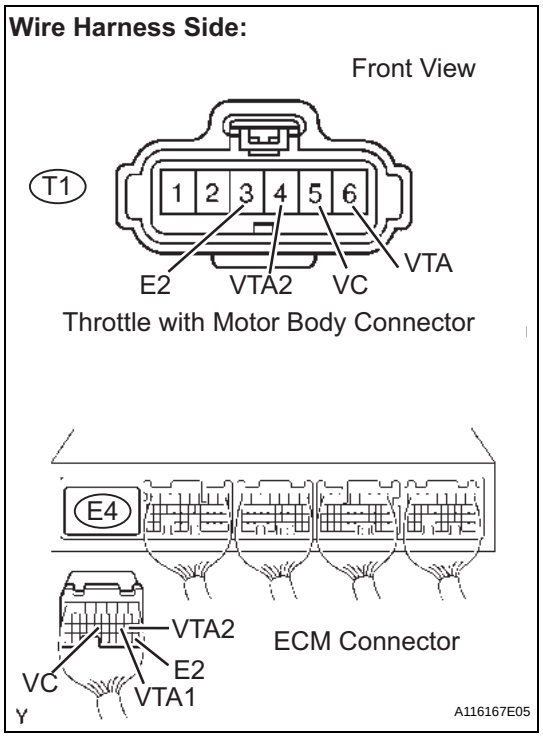
TP#1 (VTA1) When AP Released	TP#2 (VTA2) When AP Released	TP#1 (VTA1) When AP Depressed	TP#2 (VTA2) When AP Depressed	Trouble Areas	Proceed To
Between 10 % and 24 %	Between 2.1 V and 3.1 V	Between 64 % and 96 % (Not fail-safe)	Between 4.5 V and 5.0 V (Not fail-safe)	TP sensor circuit normal	B

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

B → **Go to step 5**

A

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



(a) Disconnect the T1 throttle with motor body connector.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
VC (T1-5) - VC (E4-23)	Below 1 Ω
VTA (T1-6) - VTA1 (E4-20)	
VTA2 (T1-4) - VTA2 (E4-19)	
E2 (T1-3) - E2 (E4-28)	

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
VC (T1-5) or VC (E4-23) - Body ground	10 kΩ or higher
VTA (T1-6) or VTA1 (E4-20) - Body ground	
VTA2 (T1-4) or VTA2 (E4-19) - Body ground	

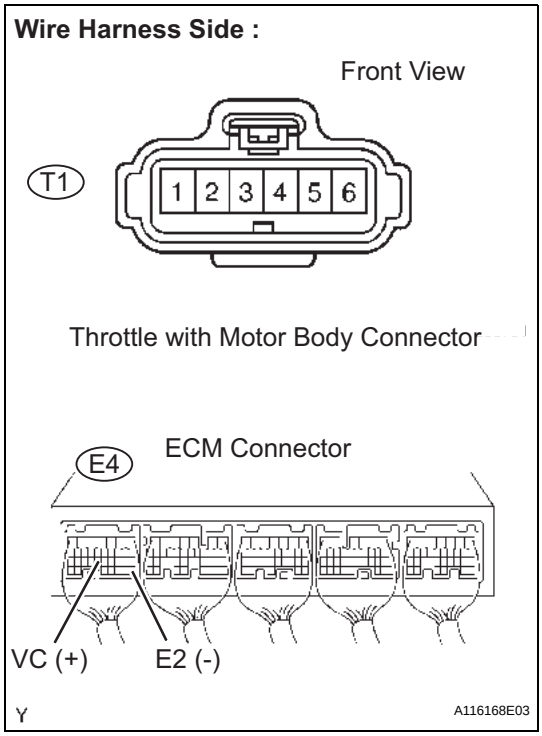
(d) Reconnect the throttle with motor body connector.
(e) Reconnect the ECM connector.

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

OK

ES

3	INSPECT ECM (VC VOLTAGE)



(a) Disconnect the T1 throttle with motor body connector.
(b) Turn the ignition switch ON.
(c) Measure the voltage between the terminals of the E4 ECM connector.

Standard Voltage

Tester Connections	Specified Conditions
VC (E4-23) - E2 (E4-28)	4.5 to 5.0 V

(d) Reconnect the throttle with motor body connector.

NG → REPLACE ECM

OK

4	REPLACE THROTTLE WITH MOTOR BODY ASSEMBLY

NEXT

5	CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Clear DTCs (See page ES-38).
(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 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

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

DESCRIPTION

Refer to DTC P0120 (See page ES-112).

DTC No.	DTC Detection Conditions	Trouble Areas
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)

ES

MONITOR DESCRIPTION

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

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

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

TYPICAL MALFUNCTION THRESHOLDS

Either of following conditions is met	-
"Difference of TP sensor voltage between VTA1 and VTA2 x 0.8"	Higher than 1.6 V
"Difference of TP sensor voltage between VTA1 and VTA2 x 0.8"	Lower than 0.8 V

FAIL-SAFE

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

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

ES

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0121)

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

Result

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

B → GO TO DTC CHART

A → REPLACE THROTTLE BODY ASSEMBLY

DTC	P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control

DESCRIPTION

Refer to DTC P0115 (See page ES-104).

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

MONITOR DESCRIPTION

The resistance of the 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	Continuous
Duration	56 seconds: Closed-loop enable temperature - 8.34°C (15°F) or more 98 seconds: Closed-loop enable temperature - 19.45 to - 8.34°C (35 to 15°F) 1200 seconds: Less than closed-loop enable temperature - 19.45°C (35°F)
MIL Operation	2 driving cycles
Sequence of Operation	P0100 - P0103 (MAF sensor) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor)

TYPICAL ENABLING CONDITIONS

All

Monitor runs whenever following DTCs not present	P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor)

Case 1

Engine coolant temperature or intake air temperature at engine start	"Closed-loop enabling temperature - 8.34°C (15°F)" or more
Engine	Running
Fuel cut	OFF

Case 2

Engine coolant temperature or intake air temperature at engine start	Between "Closed-loop enabling temperature - 19.45°C (35°F)" and "Closed-loop enabling temperature - 8.34°C (15°F)"
Engine	Running
Fuel cut	OFF

Case 3

Engine coolant temperature or intake air temperature at engine start	Lower than "Closed-loop enabling temperature - 19.45°C (35°F)"
Engine	Running
Fuel cut	OFF
Idle	OFF

TYPICAL MALFUNCTION THRESHOLDS

Engine coolant temperature	Lower than closed-loop enabling temperature

WIRING DIAGRAM

Refer to DTC P0115 (See page ES-105).

ES

HINT:

- If any of DTCs P0115, P0116, P0117 or P0118 are set simultaneously with DTC P0125, the Engine Coolant Temperature (ECT) sensor may have an open or a short circuit. Troubleshoot those DTCs first.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

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

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

Result

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

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

B → GO TO DTC CHART

A

2	INSPECT W/THERMOSTAT WATER INLET SUB-ASSEMBLY (THERMOSTAT)

(a) Remove the w/ thermostat water inlet sub-assembly (See page CO-9).
(b) Check the valve opening temperature of the thermostat.
Standard:
80° to 84°C (176° to 183°F)

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

(c) Reinstall the w/ thermostat water inlet sub-assembly (See page CO-9).

NG → **REPLACE W/THERMOSTAT WATER INLET SUB-ASSEMBLY**

OK

ES

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)

HINT:
This DTC relates to the thermostat.

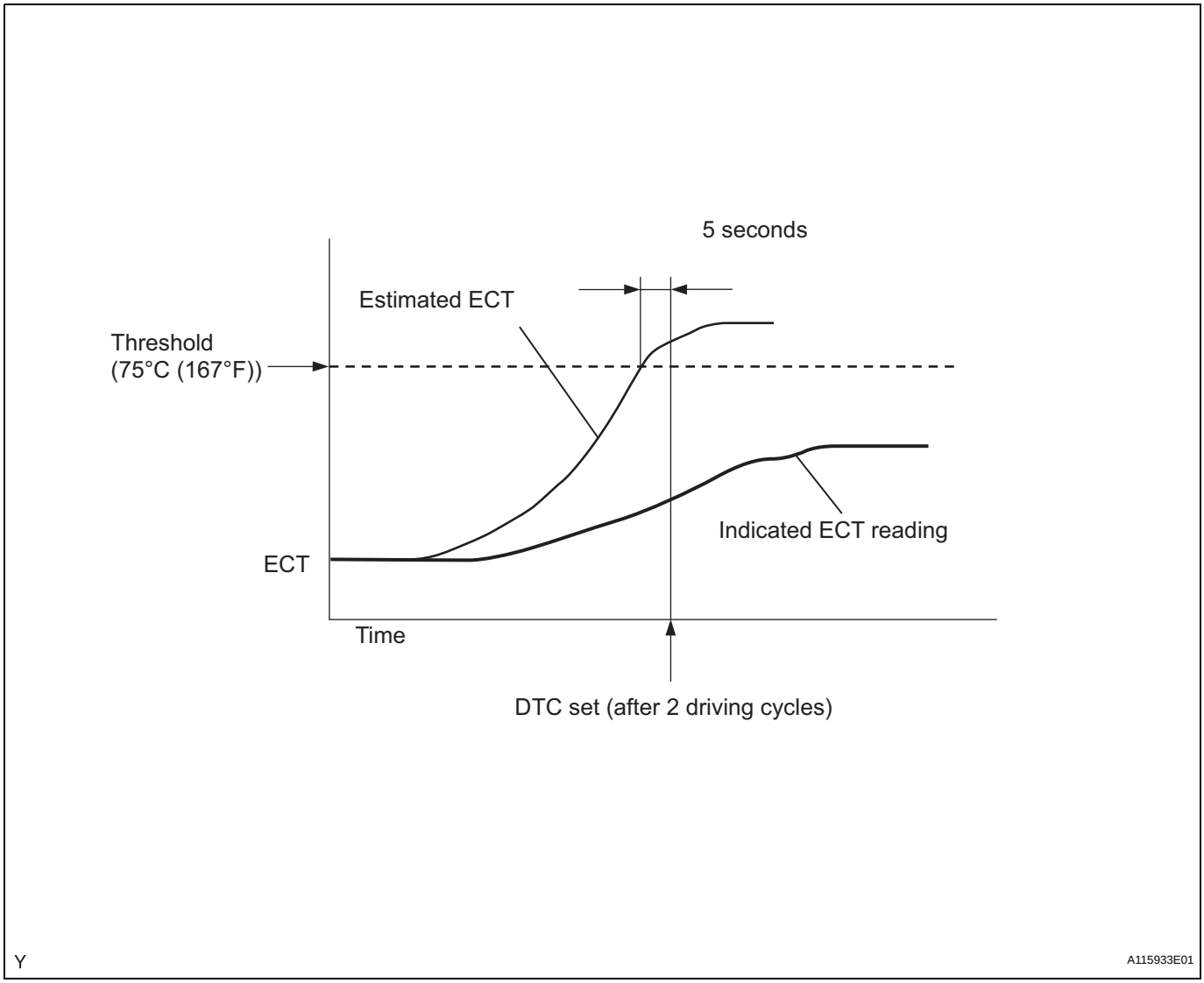
DESCRIPTION

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

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

ES

MONITOR DESCRIPTION



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

MONITOR STRATEGY

Related DTCs	P0128: Coolant Thermostat
Required Sensors/Components (Main)	Thermostat
Required Sensors/Components (Related)	Engine Coolant Temperature (ECT) sensor, Intake Air Temperature (IAT) sensor, Vehicle speed sensor
Frequency of Operation	Once per driving cycle
Duration	900 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

ES

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0010, P0020 (OCV Bank 1, 2) P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0021 (VVT System 2 - Advance) P0022 (VVT System 2 - 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 - P0306 (Misfire) P0335 (CKP sensor) P0340 (CMP sensor) P0351 - P0356 (igniter) P0500 (VSS) P2196, P2198 (A/F sensor - rationality) P2A00, P2A03 (A/F sensor - slow response)
Battery voltage	11 V or more
Throttle valve position learning	Completed
Either of following conditions 1 or 2 met:	-
1. All of following conditions met:	-
(a) ECT at engine start - IAT at engine start	-15° to 7°C (5° to 45°F)
(b) ECT at engine start	-10° to 56°C (14° to 133°F)
(c) IAT at engine start	-10° to 56°C (14° to 133°F)
2. All of following conditions met:	-
(a) ECT at engine start - IAT at engine start	More than 7°C (45°F)
(b) ECT at engine start	56°C (133°F) or less
(c) IAT at engine start	-10°C (14°F) or more
Accumulated time with 80 mph (128 km/h) or more of vehicle speed	Less than 20 seconds
Malfunction/Pass determination during this trip	Not yet

TYPICAL MALFUNCTION THRESHOLDS

Duration that following conditions A and B met	5 seconds or more
A. Simulated ECT	75°C (167°F) or more
B. ECT sensor output	Less than 75°C (167°F)

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

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

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

Result

Display (DTC Output)	Proceed to
P0128	A
P0128 and other DTCs	B

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

B → GO TO DTC CHART

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 W/THERMOSTAT WATER INLET SUB-ASSEMBLY (THERMOSTAT)

(a) Remove the w/ thermostat water inlet sub-assembly (See page CO-9).
(b) Check the valve opening temperature of the thermostat.
Standard:
80° to 84°C (176° to 183°F)
HINT:
In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.
(c) Reinstall the w/ thermostat water inlet sub-assembly (See page CO-9).

NG → REPLACE THERMOSTAT

OK

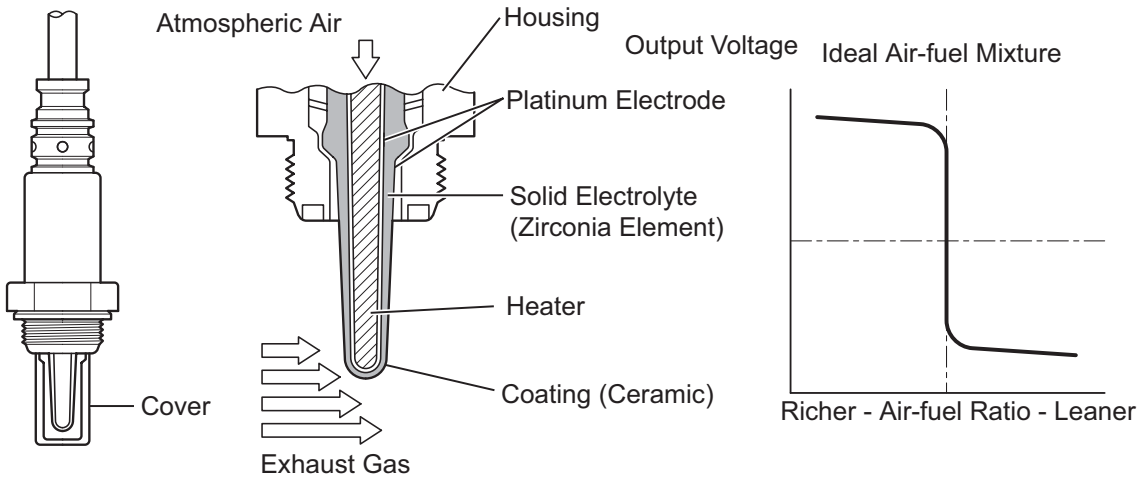
REPLACE ECM

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)
DTC	P0156	Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)
DTC	P0157	Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)
DTC	P0158	Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)

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

DESCRIPTION

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC (Three-Way Catalytic Converter) is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric air-fuel level. For the purpose of helping the ECM to deliver accurate air-fuel ratio control, a Heated Oxygen (HO2) sensor is used.
The HO2 sensor is located behind the TWC, and detects the oxygen concentration in the exhaust gas. Since the 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.



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DTC No.	DTC Detection Conditions	Trouble Areas
P0136 P0156	• Abnormal voltage output: During active air-fuel ratio control, following conditions (a) and (b) met for certain period of time (2 trip detection logic) (a) Heated Oxygen (HO2) sensor voltage does not decrease to less than 0.21 V (b) HO2 sensor voltage does not increase to more than 0.59 V • Low impedance: Sensor impedance less than 5 Ω for more than 30 seconds when ECM presumes sensor to being warmed up and operating normally (2 trip detection logic)	• Open or short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2) • Air-Fuel Ratio (A/F) sensor (bank 1, 2 sensor 1) • EFI relay • Gas leakage from exhaust system
P0137 P0157	• 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 being warmed up and operating normally (2 trip detection logic)	• Open in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2) • EFI relay • Gas leakage from exhaust system
P0138 P0158	• 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 0.59 V or more (b) Target air-fuel ratio lean • Extremely high voltage (short): HO2 sensor voltage output exceeds 1.2 V for more than 10 seconds (2 trip detection logic)	• Short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • ECM internal circuit malfunction

MONITOR DESCRIPTION

1. Active Air-Fuel Ratio Control

The ECM usually performs air-fuel ratio feedback control so that the Air-Fuel Ratio (A/F) sensor output indicates a near stoichiometric air-fuel level. This vehicle includes active air-fuel ratio control in addition to regular air-fuel ratio control. The ECM performs active air-fuel ratio control to detect any deterioration in the Three-Way Catalytic Converter (TWC) and Heated Oxygen (HO2) sensor malfunctions (refer to the diagram below).

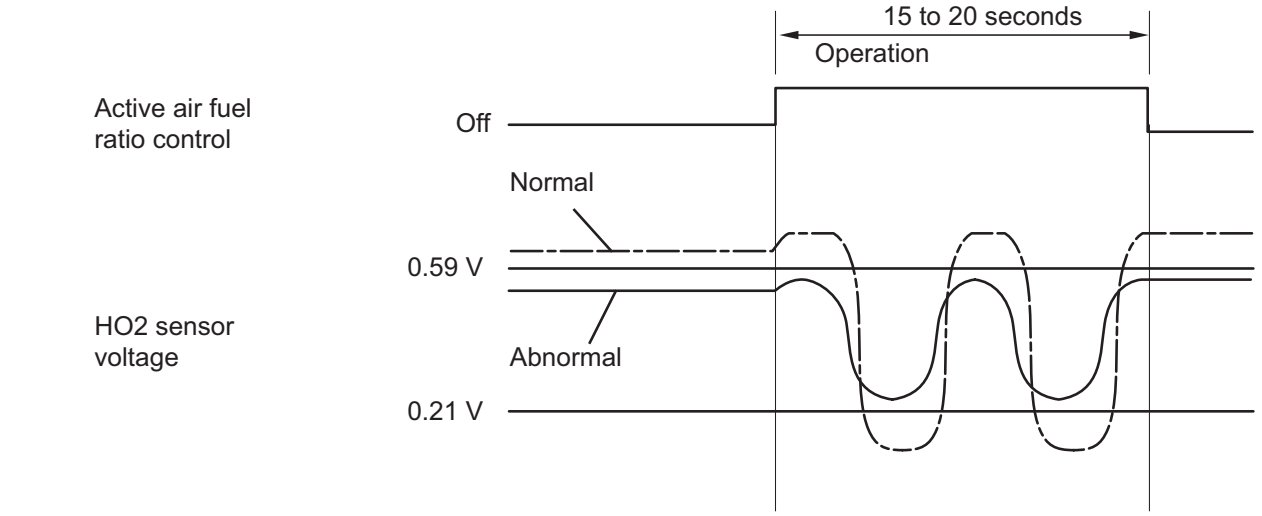
Active air-fuel ratio control is performed for approximately 15 to 20 seconds while driving with a warm engine. During active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become lean or rich by the ECM. If the ECM detects a malfunction, one of the following DTCs is set: DTC P0136 or P0156 (abnormal voltage output), P0137 or P0157 (open circuit) or P0138 or P0158 (short circuit).

2. Abnormal Voltage Output of HO2 Sensor (DTCs P0136 and P0156)

ES

While the ECM is performing active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become rich or lean. If the sensor is not functioning properly, the voltage output variation is small. For example, when the HO2 sensor voltage does not decrease to less than 0.21 V and does not increase to more than 0.59 V during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormal and sets DTCs P0136 and P0156.

HO2 SENSOR CIRCUIT MALFUNCTION (P0136 and P0156: ABNORMAL VOLTAGE)



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3. Open or Short in Heated Oxygen (HO2) Sensor Circuit (DTCs P0137 and P0157 or P0138 and P0158)

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

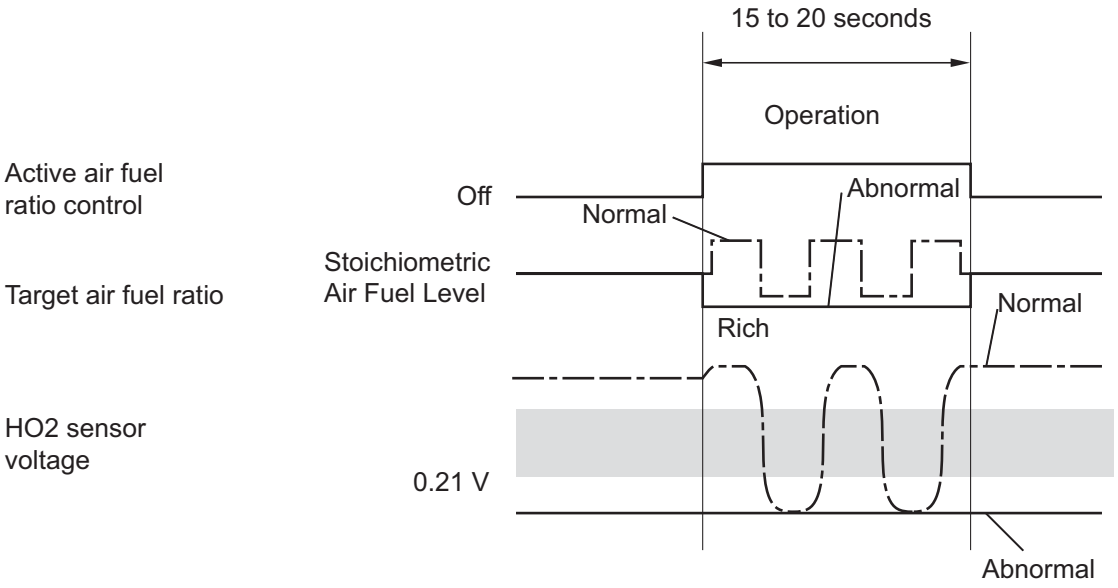
While performing active air-fuel ratio control, when the target air-fuel ratio is rich and the HO2 sensor voltage output is 0.21 V or less (lean), the ECM interprets this as an abnormally low sensor output voltage and sets DTC P0137 or P0157. When the target air-fuel ratio is lean and the voltage output is 0.59 V or more (rich) during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormally high, and sets DTC P0138 or P0158.

HINT:

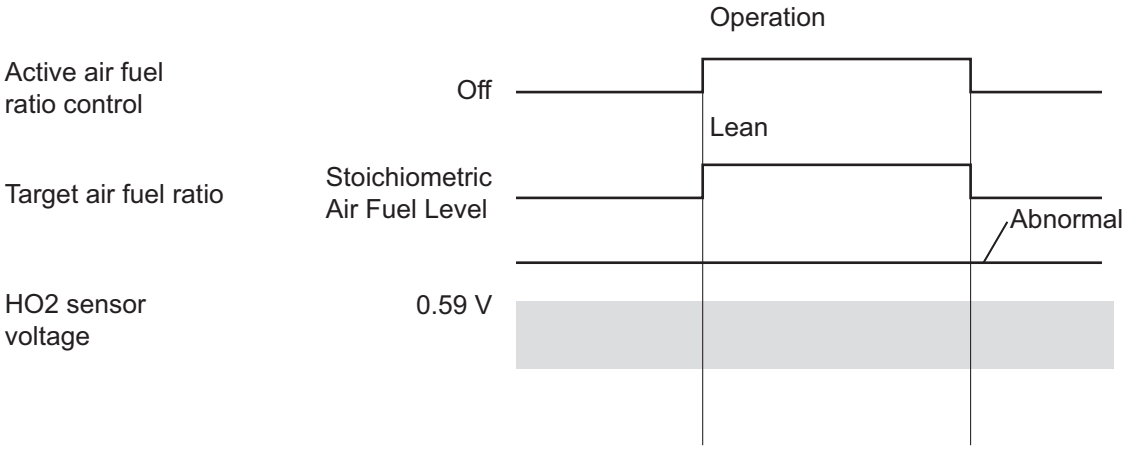
DTC P0138 or P0158 is also set if the HO2 sensor voltage output is more than 1.2 V for 10 seconds or more.

*: The TWC has the capability to store oxygen. The OSC and the emission purification capacity of the TWC are mutually related. The ECM determines whether the catalyst has deteriorated, based on the calculated OSC value (See page ES-203).

HO2 SENSOR CIRCUIT LOW VOLTAGE (P0137 and P0157: OPEN)



HO2 SENSOR CIRCUIT HIGH VOLTAGE (P0138 and P0158: SHORT)

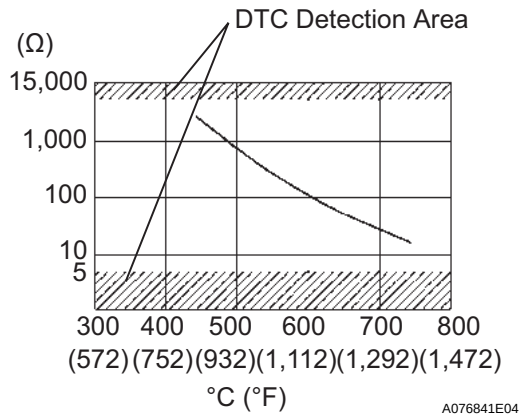


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ES

Relationship between element temperature and impedance:



4. High or Low Impedance of Heated Oxygen (HO2) Sensor (DTCs P0136 and P0156 or P0137 and P0157)

During normal air-fuel ratio feedback control, there are small variations in the exhaust gas oxygen concentration. In order to continuously monitor the slight variation of the HO2 sensor signal while the engine is running, the impedance* of the sensor is measured by the ECM. The ECM determines that there is a malfunction in the sensor when the measured impedance deviates from the standard range.

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

HINT:

- The impedance cannot be measured using an ohmmeter.
- DTCs P0136 and P0156 indicate the deterioration of the HO2 sensor. The ECM sets the DTCs by calculating the impedance of the sensor when the typical enabling conditions are satisfied (2 driving cycle).
- DTCs P0137 and P0157 indicate an open or short circuit in the HO2 sensor (2 driving cycle). The ECM sets the DTCs when the impedance of the sensor exceeds the threshold 15 kΩ.

MONITOR STRATEGY

Related DTCs	P0136: Heated oxygen sensor output voltage (Output voltage) (bank 1) P0136: Heated oxygen sensor impedance (Low) (bank 1) P0137: Heated oxygen sensor output voltage (Low voltage) (bank 1) P0137: Heated oxygen sensor impedance (High) (bank 1) P0138: Heated oxygen sensor output voltage (High voltage) (bank 1) P0138: Heated oxygen sensor output voltage (Extremely high) (bank 1) P0156: Heated oxygen sensor output voltage (Output voltage) (bank 2) P0156: Heated oxygen sensor impedance (Low) (bank 2) P0157: Heated oxygen sensor output voltage (Low voltage) (bank 2) P0157: Heated oxygen sensor impedance (High) (bank 2) P0158: Heated oxygen sensor output voltage (High voltage) (bank 2) P0158: Heated oxygen sensor impedance (Extremely high) (bank 2)
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: Others
Duration	20 seconds: Heated oxygen sensor output (Output voltage, High voltage, Low voltage) 30 seconds: Heated oxygen sensor impedance (Low) 90 seconds: Heated oxygen sensor impedance (High) 10 seconds: Heated oxygen sensor voltage (Extremely high)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS
All:

Monitor runs whenever following DTCs not present	P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0037, P0038, P0057, P0058 (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 - P0306 (Misfire) P0335 (CKP sensor) P0340 (CMP sensor) P0500 (VSS) P2196, P2198 (A/F sensor - rationality) P2A00, P2A03 (A/F sensor - slow response)

ES

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

Active air-fuel ratio control	Executing
Active air-fuel ratio control begins when all of following conditions met:	-
Battery voltage	11 V or more
Engine coolant temperature	75 °C (167°F) or more
Idling	OFF
Engine RPM	Less than 3,200 rpm
A/F sensor status	Activated
Fuel system status	closed loop
Fuel cut	OFF (for 10 seconds or more)
Engine load	10 to 70 %
Shift position	4 th or more

Heated Oxygen Sensor Impedance (Low):

Battery voltage	11 V or more
Estimated 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 sensor temperature	520°C (968°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 (Output voltage):

Either of following conditions met:	1 or 2
1. All of following conditions (a), (b) and (c) 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)	2.5 g or more
2. All of following conditions (d), (e) and (f) met	-
(d) Commanded air-fuel ratio	14.9 or more

(e) Rear HO2 sensor voltage	0.21 to 0.59 V
(f) OSC	2.5 g or more

Heated Oxygen Sensor Output Voltage (Low output voltage):

All of following conditions (a), (b) and (c) met	-
(a) Commanded air-fuel ratio	14.3 or less
(b) Rear HO2 sensor voltage	Less than 0.21 V
(c) OSC (Oxygen Storage Capacity of Catalyst)	2.5 g or more

Heated Oxygen Sensor Output Voltage (High output voltage):

All of following conditions (a), (b) and (c) met	-
(a) Commanded air-fuel ratio	14.9 or more
(b) Rear HO2 sensor voltage	More than 0.59 V
(c) OSC (Oxygen Storage Capacity of Catalyst)	2.5 g or more

ES

Heated Oxygen Sensor Impedance (Low):

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

Heated Oxygen Sensor Impedance (High):

Duration of following condition met	90 seconds or more
Heated oxygen sensor impedance	15 kΩ or more

Heated Oxygen Sensor Output Voltage (Extremely High):

Duration of following condition met	10 seconds or more
Heated oxygen sensor voltage	1.2 V or more

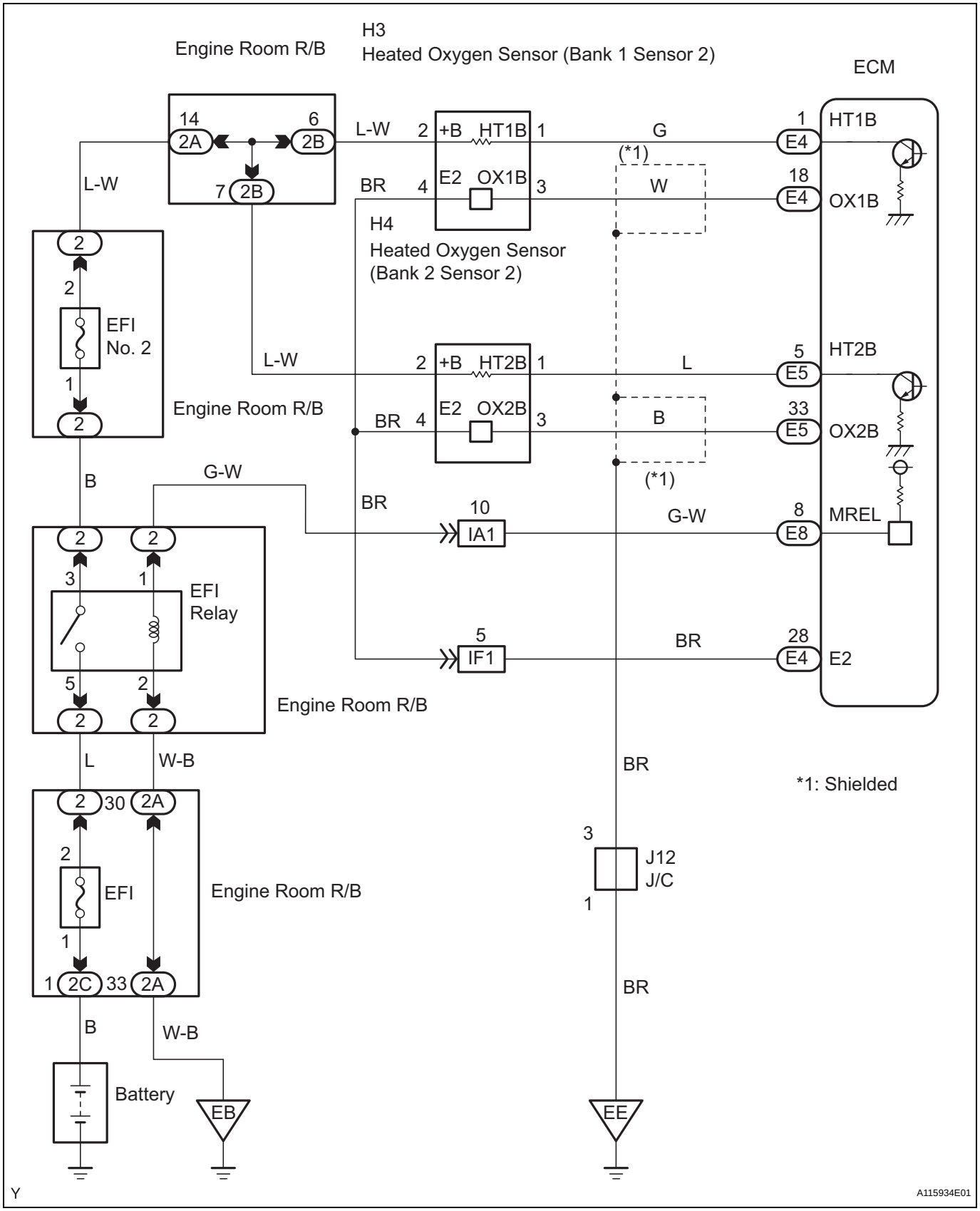
COMPONENT OPERATING RANGE

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

MONITOR RESULT

Detailed information on Checking Monitor Status (See page ES-19).

WIRING DIAGRAM



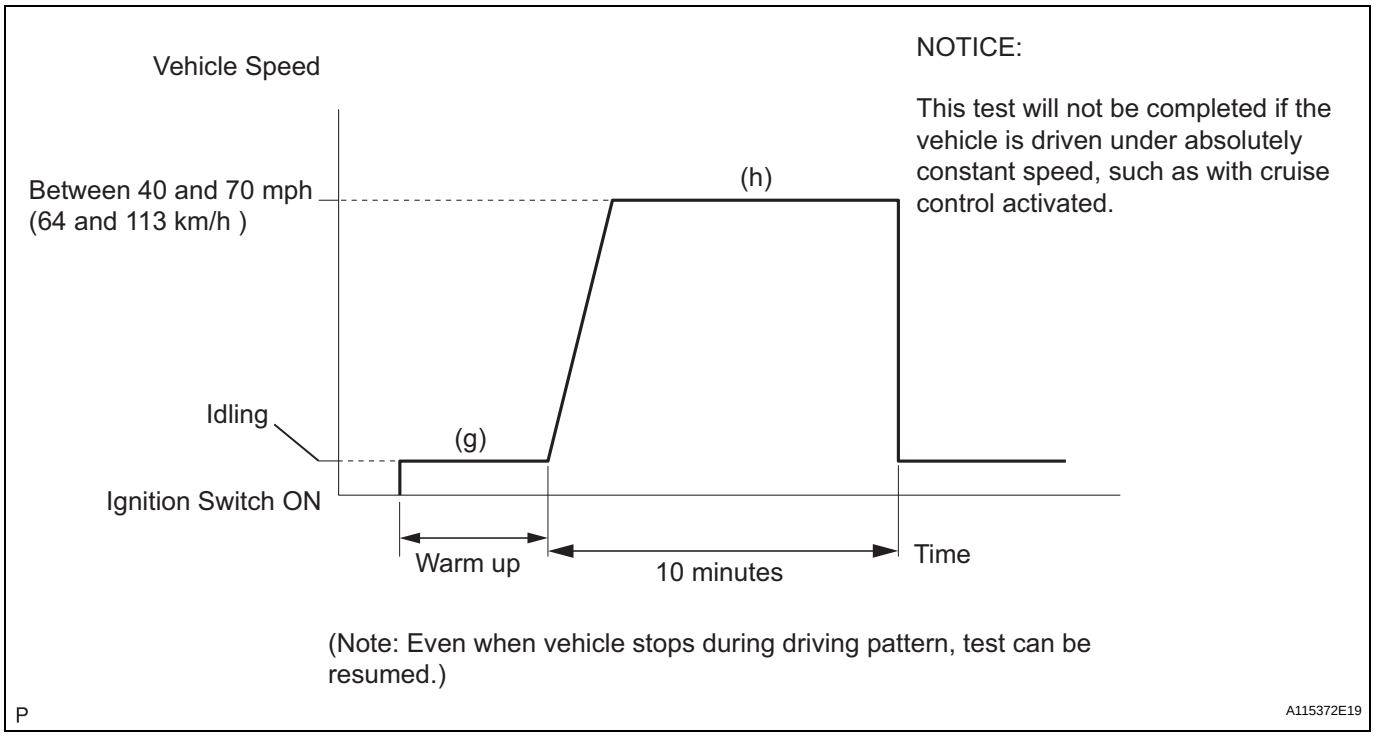
CONFIRMATION DRIVING PATTERN

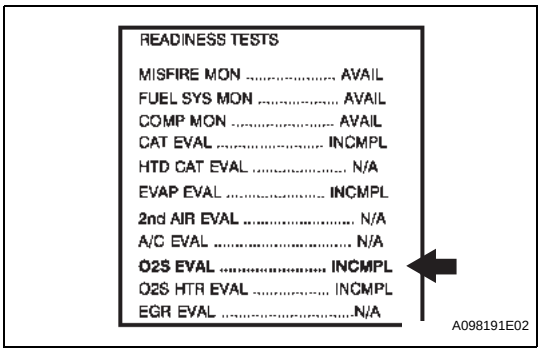
HINT:

- This confirmation driving pattern is used in the "PERFORM CONFIRMATION DRIVING PATTERN" procedure of the following diagnostic troubleshooting procedure.
- Performing this confirmation driving pattern will activate the Heated Oxygen (HO2) sensor monitor. (The catalyst monitor is performed simultaneously.) This is very useful for verifying the completion of a repair.

NOTICE:

This test will not be completed if the vehicle is driven under absolutely constant speed conditions such as with cruise control activated.





(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Clear DTCs (See page ES-38).
(e) Select the following menu items: DIAGNOSIS / CARB OBD II / READINESS TESTS.
(f) Check that O2S EVAL is INCMPL (incomplete).
(g) Start the engine and warm it up.
(h) Drive the vehicle at between 40 mph and 70 mph (64 km/h and 113 km/h) for at least 10 minutes.
(i) Note the state of the Readiness Tests items. Those items will change to COMPL (complete) as O2S EVAL monitor operates.

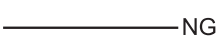
(j) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES and check if any DTCs (any pending DTCs) are set.
HINT:
If O2S EVAL does not change to COMPL, and any pending DTCs fail to set, extend the driving time.

HINT:
Intelligent tester only:
Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.
The following instructions describe how to conduct the A/F CONTROL operation using an intelligent tester.
(1) Connect an 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) 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 O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.
HINT:
- The A/F CONTROL operation lowers the fuel injection volume by 12.5 % or increases the injection volume by 25 %.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard

Tester Display (Sensor)	Injection Volumes	Status	Voltages
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 Areas
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.55 V Less than 0.4 V		
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• A/F sensor • A/F sensor heater • A/F sensor circuit
	Output Voltage Almost no reaction		Output Voltage More than 0.55 V Less than 0.4 V		

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Areas
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		

ES

- 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 or AFS B2S1 and O2S B2S2, and press the YES button and then the ENTER button followed by the F4 button.

HINT:

- If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.
- If the OX1B wire from the ECM connector is short-circuited to the +B wire, DTC P0136 will be set.
- If the OX2B wire from the ECM connector is short-circuited to the +B wire, DTC P0156 will be set.

1	CHECK ANY OTHER DTCS OUTPUT

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

Result

Display (DTC Output)	Proceed To
P0138 or P0158	A
P0137 or P0157	B
P0136 or P0156	C

B → Go to step 14

C → Go to step 7

A

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

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / O2S B1S2 or O2S B2S2.
(d) Allow the engine to idle.
(e) Read the Heated Oxygen (HO2) sensor output voltage while idling.

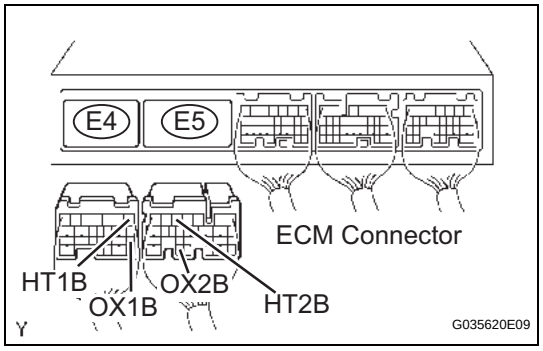
Result

HO2 Sensor Output Voltages	Proceed To
More than 1.2 V	A
Less than 1.0 V	B

B → Go to step 5

A

3	CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)



(a) Turn the ignition switch OFF and wait for 5 minutes.
(b) Disconnect the E4 or E5 ECM connector.
(c) Check the resistance.
Standard Resistance

Tester Connections	Specified Conditions
HT1B (E4-1) - OX1B (E4-18)	10 kΩ or higher
HT2B (E5-5) - OX2B (E5-33)	

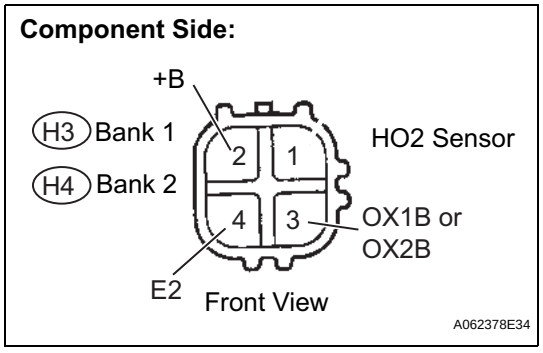
(d) Reconnect the ECM connector.

NG → Go to step 4

OK

REPLACE ECM

4	INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)



(a) Disconnect the H3 or H4 HO2 sensor connector.
(b) Check the resistance.
Standard Resistance

Tester Connections	Specified Conditions
+B (2) - E2 (4)	10 kΩ or higher
+B (2) - OX1B or OX2B (3)	

(c) Reconnect the HO2 sensor connector.

NG → REPLACE HEATED OXYGEN SENSOR

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

5	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

ES

6	CHECK WHETHER DTC OUTPUT RECURS (DTC P0138 or P0158)

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

Result

Display (DTC Output)	Proceed To
P0138 or P0158	A
No output	B

B → **CHECK FOR INTERMITTENT PROBLEMS**

A

REPLACE HEATED OXYGEN SENSOR

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

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Start the engine.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / O2S B1S2 or O2S B2S2.
(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 or P0156)

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

ES

Result

Display (DTC Output)	Proceed To
P0136 or P0156	A
No output	B

B → CHECK FOR INTERMITTENT PROBLEMS

A

10	REPLACE HEATED OXYGEN SENSOR

NEXT

11	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

12	CHECK WHETHER DTC OUTPUT RECURS (DTC P0136 or P0156)

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

Result

Display (DTC Output)	Proceed To
P0136 or P0156	A
No output	B

B → REPAIR COMPLETED

A

13	PERFORM ACTIVE TEST USING INTELLIGENT TESTER (INJECTION VOLUME)

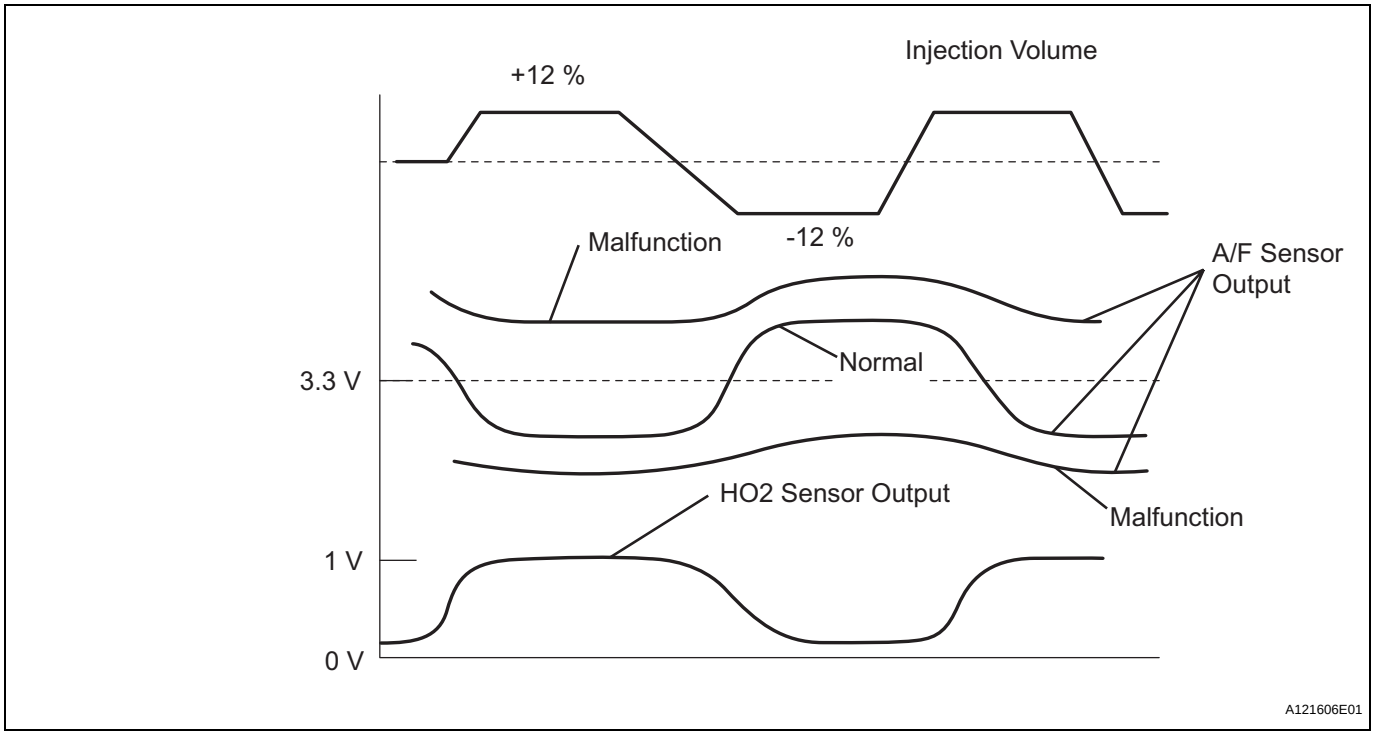
(a) Connect an intelligent tester to the DLC3.
(b) Start the engine and turn the tester ON.
(c) Warm up the engine.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / INJ VOL.
(e) Change the fuel injection volume using the tester, monitoring the voltage output of Air-Fuel 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 or AFS B2S1, and the HO2 sensor is displayed as O2S B1S2 or O2S B2S2, on intelligent testers.

ES

Result

Tester Display (Sensor)	Voltage Variations	Proceed To
AFS B1S1 (A/F) AFS B2S1 (A/F)	Alternates between more and less than 3.3 V	OK
AFS B1S1 (A/F) AFS B2S1 (A/F)	Remains at more than 3.3 V	NG
AFS B1S1 (A/F) AFS B2S1 (A/F)	Remains at less than 3.3 V	NG

HINT:
A normal HO2 sensor voltage (O2S B1S2 or O2S B2S2) 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 AND REPAIR EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO (INJECTOR, FUEL PRESSURE, GAS LEAKAGE FROM EXHAUST SYSTEM, ETC.)

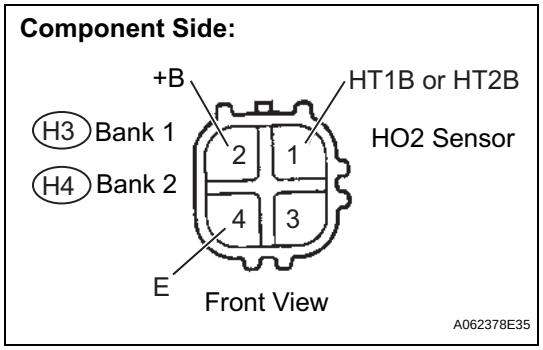
14 CHECK EXHAUST GAS LEAKAGE

OK:
No gas leakage.

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

OK

15 INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)



(a) Disconnect the H3 or H4 HO2 sensor connector.
(b) Measure the resistance between the terminals of the HO2 sensor connector.
Standard Resistance

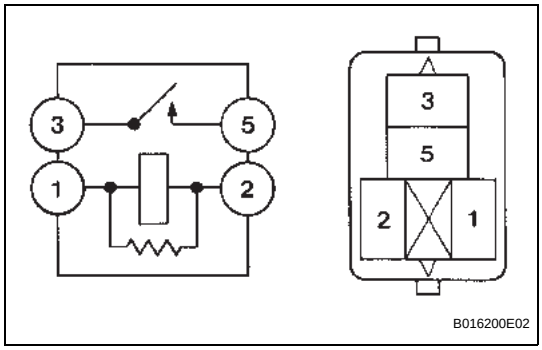
Tester Connections	Specified Conditions
HT1B or HT2B (1) - +B (2)	11 to 16 Ω at 20°C (68°F)
HT1B or HT2B (1) - E2 (4)	10 kΩ or higher

(c) Reconnect the HO2 sensor connector.

NG → **REPLACE HEATED OXYGEN SENSOR**

OK

16 INSPECT EFI RELAY



(a) Remove the EFI relay from the engine room R/B.
(b) Check the EFI relay resistance.

Standard Resistance

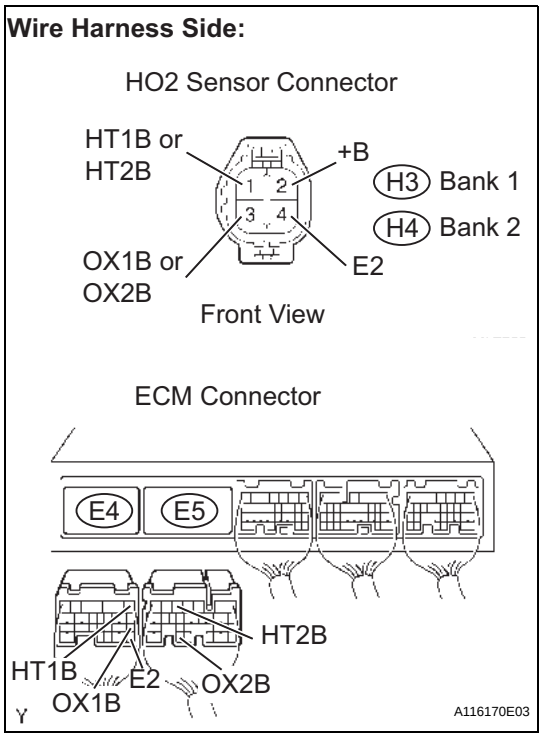
Terminal Connections	Specified Conditions
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the EFI relay.

NG → REPLACE EFI RELAY

OK

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



(a) Disconnect the H3 or H4 HO2 sensor connector.
(b) Turn the ignition switch ON.
(c) Measure the voltage between the +B terminal of the HO2 sensor connector and body ground.

Standard Voltage

Terminal Connections	Specified Conditions
+B (H3-2) - Body ground	9 to 14 V
+B (H4-2) - Body ground	

(d) Turn the ignition switch OFF.
(e) Disconnect the E4 and E5 ECM connectors.
(f) Check the resistance.

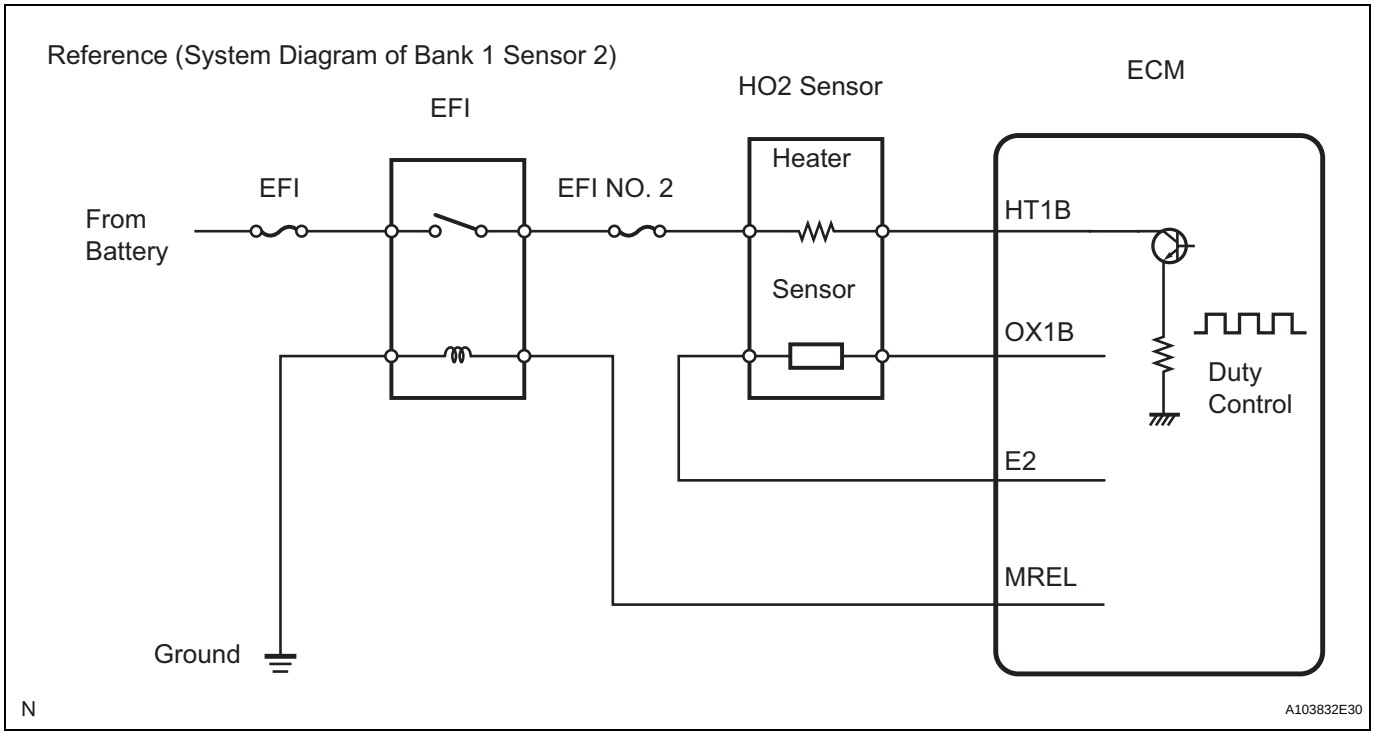
Standard Resistance (Check for open)

Terminal Connections	Specified Conditions
HT1B (H3-1) - HT1B (E4-1)	Below 1 Ω
OX1B (H3-3) - OX1B (E4-18)	
E2 (H3-4) - E2 (E4-28)	
HT2B (H4-1) - HT2B (E5-5)	
OX2B (H4-3) - OX2B (E5-33)	
E2 (H4-4) - E2 (E4-28)	

Standard Resistance (Check for short)

Terminal Connections	Specified Conditions
HT1B (H3-1) or HT1B (E4-1) - Body ground	10 kΩ or higher
OX1B (H3-3) or OX1B (E4-18) - Body ground	
HT2B (H4-1) or HT2B (E5-5) - Body ground	
OX2B (H4-3) or OX2B (E5-33) - Body ground	

(g) Reconnect the HO2 sensor connector.
(h) Reconnect the ECM connectors.



ES

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)

DTC	P0174	System Too Lean (Bank 2)

DTC	P0175	System Too Rich (Bank 2)

DESCRIPTION

ES

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.

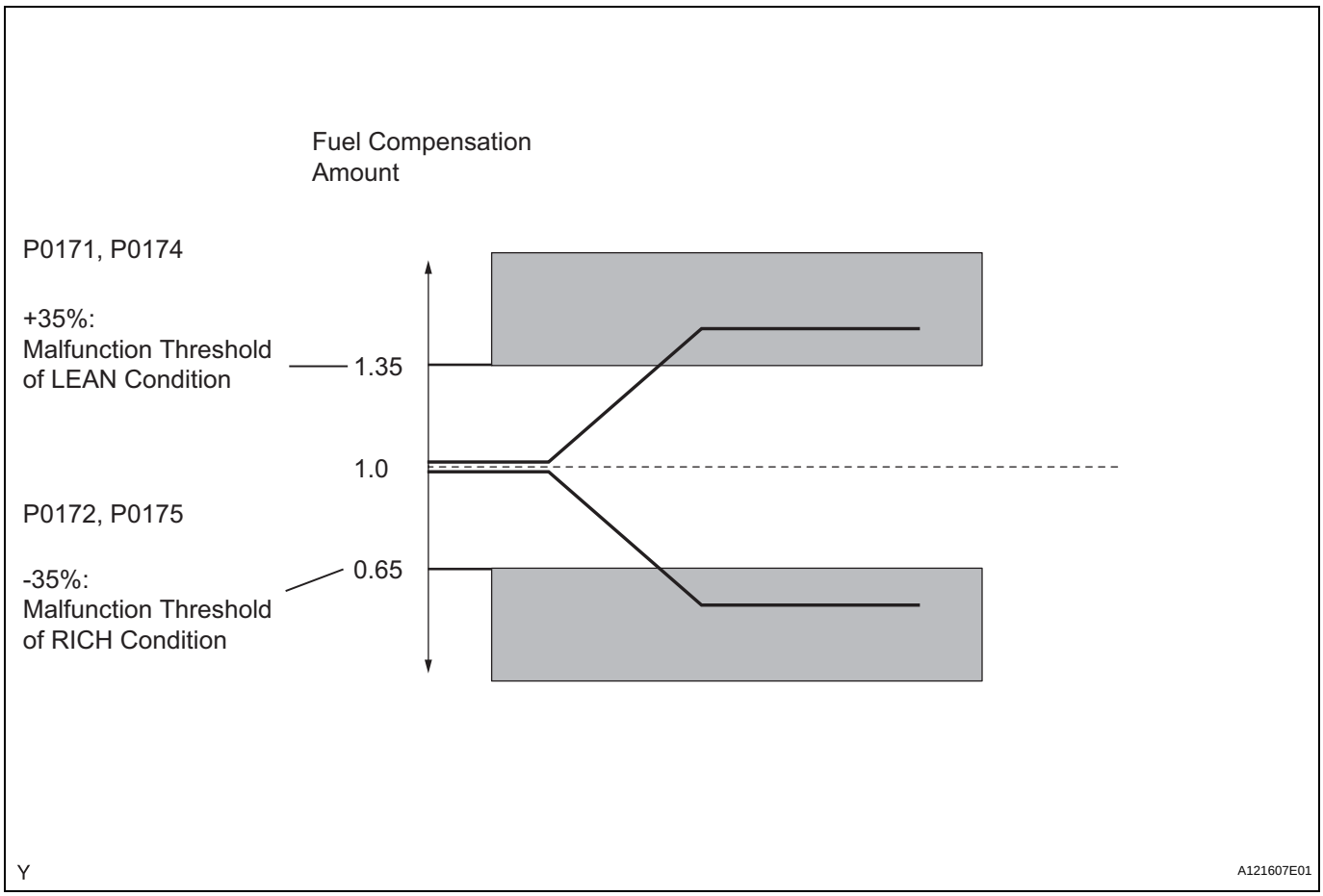
DTC No.	DTC Detection Conditions	Trouble Areas
P0171 P0174	With warm engine and stable air-fuel ratio feedback, fuel trim considerably in error to lean side (2 trip detection logic)	• Air induction system • Injector blockage • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater (bank 1, 2 sensor 1) • A/F sensor heater relay • A/F sensor heater and A/F sensor heater relay circuits • PCV valve and hose • PCV hose connections • ECM
P0172 P0175	With warm engine and stable air-fuel ratio feedback, fuel trim considerably in error to rich side (2 trip detection logic)	• Injector leakage or blockage • MAF meter • ECT sensor • Ignition system • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater (bank 1, 2 sensor 1) • A/F sensor heater relay • A/F sensor heater and A/F sensor heater relay circuits • ECM

HINT:

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

MONITOR DESCRIPTION

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



MONITOR STRATEGY

Related DTCs	P0171: Fuel trim Lean (bank 1) P0172: Fuel trim Rich (bank 1) P0174: Fuel trim Lean (bank 2) P0175: Fuel trim Rich (bank 2)
Required Sensors/Components (Main)	Fuel system
Required Sensors/Components (Related)	A/F sensor, Mass air flow meter, Crankshaft position sensor
Frequency of Operation	Continuous
Duration	Within 10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Fuel-trim:

Monitor runs whenever following DTCs not present	P0010, P0020 (OCV Bank 1, 2) P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0021 (VVT System 2 - Advance) P0022 (VVT System 2 - Retard) P0031, P0032, P0051, P0052 (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) P0351 - P0356 (Igniter) P0500 (VSS)
Fuel system status	Closed-loop
Battery voltage	11 V or more
Throttle position learning	Completed
Either of following conditions 1 or 2 set	-
1. Engine RPM	Below 1,100 rpm
2. Intake air amount per revolution	0.22 g/rev or more
Catalyst monitor	No executed

TYPICAL MALFUNCTION THRESHOLDS

Fuel-trim:

Purge-cut	Executing
Either of following conditions 1 or 2 met	-
1. Average between short-term fuel trim and long-term fuel trim	35 % or more at 80°C (176°F) of ECT
2. Average between short-term fuel trim and long-term fuel trim	-35 % or less at 80°C (176°F) of ECT

WIRING DIAGRAM

Refer to DTC P2195 (See page ES-309).

HINT:
Intelligent tester only:
Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.
The following instructions describe how to conduct the A/F CONTROL operation using an intelligent tester.
(1) Connect an 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) 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 O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.
HINT:

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

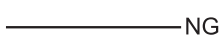
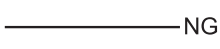
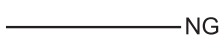
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard

Tester Display (Sensor)	Injection Volumes	Status	Voltages
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.

ES

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

- Following the A/F CONTROL procedure enables technicians to check and graph the 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 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 an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

- 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, P0172, P0174 OR P0175)

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

ES

Result

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

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

B → **GO TO DTC CHART**

A

2	CHECK PCV HOSE 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 an 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) 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 or AFS B2S1 and O2S B2S2) displayed on the tester.
HINT:
- The A/F CONTROL operation lowers the fuel injection volume by 12.5 % or increases the injection volume by 25 %.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard

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

Result:

Status AFS B1S1 or AFS B2S1	Status O2S B1S2 or O2S B2S2	A/F Condition and A/F Sensor Condition	Misfires	Suspected Trouble Areas	Proceed To
Lean/Rich	Lean/Rich	Normal	-	-	C
Lean	Lean	Actual air-fuel ratio lean	May occur	• PCV valve and hose • PCV hose connections • Injector blockage • Gas leakage from exhaust system • Air induction system • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor	A
Rich	Rich	Actual air-fuel ratio rich	-	• Injector blockage or blockage • Gas leakage from exhaust system • Ignition system • Fuel pressure • MAF meter • ECT sensor	
Lean	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	

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

B	**Go to step 11**

C → Go to step 15

A

5	READ VALUE OF INTELLIGENT TESTER (COOLANT TEMP)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(d) Read the COOLANT TEMP twice, when the engine is both cold and warmed up.
Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 80°C and 100°C (176°C and 212°F).

NG → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

OK

6	READ VALUE OF INTELLIGENT TESTER (MAF)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / MAF and COOLANT TEMP.
(d) Allow the engine to idle until the COOLANT TEMP reaches 75°C (167°F) or more.
(e) Read the MAF with the engine in an idling condition and at an engine speed of 2,500 rpm.
Standard:
MAF while engine idling: Between 3.2 g/sec and 4.7 g/sec (shift position: N, A/C: OFF).
MAF at engine speed of 2,500 rpm: Between 13.1 g/sec and 18.9 g/sec (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-6).

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

8	CHECK EXHAUST GAS LEAKAGE

OK:
No gas leakage.

NG → **REPAIR OR REPLACE EXHAUST SYSTEM**

OK

9	CHECK SPARK AND IGNITION

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

NG → **REPAIR OR REPLACE IGNITION SYSTEM**

OK

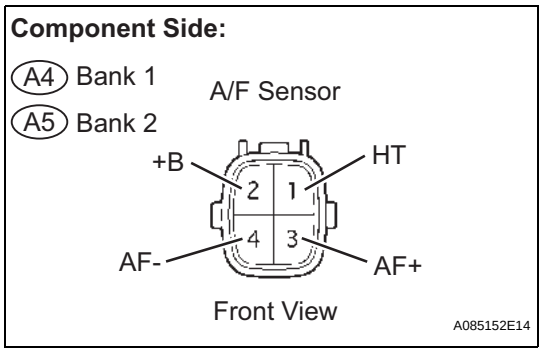
10	INSPECT FUEL INJECTOR ASSEMBLY (INJECTION AND VOLUME)

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

NG → **REPLACE FUEL INJECTOR ASSEMBLY**

OK

11	INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the A4 or A5 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor connector.
Standard Resistance

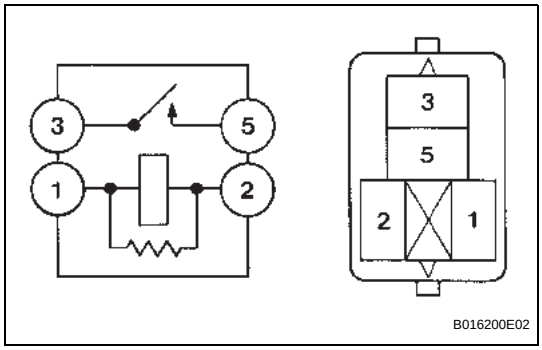
Tester Connections	Specified Conditions
HT (1) - +B (2)	1.8 Ω to 3.4 Ω at 20°C (68°F)
HT (1) - AF- (4)	10 kΩ or higher

(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

12 INSPECT AIR FUEL RATIO SENSOR HEATER RELAY



(a) Remove the A/F sensor heater relay from the engine room R/B.
(b) Check the A/F sensor heater relay resistance.

Standard Resistance

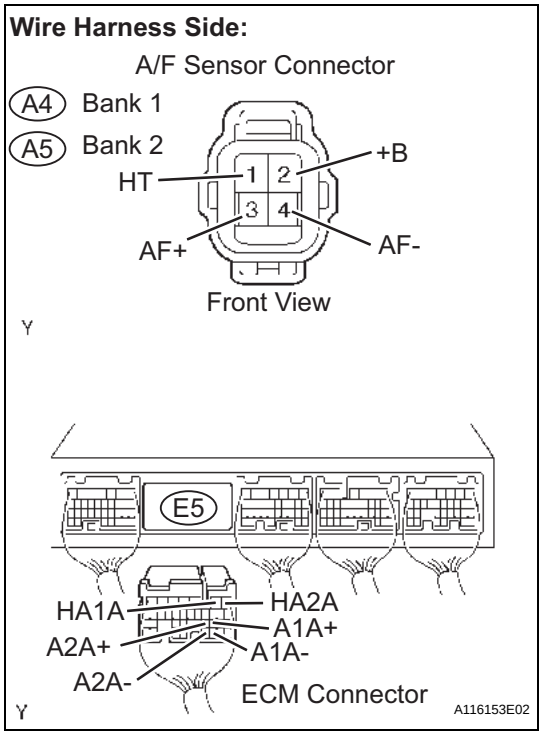
Tester Connections	Specified Conditions
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the A/F sensor heater relay.

NG → **REPLACE AIR FUEL RATIO SENSOR HEATER RELAY**

OK

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



(a) Disconnect the A4 or A5 A/F sensor connector.
(b) Turn the ignition switch ON.
(c) Measure the voltage between the +B terminal of the A/F sensor connector and body ground.

Standard Voltage

Tester Connections	Specified Conditions
+B (A4-2) - Body ground	9 to 14 V
+B (A5-2) - Body ground	

(d) Turn the ignition switch OFF.
(e) Disconnect the E5 ECM connector.
(f) Check the resistance.

Standard Resistance (Check for open)

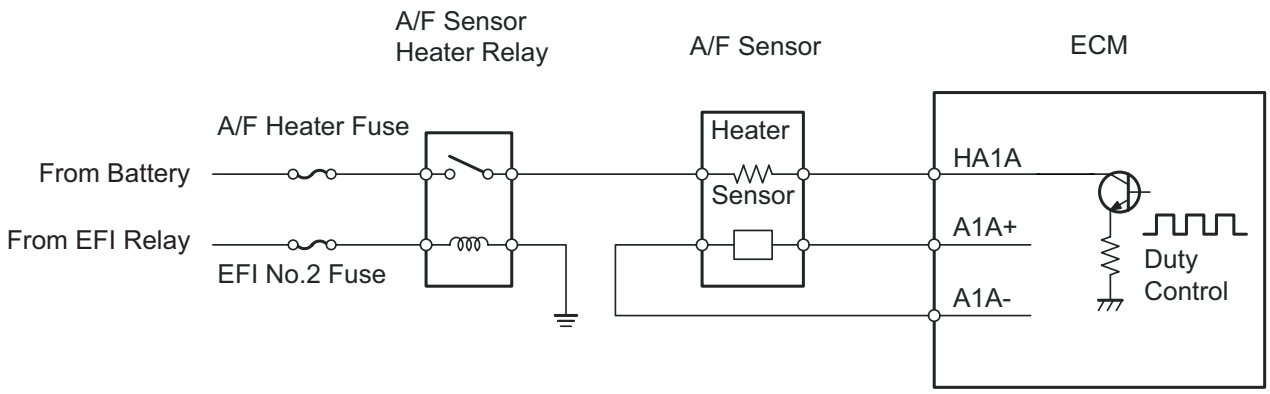
Tester Connections	Specified Conditions
HT (A4-1) - HA1A (E5-2)	Below 1 Ω
AF+ (A4-3) - A1A+ (E5-22)	
AF- (A4-4) - A1A- (E5-30)	
HT (A5-1) - HA2A (E5-1)	
AF+ (A5-3) - A2A+ (E5-23)	
AF- (A5-4) - A2A- (E5-31)	

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
HT (A4-1) or HA1A (E5-2) - Body ground	10 kΩ or higher
AF+ (A4-3) or A1A+ (E5-22) - Body ground	
AF- (A4-4) or A1A- (E5-30) - Body ground	
HT (A5-1) or HA2A (E5-1) - Body ground	
AF+ (A5-3) or A2A+ (E5-23) - Body ground	
AF- (A5-4) or A2A- (E5-31) - Body ground	

(g) Reconnect the ECM connector.
(h) Reconnect the A/F sensor connector.

Reference (Bank 1 Sensor 1 System Diagram)



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ES

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

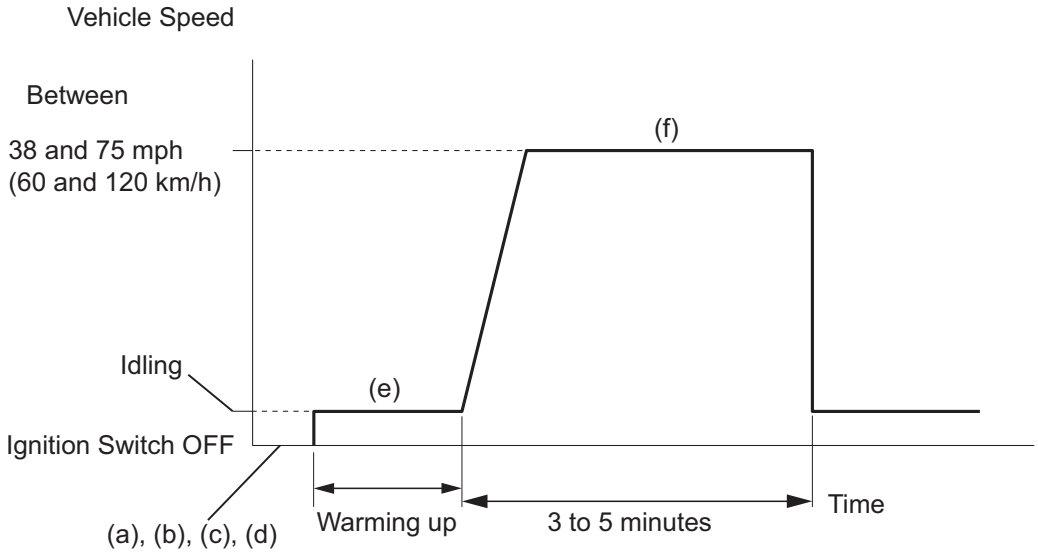
OK

14	REPLACE AIR FUEL RATIO SENSOR

(a) Replace the A/F sensor (See page EC-17).

NEXT

15	PERFORM CONFIRMATION DRIVING PATTERN



(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Clear DTCs (See page ES-38).
(d) Switch the ECM from normal mode to check mode using the tester (See page ES-41).
(e) Start the engine and warm it up with all the accessories switched OFF.
(f) Drive the vehicle at between 38 mph and 75 mph (60 km/h and 120 km/h) and at an engine speed of between 1,400 rpm and 3,200 rpm for 3 to 5 minutes.
HINT:
If the system is still malfunctioning, the MIL will be illuminated during step (f).
NOTICE:
If the conditions in this test are not strictly followed, no malfunction will be detected.

NEXT

16	CHECK WHETHER DTC OUTPUT RECURS (DTC P0171, P0172, P0174 OR P0175)

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

Result

Display (DTC output)	Proceed To
No output	A
P0171, P0172, P0174 or P0175	B

B → Go to step 5

A

END

DTC	P0230	Fuel Pump Primary Circuit

DESCRIPTION

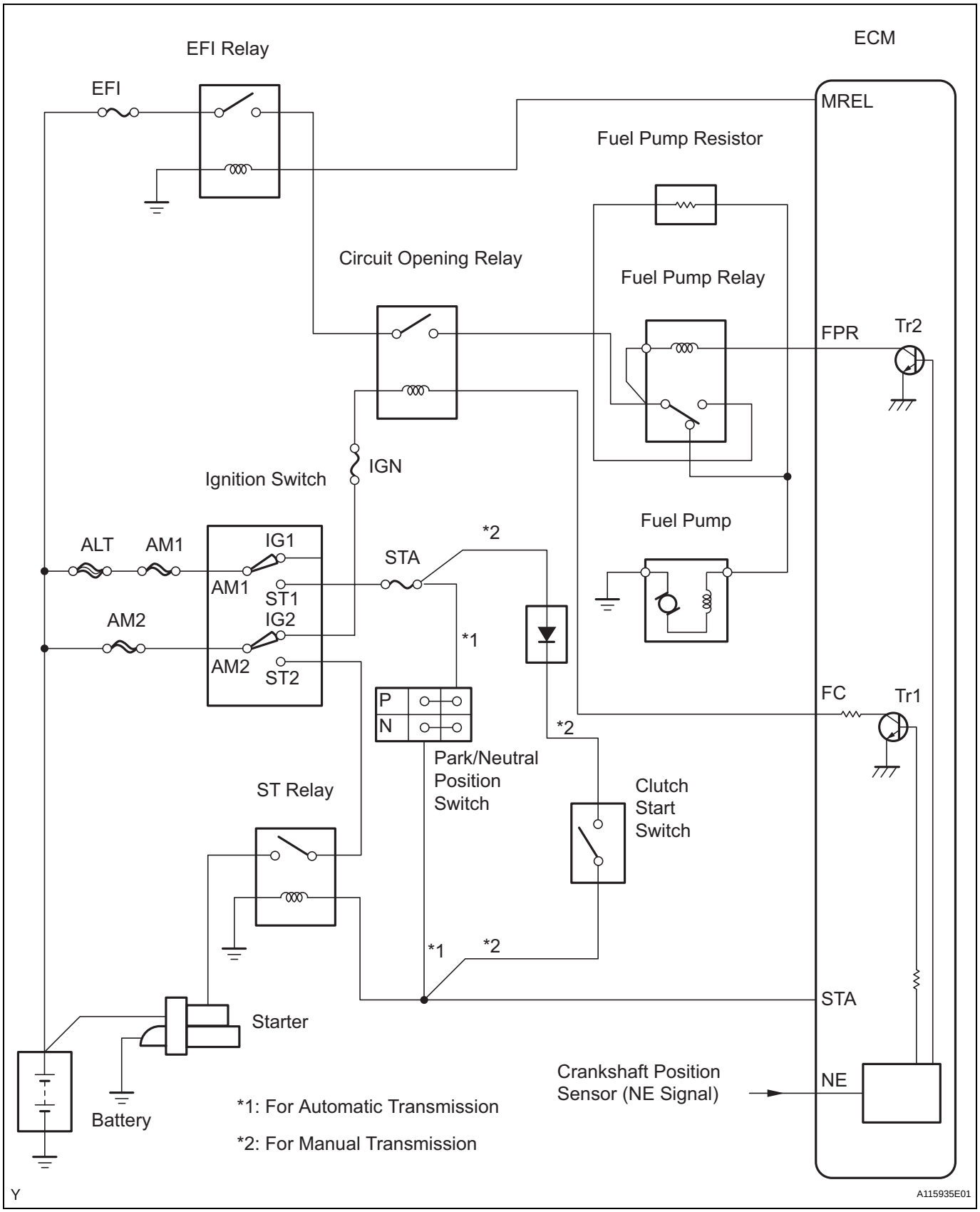
As shown in the illustration, when the engine is cranked, current flows from terminal ST1 of the ignition switch into the ECM and the ST (starter) relay coil and also current flows to terminal STA of the ECM (STA signal).

When the STA signal and NE signal are input to the ECM, Tr1 (power transistor 1) is turned ON, current flows to the coil of the circuit opening relay, the relay switches on, power is supplied to the fuel pump, and the fuel pump operates.

While the NE signal is generated (engine running), the ECM keeps the Tr1 ON (circuit opening relay ON) and the fuel pump also keeps operating.

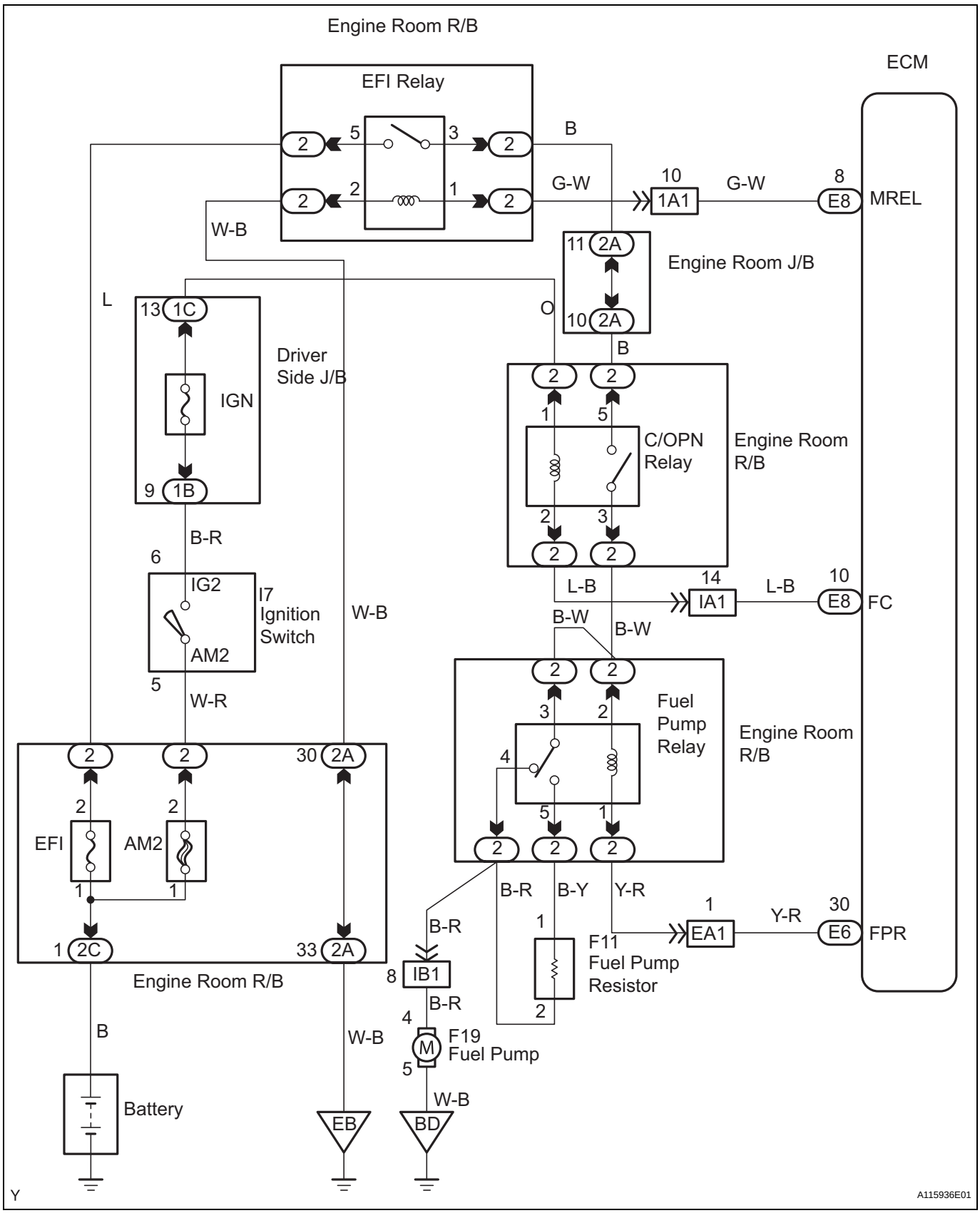
The fuel pump speed is controlled at two levels (high speed or low speed) by engine condition (starting, light load, heavy load). When the engine starts (STA ON), Tr2 (power transistor 2) in the ECM is OFF, so the fuel pump relay closes and positive battery voltage is applied directly to the fuel pump. The fuel pump operates at high speed.

During idling or under light loads, Tr2 goes ON, and then power is supplied to the fuel pump via the fuel pump resistor. The fuel pump operates at low speed.



DTC No	DTC Detection Condition	Trouble Areas
P0230	Open or short in fuel pump relay circuit (1 trip detection logic)	• Open or short in fuel pump relay circuit • Fuel pump relay • ECM

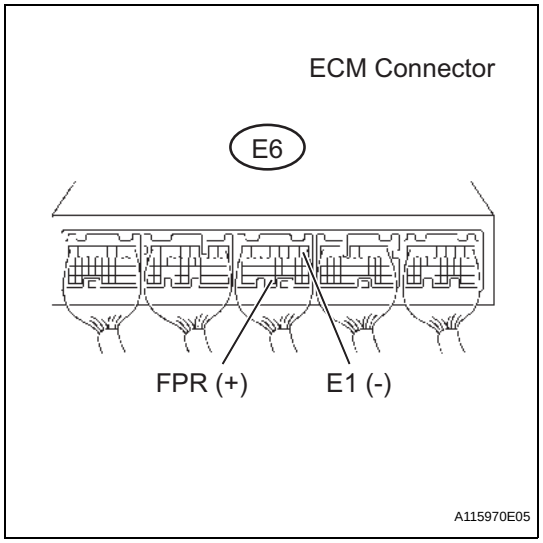
WIRING DIAGRAM



HINT:
This DTC chart is on the premise that the engine is started normally. If the engine is difficult to start, proceed to the problem symptoms table (See page ES-28).

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

1 CHECK ECM (FPR VOLTAGE)



(a) Measure the voltage between the terminals of the E6 ECM connector.
Standard Voltage

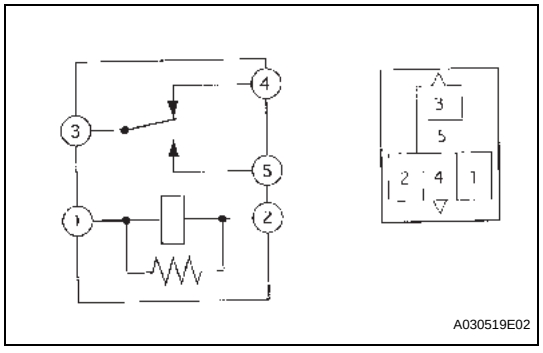
Tester Connections	Conditions	Specified Conditions
FPR (E6-30) - E1 (E6-1)	STA signal ON	9 to 14 V
FPR (E6-30) - E1 (E6-1)	STA signal OFF	0 to 3 V

ES

NG → **REPLACE ECM**

OK

2 INSPECT FUEL PUMP RELAY ASSEMBLY



(a) Remove the fuel pump relay from the engine room R/B.
(b) Check the fuel pump relay resistance.
Standard Resistance

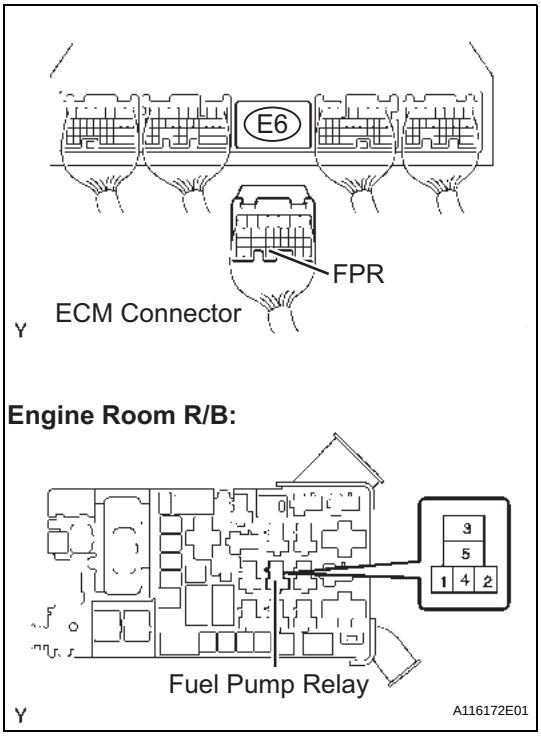
Tester Connections	Specified Conditions
3 - 4	Below 1 Ω
3 - 5	10 kΩ or higher
3 - 4	10 kΩ or higher (when battery voltage applied to terminals 1 and 2)
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the fuel pump relay.

NG → **REPLACE FUEL PUMP RELAY ASSEMBLY**

OK

3	CHECK HARNESS AND CONNECTOR (F/PMP RELAY - ECM)



(a) Remove the fuel pump relay from the engine room R/B.
(b) Disconnect the E6 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
Fuel pump relay (1) - FPR (E6-30)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
Fuel pump relay (1) or FPR (E6-30) - Body ground	10 kΩ or higher

(d) Reinstall the fuel pump relay.
(e) Reconnect the ECM connector.

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

OK

REPLACE ECM

DTC	P0300	Random / Multiple Cylinder Misfire Detected

DTC	P0301	Cylinder 1 Misfire Detected

DTC	P0302	Cylinder 2 Misfire Detected

DTC	P0303	Cylinder 3 Misfire Detected

DTC	P0304	Cylinder 4 Misfire Detected

DTC	P0305	Cylinder 5 Misfire Detected

DTC	P0306	Cylinder 6 Misfire Detected

DESCRIPTION

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

DTC No.	DTC Detection Conditions	Trouble Areas
P0300	Simultaneous misfiring of several cylinders detected (2 trip detection logic)	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304 P0305 P0306	Misfiring of specific cylinder detected (2 trip detection logic)	

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.

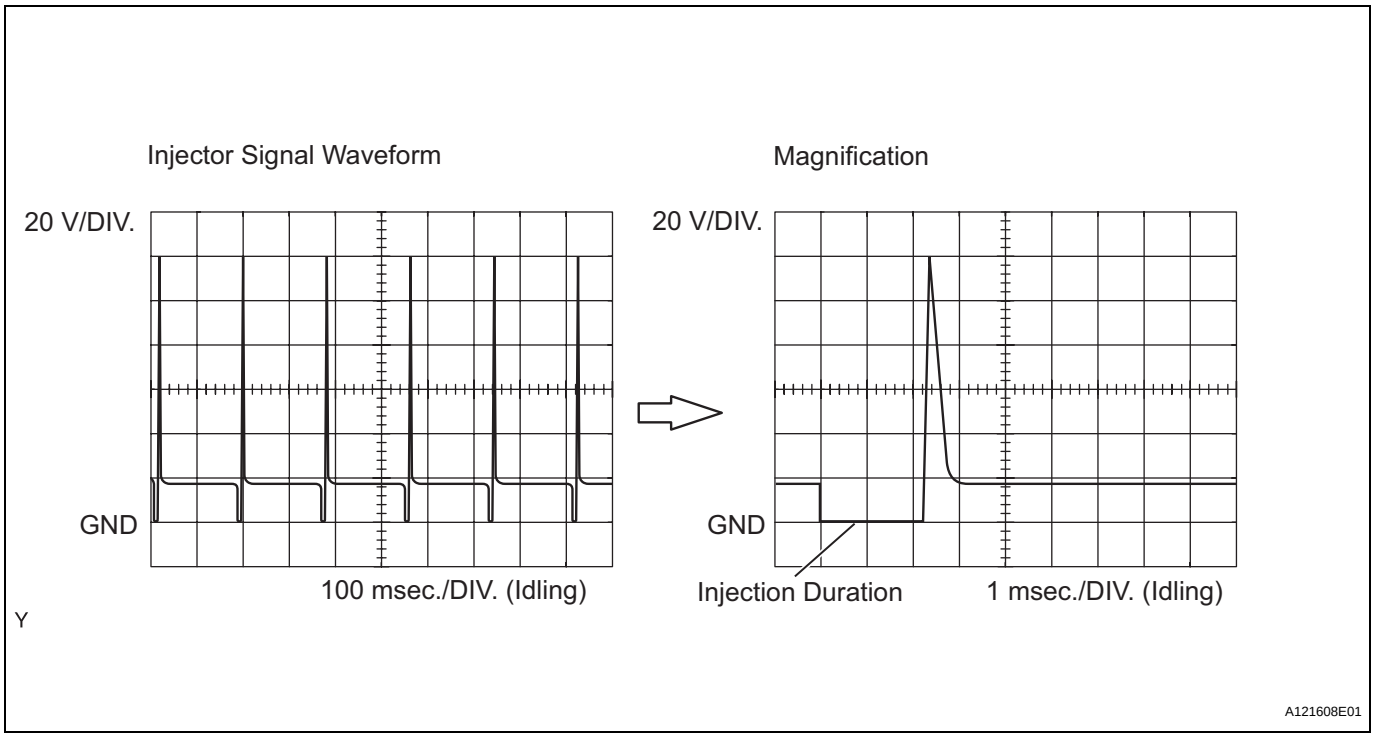
Reference: Inspection using an oscilloscope.

With the engine idling, check the waveform between terminals #10 to #60 and E1 of the ECM connectors.

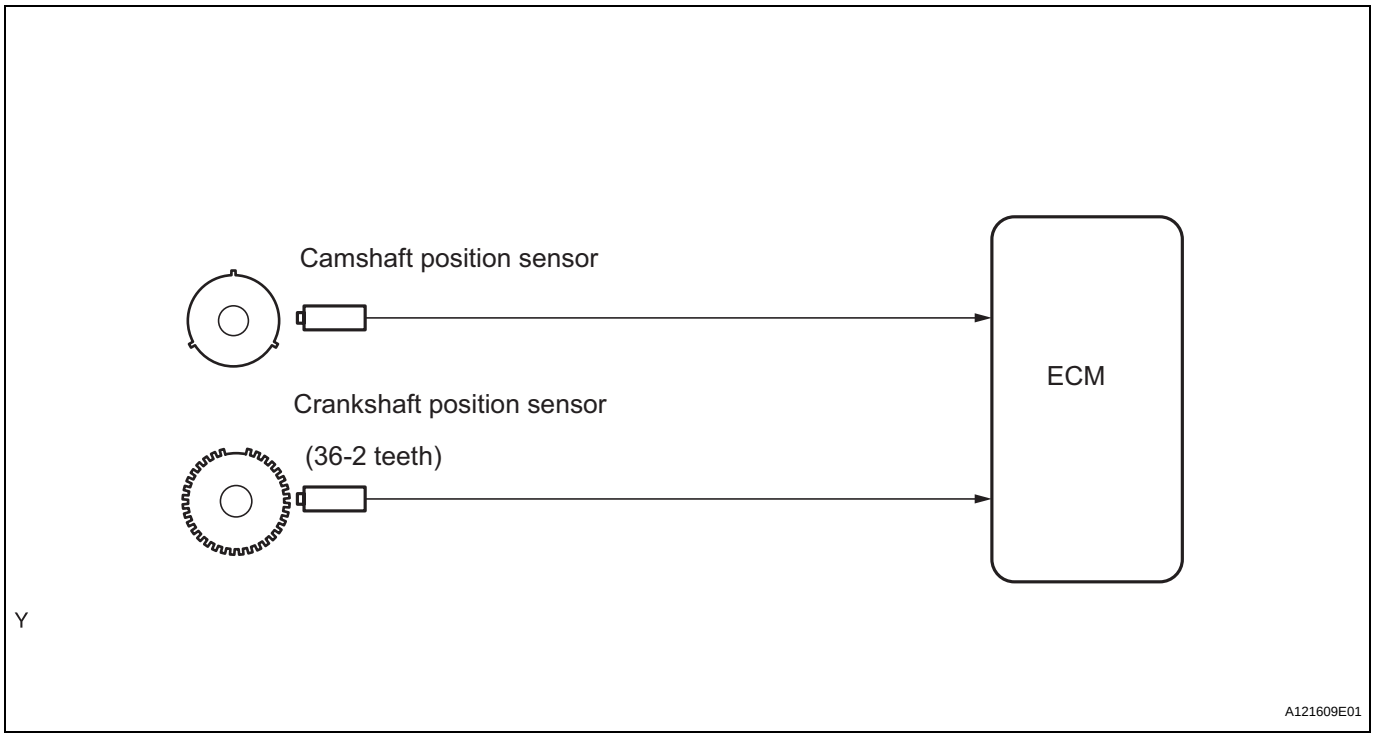
Items	Contents
Terminals	#10 to #60 - E01
Equipment Settings	20 V/Division, 100 or 1 ms/Division

Items	Contents
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 50 misfires per 1,000 crankshaft revolutions) occurs 4 times in sequential crankshaft revolutions.

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

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

MONITOR STRATEGY

Related DTCs	P0300: Multiple cylinder misfire P0301: Cylinder 1 misfire P0302: Cylinder 2 misfire P0303: Cylinder 3 misfire P0304: Cylinder 4 misfire P0305: Cylinder 5 misfire P0306: Cylinder 6 misfire
Required Sensors/Components (Main)	Injector, Ignition coil, Spark plug
Required Sensors/Components (Related)	Crankshaft, Camshaft, Engine coolant temperature and Intake air temperature sensors and Mass air flow meter
Frequency of Operation	Continuous
Duration	1,000 to 4,000 crankshaft revolutions: Emission related misfire 200 to 600 crankshaft revolutions: Catalyst damaged misfire
MIL Operation	2 driving cycles: Emission related misfire MIL flashes immediately: Catalyst damaged misfire
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Misfire:

Monitor runs whenever following DTCs not present	P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0327 - P0333 (knock sensor) P0335 (CKP sensor) P0340 (CMP sensor) P0500 (VSS)
Battery voltage	8 V or more
Throttle position learning	Completed
VVT system	Not operated by scan tool
Engine RPM	Manual Transmission: 450 to 5,400 rpm Automatic Transmission: 400 to 5,400 rpm
Both of following conditions 1 and 2 met	-
1. Engine Coolant Temperature (ECT)	-10°C (14°F) or more
2. Either of following conditions (a) or (b) met	-
(a) ECT at engine start	More than -7°C (19°F)
(b) ECT	More than 20°C (68°F)
Fuel cut	OFF

Monitor period of emission-related-misfire:

First 1,000 revolutions after engine start, or check mode	Crankshaft 1,000 revolutions
Except above	Crankshaft 1,000 revolutions x 4

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

All of following conditions 1, 2 and 3 met	Crankshaft 200 revolutions

1. Driving cycles	1st
2. Check mode	OFF
3. Engine RPM	Less than 2,800 rpm
Except above	Crankshaft 200 revolutions x 3

TYPICAL MALFUNCTION THRESHOLDS

Monitor period of emission-related-misfire:

Misfire rate	2.9 % or more (Manual transmission) 2 % or more (Automatic transmission)
Either of following conditions (a) or (b) met	-
(a) First 1,000 revolutions after engine start or check mode	Crankshaft 1,000 revolutions
(b) Except above	Crankshaft 1,000 revolutions x 4

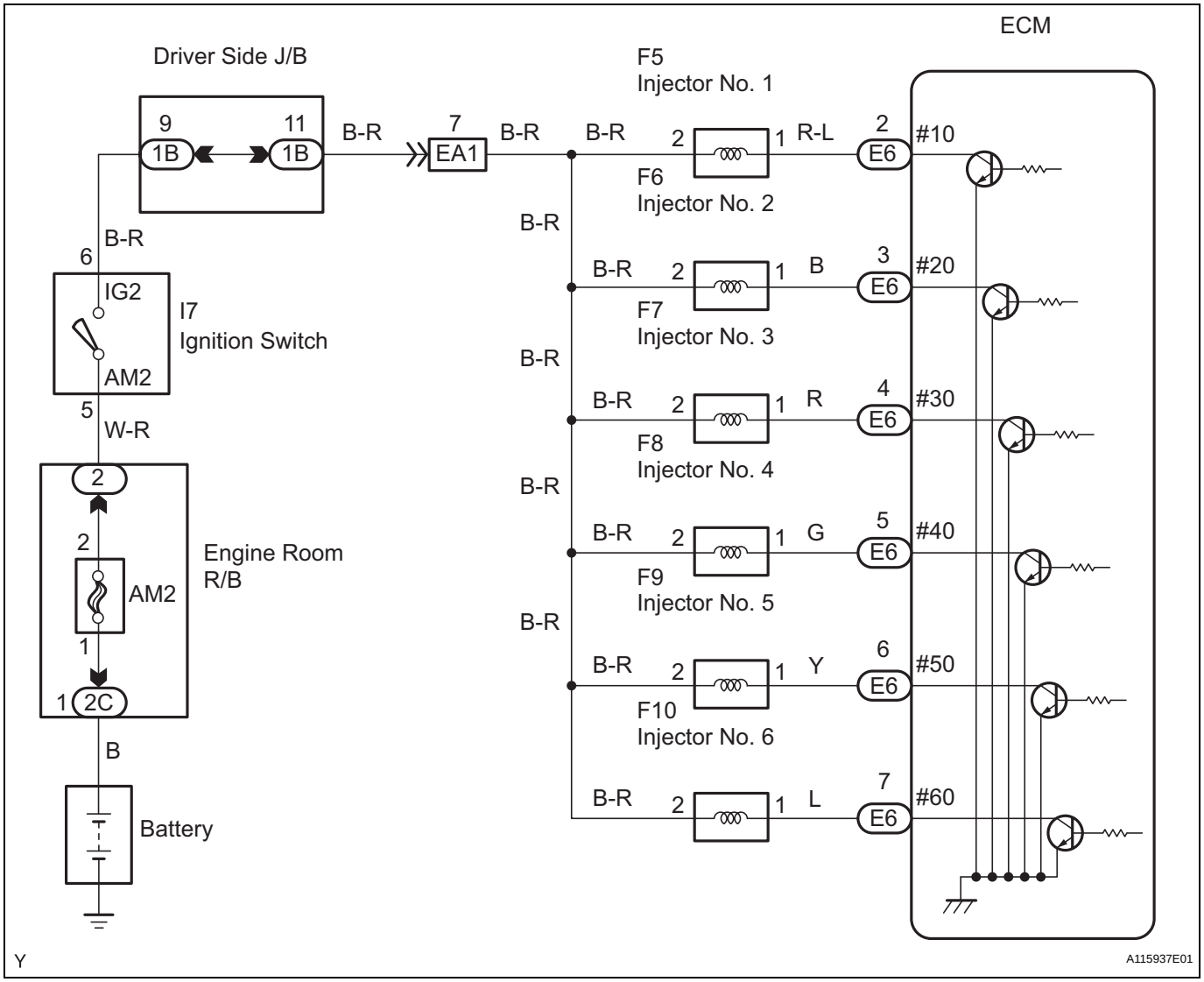
Monitor period of catalyst-damage-misfire (MIL blinks):

Number of misfires per 200 revolutions	77 or more (varies with intake air amount and RPM)
Either of following conditions (a) or (b) met	-
(a) All of following conditions A, B and C met	Crankshaft 200 revolutions x 3
A. Driving cycles	1st
B. Check mode	OFF
C. Engine RPM	Below 2,800 rpm
(b) Except above	Crankshaft 200 revolutions

MONITOR RESULT

Detailed information on Checking Monitor Status (See page ES-19).

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Record the DTC(s) and freeze frame data.
(e) Using the tester, switch the ECM from normal mode to check mode (See page ES-41).
(f) Read the misfire counts of each cylinder (CYL #1 to #6) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
(g) 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.

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

(h) 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.
(i) Record the DTC(s), freeze frame data and misfire counts.
(j) Turn the ignition switch OFF and wait for at least 5 seconds.

HINT:
- If any DTCs other than the misfire DTCs are output, troubleshoot those DTCs first.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.
- If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.
- 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 low full.
  (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, #4, #5 and #6).
- 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 DTCs (See page ES-38).
  (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.

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

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

Result

Display (DTC output)	Proceed To
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306	A
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306 and other DTCs	B

HINT:
If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305 and P0306 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART

A

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

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Select the following menu items: 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 PCV HOSE CONNECTIONS

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, #4, #5 AND #6)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Clear DTCs (See page ES-38).
(e) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / MISFIRE / CYL #1, #2, #3, #4, #5 and #6.
(f) Allow the engine to idle.
(g) Read each value of CYL #1 to #6 displayed on the tester.
If no misfire counts occur in any cylinders, perform the following operations:
  (1) Shift the gear selector lever to the D position.
  (2) Repeat steps (e) to (g) above.
  (3) Check the CYL #1 to #6.
  (4) If misfire counts are still not displayed, perform steps (h) and (i) and then check the misfire counts again.
(h) Drive the vehicle with the MISFIRE RPM and MISFIRE LOAD noted in step 2.

ES

(i) Read the CYL #1 to #6 or DTCs displayed on the tester.

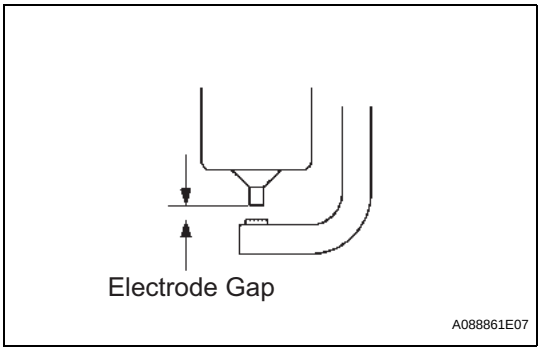
Result

Misfire count	Proceed To
One or two cylinders have misfire counts	A
Three cylinders or more have misfire counts	B

B → **Go to step 13**

A

5 CHECK SPARK PLUG



(a) Remove the ignition coil and the spark plug of the misfiring cylinder.
(b) Measure the spark plug electrode gap.
Standard:
Between 1.0 mm and 1.1 mm (0.039 in. and 0.043 in.)
(c) Check the electrode for carbon deposits.
Recommended spark plug

Manufactures	Products
DENSO	K20HR-U11
NGK	LFR6C-11

NOTICE:
If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.
(d) Reinstall the ignition coil and the spark plug.

NG → **REPLACE SPARK PLUG**

OK

6 CHECK SPARKS 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
(e) Reconnect the injector connectors.

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

ES

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 connector.
(3) Ground the spark plug.
(4) Check if sparks occur while the engine is being cranked.

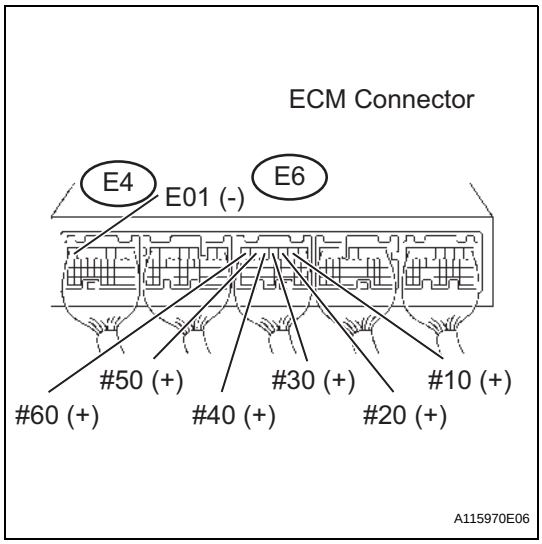
OK:
Sparks jump across electrode gap.

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

OK

REPLACE SPARK PLUG

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



(a) Turn the ignition switch ON.
(b) Measure the voltage between the terminals of the E6 and E4 ECM connectors.

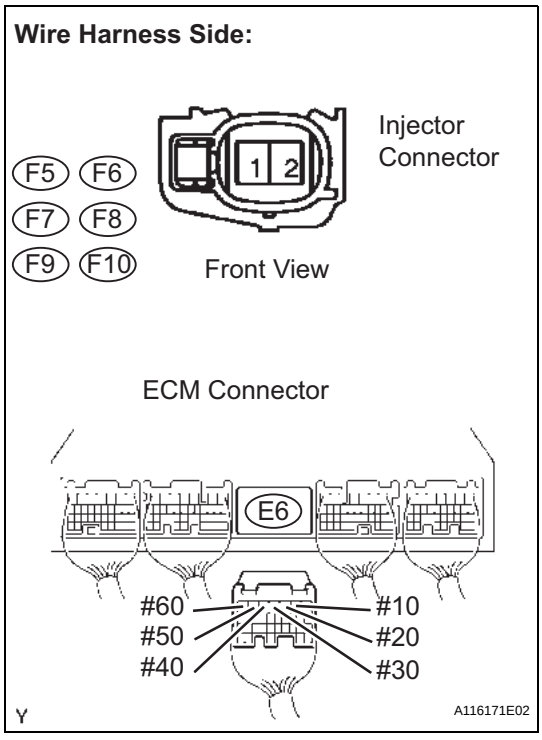
Standard Voltage

Tester Connections	Specified Conditions
#10 (E6-2) - E01 (E4-7)	9 to 14 V
#20 (E6-3) - E01 (E4-7)	
#30 (E6-4) - E01 (E4-7)	
#40 (E6-5) - E01 (E4-7)	
#50 (E6-6) - E01 (E4-7)	
#60 (E6-7) - E01 (E4-7)	

OK → Go to step 11

NG

10	CHECK HARNESS AND CONNECTOR (INJECTOR - ECM)



(a) Disconnect the injector connector (of the misfiring cylinder).
(b) Disconnect the E6 ECM connector.
(c) Turn the ignition switch ON.
(d) Measure the resistance and voltage between the injector and the ECM connector terminals.

Standard (Cylinder No. 1)

Tester Connections	Specified Conditions
F5-2 - Ground	11 to 14 V
F5-1 - Ground	10 kΩ or higher
F5-1 - #10 (E6-2)	Below 1 Ω

Standard (Cylinder No. 2)

Tester Connections	Specified Conditions
F6-2 - Ground	11 to 14 V
F6-1 - Ground	10 kΩ or higher
F6-1 - #20 (E6-3)	Below 1 Ω

Standard (Cylinder No. 3)

Tester Connections	Specified Conditions
F7-2 - Ground	11 to 14 V
F7-1 - Ground	10 kΩ or higher
F7-1 - #30 (E6-4)	Below 1 Ω

Standard (Cylinder No. 4)

Tester Connections	Specified Conditions
F8-2 - Ground	11 to 14 V
F8-1 - Ground	10 kΩ or higher

Tester Connections	Specified Conditions
F8-1 - #40 (E6-5)	Below 1 Ω

Standard (Cylinder No. 5)

Tester Connections	Specified Conditions
F9-2 - Ground	11 to 14 V
F9-1 - Ground	10 kΩ or higher
F9-1 - #50 (E6-6)	Below 1 Ω

Standard (Cylinder No. 6)

Tester Connections	Specified Conditions
F10-2 - Ground	11 to 14 V
F10-1 - Ground	10 kΩ or higher
F10-1 - #60 (E6-7)	Below 1 Ω

(e) Reconnect the injector connector.
(f) Reconnect the ECM connector.

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

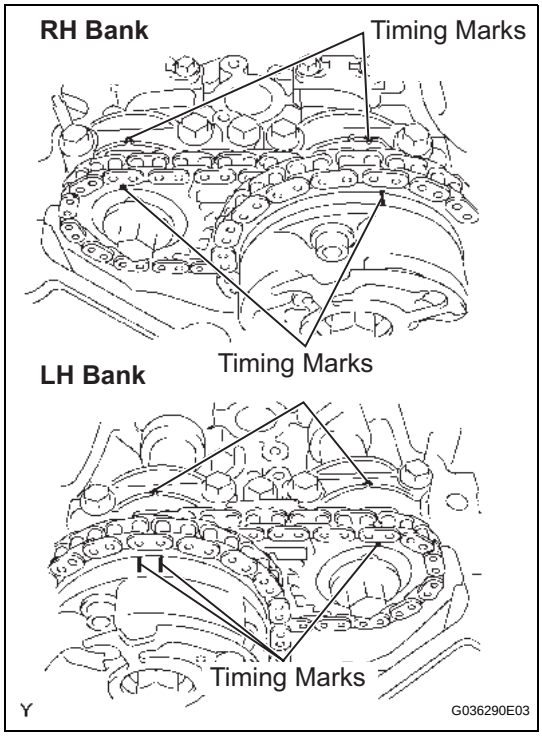
13 CHECK AIR INDUCTION SYSTEM

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

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

OK

14	CHECK VALVE TIMING



(a) Remove the cylinder head cover.
(b) Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.
(c) Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°) and align the marks as above.
OK:
Timing marks on camshaft timing gears are aligned as shown in illustration.
(d) Reinstall the cylinder head cover.

NG → **ADJUST VALVE TIMING**

OK

15	CHECK FUEL PRESSURE

(a) Check the fuel pressure (See page FU-6).

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

OK

16	READ VALUE OF INTELLIGENT TESTER (COOLANT TEMP)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(e) Read the COOLANT TEMP twice, when the engine is both cold and warmed up.
Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 80°C and 100°C (176°F and 212°F).

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR

OK

17	READ VALUE OF INTELLIGENT TESTER (MAF)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / 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 3.2 g/sec and 4.7 g/sec (shift position: N, A/C: OFF).
MAF at engine speed of 2,500 rpm: Between 13.1 g/sec and 18.9 g/sec (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)

DTC	P0332	Knock Sensor 2 Circuit Low Input (Bank 2)

DTC	P0333	Knock Sensor 2 Circuit High Input (Bank 2)

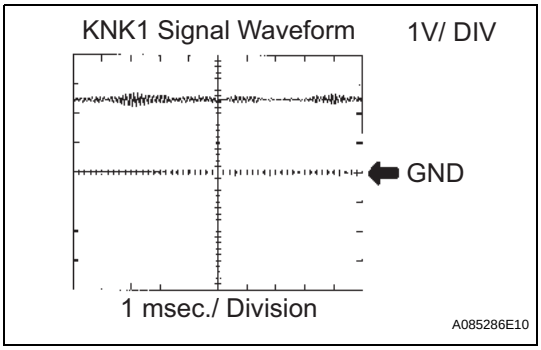
ES

DESCRIPTION

A flat type knock sensor (non-resonant type) has a structure that can detect vibrations over a wide band of frequencies: between approximately 6 kHz and 15 kHz.
Knock sensors are fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed. The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

DTC No.	DTC Detection Conditions	Trouble Areas
P0327 P0332	Output voltage of knock sensor 1 or 2 is 0.5 V or less (1 trip detection logic)	• Short in knock sensor 1 or 2 circuit • Knock sensor 1 or 2 • ECM
P0328 P0333	Output voltage of knock sensor 1 or 2 is 4.5 V or more (1 trip detection logic)	• Open in knock sensor 1 or 2 circuit • Knock sensor 1 or 2 • ECM

HINT:
When any of DTCs P0327, P0328, P0332 and P0333 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.

Items	Contents
Terminals	KNK1 - EKNK or KNK2 - EKN2
Equipment Settings	0.01 to 10 V/Division, 0.01 to 10 msec./Division
Conditions	Keep engine speed at 4,000 rpm with warm engine

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, any of DTC P0327, P0328, P0332 or P0333 is set 5 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0327: Knock sensor (Bank 1) open/short (Low voltage) P0328: Knock sensor (Bank 1) open/short (High voltage) P0332: Knock sensor (Bank 2) open/short (Low voltage) P0333: Knock sensor (Bank 2) open/short (High voltage)
Required Sensors/Components (Main)	Knock sensor (Bank 1 and 2)
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

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

TYPICAL MALFUNCTION THRESHOLDS

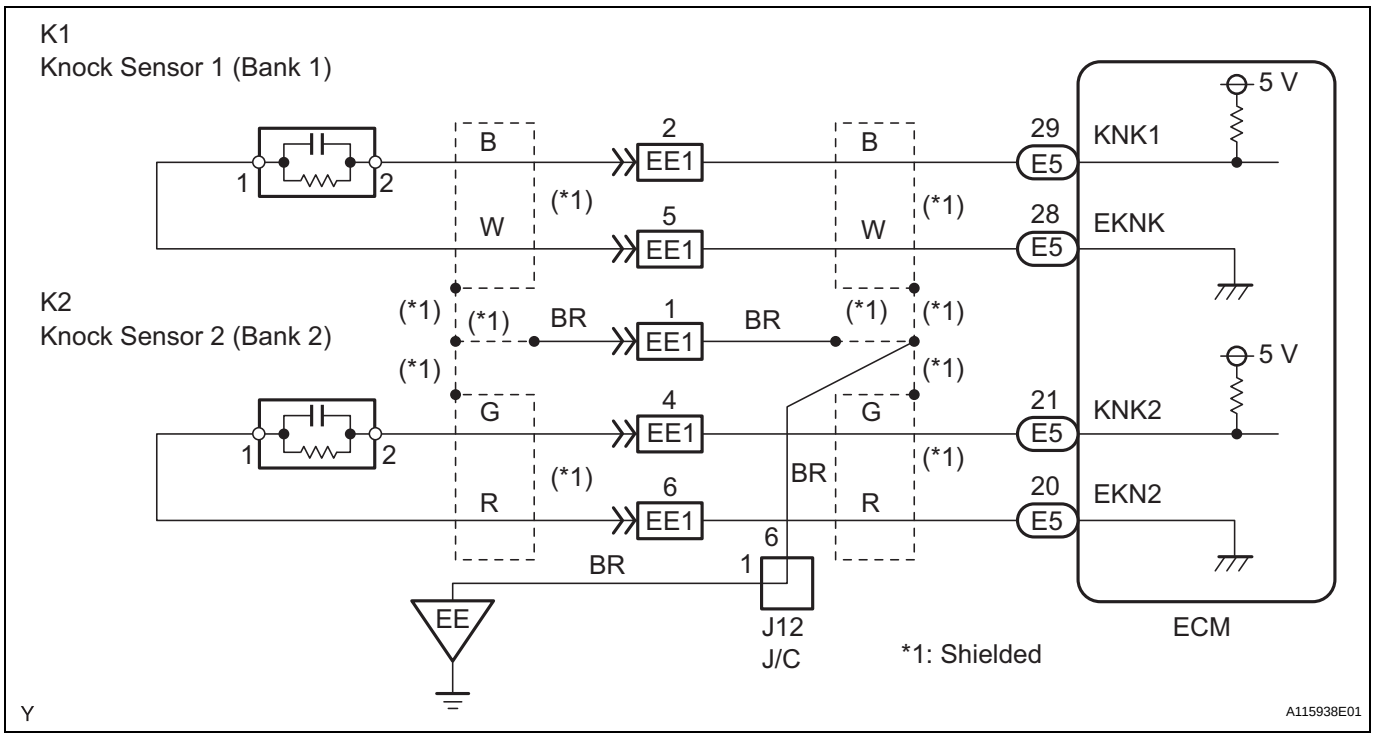
Knock Sensor Range Check (Low voltage) P0327 and P0332:

Knock sensor voltage	Less than 0.5 V

Knock Sensor Range Check (High voltage) P0328 and P0333:

Knock sensor voltage	More than 4.5 V

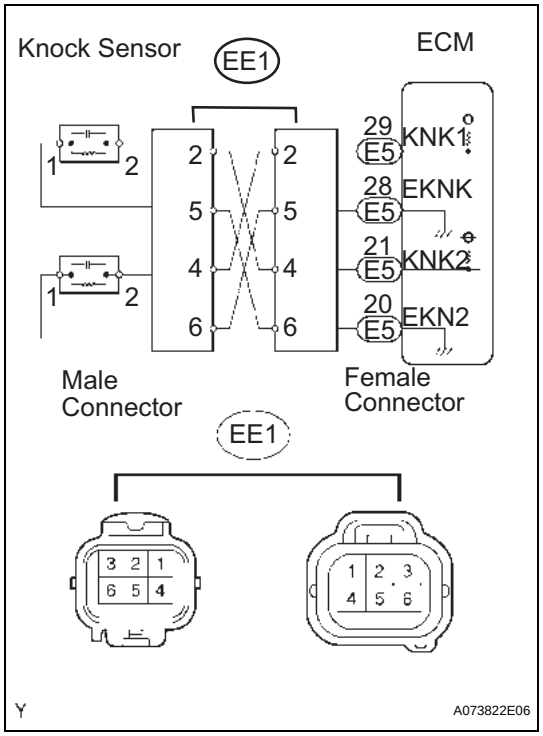
WIRING DIAGRAM



HINT:

- DTCs P0327 and P0328 are for the bank 1 knock sensor circuit.
- DTCs P0332 and P0333 are for the bank 2 knock sensor circuit.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	READ OUTPUT DTC (CHECK KNOCK SENSOR CIRCUIT)



(a) Disconnect the EE1 connector.
(b) Using lead wires, connect the connectors as follows.

Male Connector - Female Connector
Terminal 2 - Terminal 4
Terminal 5 - Terminal 6
Terminal 4 - Terminal 2
Terminal 6 - Terminal 5

(c) Warm up the engine.
(d) Run the engine at 3,000 rpm for 10 seconds or more.
(e) Connect an intelligent tester to the DLC3.
(f) Turn the ignition switch ON and turn the tester ON.
(g) Select the item: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(h) Read DTCs.

Result

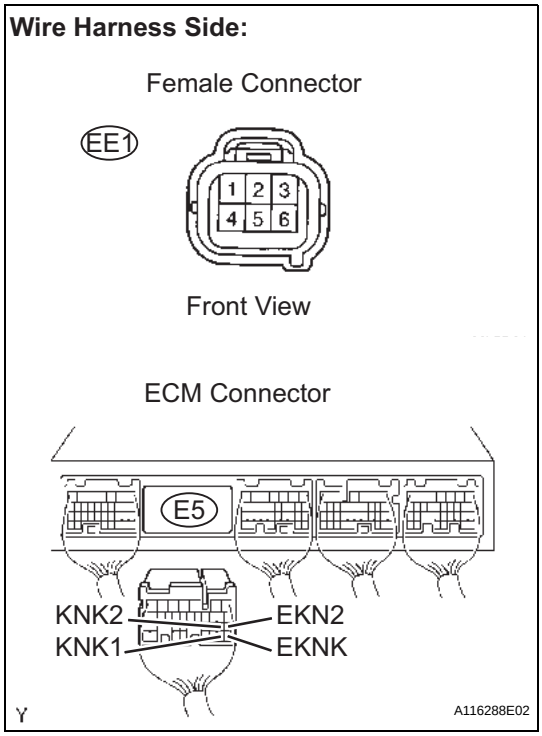
Display	Proceed to
DTCs same as when vehicle brought in P0327, P0328 → P0327, P0328 or P0332, P0333 → P0332, P0333	**A**
DTCs different from when vehicle brought in P0327, P0328 → P0332, P0333 or P0332, P0333 → P0327, P0328	**B**

(i) Reconnect the EE1 connector.

B → **Go to step 4**

A

2	CHECK HARNESS AND CONNECTOR (CONNECTOR - ECM)



(a) Disconnect the EE1 connector.
(b) Disconnect the E5 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
EE1 female connector 2 - KNK1 (E5-29)	Below 1 Ω
EE1 female connector 5 - EKNK (E5-28)	
EE1 female connector 4 - KNK2 (E5-21)	
EE1 female connector 6 - EKN2 (E5-20)	

Standard Resistance (Check for short)

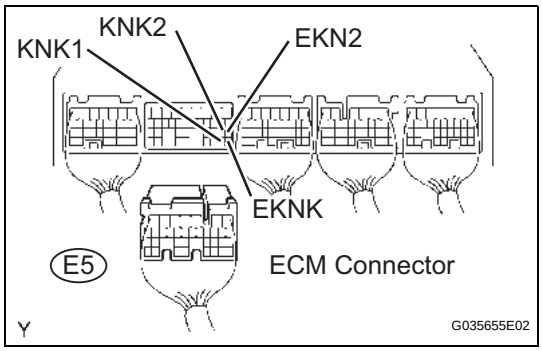
Tester Connections	Specified Conditions
EE1 female connector 2 or KNK1 (E5-29) - Body ground	10 kΩ or higher
EE1 female connector 5 or EKNK (E5-28) - Body ground	
EE1 female connector 4 or KNK2 (E5-21) - Body ground	
EE1 female connector 6 or EKN2 (E5-20) - Body ground	

(d) Reconnect the EE1 connector.
(e) Reconnect the ECM connector.

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3	INSPECT ECM



(a) Disconnect the E5 ECM connector.
(b) Turn the ignition switch ON.
(c) Measure the voltage between the ECM terminals.

Standard Voltage

Tester Connections	Specified Conditions
KNK1 (E5-29) - EKNK (E5-28)	4.5 to 5.5 V
KNK2 (E5-21) - EKN2 (E5-20)	

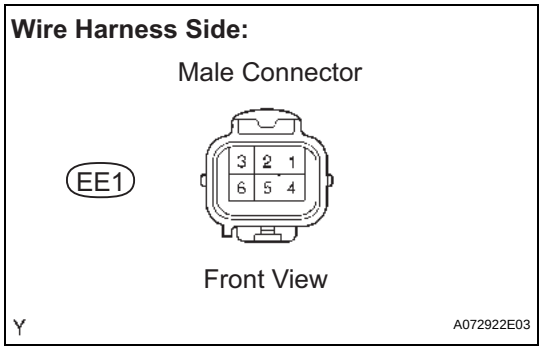
(d) Reconnect the ECM connector.

NG → REPLACE ECM

OK

CHECK FOR INTERMITTENT PROBLEMS

4 INSPECT KNOCK SENSOR



(a) Disconnect the EE1 connector.
(b) Check the resistance between the terminals of the EE1 male connector.

Standard Resistance

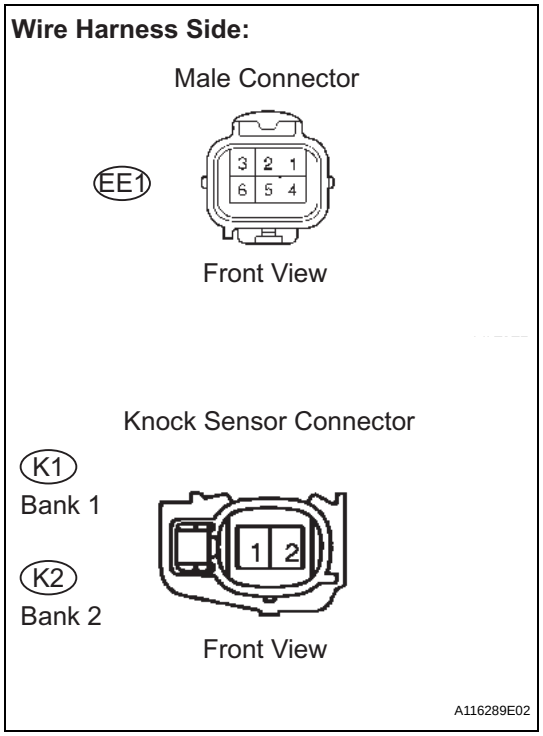
Tester Connections	Specified Conditions
EE1 male connector 2 - 5	120 to 280 kΩ
EE1 male connector 4 - 6	

(c) Reconnect the EE1connector.

OK → **CHECK FOR INTERMITTENT PROBLEMS**

NG

5 CHECK HARNESS AND CONNECTOR (CONNECTOR - KNOCK SENSOR)



HINT:
- If DTC P0327 or P0328 has changed to P0332 or P0333, check the knock sensor circuit on the right bank side.
- If DTC P0332 or P0333 has changed to P0327 or P0328, check the knock sensor circuit on the left bank side.

(a) Disconnect the EE1 connector.
(b) Disconnect the K1 and K2 knock sensor connectors.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
EE1 male connector 2 - K1-2	Below 1 Ω
EE1 male connector 5 - K1-1	
EE1 male connector 4 - K2-2	
EE1 male connector 6 - K2-1	

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
EE1 male connector 2 or K1-2 - Body ground	10 kΩ or higher
EE1 male connector 5 or K1-1 - Body ground	
EE1 male connector 4 or K2-2 - Body ground	
EE1 male connector 6 or K2-1 - Body ground	

(d) Reconnect the EE1 connector.
(e) Reconnect the knock sensor connector.

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

OK

REPLACE KNOCK SENSOR

DTC	P0335	Crankshaft Position Sensor "A" Circuit

DTC	P0339	Crankshaft Position Sensor "A" Circuit Intermittent

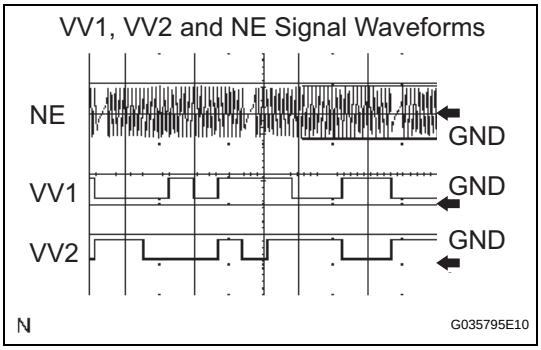
DESCRIPTION

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 Conditions	Trouble Areas
P0335	• 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	



Reference: Inspection using an oscilloscope

HINT:

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

Items	Contents
Terminals	VV1+ - VV1- VV2+ - VV2- NE+ - NE-
Equipment Settings	5 V/DIV, 20msec./DIV.
Conditions	Cranking or idling

MONITOR DESCRIPTION

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

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

MONITOR STRATEGY

Related DTCs	P0335: Crankshaft position sensor range check during cranking P0335: Crankshaft position sensor range check during engine running
Required Sensors/Components (Main)	Crankshaft Position (CKP) sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	Conditions met for 3 times: CKP sensor range check during cranking 0.016 seconds: CKP sensor range check during engine running
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs not present	None

Case 1:

Time after starter OFF to ON	0.3 seconds or more
Number of camshaft position sensor signal pulse	6 times
Battery voltage	7 V or more
Ignition switch	ON

Case 2:

Starter	OFF
Engine RPM	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, or 174 or more

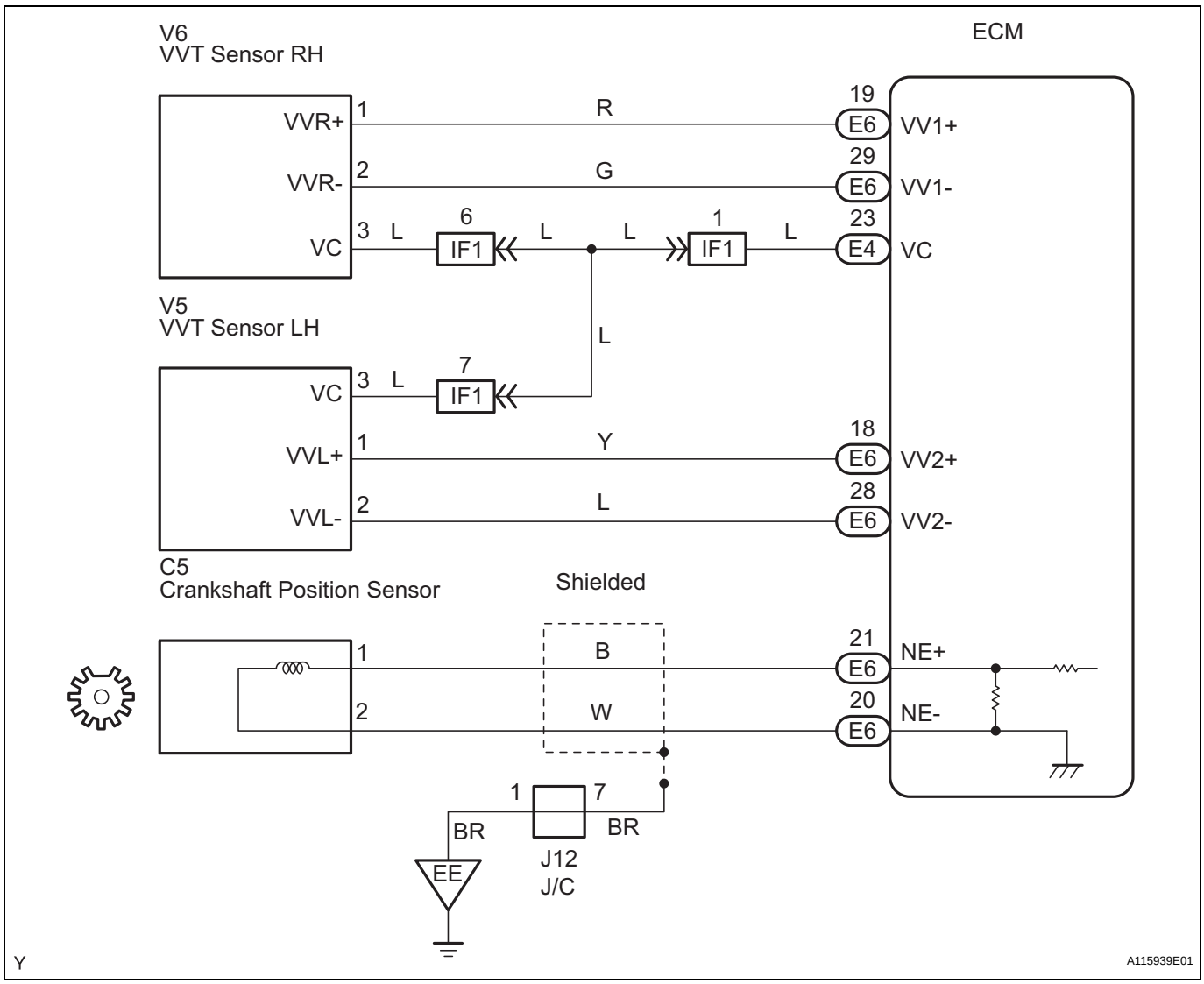
Case 2:

Engine speed signal	No signal

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM



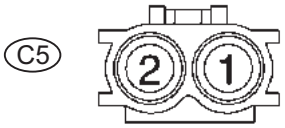
HINT:

- 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 an intelligent tester. To check, follow the operation below:
  (a) Connect an intelligent tester to the DLC3.
  (b) Start the engine.
  (c) Turn the tester ON
  (d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / ENGINE SPD.
  The engine speed may be indicated as zero despite the engine revolving normally. This is caused by a lack of NE signals from the Crankshaft Position (CKP) sensor. Alternatively, the engine speed may be indicated as lower than the actual engine speed, if the CKP sensor voltage output is insufficient.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1 INSPECT CRANKSHAFT POSITION SENSOR (RESISTANCE)

Component Side:

Crankshaft Position Sensor



Front View

A078431E04

(a) Disconnect the C5 Crankshaft Position (CKP) sensor connector.
(b) Measure the resistance between terminals 1 and 2.

Standard Resistance

Tester Connections	Specified Conditions
1 - 2	1,630 Ω to 2,740 Ω at cold
1 - 2	2,065 Ω to 3,225 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).

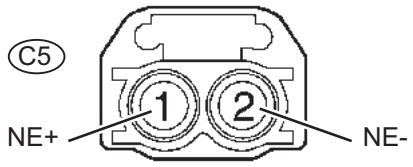
(c) Reconnect the CKP sensor connector.

NG → **REPLACE CRANKSHAFT POSITION SENSOR**

OK

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

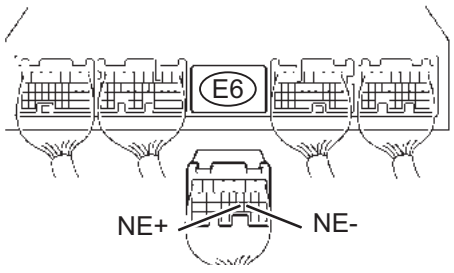
Crankshaft Position Sensor Connector



Front View

Wire Harness Side:

ECM Connector



Y

A116290E02

(a) Disconnect the C5 CKP sensor connector.
(b) Disconnect the E6 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
NE+ (C5-1) - NE+ (E6-21)	Below 1 Ω
NE- (C5-2) - NE- (E6-20)	

Standard Resistance (Check for short)

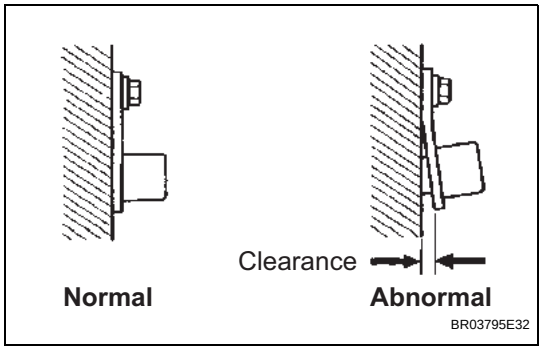
Tester Connections	Specified Conditions
NE+ (C5-1) or NE+ (E6-21) - Body ground	10 kΩ or higher
NE- (C5-2) or NE- (E6-20) - Body ground	

(d) Reconnect the ECM connector.
(e) Reconnect the CKP sensor connector.

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

OK

3	CHECK SENSOR INSTALLATION (CRANKSHAFT POSITION SENSOR)



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

NG → **TIGHTEN SENSOR**

ES

OK

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

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

NG → **REPLACE CRANKSHAFT POSITION SENSOR PLATE**

OK

REPLACE ECM

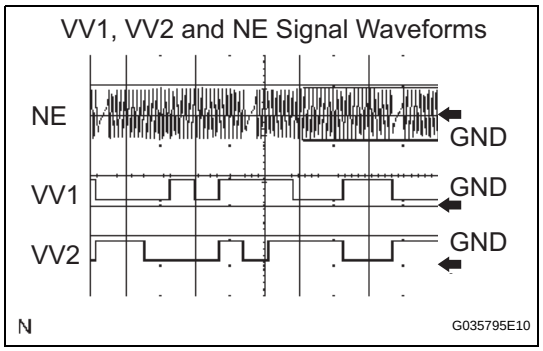
DTC	P0340	Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)
DTC	P0342	Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)
DTC	P0343	Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)
DTC	P0345	Camshaft Position Sensor "A" Circuit (Bank 2)
DTC	P0347	Camshaft Position Sensor "A" Circuit Low Input (Bank 2)
DTC	P0348	Camshaft Position Sensor "A" Circuit High Input (Bank 2)

DESCRIPTION

The Variable Valve Timing (VVT) sensor (VV signal) consists of a magnet, iron core and pickup coil. The VV signal plate has 3 teeth on its outer circumference and is installed on the camshaft timing pulley. When the camshafts rotate, the protrusion on the signal plate and the air gap on the pickup coil change, causing fluctuations in the magnetic field and generating a voltage in the pickup coil.

This sensor monitors a timing rotor located on the camshaft and is used to detect the camshaft angle by the ECM. The camshaft rotation synchronizes with the crankshaft rotation, and this sensor communicates the rotation of the camshaft timing rotor as a pulse signal to the ECM. Based on this signal, the ECM controls fuel injection time and ignition timing.

DTC No.	DTC Detection Conditions	Trouble Areas
P0340 P0345	• Input voltage to ECM remains 0.3 V or less, or 4.7 V or higher for more than 5 seconds, when 2 or more seconds have elapsed after turning ignition switch ON (2 trip detection logic) • No VVT sensor signal to ECM during cranking (1 trip detection logic)	• Open or short in VVT sensor circuit • VVT sensor • Camshaft timing pulley • Jumped tooth of timing chain • ECM
P0342 P0347	Output voltage of VVT sensor 0.3 V or less for 5 seconds (1 trip detection logic)	
P0343 P0348	Output voltage of VVT sensor 4.7 V or more for 5 seconds (1 trip detection logic)	



Reference: Inspection using an oscilloscope
HINT:
- The correct waveform is shown above.
- VV1+ and VV2+ stand for the VVT sensor signal, and NE+ stands for the CKP sensor signal.

Items	Contents
Terminals	NE+ - NE- VV1+ - VV1- VV2+ - VV2-
Equipment Settings	5V/Division, 20ms/Division
Conditions	Cranking or idling

MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine revolving, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

MONITOR STRATEGY

Related DTCs	P0340: VVT sensor (Bank 1) open/short P0340: VVT position/Crankshaft position misalignment (Bank 1) P0342: VVT position sensor (Bank 1) range check (low voltage) P0343: VVT position sensor (Bank 1) range check (hign voltage) P0345: VVT sensor (Bank 2) open/short P0345: VVT position/Crankshaft position misalignment (Bank 2) P0347: VVT position sensor (Bank 2) range check (low voltage) P0348: VVT position sensor (Bank 2) range check (hign voltage)
Required Sensors/Components (Main)	VVT position sensors (Banks 1 and 2)
Required Sensors/Components (Related)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	4 seconds: P0340 (Camshaft position sensor range check), P0345 (VVT sensor range check (While starting engine)) 5 seconds: Others
MIL Operation	2 driving cycles: P0340 (Camshaft position sensor range check), P0345 (VVT sensor range check (While starting engine)) Immediate: Others
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs not present	None

Camshaft Position Sensor Range Check:

Starter	ON and not starter ON again
Minimum battery voltage while starter ON	Less than 11V

Camshaft Position/Crankshaft Position Misalignment:

Engine RPM	600 rpm or more
Starter	OFF

Camshaft Position Sensor Range Check (Fluctuating, Low voltage, High voltage):

Starter	OFF
Ignition switch ON and time after ignition switch is OFF to ON	2 seconds or more

VVT sensor range check (While starting engine):

Starter	ON
Battery voltage while starter ON once at least	Less than 11 V

VVT sensor range check (After starting engine):

Engine RPM	600 rpm or more
Starter	OFF
Battery voltage	8 V or more
Ignition switch	ON

VVT sensor range check (Fluctuating, Low voltage, High voltage):

Starter	OFF
Ignition switch ON and time after ignition switch is OFF to ON	2 seconds or more
Battery voltage	8 V or more

ES

TYPICAL MALFUNCTION THRESHOLDS

Camshaft Position Sensor Range Check:

Camshaft position signal	No signal

Camshaft Position/Crankshaft Position Misalignment:

Camshaft position and crankshaft position phase	Mis-aligned

Camshaft Position Sensor Range Check (Fluctuating):

Camshaft position position voltage	Less than 0.3 V, or more than 4.7 V

Camshaft Position Sensor Range Check (Low voltage):

Camshaft position position voltage	Less than 0.3 V

Camshaft Position Sensor Range Check (High voltage):

Camshaft position position voltage	More than 4.7 V

VVT sensor range check (While starting engine):

VVT sensor signal	No signal

VVT sensor range check (After starting engine):

VVT sensor signal	No signal

VVT sensor range check (Fluctuating):

VVT sensor voltage	Less than 0.3 V, or more than 4.7 V

VVT sensor range check (Low voltage):

VVT sensor voltage	Less than 0.3 V

VVT sensor range check (High voltage):

VVT sensor voltage	More than 4.7 V

COMPONENT OPERATING RANGE

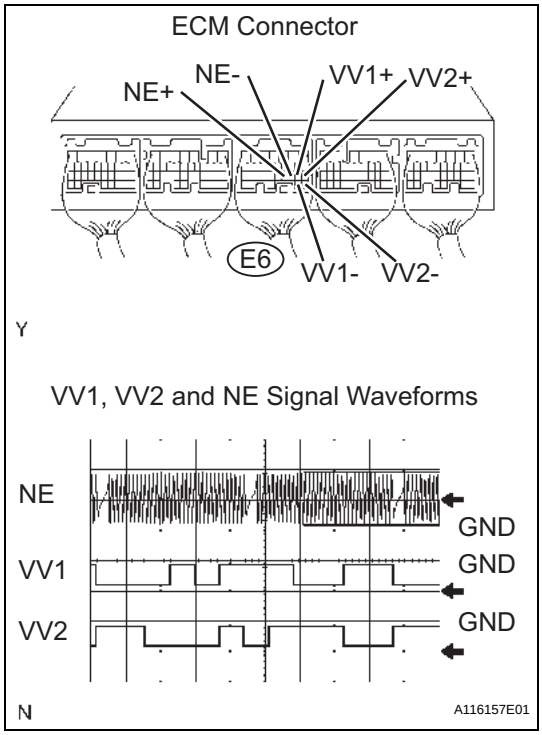
VVT sensor voltage	0.3 to 4.7 V

WIRING DIAGRAM

Refer to DTC P0335 (See page ES-184).

HINT:
Read freeze frame data using an 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.

1 CHECK ECM TERMINAL VOLTAGE



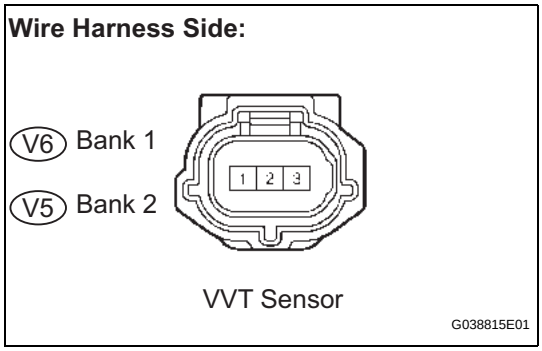
(a) Inspect the ECM using an oscilloscope.
(1) While the engine is idling, check the waveform between the terminals of the ECM connector.
Standard

Tester Connections	Specified Conditions
VV1+ (E6-19) - VV1- (E6-29)	Correct waveform as shown in illustration
VV2+ (E6-18) - VV2- (E6-28)	
NE+ (E6-21) - NE- (E6-20)	

NG → **REPLACE VVT SENSOR**

OK

2 CHECK VVT SENSOR (SENSOR POWER SOURCE)



(a) Disconnect the V6 or V5 VVT sensor connector.
(b) Measure the voltage between the terminals of the VVT sensor.
Standard Voltage

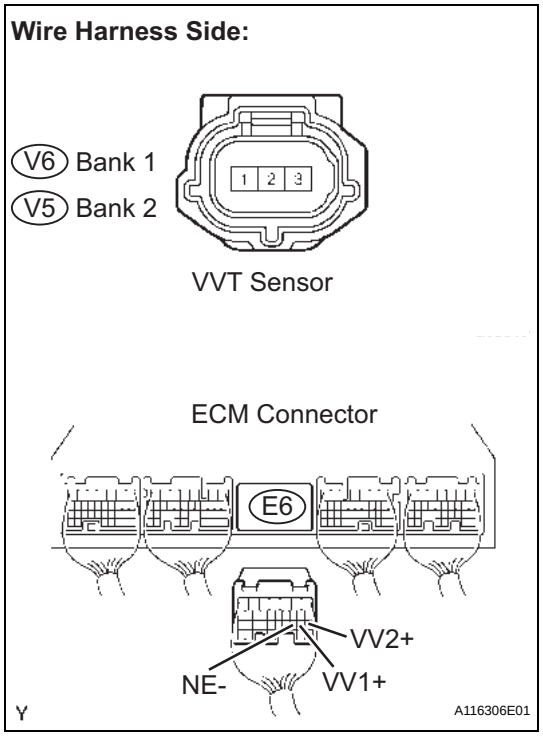
Tester Connection	Specified Condition
3 - Body ground	4.5 to 5.0 V

(c) Reconnect the VVT sensor connector.

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

OK

3	CHECK HARNESS AND CONNECTOR (VVT SENSOR - ECM)



(a) Disconnect the V5 or V6 VVT sensor connector.
(b) Disconnect the E6 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
VVT sensor (V6-1) - VV1+ (E6-19)	Below 1 Ω
VVT sensor (V5-1) - VV2+ (E6-18)	
VVT sensor (V6-2) - VV1- (E6-29)	
VVT sensor (V5-2) - VV2- (E6-28)	

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
VVT sensor (V6-1) or VV1+ (E6-19) - Body ground	10 kΩ or higher
VVT sensor (V5-1) or VV2+ (E6-18) - Body ground	
VVT sensor (V6-2) or VV1- (E6-29) - Body ground	
VVT sensor (V5-2) or VV2- (E6-28) - Body ground	

(d) Reconnect the VVT sensor connector.
(e) Reconnect the ECM connector.

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

OK ↓

4	CHECK SENSOR INSTALLATION (VVT SENSOR)

NG → **TIGHTEN SENSOR**

OK ↓

5	CHECK CAMSHAFT TIMING GEAR ASSEMBLY (TEETH PLATE)

(a) Check the teeth of the signal plate.

OK:

Sensor plate teeth do not have any cracks or deformation.

NG → **REPLACE CAMSHAFT TIMING GEAR ASSEMBLY**

OK ↓

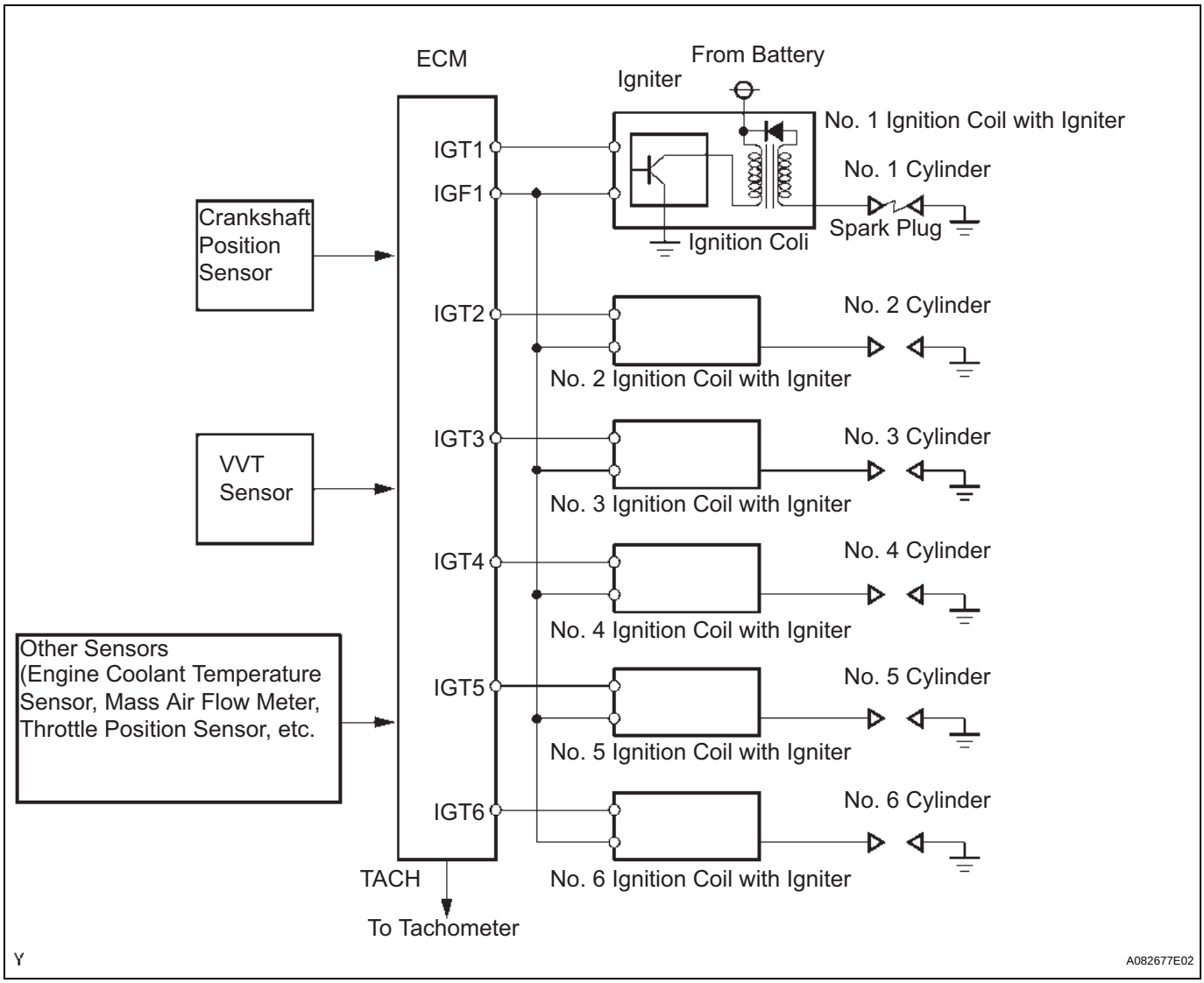
REPLACE ECM

DTC	P0351	Ignition Coil "A" Primary / Secondary Circuit
DTC	P0352	Ignition Coil "B" Primary / Secondary Circuit
DTC	P0353	Ignition Coil "C" Primary / Secondary Circuit
DTC	P0354	Ignition Coil "D" Primary / Secondary Circuit
DTC	P0355	Ignition Coil "E" Primary / Secondary Circuit
DTC	P0356	Ignition Coil "F" Primary / Secondary Circuit

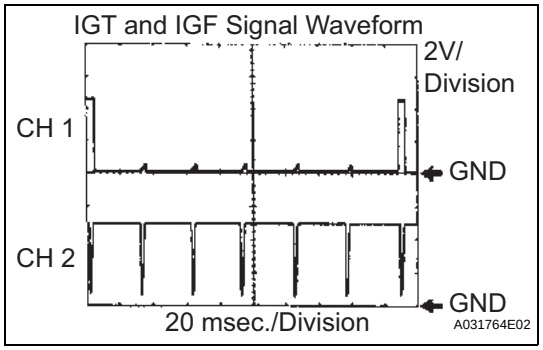
HINT:
- These DTCs indicate malfunctions relating to the primary circuit.
- If DTC P0351 is set, check No. 1 ignition coil with igniter circuit.
- If DTC P0352 is set, check No. 2 ignition coil with igniter circuit.
- If DTC P0353 is set, check No. 3 ignition coil with igniter circuit.
- If DTC P0354 is set, check No. 4 ignition coil with igniter circuit.
- If DTC P0355 is set, check No. 5 ignition coil with igniter circuit.
- If DTC P0356 is set, check No. 6 ignition coil with igniter circuit.

DESCRIPTION

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.



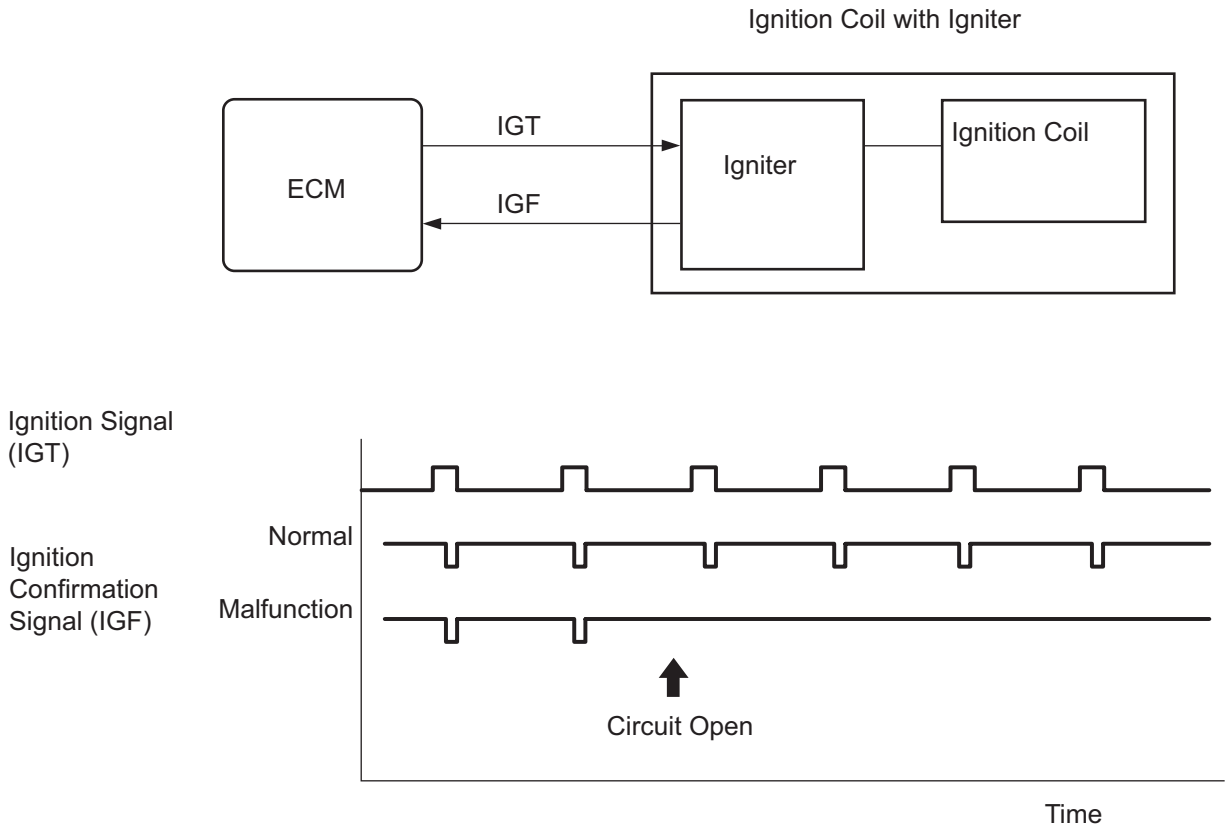
DTC No.	DTC Detection Conditions	Trouble Areas
P0351 P0352 P0353 P0354 P0355 P0356	No IGF signal to ECM while engine running (1 trip detection logic)	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 6) between ignition coil with igniter and ECM • No. 1 to No. 6 ignition coils with igniters • ECM



Reference: Inspection using an oscilloscope
While cranking or idling, check the waveform between terminals IGT(1 to 6) and E1, and IGF1 and E1 of the ECM connector.

Items	Contents
Terminals	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6 - E1 CH2: IGF1 - E1
Equipment Settings	2 V/Division, 20 ms/Division
Conditions	Cranking or idling

MONITOR DESCRIPTION



Y A115898E01

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

MONITOR STRATEGY

Related DTCs	P0351: Igniter (Cylinder 1) malfunction P0352: Igniter (Cylinder 2) malfunction P0353: Igniter (Cylinder 3) malfunction P0354: Igniter (Cylinder 4) malfunction P0355: Igniter (Cylinder 5) malfunction P0356: Igniter (Cylinder 6) malfunction

Required Sensors/Components (Main)	Igniter (Cylinder 1 to 6)
Required Sensors/Components (Related)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	0.256 seconds and 4 sparks
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Either of following conditions 1 or 2 met	-
1. Following conditions (a) and (b) met:	-
(a) Engine RPM	500 rpm or less
(b) Battery voltage	6 V or more
2. Following conditions (a) and (b) met:	-
(a) Engine RPM	More than 500 rpm
(b) Battery voltage	10 V or more
(c) Number of sparks after CPU is reset	5 sparks or more

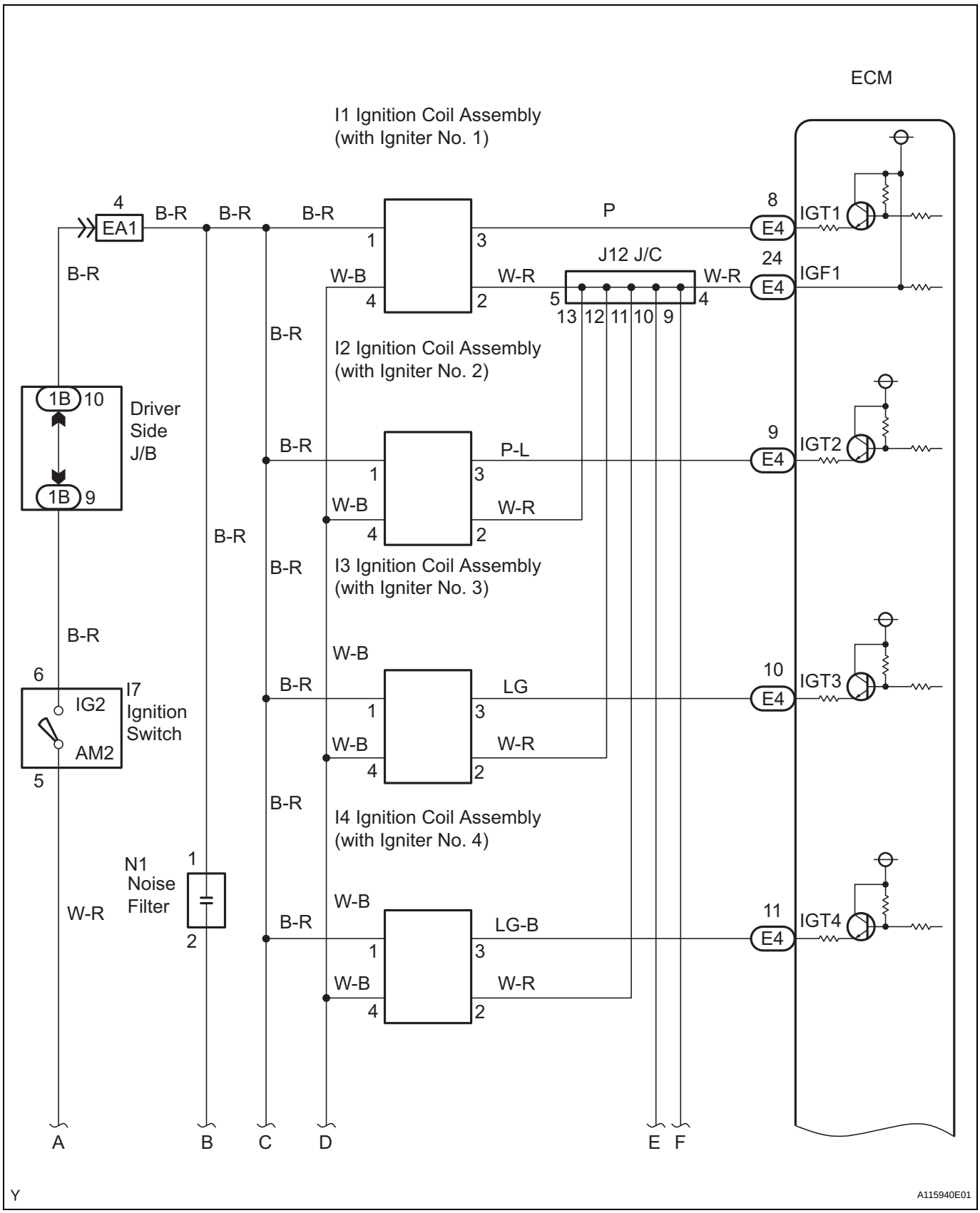
TYPICAL MALFUNCTION THRESHOLDS

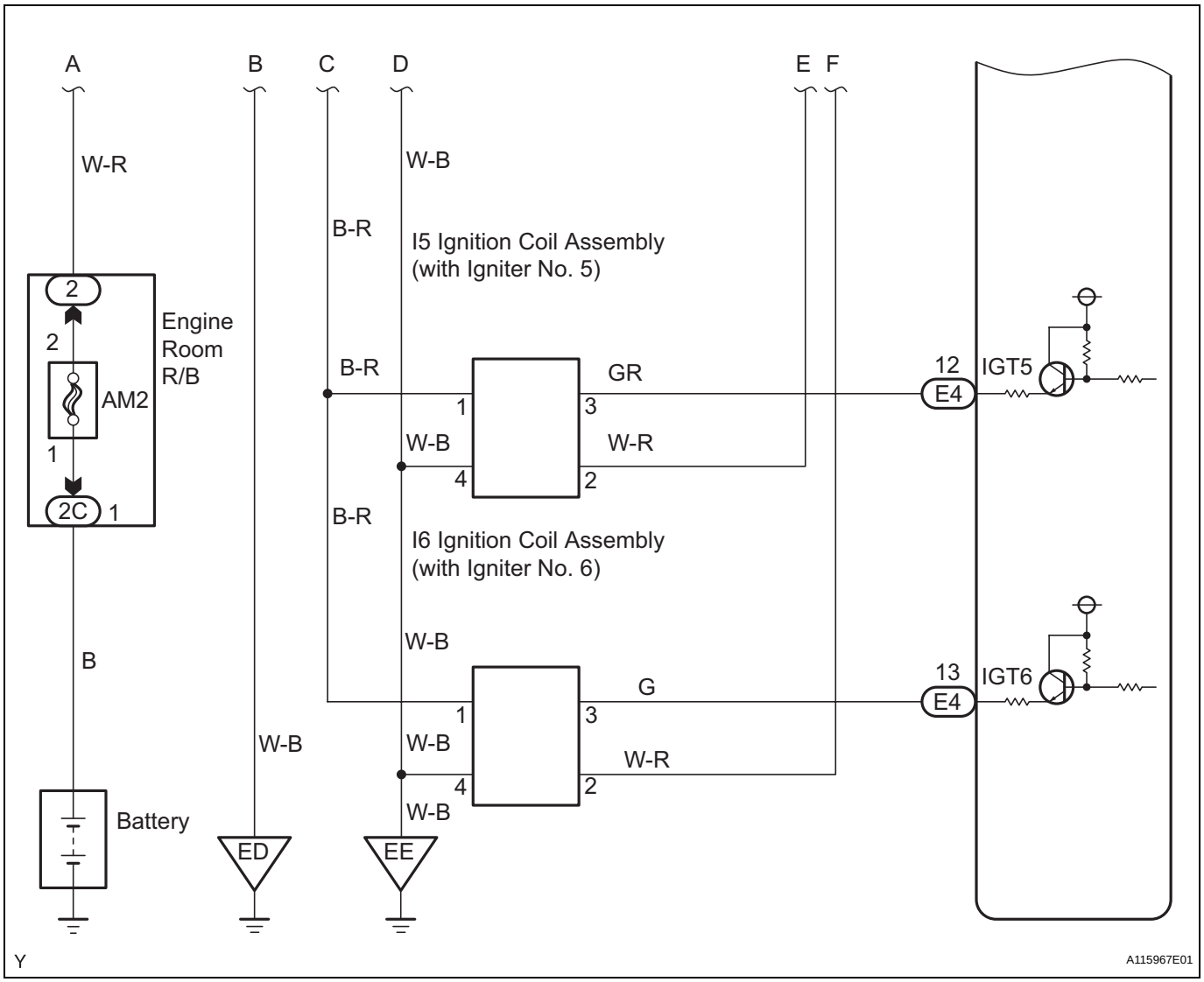
Ignition signal fail count	More than 2 times
Ignition signal fail count is on the right:	When IGF does not return despite sending IGT.

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM





ES

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

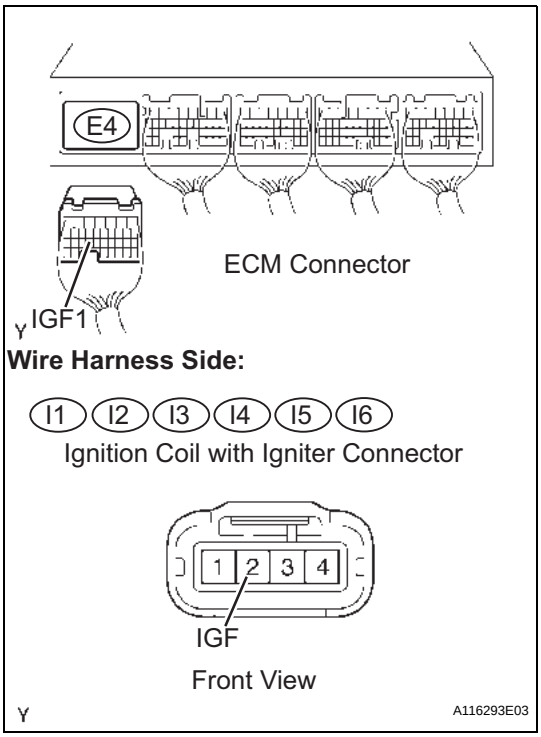
1	CHECK SPARK PLUG AND SPARK OF MISFIRING CYLINDER

(a) Check the spark plug and sparks of the misfiring cylinder (See page IG-3).

NG → Go to step 4

OK

2	CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM (IGF1 SIGNAL TERMINAL))



(a) Disconnect the I1, I2, I3, I4, I5 or I6 ignition coil with igniter connector.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
IGF (I1-2) - IGF1 (E4-24)	Below 1 Ω
IGF (I2-2) - IGF1 (E4-24)	
IGF (I3-2) - IGF1 (E4-24)	
IGF (I4-2) - IGF1 (E4-24)	
IGF (I5-2) - IGF1 (E4-24)	
IGF (I6-2) - IGF1 (E4-24)	

Standard Resistance (Check for short)

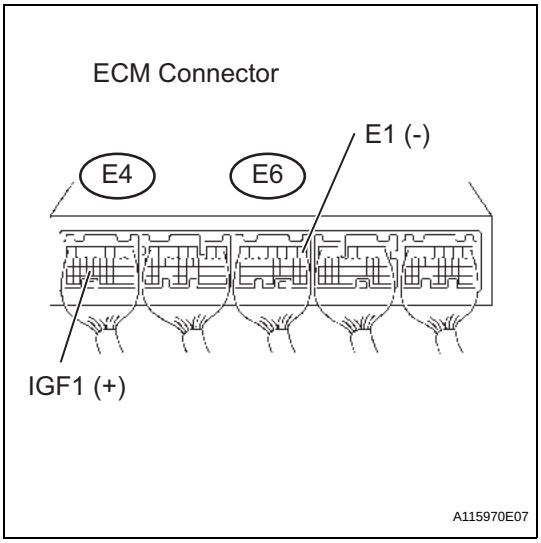
Tester Connections	Specified Conditions
IGF (I1-2) or IGF1 (E4-24) - Body ground	10 kΩ or higher
IGF (I2-2) or IGF1 (E4-24) - Body ground	
IGF (I3-2) or IGF1 (E4-24) - Body ground	
IGF (I4-2) or IGF1 (E4-24) - Body ground	
IGF (I5-2) or IGF1 (E4-24) - Body ground	
IGF (I6-2) or IGF1 (E4-24) - Body ground	

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

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

OK

3	INSPECT ECM (IGF1 VOLTAGE)



(a) Disconnect the ignition coil connector.
(b) Turn the ignition switch ON.
(c) Measure the voltage between the terminals of the E4 and E6 ECM connectors.

Standard Voltage

Tester Connection	Specified Condition
IGF1 (E4-24) - E1 (E6-1)	4.5 to 5.5 V

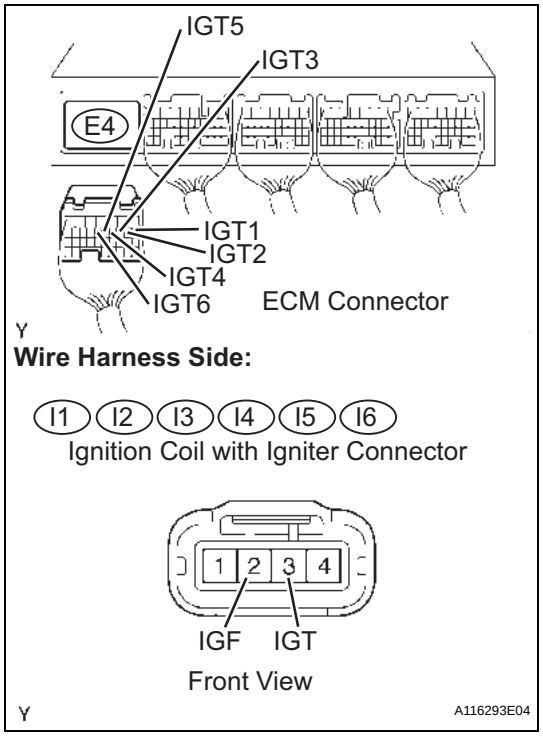
(d) Reconnect the ignition coil connector.

NG → **REPLACE ECM**

OK

REPLACE IGNITION COIL ASSEMBLY

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



(a) Disconnect the I1, I2, I3, I4, I5 or I6 ignition coil with igniter connector.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
IGT (I1-3) - IGT1 (E4-8)	Below 1 Ω
IGT (I2-3) - IGT2 (E4-9)	
IGT (I3-3) - IGT3 (E4-10)	
IGT (I4-3) - IGT4 (E4-11)	
IGT (I5-3) - IGT5 (E4-12)	
IGT (I6-3) - IGT6 (E4-13)	

Standard Resistance (Check for short)

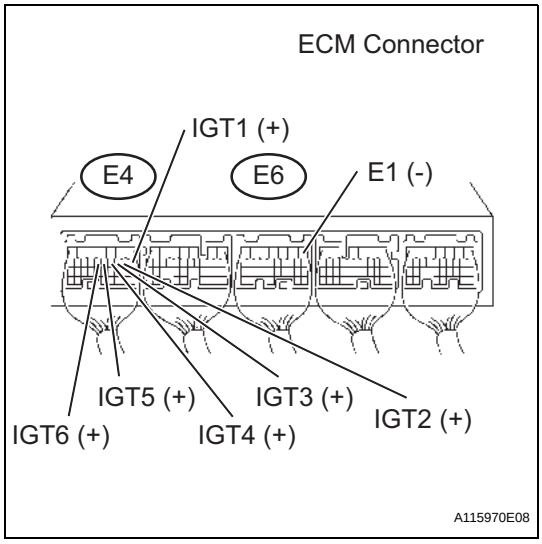
Tester Connections	Specified Conditions
IGT (I1-3) or IGT1 (E4-8) - Body ground	10 kΩ or higher
IGT (I2-3) or IGT2 (E4-9) - Body ground	
IGT (I3-3) or IGT3 (E4-10) - Body ground	
IGT (I4-3) or IGT4 (E4-11) - Body ground	
IGT (I5-3) or IGT5 (E4-12) - Body ground	
IGT (I6-3) or IGT6 (E4-13) - Body ground	

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

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

OK

5	INSPECT ECM (IGT1, IGT2, IGT3, IGT4, IGT5, OR IGT6 VOLTAGE)



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

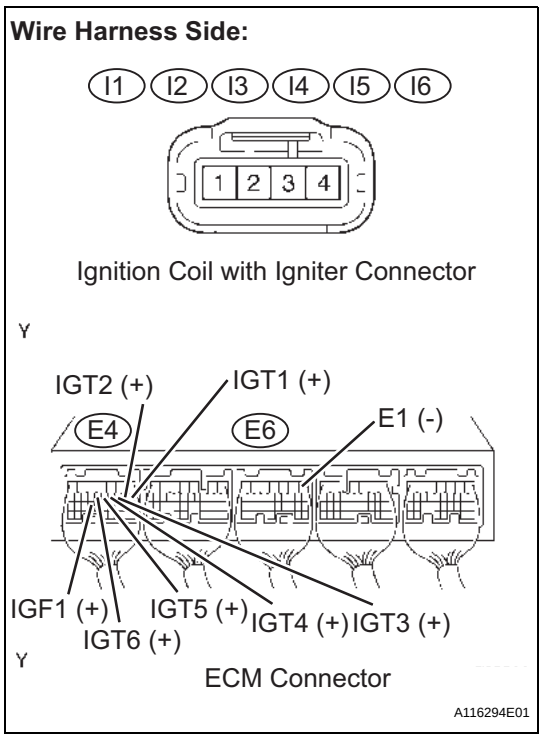
Standard Voltage

Tester Connections	Specified Conditions
IGT1 (E4-8) - E1 (E6-1)	0.1 to 4.5 V
IGT2 (E4-9) - E1 (E6-1)	
IGT3 (E4-10) - E1 (E6-1)	
IGT4 (E4-11) - E1 (E6-1)	
IGT5 (E4-12) - E1 (E6-1)	
IGT6 (E4-13) - E1 (E6-1)	

NG → **REPLACE ECM**

OK

6	INSPECT ECM (IGT1, IGT2, IGT3, IGT4, IGT5, OR IGT6 VOLTAGE)



(a) Disconnect the I1, I2, I3, I4, I5 or I6 ignition coil connector.

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

Standard Voltage

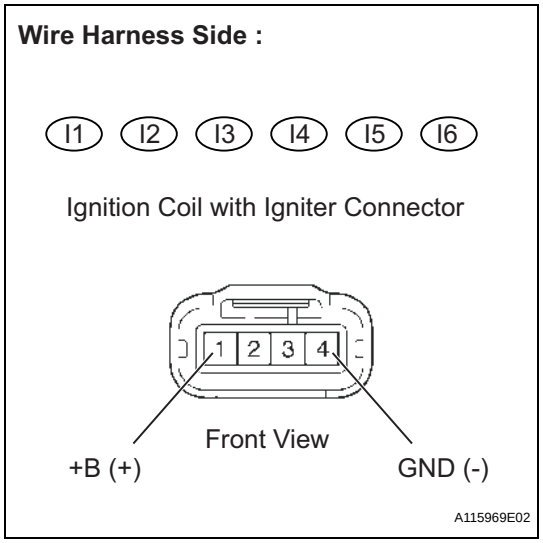
Tester Connections	Specified Conditions
IGT1 (E4-8) - E1 (E6-1)	4.5 V or more
IGT2 (E4-9) - E1 (E6-1)	
IGT3 (E4-10) - E1 (E6-1)	
IGT4 (E4-11) - E1 (E6-1)	
IGT5 (E4-12) - E1 (E6-1)	
IGT6 (E4-13) - E1 (E6-1)	

(c) Reconnect the ignition coil connector.

NG → **Go to step 8**

OK

7	INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)



(a) Disconnect the I1, I2, I3, I4, I5 or I6 ignition coil with igniter connector.

(b) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
GND (I1-4) - Body ground	Below 1 Ω
GND (I2-4) - Body ground	
GND (I3-4) - Body ground	
GND (I4-4) - Body ground	
GND (I5-4) - Body ground	
GND (I6-4) - Body ground	

(c) Turn the ignition switch ON.

(d) Measure the voltage between the terminals of the wire harness side connector.

Standard Voltage

Tester Connections	Specified Conditions
+B (I1-1) - GND (I1-4)	9 to 14 V
+B (I2-1) - GND (I2-4)	
+B (I3-1) - GND (I3-4)	
+B (I4-1) - GND (I4-4)	
+B (I5-1) - GND (I5-4)	
+B (I6-1) - GND (I6-4)	

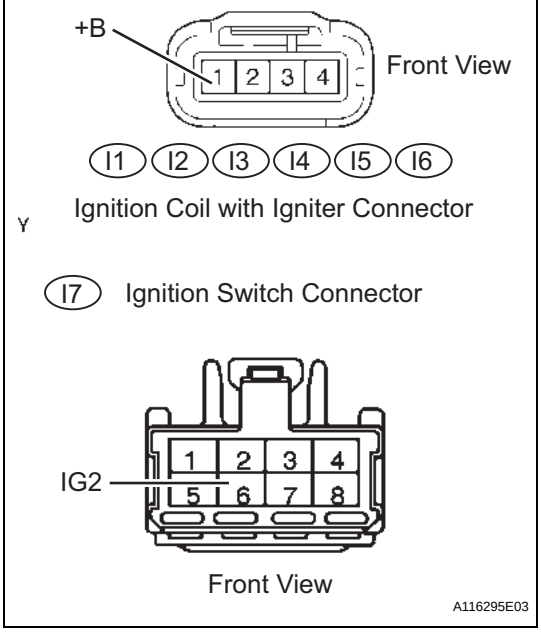
(e) Reconnect the ignition coil with igniter connector.

OK → **REPLACE IGNITION COIL ASSEMBLY**

NG

8	CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - IGNITION SWITCH)

Wire Harness Side:



(a) Disconnect the I1, I2, I3, I4, I5 or I6 ignition coil with igniter connector.
(b) Disconnect the I7 ignition switch connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
+B (I1-1) - IG2 (I7-6)	Below 1 Ω
+B (I2-1) - IG2 (I7-6)	
+B (I3-1) - IG2 (I7-6)	
+B (I4-1) - IG2 (I7-6)	
+B (I5-1) - IG2 (I7-6)	
+B (I6-1) - IG2 (I7-6)	

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
+B (I1-1) or IG2 (I7-6) - Body ground	10 kΩ or higher
+B (I2-1) or IG2 (I7-6) - Body ground	
+B (I3-1) or IG2 (I7-6) - Body ground	
+B (I4-1) or IG2 (I7-6) - Body ground	
+B (I5-1) or IG2 (I7-6) - Body ground	
+B (I6-1) or IG2 (I7-6) - Body ground	

(d) Reconnect the ignition coil with igniter connector.
(e) Reconnect the ignition switch connector.

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

OK

REPLACE IGNITION COIL ASSEMBLY

DTC	P0420	Catalyst System Efficiency Below Threshold (Bank 1)

DTC	P0430	Catalyst System Efficiency Below Threshold (Bank 2)

MONITOR DESCRIPTION

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

The first sensor, the Air-Fuel Ratio (A/F) sensor, sends pre-catalyst information to the ECM. The second sensor, the Heated Oxygen (HO2) sensor, sends post-catalyst information to the ECM.

In order to detect any deterioration in the TWC, the ECM calculates the Oxygen Storage Capacity (OSC) of the TWC. This calculation is based on the voltage output of the HO2 sensor while performing active air-fuel ratio control, rather than the conventional detecting method, which uses the locus ratio.

The OSC value is an indication of the oxygen storage capacity of the TWC. When the vehicle is being driven with a warm engine, active air-fuel ratio control is performed for approximately 15 to 20 seconds. When it is performed, the ECM deliberately sets the air-fuel ratio to lean or rich levels. If a rich-lean cycle of the HO2 sensor is long, the OSC becomes greater. There is a direct correlation between the OSCs of the HO2 sensor and the TWC.

The ECM uses the OSC value to determine the state of the TWC. If any deterioration has occurred, it illuminates the MIL and sets a DTC.

DTC No.	DTC Detection Conditions	Trouble Areas
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 (bank 1 sensor 1) • HO2 sensor (bank 1 sensor 2) • Exhaust manifold (TWC)
P0430	OSC value smaller than standard value under active air-fuel ratio control (2 trip detection logic)	• Gas leakage from exhaust system • A/F sensor (bank 2 sensor 1) • HO2 sensor (bank 2 sensor 2) • Exhaust manifold (TWC)

HINT:

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

MONITOR STRATEGY

Related DTCs	P0420: Catalyst Deterioration P0430: Catalyst Deterioration
Required Sensors/Components (Main)	A/F sensor and heated oxygen sensor
Required Sensors/Components (Related)	Intake air temperature sensor, mass air flow meter, crankshaft position sensor and engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	30 seconds or more
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0021 (VVT System 2 - Advance) P0022 (VVT System 2 - Retard) P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0037, P0038, P0057, P0058 (HO2 sensor Heater - Sensor 2) P0100 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0136, P0156 (HO2 Sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0306 (Misfire) P0335 (CKP sensor) P0340 (CMP sensor) P0351 - P0356 (Ignitor) P0500 (VSS) P2196, P2198 (A/F sensor - rationality) P2A00, P2A03 (A/F sensor - slow response)
Battery voltage	11 V or more
IAT	-10°C (14°F) or more
Engine coolant temperature sensor	75°C (167°F) or more
Atmospheric pressure coefficient	0.75 or more
Delay time after IDCE ON	Less than 5 seconds
Engine RPM	Less than 3,200 rpm
A/F sensor status	Activated
Fuel system status	Closed loop
Delay time after fuel cut	10 seconds or more
Engine load	10 to 70 %
All of the following conditions are met	Condition 1, 2 and 3
1. Mass air flow rate	5 to 70 g/sec
2. Front catalyst temperature (estimated)	650 to 840°C (1,202 to 1,544°F)
3. Rear catalyst temperature (estimated)	100 to 900°C (212 to 1,652°F)

TYPICAL MALFUNCTION THRESHOLDS

Oxygen Storage Capacity (OSC) of Three-Way Catalytic Converter (TWC)	Less than 0.04 g

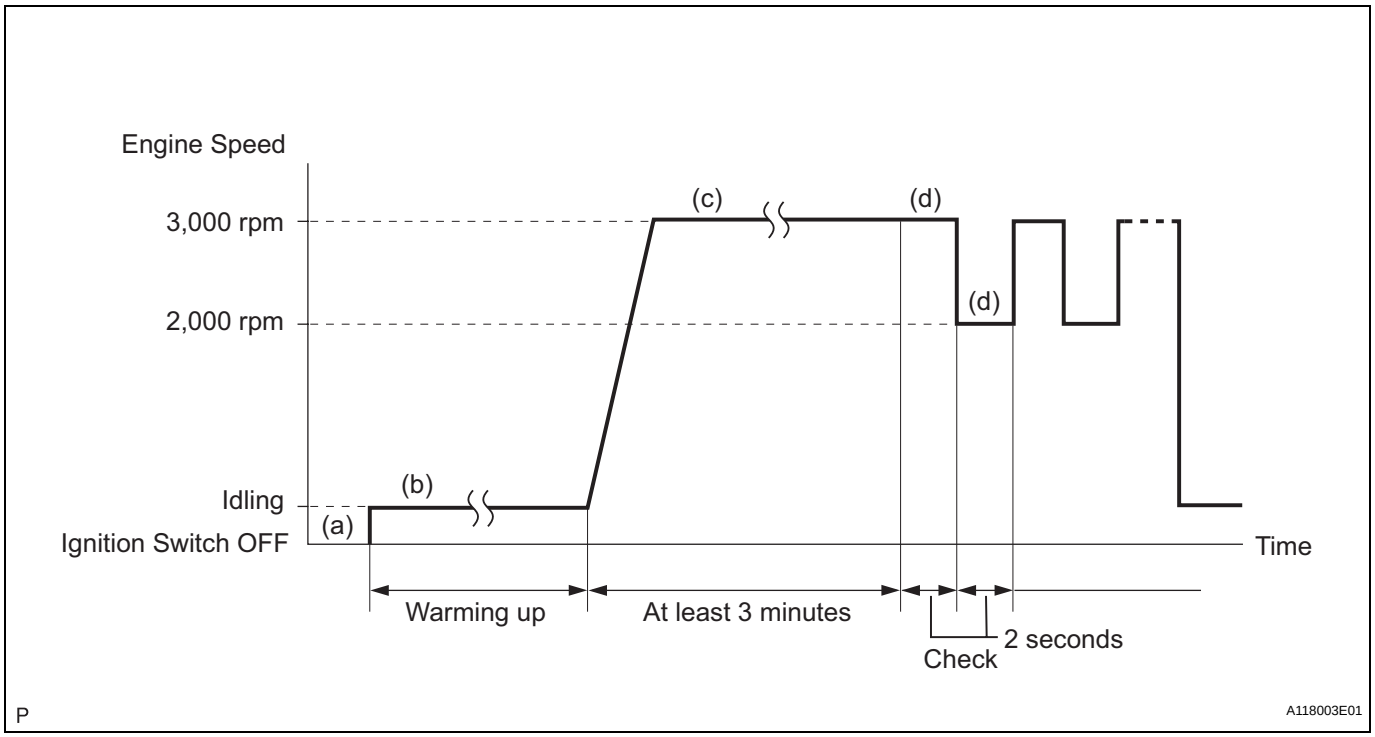
MONITOR RESULT

Detailed information on Checking Monitor Status (See page ES-19).

CONDITIONING FOR SENSOR TESTING

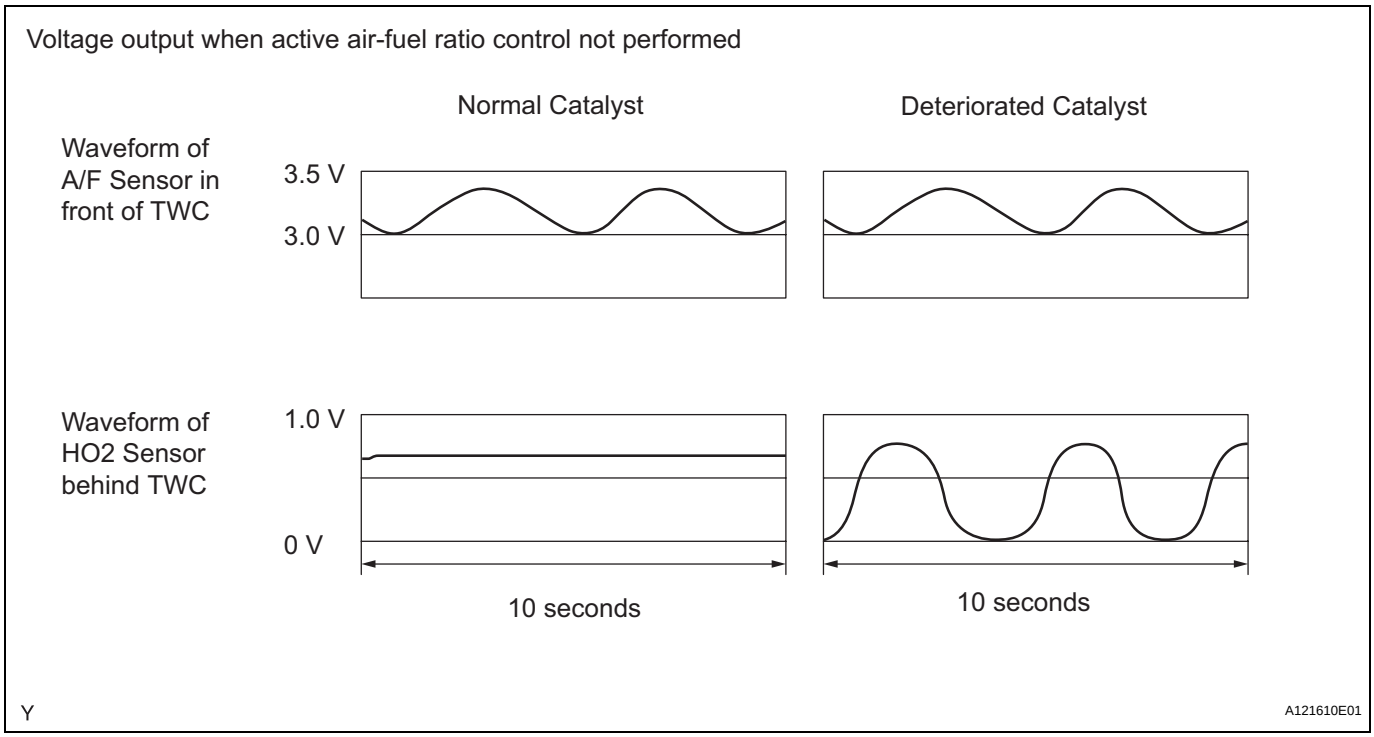
HINT:

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 an intelligent tester to the DLC3.
(b) Start the engine and warm it up with all the accessories switched OFF, until the engine coolant temperature stabilizes.
(c) Run the engine at an engine speed of between 2,500 rpm and 3,000 rpm for at least 3 minutes.
(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.
HINT:

- If either of the voltage outputs of the Air-Fuel Ratio (A/F) or Heated Oxygen (HO2) sensor does not fluctuate, or either of the sensors makes a noise, the sensor may be malfunctioning.
- If the voltage outputs of both the sensors remain lean or rich, the air-fuel ratio may be extremely lean or rich. In such cases, perform the following A/F CONTROL using an intelligent tester.
- If the Three-Way Catalytic Converter (TWC) has deteriorated, the HO2 sensor (located behind the TWC) voltage output fluctuates up and down frequently, even under normal driving conditions (active air-fuel ratio control is not performed).



CONDITIONING FOR SENSOR TESTING

HINT:
Intelligent tester only:
Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.
The following instructions describe how to conduct the A/F CONTROL operation using an intelligent tester.
(1) Connect an 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) 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 O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.
HINT:

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

Standard

Tester Display (Sensor)	Injection Volumes	Status	Voltages
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 Areas
1	Injection volume +25 % -12.5 %		Injection volume +25 % -12.5 %		-
	Output voltage More than 3.35 V Less than 3.0 V		Output voltage More than 0.55 V Less than 0.4 V		
2	Injection volume +25 % -12.5 %		Injection volume +25 % -12.5 %		• A/F sensor • A/F sensor heater • A/F sensor circuit
	Output voltage Almost no reaction		Output voltage More than 0.55 V Less than 0.4 V		
3	Injection volume +25 % -12.5 %		Injection volume +25 % -12.5 %		• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
	Output voltage More than 3.35 V Less than 3.0 V		Output voltage Almost no reaction		
4	Injection volume +25 % -12.5 %		Injection volume +25 % -12.5 %		• Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output voltage Almost no reaction		Output voltage Almost no reaction		

- Following the A/F CONTROL procedure enables technicians to check and graph the 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 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 an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0420 AND/OR P0430)

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

Result

Display (DTC Output)	Proceed To
P0420 and/or P0430	A

Display (DTC Output)	Proceed To
P0420 and/or P0430 and other DTCs	B

HINT:
If any DTCs other than P0420 or P0430 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART

A

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

ES

(a) Connect an 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) 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 or AFS B2S1 and O2S B2S2) displayed on the tester.
HINT:
- The A/F CONTROL operation lowers the fuel injection volume by 12.5 % or increases the injection volume by 25 %.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard

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

Result

Status AFS B1S1 or AFS B2S1	Status O2S B1S2 or O2S B2S2	A/F Condition and A/F and HO2 Sensors Conditions	Misfires	Main Suspected Trouble Areas	Proceed To
Lean/Rich	Lean/Rich	Normal	-	• Three-Way Catalytic Converter (TWC) • Gas leakage from exhaust system	A
Lean	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	
Lean/Rich	Lean	HO2 sensor malfunction	-	• HO2 sensor • Gas leakage from exhaust system	C
Lean/Rich	Rich	HO2 sensor malfunction	-	• HO2 sensor • Gas leakage from exhaust system	

Status AFS B1S1 or AFS B2S1	Status O2S B1S2 or O2S B2S2	A/F Condition and A/F and HO2 Sensors Conditions	Misfires	Main Suspected Trouble Areas	Proceed To
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	

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

ES

B → **CHECK AND REPLACE AIR FUEL RATIO SENSOR**

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

A

3 CHECK FOR EXHAUST GAS LEAKAGE

OK:
No gas leakage.

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

OK

REPLACE THREE-WAY CATALYTIC CONVERTER

DTC	P043E	Evaporative Emission System Reference Orifice Clog Up

DTC	P043F	Evaporative Emission System Reference Orifice High Flow

DTC SUMMARY

DTCs	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timings	Detection Logics
P043E	Reference orifice clogged	Leak detection pump creates negative pressure through reference orifice, and EVAP system pressure measured to determine 0.02 inch leak criterion. 0.02 inch leak criterion measured at start and at end of leak check. If system pressure lower than -4.85 kPa (-36.38 mmHg)*, ECM determines that reference orifice has clogging malfunction.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM • Leakage from EVAP system	While ignition switch OFF	2 trips
P043F	Reference orifice high-flow	Leak detection pump creates negative pressure through reference orifice, and EVAP system pressure measured to determine 0.02 inch leak criterion. 0.02 inch leak criterion generated at start and at end of leak check. If system pressure higher than -1.06 kPa (-7.95 mmHg)*, ECM determines that reference orifice has high-flow malfunction.			

*: The threshold values vary according to the atmospheric pressure measured at the beginning of the EVAP system monitor. The values described in the table above are based on an atmospheric pressure of 100 kPa (750.1 mmHg) (absolute pressure).
HINT:
The reference orifice is located inside the canister pump module.

DESCRIPTION

The circuit description can be found in the EVAP System (See page ES-351).

Refer to the EVAP System (See page ES-351).

MONITOR DESCRIPTION

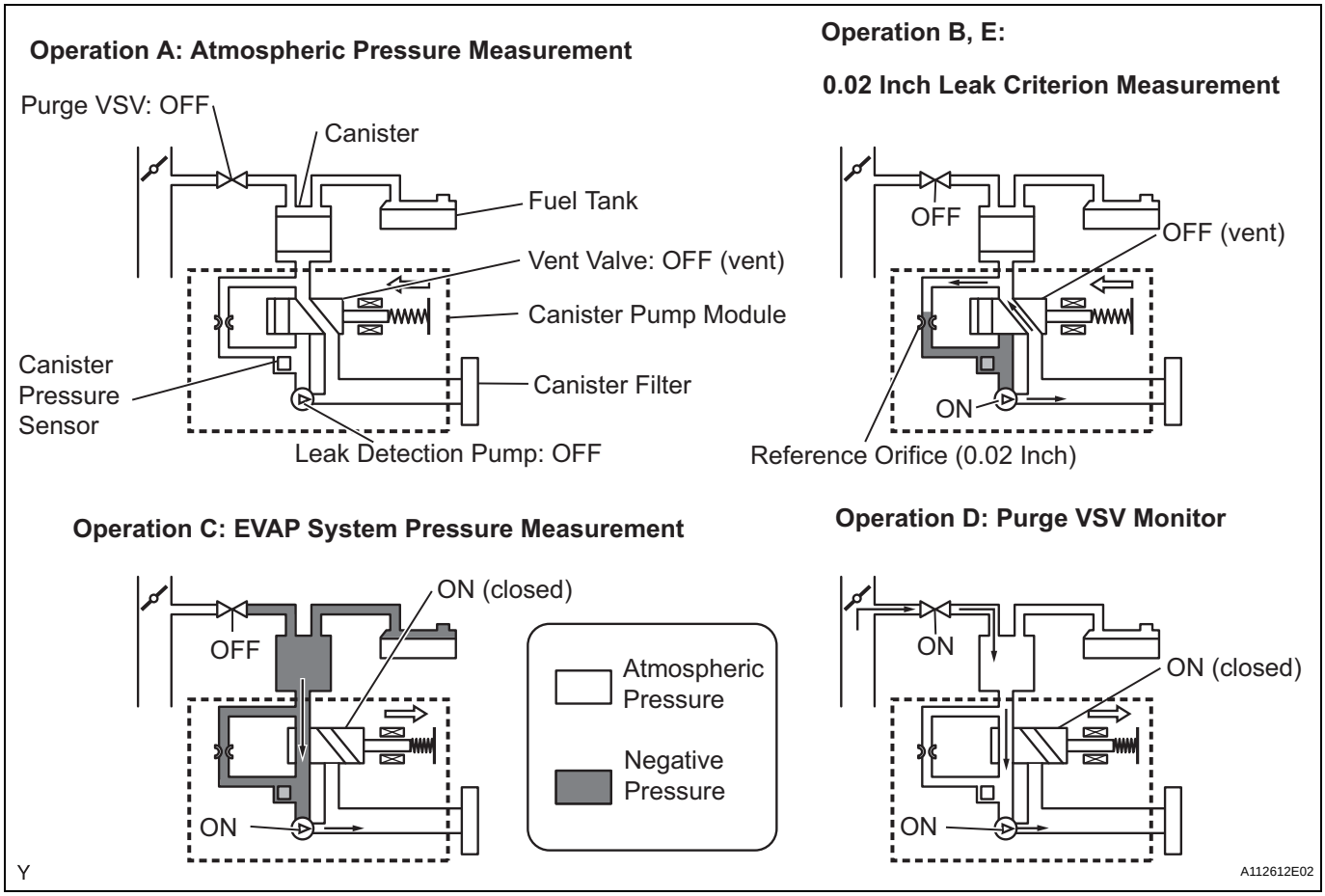
5 hours* after the ignition switch is turned OFF, the electric leak detection pump creates negative pressure (vacuum) in the EVAP (Evaporative Emission) system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.
HINT:
*: If the engine coolant temperature is not below 35°C (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 turned 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

Sequence	Operations	Descriptions	Duration
B	First 0.02 inch leak criterion measurement	In order to determine 0.02 inch leak criterion, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as they will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes*
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak criterion measurement	After second 0.02 inch leak criterion measurement, leak check performed by comparing first and second 0.02 inch leak criterion. If stabilized system pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system leaking.	60 seconds
F	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

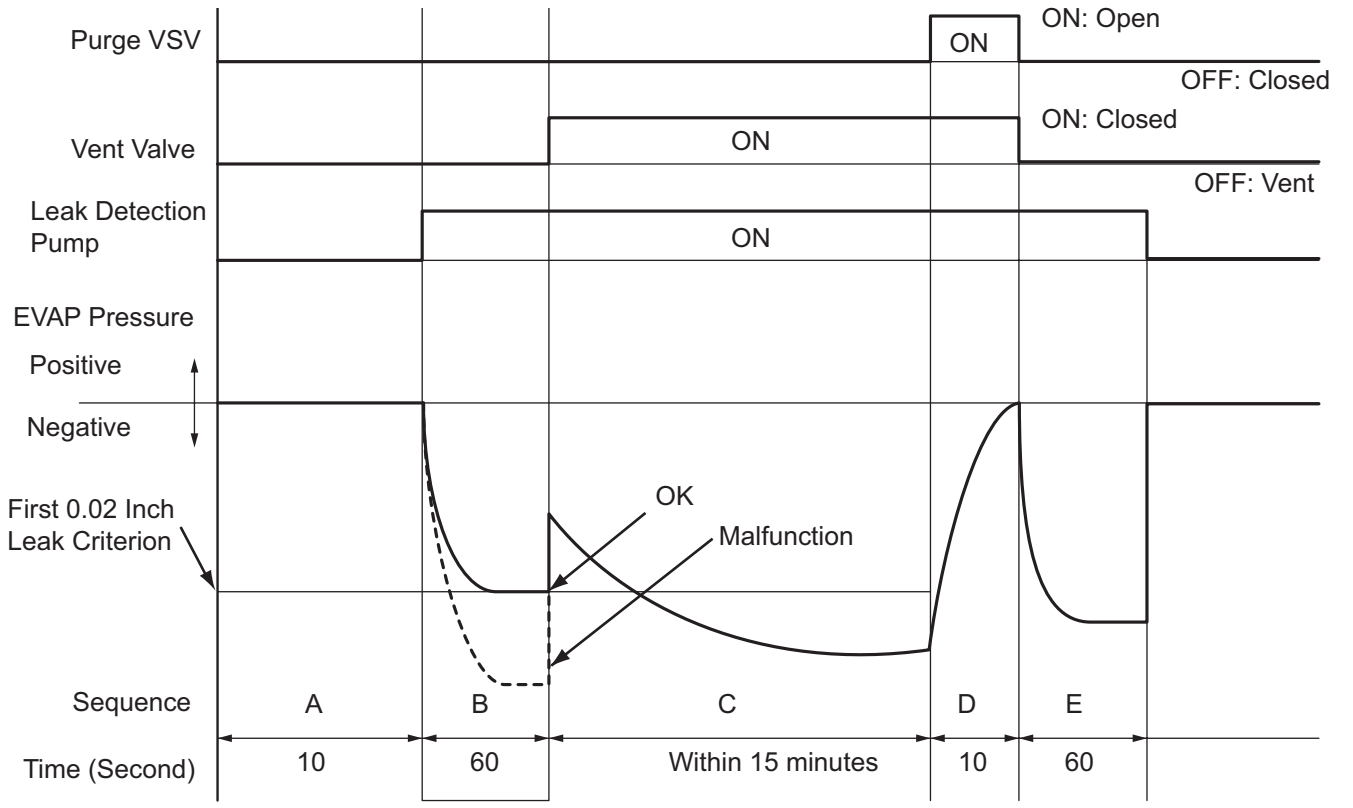
ES

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



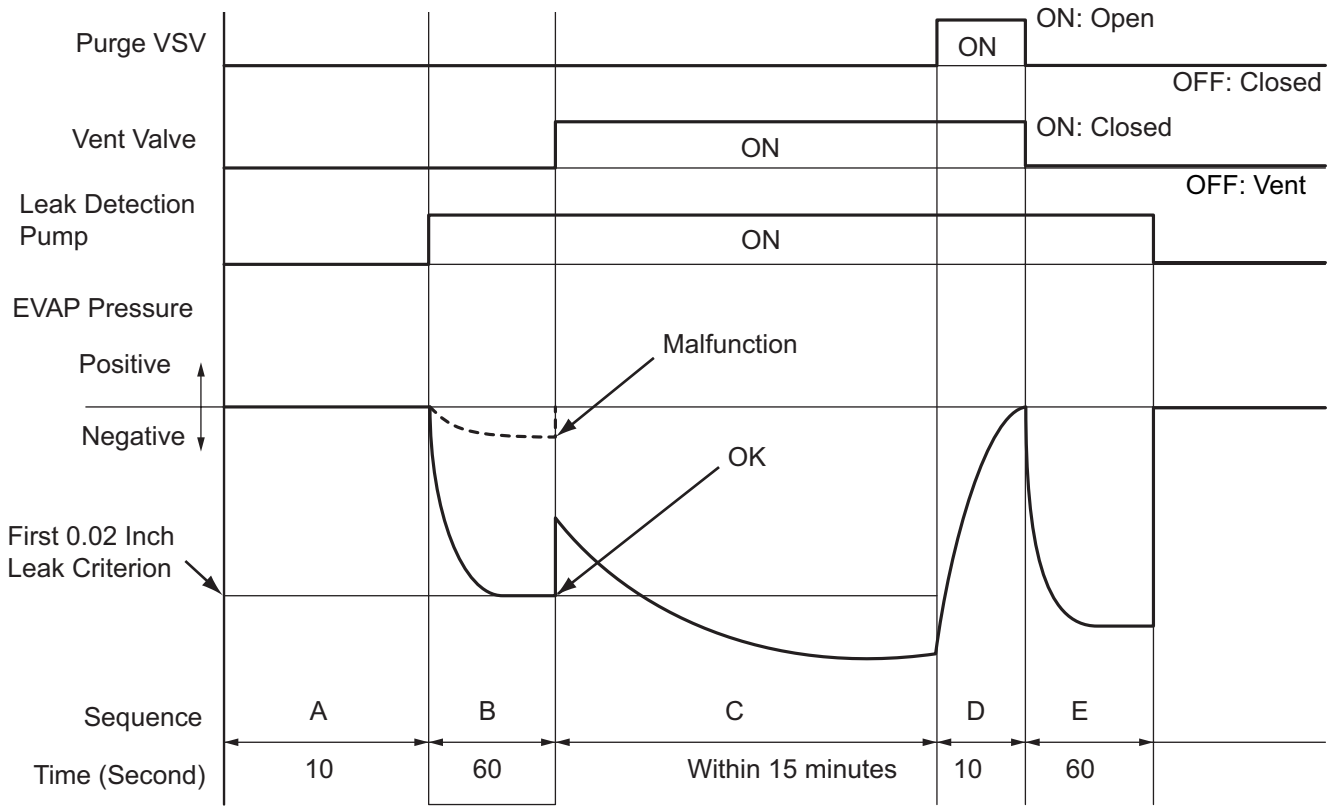
1. P043E: Reference orifice clogged
   In operation B, the leak detection pump creates negative pressure (vacuum) through the reference orifice. The EVAP system pressure is then measured by the ECM, using the canister pressure sensor, to determine the 0.02 inch leak criterion. If the pressure is lower than -4.85 kPa (-36.38 mmHg)*, the ECM interprets this as a clog malfunction in the reference orifice, and stops the EVAP (Evaporative Emission) system monitor. The ECM then illuminates the MIL and sets the DTC (2 trip detection logic).
   *: The threshold varies according to the atmospheric pressure measured in operation A. The value described above is based on an atmospheric pressure of 100 kPa (750.1 mmHg): absolute pressure.

EVAP Pressure when Reference Orifice Clogged:



2. P043F: Reference orifice high-flow
In operation B, the leak detection pump creates negative pressure (vacuum) through the reference orifice. The EVAP system pressure is then measured by the ECM using the canister pressure sensor to determine the 0.02 inch leak criterion. If the pressure is higher than -1.06 kPa (-7.95 mmHg)*, the ECM interprets this as a high-flow malfunction in the reference orifice, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (2 trip detection logic).
*: The threshold varies according to the atmospheric pressure measured in operation A. The value described above is based on a atmospheric pressure of 100 kPa (750.1 mmHg): absolute pressure.

EVAP Pressure when Reference Orifice High-flow Malfunction:



MONITOR STRATEGY

Required Sensors/Components	Canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes (varies with amount of fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever these DTCs not present	None
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	525 to 825 mmHg (70 to 110 kPa)
Battery voltage	10.5 V or more
Vehicle speed	Below 2.5 mph (4 km/h)
Ignition switch	OFF
Engine condition	Not running

Fuel tank pressure sensor malfunction (P0450, P0452 and/or P0453)	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before IG switch OFF	Conditions 1 and 2
1. Duration that vehicle driven	5 minutes or more
2. Purge flow	Executed
ECT	4.4° to 35°C (40° to 95°F)
IAT	4.4° to 35°C (40° to 95°F)

Example of restart time

First time	7 hours
Second time	9 hours and 30 minutes

ES

1. Key-off monitor sequence is 1 to 8

1. Atmospheric pressure

Next sequence is run if following condition set	-
Atmospheric pressure change for 10 sec.	Less than 2.25 mmHg (0.3 kPa) for 1 second

2. First 0.02 inch leak criterion

Next sequence is run if all of following conditions set	Conditions 1, 2 and 3
1. Fuel tank pressure when 4 seconds after 0.02 inch leak criterion measurement began	-7.5 mmHg (-1 kPa) or less
2. 0.02 inch leak criterion	-33.38 to -7.93 mmHg (-4.85 to -1.057 kPa)
3. 0.02 inch leak criterion	Saturated within 55 seconds

3. Vent valve stuck closed check

Next sequence is run if following condition set	-
Fuel tank pressure change for 10 seconds after vent valve ON (closed)	2.25 mmHg (0.3 kPa) or more

4. Vacuum introduction

Next sequence is run if both of following condition set	-
1. Vacuum introduction time	12 minutes or less
2. Fuel tank pressure	Fuel tank pressure was standard

5. Purge VSV stuck closed check

Next sequence is run if following condition set	-
Fuel tank pressure change for 10 seconds after purge VSV ON (open)	2.25 mmHg (0.3 kPa) or more

6. Second 0.02 inch leak criterion measurement

Next sequence is run if all of following conditions set	Conditions 1, 2, 3 and 4
1. Fuel tank pressure when 4 seconds after 0.02 inch leak criterion measurement began	-7.5 mmHg (-1 kPa) or less
2. 0.02 inch leak criterion	-36.4 to -7.92 mmHg (-4.85 to -1.057 kPa)
3. 0.02 inch leak criterion	Saturated within 55 seconds
4. 0.02 inch leak criterion difference between first and second	5.25 mmHg (0.7 kPa) or less

7. Leak check

Next sequence is run if following condition set	-
Arrival pressure when vacuum introduced for EVAP system	Leak detection criteria or less

8. Atmospheric pressure

Monitor is complete if following	-
Atmospheric pressure difference between sequences 1 and 8	2.25 mmHg (0.3 kPa) or less

TYPICAL MALFUNCTION THRESHOLDS

One of following conditions met	-
Fuel tank pressure when 4 seconds after 0.02 inch leak criterion measurement began	More than -7.5 mmHg (-1 kPa)
0.02 inch leak criterion	Less than -36.4 mmHg (-4.85 kPa)
0.02 inch leak criterion	-7.9 mmHg (-1.057 kPa) or more
0.02 inch leak criterion	Not saturated
0.02 inch leak criterion difference between first and second	5.3 mmHg (0.7 kPa) or more

"Saturated" indicates that the EVAP pressure change is less than 0.75 mmHg (0.1 kPa) in 30 seconds.

MONITOR RESULT

Detailed information on Checking Monitor Status (See page ES-19).

DTC	P0441	Evaporative Emission Control System Incorrect Purge Flow

DTC SUMMARY

DTCs	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timings	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. 0.02 inch leak criterion measured at start and at end of leak check. If stabilized pressure higher than [second 0.02 inch leak criterion x 0.2], ECM determines that purge VSV stuck open	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • ECM • Canister pump module • Leakage from EVAP system	While ignition Switch OFF	2 trip
	Purge VSV stuck closed	After EVAP leak check performed, purge VSV turned ON (open), and atmospheric air introduced into EVAP system. 0.02 inch leak criterion measured at start and at end of leak check. If pressure does not return to near atmospheric pressure, ECM determines that purge VSV stuck closed	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • ECM • Canister pump module • Leakage from EVAP system	While ignition Switch OFF	2 trip
	Purge flow	While engine running, following conditions successively met: • Negative pressure not created in EVAP system when purge VSV turned ON (open) • EVAP system pressure change less than 0.5 kPa (3.75 mmHg) when vent valve turned ON (closed) • Atmospheric pressure change before and after purge flow monitor less than 0.1 kPa (0.75 mmHg)	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • Leakage from EVAP line (Purge VSV - Intake manifold) • ECM	While engine running	2 trip

DESCRIPTION

The circuit description can be found in the EVAP System (See page ES-351).

Refer to the EVAP System (See page ES-351).

MONITOR DESCRIPTION

The two monitors, Key-Off and Purge Flow, are used to detect malfunctions relating to DTC P0441. The Key-Off monitor is initiated by the ECM internal timer, known as the soak timer, 5 hours* after the ignition switch is 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 electric leak detection pump creates negative pressure (vacuum) in the EVAP (Evaporative Emission) system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

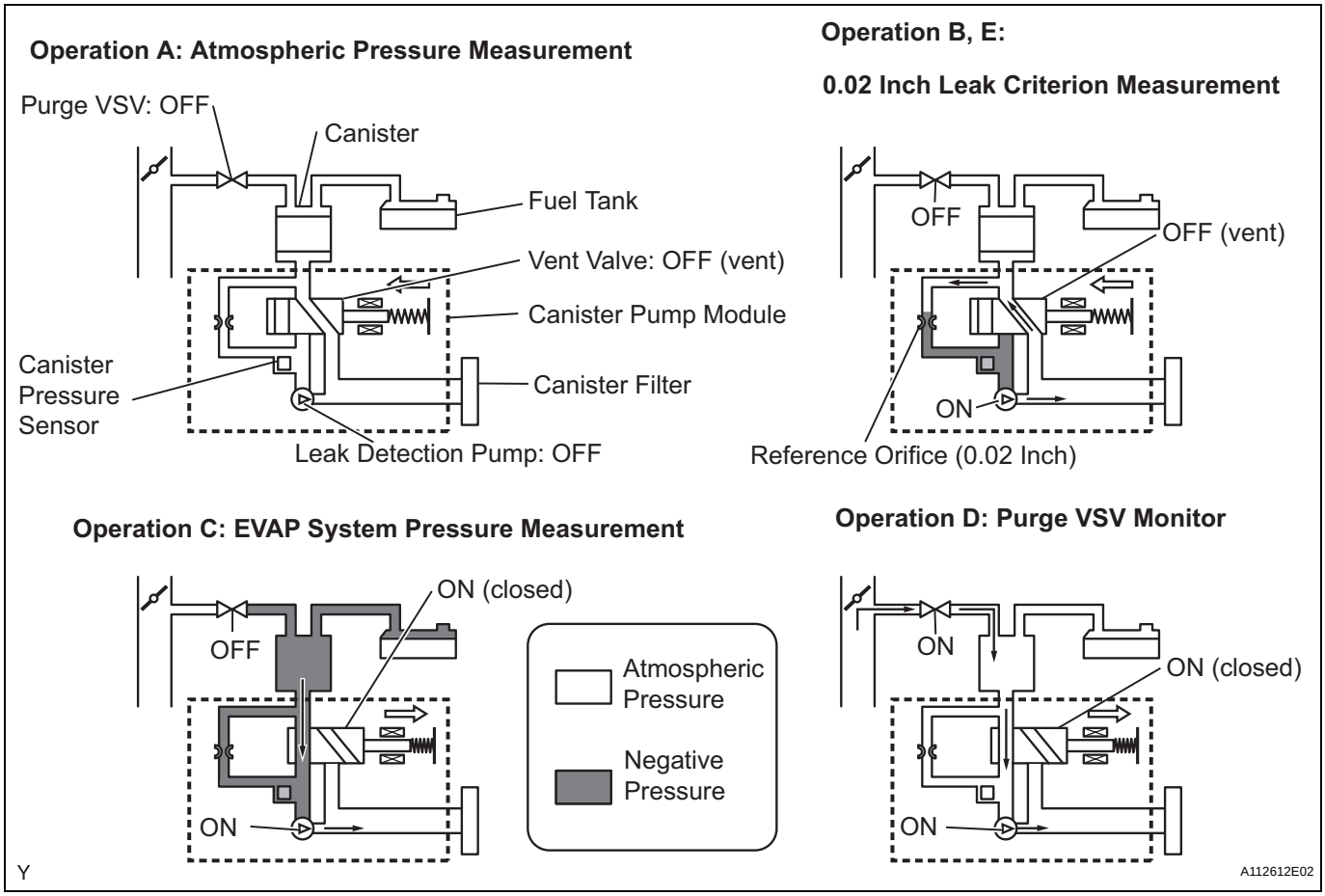
HINT:

*: 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.

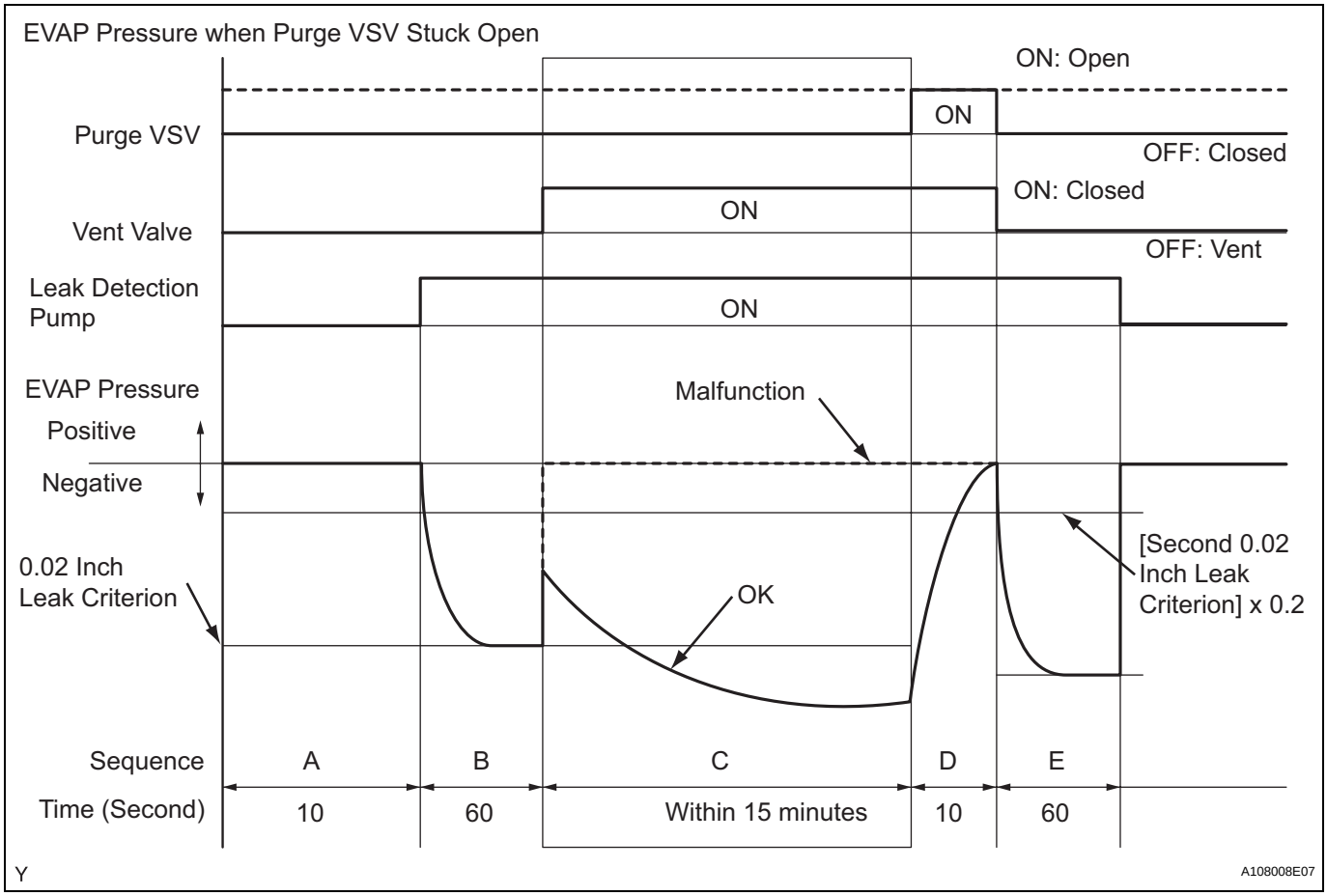
Sequence	Operation	Descriptions	Duration
-	ECM activation	Activated by soak timer, 5 hours (7 or 9.5 hours) after ignition switch turned OFF.	-

Sequence	Operation	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 not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak criterion measurement	In order to determine 0.02 inch leak criterion, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as they will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes*
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak criterion measurement	After second 0.02 inch leak criterion measurement, leak check performed by comparing first and second 0.02 inch leak criterion. If stabilized system pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system leaking.	60 seconds
F	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

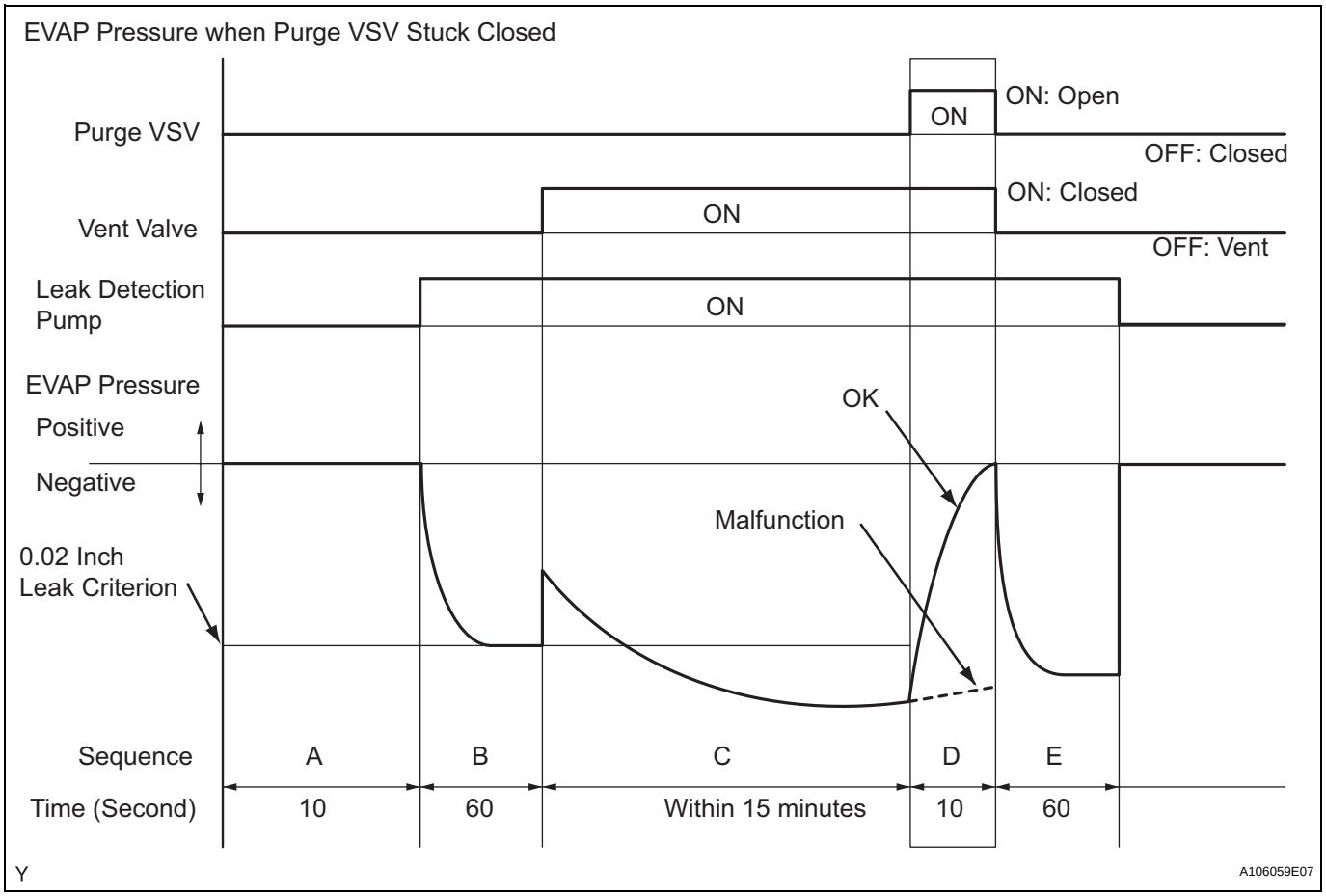
* If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.

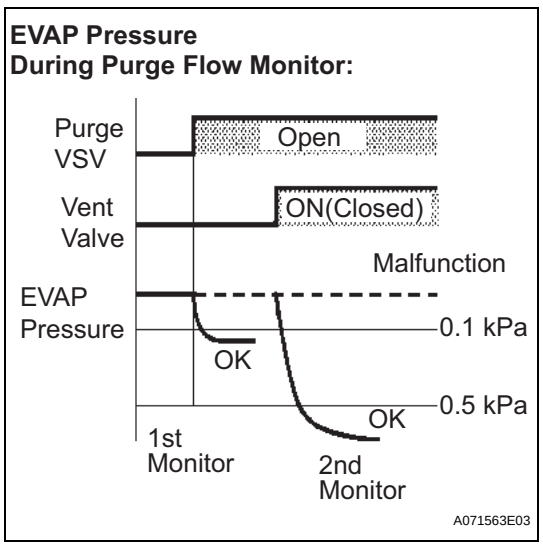


1. Purge VSV stuck open
   In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP (Evaporative Emission) system. The EVAP system pressure is then measured by the ECM using the canister pressure sensor. If the stabilized system pressure is higher than [second 0.02 inch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



2. Purge VSV stuck closed
In operation D, the canister pressure sensor measures the EVAP (Evaporative Emission) system pressure. Pressure measurement for the purge VSV monitor is begun when the purge VSV is turned ON (open) after the EVAP leak check. When the measured pressure indicates an increase of 0.3 kPa (2.25 mmHg) or more, the purge VSV is functioning normally. If the pressure does not increase, the ECM interprets this as the being stuck closed. The ECM illuminates the MIL and sets the DTC (2 trip detection logic).





2. PURGE FLOW MONITOR

The purge flow monitor consists of the two 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 (Vacuum Switching Valve) is ON (open), the ECM monitors the purge flow by measuring the EVAP pressure change. If negative pressure is not created, the ECM begins the 2nd monitor.
- The 2nd monitor
  The vent valve is turned ON (closed) and the EVAP pressure is 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 pressures, before and after conduction of the purge flow monitor, is measured by the ECM.

OBD II MONITOR SPECIFICATIONS

1. Key-off Monitor

Monitor Strategy

Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes (varies with fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or higher
Vehicle speed	4 km/h (2.5 mph) or less
Ignition switch	OFF
EVAP control system pressure sensor	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of 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)

Example of restart time

First time	7 hours
Second time	9 hours and 30 minutes

2. Key-off monitor sequence 1 to 8

1. Atmospheric pressure measurement

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

2. First 0.02 inch leak criterion measurement

Next sequence is run if the following conditions set	Conditions 1, 2 and 3
1. EVAP pressure just after 0.02 inch leak criterion measurement start	-7.5 mmHg (-1 kPa) or less
2. 0.02 inch leak criterion	-33.38 to -7.93 mmHg (-4.85 to 1.057 kPa)
3. 0.02 inch leak criterion	Saturated within 55 seconds

3. Vent valve stuck closed check

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

4. Vacuum introduction

Next sequence is run if the following condition set	-
Vacuum introduction time	12 minutes or less

5. Purge VSV stuck closed check

Next sequence is run if the following condition set	-
EVAP pressure change after purge VSV is open	2.25 mmHg (0.3 kPa) or more

6. Second 0.02 inch leak criterion measurement

Next sequence is run if the following conditions set	Conditions 1, 2, 3 and 4
1. EVAP pressure just after 0.02 inch leak criterion measurement	-7.5 mmHg (-1 kPa) or less
2. 0.02 inch leak criterion	-36.4 to -7.92 mmHg (-4.85 to -1.057 kPa)
3. 0.02 inch leak criterion	Saturated within 55 seconds
4. 0.02 inch leak criterion difference between first and second	5.25 mmHg (0.7 kPa) or less

7. Leak check

Next sequence is run if the following condition set	-
EVAP pressure when vacuum introduction is complete	Leak detection criteria or less

8. Atmospheric pressure measurement

EVAP monitor is complete if the following condition set	-
Atmospheric pressure difference between sequences 1 and 8	2.25 mmHg (0.3 kPa) or less

Typical Malfunction Thresholds

Purge VSV stuck open	-
FTP when vacuum introduction complete	Higher than reference pressure x 0.2
Purge VSV stuck closed	-
FTP change for 10 seconds after purge VSV ON (open)	Less than 0.3 kPa (2.25 mmHg)

"Saturated" indicates that the EVAP pressure change is less than 0.1 kPa (0.75 mmHg) in 30 seconds.

OBD II MONITOR SPECIFICATIONS

1. Purge Flow Monitor

Monitor Strategy

Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 10 minutes (varies with fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTC not present	None
Engine	Running
ECT	4.4°C (40°F) or more
IAT	4.4°C (40°F) or more
EVAP control system pressure sensor	Not detected
Purge VSV	Not detected by scan tool
EVAP system check	Not detected by scan tool
Battery voltage	10 V or higher
Purge duty cycle	8% or more

2. TYPICAL MALFUNCTION THRESHOLDS

Purge Flow Monitor:

Both of the following conditions are met	Conditions 1 or 2
1. FTP change when purge operation started	Less than 0.1 kPa (0.75 mmHg)
2. FTP change during purge operation when vent valve closed	Less than 0.5 kPa (3.75 mmHg)

MONITOR RESULT

Detailed information on Checking Monitor Status (See page ES-19).

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

DTC SUMMARY

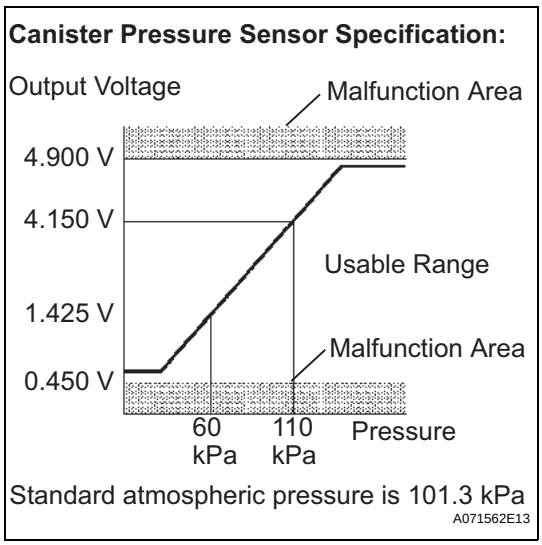
DTC	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timings	Detection logic
P0450	Canister pressure sensor voltage abnormal fluctuation	Sensor output voltage rapidly fluctuates beyond upper and lower malfunction thresholds for 0.5 seconds.	• Canister pump module • ECM	• EVAP monitoring (ignition OFF) • Ignition ON	1 trip
P0451	Canister pressure sensor noise	Sensor output voltage fluctuates frequently in certain time period.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM	• EVAP monitoring (ignition OFF) • Engine running	2 trip
	Canister pressure sensor voltage fixed	Sensor output voltage does not vary in certain time period.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM	• EVAP monitoring (ignition OFF)	2 trip
P0452	Canister pressure sensor voltage low	Sensor output voltage less than 0.45 V for 0.5 seconds.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM	• Ignition ON • EVAP monitoring (ignition OFF)	1 trip
P0453	Canister pressure sensor voltage high	Sensor output voltage more than 4.9 V for 0.5 seconds.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM	• Ignition ON • EVAP monitoring (ignition OFF)	1 trip

HINT:
The canister pressure sensor is built into the canister pump module.

DESCRIPTION

The circuit description can be found in the EVAP System (See page ES-351).

MONITOR DESCRIPTION



(a) DTC P0450: Canister pressure sensor voltage abnormal fluctuation
If the canister pressure sensor voltage output rapidly fluctuates between less than 0.45 V and more than 4.9 V, the ECM interprets this as an open or short circuit malfunction in the canister pressure sensor or its circuit, and stops the EVAP (Evaporative Emission) system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).
(b) DTC P0451: Canister pressure sensor noise 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 the malfunctions are detected by 2 trip detection logic).
(c) DTC P0452: Canister pressure sensor voltage low
If the canister pressure sensor voltage output is below 0.45 V, the ECM interprets this as an open or short circuit malfunction in the canister pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).
(d) DTC P0453: Canister pressure sensor voltage high
If the canister pressure sensor voltage output is 4.9 V or more, the ECM interprets this as an open or short circuit malfunction in the canister pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).

MONITOR STRATEGY

Required Sensors/Components	Canister pump module
Frequency of Operation	Once per driving cycle: P0451 sensor stuck Continuous: P0451 sensor noise, P0450, P0452 and P0453
Duration	-
MIL Operation	Immediate: P0450, P0452 and P0453 2 driving cycles: P0451
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0451 (Noise monitor):

Monitor runs whenever these DTCs not present	None
Atmospheric pressure (absolute pressure)	70 kPa (525 mmHg) or more, less than 110 kPa (825 mmHg)
Battery voltage	10.5 V or more

Intake air temperature	4.4° to 35°C (40° to 95°F)
Either of following conditions met	A or B
A. Engine	Running
B. Soak time (ignition switch OFF time)	5 hours

Example of restart time

First time	7 hours
Second time	9 hours and 30 minutes

P0451 (Fixed monitor):

Monitor runs whenever these DTCs not present	None
Atmospheric pressure	Less than 70 kPa (525 mmHg), or 110 kPa (825 mmHg) or more
Battery voltage	10.5 V or more
Intake air temperature	4.4° to 35°C (40° to 95°F)
Soak time (ignition switch OFF time)	5 hours

ES

Example of restart time

First time	7 hours
Second time	9 hours and 30 minutes

P0450, P0452 and P0453:

Monitor runs whenever these DTCs not present	None
Either of following conditions 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 (317 mmHg), or more than 123.8 kPa (928.5 mmHg)

P0451: Canister pressure sensor noise

Pressure variation indicated by canister pressure sensor in 10 seconds	More than +-0.3 kPa (+-2.25 mmHg) 10 times

P0451: Canister pressure sensor voltage fixed

0.02 inch leak criterion variation indicated by canister pressure sensor in 10 seconds	Less than 0.65 kPa (4.87 mmHg)

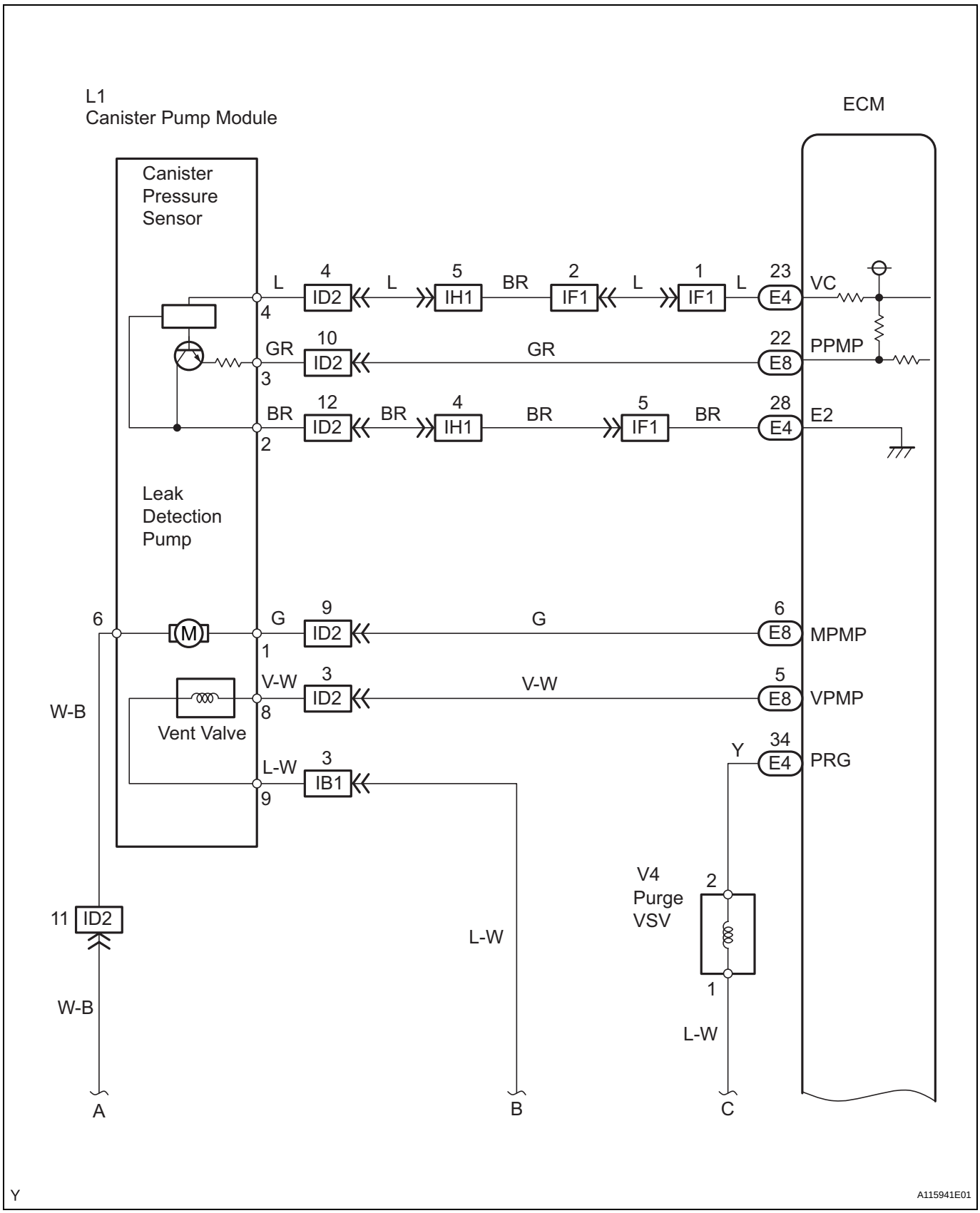
P0452: Canister pressure sensor low voltage

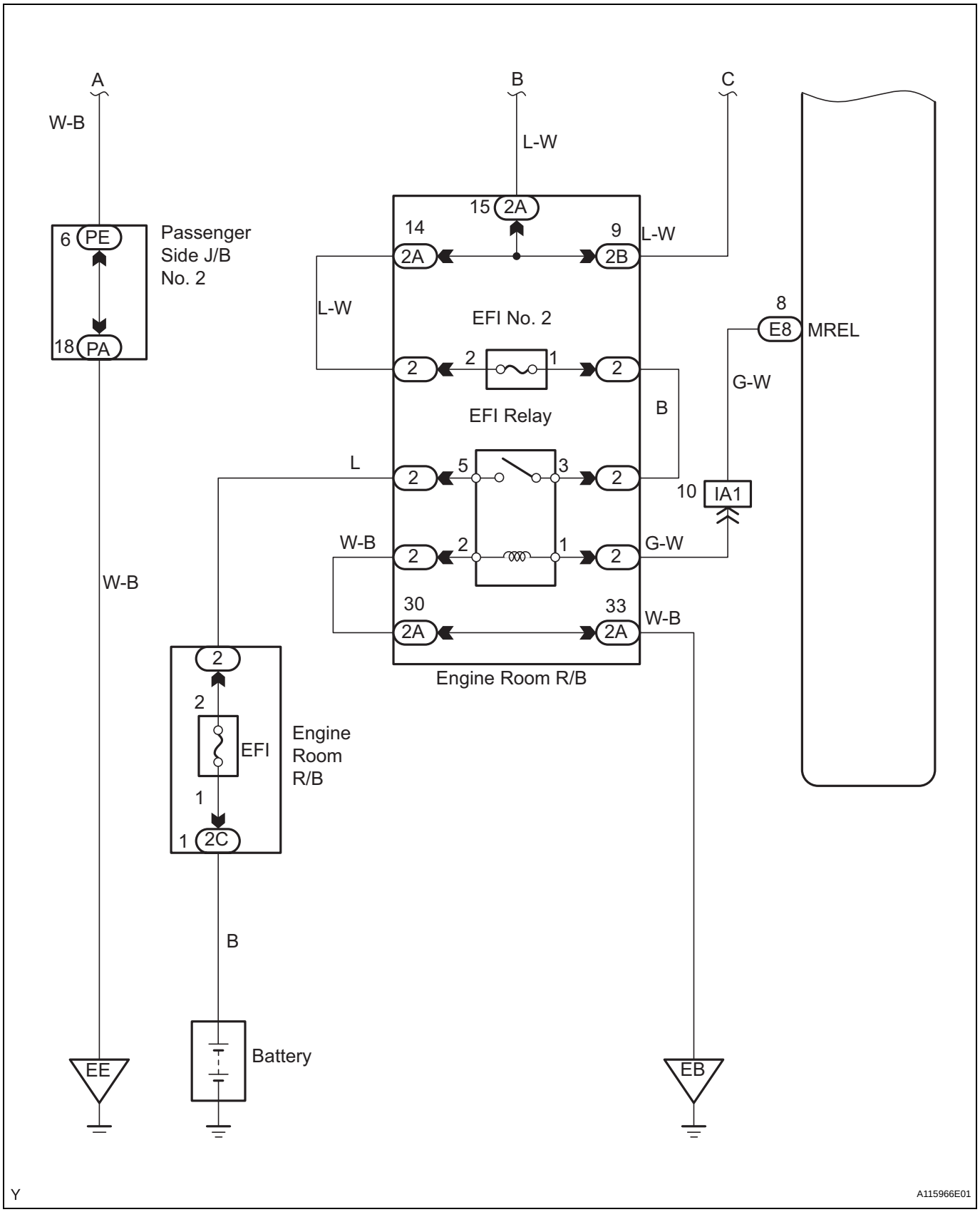
EVAP pressure	Less than 42.1 kPa (317 mmHg)

P0453: Canister pressure sensor high voltage

EVAP pressure	More than 123.8 kPa (928.5 mmHg)

WIRING DIAGRAM





NOTICE:

- **When a vehicle is brought into the workshop, leave it as it is. Do not change the vehicle condition. For example, do not tighten the fuel cap.**
- **Do not disassemble the canister pump module.**

- **An intelligent tester is required to conduct the following diagnostic troubleshooting procedure.**

1	CONFIRM DTC AND EVAP PRESSURE

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON (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 DTCs.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / VAPOR PRESS.
(g) Read the EVAP (Evaporative Emission) pressure displayed on the tester.

ES

Result

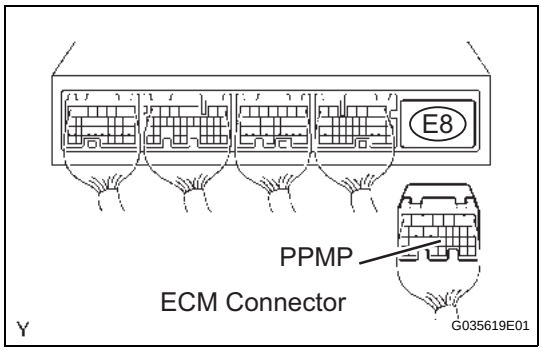
Display (DTC Output)	Test Results	Suspected Trouble Areas	Proceed to
P0451	-	• Canister pressure sensor	C
P0452	Less than 45 kPa (430 mmHg)	• Wire harness/connector (ECM - canister pressure sensor) • Canister pressure sensor • Short in ECM circuit	A
P0453	More than 120 kPa (900 mmHg)	• Wire harness/connector (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 HARNESS AND CONNECTOR (CANISTER PUMP MODULE - ECM)



(a) Turn the ignition switch OFF.
(b) Disconnect the E8 ECM connector.
(c) Measure the resistance between the PPMP terminal of the ECM connector and the body ground.

Result

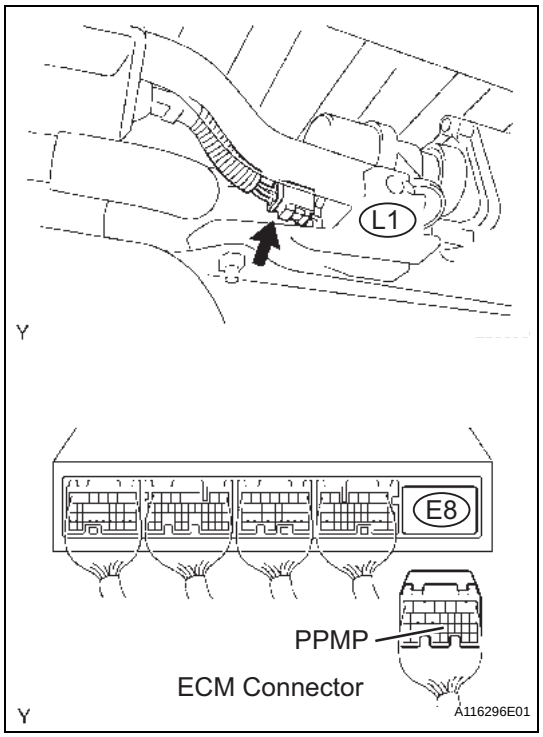
Test Results	Suspected Trouble Areas	Proceed To
10 Ω or less	• Wire harness/connector (ECM - canister pressure sensor) • Short in canister pressure sensor circuit	A
10 kΩ or more	• Wire harness/connector (ECM - canister pressure sensor) • Short in ECM circuit	B

(d) Reconnect the ECM connector.

B → Go to step 7

A

3	CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - ECM)



(a) Disconnect the L1 canister connector.
(b) Disconnect the E8 ECM connector.
(c) Check the resistance between the PPMP terminal of the ECM connector and the body ground.

ES

Result

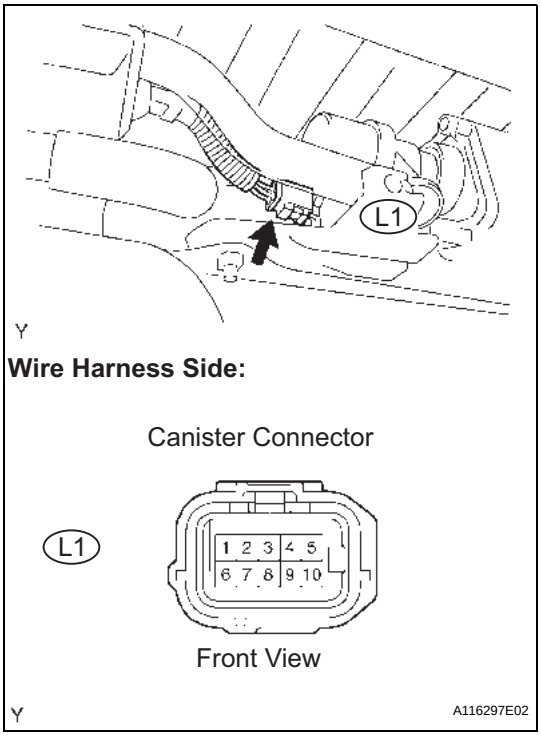
Test Results	Suspected Trouble Areas	Proceed To
10 kΩ or more	• Short in canister pressure sensor circuit	A
10 Ω or less	• Short in wire harness/connector (ECM - canister pressure sensor)	B

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

A → Go to step 5

B → Go to step 6

4	CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - ECM)



(a) Disconnect the L1 canister connector.
(b) Turn the ignition switch ON.
(c) Measure the voltage and resistance of the L1 canister connector.

Standard

Tester Connections	Specified Conditions
L1-4 - Body ground	Between 4.5 V and 5.5 V
L1-3 - Body ground	
L1-2 - Body ground	100 Ω or less

Result

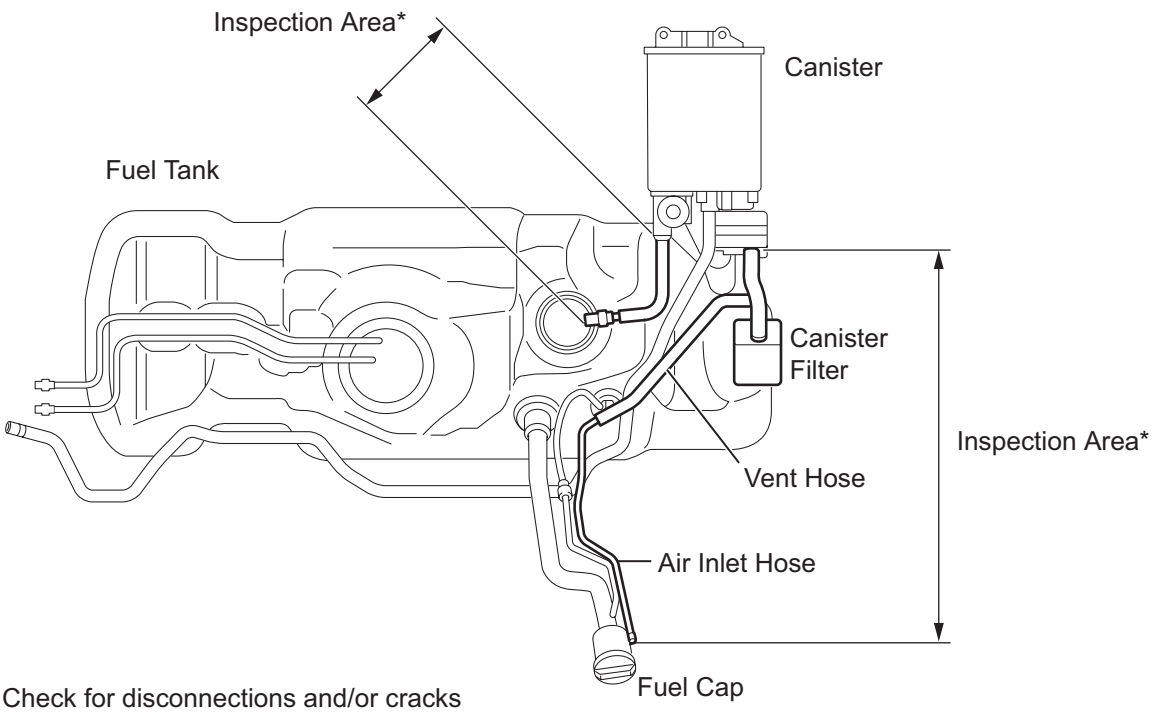
Test Results	Suspected Trouble Areas	Proceed To
Voltage and resistance within standard ranges	• Open in canister pressure sensor circuit	A
Voltage and resistance outside standard ranges	• Open in wire harness/connector (ECM - canister pressure sensor)	B

(d) Reconnect the canister connector.

A	Go to step 5
B	Go to step 6

5	REPLACE CANISTER ASSEMBLY

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



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

NEXT	Go to step 8

6	REPAIR OR REPLACE HARNESS AND CONNECTOR

HINT:
If the exhaust tail pipe has been removed, go to the next step before reinstalling it.

NEXT	Go to step 8

7	REPLACE ECM

NEXT	Go to step 8

8	CHECK WHETHER DTC OUTPUT RECURS (AFTER REPAIR)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Wait for at least 60 seconds.
(d) 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.

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	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timings	Detection logic
P0455	EVAP gross leak	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. 0.02 inch leak criterion measured at start and at end of leak check. If stabilized pressure higher than [second 0.02 inch leak criterion x 0.2], ECM determines that EVAP system has large leakage.	• Fuel cap (loose) • Leakage from EVAP line (Canister - Fuel tank) • Leakage from EVAP line (Purge VSV - Canister) • Canister pump module • Leakage from fuel tank • Leakage from canister	While ignition switch OFF	2 trip
P0456	EVAP small leak	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. 0.02 inch leak criterion measured at start and at end of leak check. If stabilized pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system has small leakage.	Same above	While ignition switch OFF	2 trip

ES

DESCRIPTION

The circuit description can be found in the EVAP System (See page ES-351).

Refer to the EVAP System (See page ES-351).

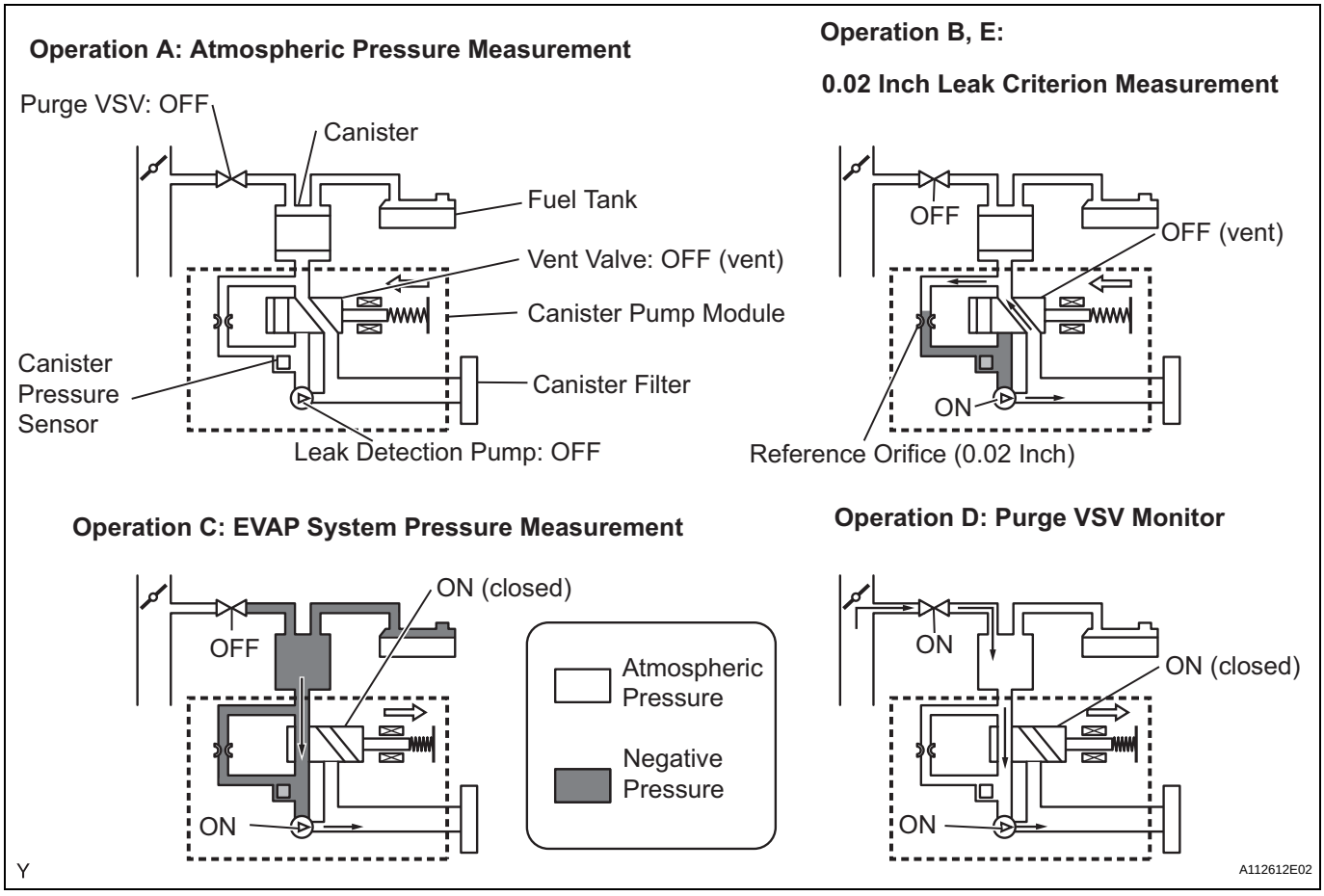
MONITOR DESCRIPTION

5 hours* after the ignition switch is turned OFF, the electric leak detection 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:
*: 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 turned OFF.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak criterion measurement	In order to determine 0.02 inch leak criterion, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as they will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes*

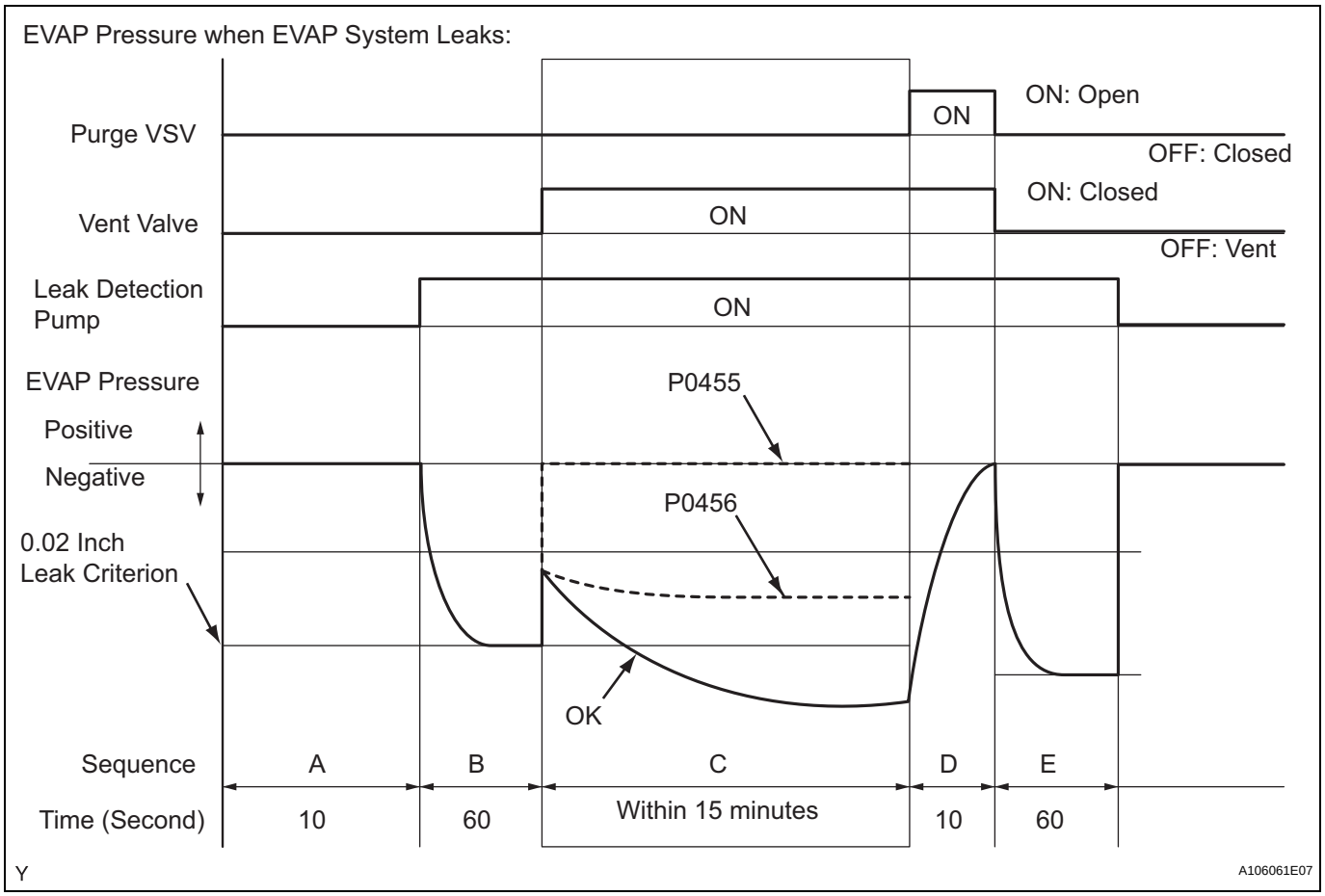
Sequence	Operations	Descriptions	Duration
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak criterion measurement	After second 0.02 inch leak criterion measurement, leak check performed by comparing first and second 0.02 inch leak criterion. If stabilized system pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system leaking.	60 seconds
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.



1. P0455: EVAP (Evaporative Emission) gross leak
   In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system and the EVAP system pressure is measured. If the stabilized system pressure is higher than [second 0.02 inch leak criterion x 0.2] (near atmospheric pressure), the ECM determines that the EVAP system has a large leakage, illuminates the MIL and sets the DTC (2 trip detection logic).

2. P0456: EVAP very small leak
   In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system and the EVAP system pressure is measured. If the stabilized system pressure is higher than second 0.02 inch leak criterion, the ECM determines that the EVAP system has a small leakage, illuminates the MIL and sets the DTC (2 trip detection logic).



MONITOR STRATEGY

Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes (varies with amount of fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever these DTCs not present	None
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	525 to 825 mmHg (70 to 110 kPa)
Battery voltage	10.5 V or more
Vehicle speed	Below 2.5 mph (4 km/h)
Ignition switch	OFF
Engine condition	Not running
Fuel tank pressure sensor malfunction (P0450, P0451, P0452 and/or P0453)	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool

Leak detection pump	Not operated by scan tool
Both of following conditions met before IG switch OFF	Conditions 1 and 2
1. Duration that vehicle driven	5 min. or more
2. Purge flow	Executed
ECT	4.4° to 35°C (40° to 95°F)
IAT	4.4° to 35°C (40° to 95°F)

1. Key-off monitor sequence 1 to 8

1. Atmospheric pressure

Next sequence is run if following condition set	-
Atmospheric pressure change for 10 seconds	Less than 2.25 mmHg (0.3 kPa) for 1 seconds

2. First 0.02 inch leak criterion

Next sequence is run if all of following conditions set	Conditions 1, 2 and 3
1. FTP when 4 seconds after 0.02 inch leak criterion measurement	-7.5 mmHg (-1 kPa) or less
2. 0.02 inch leak criterion	-36.28 to -7.93 mmHg (-4.85 to -1.057 kPa)
3. 0.02 inch leak criterion	Saturated within 55 seconds

3. Vent valve stuck closed check

Next sequence is run if following condition set	-
Fuel tank pressure change for 10 seconds after vent valve ON (closed)	2.25 mmHg (0.3 kPa) or more

4. Vacuum introduction

Next sequence is run if both of following conditions set	-
1. Vacuum introduction time	Saturated within 12 minutes
2. Fuel tank pressure	Fuel tank pressure was standard

5. Purge VSV stuck closed check

Next sequence is run if following condition set	-
Fuel tank pressure change for 10 seconds after purge VSV ON (open)	2.25 mmHg (0.3 kPa) or more

6. Second 0.02 inch leak criterion measurement

Next sequence is run if all of following conditions set	Conditions 1, 2, 3 and 4
1. Fuel tank pressure when 4 sec. after 0.02 inch leak criterion measurement	-7.5 mmHg (-1 kPa) or less
2. 0.02 inch leak criterion	-36.4 to -7.92 mmHg (-4.85 to -1.057 kPa)
3. 0.02 inch leak criterion	Saturated within 55 seconds
4. 0.02 inch leak criterion difference between first and second	5.25 mmHg (0.7 kPa) or less

7. Leak check

Next sequence is run if following condition set	-
Fuel tank pressure when vacuum introduction was complete	Second 0.02 inch leak criterion or less

8. Atmospheric pressure

Monitor is complete if following conditions set	-
Atmospheric pressure difference between sequences 1 and 8	2.25 mmHg (0.3 kPa) or less

TYPICAL MALFUNCTION THRESHOLDS

P0455: EVAP gross leak

Fuel tank pressure when vacuum introduction complete	Higher than 0.02 inch leak criterion x 0.2

P0456: EVAP small leak

Fuel tank pressure when vacuum introduction complete	Between 1 and 2
Condition 1	Higher than second 0.02 inch leak criterion

Condition 2	Lower than 0.02 inch leak criterion x 0.2
Atmospheric pressure (absolute pressure)	70 kPa (525 mmHg) or more, and less than 110 kPa (825 mmHg)

"Saturated" indicates that the EVAP pressure change is less than 0.1 kPa (0.75 mmHg) in 30 seconds.

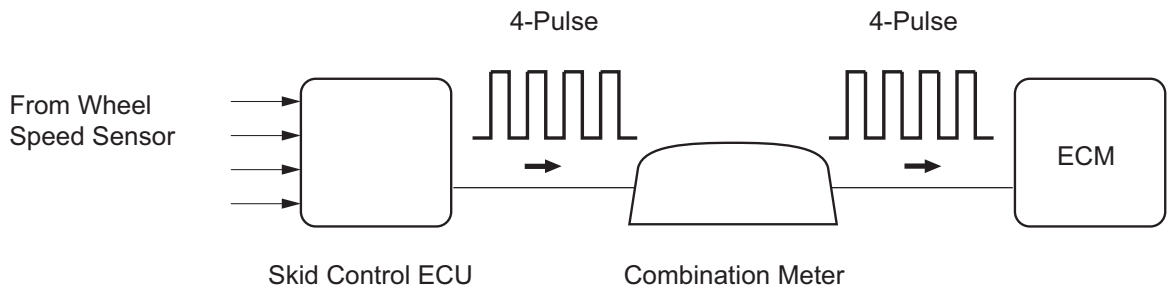
MONITOR RESULT

Detailed information on Checking Monitor Status (See page ES-19).

DTC	P0500	Vehicle Speed Sensor "A"

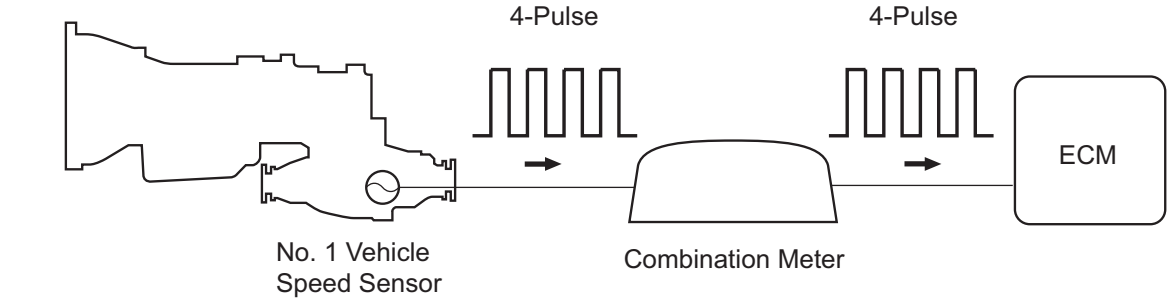
DESCRIPTION

Automatic Transaxle Models:
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.



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Manual Transaxle Models:
Vehicles, which are equipped with manual transaxle, detect the vehicle speed using the No. 1 vehicle speed sensor. The No. 1 vehicle speed sensor transmits a 4-pulse signal for every revolution of the rotor shaft, which is rotated by the transaxle or transfer output shaft via the driven gear. The 4-pulse signal is converted into a more precise rectangular waveform by the waveform shaping circuit inside the combination meter. The signal is then transmitted to the ECM. The ECM determines the vehicle speed based on the frequency of the pulse signal.



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DTC No.	DTC Detection Conditions	Trouble Areas
P0500	ECM detects following conditions simultaneously 500 times (1 trip detection logic) • No SP1 (speed sensor) signal while ECM detects SP2 (No. 2 speed sensor) signal • Vehicle speed 6 mph (9 km/h) or more for 4 seconds • Park/Neutral position switch OFF (shift lever other than P and N positions) • Transfer lever in other than N position (4WD)	• Open or short in speed signal circuit • Combination meter • ECM • Skid control ECU

MONITOR DESCRIPTION

Automatic 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 combination meter, despite the ECM detecting the speed signal from the speed sensor No. 2, the ECM interprets this as a malfunction in the speed signal circuit. The ECM then illuminates the MIL and sets a DTC.
Manual Transaxle Models:
The ECM assumes that the vehicle is being driven, when the indicated engine speed is more than 2,000 rpm and the engine load calculated by the ECM is more than certain level. If there is no signal from the vehicle speed sensor, despite these conditions being met, the ECM interprets this as a malfunction in the speed signal circuit. The ECM then illuminates the MIL and sets a DTC.

ES

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)	Park/neutral Position (PNP) switch, Engine Coolant Temperature (ECT) sensor, Crankshaft Position (CKP) sensor and Mass Air Flow (MAF) meter
Frequency of Operation	Continuous
Duration	8 seconds: Manual transmission Conditions met 500 times: Automatic transmission
MIL Operation	Immediate: Manual transmission 2 driving cycles: Automatic transmission
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

Manual Transmission:

Engine coolant temperature	70°C (158°F) or more
Engine speed	2,000 to 6,800 rpm
Fuel cut at high engine speed	Not executing
Engine load	38.5 % at 2,000 rpm 40 % at 3,600 rpm 43.5 % at 5,200 rpm 50 % at 6,800 rpm

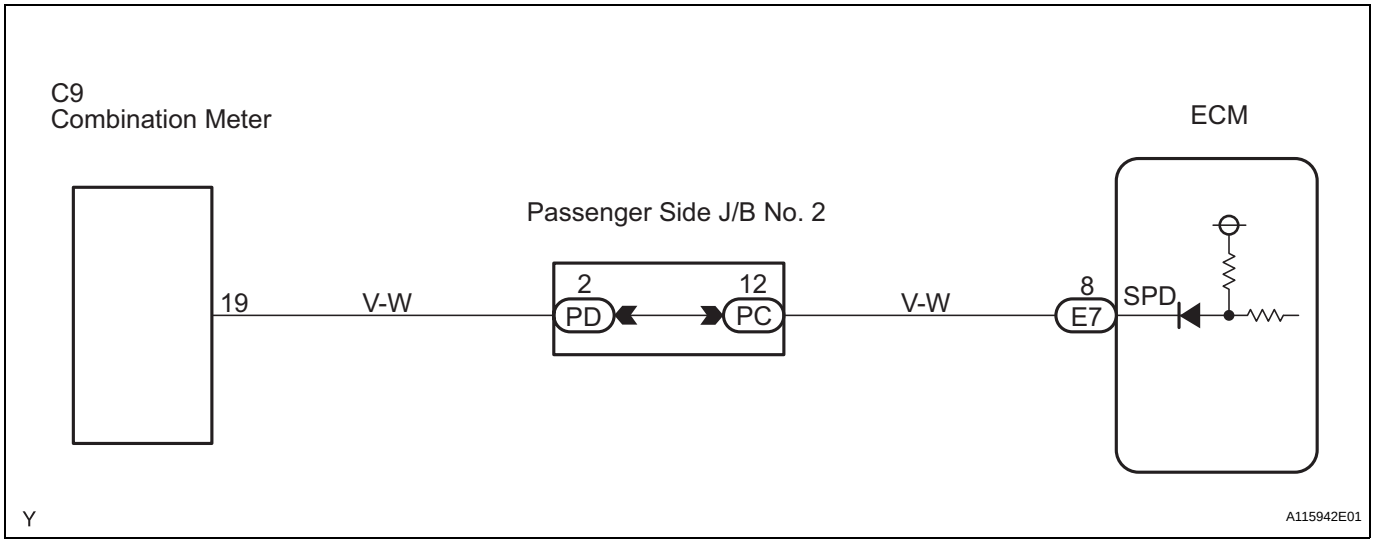
Automatic Transmission:

Time after following conditions met:	4 seconds or more
Ignition switch	ON
Park/neutral position switch	OFF
Vehicle speed	5.59 mph (9 km/h) or more
Time after ignition switch OFF to ON	More than 0.5 seconds

TYPICAL MALFUNCTION THRESHOLDS

Vehicle speed sensor signal	No pulse input

WIRING DIAGRAM



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

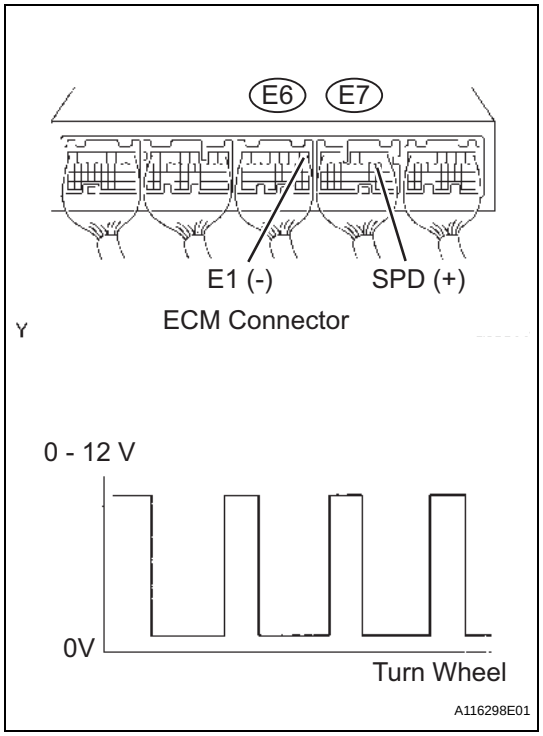
1	**CHECK OPERATION OF SPEEDOMETER**

(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 ON.
(d) Check the voltage between the terminals of the E6 and E7 ECM connectors as the wheel is turned slowly.

Standard

Tester Connections	Specified Conditions
SPD (E7-8) - E1 (E6-1)	Voltage generated intermittently

HINT:
The output voltage should fluctuate up and down similarly to the diagram on the left when the wheel is turned slowly.

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

OK

REPLACE ECM

ES

DTC	P0504	Brake Switch "A" / "B" Correlation

DESCRIPTION

The stop light switch is a duplex system that transmits two signals: STP and ST1-. These two signals are used by the ECM to monitor whether or not the brake system is working properly. If the signals, which indicate the brake pedal is being depressed and released, are detected simultaneously, the ECM interprets this as a malfunction in the stop light switch and sets the DTC.

HINT:

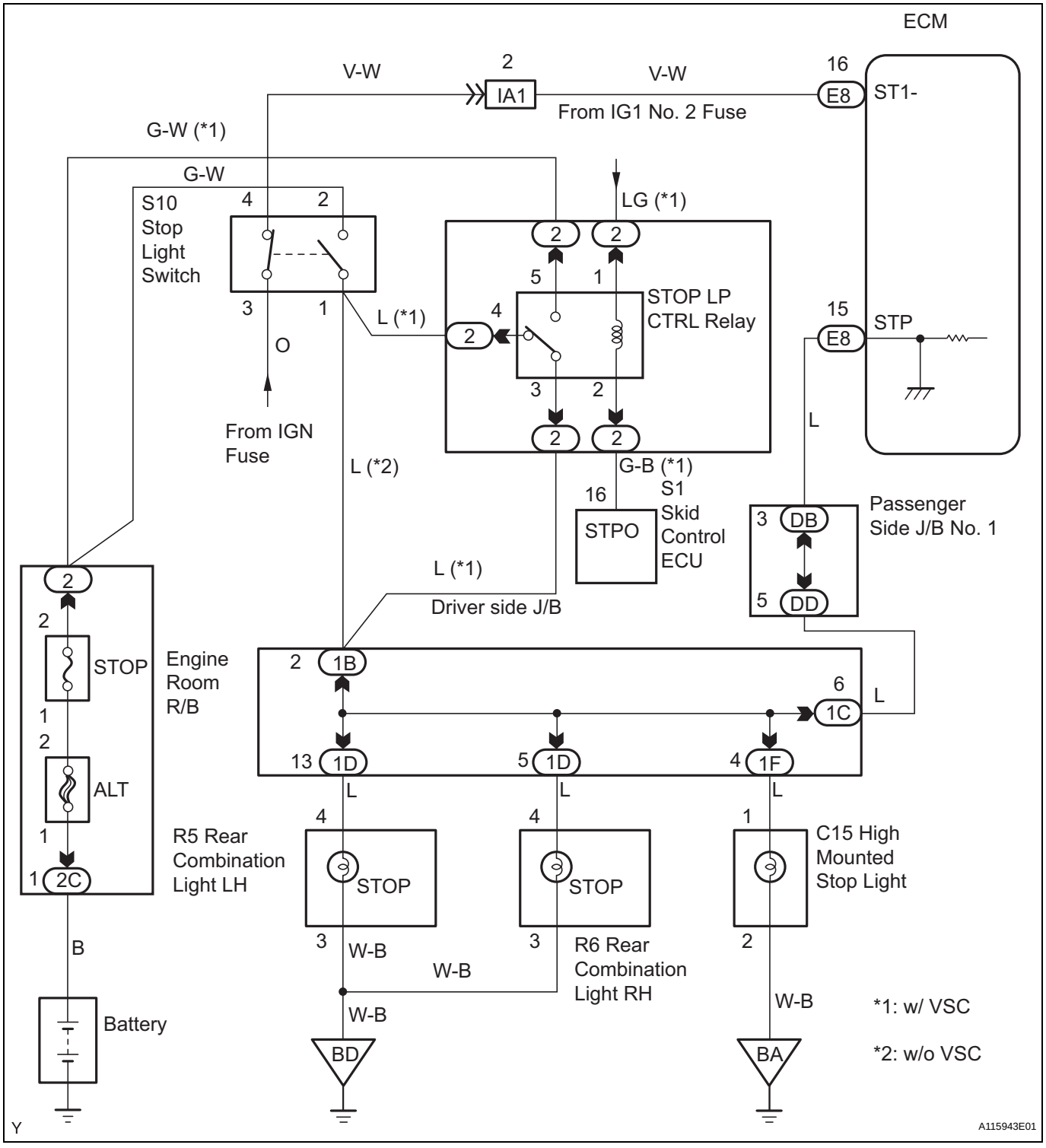
The normal conditions are as shown in the table below. The signals can be read using an intelligent tester.

Signals	Brake Pedal Released	In Transition	Brake Pedal Depressed
STP	OFF	ON	ON
ST1-	ON	ON	OFF

ES

DTC No.	DTC Detection Conditions	Trouble Areas
P0504	Conditions (a), (b) and (c) continue for 0.5 seconds or more (1 trip detection logic) (a) Ignition switch ON (b) Brake pedal released (c) STP signal OFF when ST1- signal OFF	• Short in stop light switch signal circuit • STOP fuse • Stop light switch • ECM

WIRING DIAGRAM



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

1	CHECK OPERATION OF STOP LIGHT

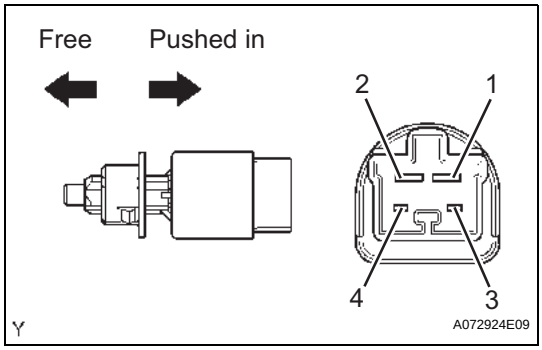
(a) Check whether the stop lights turn on and off normally when the brake pedal is depressed and released.
OK:
Stop lights turn ON when brake pedal is depressed.

NG → **REPAIR OR REPLACE STOP LIGHT SWITCH CIRCUIT**

OK

ES

2	INSPECT STOP LIGHT SWITCH ASSEMBLY



(a) Remove the stop light switch assembly.
(b) Check the resistance.
Standard Resistance

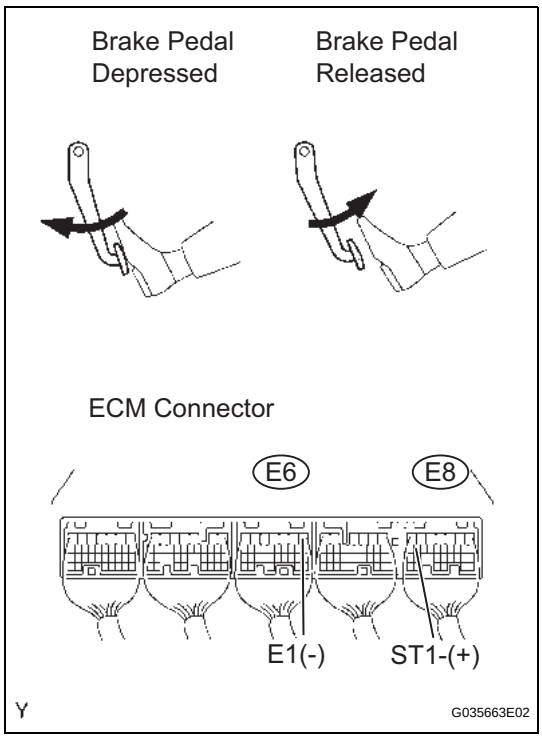
Switch Positions	Tester Connections	Specified Conditions
Switch pin free	1 - 2	Below 1 Ω
Switch pin free	3 - 4	10 kΩ or higher
Switch pin pushed in	1 - 2	10 kΩ or higher
Switch pin pushed in	3 - 4	Below 1 Ω

(c) Reinstall the stop light switch assembly.

NG → **REPLACE STOP LIGHT SWITCH ASSEMBLY**

OK

3	READ VALUE OF INTELLIGENT TESTER (STP SIGNAL AND ST1 - VOLTAGE)



(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / STOP LIGHT SW.
(d) Check the STP signal when the brake pedal is depressed and released.
Standard

Brake Pedal Operations	Specified Conditions
Depressed	STP signal ON
Released	STP signal OFF

(e) Measure the voltage between the terminals of the E8 and E6 ECM connectors.
Standard Voltage

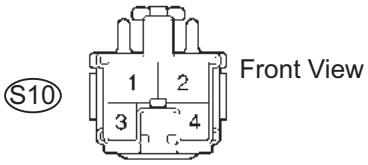
Tester Connections	Brake Pedal Operations	Specified Conditions
ST1 - (E8-16) - E1 (E6-1)	Depressed	Below 1.5 V
ST1 - (E8-16) - E1 (E6-1)	Released	7.5 to 14 V

OK → **CHECK FOR INTERMITTENT PROBLEMS**

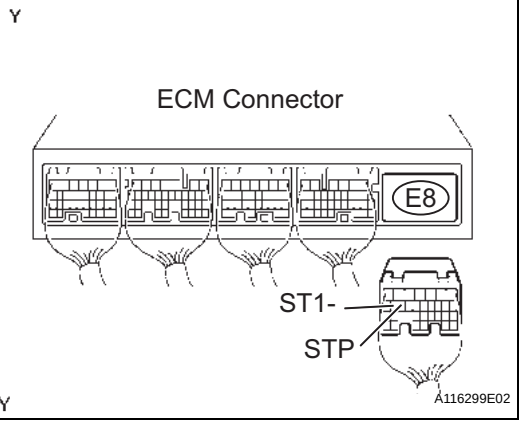
NG

4	CHECK HARNESS AND CONNECTOR (STOP LIGHT SWITCH - ECM)

Wire Harness Side:



Stop Light Switch Connector



(a) Disconnect the S10 stop light switch connector.
(b) Disconnect the E8 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
Stop light switch (S10-1) - STP (E8-15)	Below 1 Ω
Stop light switch (S10-4) - ST1- (E8-16)	

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
Stop light switch (S10-1) or STP (E8-15) - Body ground	10 kΩ or higher
Stop light switch (S10-4) or ST1- (E8-16) - Body ground	

(d) Reconnect the stop light switch connector.
(e) Reconnect the ECM connector.

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 ETCS is comprised of: 1) the one valve type throttle body; 2) the throttle actuator, which operates the throttle valve; 3) the Throttle Position (TP) sensor, which detects the opening angle of the throttle valve; 4) the Accelerator Pedal Position (APP) sensor, which detects the accelerator pedal position; and 5) the ECM, which controls the ETCS. Based on the target idling speed, the ECM controls the throttle actuator to provide the proper throttle valve opening angle.

DTC No.	DTC Detection Conditions	Trouble Areas
P0505	Idling speed continues to vary greatly from target idling speed (2 trip detection logic)	• ETCS • Air induction system • PCV hose connection • 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 apply:

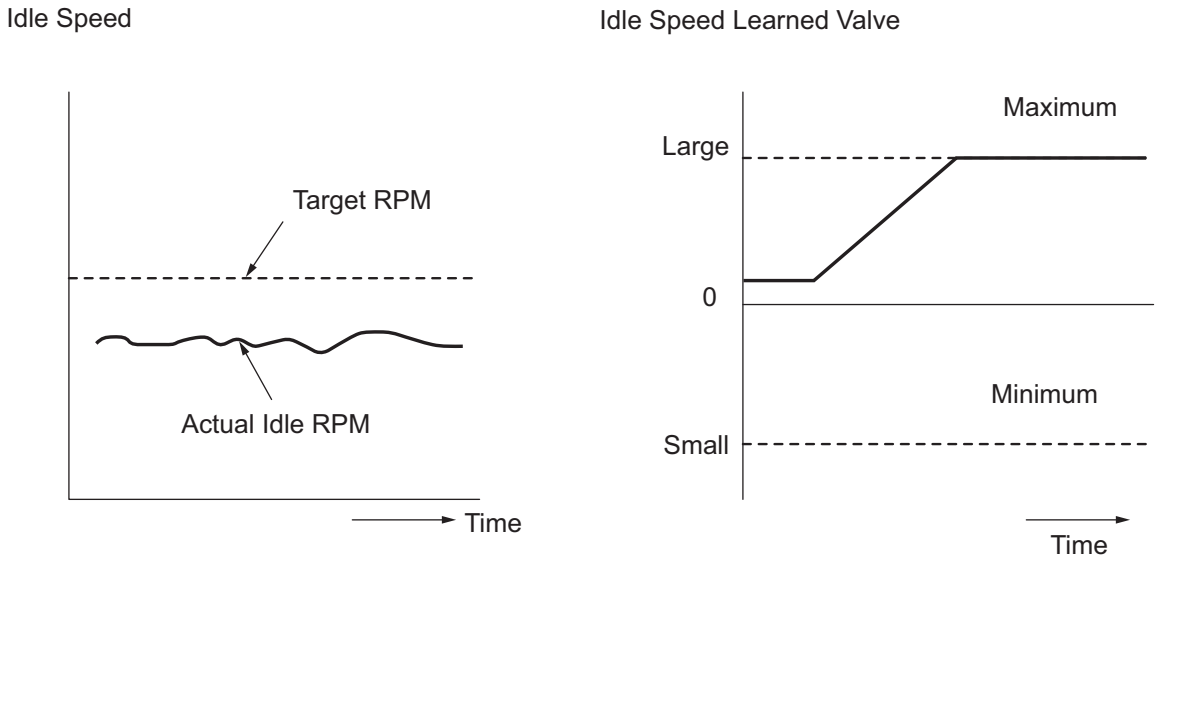
- The learned idling air flow volume remains at the maximum or minimum volume 5 times or more during a drive cycle.
- While driving at 6 mph (10 km/h) or more, the actual engine idling speed varies from the target idling speed by between 100 rpm and 200 rpm, 5 times or more during a drive cycle.

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.

Example



Y A121611E01

ES

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

TYPICAL ENABLING CONDITIONS

Functional check:

Monitor runs whenever following DTCs not present	None
Engine	Running

TYPICAL MALFUNCTION THRESHOLDS

Functional check:

Either of following conditions 1 or 2 met	-
1. Frequency that following conditions (a) and (b) met	5 times or more
(a) Engine RPM - target engine RPM (A/C OFF and NSW OFF)	Below -100 rpm, or 150 rpm or more
(b) ISC feedback correction amount	-0.17 L/sec or less, or 2.08 L/sec or more
2. Frequency that following conditions (c) and (d) met	Once
(c) Engine RPM - target engine RPM (A/C OFF and NSW OFF)	Below -100 rpm, or 150 rpm or more
(d) ISC airflow rate (learning value)	1.3 L/sec. or less, or 8.5 L/sec. or more

HINT:

- The following conditions may also cause DTC P0505 to be set:
  (1) The floor carpet overlapping slightly onto the accelerator pedal, causing the accelerator pedal to be slightly depressed and therefore the throttle valve position to be slightly open.
  (2) The accelerator pedal being not fully released.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

ES

1 CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0505)

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

Result

Display (DTC Output)	Proceed To
P0505	A
P0505 and other DTCs	B

HINT:
If any DTCs other than P0505 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	CHECK THROTTLE VALVE

(a) Check the throttle valve condition.

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

OK

REPLACE ECM

DTC	P050A	Cold Start Idle Air Control System Performance

DTC	P050B	Cold Start Ignition Timing Performance

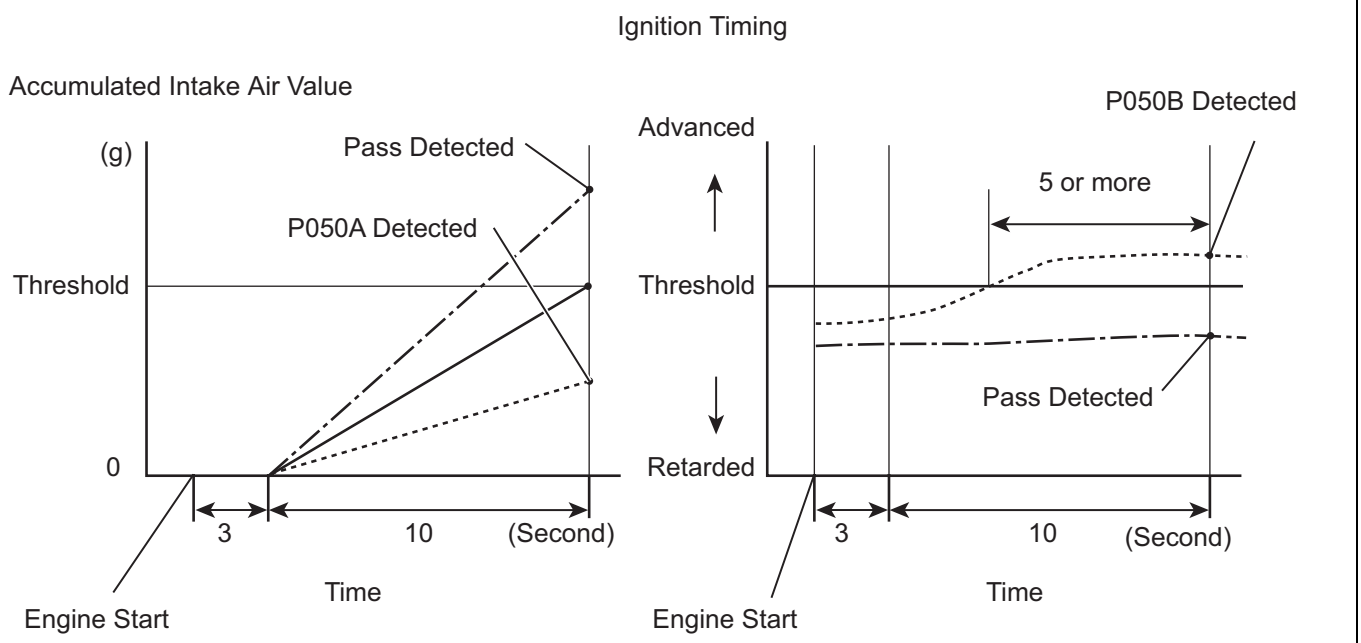
DESCRIPTION

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.

ES

DTC No.	DTC Detection Conditions	Trouble Areas
P050A	Accumulated intake air amount during 10 seconds of idling after cold start, 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)	

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.

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 (Automatic Transmission)	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 (Manual Transmission)	Varies with ECT (Example: Less than 42.5 g)
Accumulated air flow amount (Automatic Transmission)	Varies with ECT (Example: Less than 47.5 g)

P050B:

Accumulated time when ignition timing retard value insufficient	5 seconds or more

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

ES

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P050A AND/OR P050B)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Select the following 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 OF INTELLIGENT TESTER (FUEL TRIM)

HINT:
Calculate the total fuel trim values to check the characteristic deviation of the mass air flow meter.
(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(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 the SHORT FT #1 and LONG FT #1 values is between -20 % and 20 %.

OK → **Go to step 14**

NG

3	PERFORM ACTIVE TEST USING INTELLIGENT TESTER (PURGE VSV)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV.
(e) Disconnect the hose (connected to the canister) from the purge VSV.
(f) Start the engine.
(g) Using the tester, turn off the purge VSV (EVAP VSV: OFF).
(h) Use your finger to confirm that the purge VSV has no suction.
OK:
Purge VSV has no suction.
(i) Using the tester, turn on the purge VSV (EVAP VSV: ON).
(j) Use your finger to confirm that the purge VSV has suction.
OK:
Purge VSV has suction.

NG → **Go to step 9**

OK

4	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.

NG → **Go to step 10**

OK

5	CHECK PCV HOSE CONNECTIONS

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

NG → **Go to step 11**

OK

6	CHECK AIR INDUCTION SYSTEM

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

NG → **Go to step 12**

OK

ES

7	CHECK AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY

NEXT → **Go to step 13**

OK

8	REPLACE MASS AIR FLOW METER

NEXT → **Go to step 19**

9	REPLACE PURGE VSV

NEXT → **Go to step 19**

10	CHECK AND REPAIR VVT SYSTEM

NEXT → **Go to step 19**

11	REPAIR OR REPLACE PCV HOSE

NEXT → **Go to step 19**

12	REPAIR OR REPLACE AIR INDUCTION SYSTEM

NEXT → **Go to step 19**

13	REPLACE AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY

NEXT → **Go to step 19**

14	READ VALUE OF INTELLIGENT TESTER (ENGINE SPD)

NG → Go to step 17

OK

15	CHECK THROTTLE VALVE

(a) Check for deposits around the throttle valve and throttle valve condition.

OK:

No deposits around the throttle valve and throttle valve moves smoothly

NG → Go to step 18

OK

16	REPLACE ECM

NEXT → Go to step 19

17	REPAIR OR REPLACE CRANKSHAFT POSITION SENSOR CIRCUIT

NEXT → Go to step 19

18	REPAIR OR REPLACE THROTTLE BODY ASSEMBLY

NEXT → Go to step 19

19	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 an intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the tester ON.
(d) Clear DTCs (See page ES-38).
(e) Switch the ECM from normal mode to check mode using the tester (See page ES-41).
(f) Start the engine to idle for a minute.

OK:

Stable fast idling.

(g) Read DTCs.

OK:
No DTC output.

NEXT

END

DTC	P0560	System Voltage

DESCRIPTION

The battery supplies electricity to the ECM even when the ignition switch is in the OFF position. This power allows the ECM to store data such as DTC history, freeze frame data and fuel trim values. If the battery voltage falls below a minimum level, 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 Conditions	Trouble Areas
P0560	Open in ECM back up power source circuit (1 trip detection logic)	• Open in back up power source circuit • EFI fuse • ECM

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

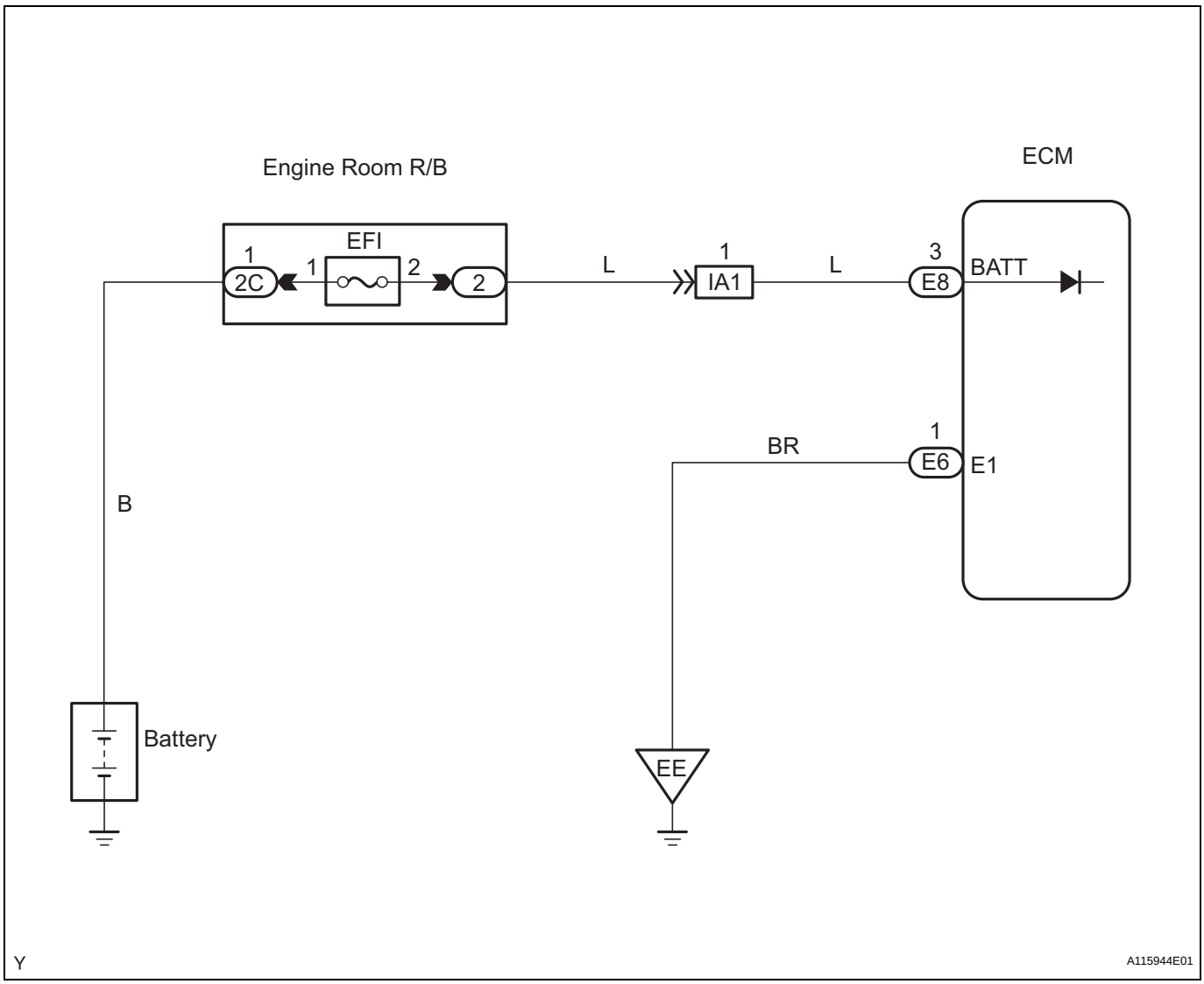
TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Stand-by RAM	Initialized

TYPICAL MALFUNCTION THRESHOLDS

ECM power source	Less than 3.5 V

WIRING DIAGRAM

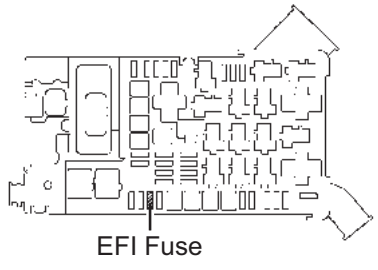


ES

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

1	CHECK FUSE (EFI FUSE)

Engine Room R/B:

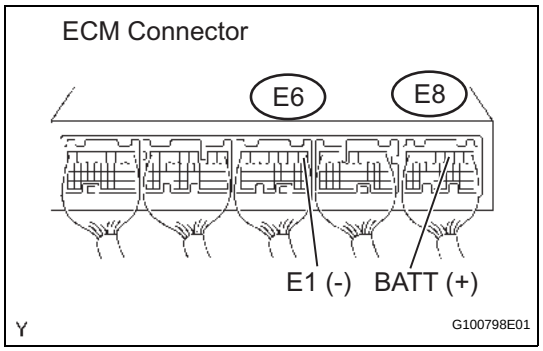


(a) Remove the EFI fuse from the engine room R/B.
(b) Check the resistance.
Standard Resistance:
Below 1 Ω
(c) Reinstall the EFI fuse.

NG → **CHECK FOR SHORT IN ALL HARNESSES AND COMPONENTS CONNECTED TO FUSE**

OK

2 INSPECT ECM (BATT VOLTAGE)



(a) Measure the voltage between the terminals of the E8 and E6 ECM connectors.

Standard Voltage

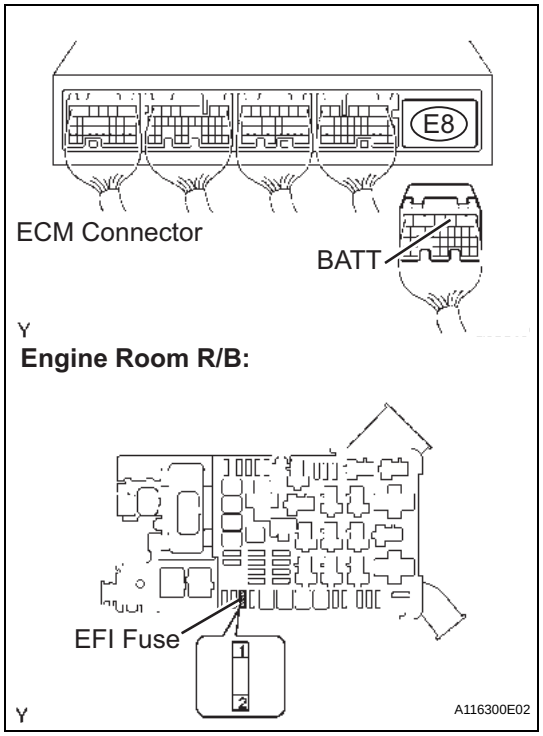
Tester Connections	Specified Conditions
BATT (E8-3) - E1 (E6-1)	9 to 14 V

NG → **Go to step 3**

OK

REPLACE ECM

3 CHECK HARNESS AND CONNECTOR (ECM - EFI FUSE, EFI FUSE - BATTERY)



(a) Check the harness and the connector between the EFI fuse and ECM.
(1) Remove the EFI fuse from the engine room R/B.
(2) Disconnect the E8 ECM connector.
(3) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
EFI fuse (2) - BATT (E8-3)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
EFI fuse (2) or BATT (E8-3) - Body ground	10 kΩ or higher

(4) Reconnect the ECM connector.
(5) Reinstall the EFI fuse.

(b) Check the harness and the connector between the EFI fuse and battery.
(1) Remove the EFI fuse from the engine room R/B.
(2) Disconnect the positive battery terminal.
(3) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
Battery positive terminal - EFI fuse (1)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
Battery positive terminal or EFI fuse (1) - Body ground	10 kΩ or higher

(4) Reconnect the positive battery terminal.

ES

(5) Reinstall the EFI fuse.

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

DTC	P0606	ECM / PCM Processor

DTC	P0607	Control Module Performance

DTC	P0657	Actuator Supply Voltage Circuit / Open

DESCRIPTION

The ECM continuously monitors its own internal memory status, internal circuits, and output signals transmitted to the throttle actuator. This self-check insures that the ECM is functioning properly. If any malfunction is detected, the ECM sets the appropriate DTC and illuminates the MIL.
The ECM memory status is diagnosed by internal mirroring of the main CPU and the sub CPU to detect Random Access Memory (RAM) errors. The two CPUs also perform continuous mutual monitoring. The ECM illuminates the MIL and sets a DTC if: 1) outputs from the two CPUs are different or deviate from the standards, 2) the signals sent to the throttle actuator deviate from the standards, 3) a malfunction is found in the throttle actuator supply voltage, and 4) any other ECM malfunction is found.

DTC No.	DTC Detection Conditions	Trouble Areas
P0604 P0606 P0607 P0657	ECM internal error (1 trip detection logic)	ECM

MONITOR STRATEGY

Related DTCs	P0604: ECM RAM error P0606: ECM range check P0607: ECM CPU malfunction P0657: ETCS power supply
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	P0604: 6 times or more P0606: Within 16 seconds P0607 and P0657: Within 1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

ECM RAM errors (P0604):

RAM mirror check	fail

ECM CPU range check (P0606):

Either of following conditions met:	-
Difference between throttle valve position of main CPU and throttle valve position of sub CPU	0.3 V or more
Difference between accelerator pedal position of main CPU and accelerator pedal position of sub CPU	0.3 V or more

ECM CPU malfunction (P0607):

Either A or B met	-
A. Following conditions met	
CPU reset	1 time or more
Learned TP - learned APP	0.4 V or more
Throttle actuator	OFF
B. CPU reset	2 times or more

Electronic throttle control system power supply function of ECM malfunctions (P0657):

ETCS (Electronic Throttle Control System) power supply when ignition switch turned ON	7 V or more

ES

Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0604/P0606/P0607/P0657)

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

Result

Display (DTC output)	Proceed to
P0604, P0606, P0607, P0657	A
No output DTC	B

B → GO TO DTC CHART

A

REPLACE ECM

DTC	P0617	Starter Relay Circuit High

DESCRIPTION

While the engine is being 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 Conditions	Trouble Areas
P0617	When conditions (a), (b) and (c) met, positive (+B) battery voltage 10.5 V or more applied to ECM for 20 seconds (1 trip detection logic) (a) Vehicle speed more than 12.4 mph (20 km/h) (b) Engine speed more than 1,000 rpm (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 Transmission models and M/T denotes Manual Transmission 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

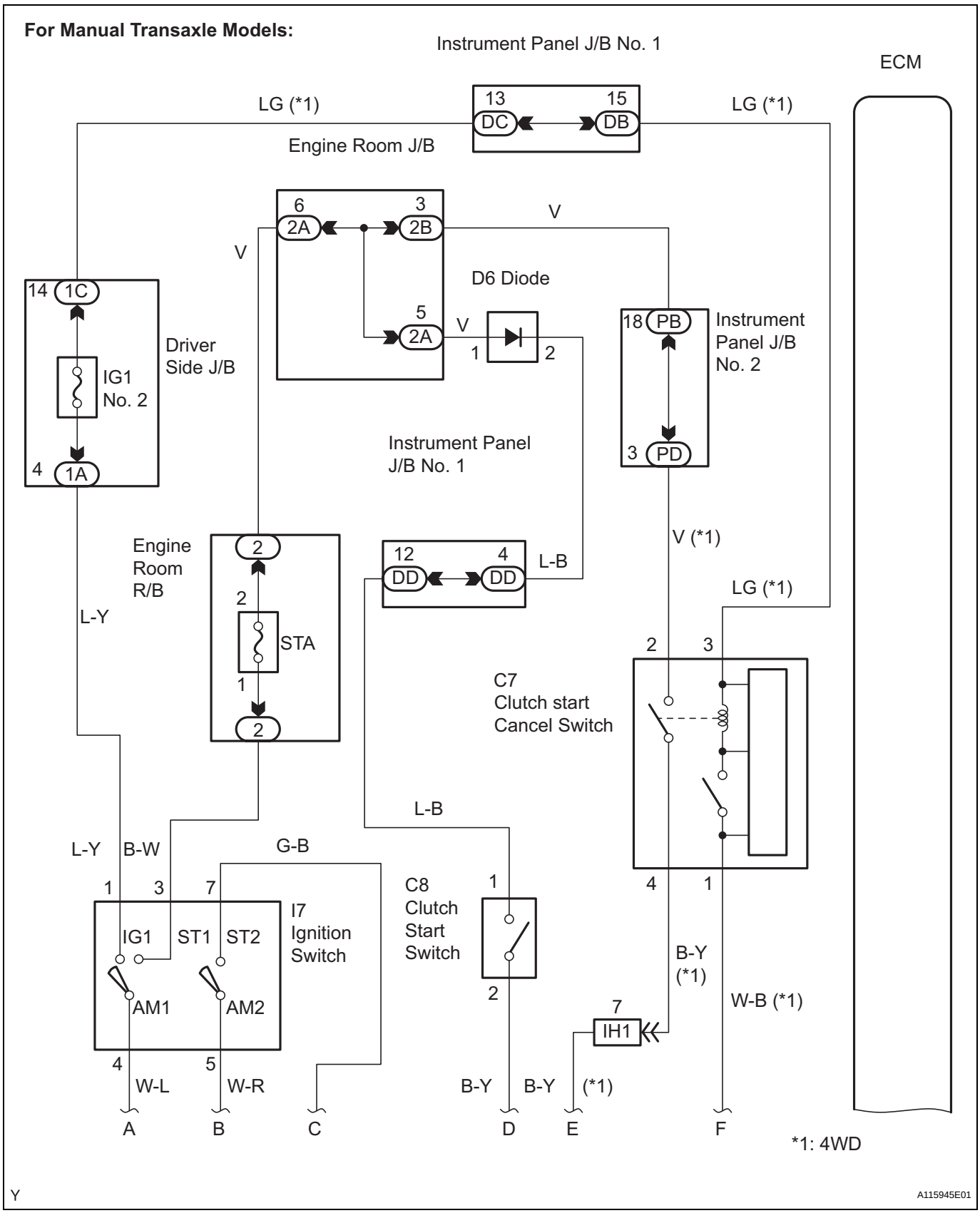
TYPICAL ENABLING CONDITIONS

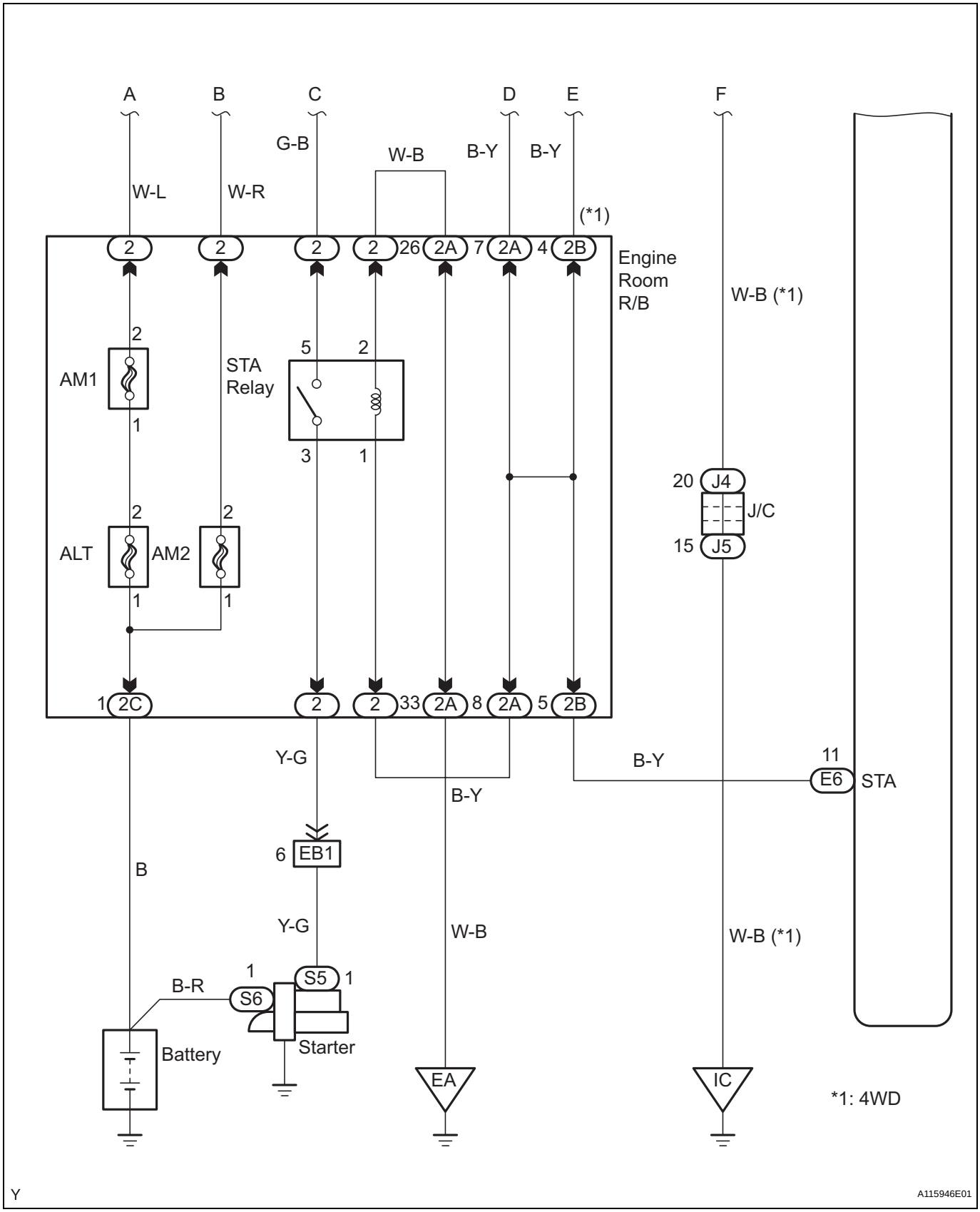
Monitor runs whenever following DTCs not present	None
Battery voltage	10.5 V or more
Vehicle speed	12.4 mph (20 km/h) or more
Engine speed	1,000 rpm or more

TYPICAL MALFUNCTION THRESHOLDS

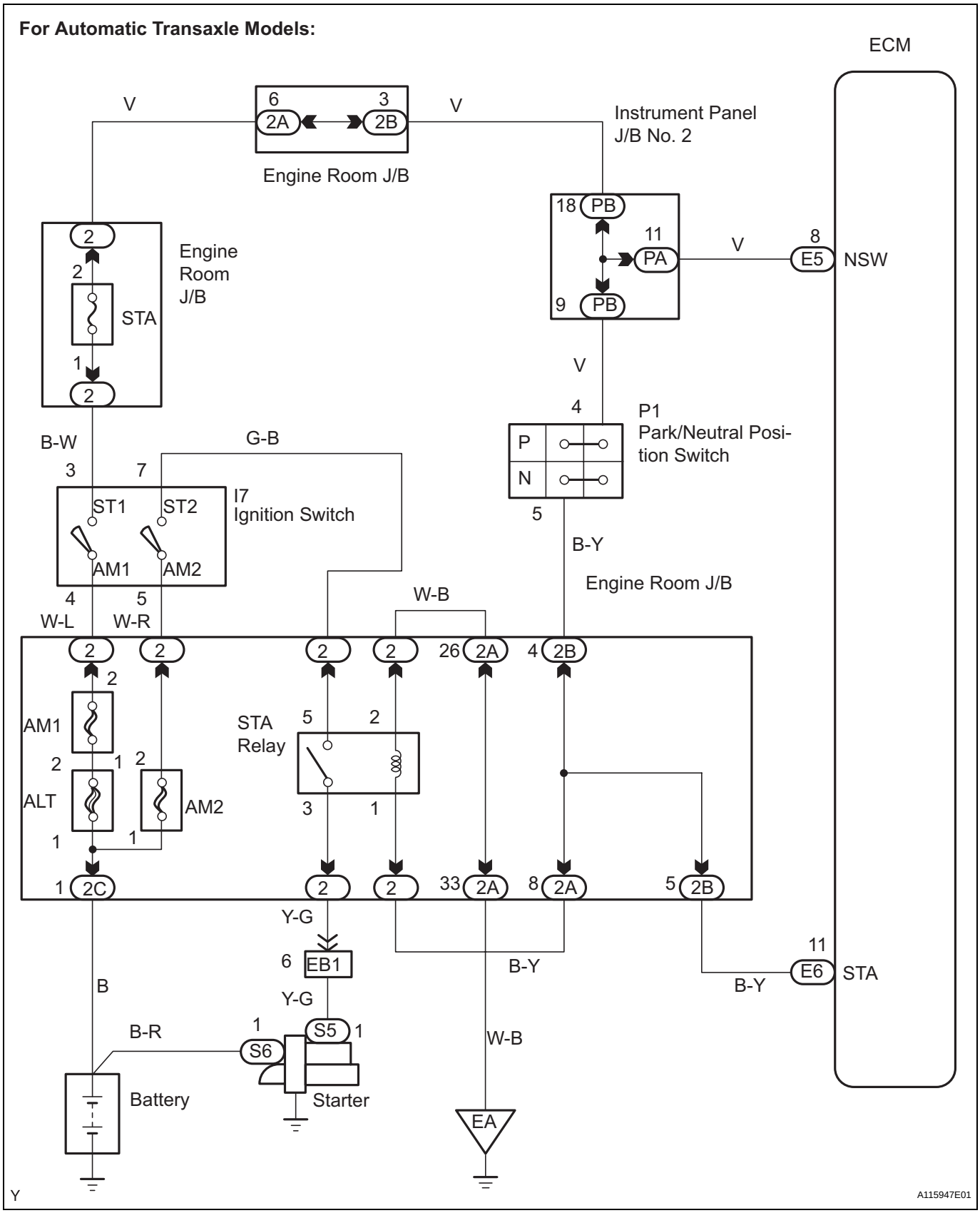
Starter signal	ON

WIRING DIAGRAM




A
B
C
D
E
F
G-B
W-B
B-Y
B-Y
W-L
W-R
(*1)
2
2
2
2
26
2A
7
2A
4
2B
Engine Room R/B
W-B (*1)
2
AM1
1
STA Relay
5
2
3
1
20
J4
J/C
15
J5
2
2
ALT
AM2
1
1
1
2C
2
2
33
2A
8
2A
5
2B
Y-G
B-Y
11
E6
STA
B-Y
6
EB1
B
Y-G
W-B
W-B (*1)
1
S5
1
B-R
S6
Battery
Starter
EA
IC
*1: 4WD
Y
A115946E01

ES



HINT:

- The following troubleshooting flowchart is based on the premise that the engine is cranked normally. If the engine will not crank, proceed to the problem symptoms table (See page ES-28).

- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1 READ VALUE OF INTELLIGENT TESTER (STARTER SIGNAL)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / STARTER SIG.
(d) Check the value displayed on the tester when the ignition switch is turned to ON and START positions.

ES

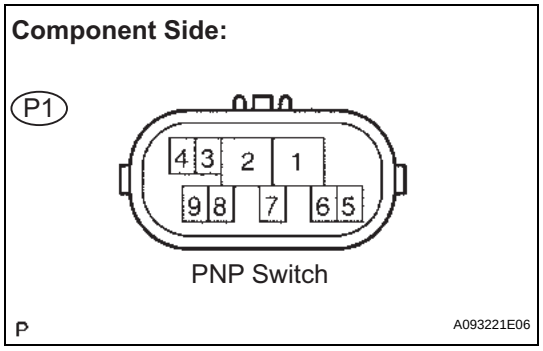
OK

Ignition Switch Positions	ON	START
STARTER SIG	OFF	ON

OK → REPLACE ECM

NG

2 INSPECT PARK/NEUTRAL POSITION SWITCH OR CLUTCH START SWITCH

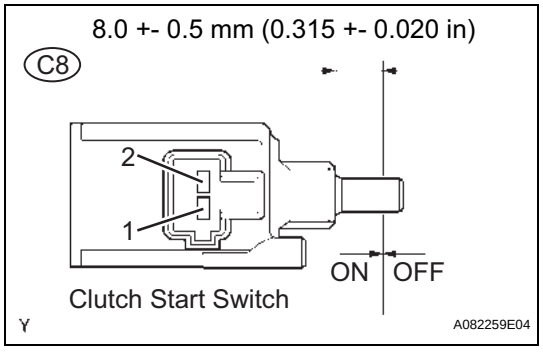


(a) Inspect the Park/Neutral Position (PNP) switch (For Automatic Transmission models).
(1) Disconnect the P1 PNP switch connector.
(2) Check the resistance when the transmission gear selector lever is moved to each position.

Standard Resistance

Gear Selector Lever Positions	Tester Connections	Specified Conditions
P	2 - 6, 4 - 5	Below 1 Ω
R	1 - 2	
N	2 - 9, 4 - 5	
D	2 - 7	
2	2 - 3	
L	2 - 8	

(3) Reconnect the PNP switch connector.



(b) Inspect the clutch start switch (For Manual Transmission models).
(1) Disconnect the C8 clutch start switch connector.
(2) Check the resistance when the clutch start switch is ON and OFF.

Standard Resistance

Ignition Switch Positions	Tester Connections	Specified Conditions
ON (pushed)	1 - 2	Below 1 Ω
OFF (free)	1 - 2	10 kΩ or higher

(3) Reconnect the clutch start switch connector.

NG → REPLACE PARK / NEUTRAL POSITION SWITCH ASSEMBLY (THEN CHECK CRANKING HOLDING FUNCTION CIRCUIT)

OK

3 READ VALUE OF INTELLIGENT TESTER (STARTER SIGNAL)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / STARTER SIG.
(d) Check the value displayed on the tester when the ignition switch is turned to ON and START positions.

OK

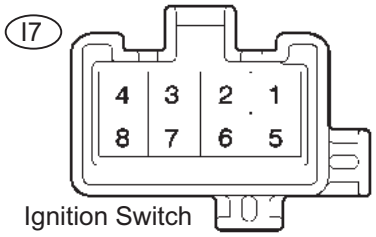
Ignition Switch Positions	ON	START
STARTER SIG	OFF	ON

OK → SYSTEM OK

NG

4 INSPECT IGNITION OR STARTER SWITCH ASSEMBLY

Component Side:



(a) Disconnect the I7 ignition switch connector.
(b) Check the resistance.

Standard Resistance

Ignition Switch Positions	Tester Connections	Specified Conditions
LOCK	All Terminals	10 kΩ or higher
ACC	2 - 4	Below 1 Ω
ON	1 - 2, 1 - 4, 5 - 6	
START	1 - 3, 1 - 4, 3 - 4, 5 - 6, 5 - 7, 6 - 7	

(c) Reconnect the ignition switch connector.

NG → REPLACE IGNITION OR STARTER SWITCH ASSEMBLY

OK

5 READ VALUE OF INTELLIGENT TESTER (STARTER SIGNAL)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / STARTER SIG.
(d) Check the value displayed on the tester when the ignition switch is turned to ON and START positions.

OK

Ignition Switch Positions	ON	START
STARTER SIG	OFF	ON

OK → SYSTEM OK

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

DTC	P0630	VIN not Programmed or Mismatch - ECM / PCM

DESCRIPTION

DTC P0630 is set when the Vehicle Identification Number (VIN) is not stored in the Engine Control Module (ECM) or the input VIN is not accurate. Input the VIN with an intelligent tester.

DTC No.	DTC Detection Conditions	Trouble Areas
P0630	• VIN not stored in ECM • Input VIN in ECM not accurate	• ECM

MONITOR STRATEGY

Related DTCs	P0630: VIN not programmed
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 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

1	READ CURRENT DTC

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

Result

Display (DTC Output)	Proceed To
P0630	**A**
P0630 and other DTCs	**B**

If any DTCs other than P0630 are output, troubleshoot those DTCs first.

NOTICE:
If P0630 is set, the VIN must be input to the ECM using an 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.

B	GO TO DTC CHART

A

2	INPUT VIN WITH INTELLIGENT TESTER

NEXT

END

DTC	P0724	Brake Switch "B" Circuit High

DESCRIPTION

The purpose of this circuit is to prevent the engine from stalling, while driving in lock-up condition, when brakes are suddenly applied.
When the brake pedal is depressed, this switch sends a signals to the ECM. Then the ECM cancels the operation of the lock-up clutch while braking is in progress.

DTC No.	DTC Detection Conditions	Trouble Areas
P0724	The stop light switch remains ON even when the vehicle repeats 5 cycles of STOP (less than 1.86 mph (3 km/h)) and GO (18.65 mph (30 km/h)or more) (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 "stop and go" driving, the ECM interprets this as a fault in the stop light switch and the MIL comes on and the ECM stores the DTC. The vehicle must stop (less than 1.86 mph (3 km/h)) and go (18.65 mph (30 km/h) or more) 5 times during 2 driving cycles, in order to detect a malfunction.

MONITOR STRATEGY

Related DTCs	P0724: Stop light switch/Range check/Rationality
Required sensors/Components (Main)	Stop light switch
Required sensors/Components (Related)	Speed sensor
Frequency of Operation	Continuous
Duration	5 times
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

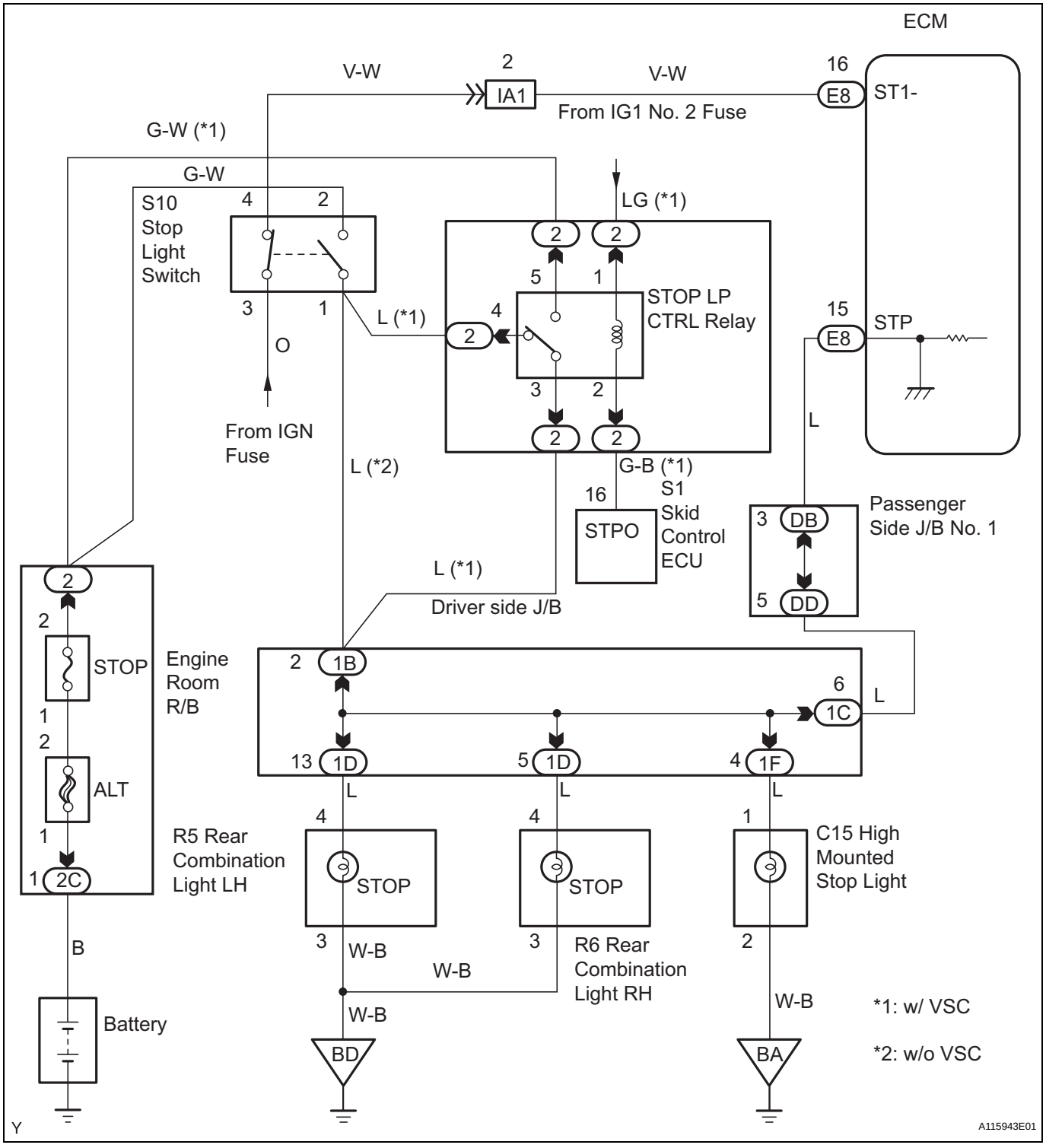
The stop light switch remains ON during GO and STOP 5 times.
GO and STOP are defined as follows;

Monitor will run whenever following DTCs not present	None
GO: Vehicle speed	18.65 mph (30 km/h) or more
STOP: Vehicle speed	Less than 1.86 mph (3 km/h)

TYPICAL MALFUNCTION THRESHOLDS

Stop light switch status	Stuck ON

WIRING DIAGRAM



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

1	READ VALUE OF INTELLIGENT TESTER (STOP LIGHT SW)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / STOP LIGHT SW.
(d) Read the values displayed on the tester.

OK

Item	Measurement Item: Range (display)	Normal Condition
STOP LIGHT SW	Stop light switch status: ON or OFF	• ON: Brake pedal is depressed • OFF: Brake pedal is released

ES

OK → CHECK FOR INTERMITTENT PROBLEMS

NG

2	INSPECT STOP LIGHT SWITCH ASSEMBLY (See page ES-250)

NG → REPLACE STOP LIGHT SWITCH ASSEMBLY

OK

3	CHECK HARNESS AND CONNECTOR (STOP LIGHT SWITCH - ECM) (See page ES-251)

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

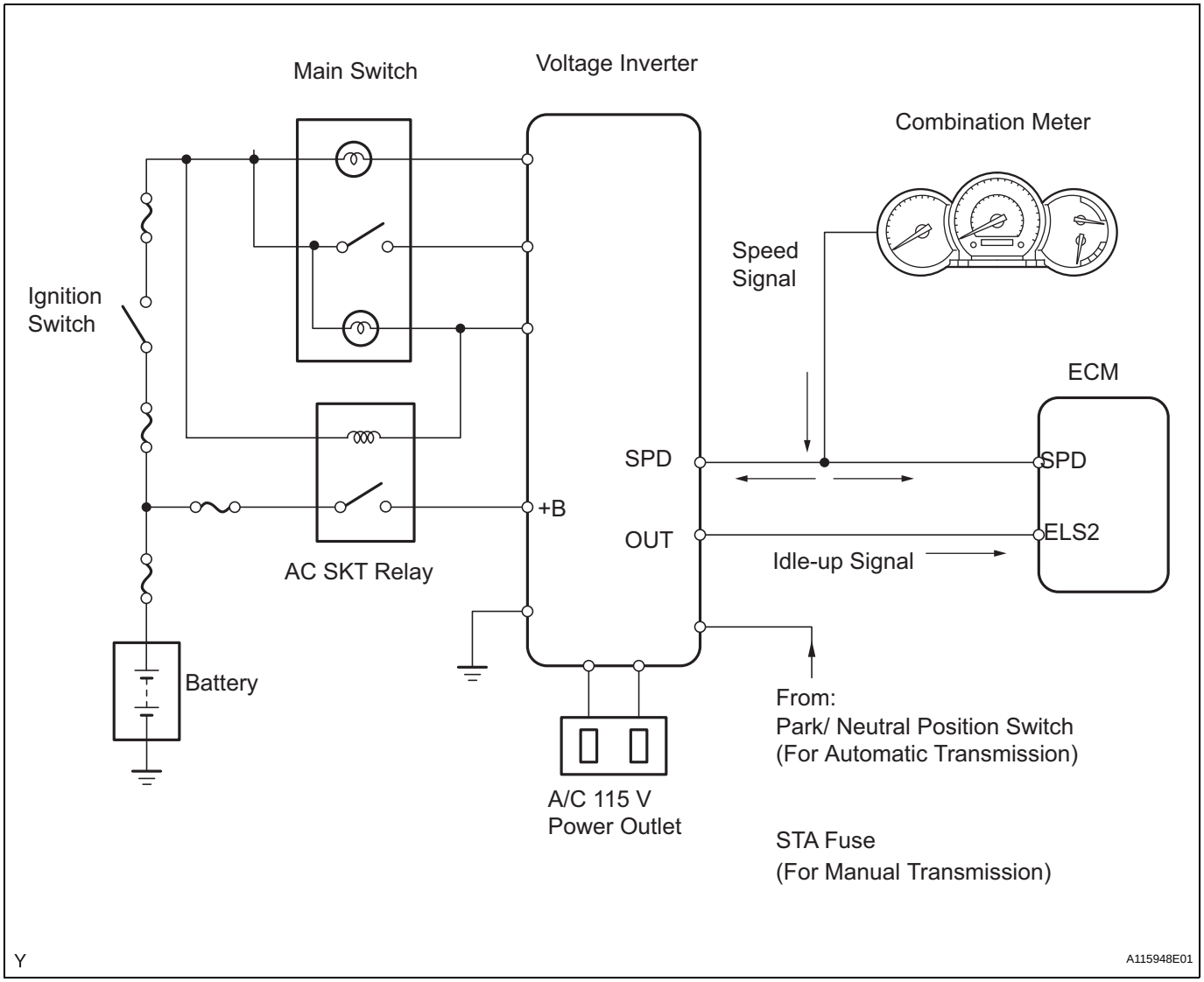
OK

REPLACE ECM

DTC	P1500	AC Inverter Malfunction

DESCRIPTION

This vehicle is equipped with a voltage inverter, which supplies power to various electrical appliances. When the main switch of the voltage inverter is turned ON, the inverter relay turns ON, and the inverter then converts the 12 V Direct Current (DC) of the battery into an 115 V Alternating Current (AC). The voltage inverter can output a maximum of 400W from an outlet.
When the AC 115 V is output, a load is applied to the engine. The ECM controls the engine idling speed according to the vehicle speed and engine load. A speed signal is input to the inverter and an idle-up signal is transmitted to the ECM.



DTC No.	DTC Detection Conditions	Trouble Areas
P1500	While vehicle running, idle-up signal input to ECM for 10 seconds	• Open or short in speed signal circuit • Short between idle-up signal and +B circuits • Voltage inverter • ECM

MONITOR DESCRIPTION

While the engine is idling, the ECM performs idle-up according to the power supply of the inverter to stabilize the engine idling speed.

When the vehicle is stationary and the inverter input exceeds 8.3 A, the inverter sends an idle-up signal from the OUT terminal of the inverter to the ELS2 terminal of the ECM.
If the idle-up signal is input into the ECM for 10 seconds while the vehicle is running, the ECM interprets this as a malfunction in the inverter circuit and sets the DTC.

MONITOR STRATEGY

Related DTCs	P1500: Voltage inverter performance
Required Sensors/Components (Main)	Voltage inverter
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

ES

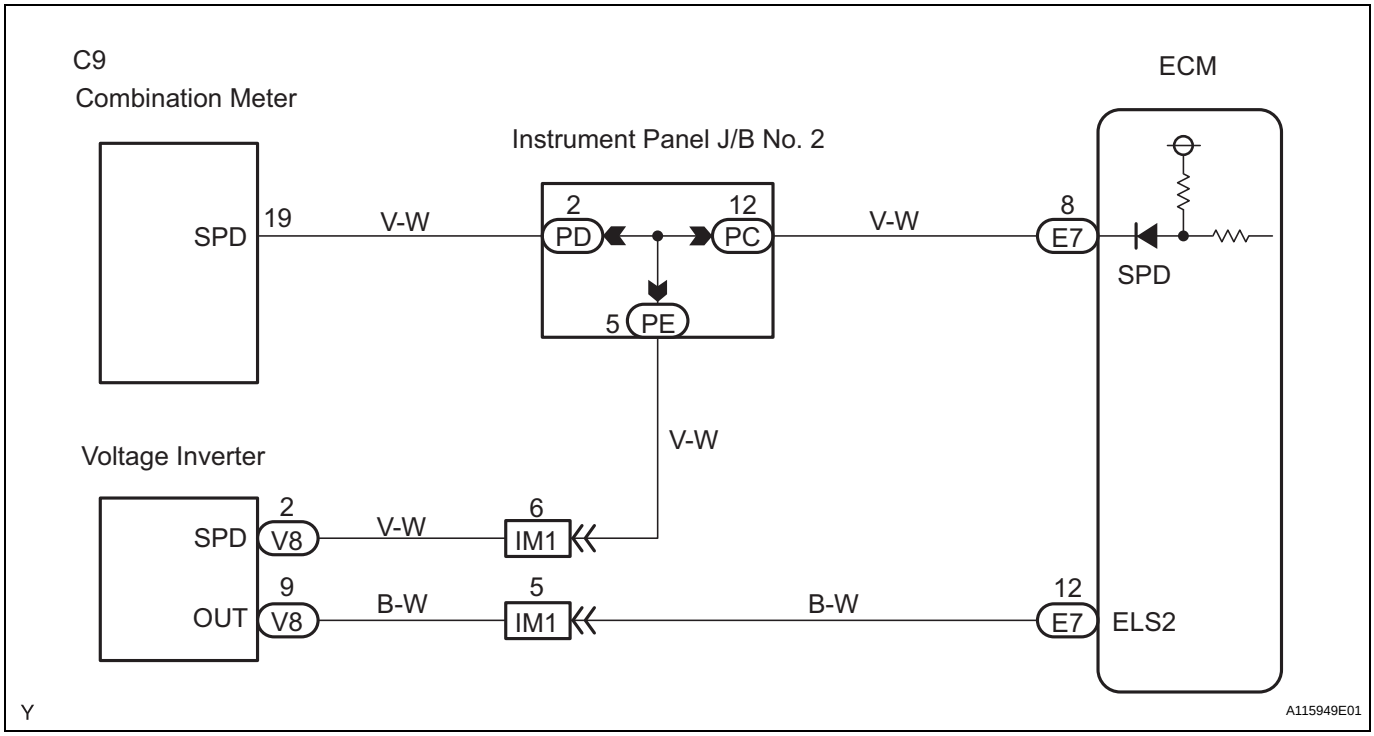
TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Vehicle speed	3.11 mph (5 km/h) or more
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

Electric load signal 2	ON

WIRING DIAGRAM



1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P1500)

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

Result

Display (DTC output)	Proceed To
P1500	A
P1500 and other DTCs	B

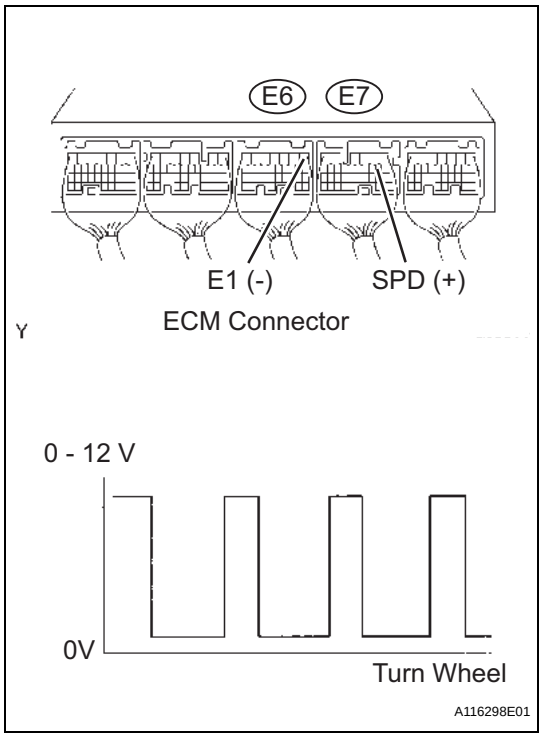
ES

HINT:
If any DTCs other than P1500 are output, troubleshoot those DTCs first.

NG → **GO TO DTC CHART**

OK

2	INSPECT VOLTAGE INVERTER ASSEMBLY (SPD SIGNAL)



(a) Shift the transmission gear selector lever to the neutral position.
(b) Jack up the vehicle.
(c) Turn the ignition switch ON.
(d) Check the voltage between the terminals of the ECM connectors as the wheel is turned slowly.

Standard

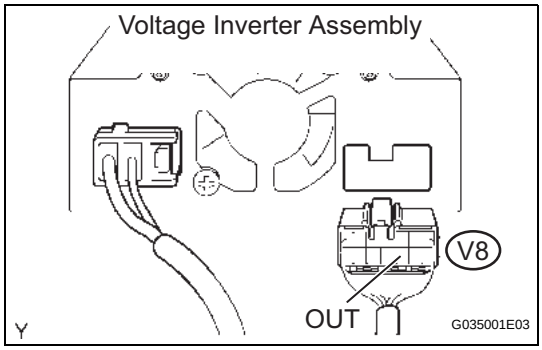
Tester Connections	Specified Conditions
SPD (E7-8) - E1 (E6-1)	Voltage generated intermittently

HINT:
The output voltage should fluctuate up and down similarly to the diagram on the left when the wheel is turned slowly.

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

OK

3 **INSPECT ECM**



(a) Disconnect the V8 inverter connector.
(b) Start the engine.
(c) Measure the voltage between the OUT terminal of inverter and the body ground.
Standard Voltage

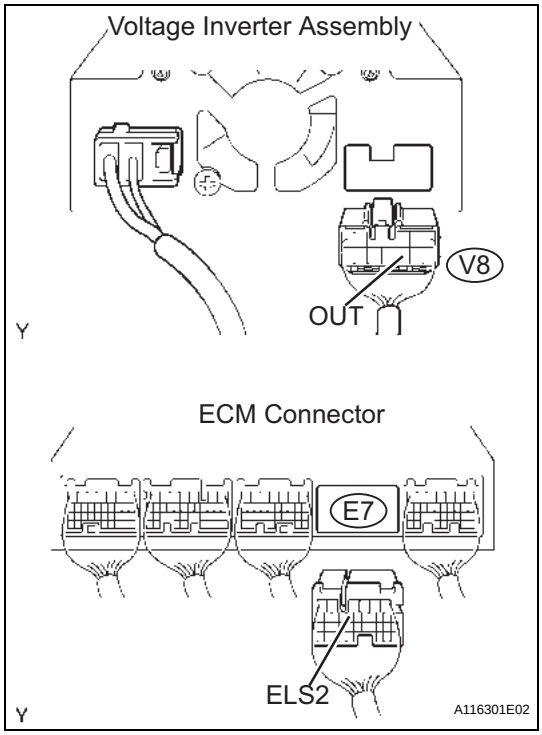
Tester Connections	Specified Conditions
OUT (V8-9) - Body ground	1 V or less

(d) Reconnect the inverter connector.

OK → **REPLACE VOLTAGE INVERTER ASSEMBLY**

NG

4 **CHECK HARNESS AND CONNECTOR (ECM - INVERTER, INVERTER - POWER SOURCE)**



(a) Disconnect the V8 inverter connector.
(b) Disconnect the E7 ECM connector.
(c) Turn the ignition switch ON.
(d) Measure the voltage between the terminals of the wire harness side connectors and body ground.
Standard Voltage (Check for short in idling up signal circuit)

Tester Connections	Specified Conditions
OUT (V8-9) - Body ground	1 V or less
ELS2 (E7-12) - Body ground	

(e) Reconnect the inverter connector and the ECM connector.

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

OK

REPLACE ECM

ES

DTC	P2102	Throttle Actuator Control Motor Circuit Low

DTC	P2103	Throttle Actuator Control Motor Circuit High

SYSTEM DESCRIPTION

The throttle actuator is operated by the ECM and opens and closes the throttle valve using gears.
The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM. This feedback allows the ECM to appropriately control the throttle actuator and monitor the throttle opening angle as the ECM responds to driver inputs.
HINT:
This ETCS (Electronic Throttle Control System) does not use a throttle cable.

ES

DTC No.	DTC Detection Conditions	Trouble Areas
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	Throttle actuator current 7 A or more for 0.6 seconds (1 trip detection logic)	• 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 seconds or 0.6 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

P2102:

Electronic throttle actuator	ON
Electronic throttle actuator drive duty	80 % or more

Electronic throttle actuator power supply voltage	8 V or more
Motor current change during latest 0.016 sec	Less than 0.2 A

P2103:

Electronic throttle actuator	ON
Either of the following conditions 1 or 2 met:	-
1. Electronic throttle actuator power supply voltage	8 V or more
2. Electronic throttle actuator power	ON
Battery voltage	8 V or more
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

ES

P2102:

Motor current	Less than 0.5 A

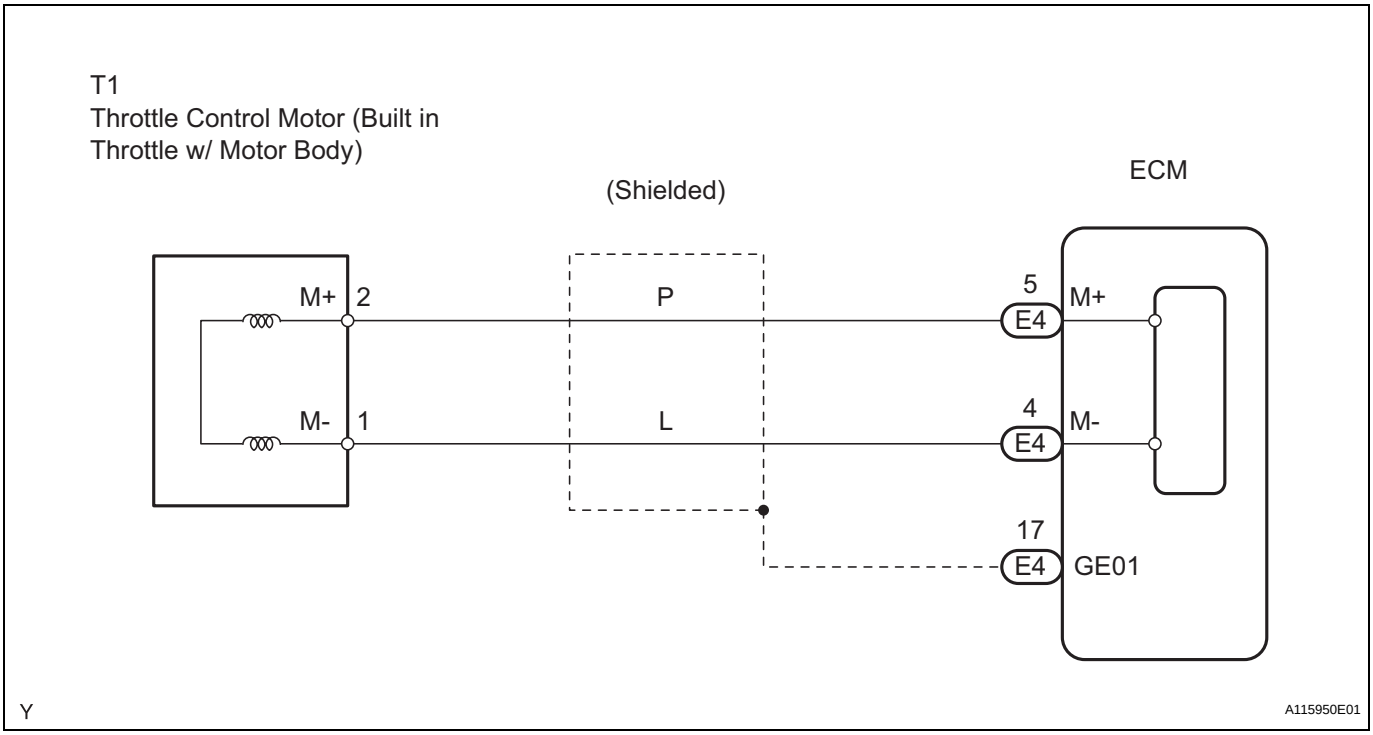
P2103:

Hybrid IC diagnosis signal	Fail
Hybrid IC current limitter port	Fail

FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue 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.

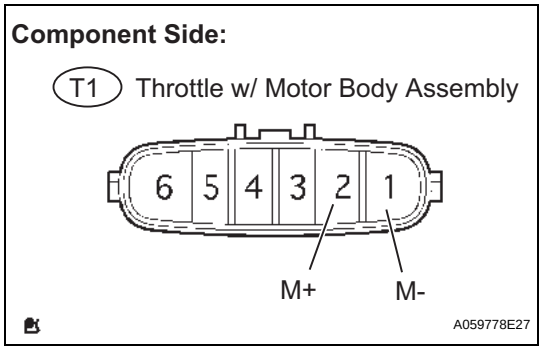
WIRING DIAGRAM



HINT:

- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.
- The throttle actuator current (THROTTLE MOT) and the throttle actuator duty ratio (THROTTLE OPN / THROTTLE CLS) can be read using an intelligent tester. However the ECM shuts off the throttle actuator current when the ETCS malfunctions.

1 INSPECT THROTTLE W/MOTOR BODY ASSEMBLY (RESISTANCE OF THROTTLE CONTROL MOTOR)



(a) Disconnect the T1 throttle w/ motor body connector.
(b) Measure the resistance between the terminals of the throttle control motor.

Standard Resistance

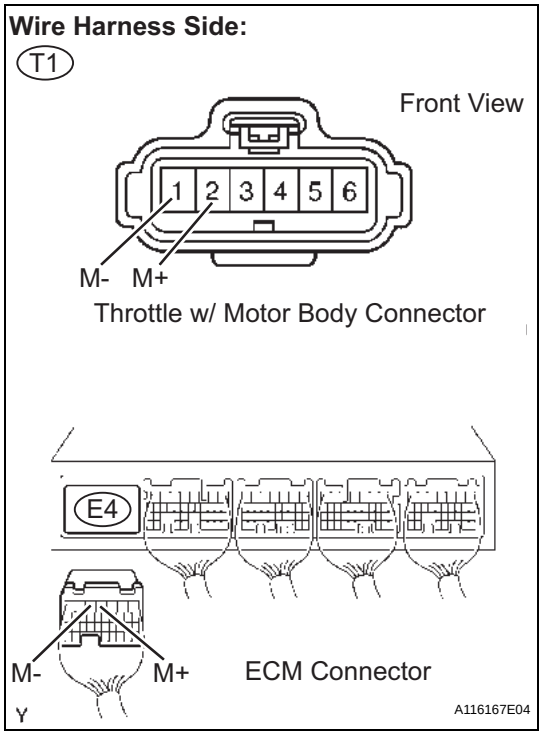
Tester Connections	Specified Conditions
M+ (T1-2) - M- (T1-1)	0.3 to 100 Ω at 20°C (68°F)

(c) Reconnect the throttle w/ motor body connector.

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

OK

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



(a) Disconnect the T1 throttle w/ motor body connector.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
M+ (T1-2) - M+ (E4-5)	Below 1 Ω
M- (T1-1) - M- (E4-4)	

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
M+ (T1-2) or M+ (E4-5) - Body ground	10 kΩ or higher
M- (T1-1) or M- (E4-4) - Body ground	

(d) Reconnect the throttle w/ motor body connector.
(e) Reconnect the ECM connector.

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

OK

3	INSPECT THROTTLE W/MOTOR BODY ASSEMBLY

(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 W/MOTOR BODY ASSEMBLY**

OK

REPLACE ECM

DTC	P2111	Throttle Actuator Control System - Stuck Open

DTC	P2112	Throttle Actuator Control System - Stuck Closed

SYSTEM DESCRIPTION

The throttle actuator is operated by the ECM, and opens and closes the throttle valve using 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:
This ETCS (Electronic Throttle Control System) does not use a throttle cable.

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

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 following DTCs not present	None

P2111 (Throttle actuator stuck open):

All of following conditions met	-
System guard*	ON
Throttle motor current	2 A or more
Throttle motor close duty	80 % or more

P2112 (Throttle actuator stuck closed):

All of following conditions met	-
System guard*	ON
Throttle motor current	2 A or more
Throttle motor open duty	80 % or more
* System guard set when following conditions met	-
Throttle motor	ON

Motor duty calculation	Executing
TPS fail determination	Fail determined
Motor current-cut operation	Not executing
Actuator power supply voltage	4 V or more
Motor fail determination	Fail determined

TYPICAL MALFUNCTION THRESHOLDS

P2111 (Throttle actuator stuck open):

TP sensor voltage change for 0.016 seconds	Less than 0.1 V for 0.5 seconds or more

P2112 (Throttle actuator stuck closed):

TP sensor voltage change for 0.016 seconds	Less than 0.1 V for 0.5 seconds or more

ES

FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue 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-280).

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

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

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

Result

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

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

B	GO TO DTC CHART

A

2	INSPECT THROTTLE W/MOTOR BODY ASSEMBLY (VISUALLY CHECK THROTTLE VALVE)

(a) Check for contamination between the throttle valve and the housing. If necessary, clean the throttle body. And check that the throttle valve moves smoothly.
OK:
Throttle valve is not contaminated with foreign objects and moves smoothly.

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

ES

OK

3	CHECK WHETHER DTC OUTPUT RECURS (DTC P2111 OR P2112)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Clear DTCs (See page ES-38).
(e) Start the engine, and fully depress and release the accelerator pedal quickly (to fully open and close the throttle valve).
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Read DTCs.

Result

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

B → **REPLACE ECM**

A

CHECK FOR INTERMITTENT PROBLEMS

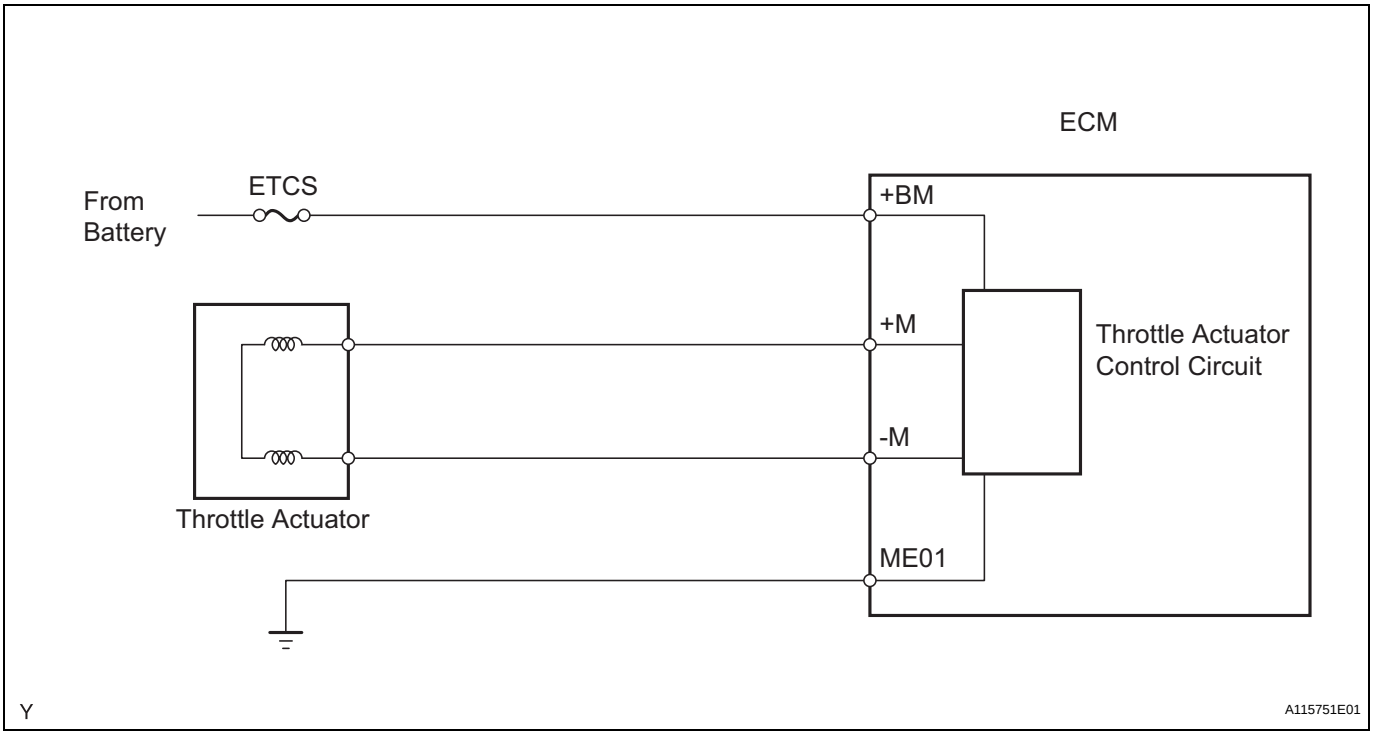
DTC	P2118	Throttle Actuator Control Motor Current Range / Performance

DESCRIPTION

The ETCS (Electronic Throttle Control System) has a dedicated power supply circuit. The voltage (+BM) is monitored and when it is low (less than 4 V), the ECM determines that there is a malfunction in the ETCS and cuts off the current to the throttle actuator.
When the voltage becomes unstable, the ETCS itself becomes unstable. For this reason, when the voltage is low, the current to the throttle actuator is cut. If repairs are made and the system returns to normal, turn the ignition switch OFF. The ECM then allows the current to flow to the throttle actuator so that it can be restarted.

ES

HINT:
The ETCS does not use a throttle cable.



DTC No.	DTC Detection Conditions	Trouble Areas
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 to below 4 V for 0.8 seconds or more, the ECM interprets this as an open in the power supply circuit (+BM). The ECM illuminates the MIL and sets the DTC.
If the malfunction is not repaired successfully, the DTC is set 5 seconds after the engine is next started.

MONITOR STRATEGY

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

MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

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

TYPICAL MALFUNCTION THRESHOLDS

Electronic throttle actuator power supply voltage (+BM)	Less than 4 V

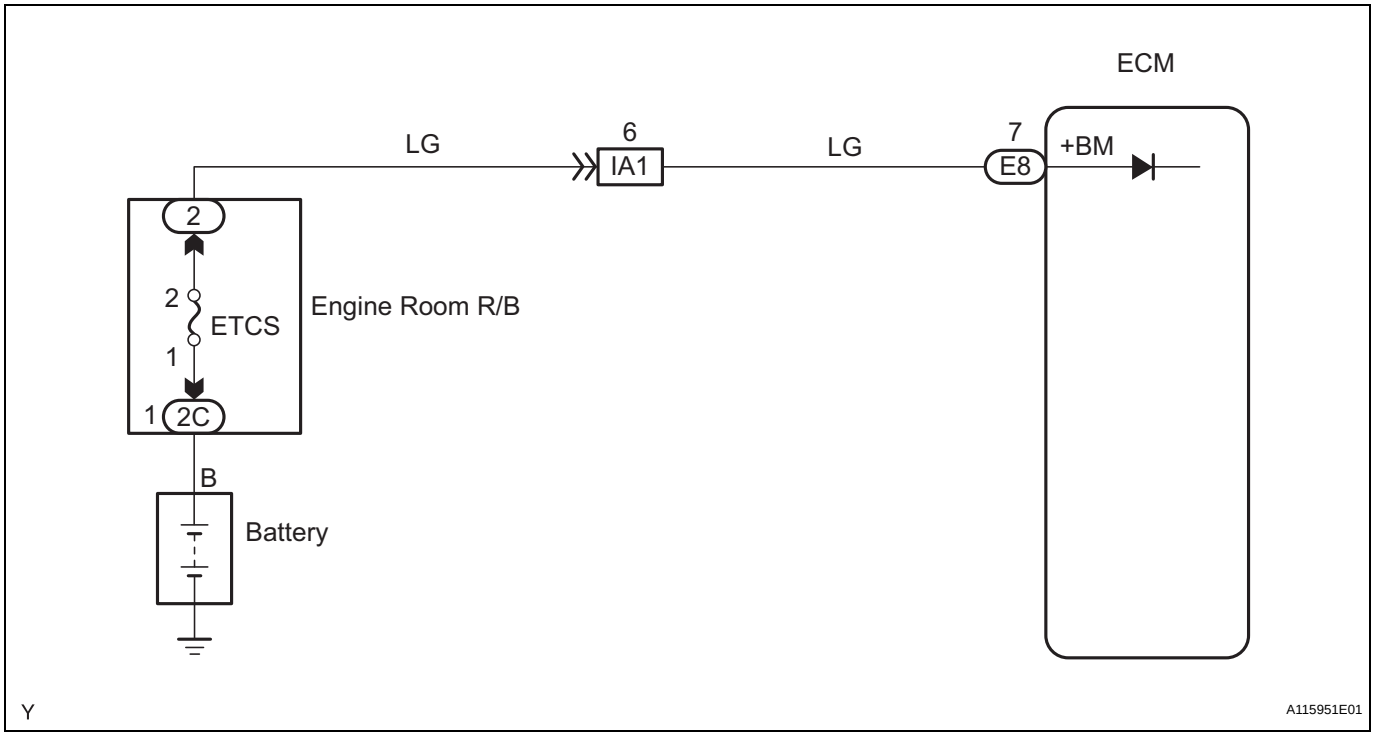
COMPONENT OPERATING RANGE

Throttle actuator power supply voltage	9 to 14 V

FAIL-SAFE

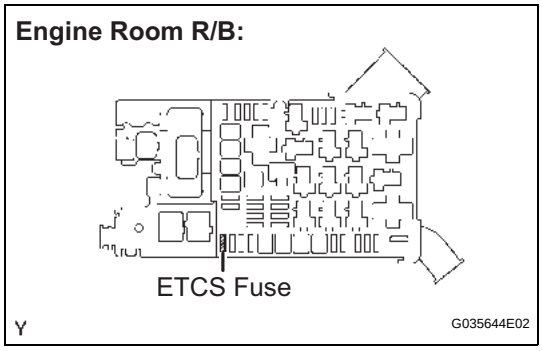
When this DTC, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue 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



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

1 CHECK FUSE (ETCS FUSE)

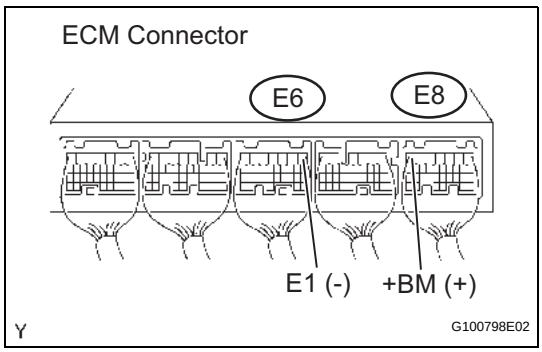


(a) Remove the ETCS fuse from the engine room R/B.
(b) Check the ETCS fuse resistance.
Standard resistance:
Below 1 Ω
(c) Reinstall the ETCS fuse.

NG → **CHECK FOR SHORT IN ALL HARNESS AND COMPONENTS CONNECTED TO FUSE**

OK

2 INSPECT ECM (+BM VOLTAGE)



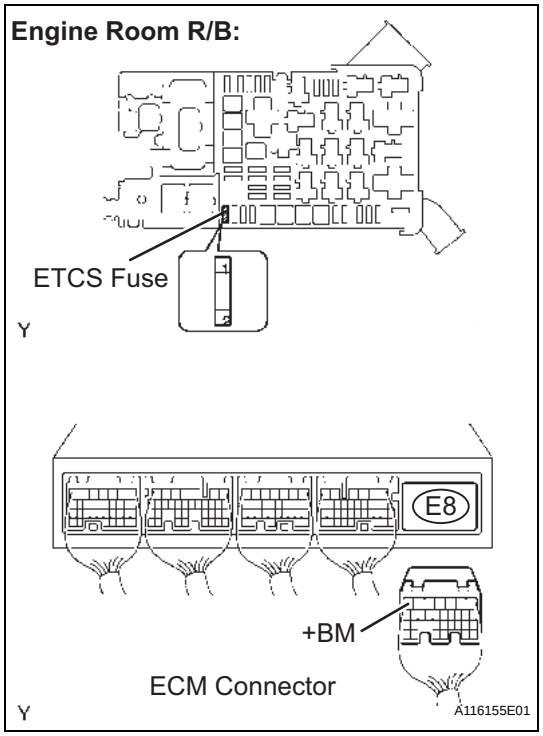
(a) Measure the voltage between the terminals of the E8 and E6 ECM connectors.
Standard Voltage

Tester Connections	Specified Conditions
+BM (E8-7) - E1 (E6-1)	9 to 14 V

OK → **CHECK FOR INTERMITTENT PROBLEMS**

NG

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



(a) Check the harness and connector between the ETCS fuse and ECM.
  (1) Remove the ETCS fuse from the engine room R/B.
  (2) Disconnect the E8 ECM connector.
  (3) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
ETCS fuse (2) - +BM (E8-7)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
ETCS fuse (2) or +BM (E8-7) - Body ground	10 kΩ or higher

  (4) Reinstall the ETCS fuse.
  (5) Reconnect the ECM connector.

(b) Check the harness and connector between the ETCS fuse and positive battery cable.
  (1) Remove the ETCS fuse from the engine room R/B.
  (2) Disconnect the positive battery cable.
  (3) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
Positive battery cable - ETCS fuse (1)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
Positive battery cable or ETCS fuse (1) - Body ground	10 kΩ or higher

  (4) Reinstall the ETCS fuse.
  (5) Reconnect the positive battery cable.

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

OK

REPLACE ECM

ES

DTC	P2119	Throttle Actuator Control Throttle Body Range / Performance

SYSTEM DESCRIPTION

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

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

ES

MONITOR DESCRIPTION

The ECM determines the actual opening angle of the throttle valve from the TP sensor signal. The actual opening angle is compared to the target opening angle commanded by the ECM. If the difference between these two values is outside the standard range, the ECM interprets this as a malfunction in the ETCS. The ECM then illuminates the MIL and sets the DTC.
If the malfunction is not repaired successfully, the DTC is set when the accelerator pedal is quickly released (to close the throttle valve) after the engine speed reaches 5,000 rpm by the accelerator pedal being fully depressed (fully open the throttle valve).

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
System guard*	ON
*System guard set when following conditions met	-
Throttle motor	ON
Motor duty calculation	Executing
TPS fail determination	Fail determined
Motor current-cut operation	Not executing
Actuator power supply	4 V or more
Motor fail determination	Fail determined

TYPICAL MALFUNCTION THRESHOLDS

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

FAIL-SAFE

When this DTC, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue 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-280).

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

ES

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

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

Result

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

HINT:
If any 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 an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Clear DTCs (See page ES-38).
(e) Allow the engine to idle for 15 seconds.
CAUTION:
Exercise extreme care and take precautions at steps (f) and (g) 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.

(g) While depressing the brake pedal securely, fully depress the accelerator pedal for 5 seconds.
(h) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(i) Read DTCs.
HINT:
The voltage output of the throttle position sensor can be checked during step (g) using an intelligent tester. Variations in the voltage output indicate that the throttle actuator is in operation. To check the voltage output using an intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / THROTTLE POS #1.
OK:
No DTC output.

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

OK

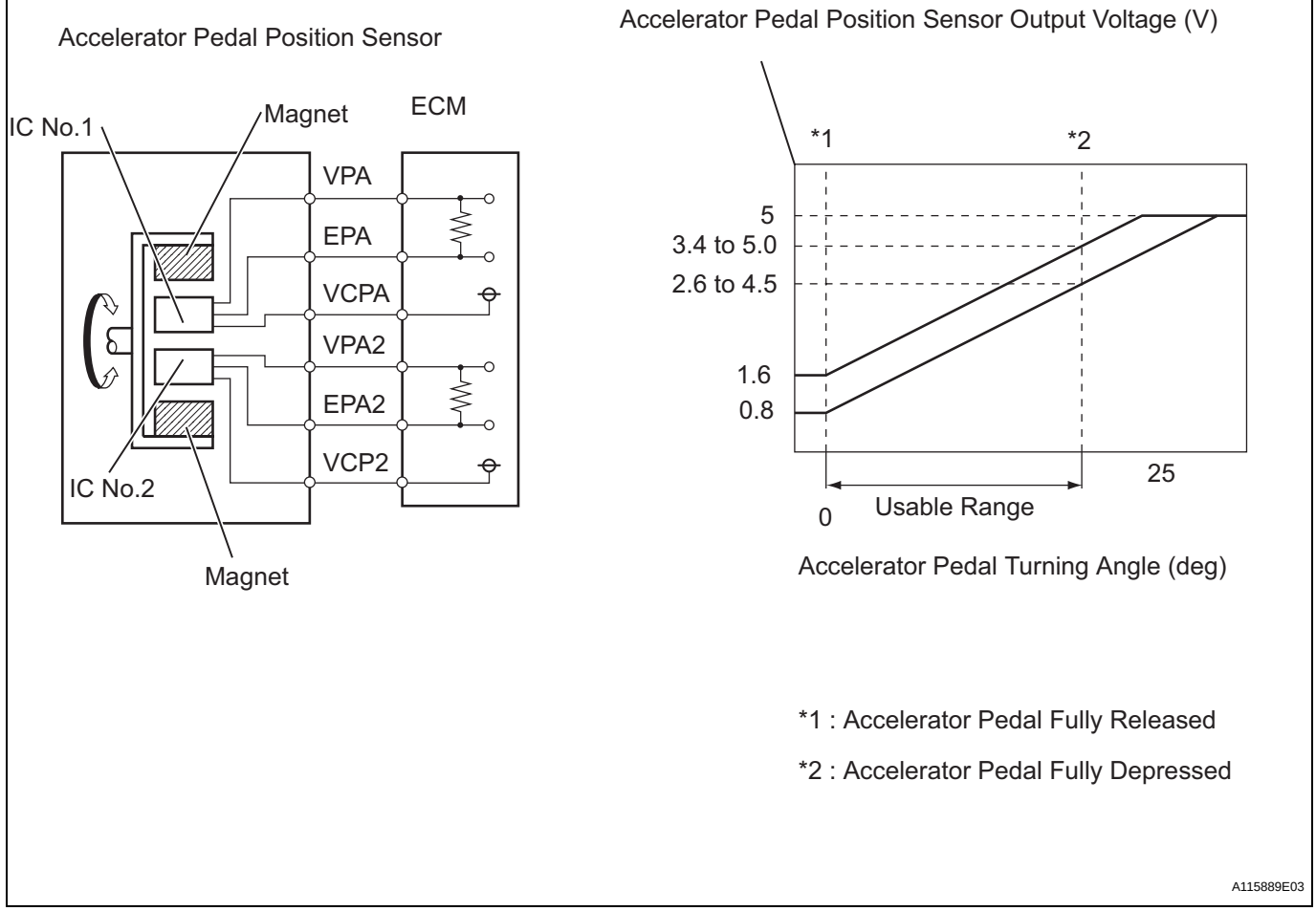
NORMAL

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

HINT:
These DTCs relate to the Accelerator Pedal Position (APP) sensor.

DESCRIPTION

HINT:
This ETCS (Electronic Throttle Control System) does not use a throttle cable.
The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type, and uses Hall-effect elements, in order to yield accurate signals, even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0 V and 5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.
The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC No.	DTC Detection Conditions	Trouble Areas
P2120	VPA fluctuates rapidly beyond upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic)	• Accelerator Pedal Position (APP) sensor • ECM
P2122	VPA 0.4 V or less for 0.5 seconds or more when accelerator pedal fully released (1 trip detection logic)	• APP sensor • Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA 4.8 V or more for 2.0 seconds or more (1 trip detection logic)	• 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) VPA 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 VPA and VPA2 0.02 V or less (b) VPA 0.4 V or less and VPA2 1.2 V or less	• Short between VPA and VPA2 circuits • APP sensor • ECM

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

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

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

ES

MONITOR DESCRIPTION

When either of the output voltages of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and sets a DTC.
Example:
When the output voltage of VPA drops to below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is set.
If the malfunction is not repaired successfully, a DTC is set 2 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P2120: Accelerator Pedal Position (APP) sensor 1 range check (fluctuating) P2122: APP sensor 1 range check (low voltage) P2123: APP sensor 1 range check (high voltage) P2125: APP sensor 2 range check (fluctuating) P2127: APP sensor 2 range check (low voltage) P2128: APP sensor 2 range check (high voltage) P2138: APP sensor range check (correlation)
Required Sensors/Components (Main)	APP sensor
Required Sensors/Components (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 following DTCs not present	None
Ignition switch	ON
Electronic throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

P2120:

Either of the following conditions is met:	Condition 1 or 2
1. VPA1 voltage when VPA2 voltage is V or more	0.4 V or less
2. VPA1 voltage	4.8 V or more

P2122:

VPA1 voltage when VPA2 voltage is 0.04 V or more	0.4 V or less

P2123:

VPA1 voltage	4.8 V or more

P2125:

Either of the following conditions is met:	Condition 1 or2
1. VPA2 voltage when VPA1 is 0.04 V or more	1.2 V or less
2. VPA2 voltage when VPA1 is 0.4 to 3.45 V	4.8 V or more

P2127:

VPA2 voltage when VPA1 0.04 V or more	1.2 V or less

P2128:

VPA2 voltage when VPA1 0.4 to 3.45 V	4.8 V or more

P2138:

Either of following conditions A or B met:	-
Condition A	-
Difference between VPA1 and VPA 2 voltages	0.02 V or less
Condition B	-
VPA1 voltage	0.4 V or less
VPA2 voltage	1.2 V or less

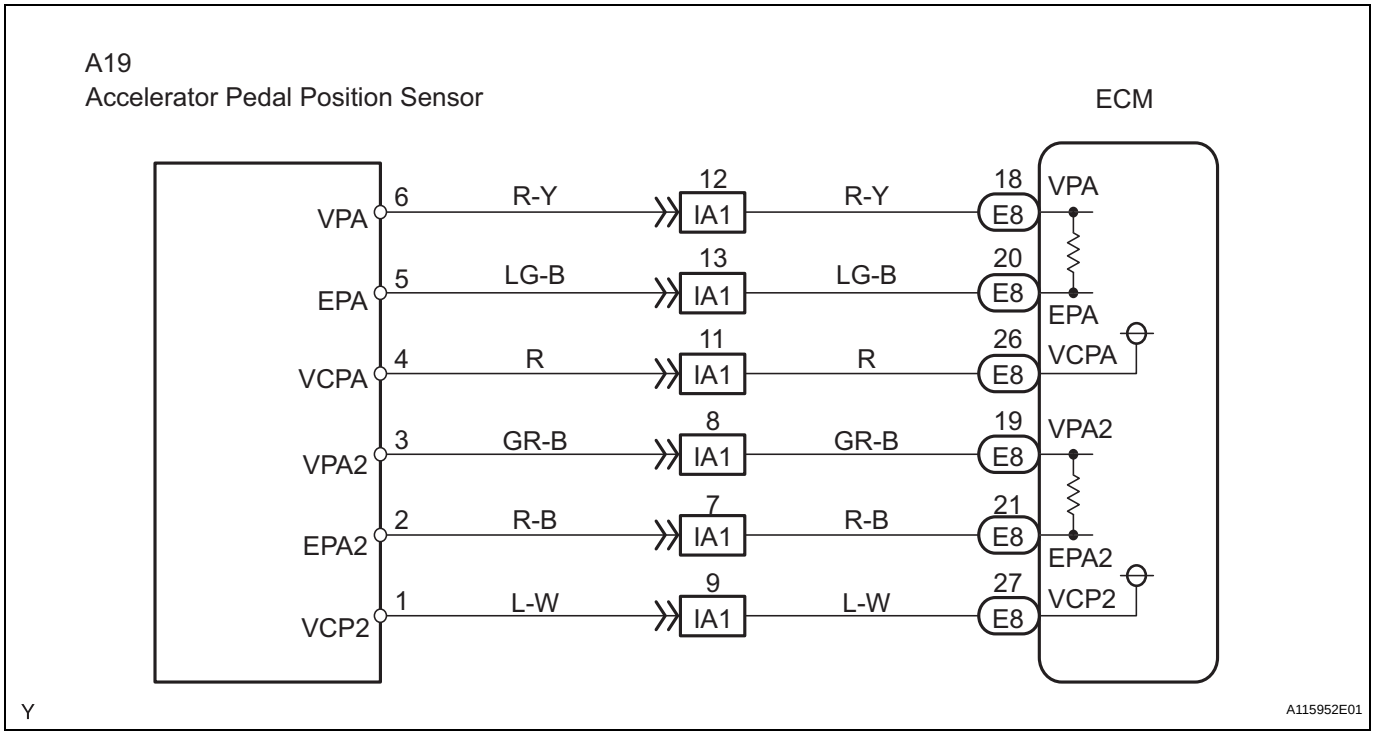
COMPONENT OPERATING RANGE

VPA1 voltage	0.4 V to 4.8 V
VPA2 voltage	1.2 V to 4.8 V

FAIL-SAFE

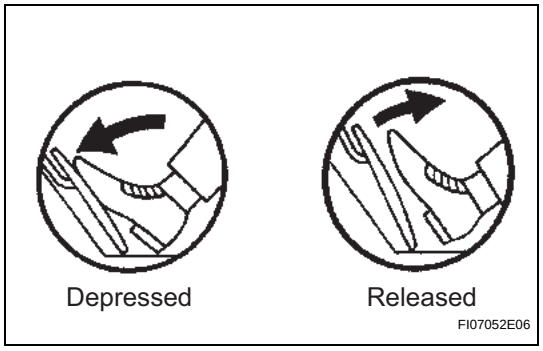
When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are set, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits 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



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

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



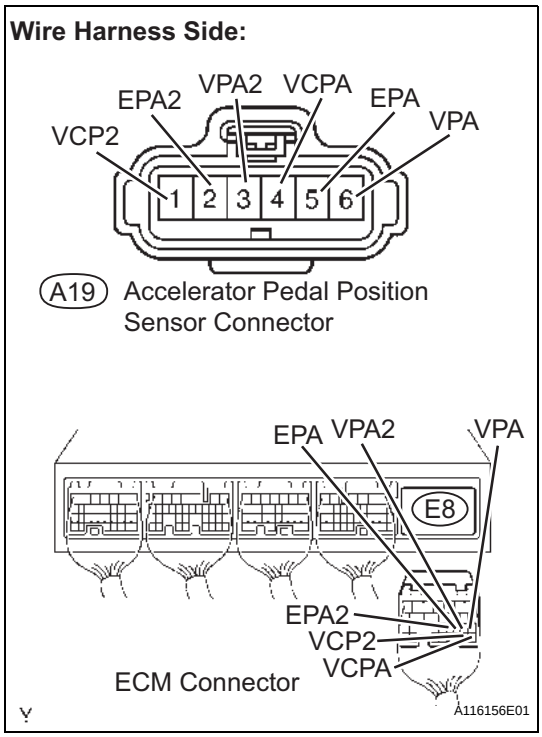
(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / ACCEL POS #1 and ACCEL POS #2.
(d) Read the value displayed on the tester.
Standard Voltage

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

OK → **Go to step 5**

NG

2	CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)



(a) Disconnect the A19 Accelerator Pedal Position (APP) sensor connector.
(b) Disconnect the E8 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
VPA (A19-6) - VPA (E8-18)	Below 1 Ω
EPA (A19-5) - EPA (E8-20)	
VCPA (A19-4) - VCPA (E8-26)	
VPA2 (A19-3) - VPA2 (E8-19)	
EPA2 (A19-2) - EPA2 (E8-21)	
VCP2 (A19-1) - VCP2 (E8-27)	

Standard Resistance (Check for short)

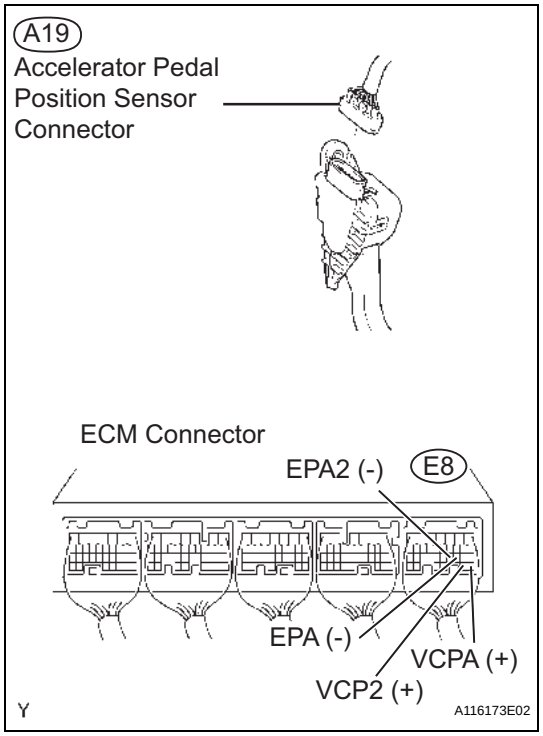
Tester Connections	Specified Conditions
VPA (A19-6) or VPA (E8-18) - Body ground	10 kΩ or higher
EPA (A19-5) or EPA (E8-20) - Body ground	
VCPA (A19-4) or VCPA (E8-26) - Body ground	
VPA2 (A19-3) or VPA2 (E8-19) - Body ground	
EPA2 (A19-2) or EPA2 (E8-21) - Body ground	
VCP2 (A19-1) or VCP2 (E8-27) - Body ground	

(d) Reconnect the APP sensor connector.
(e) Reconnect the ECM connector.

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

OK

3	INSPECT ECM (VCPA AND VCP2 VOLTAGE)



(a) Disconnect the A19 APP sensor connector.
(b) Turn the ignition switch ON.
(c) Measure the voltage between the terminals of the E8 ECM connector.

Standard Voltage

Tester Connections	Specified Conditions
VCPA (E8-26) - EPA (E8-20)	4.5 to 5.0 V
VCP2 (E8-27) - EPA2 (E8-21)	

(d) Reconnect the APP sensor connector.

ES

NG → REPLACE ECM

OK

4	REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

NEXT

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

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Clear DTCs (See page ES-38).
(d) Start the engine.
(e) Allow the engine to idle for 15 seconds.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Read DTCs.

Result

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

B → SYSTEM OK

A

REPLACE ECM

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

HINT:
This DTC relates to the Accelerator Pedal Position (APP) sensor.

DESCRIPTION

Refer to DTC P2120 (See page ES-293).

DTC No.	DTC Detection Conditions	Trouble Areas
P2121	Difference between VPA and VPA2 less than 0.4 V, or more than 1.2 V for 0.5 seconds (1 trip detection logic)	• Accelerator position sensor • ECM

ES

MONITOR DESCRIPTION

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

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Either of following conditions 1 or 2 met:	-
1. Ignition switch	ON
2. Throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

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

FAIL-SAFE

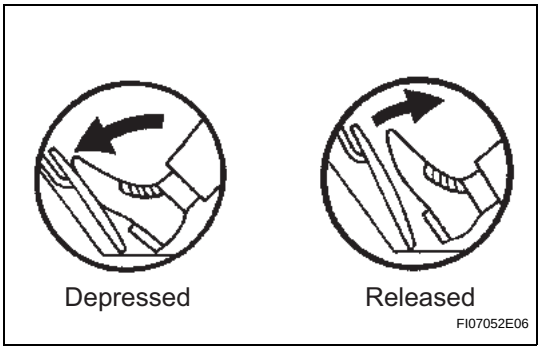
The accelerator pedal position sensor has two (main and sub) sensor circuits. If a malfunction occurs in either of the sensor circuits, the ECM detects the abnormal signal voltage difference between the two sensor circuits and switches to limp mode. In limp mode, the functioning circuit is used to calculate the accelerator pedal opening angle to allow the vehicle to continue driving. If both circuits malfunction, the ECM regards the opening angle of the accelerator pedal as being fully closed. In this case, the throttle valve remains closed as if the engine is idling.
If a pass condition is detected and then the ignition switch is turned OFF, the fail-safe operation stops and the system returns to a normal condition.

WIRING DIAGRAM

Refer to DTC P2120 (See page ES-297).

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

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



(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / ACCEL POS #1 and ACCEL POS #2.
(d) Read the values displayed on the tester.

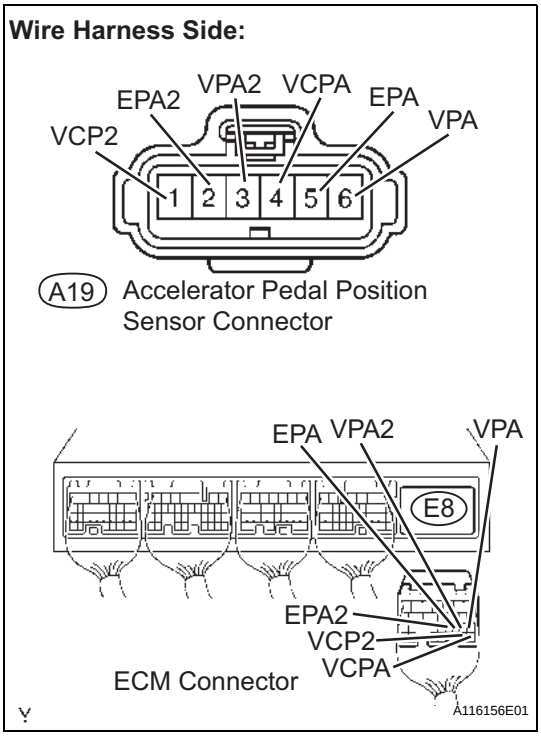
Standard Voltage

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

OK → **Go to step 3**

NG

2	CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)



(a) Disconnect the A19 Accelerator Pedal Position (APP) sensor connector.
(b) Disconnect the E8 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
VPA (A19-6) - VPA (E8-18)	Below 1 Ω
EPA (A19-5) - EPA (E8-20)	
VCPA (A19-4) - VCPA (E8-26)	
VPA2 (A19-3) - VPA2 (E8-19)	
EPA2 (A19-2) - EPA2 (E8-21)	
VCP2 (A19-1) - VCP2 (E8-27)	

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
VPA (A19-6) or VPA (E8-18) - Body ground	10 kΩ or higher
EPA (A19-5) or EPA (E8-20) - Body ground	
VCPA (A19-4) or VCPA (E8-26) - Body ground	
VPA2 (A19-3) or VPA2 (E8-19) - Body ground	
EPA2 (A19-2) or EPA2 (E8-21) - Body ground	
VCP2 (A19-1) or VCP2 (E8-27) - Body ground	

(d) Reconnect the APP sensor connector.
(e) Reconnect the ECM connector.

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

OK

3	REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

NEXT

ES

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

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Clear DTCs (See page ES-38).
(d) Start the engine.
(e) Allow the engine to idle for 15 seconds.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Read DTCs.

Result

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

B → **SYSTEM OK**

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

ES

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.

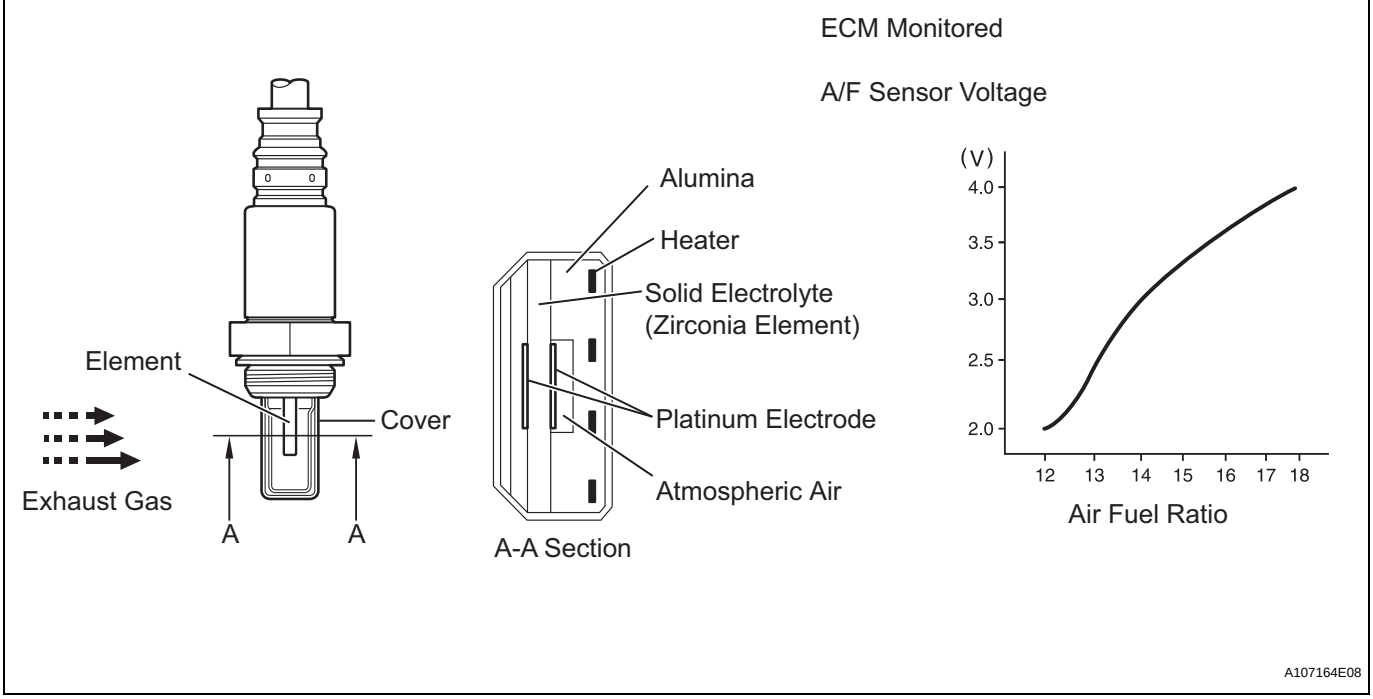
DESCRIPTION

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 though the alumina, therefore the sensor activation is accelerated.

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric level.

*: Value changes inside the ECM. Since the A/F sensor is the current output element, a current is converted in 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 Conditions	Trouble Areas
P2195 P2197	Conditions (a) and (b) continue for 10 seconds or more (2 trip detection logic) (a) Air-Fuel Ratio (A/F) sensor voltage more than 3.8 V (b) Heated Oxygen (HO2) sensor voltage 0.15 V or more	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor (bank 1, 2 sensor 1) heater • A/F sensor heater relay • A/F sensor heater and relay circuits • Air induction system • Fuel pressure • Injector • ECM
P2195 P2197	While fuel-cut operation performed (during vehicle deceleration), air-furl ratio (A/F) sensor current 3.6 mA or more for 3 seconds (2 trip detection logic)	• A/F sensor • ECM
P2196 P2198	Conditions (a) and (b) continue for 10 seconds or more (2 trip detection logic) (a) A/F sensor voltage less than 2.8 V (b) HO2 sensor voltage less than 0.6 V	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor (bank 1, 2 sensor 1) heater • A/F sensor heater relay • A/F sensor heater and relay circuits • Air induction system • Fuel pressure • Injector • ECM
P2196 P2198	While fuel-cut operation performed (during vehicle deceleration), air-furl ratio (A/F) sensor current less than 1.57 mA for 3 seconds (2 trip detection logic)	• A/F sensor • ECM

HINT:

- DTCs P2195 and P2196 indicate malfunctions related to bank 1 A/F sensor circuit.
- DTCs P2197 and P2198 indicate malfunctions related to bank 2 A/F sensor circuit.
- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that includes cylinder No. 2.
- When any of these DTCs are set, check the A/F sensor voltage output by selecting the following menu items on an intelligent tester: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / AFS B1S1 or AFS B2S1.
- Short-term fuel trim values can also be read using an intelligent tester.

ES

- The ECM regulates the voltages at the A1A+, A2A+, A1A- and A2A- terminals of the ECM to a constant level. Therefore, the A/F sensor voltage output cannot be confirmed without using an intelligent tester.
- If a A/F sensor malfunction is detected, the ECM sets a DTC.

MONITOR DESCRIPTION

Sensor voltage detection monitor

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

Example:

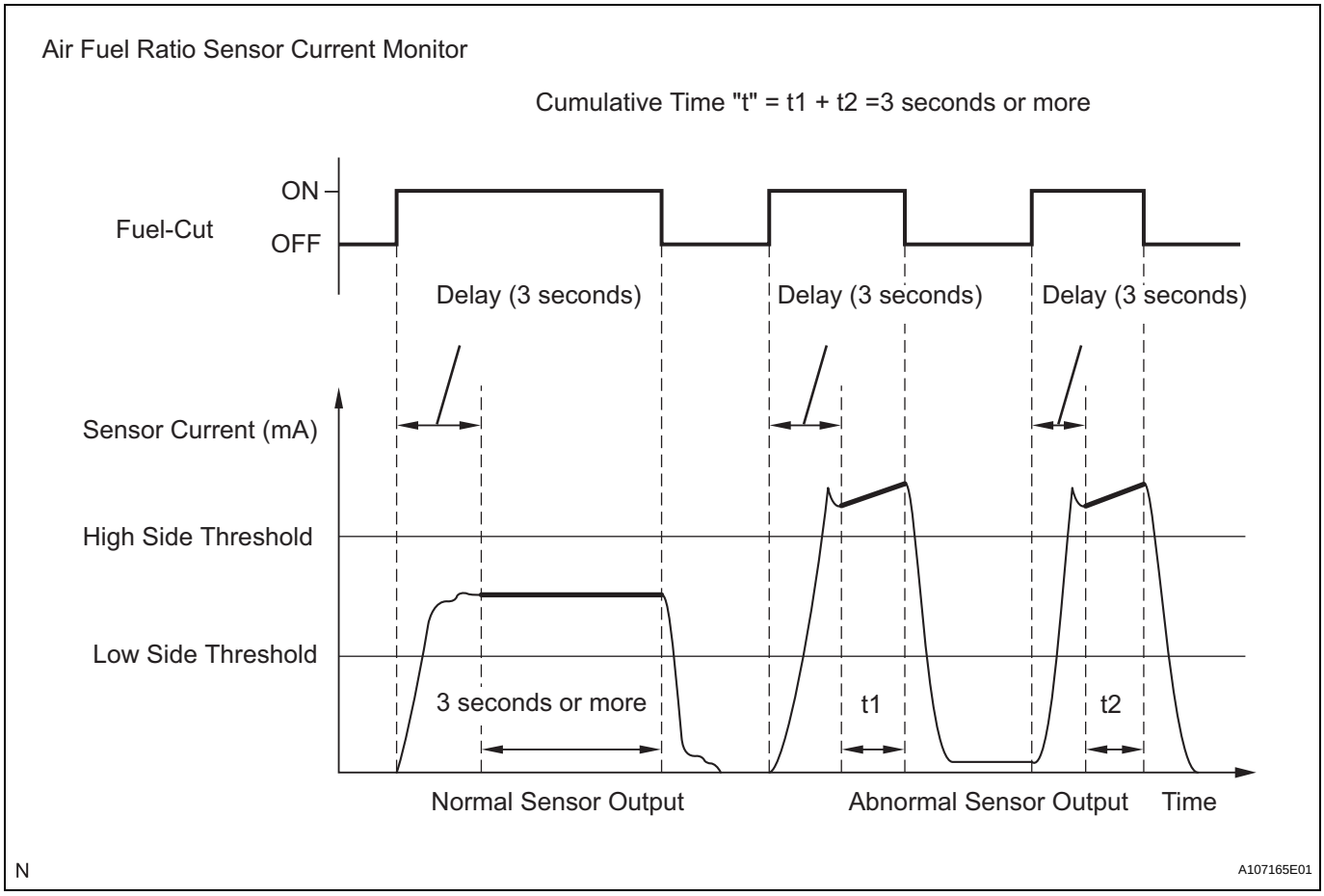
If the A/F sensor voltage output is less than 2.8 V (very rich condition) for 10 seconds, despite the HO2 sensor voltage output being less than 0.6 V, the ECM sets DTC P2196. Alternatively, if the A/F sensor voltage output is more than 3.8 V (very lean condition) for 10 seconds, despite the HO2 sensor voltage output being 0.15 V or more, DTC P2195 is set.

ES

Sensor current detection monitor

A rich air-fuel mixture causes a low A/F sensor current, and a lean air-fuel mixture causes a high A/F sensor current. Therefore, the sensor output becomes low during acceleration, and it becomes high during deceleration with the throttle valve fully closed. The ECM monitors the A/F sensor current during fuel-cut and detects any abnormal current values.

If the A/F sensor output is 3.6 mA or more for more than 3 seconds of cumulative time, the ECM interprets this as a malfunction in the A/F sensor and sets DTC P2195 (high-side stuck). If the A/F sensor output is 1.57 mA or less for more than 3 seconds of cumulative time, the ECM sets DTC P2196 (low-side stuck).



MONITOR STRATEGY

Related DTCs	P2195: A/F sensor (Bank 1) signal stuck lean P2196: A/F sensor (Bank 1) signal stuck rich P2197: A/F sensor (Bank 2) signal stuck lean P2198: A/F sensor (Bank 2) signal stuck rich
Required Sensors/Components (Main)	A/F sensor
Required Sensors/Components (Related)	HO2 sensor
Frequency of Operation	Continuous
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

ALL

The monitor will run whenever these DTCs are not present	P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0037, P0038, P0057, P0058 (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, P0156 (O2 Sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0306 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0500 (VSS)

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

Time while all of following conditions met	2 seconds or more
Rear HO2 sensor voltage	0.15 V or more
Time after engine start	30 seconds or more
A/F sensor status	Activated
Fuel system status	Closed-loop
Engine	Running

Sensor voltage detection monitor (Rich side malfunction P2196, P2198):

Time while all of following conditions met	2 seconds or more
Rear HO2 sensor voltage	Below 0.6 V
Time after engine start	30 seconds or more
A/F sensor status	Activated
Fuel system status	Closed-loop
Engine	Running

Sensor Current detection monitor (P2195, P2196, P2197 P2198):

Battery voltage	11 V or more
Atmospheric pressure	570 mmHg or higher
Air-fuel ratio sensor status	Activated
Pass/Malfunction determination in this driving cycle	Not determined
Engine coolant temperature	75°C (167°F) or more
Continuous time of fuel cut	3 to 10 seconds

TYPICAL MALFUNCTION THRESHOLDS

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

A/F sensor voltage	More than 3.8 V

Sensor voltage detection monitor (Rich side malfunction P2196, P2198):

A/F sensor voltage	Less than 2.8 V

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

Following condition met for:	3 seconds or more
Air-fuel ratio sensor current during fuel cut	3.6 mA or more

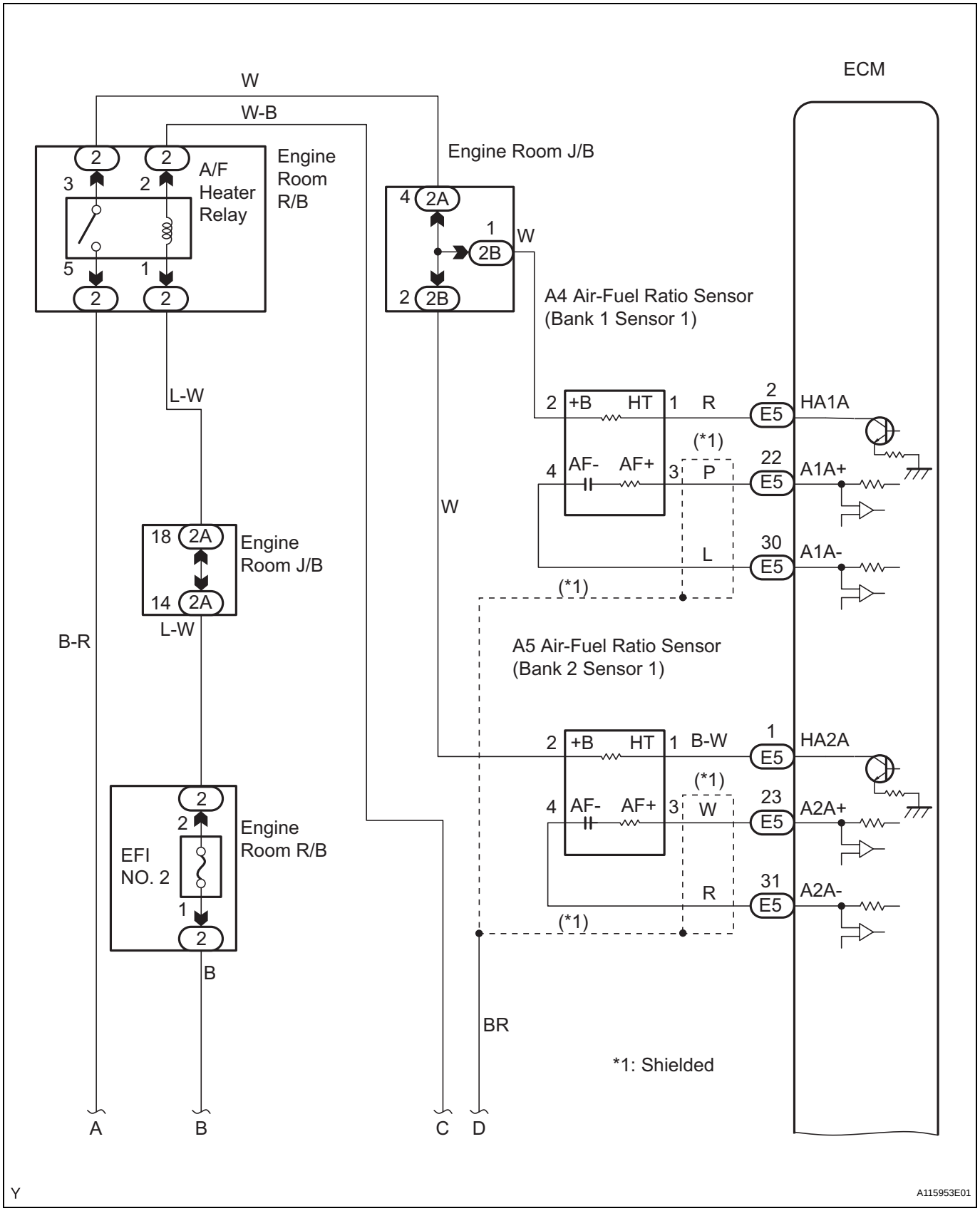
Sensor current detection monitor (Rich side malfunction P2196, P2198):

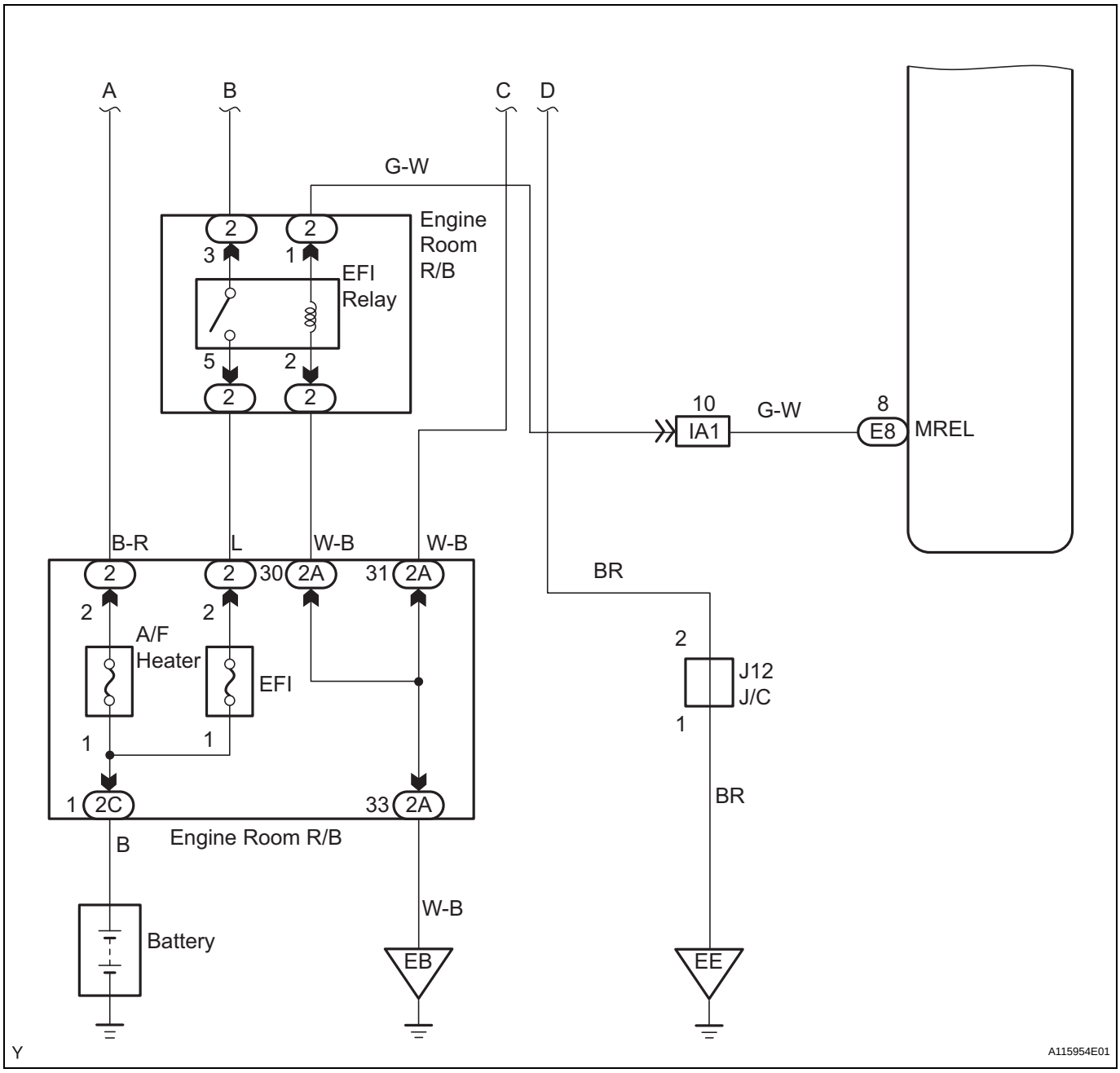
Following condition met for:	3 seconds or more
Air-fuel ratio sensor current during fuel cut	Less than 1.57 mA

MONITOR RESULT

Detailed information on Checking Monitor Status (See page ES-19).

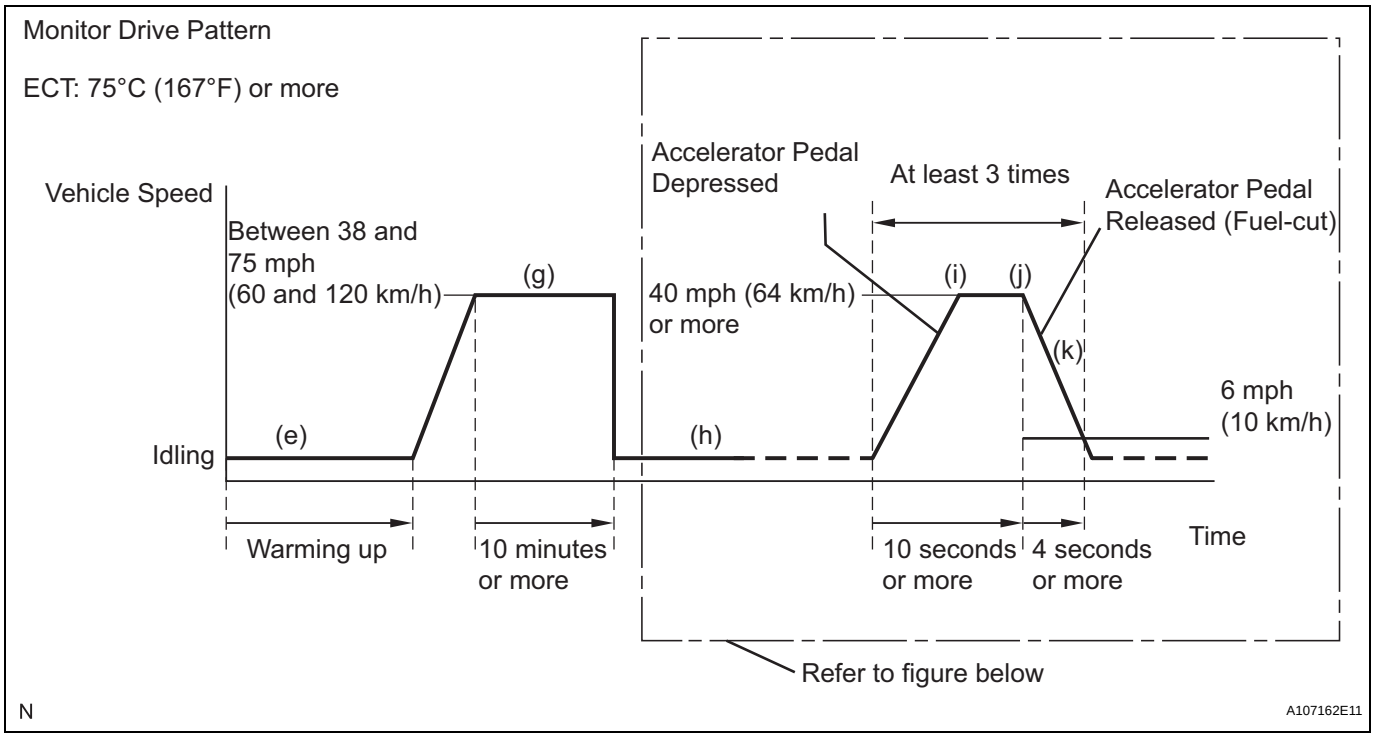
WIRING DIAGRAM

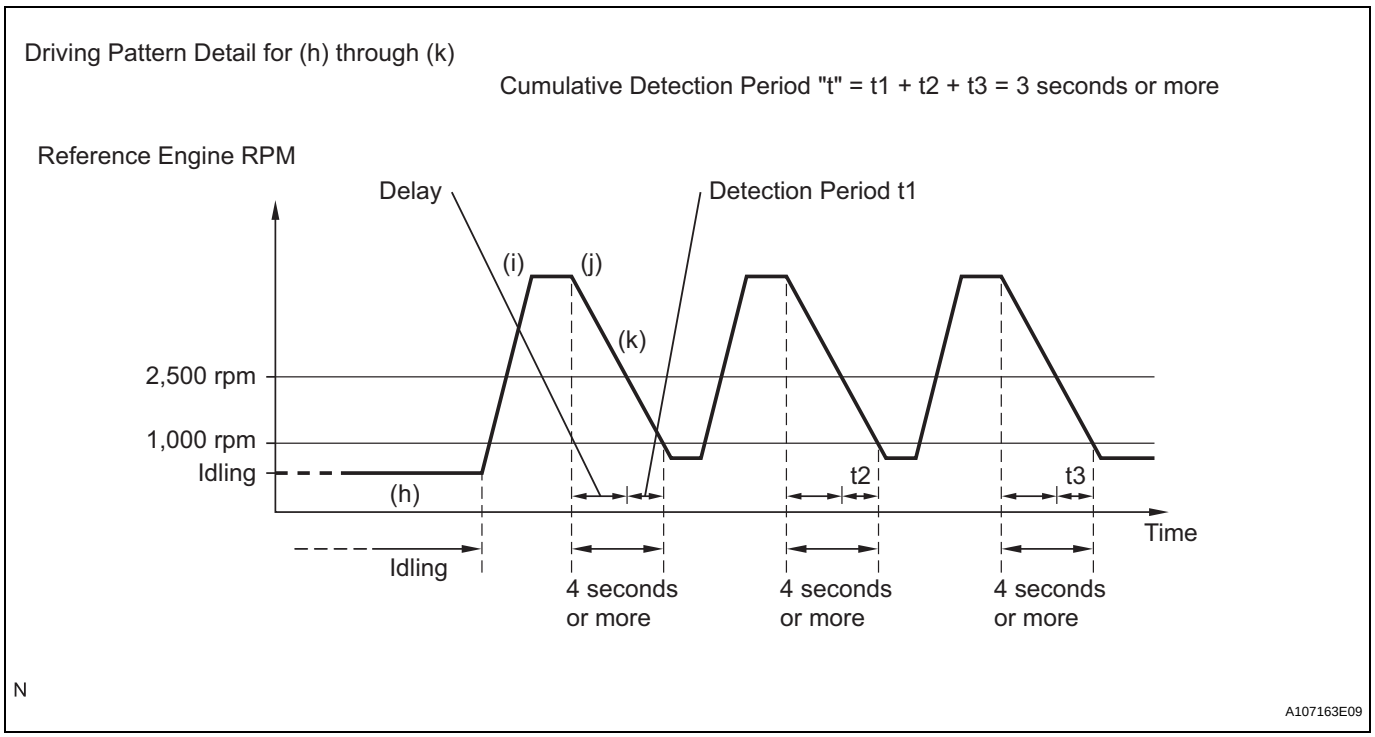




CONFIRMATION DRIVING PATTERN

This confirmation driving pattern is used in the "PERFORM CONFIRMATION DRIVING PATTERN" procedure of the following diagnostic troubleshooting procedure.





(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Clear DTCs (See page ES-38).
(e) Start the engine, and warm it up until the ECT reaches 75°C (167°F) or higher.
(f) Select the following menu items to check the fuel-cut status: DIAGNOSIS / ENHANCED OBD II / DATA LIST / USER DATA / FC IDLE.
(g) Drive the vehicle at between 38 mph (60 km/h) and 75 mph (120 km/h) for at least 10 minutes.
(h) Change the transmission to 2nd gear.

(i) Drive the vehicle at proper vehicle speed to perform fuel-cut operation (refer to the following HINT).
HINT:
Fuel-cut is performed when the following conditions are met:
- Accelerator pedal fully released.
- Engine speed is 2,500 rpm or more (fuel injection returns at 1,000 rpm).

(j) Accelerate the vehicle to 40 mph (64 km/h) or more by depressing the accelerator pedal for at least 10 seconds.
(k) Soon after performing step (j) above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal, in order to execute fuel-cut control.
(l) Allow the vehicle to decelerate until the vehicle speed declines to less than 6 mph (10 km/h).
(m) Repeat steps from (h) through (k) above at least 3 times in one driving cycle.
HINT:
Completion of all A/F sensor monitors is required to change the value in TEST RESULT.

ES

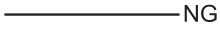
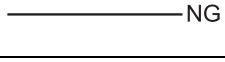
CAUTION:
Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.

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 an intelligent tester.
(1) Connect an 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) 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 O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.
HINT:
- The A/F CONTROL operation lowers the fuel injection volume by 12.5 % or increases the injection volume by 25 %.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard

Tester Display (Sensor)	Injection Volumes	Status	Voltages
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 Areas
1	Injection volume +25 % -12.5 %		Injection volume +25 % -12.5 %		-
	Output voltage More than 3.35 V Less than 3.0 V		Output voltage More than 0.55 V Less than 0.4 V		
2	Injection volume +25 % -12.5 %		Injection volume +25 % -12.5 %		• A/F sensor • A/F sensor heater • A/F sensor circuit
	Output voltage Almost no reaction		Output voltage More than 0.55 V Less than 0.4 V		
3	Injection volume +25 % -12.5 %		Injection volume +25 % -12.5 %		• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
	Output voltage More than 3.35 V Less than 3.0 V		Output voltage Almost no reaction		
4	Injection volume +25 % -12.5 %		Injection volume +25 % -12.5 %		• Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output voltage Almost no reaction		Output voltage Almost no reaction		

- Following the A/F CONTROL procedure enables technicians to check and graph the 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 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 an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.
- A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P2195, P2196, P2197 OR P2198)

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

ES

Result

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

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

B → **GO TO DTC CHART**

A

ES

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

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Clear DTCs (See page ES-38).
(d) Allow the vehicle to drive in accordance with the drive pattern described in the CONFIRMATION DRIVING PATTERN.
(e) Select the following menu items on the tester: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / MONITOR STATUS.
(f) Check that the status of O2S MON is COMPL.
If the status is still INCMPL, drive the vehicle according to the driving pattern again.
HINT:
- AVAIL indicates that the component has not been monitored yet.
- COMPL indicates that the component is functioning normally.
- INCMPL indicates that the component is malfunctioning.

(g) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / TEST RESULT / RANGE B1S1, then press the ENTER button.
(h) Check the test value of the A/F sensor output current during fuel-cut.

Result

Test Value	Proceed To
Within normal range (1.57 mA or more, and less than 3.6 mA)	A
Outside normal range (Less than 1.57 mA, or 3.6 mA or more)	B

B → **Go to step 20**

A

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

(a) Connect an intelligent tester to the DLC3.
(b) Start the engine.
(c) Turn the tester ON.

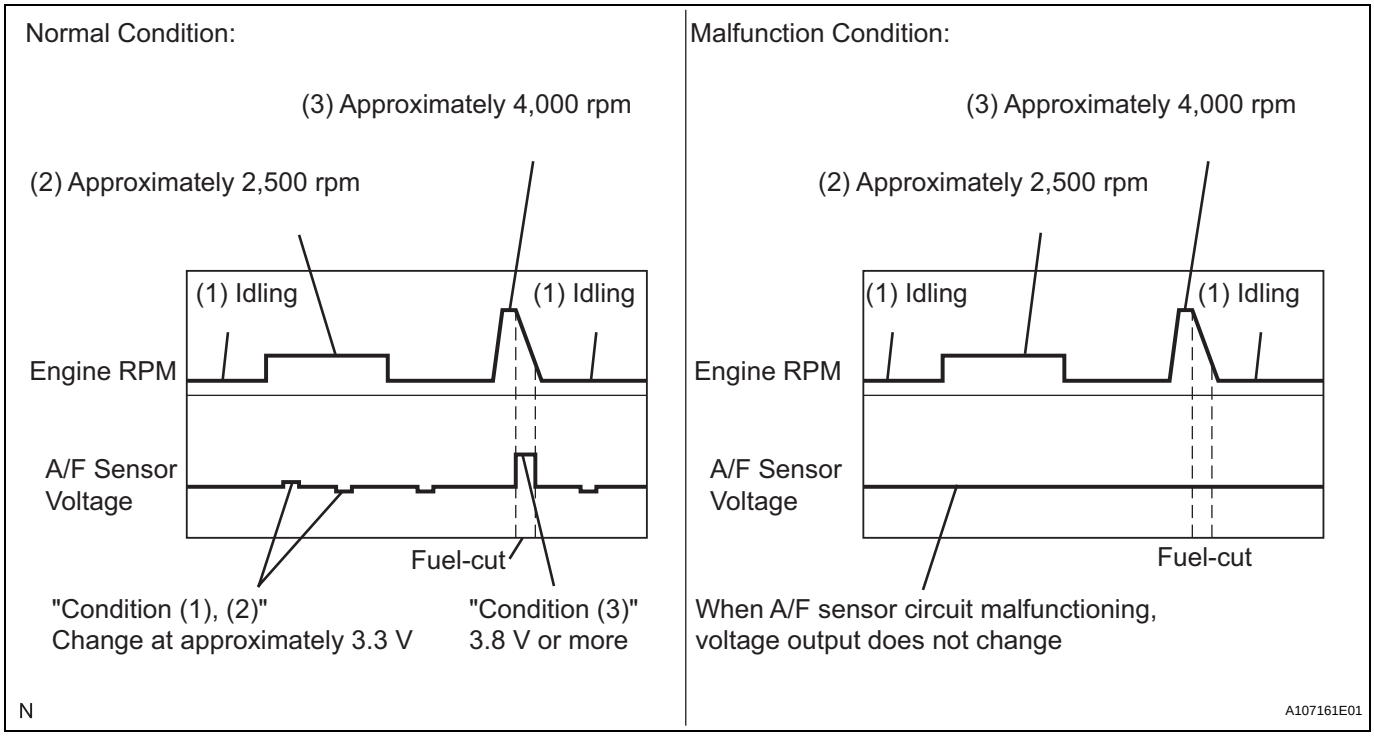
(d) Warm up the Air-Fuel Ratio (A/F) sensor at an engine speed of 2,500 rpm for 90 seconds.
(e) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / SNAPSHOT / MANUAL SNAPSHOT / USER DATA / AFS B1S1 or AFS B2S1 and ENGINE SPD.
(f) Check the A/F sensor voltage three times, when the engine is in each of the following conditions:
  (1) While idling (check for at least 30 seconds)
  (2) At an engine speed of approximately 2,500 rpm (without any sudden changes in engine speed)
  (3) Raise the engine speed to 4,000 rpm and then quickly release the accelerator pedal so that the throttle valve is fully closed.

ES

Standard

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

HINT:
For more information, see the diagrams below.



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 10**

OK

4	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

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

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

Result

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

B → **Go to step 9**

A

6	REPLACE AIR FUEL RATIO SENSOR

NEXT

7	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

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

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

ES

Result

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

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

A

9	CONFIRM WHETHER VEHICLE HAS RUN OUT OF FUEL IN PAST

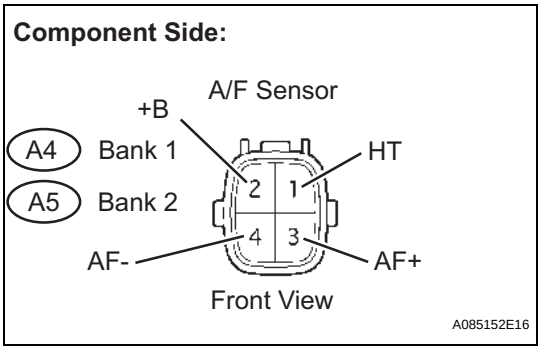
NO → **CHECK FOR INTERMITTENT PROBLEMS**

YES

DTC CAUSED BY RUNNING OUT OF FUEL

10	INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

Component Side:



(a) Disconnect the A4 or A5 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor connector.

Standard Resistance

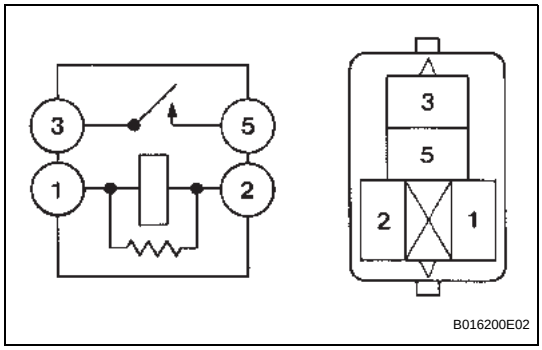
Tester Connections	Specified Conditions
HT (1) - +B (2)	1.8 to 3.4 Ω at 20°C (68°F)
HT (1) - AF- (4)	10 kΩ or higher

(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

11 INSPECT AIR FUEL RATIO SENSOR HEATER RELAY



(a) Remove the A/F sensor heater relay from the engine room R/B.
(b) Check the A/F sensor heater relay resistance.

Standard Resistance

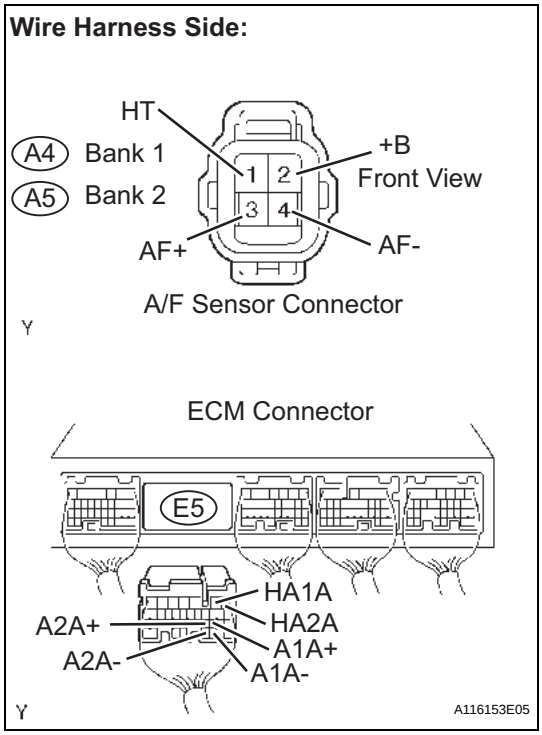
Tester Connections	Specified Conditions
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the A/F sensor heater relay.

NG → **REPLACE AIR FUEL RATIO SENSOR HEATER RELAY**

OK

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



(a) Disconnect the A4 or A5 A/F sensor connector.
(b) Turn the ignition switch ON.
(c) Measure the voltage between the +B terminal of the A/F sensor connector and body ground.

Standard Voltage

Tester Connections	Specified Conditions
+B (A4-2) - Body ground	9 to 14 V
+B (A5-2) - Body ground	

(d) Turn the ignition switch OFF.
(e) Disconnect the E5 ECM connector.
(f) Check the resistance.

Standard Resistance (Check for open)

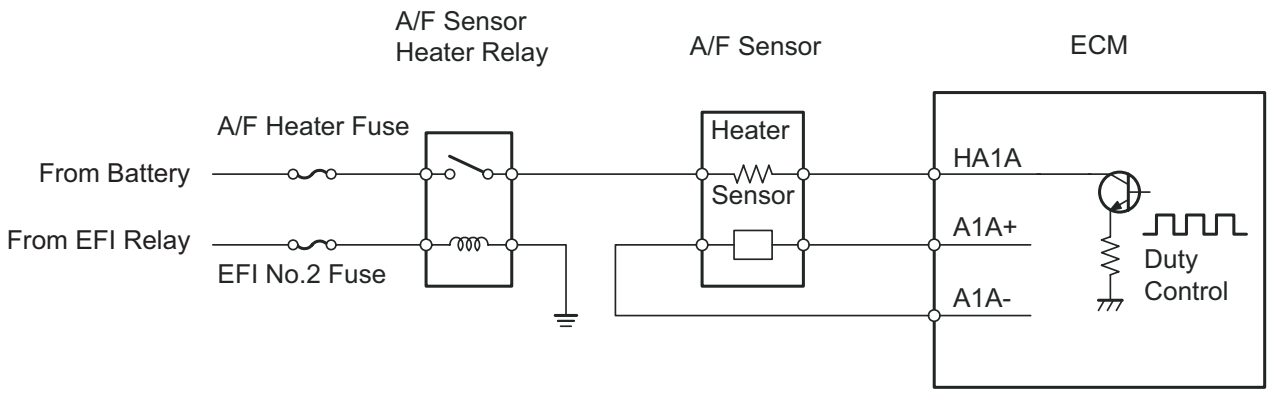
Tester Connections	Specified Conditions
HT (A4-1) - HA1A (E5-2)	Below 1 Ω
AF+ (A4-3) - A1A+ (E5-22)	
AF- (A4-4) - A1A- (E5-30)	
HT (A5-1) - HA2A (E5-1)	
AF+ (A5-3) - A2A+ (E5-23)	
AF- (A5-4) - A2A- (E5-31)	

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
HT (A4-1) or HA1A (E5-2) - Body ground	10 kΩ or higher
AF+ (A4-3) or A1A+ (E5-22) - Body ground	
AF- (A4-4) or A1A- (E5-30) - Body ground	
HT (A5-1) or HA2A (E5-1) - Body ground	
AF+ (A5-3) or A2A+ (E5-23) - Body ground	
AF- (A5-4) or A2A- (E5-31) - Body ground	

(g) Reconnect the ECM connector.
(h) Reconnect the A/F sensor connector.

Reference (Bank 1 Sensor 1 System Diagram)



A115897E02

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

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

14	CHECK FUEL PRESSURE

(a) Check the fuel pressure.

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

15	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**

ES

OK

16	REPLACE AIR FUEL RATIO SENSOR

NEXT

17	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

ES

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

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

Result

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

B → REPAIR OR REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN

A

19	CONFIRM WHETHER VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → CHECK FOR INTERMITTENT PROBLEMS

YES

DTC CAUSED BY RUNNING OUT OF FUEL

20	REPLACE AIR FUEL RATIO SENSOR

NEXT

21	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

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

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

Result

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

B → REPLACE ECM

A → END

DTC	P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)
DTC	P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)
DTC	P2241	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)
DTC	P2242	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)
DTC	P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)
DTC	P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)
DTC	P2255	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)
DTC	P2256	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

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

Refer to DTC P2195 (See page ES-304).

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

HINT:
- DTC P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.

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

MONITOR DESCRIPTION

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

MONITOR STRATEGY

Related DTCs	P2238: A/F sensor (Bank 1) open circuit between AF+ and AF- P2238: A/F sensor (Bank 1) short circuit between AF+ and AF- P2238: A/F sensor (Bank 1) short circuit between AF+ and GND P2239: A/F sensor (Bank 1) short circuit between AF+ and +B P2241: A/F sensor (Bank 2) open circuit between AF+ and AF- P2241: A/F sensor (Bank 2) short circuit between AF+ and AF- P2241: A/F sensor (Bank 2) short circuit between AF+ and GND P2242: A/F sensor (Bank 2) short circuit between AF+ and +B P2252: A/F sensor (Bank 1) short circuit between AF- and GND P2253: A/F sensor (Bank 1) short circuit between AF- and +B P2255: A/F sensor (Bank 2) short circuit between AF- and GND P2256: A/F sensor (Bank 2) short circuit between AF- and +B
Required Sensors/Components (Main)	A/F sensor
Required Sensors/Components (Related)	Engine Coolant Temperature (ECT) sensor, Crankshaft position sensor
Frequency of Operation	Once per driving cycle
Duration	10 seconds: A/F sensor open circuit between AF+ and AF- 5 seconds: Others
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

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

AF+ terminal voltage	0.5 to 4.5 V
AF- terminal voltage	0.5 to 4.5 V
Difference between AF+ and AF- terminal voltages	0.1 to 0.8 V
ECT	20°C (68°F) or more
Engine condition	Running
Fuel-cut	OFF
A/F sensor heater	ON
Battery voltage	11 V or more
Ignition switch	ON
Time after ignition switch is OFF to ON	5 seconds or more

Others:

Battery voltage	11 V or more
Ignition switch	ON
Time after ignition switch is OFF to ON	5 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

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

A/F sensor admittance	Below 0.022 1/Ω

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

AF+ terminal voltage	0.5 V or less

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

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

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

AF+ terminal voltage	More than 4.5 V

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

AF- terminal voltage	0.5 V or less

P2253 and P2256 (Short circuit between AF- and +B):

AF- terminal voltage	More than 4.5 V

ES

WIRING DIAGRAM

Refer to DTC P2195 (See page ES-309).

HINT:
Intelligent tester only:
Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.
The following instructions describe how to conduct the A/F CONTROL operation using an intelligent tester.
(1) Connect an 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) 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 O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.
HINT:

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

Standard

Tester Display (Sensor)	Injection Volumes	Status	Voltages
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 Areas
1	Injection volume +25 % -12.5 %		Injection volume +25 % -12.5 %		-
	Output voltage More than 3.35 V Less than 3.0 V		Output voltage More than 0.55 V Less than 0.4 V		
2	Injection volume +25 % -12.5 %		Injection volume +25 % -12.5 %		• A/F sensor • A/F sensor heater • A/F sensor circuit
	Output voltage Almost no reaction		Output voltage More than 0.55 V Less than 0.4 V		
3	Injection volume +25 % -12.5 %		Injection volume +25 % -12.5 %		• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
	Output voltage More than 3.35 V Less than 3.0 V		Output voltage Almost no reaction		
4	Injection volume +25 % -12.5 %		Injection volume +25 % -12.5 %		• Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output voltage Almost no reaction		Output voltage Almost no reaction		

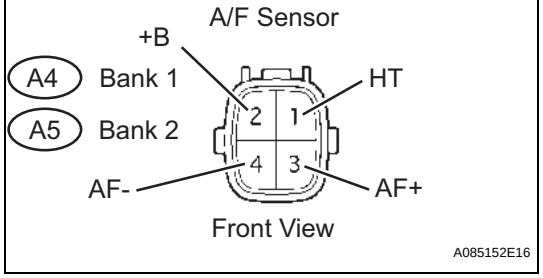
- Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, select the following menu items on the tester: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2 or AFS B2S1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

HINT:

Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

Component Side:



(a) Disconnect the A4 or A5 A/F sensor connector.

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

Standard Resistance

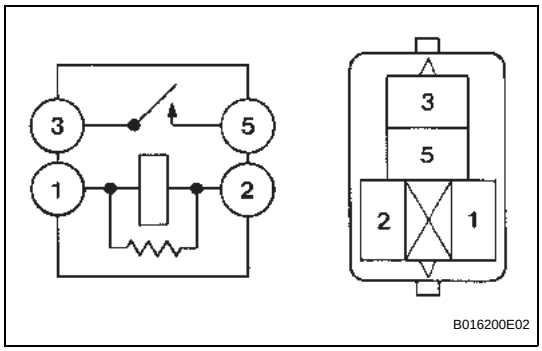
Tester Connections	Specified Conditions
HT (1) - +B (2)	1.8 to 3.4 Ω at 20°C (68°F)
HT (1) - AF- (4)	10 kΩ or higher

(c) Reconnect the A/F sensor connector.

NG → REPLACE AIR FUEL RATIO SENSOR

OK

2 INSPECT AIR FUEL RATIO SENSOR HEATER RELAY



(a) Remove the A/F sensor heater relay from the engine room R/B.
(b) Check the A/F sensor heater relay resistance.
Standard Resistance

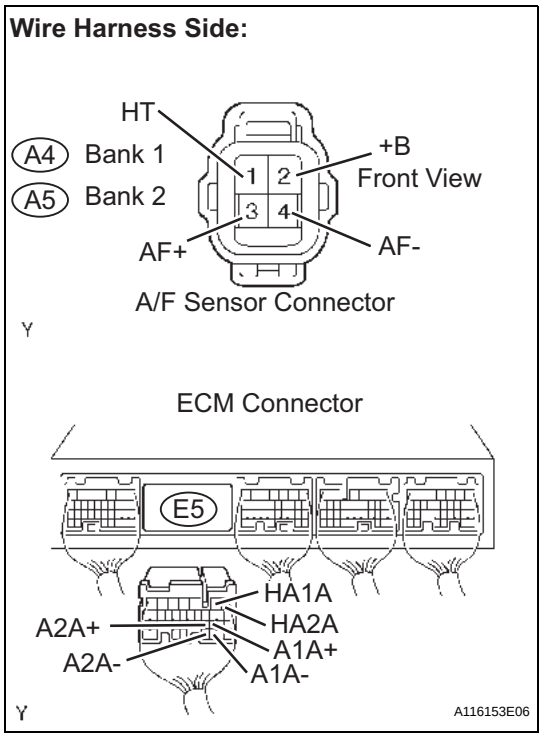
Tester Connections	Specified Conditions
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the A/F sensor heater relay.

NG → **REPLACE AIR FUEL RATIO SENSOR HEATER RELAY**

OK

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



(a) Disconnect the A4 or A5 A/F sensor connector.
(b) Turn the ignition switch ON.
(c) Measure the voltage between the +B terminal of the A/F sensor connector and body ground.
Standard Voltage

Tester Connections	Specified Conditions
+B (A4-2) - Body ground	9 to 14 V
+B (A5-2) - Body ground	

(d) Turn the ignition switch OFF.
(e) Disconnect the E5 ECM connector.
(f) Check the resistance.
Standard Resistance (Check for open)

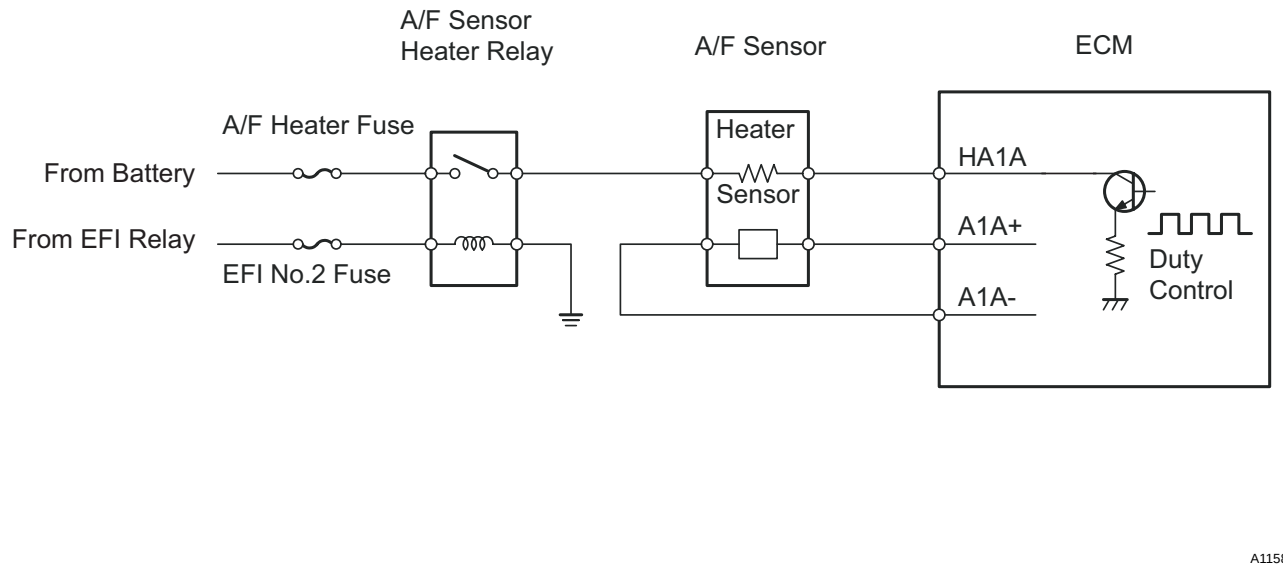
Tester Connections	Specified Conditions
HT (A4-1) - HA1A (E5-2)	Below 1 Ω
AF+ (A4-3) - A1A+ (E5-22)	
AF- (A4-4) - A1A- (E5-30)	
HT (A5-1) - HA2A (E5-1)	
AF+ (A5-3) - A2A+ (E5-23)	
AF- (A5-4) - A2A- (E5-31)	

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
HT (A4-1) or HA1A (E5-2) - Body ground	10 kΩ or higher
AF+ (A4-3) or A1A+ (E5-22) - Body ground	
AF- (A4-4) or A1A- (E5-30) - Body ground	
HT (A5-1) or HA2A (E5-1) - Body ground	
AF+ (A5-3) or A2A+ (E5-23) - Body ground	
AF- (A5-4) or A2A- (E5-31) - Body ground	

(g) Reconnect the ECM connector.
(h) Reconnect the A/F sensor connector.

Reference (Bank 1 Sensor 1 System Diagram)



ES

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

OK

REPLACE ECM

DTC	P2401	Evaporative Emission System Leak Detection Pump Control Circuit Low

DTC	P2402	Evaporative Emission System Leak Detection Pump Control Circuit High

DTC SUMMARY

DTCs	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timings	Detection Logic
P2401	Leak detection pump stuck OFF	Leak detection pump creates negative pressure through reference orifice, and EVAP system pressure measured to determine leak criterion. 0.02 inch leak criterion is measured at start and at end of leak check. If system pressure higher than -1.06 kPa (-7.95 mmHg)*, or lower than -4.85 kPa (-36.38 mmHg)*, ECM determines that leak detection pump stuck OFF.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM • Leakage from EVAP system	While ignition switch OFF	2 trip
P2402	Leak detection pump stuck ON	Leak detection pump creates negative pressure through reference orifice, and EVAP system pressure measured to determine leak criterion. If system pressure higher than -1.06 kPa (-7.95 mmHg)*, or lower than -4.85 kPa (-36.38 mmHg)*, ECM determines that leak detection pump stuck ON.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM	While ignition switch OFF	2 trip

*: The threshold values vary according to the atmospheric pressure measured in operation A. The values described in the table above are based on an atmospheric pressure of 100 kPa (750.1 mmHg).
HINT:
The leak detection pump is built into the canister pump module.

DESCRIPTION

The circuit description can be found in the EVAP System (See page ES-351).

Refer to the EVAP System (See page ES-351).

MONITOR DESCRIPTION

5 hours* after the ignition switch is turned OFF, the electric leak detection 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:
*: 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.

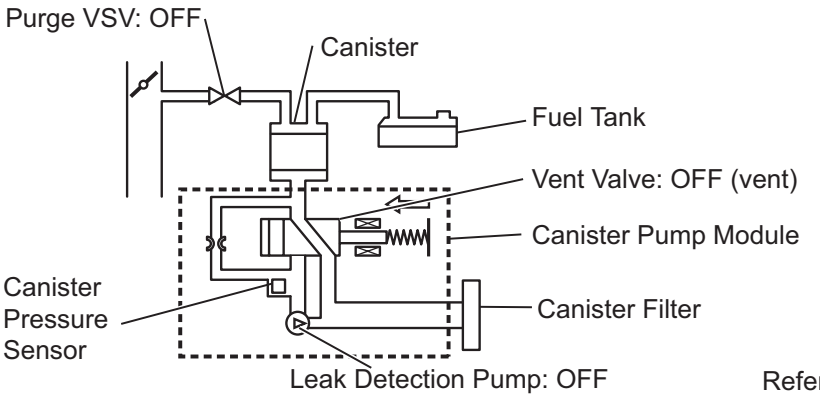
Sequence	Operations	Descriptions	Duration
-	ECM activation	Activated by soak timer, 5 hours (7 or 9.5 hours) after ignition switch turned OFF.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak criterion measurement	In order to determine 0.02 inch leak criterion, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds

Sequence	Operations	Descriptions	Duration
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes*
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak criterion measurement	After second 0.02 inch leak criterion measurement, leak check performed by comparing first and second 0.02 inch leak criterions. If stabilized system pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system leaking.	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.

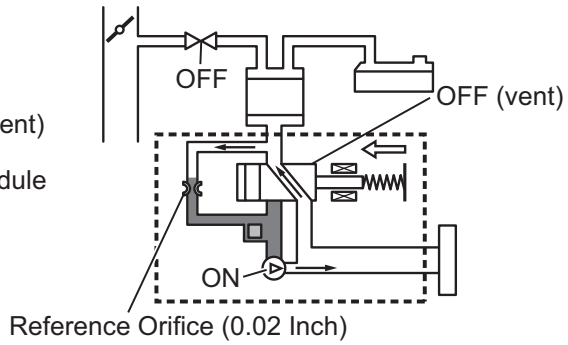
ES

Operation A: Atmospheric Pressure Measurement

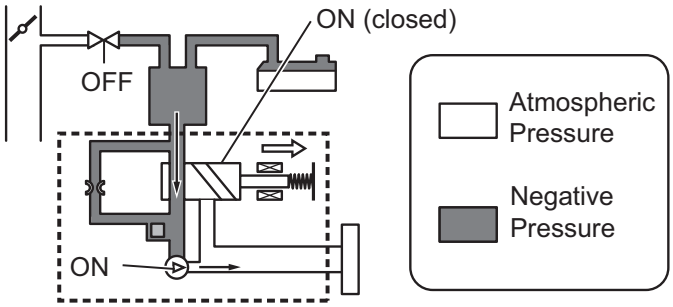


Operation B, E:

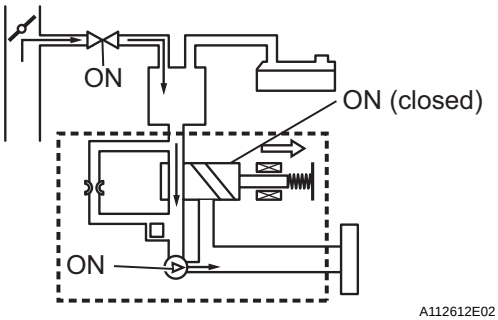
0.02 Inch Leak Criterion Measurement



Operation C: EVAP System Pressure Measurement



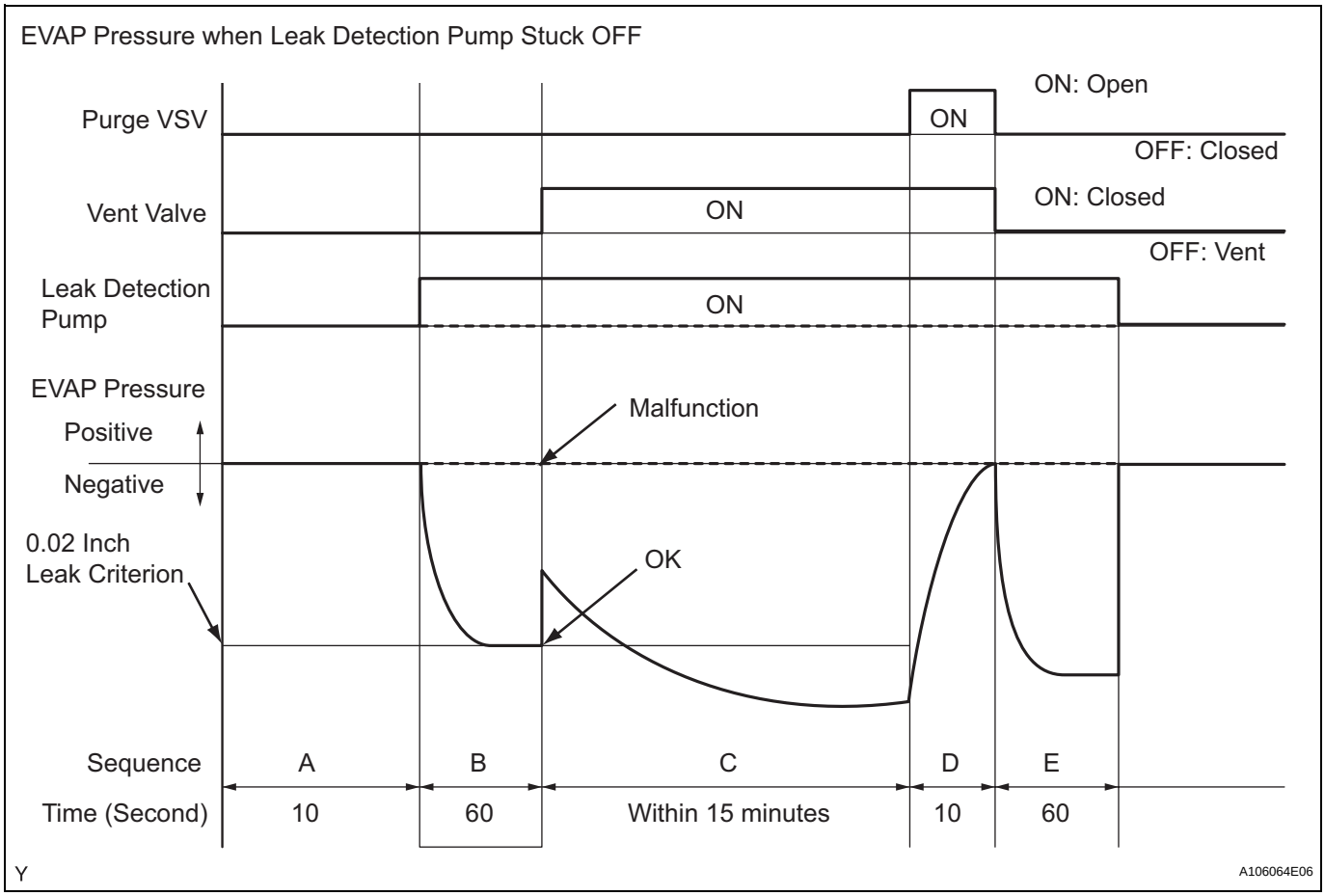
Operation D: Purge VSV Monitor



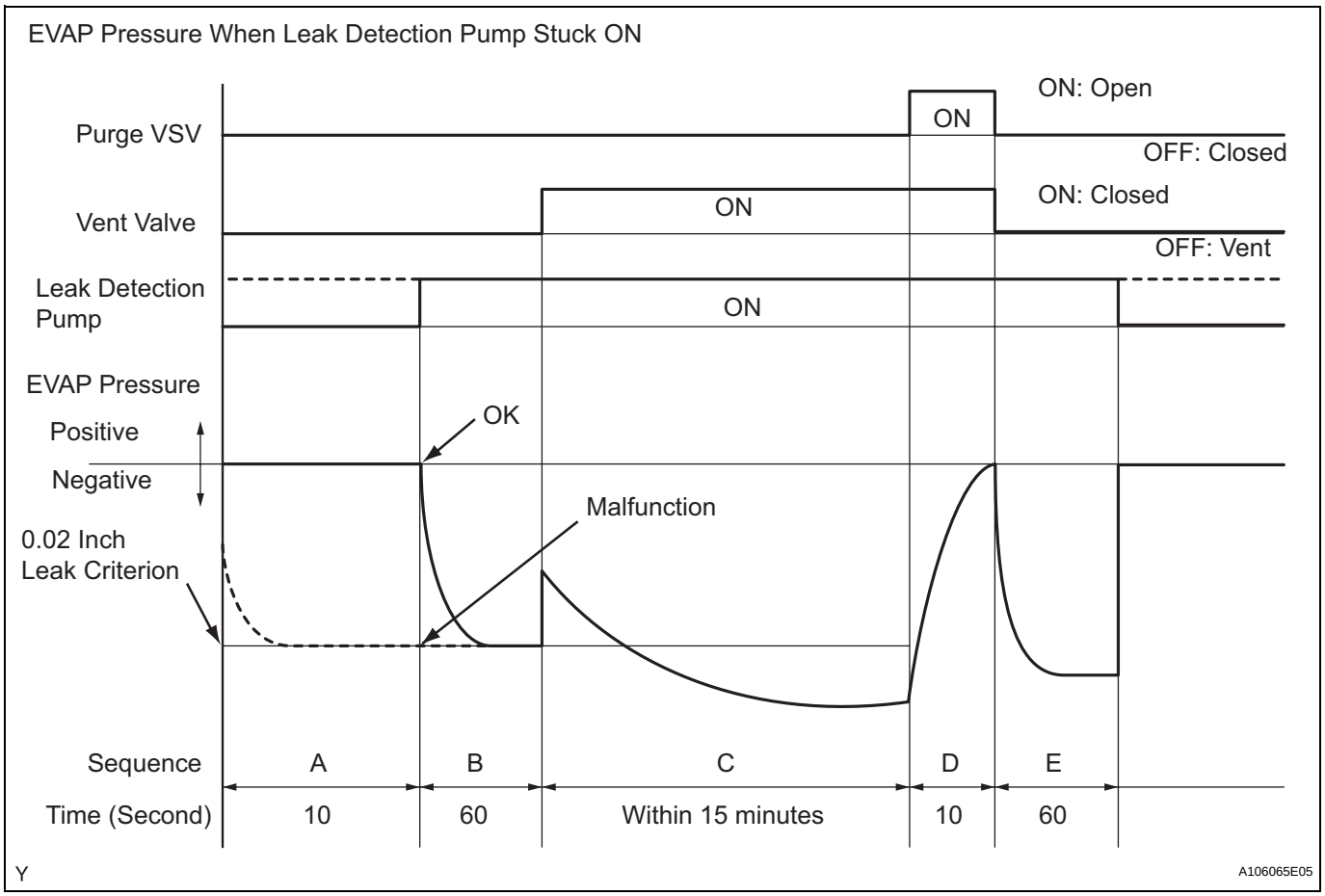
Y

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1. P2401: Leak detection pump stuck OFF
   In operation B, the leak detection pump creates negative pressure (a vacuum) through the reference orifice. The EVAP (Evaporative Emission) system pressure is then measured by the ECM, using the canister pressure sensor, to determine the 0.02 inch leak criterion. If the pressure is higher than -1.06 kPa (-7.95 mmHg)*, or lower than -4.85 kPa (-36.38 mmHg)*, the ECM interprets this as the leak detection pump being stuck OFF (not operating). The ECM illuminates the MIL and sets the DTC (2 trip detection logic).
   *: The thresholds vary according to the atmospheric pressure measured in operation A. The values described above are based on an atmospheric pressure of 100 kPa (750.1 mmHg): absolute pressure.



2. P2402: Leak detection pump stuck ON
In operation B, the leak detection pump creates negative pressure (a vacuum) through the reference orifice. The EVAP (Evaporative Emission) system pressure is then measured by the ECM, using the canister pressure sensor, to determine the 0.02 inch leak criterion. If the pressure is higher than -1.06 kPa (-7.95 mmHg)*, or lower than -4.85 kPa (-36.38 mmHg)*, the ECM interprets this as the leak detection pump being stuck ON (remaining ON all the time). The ECM illuminates the MIL and sets the DTC (2 trip detection logic).
*: The thresholds vary according to the atmospheric pressure measured in operation A. The values described above are based on an atmospheric pressure of 100 kPa (750.1 mmHg): absolute pressure.



HINT:
The detection logic of DTCs P2401 and P2402 is the same because in both cases the 0.02 inch leak criterion measured in operation B is compared to the atmospheric pressure registered in operation A. The ECM calculates the difference between these pressures by deducting [the 0.02 inch leak criterion] from [the stored atmospheric pressure], and uses this to monitor the EVAP system pressure change.

MONITOR STRATEGY

Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes (varies with amount of fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	525 to 825 mmHg (70 to 110 kPa)
Battery voltage	10.5 V or more
Vehicle speed	Below 2.5 mph (4 km/h)
Ignition switch	OFF
Engine condition	Not running
Fuel tank pressure sensor malfunction (P0450, P0451, P0452 and/or P0453)	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before IG switch OFF	Conditions 1 and 2
1. Duration that vehicle driven	5 minutes or more
2. Purge flow	Executed
ECT	4.4° to 35°C (40° to 95°F)
IAT	4.4° to 35°C (40° to 95°F)

1. Key-off monitor sequence is 1 to 8

1. Atmospheric pressure

Next sequence is run if following condition set	-
Atmospheric pressure change for 10 seconds	Less than 2.25 mmHg (0.3 kPa) for 1 second

2. First 0.02 inch leak criterion

Next sequence is run if all of following conditions set	Conditions 1, 2 and 3
1. Fuel tank pressure when 4 seconds after 0.02 inch leak criterion measurement	-7.5 mmHg (-1 kPa) or less
2. 0.02 inch leak criterion	-36.38 to -7.93 mmHg (-4.85 to -1.057 kPa)
3. 0.02 inch leak criterion	Saturated within 55 seconds

3. Vent valve stuck closed check

Next sequence is run if following condition set	-
Fuel tank pressure change for 10 seconds after vent valve ON (closed)	2.25 mmHg (0.3 kPa) or more

4. Vacuum introduction and leak

Next sequence is run if both of following conditions set	-
1. Vacuum introduction time	Saturated within 12 minutes
2. Fuel tank pressure	Fuel tank pressure was standard

5. Purge VSV stuck closed check

Next sequence is run if following condition set	-
Fuel tank pressure change for 10 seconds after purge VSV ON (open)	2.25 mmHg (0.3 kPa) or more

6. Second 0.02 inch leak criterion measurement

Next sequence is run if all of following conditions set	Conditions 1, 2, 3 and 4
1. Fuel tank pressure when 4 seconds after 0.02 inch leak criterion measurement	-7.5 mmHg (-1 kPa) or less
2. 0.02 inch leak criterion	-36.4 to -7.92 mmHg (-4.85 to -1.057 kPa)
3. 0.02 inch leak criterion	Saturated within 55 seconds
4. 0.02 inch leak criterion difference between first and second	5.25 mmHg (0.7 kPa) or less

7. Leak check

Next sequence is run if following condition set	-
Fuel tank pressure when vacuum introduction was complete	Second 0.02 inch leak criterion or less

8. Atmospheric pressure

Monitor is complete if following condition set	-
Atmospheric pressure difference between sequences 1 and 8	2.25 mmHg (0.3 kPa) or less

TYPICAL MALFUNCTION THRESHOLDS

One of following conditions met	-
Fuel tank pressure when 4 seconds after 0.02 inch leak criterion measurement began	More than -7.5 mmHg (-1 kPa)
0.02 inch leak criterion	Less than -36.4 mmHg (-4.85 kPa)
0.02 inch leak criterion	-7.9 mmHg (-1.057 kPa) or more
0.02 inch leak criterion	Not saturated
0.02 inch leak criterion difference between first and second	5.2 mmHg (0.7 kPa) or more

"Saturated" indicates that the EVAP pressure change is less than 0.75 mmHg (0.1 kPa) in 30 seconds.

MONITOR RESULT

Detailed information on Checking Monitor Status (See page ES-19).

DTC	P2419	Evaporative Emission System Switching Valve Control Circuit Low

DTC	P2420	Evaporative Emission System Switching Valve Control Circuit High

DTC SUMMARY

DTCs	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timings	Detection Logic
P2419	Vent valve stuck closed	Leak detection pump creates negative pressure through reference orifice and EVAP system pressure measured to determine leak criterion. If system pressure higher than -1.06 kPa (-7.95 mmHg)* 4 seconds after leak detection pump turned ON, ECM determines that vent valve stuck closed.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM	While ignition switch OFF	2 trip
P2420	Vent valve stuck open (vent)	Leak detection pump creates negative pressure through reference orifice and EVAP system pressure measured to determine leak criterion. 0.02 inch leak criterion measured at start and at end of leak check. If system pressure does not increase by more than 0.3 kPa (2.25 mmHg) within 10 seconds when vent valve turned ON, ECM determines that vent valve stuck closed.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM • Leakage from EVAP system	While ignition switch OFF	2 trip

*: The threshold value varies according to the atmospheric pressure measured in operation A. The value described above is based on an atmospheric pressure of 100 kPa (750.1 mmHg): absolute pressure.
HINT:
The vent valve is built into the canister pump module.

DESCRIPTION

The circuit description can be found in the EVAP System (See page ES-351).

Refer to the EVAP System (See page ES-351).

MONITOR DESCRIPTION

5 hours* after the ignition switch is turned OFF, the electric leak detection 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:
*: 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.

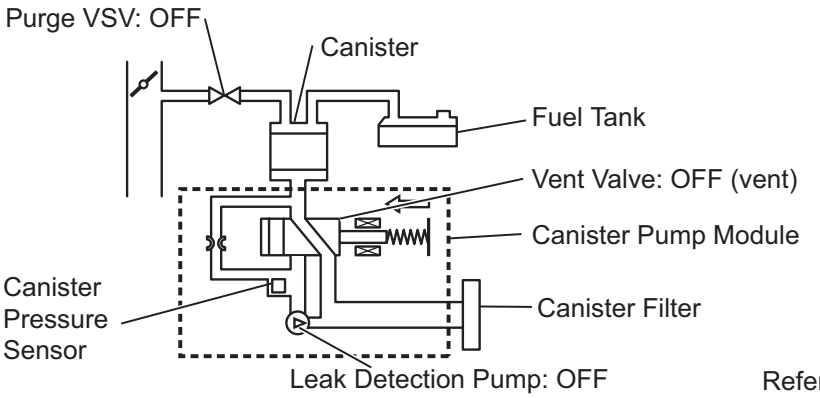
Sequence	Operations	Descriptions	Duration
-	ECM activation	Activated by soak timer, 5 hours (7 or 9.5 hours) after ignition switch turned OFF.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds

Sequence	Operations	Descriptions	Duration
B	First 0.02 inch leak criterion measurement	In order to determine 0.02 inch leak criterion, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as they will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes*
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak criterion measurement	After second 0.02 inch leak criterion measurement, leak check performed by comparing first and second 0.02 inch leak criterions. If stabilized system pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system leaking.	60 seconds
F	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

ES

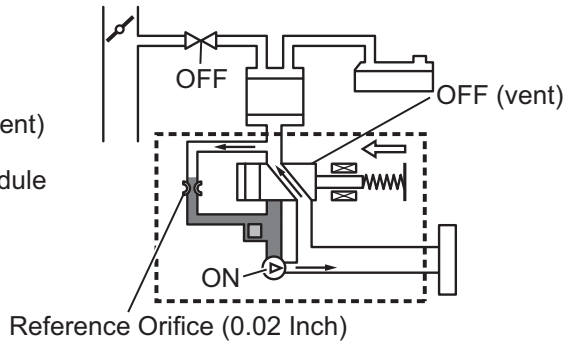
* If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.

Operation A: Atmospheric Pressure Measurement

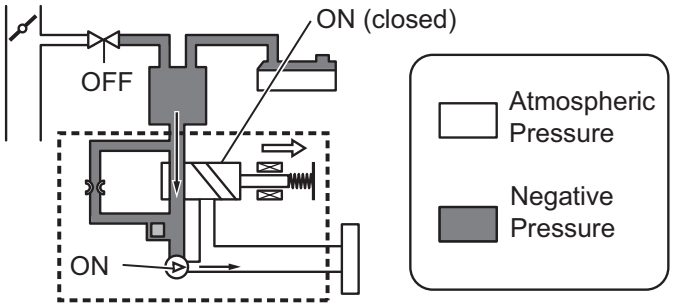


Operation B, E:

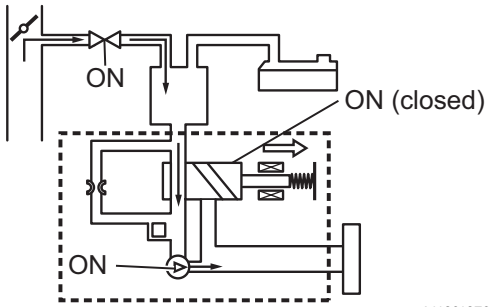
0.02 Inch Leak Criterion Measurement



Operation C: EVAP System Pressure Measurement



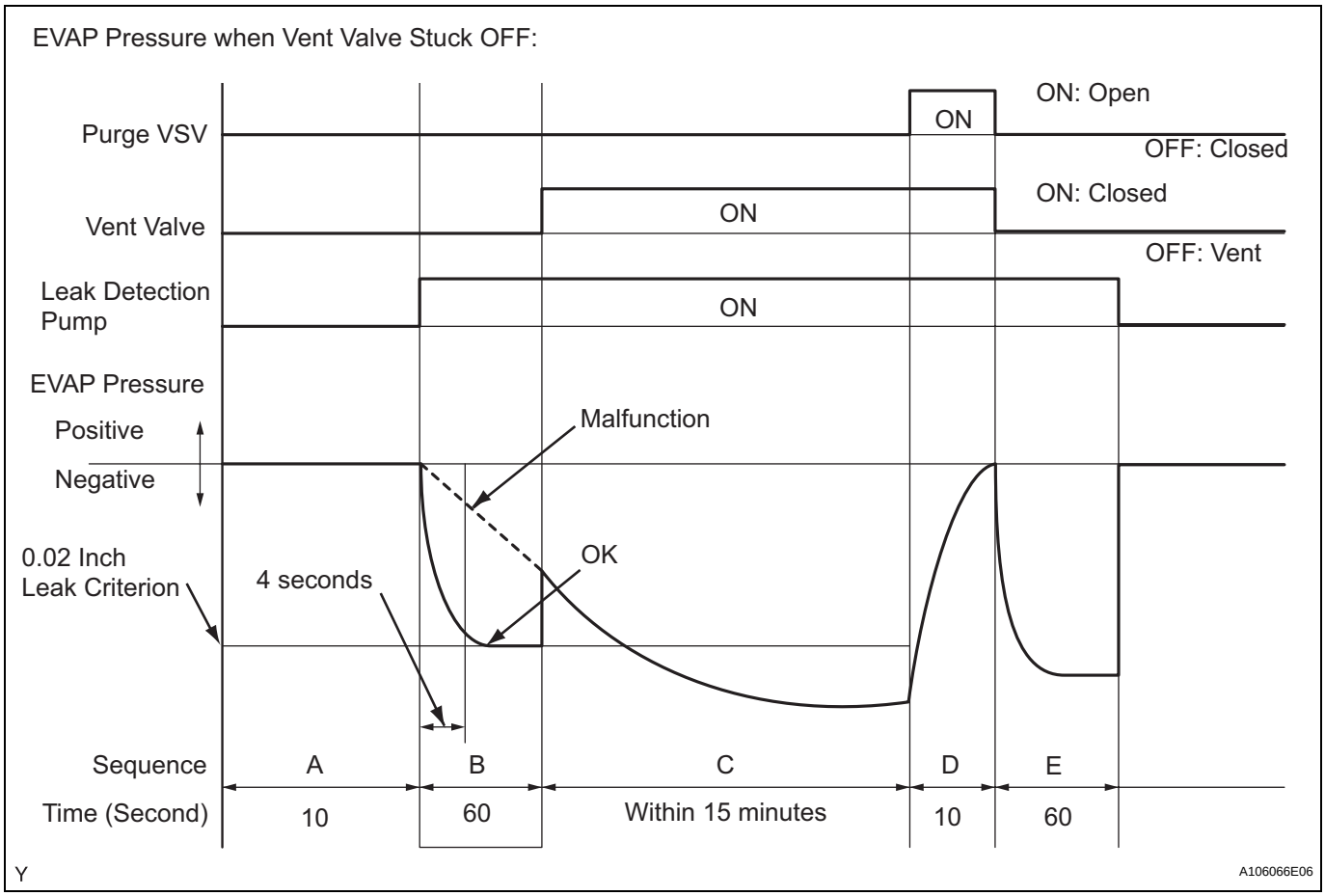
Operation D: Purge VSV Monitor



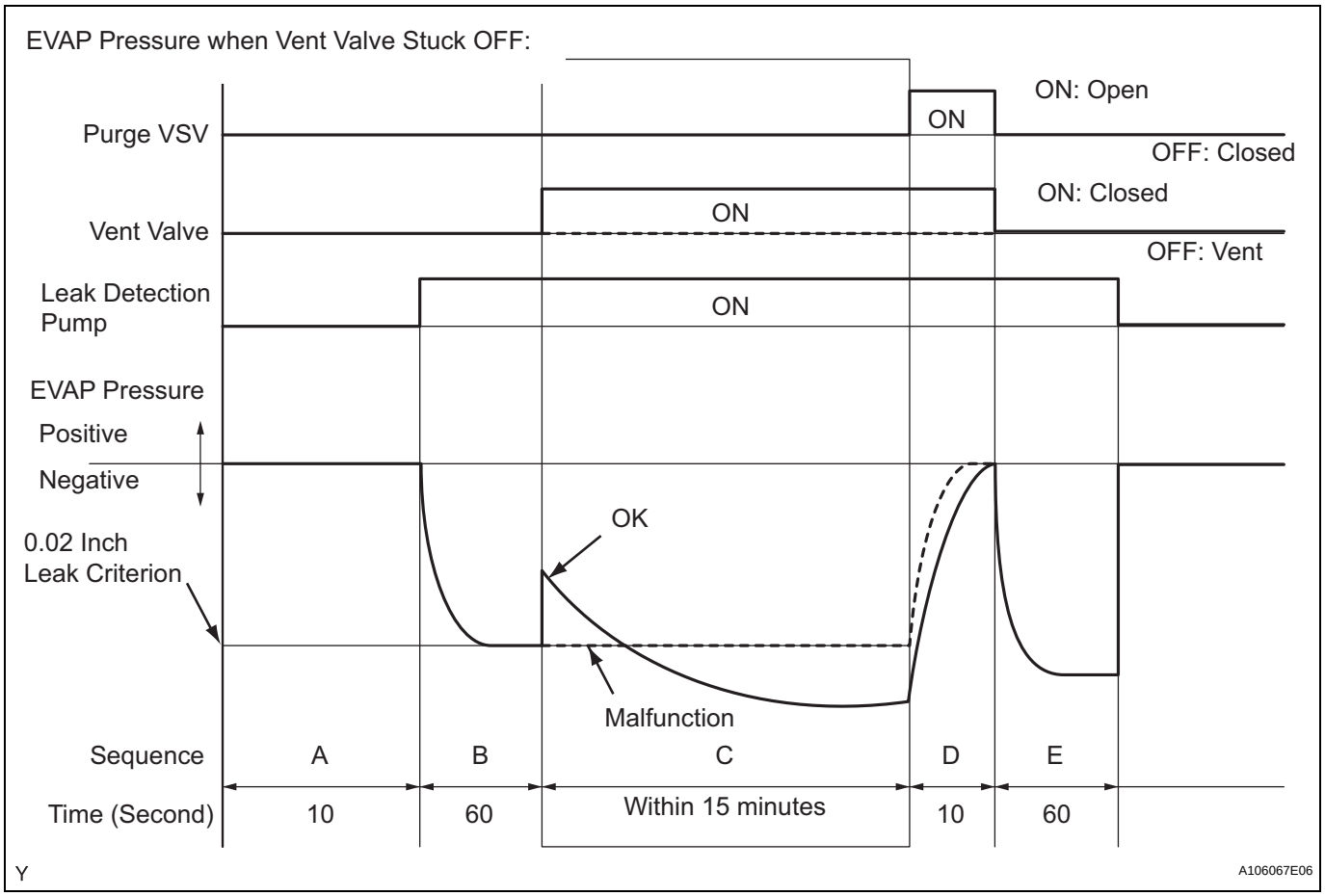
Y

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1. P2419: Vent valve stuck closed
   In operation B, the leak detection pump creates negative pressure (a vacuum) through the reference orifice. The EVAP (Evaporative Emission) system pressure is then measured by the ECM, using the canister pressure sensor, to determine the 0.02 inch leak criterion. If the pressure exceeds -1.06 kPa (-7.95 mmHg)* 4 seconds after the leak detection pump is turned ON, the ECM interprets this as the vent valve being stuck closed. The ECM illuminates the MIL and sets the DTC (2 trip detection logic).
   *: The threshold varies according to the atmospheric pressure measured in operation A. The value described above is based on an atmospheric pressure of 100 kPa (750.1 mmHg): absolute pressure.



2. P2420: Vent valve stuck open (vent)
   In operation C, the vent valve turns ON (closes) and the EVAP (Evaporative Emission) system pressure is then measured by the ECM, using the canister pressure sensor, to conduct an EVAP leak check. If the pressure does not increase when the vent valve is open, the ECM interprets this as the vent valve being stuck open. The ECM illuminates the MIL and sets the DTC.



MONITOR STRATEGY

Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes (varies with amount of fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	525 to 825 mmHg (70 to 110 kPa)
Battery voltage	10.5 V or more
Vehicle speed	Below 2.5 mph (4 km/h)
Ignition switch	OFF
Engine condition	Not running
Fuel tank pressure sensor malfunction (P0450, P0451, P0452 and/or P0453)	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool

Leak detection pump	Not operated by scan tool
Both of following conditions met before IG switch OFF	Conditions 1 and 2
1. Duration that vehicle driven	5 minutes or more
2. Purge flow	Executed
ECT	4.4° to 35°C (40° to 95°F)
IAT	4.4° to 35°C (40° to 95°F)

1. Key-off monitor sequence 1to 8

1. Atmospheric pressure

Next sequence is run if following condition set	-
Atmospheric pressure change for 10 seconds	Less than 2.25 mmHg (0.3 kPa) for 1 second

2. First 0.02 inch leak criterion

Next sequence is run if all of following conditions set	Conditions 1, 2 and 3
1. Fuel tank pressure when 4 seconds after 0.02 inch leak criterion measurement	-7.5 mmHg (-1 kPa) or less
2. 0.02 inch leak criterion	-36.38 to -7.93 mmHg (-4.85 to -1.057 kPa)
3. 0.02 inch leak criterion	Saturated within 55 seconds

3. Vent valve stuck closed check

Next sequence is run if following condition set	-
Fuel tank pressure change for 10 seconds after vent valve ON (closed)	2.25 mmHg (0.3 kPa) or more

4. Vacuum introduction and leak

Next sequence is run if both of following conditions set	-
1. Vacuum introduction time	Saturated within 55 seconds
2. Fuel tank pressure	Fuel tank pressure was standard

5. Purge VSV stuck closed check

Next sequence is run if following condition set	-
Fuel tank pressure change for 10 seconds after purge VSV ON (open)	2.25 mmHg (0.3 kPa) or more

6. Second 0.02 inch leak criterion measurement

Next sequence is run if all of following conditions set	Conditions 1, 2, 3 and 4
1. Fuel tank pressure when 4 seconds after 0.02 inch leak criterion measurement	-7.5 mmHg (-1 kPa) or less
2. 0.02 inch leak criterion	-36.4 to -7.92 mmHg (-4.85 to -1.057 kPa)
3. 0.02 inch leak criterion	Saturated within 55 seconds
4. 0.02 inch leak criterion difference between first and second	5.25 mmHg (0.7 kPa) or less

7. Leak check

Next sequence is run if following condition set	-
Fuel tank pressure when vacuum introduction was complete	Second 0.02 inch leak criterion or less

8. Atmospheric pressure

Monitor is complete if following condition set	-
Atmospheric pressure difference between sequences 1 and 8	2.25 mmHg (0.3 kPa) or less

TYPICAL MALFUNCTION THRESHOLDS

1. P2419: Vent valve stuck closed. "Saturated" indicates that the EVAP pressure change is less than 0.1 kPa (0.75 mmHg) in 30 seconds.

One of following condition set	-
EVAP pressure just after 0.02 inch leak criterion measurement start	-1 kPa (-7.5 mmHg) or higher
0.02 inch leak criterion	Less than -4.85 kPa (-36.38 mmHg)

0.02 inch leak criterion	-1.1 kPa (-8.3 mmHg) or more
0.02 inch leak criterion	Not saturated within 55 seconds
Difference between first 0.02 inch leak criterion and second 0.02 inch leak criterion	0.7 kPa (5.25 mmHg) or more

2. P2420: Vent valve stuck open (vent)

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

MONITOR RESULT

Detailed information on Checking Monitor Status (See page ES-19).

DTC	P2610	ECM / PCM Internal Engine Off Timer Performance

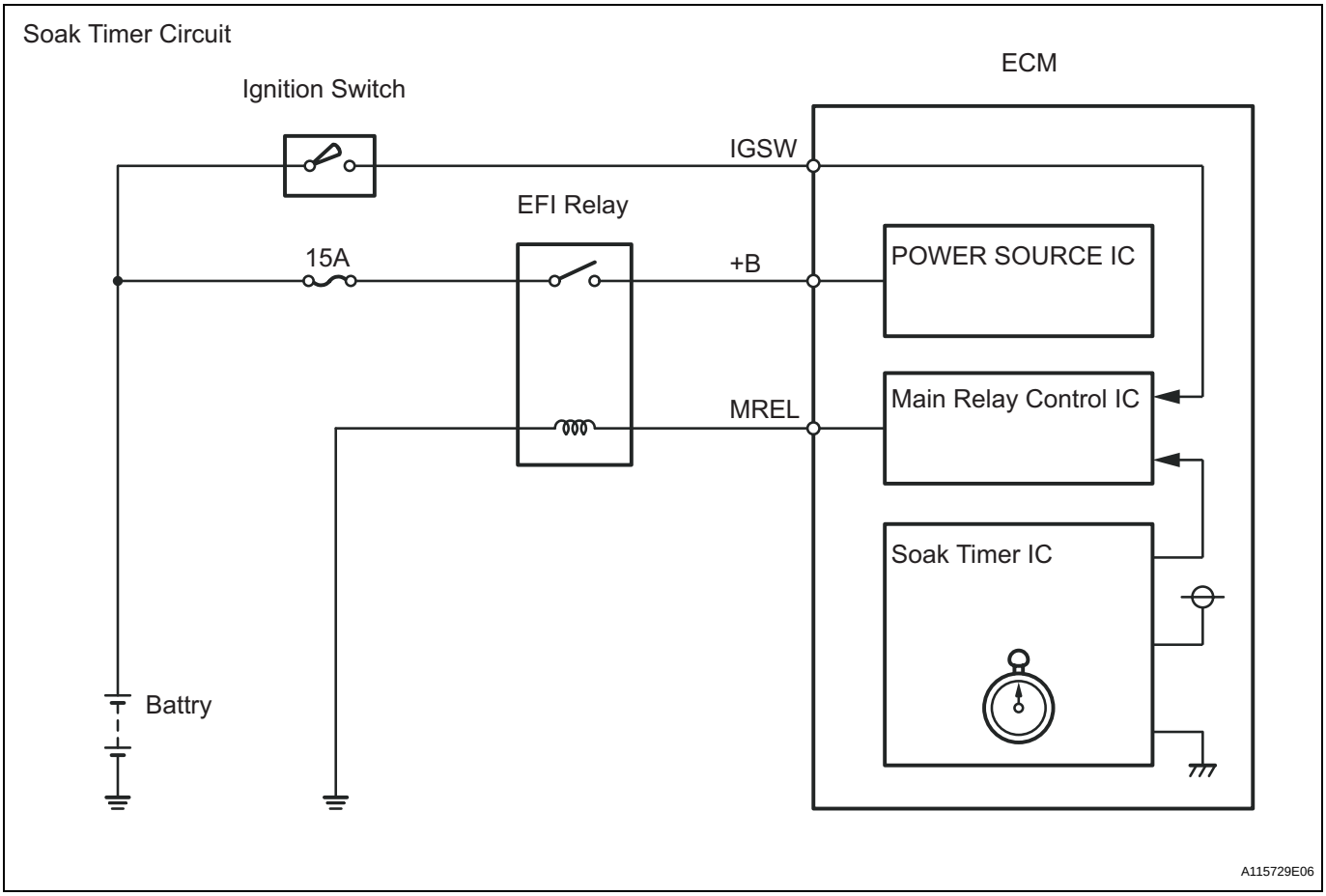
DTC SUMMARY

DTC	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timings	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. 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 these two are not synchronized, the ECM interprets this as a malfunction, illuminates the MIL and sets the DTC (2 trip detection logic).

MONITOR STRATEGY

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

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTC not present	None
Ignition switch	ON
Engine	Running
Battery voltage	8 V or more
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

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

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 an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	**REPLACE ECM**

NEXT

2	**CHECK WHETHER DTC OUTPUT RECURS**

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Clear DTCs (See page ES-38).
(d) Start the engine and wait for 10 minutes or more.
(e) 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)

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

HINT:
- DTC P2A00 indicates malfunctions related to the bank 1 A/F sensor.
- DTC P2A03 indicates malfunctions related to the bank 2 A/F sensor.
- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that includes cylinder No. 2.
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.

ES

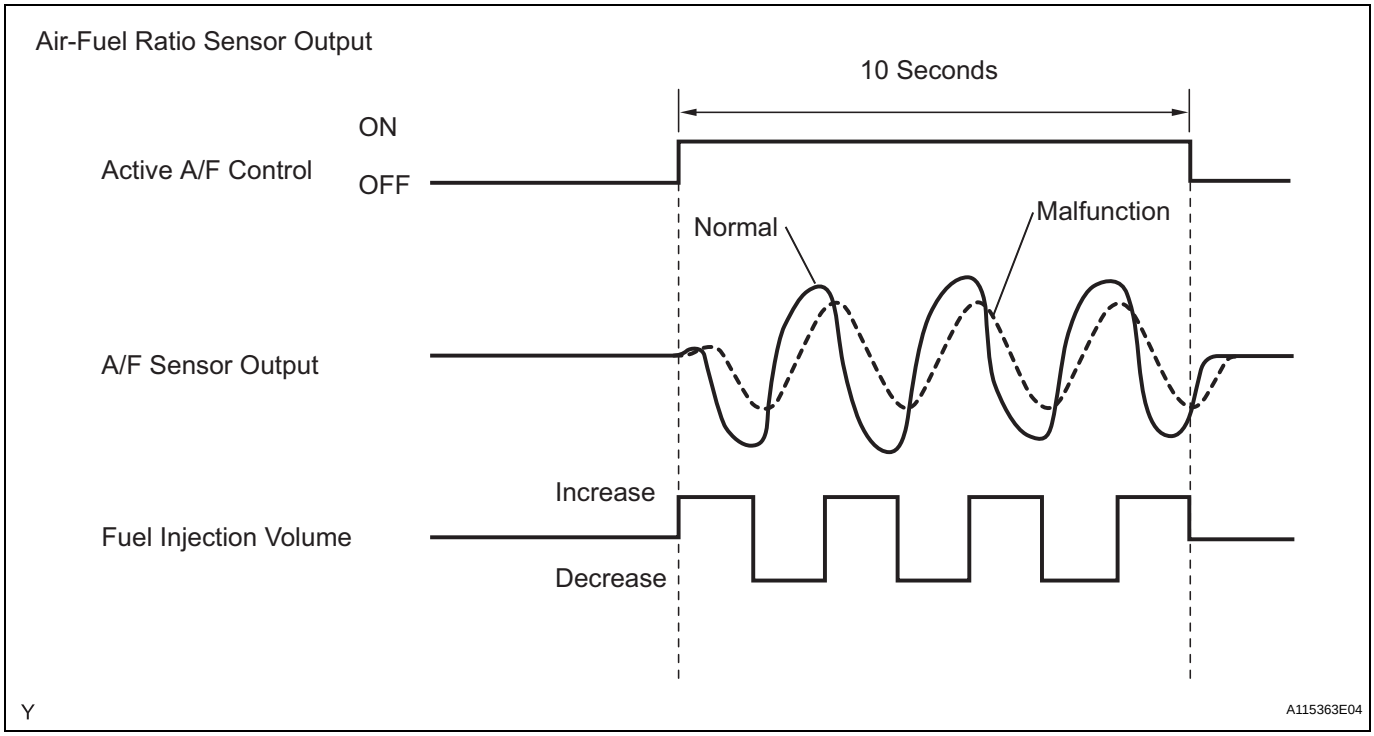
DESCRIPTION

Refer to DTC P2195 (See page ES-304).

DTC No.	DTC Detection Conditions	Trouble Areas
P2A00 P2A03	Calculated value for air-fuel ratio (A/F) sensor response rate deterioration level is less than threshold	• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor • ECM

MONITOR DESCRIPTION

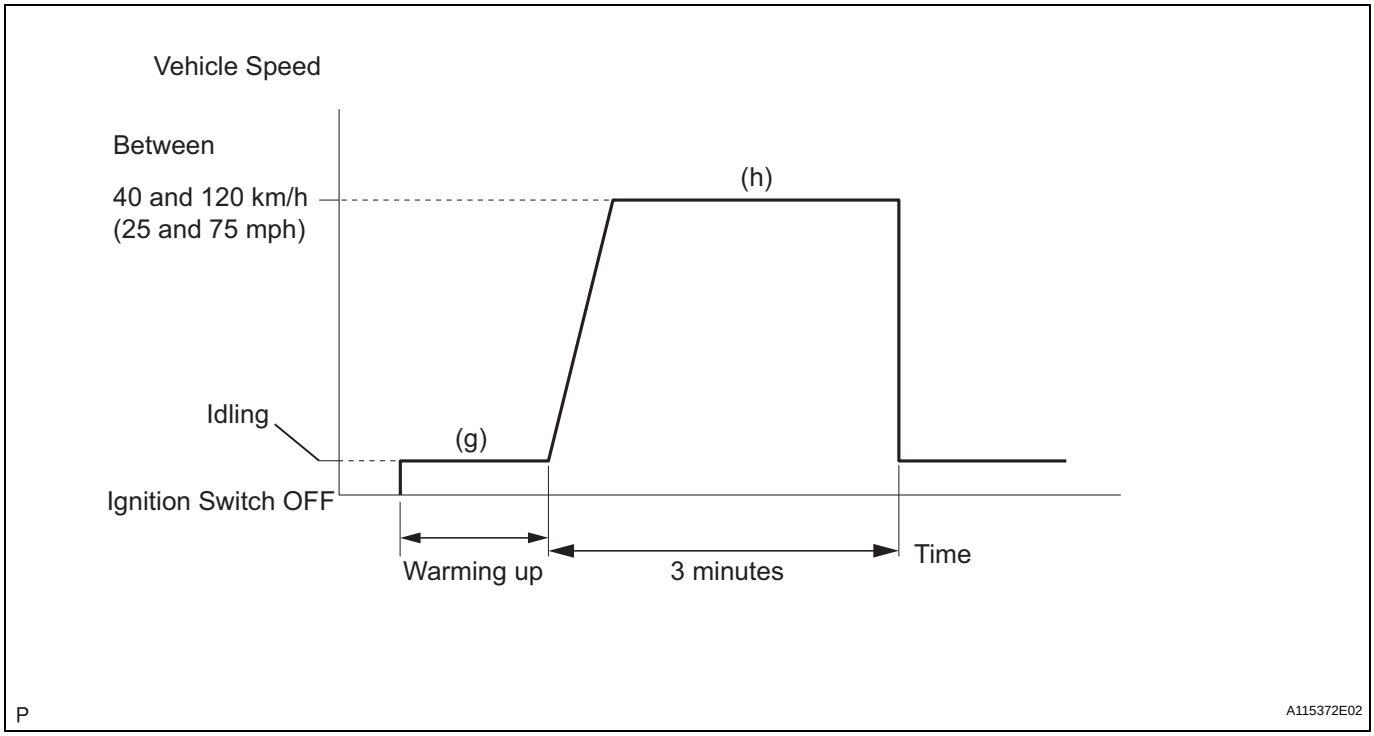
After engine is warmed up, the ECM performs air-fuel ratio feedback control to maintain the air-fuel ratio at the stoichiometric level. In addition, active A/F ratio control is performed for approximately 10 seconds after preconditions are met in order to measure the A/F sensor response rate. During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

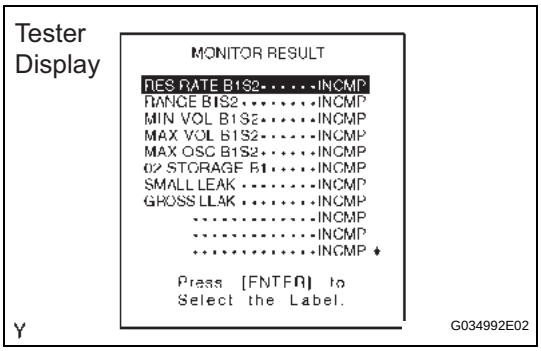


CONFIRMATION DRIVING PATTERN

HINT:

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





(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Clear DTCs (See page ES-38).
(e) Select the following menu items: DIAGNOSIS /ENHANCED OBD II / MONITOR INFO / MONITOR RESULT.
(f) Check that AFS B1 is INCOMPL.
(g) Start the engine and warm it up.
(h) Drive the vehicle at between 25 mph and 75 mph (40 km/h and 120 km/h) for 3 minutes. However, the vehicle should be driven at a constant speed.
(i) Check the monitor result values on an intelligent tester by selecting the following menu items: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / TEST RESULT.
(j) If the values indicated on the tester do not change, perform READINESS MONITOR DRIVE PATTERN for the A/F sensor and the heated oxygen sensor (See page ES-23).
HINT:
Completion of all A/F sensor monitors is required to change the value in TEST RESULT.
(k) Note the value of the Monitor Result.
(l) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.
(m) Check if any DTCs (any pending DTCs) are set.

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0171, P0172 (Fuel system) P0300 - P0306 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0442 - P0456 (EVAP system) P0500 (VSS) P2196, P2198 (A/F sensor - rationality)

A/F sensor active control	Executing
Engine coolant temperature	75°C (167°F) or more
Battery voltage	11 V or more
Malfunction determination in this driving cycle	Not yet
Fuel-cut	OFF
Engine RPM	Less than 4,000 rpm
A/F sensor status	Activated
Delay time after fuel-cut ended	5 seconds or more
Engine load	10 to 70 %
Estimated catalyst temperature	500 to 800°C (932 to 1,472°F)
Shift position	2 or more
Intake air amount	3 to 10.5 g/sec

TYPICAL MALFUNCTION THRESHOLDS

Response rate deterioration level	Less than 0.2 V

MONITOR RESULT

Detailed information on Checking Monitor Status (See page ES-19).

WIRING DIAGRAM

Refer to DTC P2195 (See page ES-309).

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 an intelligent tester.
(1) Connect an 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) 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 O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.
HINT:

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

Standard

Tester Display (Sensor)	Injection Volumes	Status	Voltages
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		

- 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 or AFS B2S1 and O2S B2S2, and press the YES button and then the ENTER button followed by the F4 button.
- Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.

HINT:

- DTC P2A00 or P2A03 may be also set, when the air-fuel ratio is stuck rich or lean.
- A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

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

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

(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read DTCs.

Result

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

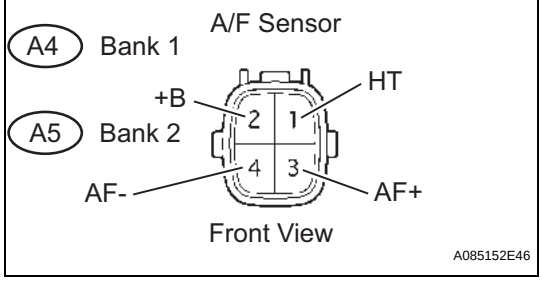
HINT:
If any DTCs other than P2A00 or P2A03 are output, troubleshoot those DTCs first.

B → **GO TO DTC CHART**

A

2 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

Component Side:



(a) Disconnect the A4 or A5 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor connector.

Standard Resistance

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

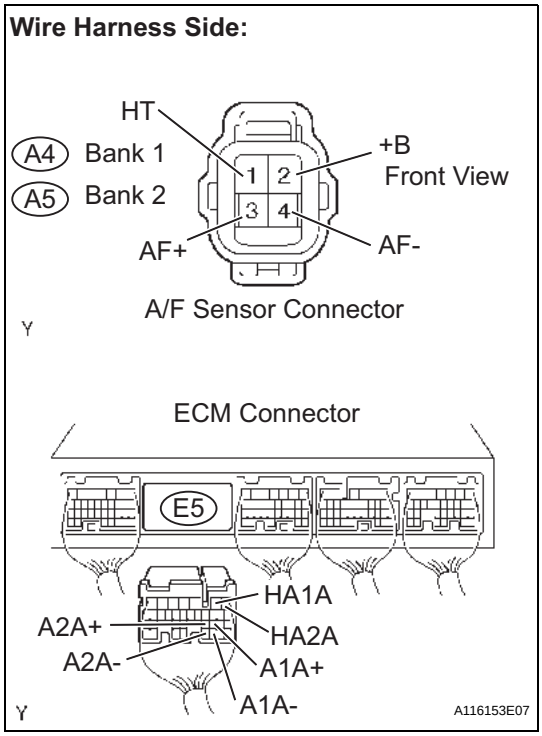
(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

ES

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



(a) Disconnect the A4 or A5 A/F sensor connector.
(b) Turn the ignition switch ON.
(c) Measure the voltage between the +B terminal of the A/F sensor connector and body ground.

Standard Voltage

Tester Connections	Specified Conditions
+B (A4-2) - Body ground	9 to 14 V
+B (A5-2) - Body ground	

(d) Turn the ignition switch OFF.
(e) Disconnect the E5 ECM connector.
(f) Check the resistance.

Standard Resistance (Check for open)

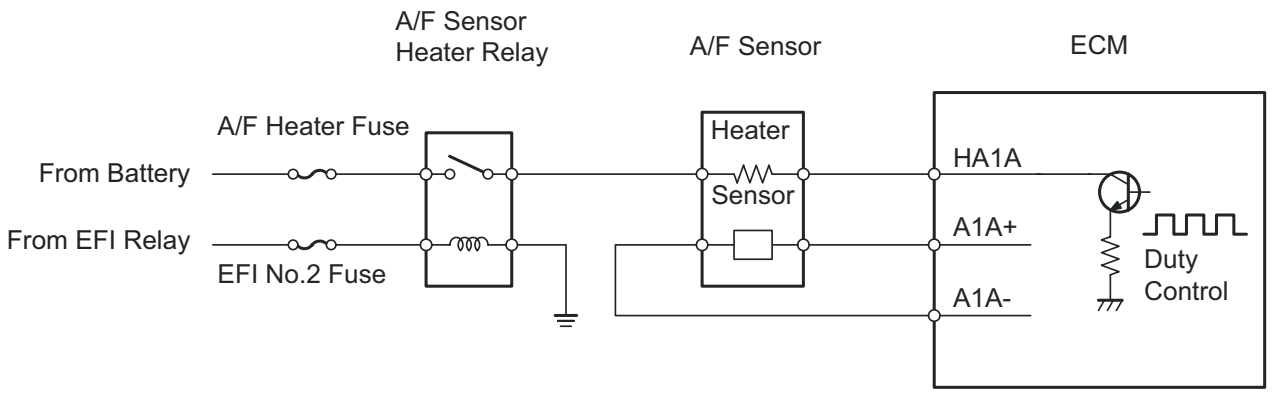
Tester Connections	Specified Conditions
HT (A4-1) - HA1A (E5-2)	Below 1 Ω
AF+ (A4-3) - A1A+ (E5-22)	
AF- (A4-4) - A1A- (E5-30)	
HT (A5-1) - HA2A (E5-1)	
AF+ (A5-3) - A2A+ (E5-23)	
AF- (A5-4) - A2A- (E5-31)	

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
HT (A4-1) or HA1A (E5-2) - Body ground	10 kΩ or higher
AF+ (A4-3) or A1A+ (E5-22) - Body ground	
AF- (A4-4) or A1A- (E5-30) - Body ground	
HT (A5-1) or HA2A (E5-1) - Body ground	
AF+ (A5-3) or A2A+ (E5-23) - Body ground	
AF- (A5-4) or A2A- (E5-31) - Body ground	

(g) Reconnect the ECM connector.
(h) Reconnect the A/F sensor connector.

Reference (Bank 1 Sensor 1 System Diagram)



ES

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

OK

4	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

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

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

Result

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

B → **CHECK FOR INTERMITTENT PROBLEMS**

A

6	REPLACE AIR FUEL RATIO SENSOR

NEXT

7	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

ES

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

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

Result

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

B → CHECK EXTREMLY RICH OR LEAN ACTUAL AIR FUEL RATIO (REFER TO DTC P0171 PROCEDURE)

A

END

EVAP System

RELATED DTCS

DTCs	Monitoring Items	See Page
P043E	Reference orifice clogged (built into canister pump module)	ES-210
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-216
P0450	Canister pressure sensor (built into canister pump module) voltage abnormal fluctuation	ES-223
P0451	• Canister pressure sensor (built into canister pump module) noise • Canister pressure sensor fixed (built into canister pump module)	
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-233
P0456	EVAP small leak	
P2401	Leak detection pump stuck OFF (built into canister pump module)	ES-328
P2402	Leak detection pump stuck ON (built into canister pump module)	
P2419	Vent valve stuck ON (closed) (built into canister pump module)	ES-334
P2420	Vent valve stuck OFF (vent) (built into canister pump module)	
P2610	Soak timer (built into ECM)	ES-340

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

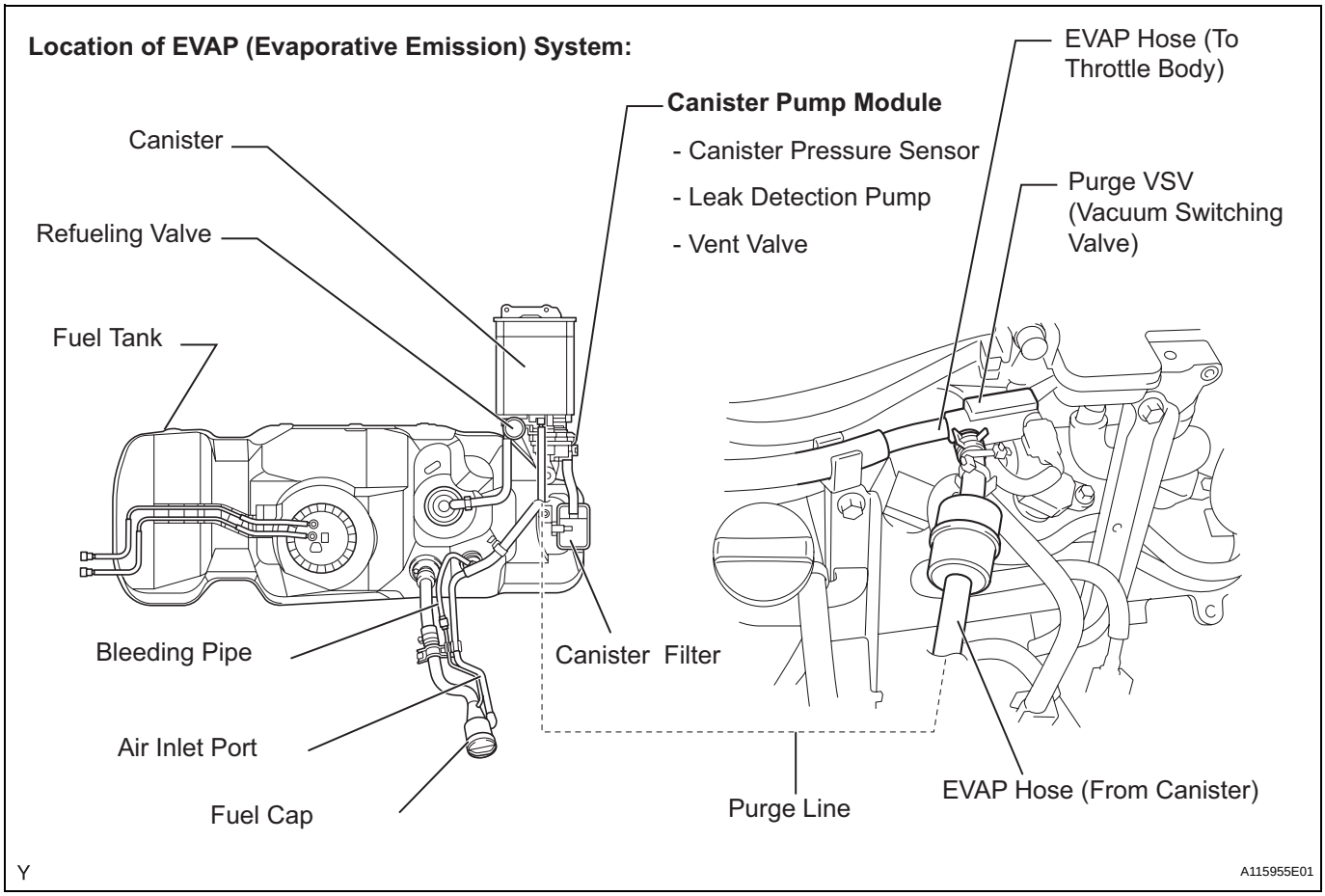
DTCs / Malfunctioning Areas	P043E P043F	P0441	P0450	P0451	P0452	P0453	P0455	P0456	P2401 P2402	P2419	P2420
Reference orifice clogged	●								●	●	
Reference orifice high-flow	●								●	●	
Purge VSV stuck open		●					●				
Purge VSV stuck closed		●									
Canister pressure sensor fixed				●							
Canister 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

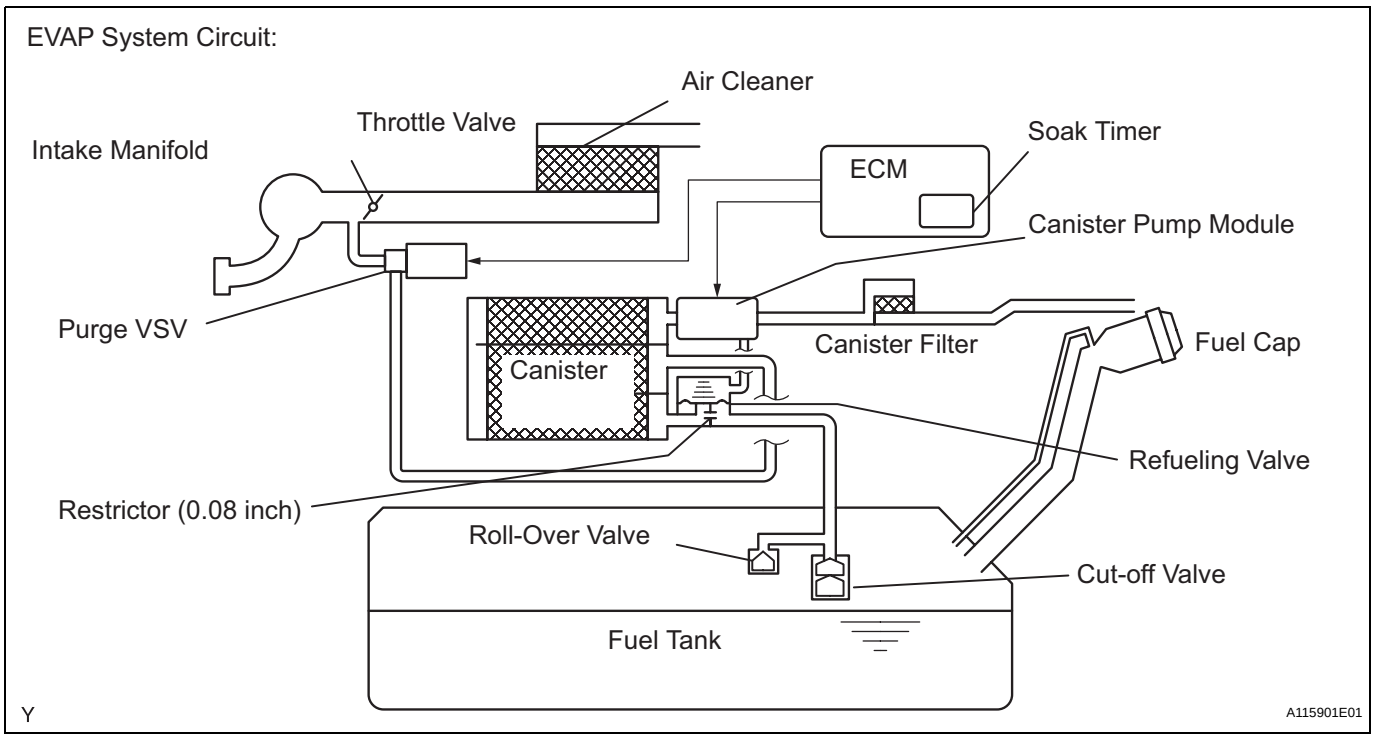
A106731E14

NOTICE:
If the 0.02 inch leak criterion difference between the first and second checks is greater than the specification, the DTCs corresponding to the leak criterion (P043E, P043F, P2401, P2402 and P2419) will be all stored.

DESCRIPTION



NOTICE:
The canister is located near the fuel tank, underneath the body.



NOTICE:
In this vehicle's EVAP system, turning ON the vent valve does not seal off the EVAP system. To check for leaks in the EVAP system, disconnect the air inlet vent hose and apply pressure from the atmosphere side of the canister.

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

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

The following two monitors run to confirm 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. More than 5 hours are required to allow enough time for the fuel to cool down to stabilize the fuel tank pressure, thus making the EVAP system monitor more accurate.

The electric 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

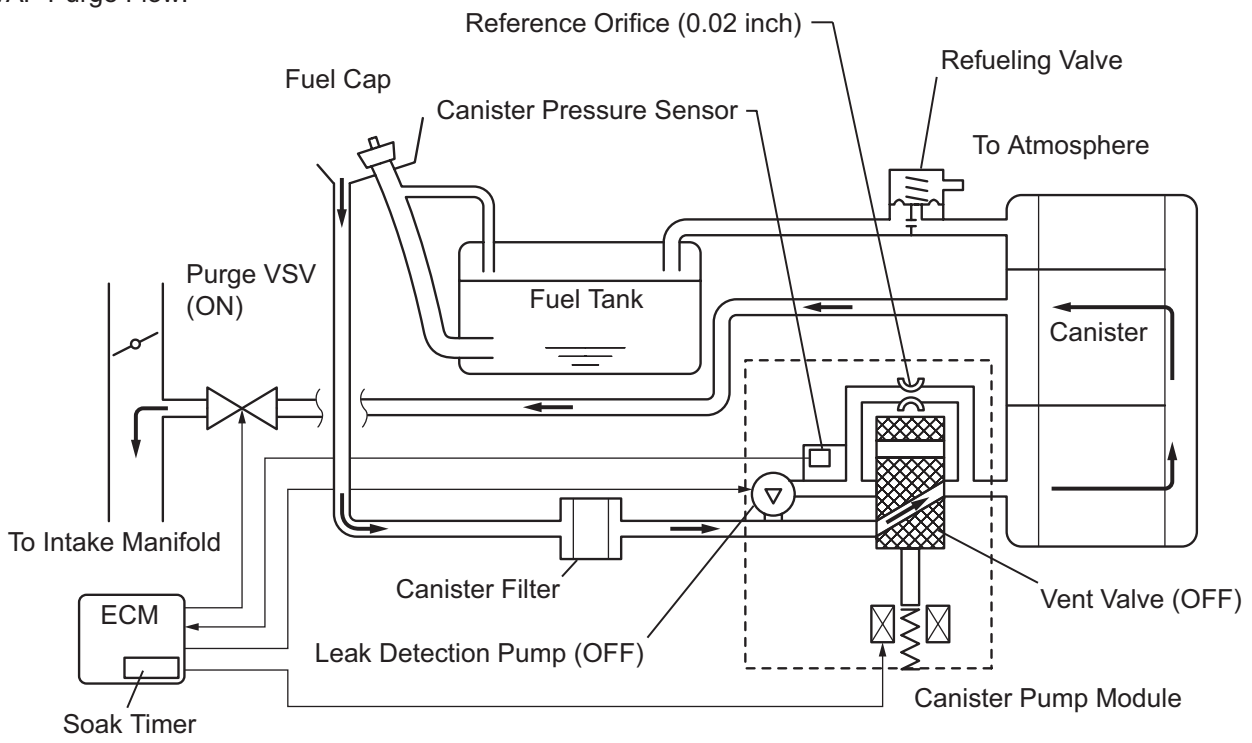
The purge flow monitor consists of the two monitors. The 1st monitor is always conducted every time and the 2nd monitor is activated if necessary.

- 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 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 pressures, before and after conduction of the purge flow monitor, is measured by the ECM.

EVAP Purge Flow:

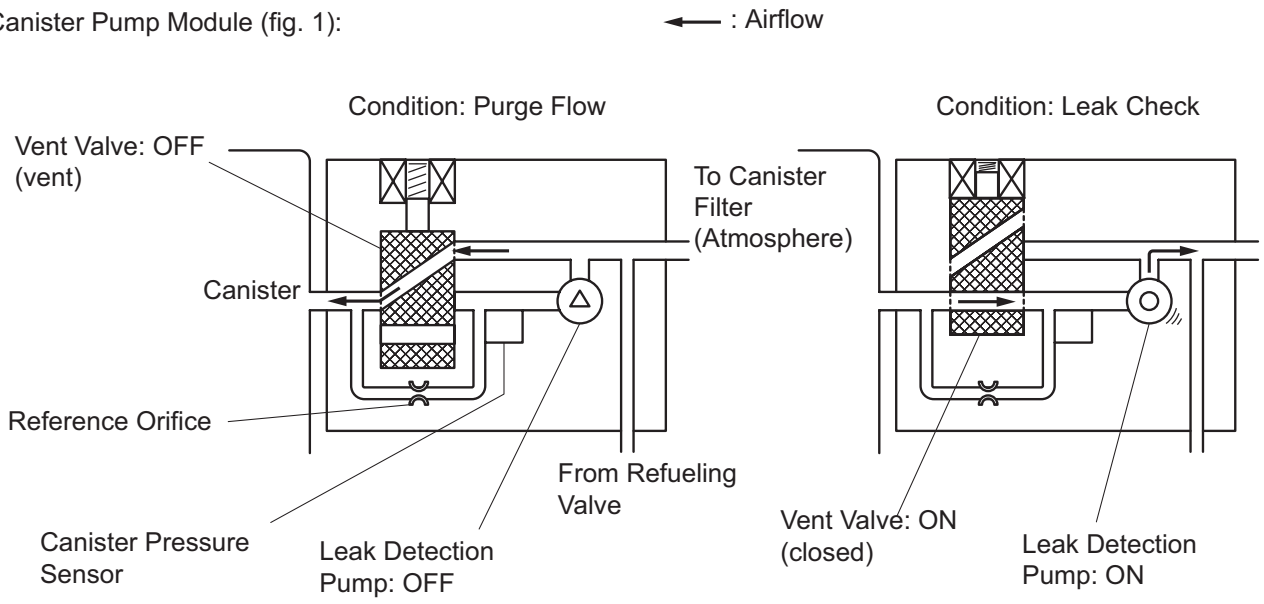


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Components	Operations
Canister	Contains activated charcoal to absorb EVAP (Evaporative Emissions) generated in fuel tank.
Cut-off valve	Located in fuel tank. Valve floats and closes when fuel tank 100 % full.
Purge VSV (Vacuum Switching Valve)	Opens or closes line between canister and intake manifold. ECM uses purge VSV to control EVAP purge flow. In order to discharge EVAP absorbed by canister to intake manifold, ECM opens purge VSV. EVAP discharge volume to intake manifold controlled by purge VSV duty cycle ratio (current-carrying time). (Open: ON, Close: OFF)
Refueling valve	Controls EVAP pressure from fuel tank to canister. Valve consists of diaphragm, spring and restrictor (diameter: 0.08 inch). When fuel vapor and pressure inside fuel tank increase, valve opens. While EVAP purged, valve closes and restrictor prevents large amount of vacuum from affecting pressure in fuel tank. Valve opened while refueling. When valve open, adding fuel into fuel tank possible.
Roll-over valve	Located in fuel tank. Valve closes by its own weight when vehicle overturns to prevent fuel from spilling out.
Soak timer	Built into ECM. To ensure accurate EVAP monitor, measures 5 hours (+-15 min) after ignition switch turned OFF. This allows fuel to cool down, stabilizing fuel tank pressure. When approx 5 hours elapsed, ECM activates (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 closed. When, ECM turns valve OFF, EVAP system vented. Negative pressure (vacuum) created in EVAP system to check for EVAP leaks by closing purge VSV, turning on vent valve (closed) and operating leak detection pump (refer to fig. 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 produced through orifice by closing purge VSV, turning off vent valve and operating leak detection pump, to monitor 0.02 inch leak criterion. 0.02 inch leak criterion indicates small leak of EVAP.

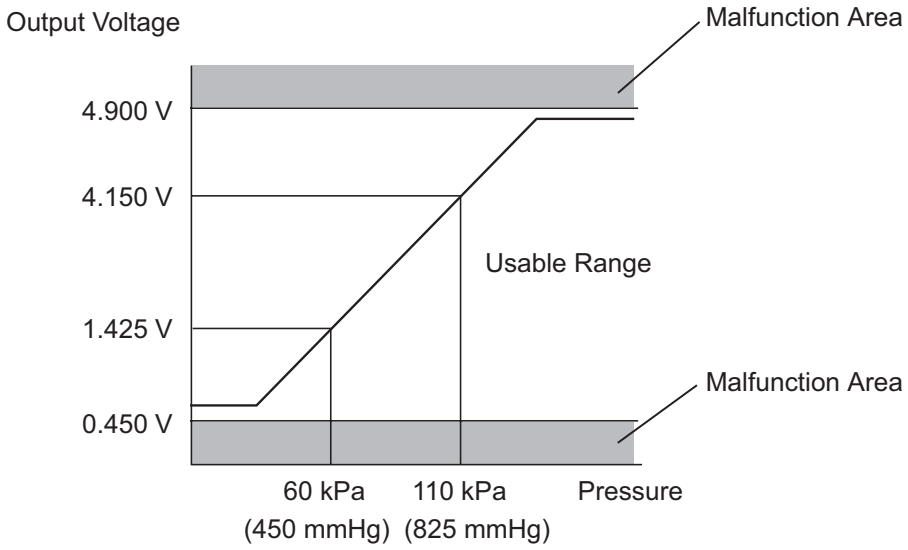
Canister Pump Module (fig. 1):



Y

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Canister Pressure Sensor Specification (fig. 2):

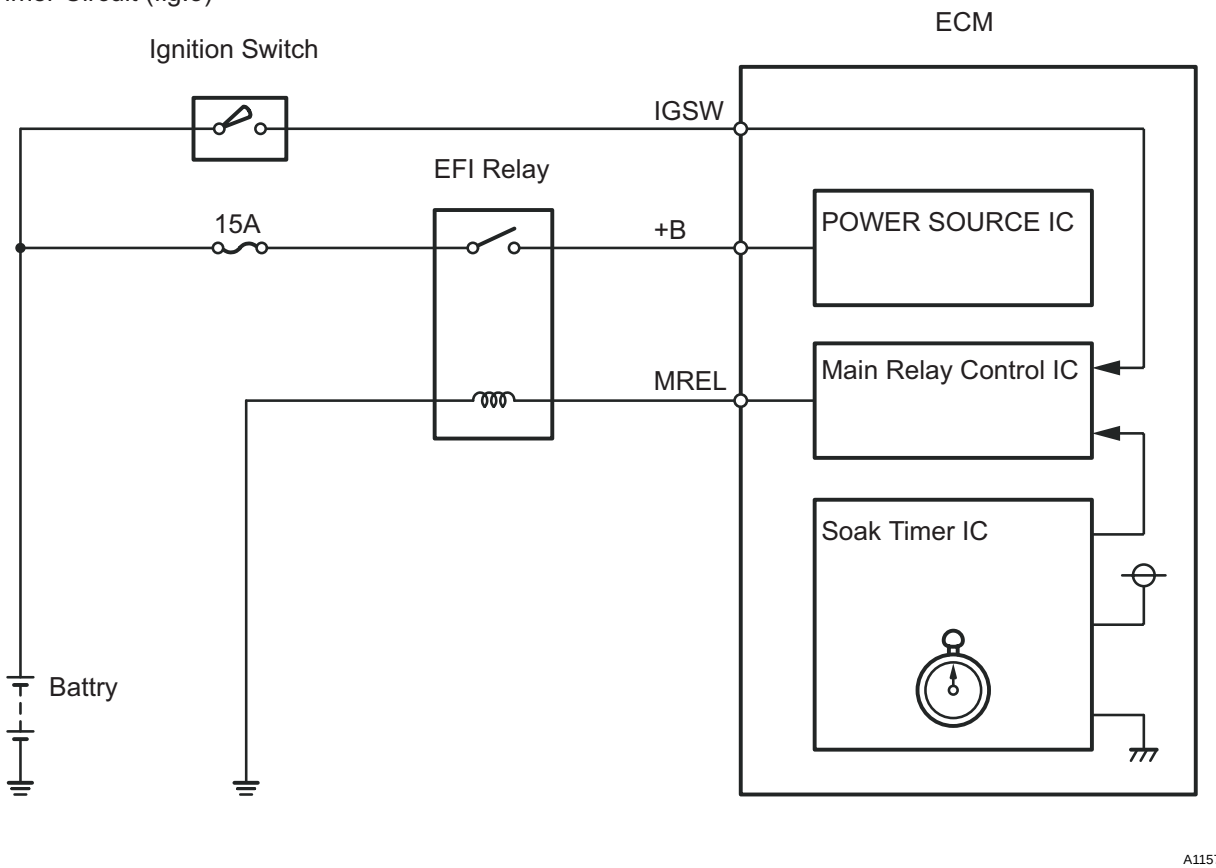


HINT:

Standard atmospheric pressure is 101.3 kPa (760 mmHg)

A115543E07

Soak Timer Circuit (fig.3)



WIRING DIAGRAM

Refer to DTC P0450 (See page ES-226).

NOTICE:

An intelligent tester is required to conduct the following diagnostic troubleshooting procedure.

HINT:

- Using an intelligent tester monitor results enables the EVAP (Evaporative Emission) system to be confirmed.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	**CONFIRM DTC**

(a) Turn the ignition switch OFF and wait for 10 seconds.
(b) Turn the ignition switch ON.
(c) Turn the ignition switch OFF and wait for 10 seconds.
(d) Connect an intelligent tester to the DLC3.
(e) Turn the ignition switch ON 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.

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 stuck				●							
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

NOTICE:
If the 0.02 inch leak criterion difference between the first and second checks is greater than the specification, the DTCs corresponding to the leak criterion (P043E, P043F, P2401, P2402 and P2419) will be all stored.

NEXT

2	PERFORM EVAP SYSTEM CHECK (AUTO OPERATION)

NOTICE:
- **The EVAP SYSTEM CHECK (AUTO OPERATION) consists of five 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 and making the leak check of the fuel tank unavailable.**
- **Do not run the engine in this step.**

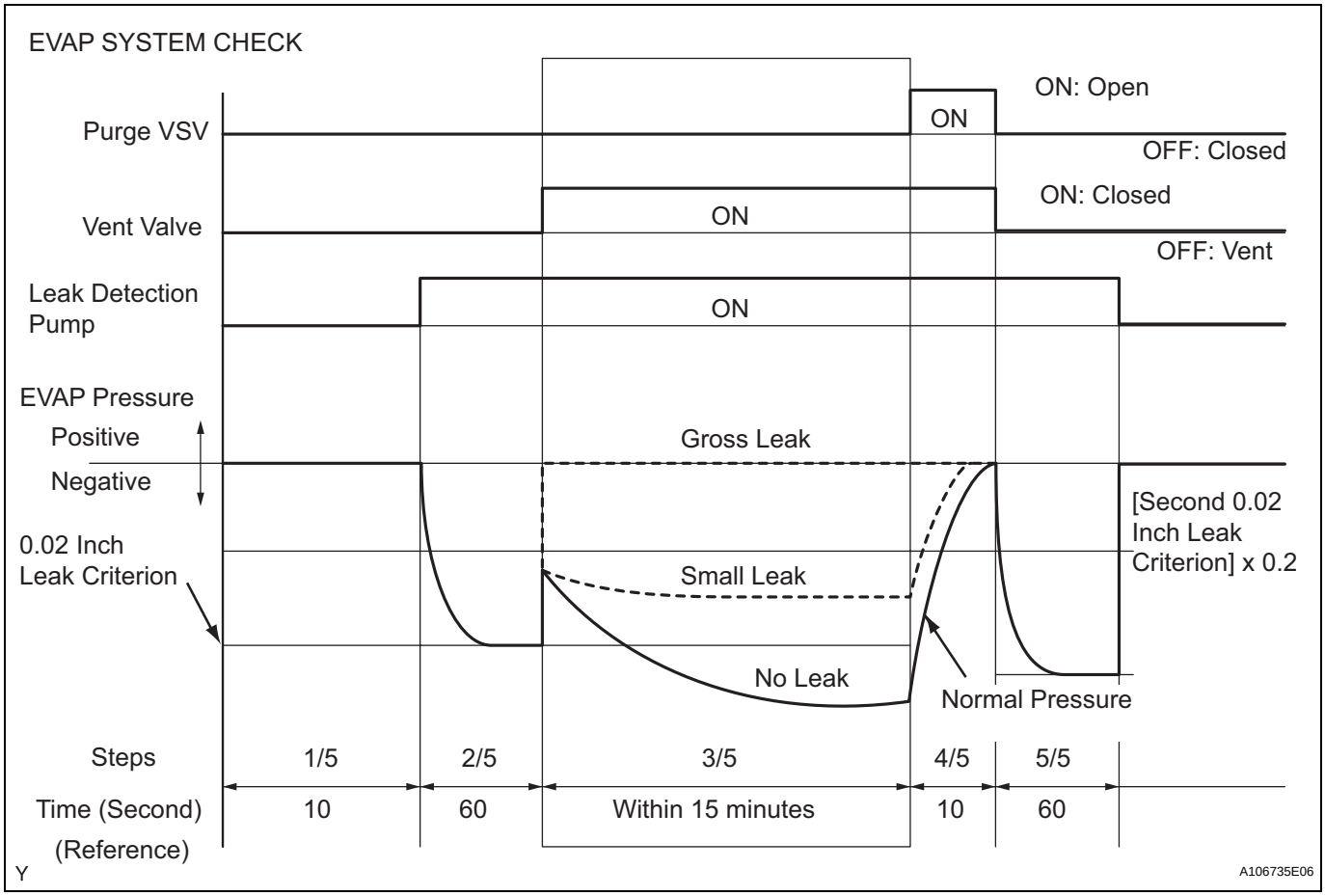
- **When the temperature of the fuel is 35°C(95°F) or more, a large amount of vapor forms and any check results become inaccurate. When performing the EVAP SYSTEM CHECK, keep the temperature below 35°C (95°F).**

(a) Clear DTCs (See page ES-38).
(b) 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 DTC is displayed, perform the MONITOR CONFIRMATION (see "Diagnostic Help" menu). After this confirmation, check for pending DTCs. If no DTC is displayed, the EVAP system is normal.

ES

NEXT

3	PERFORM EVAP SYSTEM CHECK (MANUAL OPERATION)



NOTICE:

- **In the EVAP SYSTEM CHECK (MANUAL OPERATION), the series of 5 EVAP SYSTEM CHECK steps are performed manually by 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 and making the leak check of the fuel tank 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 the EVAP SYSTEM CHECK, keep the temperature below 35°C (95°F).**

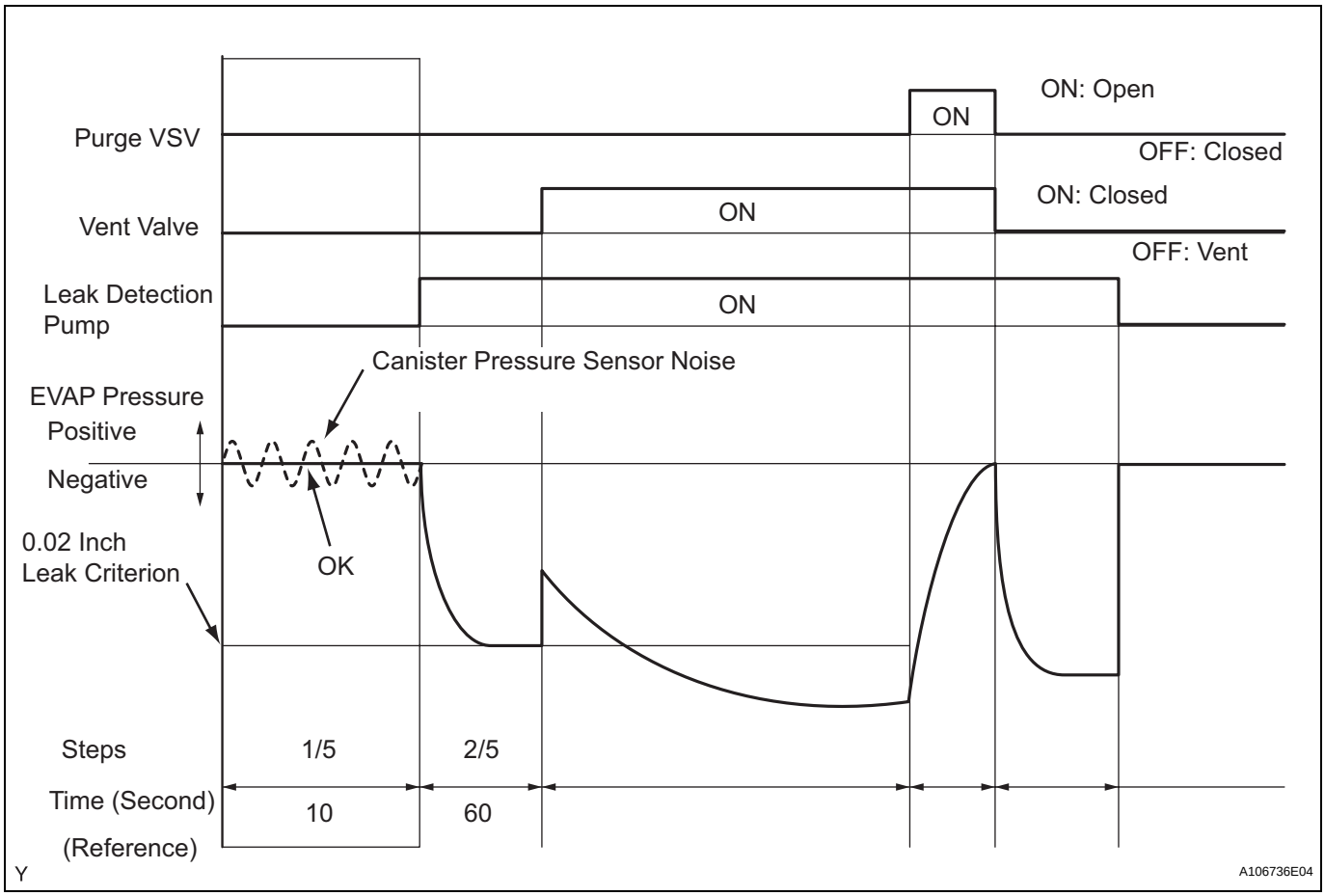
(a) Clear DTCs (See page ES-38).

(b) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / MANUAL OPERATION.

ES

NEXT

4	PERFORM EVAP SYSTEM CHECK (STEP 1/5)



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

Result

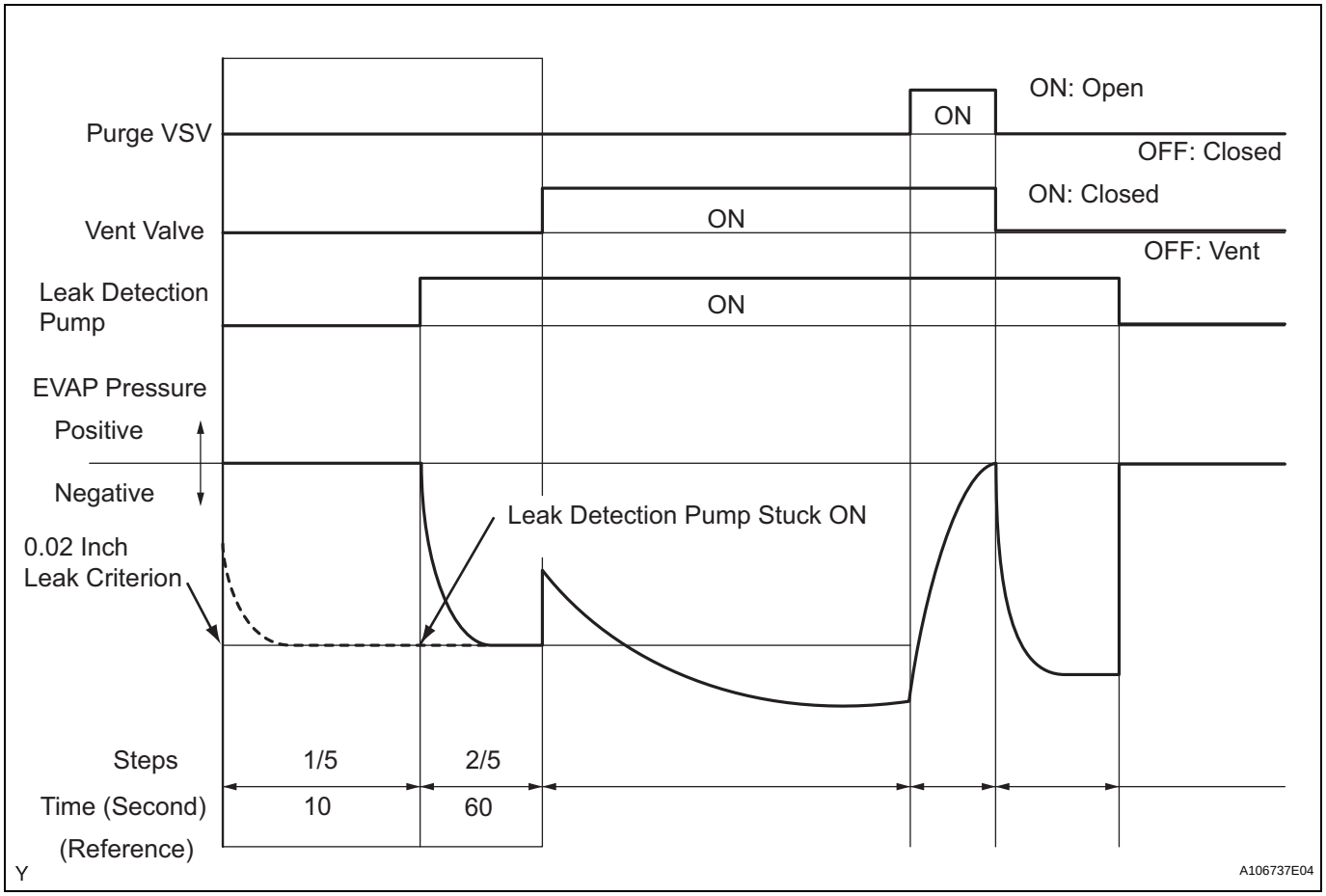
DTCs*	Test Results	Suspected Trouble Areas	Proceed To
-	Virtually no variation in EVAP pressure	Not yet determined	A
P0451	EVAP pressure fluctuates by +-0.3 kPa (2.25 mmHg) or more	Canister pressure sensor noise	B

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in step 1.

B → Go to step 30

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

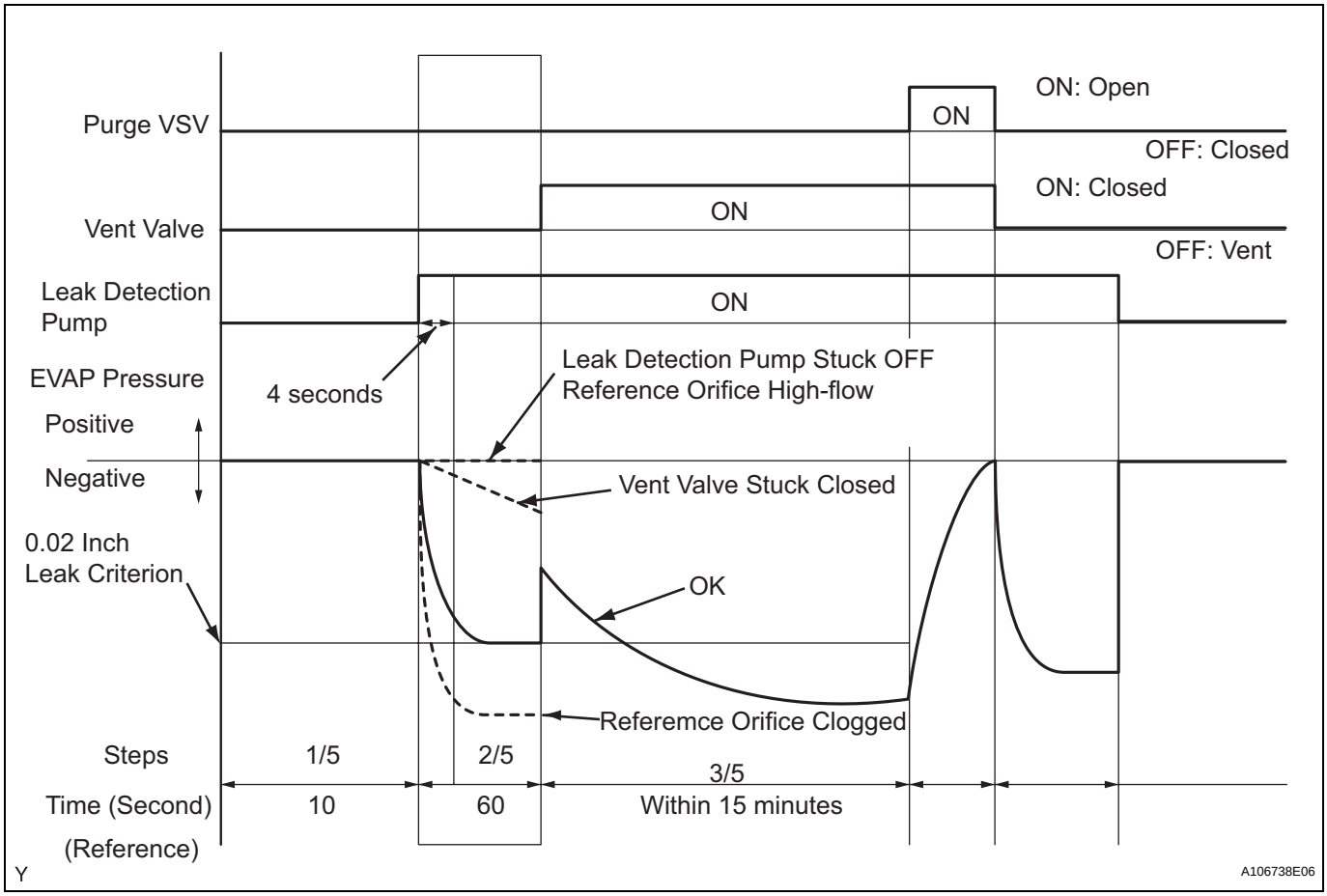
DTCs*	Test Results	Suspected Trouble Areas	Proceed To
-	Virtually no variation in EVAP pressure during step 1/5. Then decreases to 0.02 inch leak criterion*	Not yet determined	A
P2402	Small difference between EVAP pressures during steps 1/5 and 2/5	Leak detection pump stuck ON	B

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in step 1.
HINT:
The first 0.02 inch leak criterion is the value determined in step 2/5.

B → Go to step 23

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*.
(b) Check the EVAP pressure again when it has stabilized. This pressure is the 0.02 inch leak criterion.
*: The leak detection pump begins to operate as step 1/5 is proceeded to step 2/5.

Result

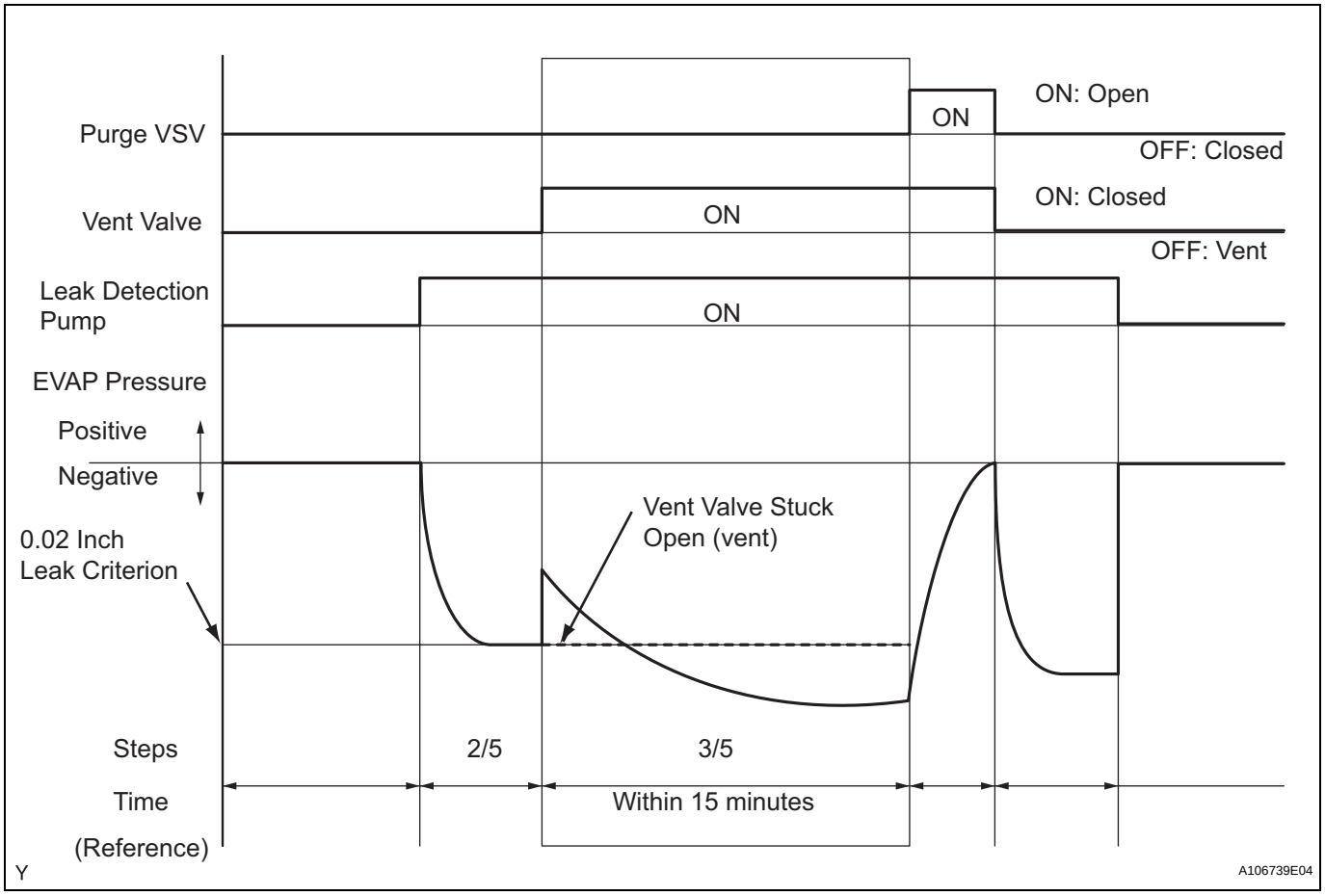
DTCs*	Test Results	Suspected Trouble Areas	Proceed To
-	EVAP pressure in step (b) between -4.85 kPa and -1.06 kPa (-36.38 mmHg and -7.95 mmHg)	Not yet determined	A
P043F and P2401	EVAP pressure in step (b) -1.06 kPa (-7.95 mmHg) or more	• Reference orifice high-flow • Leak detection pump stuck OFF	B
P043E	EVAP pressure in step (b) below -4.85 kPa (-36.38 mmHg)	Reference orifice clogged	C
P2419	EVAP pressure in step (a) more than -1.06 kPa (-7.95 mmHg)	Vent valve stuck closed	D

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in step 1.

B	Go to step 11
C	Go to step 30
D	Go to step 19

A

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



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

Result

DTCs*	Test Results	Suspected Trouble Areas	Proceed To
-	EVAP pressure increases by 0.3 kPa (2.25 mmHg) 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 stuck	C

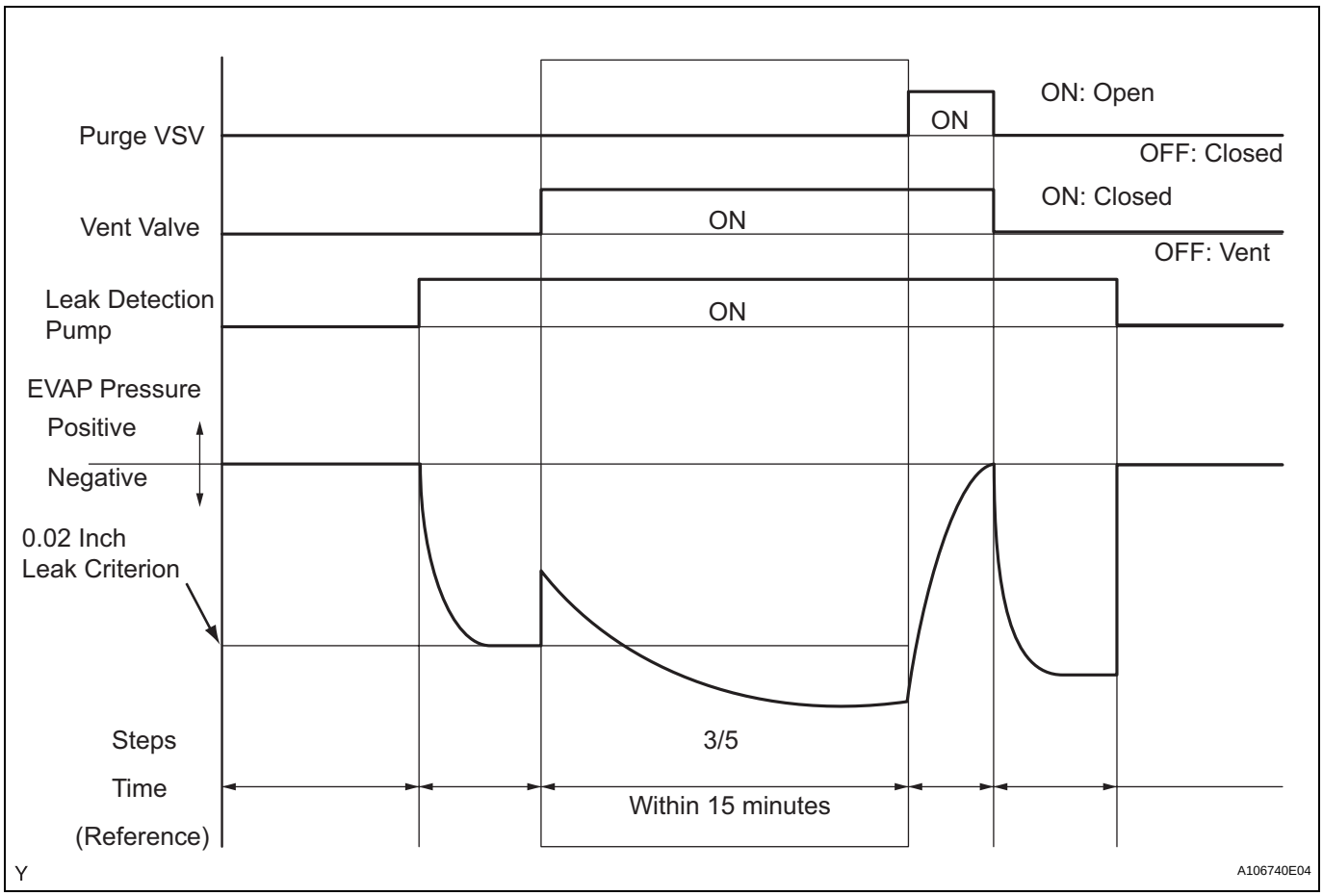
*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in step 1.

B	Go to step 20

C → Go to step 30

A

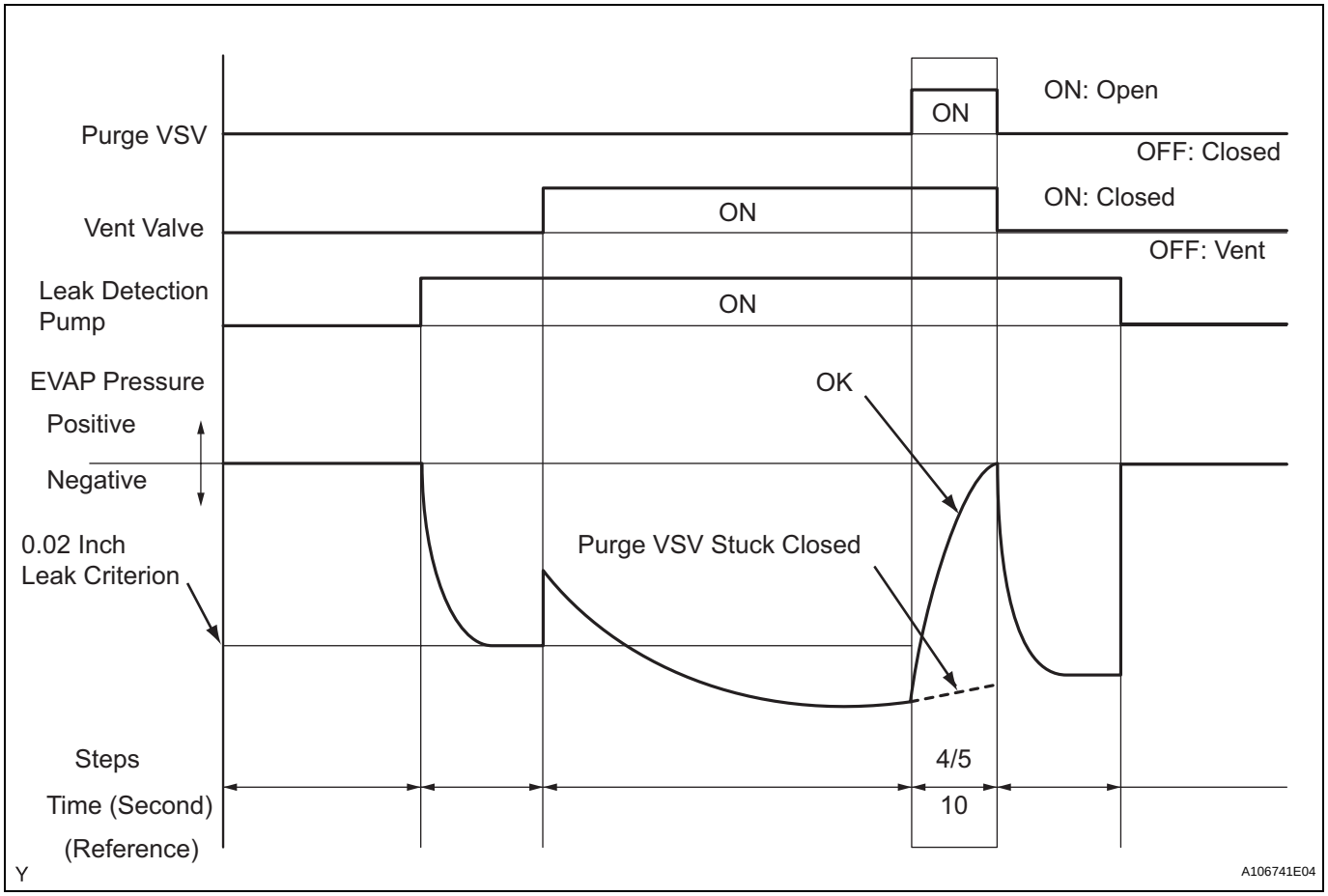
8	PERFORM EVAP SYSTEM CHECK (STEP 3/5)



(a) Wait until the EVAP pressure change is less than 0.1 kPa (0.75 mmHg) 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 (900 seconds).

NEXT

9	PERFORM EVAP SYSTEM CHECK (STEP 4/5)



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

Result

DTCs*	Test Results	Suspected Trouble Areas	Proceed To
-	EVAP pressure increases by 0.3 kPa (2.25 mmHg) 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 (2.25 mmHg) 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 (2.25 mmHg) for 10 seconds, after proceeding from step 3/5 to step 4/5	Purge VSV stuck closed	C

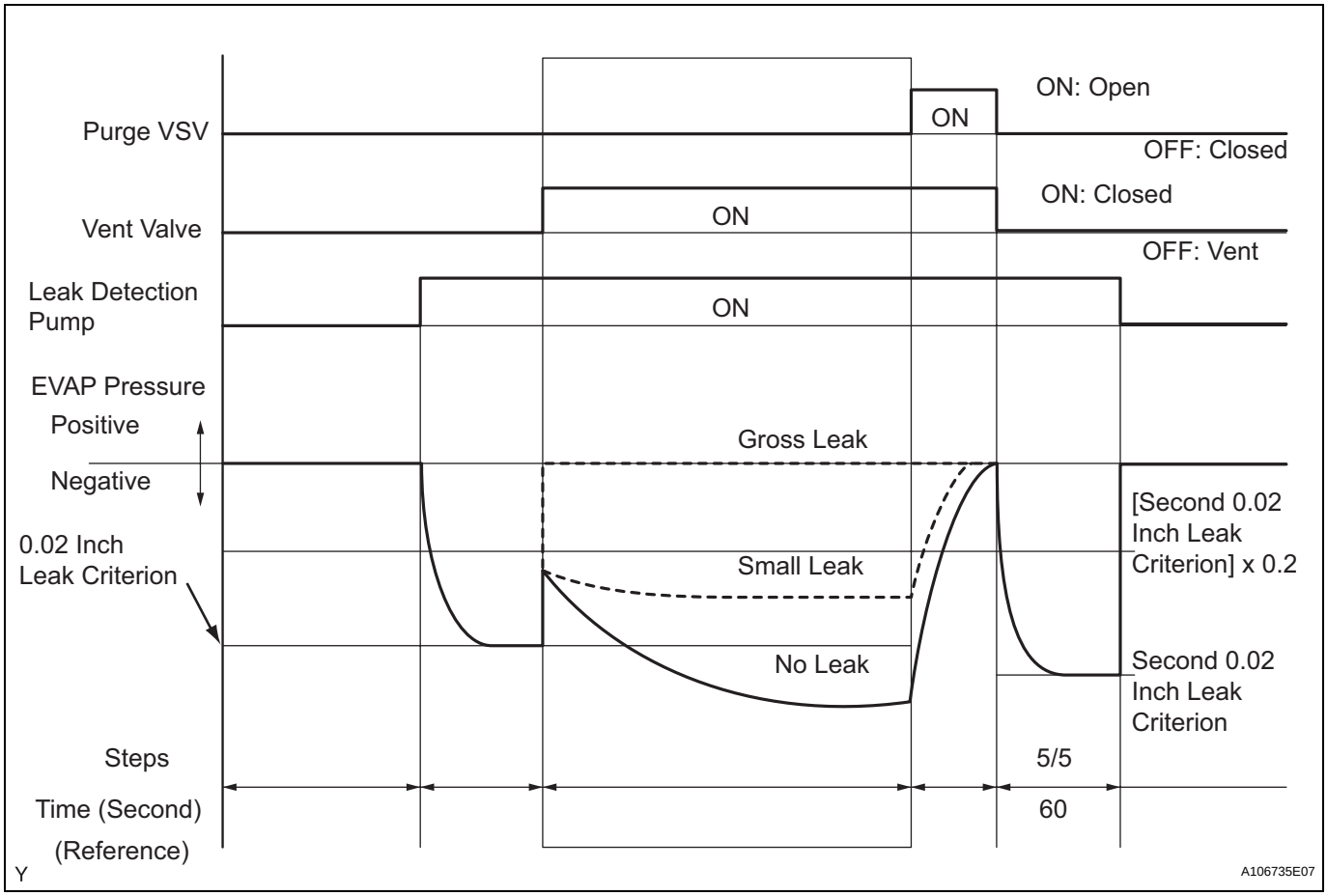
*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in step 1.

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 0.02 inch leak criterion (step 5/5).

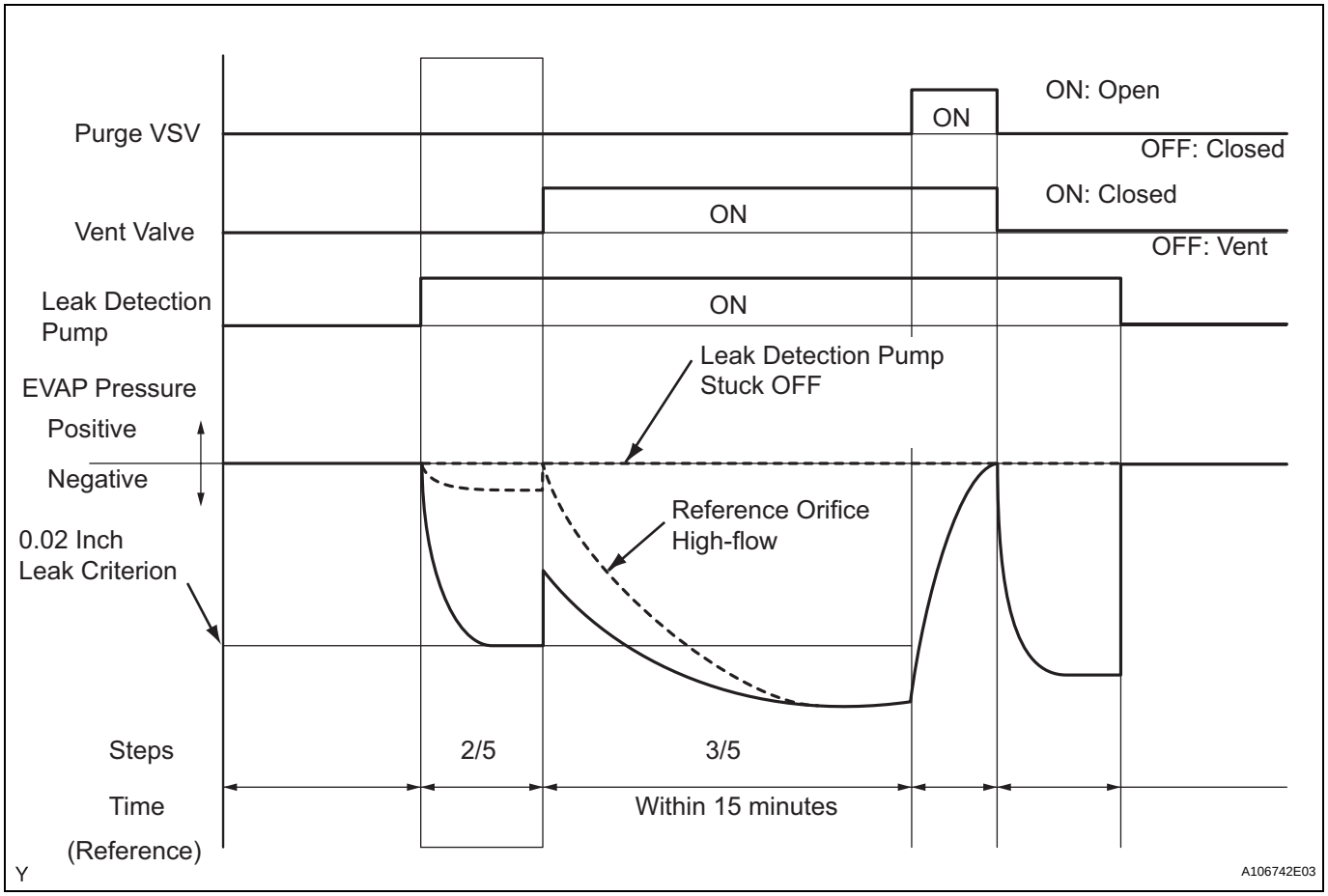
Result

DTCs*	Test Results	Suspected Trouble Areas	Proceed To
-	EVAP pressure (step 3/5) lower than second 0.02 inch leak criterion (step 5/5)	Not yet determined (no leakage from EVAP system)	A
P0441 and P0455	EVAP pressure (step 3/5) higher than [second 0.02 inch leak criterion (step 5/5) x 0.2]	• Purge VSV stuck open • EVAP gross leak	B
P0456	EVAP pressure (step 3/5) higher than second 0.02 inch leak criterion (step 5/5)	EVAP small leak	B

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in step 1.

A	Go to step 36
B	Go to step 12

11	PERFORM EVAP SYSTEM CHECK (STEP 3/5)



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

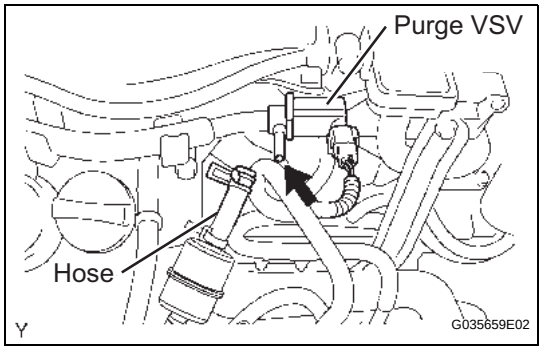
Result

DTCs*	Test Results	Suspected Trouble Areas	Proceed To
P043F	EVAP pressure less than [0.02 inch leak criterion] measured at 2/5	Reference orifice high-flow	A
P2401	EVAP pressure almost same as [0.02 inch leak criterion] 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 step 1.
HINT:
The first 0.02 inch leak criterion is the value determined in step 2/5.

A	Go to step 30
B	Go to step 23

12	PERFORM ACTIVE TEST USING INTELLIGENT TESTER (PURGE VSV)



(a) Select the following menu items: DIAGNOSIS / ENHANCED OBD II/ ACTIVE TEST / EVAP VSV.
(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 Results	Suspected Trouble Areas	Proceed To
No suction when purge VSV turned OFF, and suction applied when turned ON	Purge VSV normal	A
Suction applied when purge VSV turned OFF	Purge VSV stuck open	B
No suction when purge VSV turned ON	• Purge VSV stuck closed • Problems with EVAP hose between purge VSV and throttle body	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) Confirm that the fuel cap is tightened until a few 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 adaptor.
(2) Connect an EVAP tester pump hose to the adaptor, and pressurize the cap to 3.2 to 3.7 kPa (24 to 28 mmHg) using an EVAP tester pump.
(3) Seal the adaptor and wait for 2 minutes.
(4) Check the pressure. If the pressure is 2 kPa (15 mmHg) or more, the fuel cap is normal.
(5) Reinstall the fuel cap.

Result

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

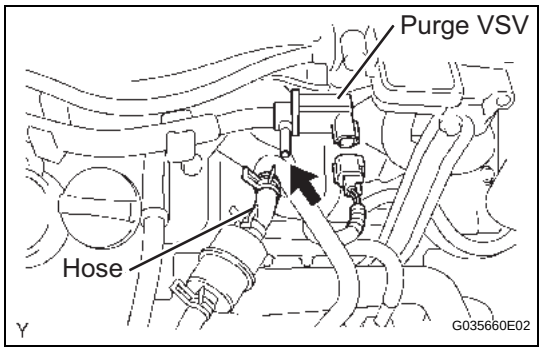
Test Results	Suspected Trouble Areas	Proceed To
Fuel cap loose	• Fuel cap improperly installed • Defective fuel cap • Fuel cap does not meet OEM specifications	B
No fuel cap	-	C

A → Go to step 29

B → Go to step 27

C → Go to step 28

14 INSPECT VACUUM SWITCHING VALVE ASSEMBLY NO.1



(a) Turn the ignition switch OFF.
(b) Disconnect the B19 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

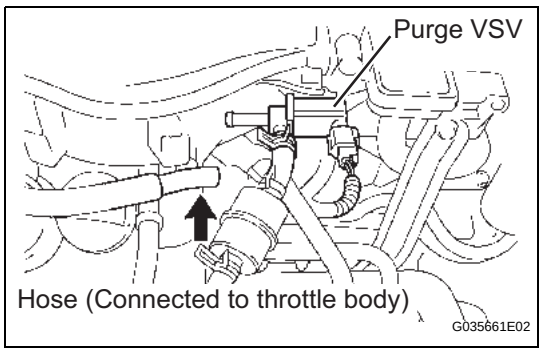
Test Results	Suspected Trouble Areas	Proceed To
No suction	ECM	A
Suction applied	Purge VSV	B

(f) Reconnect the purge VSV connector.
(g) Reconnect the hose.

A → Go to step 35

B → Go to step 31

15 CHECK EVAP HOSE (PURGE VSV - THROTTLE BODY)



(a) Disconnect the hose (connected to the throttle body) from the purge VSV.
(b) Start the engine.
(c) Use your finger to confirm that the hose has suction.

Result

Test Results	Suspected Trouble Areas	Proceed To
Suction applied	EVAP hose between purge VSV and throttle body normal	A

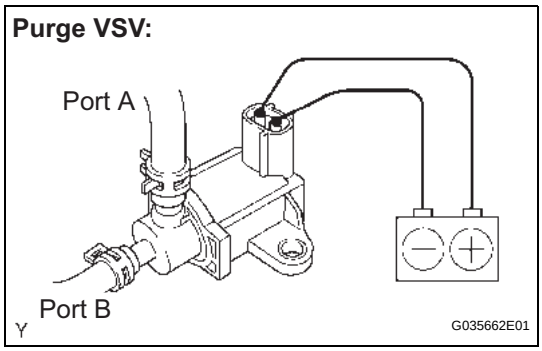
Test Results	Suspected Trouble Areas	Proceed To
No suction	• Throttle body • EVAP hose between purge VSV and throttle body	B

(d) Reconnect the hose.

B → Go to step 26

A

16 INSPECT VACUUM SWITCHING VALVE ASSEMBLY NO.1 (PURGE VSV)



(a) Remove the purge VSV.
(b) Apply 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

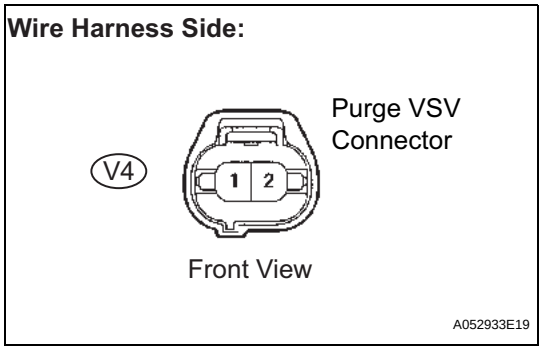
Test Results	Suspected Trouble Areas	Proceed To
Air flows	Purge VSV normal	A
No air flow	Purge VSV	B

(d) Reinstall the purge VSV.

B → Go to step 31

A

17 CHECK HARNESS AND CONNECTOR (POWER SOURCE OF PURGE VSV)



(a) Disconnect the V4 purge VSV connector.
(b) Turn the ignition switch ON.
(c) Measure the voltage between terminal 1 of the purge VSV connector and the body ground.

Result

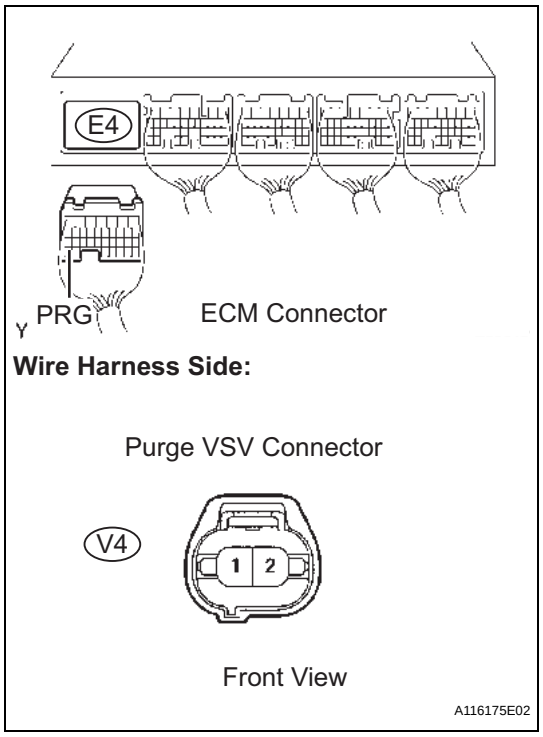
Test Results	Suspected Trouble Areas	Proceed To
Between 11 V and 14 V	Normal	A
Other than result above	Wire harness or connectors between purge VSV and ECM	B

(d) Reconnect the purge VSV connector.

B → Go to step 32

A

18 CHECK HARNESS AND CONNECTOR (PURGE VSV - ECM)



(a) Disconnect the E4 ECM connector and the V4 purge VSV connector.
(b) Check the resistance.
Standard Resistance

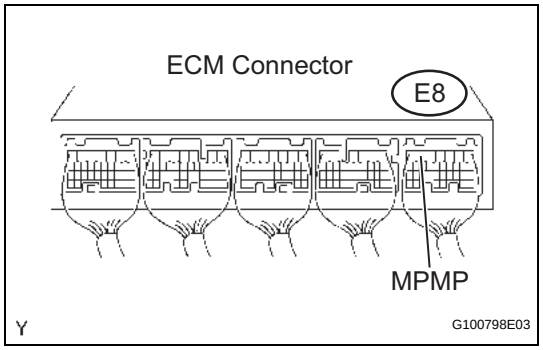
Tester Connections	Specified Conditions
E4-34 (PRG) - V4-2	Below 1 Ω
E4-34 (PRG) - Body ground	10 kΩ or higher
V4-2 - Body ground	10 kΩ or higher

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

OK	Go to step 35
NG	Go to step 32

ES

19 PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FOR VENT VALVE)



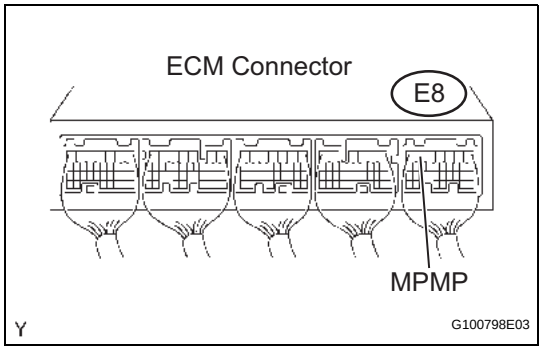
(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VENT VALVE (ALONE).
(d) Measure the voltage between terminal VPMP of the ECM connector and the body ground when the vent valve is turned ON (close) and OFF (vent) using the tester.

Result

Test Results	Suspected Trouble Areas	Proceed To
Between 9 V and 14 V when OFF Below 3 V when ON	Vent valve	A
Below 3 V when OFF and ON	ECM	B

A	Go to step 22
B	Go to step 35

20	PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FOR VENT VALVE)



(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VENT VALVE (ALONE).
(d) Measure the voltage between terminal VPMP of the ECM connector and the body ground when the vent valve is turned ON (close) and OFF (vent) using the tester.

ES

Result

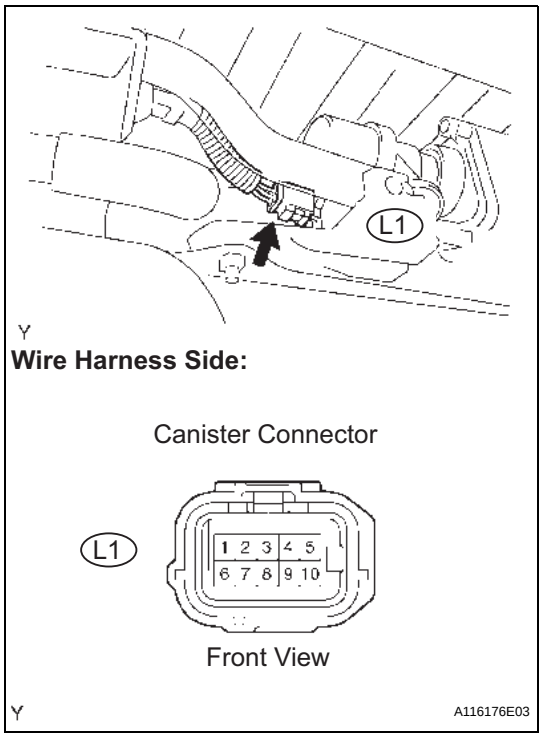
Test Results	Suspected Trouble Areas	Proceed To
Below 3 V when OFF and ON	Power source of vent valve	A
Between 9 V and 14 V when OFF Below 3 V when ON	Vent valve	B
Between 9 V and 14 V when OFF and ON	ECM	C

B → Go to step 22

C → Go to step 35

A

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



(a) Turn the ignition switch OFF.
(b) Disconnect the L1 canister connector.
(c) Turn the ignition switch ON.
(d) Measure the voltage between terminal 9 of the canister connector and the body ground.

Result

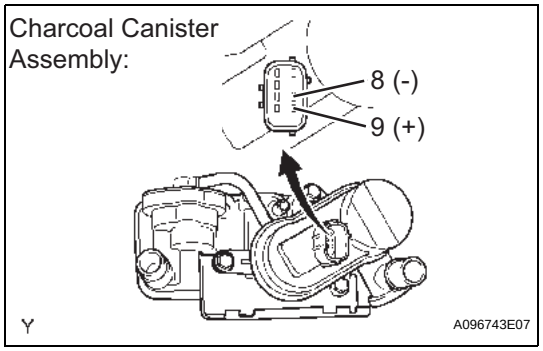
Test Results	Suspected Trouble Areas	Proceed To
Between 9 V and 14 V	Normal	A
Between 0 V and 3 V	Power source wire harness of vent valve	B

(e) Reconnect the canister connector.

B → **Go to step 32**

A

22 INSPECT CANISTER PUMP MODULE (VENT VALVE OPERATION)



(a) Turn the ignition switch OFF.
(b) Disconnect the L1 canister connector.
(c) Apply the battery voltage to terminals 9 and 8 of the canister pump module.
(d) Touch the canister pump module to confirm the vent valve operation.

Result

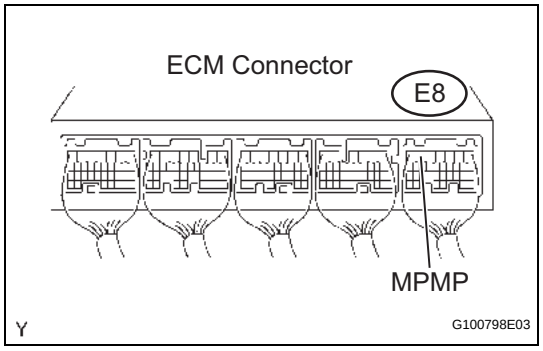
Test Results	Suspected Trouble Areas	Proceed To
Operating	Wire harness between vent valve and ECM	A
Not operating	Vent valve	B

(e) Reconnect the canister connector.

A → **Go to step 32**

B → **Go to step 30**

23 PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FOR CANISTER PUMP MODULE (LEAK DETECTION PUMP))



(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VACUUM PUMP.
(d) Measure the voltage between terminal MPMP of the ECM connector and the body ground when the leak detection pump is turned ON and OFF using the tester.

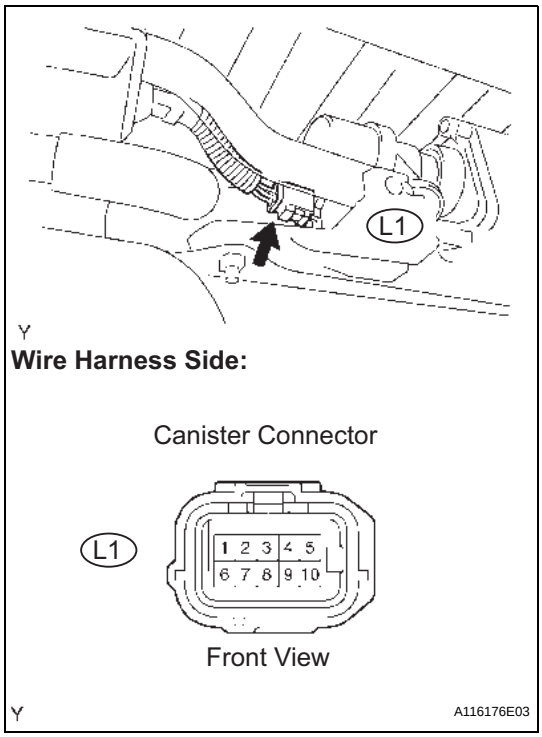
Result

Test Results	Suspected Trouble Areas	Proceed To
Between 0 V and 3 V when OFF Between 9 V and 14 V when ON	ECM normal	A
Between 9 V and 14 V when OFF Between 0 V and 3 V when ON	ECM	B

B	Go to step 35

A

24	CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - ECM)



(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch OFF.
(c) Disconnect the L1 canister connector.
(d) Turn the ignition switch ON and turn the tester ON.
(e) On the intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VACUUM PUMP.
(f) Turn the leak detection pump ON.
(g) Measure the voltage between terminal 1 of the canister connector and the body ground.

Result

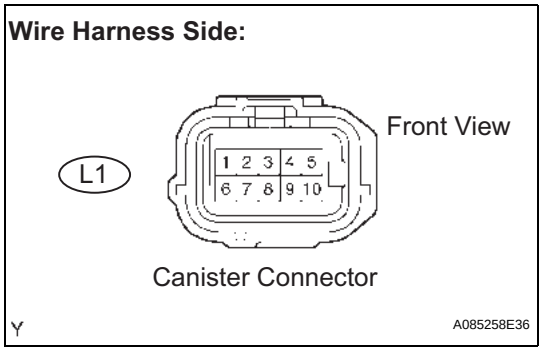
Test Results	Suspected Trouble Areas	Proceed To
Between 9 V and 14 V	Normal	A
Between 0 V and 3 V	Wire harness between ECM and leak detection pump	B

(h) Reconnect the canister connector.

B	Go to step 32

A

25	CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - GROUND)



(a) Disconnect the L1 canister connector.
(b) Turn the ignition switch OFF.
(c) Check the resistance between terminal 6 of the canister connector and the body ground.

Result

Test Results	Suspected Trouble Areas	Proceed To
Below 1 Ω	Leak detection pump	A
10 kΩ or more	Wire harness between leak detection pump and body ground	B

(d) Reconnect the canister connector.

A	Go to step 30
B	Go to step 32

26 INSPECT THROTTLE W/MOTOR BODY ASSEMBLY (EVAP PURGE PORT)

ES

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

Result

Test Results	Suspected Trouble Areas	Proceed To
Suction applied	EVAP hose between throttle body and purge VSV	A
No suction	Throttle body	B

(e) Reconnect the EVAP hose.

A	Go to step 33
B	Go to step 34

27 CORRECTLY REINSTALL OR REPLACE FUEL CAP ASSEMBLY

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 few click sounds are heard.

NEXT	Go to step 37

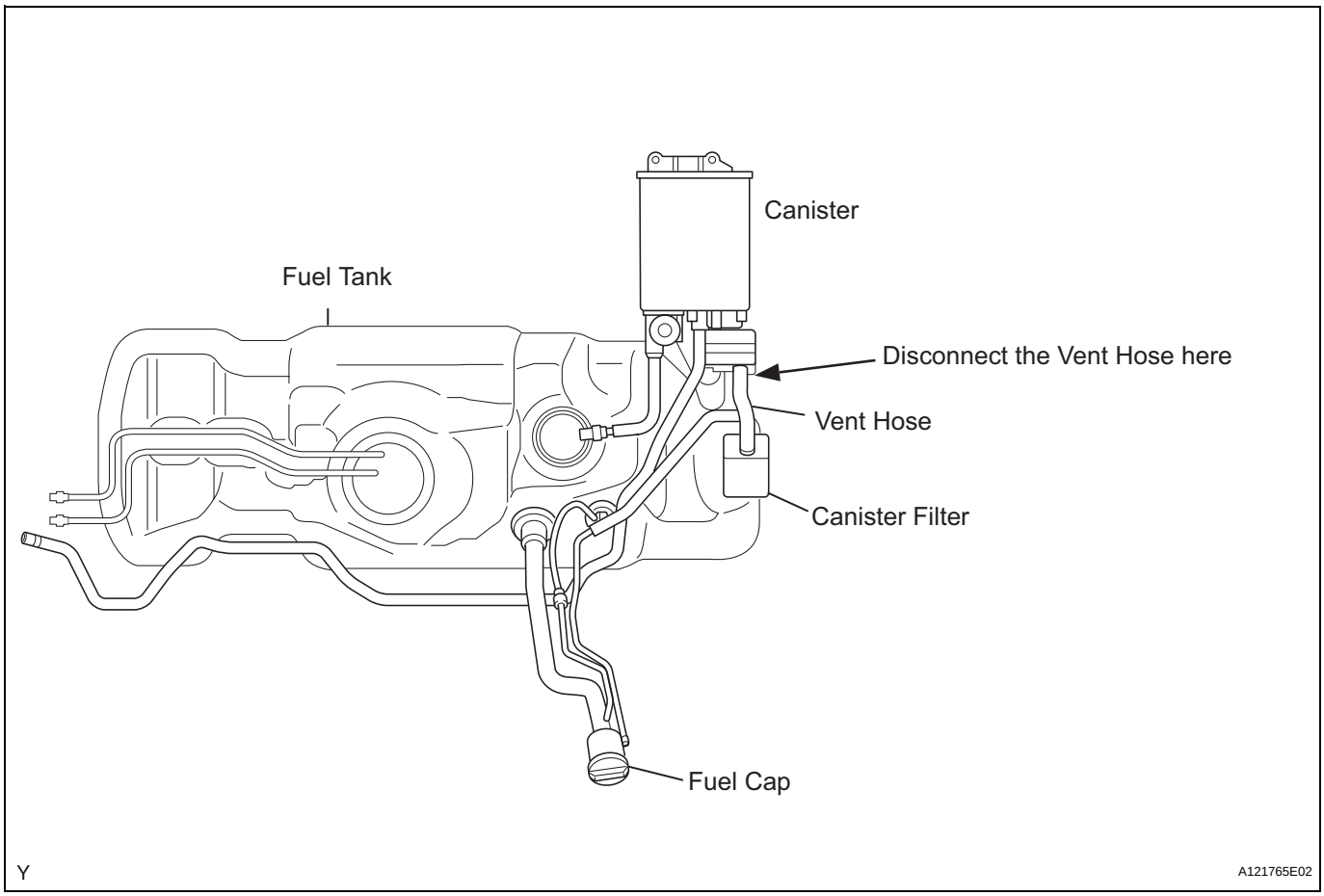
28 REPLACE FUEL CAP ASSEMBLY

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

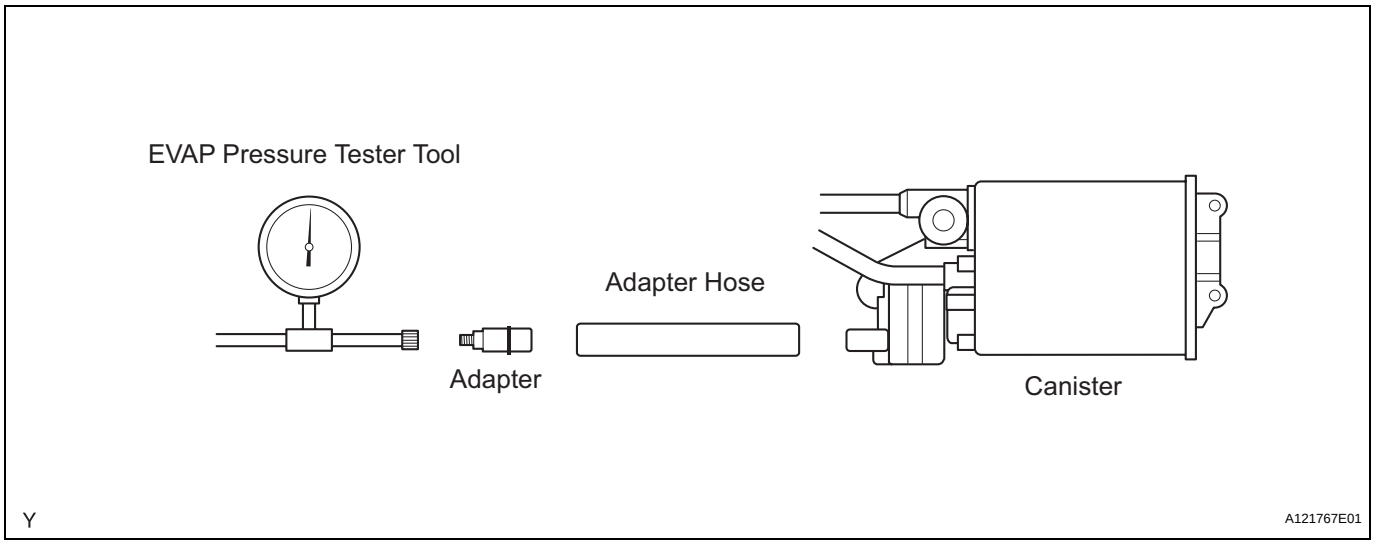
NEXT	Go to step 37

29 REPAIR LOCATE EVAP LEAK

(a) Reinstall the fuel cap.
(b) Disconnect the vent hose.



(c) Connect the EVAP pressure tester tool to the canister with the adapter.



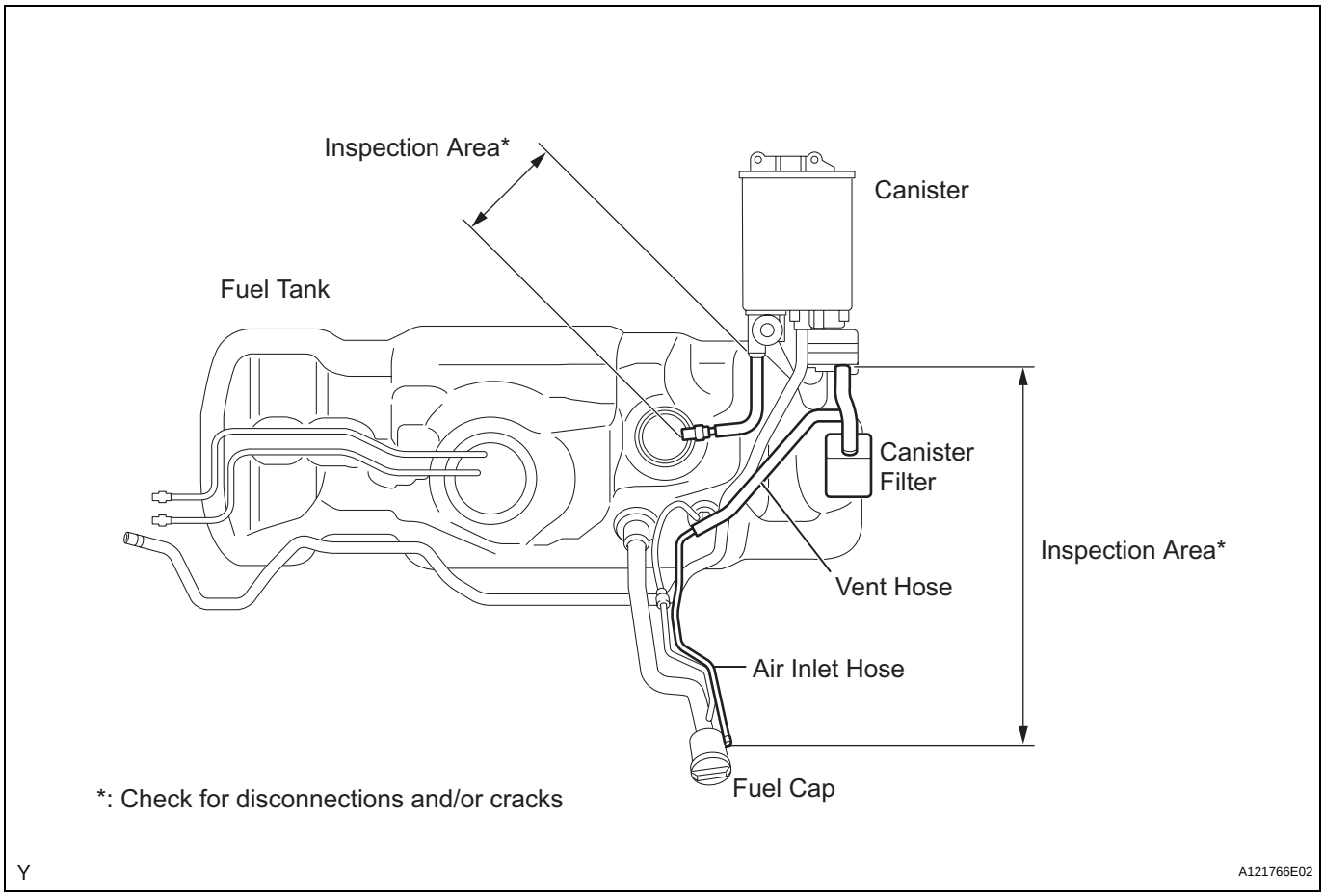
(d) Pressurize the EVAP system to 3.2 to 3.7 kPa (24 to 28 mmHg).
(e) Apply soapy water to the piping and connecting parts of the EVAP system.
(f) Look for areas where bubbles appear. This indicates leak point.
(g) Repair or replace the leak point.

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 37

30	REPLACE CANISTER ASSEMBLY

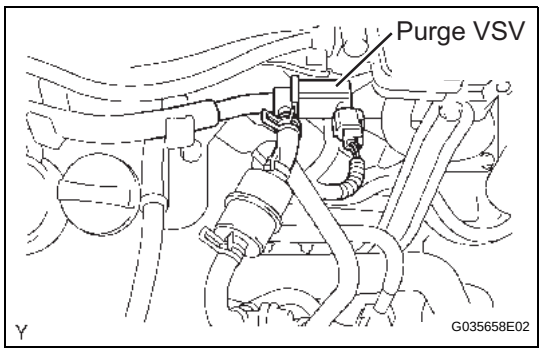
(a) Replace the canister assembly (See page EC-9).



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

NEXT	Go to step 37

31	REPLACE VACUUM SWITCHING VALVE ASSEMBLY NO.1 (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 37

ES

32	REPAIR OR REPLACE HARNESS AND CONNECTOR

NEXT → Go to step 37

33	REPLACE EVAP HOSE (THROTTLE BODY - PURGE VSV)

NEXT → Go to step 37

34	INSPECT THROTTLE W/MOTOR BODY ASSEMBLY

(a) Remove the throttle body (See page ES-414).
(b) Check that the EVAP purge port of the throttle body is not clogged. If necessary, replace the throttle body.

NEXT → Go to step 37

35	REPLACE ECM

(a) Replace the ECM (See page ES-428).

NEXT → Go to step 37

36	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 37

37	PERFORM EVAP SYSTEM CHECK (AUTO OPERATION)

NOTICE:

- **In the EVAP SYSTEM CHECK (AUTO OPERATION), the series of 5 EVAP SYSTEM CHECK steps is performed automatically. 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 and making the leak check of the fuel tank 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 DTCs (See page ES-38).

(b) 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 DTC is found, the repair has been successfully completed.

NEXT

COMPLETED

CONFIRMATION DRIVING PATTERN

HINT:
After a repair, check the 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 free way)
- 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 to 35°C (40°F to 95°F)
- The Intake Air Temperature (IAT) is between 4.4°C to 35°C (40°F to 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 an intelligent tester to the DLC3.
2. Turn the ignition switch ON 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 completed. Make sure that the preconditions have been met, and perform the Monitor Conditions again.

2. Purge flow monitor confirmation (P0441)

HINT:
Perform this monitor confirmation after the Key-Off Monitor Confirmation shows 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 free way)
- The ECT is between 4.4°C to 35°C (40°F to 95°F)
- The IAT is between 4.4°C to 35°C (40°F to 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 (where ON or the engine is running).
2. Connect an intelligent tester to the DLC3.
3. Turn the ignition switch ON 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 completed. Make sure that the preconditions have been met, and perform the Monitor Conditions again.

MONITOR RESULT

Detailed information on Checking Monitor Status (See page ES-38).

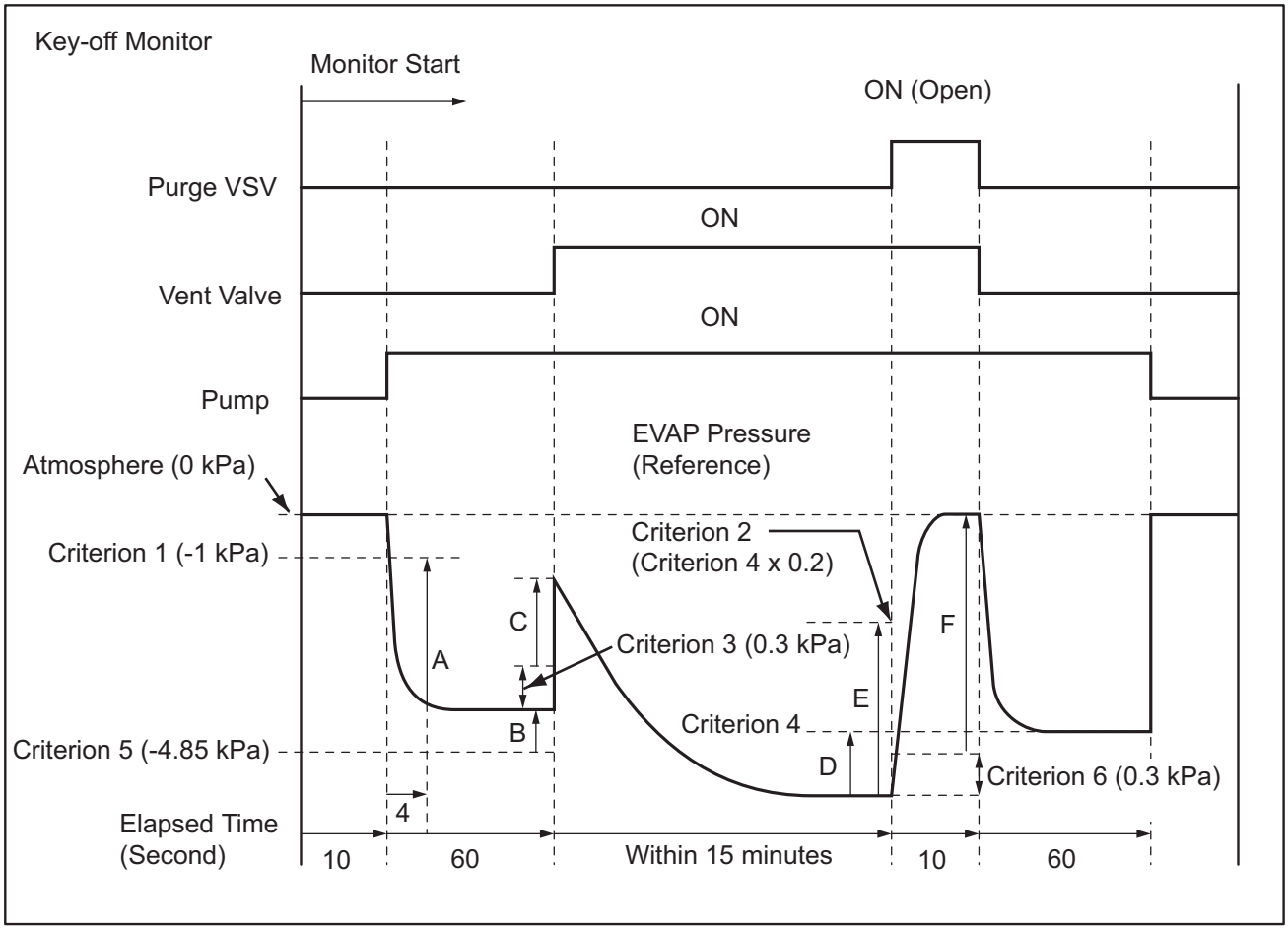
The test value and test limit information are described as shown in the following table. This information is included under MONITOR RESULT in the emissions-related DTC sections:
- MID (Monitor Identification Data) is assigned to each emissions-related component.
- TID (Test Identification Data) is assigned to each test value.
- Scaling is used to calculate the test value indicated on generic OBD II scan tools.

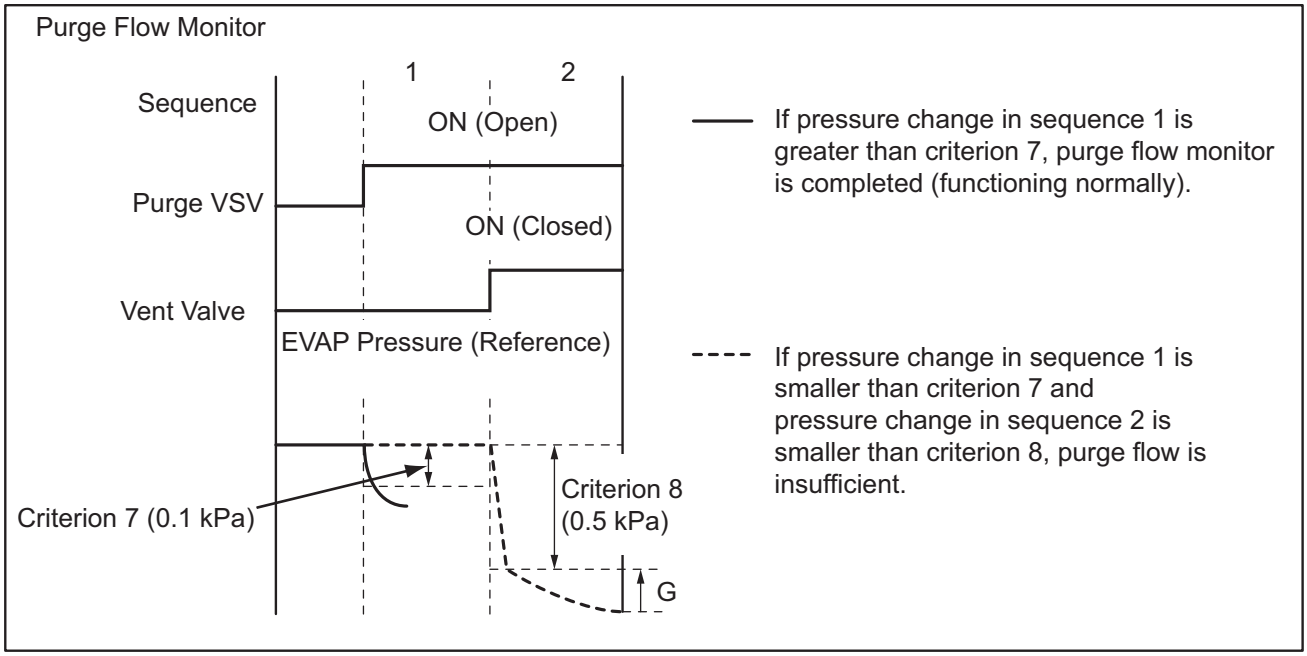
Thermostat

MID	TID	Scaling	Description of Test Value	Minimum Test Limit	Maximum Test Limit
$3D	$C9	Multiply by 0.001 [kPa]	Test value for small leak (P0456) Refer to pressure D*	Minimum test limit for small leak	Maximum test limit for small leak
$3D	$CA	Multiply by 0.001 [kPa]	Test value for gross leak (P0455) Refer to pressure E*	Minimum test limit for gross leak	Maximum test limit for gross leak
$3D	$CB	Multiply by 0.001 [kPa]	Test value for leak detection pump stuck OFF (P2401) Refer to pressure A*	Minimum test limit for leak detection pump stuck OFF	Maximum test limit for leak detection pump stuck OFF
$3D	$CD	Multiply by 0.001 [kPa]	Test value for leak detection pump stuck ON (P2402) Refer to pressure A*	Minimum test limit for leak detection pump stuck ON	Maximum test limit for leak detection pump stuck ON
$3D	$CE	Multiply by 0.001 [kPa]	Test value for vent valve stuck OFF (vent) (P2420) Refer to pressure C*	Minimum test limit for vent valve stuck ON	Maximum test limit for vent valve stuck ON

MID	TID	Scaling	Description of Test Value	Minimum Test Limit	Maximum Test Limit
$3D	$CF	Multiply by 0.001 [kPa]	Test value for vent valve stuck ON (P2419) Refer to pressure A*	Minimum test limit for vent valve stuck OFF	Maximum test limit for vent valve stuck OFF
$3D	$D0	Multiply by 0.001 [kPa]	Test value for reference orifice low flow (P043E) Refer to pressure B*	Minimum test limit for reference orifice low flow	Maximum test limit for reference orifice low flow
$3D	$D1	Multiply by 0.001 [kPa]	Test value for reference orifice high flow (P043F) Refer to pressure A*	Minimum test limit for reference orifice high flow	Maximum test limit for reference orifice high flow
$3D	$D4	Multiply by 0.001 [kPa]	Test value for purge VSV stuck closed (P0441) Refer to pressure F*	Minimum test limit for purge VSV stuck closed	Maximum test limit for purge VSV stuck closed
$3D	$D5	Multiply by 0.001 [kPa]	Test value for purge VSV stuck open (P0441) Refer to pressure E*	Minimum test limit for purge VSV stuck open	Maximum test limit for purge VSV stuck open
$3D	$D7	Multiply by 0.001 [kPa]	Test value for purge flow (P0441) Refer to pressure G*	Minimum test limit for purge flow	Maximum test limit for purge flow

* Pressures A to G are indicated as shown in the diagram below.





Y

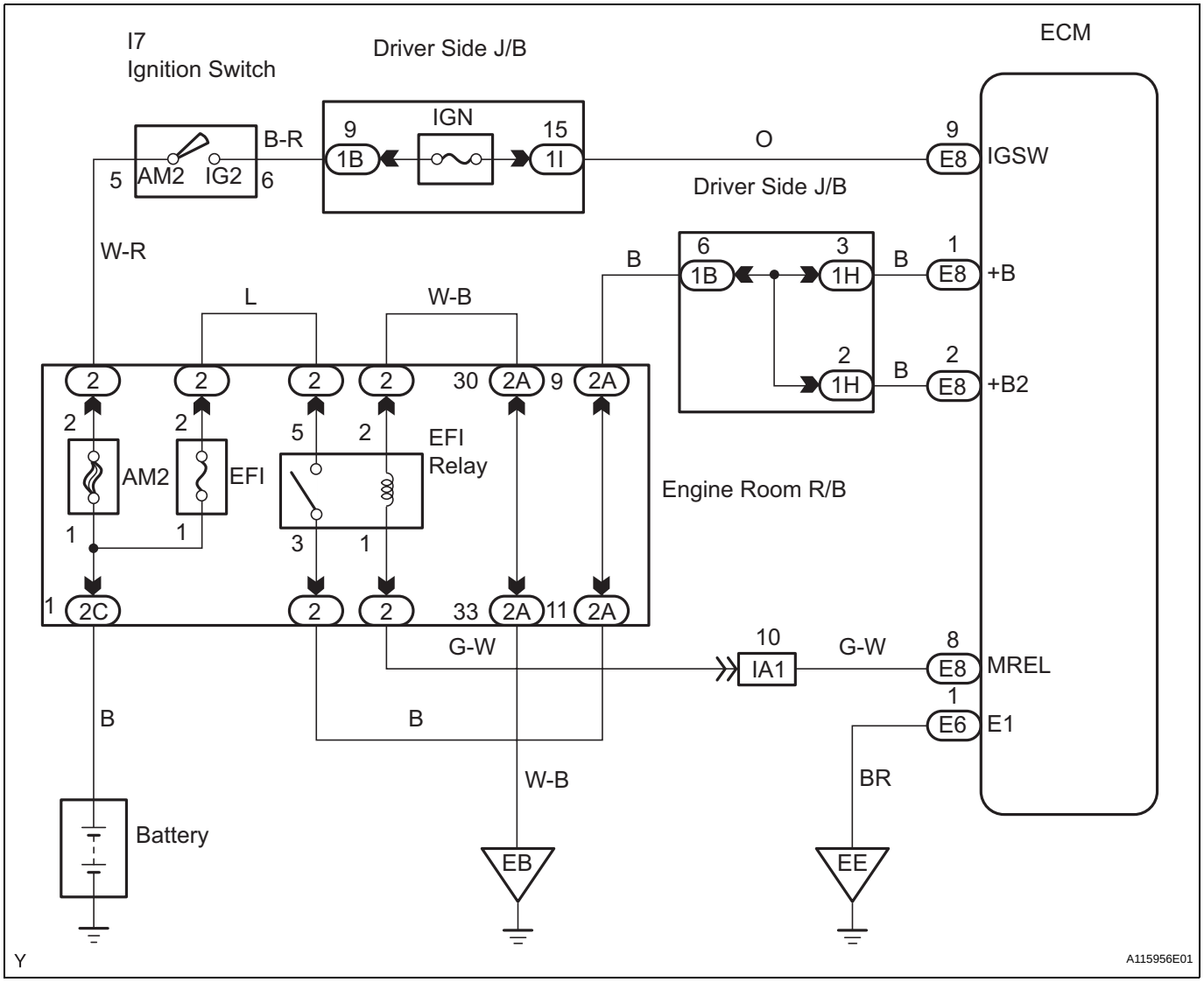
A106747E08

ECM Power Source Circuit

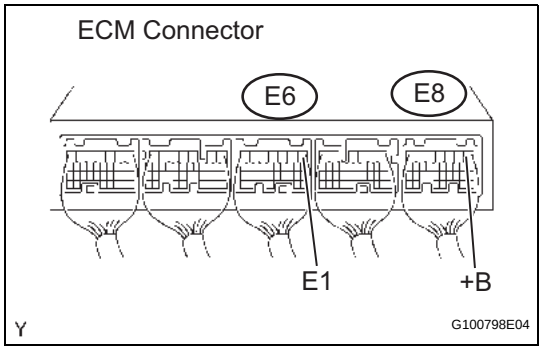
DESCRIPTION

When the ignition switch is turned ON, the battery voltage is applied to terminal IGSW of the ECM. The ECM MREL output signal causes a current to flow to the coil, closing the contacts of the EFI relay and supplying power to terminal +B of the ECM.
If the ignition switch is turned OFF, the ECM holds the EFI relay ON for a maximum of 2 seconds to allow for the initial setting of the throttle valve.

WIRING DIAGRAM



1	INSPECT ECM (+B VOLTAGE)



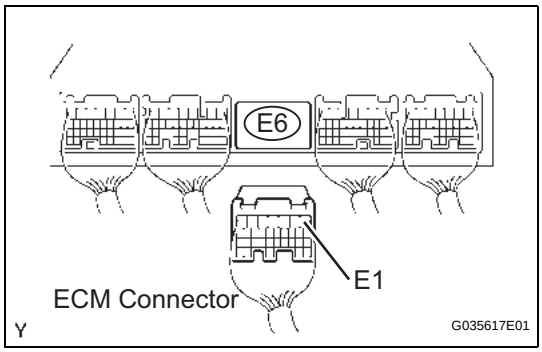
(a) Turn the ignition switch ON.
(b) Measure the voltage between the terminals of the E8 and E6 ECM connectors.
Standard Voltage

Tester Connections	Specified Conditions
+B (E8-1) - E1 (E6-1)	9 to 14 V

OK → **PROCEED TO NEXT CIRCUIT INSPECTION SHOWN ON PROBLEM SYMPTOMS TABLE**

NG

2	CHECK HARNESS AND CONNECTOR (ECM - BODY GROUND)



(a) Disconnect the E6 ECM connector.
(b) Check the resistance.
Standard Resistance (Check for open)

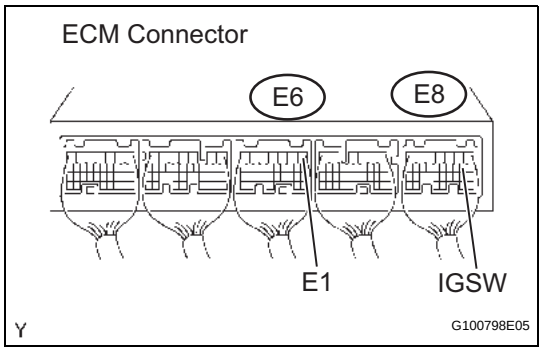
Tester Connections	Specified Conditions
E1 (E6-1) - Body ground	Below 1 Ω

(c) Reconnect the ECM connector.

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

OK

3	INSPECT ECM (IGSW VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage between the terminals of the E8 and E6 ECM connectors.
Standard Voltage

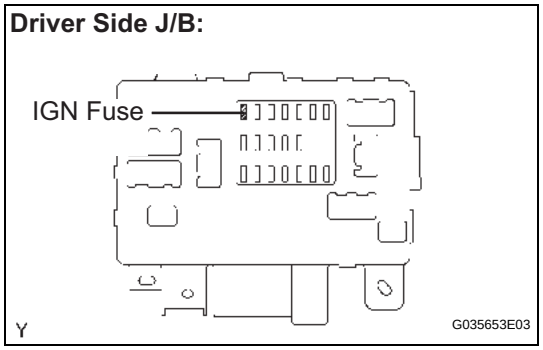
Tester Connections	Specified Conditions
IGSW (E8-9) - E1 (E6-1)	9 to 14 V

OK → **Go to step 6**

NG

ES

4 CHECK FUSE (IGN FUSE)

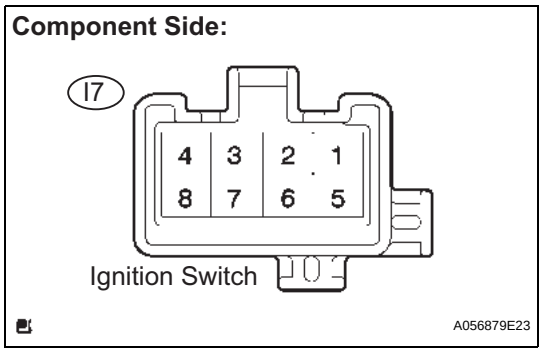


(a) Remove the IGN fuse from the driver side J/B.
(b) Check the IGN fuse resistance.
Standard Resistance:
Below 1 Ω
(c) Reinstall the IGN fuse.

NG → **CHECK FOR SHORT IN ALL HARNESSES AND COMPONENTS CONNECTED TO FUSE**

OK

5 INSPECT IGNITION OR STARTER SWITCH ASSEMBLY



(a) Disconnect the I7 ignition switch connector.
(b) Check the resistance.
Standard Resistance

Ignition Switch Positions	Tester Connections	Specified Conditions
LOCK	All Terminals	10 kΩ or higher
ACC	2-4	Below 1 Ω
ON	1-2, 1-4, 5-6	
START	1-3, 1-4, 3-4, 5-6, 5-7, 6-7	

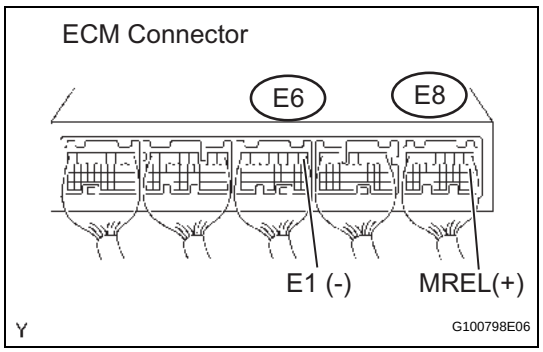
(c) Reconnect the ignition switch connector.

NG → **REPLACE IGNITION OR STARTER SWITCH ASSEMBLY**

OK

CHECK AND REPLACE HARNESS AND CONNECTOR (BATTERY - IGNITION SWITCH, IGNITION SWITCH - ECM)

6 INSPECT ECM (MREL VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage between the terminals of the E6 and E8 ECM connectors.
Standard Voltage

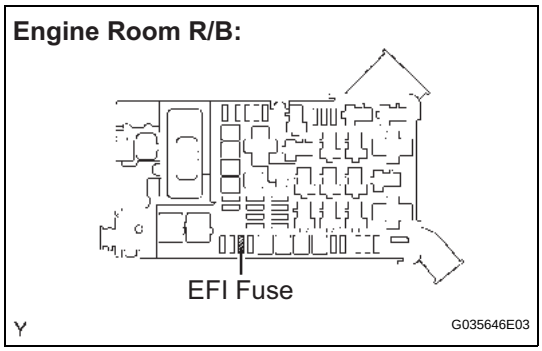
Tester Connections	Specified Conditions
MREL (E8-8) - E1 (E6-1)	9 to 14 V

NG → **REPLACE ECM**

ES

OK

7	CHECK FUSE (EFI FUSE)

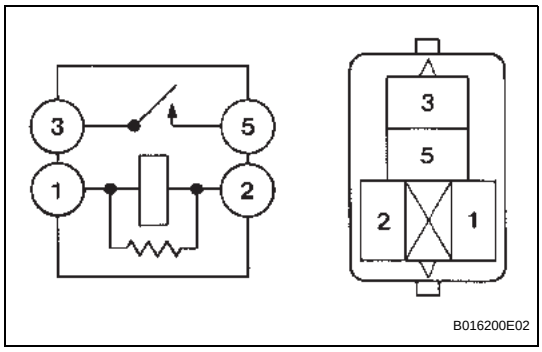


(a) Remove the EFI fuse from the engine room R/B.
(b) Check the EFI fuse resistance.
Standard Resistance:
Below 1 Ω
(c) Reinstall the EFI fuse.

NG → **CHECK FOR SHORT IN ALL HARNESSES AND COMPONENTS CONNECTED TO FUSE**

OK

8	INSPECT EFI RELAY



(a) Remove the EFI relay from the engine room R/B.
(b) Check the EFI relay resistance.
Standard Resistance

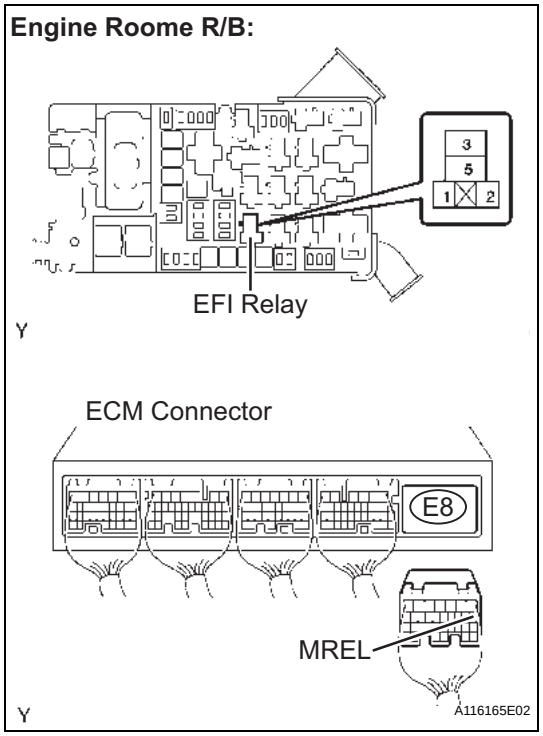
Tester Connections	Specified Conditions
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the EFI relay.

NG → **REPLACE EFI RELAY**

OK

9	CHECK HARNESS AND CONNECTOR (EFI RELAY- ECM, EFI RELAY - BODY GROUND)



(a) Check the harness and connector between the EFI relay and ECM.
  (1) Remove the EFI relay from the engine room R/B.
  (2) Disconnect the E8 ECM connector.
  (3) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
EFI relay (1) - MREL (E8-8)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
EFI relay (1) or MREL (E8-8) - Body ground	10 kΩ or higher

  (4) Reinstall the EFI relay.
  (5) Reconnect the ECM connector.

(b) Check the harness and connector between the EFI relay and body ground.
  (1) Remove the EFI relay from the engine room R/B.
  (2) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
EFI relay (2) - Body ground	Below 1 Ω

  (3) Reinstall the EFI relay.

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

OK

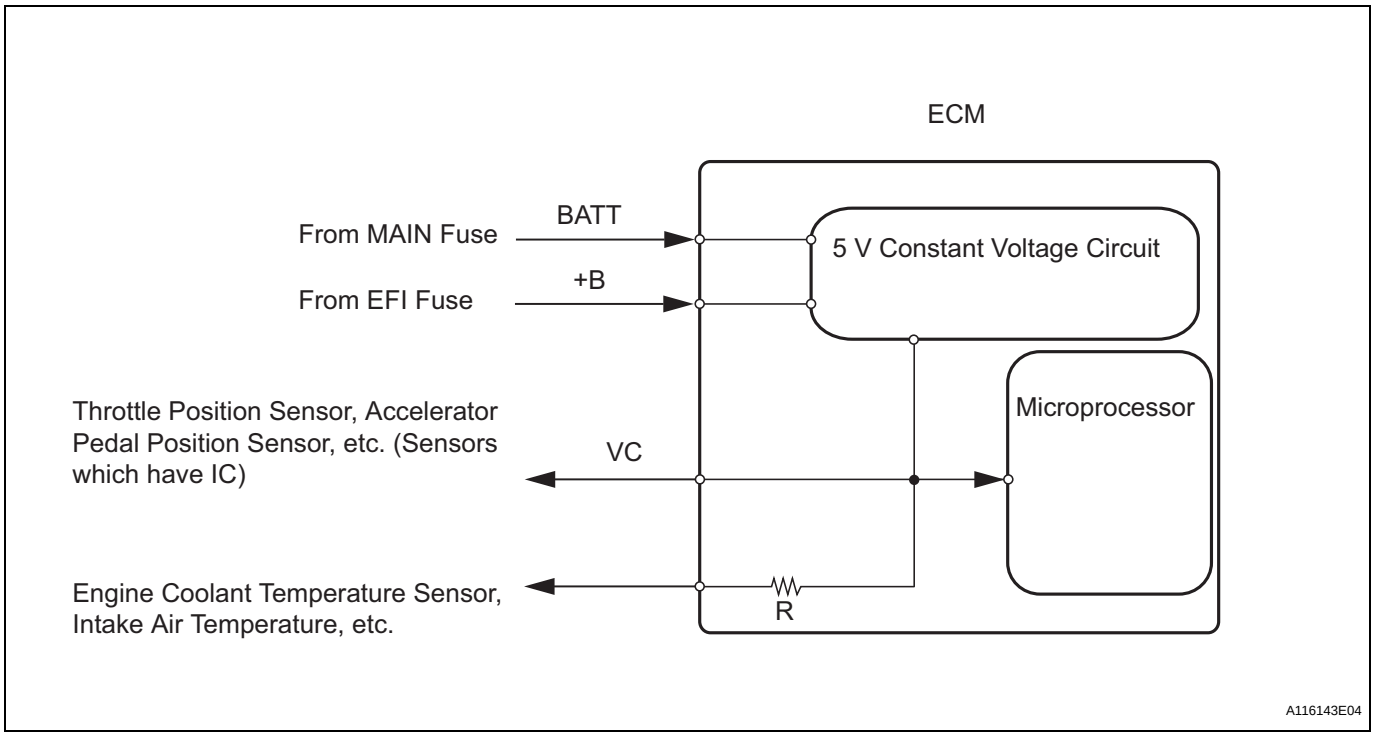
CHECK AND REPAIR HARNESS AND CONNECTOR (TERMINAL +B OF ECM - BATTERY POSITIVE TERMINAL)

ES

VC Output Circuit

DESCRIPTION

The ECM constantly generates 5 V power from the battery voltage supplied to the +B (BATT) terminal to operate the microprocessor. The ECM also provides this power to the sensors through the VC output circuit.



When the VC circuit is short-circuited, the microprocessor in the ECM and sensors that are supplied power through the VC circuit are inactivated because the power is not supplied from the VC circuit. Under this condition, the system does not start up and the MIL does not illuminate even if the system malfunctions.

HINT:

Under normal conditions, the MIL is illuminated for several seconds when the ignition switch is first turned ON. The MIL goes off when the engine is started.

WIRING DIAGRAM

Refer to the following pages.

- Throttle position sensor circuit (See page ES-112).
- Canister pump module circuit (See page ES-351).
- Accelerator pedal circuit (See page ES-293).

1	**CHECK MIL**

(a) Check that the Malfunction Indicator Lamp (MIL) lights up when turning the ignition switch ON.

OK:

MIL lights up

OK	**SYSTEM OK**

NG

2 CHECK CONNECTION BETWEEN INTELLIGENT TESTER AND ECM

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Check the communication between an intelligent tester and ECM.

Result

Result	Proceed to
Communication is possible	A
Communication is not possible	B

A → **GO TO MIL CIRCUIT**

B

3 CHECK MIL (THROTTLE BODY)

(a) Disconnect the throttle body connector.
(b) Turn the ignition switch ON.
(c) Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

(d) Reconnect the throttle body connector.

A → **REPLACE THROTTLE BODY**

B

4 CHECK MIL (ACCELERATOR PEDAL)

(a) Disconnect the accelerator pedal connector.
(b) Turn the ignition switch ON.
(c) Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

(d) Reconnect the accelerator pedal connector.

A → **REPLACE ACCELERATOR PEDAL ASSEMBLY**

B

ES

5	CHECK MIL (CANISTER PUMP MODULE)

(a) Disconnect the canister pump module connector.
(b) Turn the ignition switch ON.
(c) Check the MIL.
Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

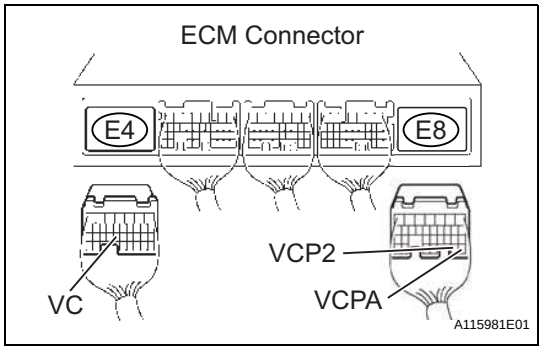
(d) Reconnect the canister pump module connector.

ES

A → **REPLACE CHARCOAL CANISTER ASSEMBLY**

B

6	CHECK HARNESS AND CONNECTOR



(a) Disconnect the throttle body connector.
(b) Disconnect the accelerator pedal connector.
(c) Disconnect the canister pump module connector.
(d) Disconnect the ECM connector.
(e) Measure the resistance of the wire harness side connector.
Standard Resistance (check for short)

Tester Connection	Specified Condition
VC (E4-23) - Body ground	10 kΩ or higher
VCPA (E8-26) - Body ground	
VCP2 (E8-27) - Body ground	

(f) Reconnect the throttle body connector.
(g) Reconnect the accelerator pedal connector.
(h) Reconnect the canister pump module connector.
(i) Reconnect the ECM connector.

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

OK

REPLACE ECM

Fuel Pump Control Circuit

DESCRIPTION

Refer to DTC P0230 (See page ES-158).

WIRING DIAGRAM

Refer to DTC P0230 (See page ES-160).

1	CHECK FUEL PUMP OPERATION

(a) Check if there is pressure in the fuel inlet hose.
HINT:
If there is fuel pressure, you will hear the sound of fuel flowing.

OK → **Go to step 10**

NG

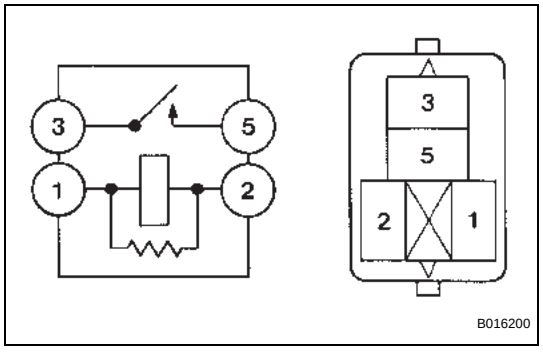
2	PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE CIRCUIT OPENING RELAY)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Select the following menu items: 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 5**

NG

3	INSPECT CIRCUIT OPENING RELAY



(a) Remove the circuit opening relay from the engine room R/B.
(b) Check the circuit opening relay resistance.
Standard Resistance

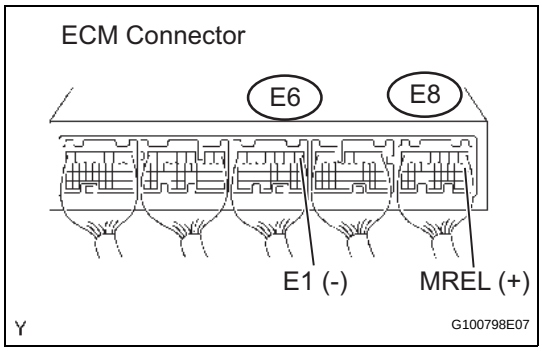
Tester Connections	Specified Conditions
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the circuit opening relay.

NG → **REPLACE CIRCUIT OPENING RELAY**

OK

4	INSPECT ECM (FC VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage between the terminals of the E8 and E6 ECM connectors.

Standard Voltage

Tester Connections	Specified Conditions
FC (E8-10) - E1 (E6-1)	9 to 14 V

OK → REPLACE ECM

NG

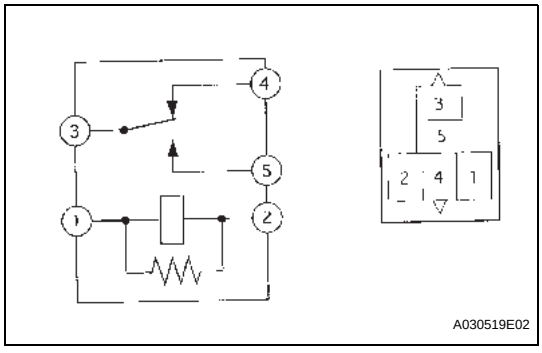
CHECK AND REPLACE HARNESS AND CONNECTOR (ECM - CIRCUIT OPENING RELAY - IGNITION)

5	INSPECT ECM POWER SOURCE CIRCUIT

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6	INSPECT FUEL PUMP RELAY ASSEMBLY



(a) Remove the fuel pump relay from the engine room R/B.
(b) Check the fuel pump relay resistance.

Standard Resistance

Tester Connections	Specified Conditions
3 - 4	Below 1 Ω
3 - 5	10 kΩ or higher
3 - 4	10 kΩ or higher (when battery voltage applied to terminals 1 and 2)
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

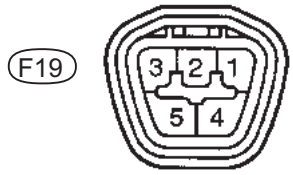
(c) Reinstall the fuel pump relay.

NG → REPLACE FUEL PUMP RELAY ASSEMBLY

OK

7	INSPECT FUEL PUMP ASSEMBLY

Component Side:



Fuel Pump

A074356E09

(a) Inspect the fuel pump resistance.
  (1) Measure the resistance between terminals 4 and 5.
  Standard Resistance:
  0.2 to 3.0 Ω at 20°C (68°F)

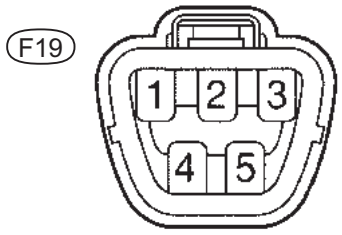
(b) Inspect the fuel pump operation.
  (1) Apply battery voltage to both terminals. Check that the pump operates.
  NOTICE:
  - **These tests must be done quickly (within 10 seconds) to prevent the coil from burning out.**
  - **Keep the fuel pump as far away from the battery as possible.**
  - **Always do the switching at the battery side.**

NG → **REPLACE FUEL PUMP ASSEMBLY**

OK

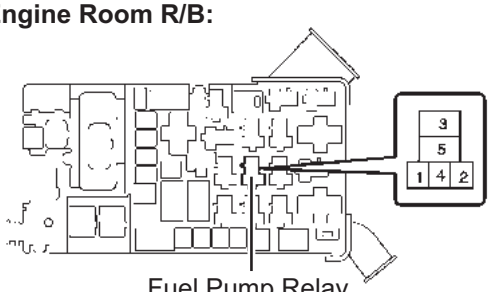
8	CHECK HARNESS AND CONNECTOR (FUEL PUMP - FUEL PUMP RELAY, FUEL PUMP - BODY GROUND)

Wire Harness Side:



P Fuel Pump Connector

Engine Room R/B:



Fuel Pump Relay

Y A116166E01

(a) Check the harness and connector between the fuel pump and fuel pump relay.
  (1) Disconnect the F19 fuel pump connector.
  (2) Remove the fuel pump relay from the engine room R/B.
  (3) Check the resistance.
  Standard Resistance (Check for open)

Tester Connections	Specified Conditions
Fuel pump (F19-4) - Fuel pump relay (4)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
Fuel pump (F19-4) or Fuel pump relay (4) - Body ground	10 kΩ or higher

  (4) Reconnect the fuel pump connector.
  (5) Reinstall the fuel pump relay.

(b) Check the harness and connector between the fuel pump and body ground.
  (1) Disconnect the fuel pump connector.
  (2) Check the resistance.
  Standard Resistance (Check for open)

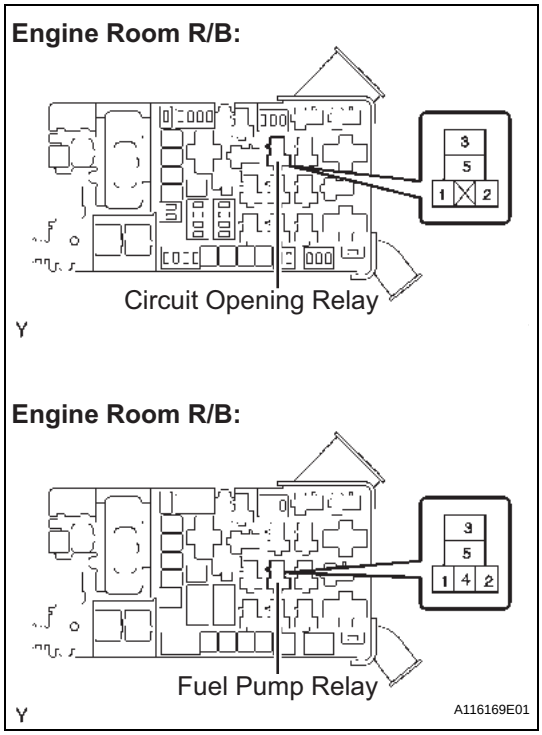
Tester Connections	Specified Conditions
Fuel pump (F19-5) - Body ground	Below 1 Ω

  (3) Reconnect the fuel pump connector.

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

OK

9	CHECK HARNESS AND CONNECTOR (CIRCUIT OPENING RELAY - FUEL PUMP RELAY)



(a) Remove the circuit opening relay from the engine room R/B.
(b) Remove the fuel pump relay from the engine room R/B.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
Circuit opening relay (3) - Fuel pump relay (3)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
Circuit opening relay (3) or Fuel pump relay (3) - Body ground	10 kΩ or higher

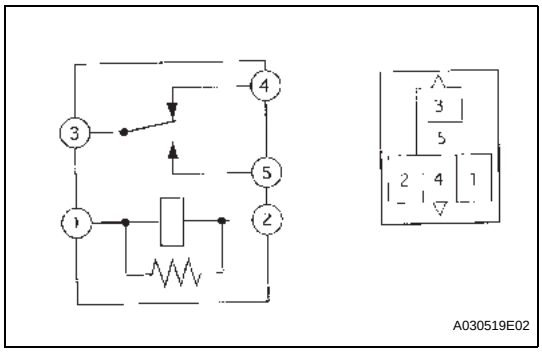
(d) Reinstall the circuit opening relay.
(e) Reinstall the fuel pump relay.

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK AND REPAIR HARNESS AND CONNECTOR (EFI RELAY - CIRCUIT OPENING RELAY)

10	INSPECT FUEL PUMP RELAY ASSEMBLY



(a) Remove the fuel pump relay from the engine room R/B.
(b) Check the fuel pump relay resistance.

Standard Resistance

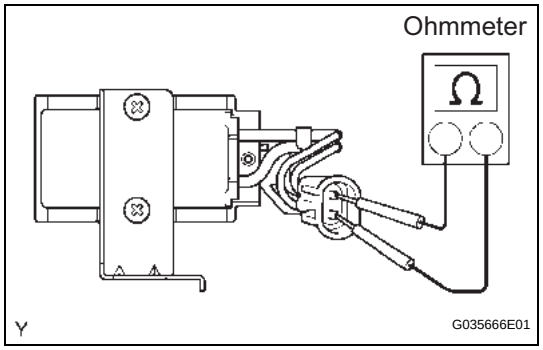
Tester Connections	Specified Conditions
3 - 4	Below 1 Ω
3 - 5	10 kΩ or higher
3 - 4	10 kΩ or higher (when battery voltage applied to terminals 1 and 2)
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the fuel pump relay.

NG → REPLACE FUEL PUMP RELAY ASSEMBLY

OK

11	INSPECT FUEL PUMP RESISTER (RESISTANCE)

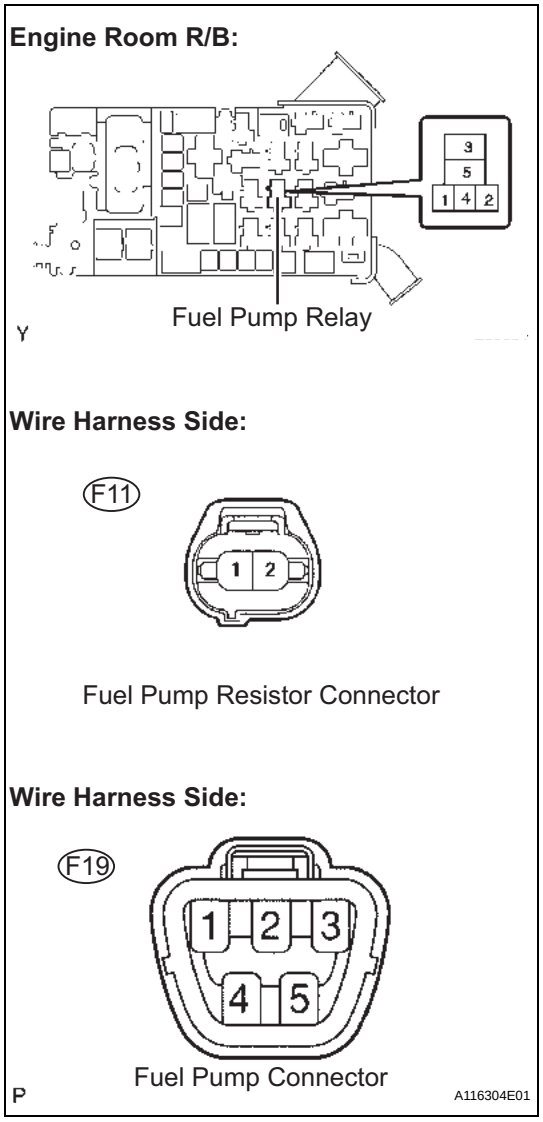


(a) Inspect the fuel pump resistor resistance.
  (1) Measure the resistance.
    Standard Resistance:
    0.70 to 0.76 Ω at 20°C (68°F)

NG → **REPLACE FUEL PUMP RESISTER**

OK

12	CHECK HARNESS AND CONNECTOR (FUEL PUMP RELAY - FUEL PUMP RESISTOR - FUEL PUMP)



(a) Check the harness and connector between the fuel pump relay and fuel pump resistor.
  (1) Remove the fuel pump relay from the engine room R/B.
  (2) Disconnect the F11 fuel pump resistor connector.
  (3) Check the resistance.
    Standard Resistance (Check for open)

Tester Connections	Specified Conditions
Fuel pump relay (5) - Fuel pump resistor (F11-1)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
Fuel pump relay (5) or Fuel pump resistor (F11-1) - Body ground	10 kΩ or higher

  (4) Reinstall the fuel pump relay.
  (5) Reconnect the fuel pump resistor connector.

(b) Check the harness and connector between the fuel pump resistor and fuel pump.
  (1) Disconnect the F11 fuel pump resistor connector.
  (2) Disconnect the fuel pump connector.
  (3) Check the resistance.
    Standard Resistance (Check for open)

Tester Connections	Specified Conditions
Fuel pump resistor (F11-2) - Fuel pump (F19-4)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
Fuel pump resistor (F11-2) or Fuel pump (F19-4) - Body ground	10 kΩ or higher

  (4) Reconnect the fuel pump resistor connector.
  (5) Reconnect the fuel pump connector.

NG → PROCEED TO NEXT CIRCUIT INSPECTION SHOWN ON PROBLEM SYMPTOMS TABLE

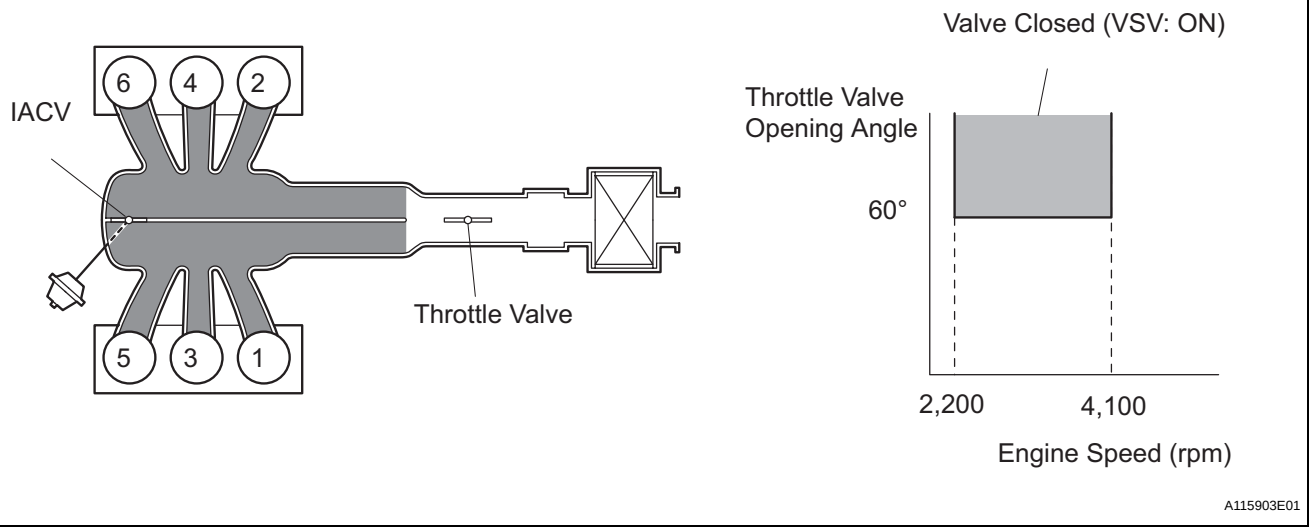
NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

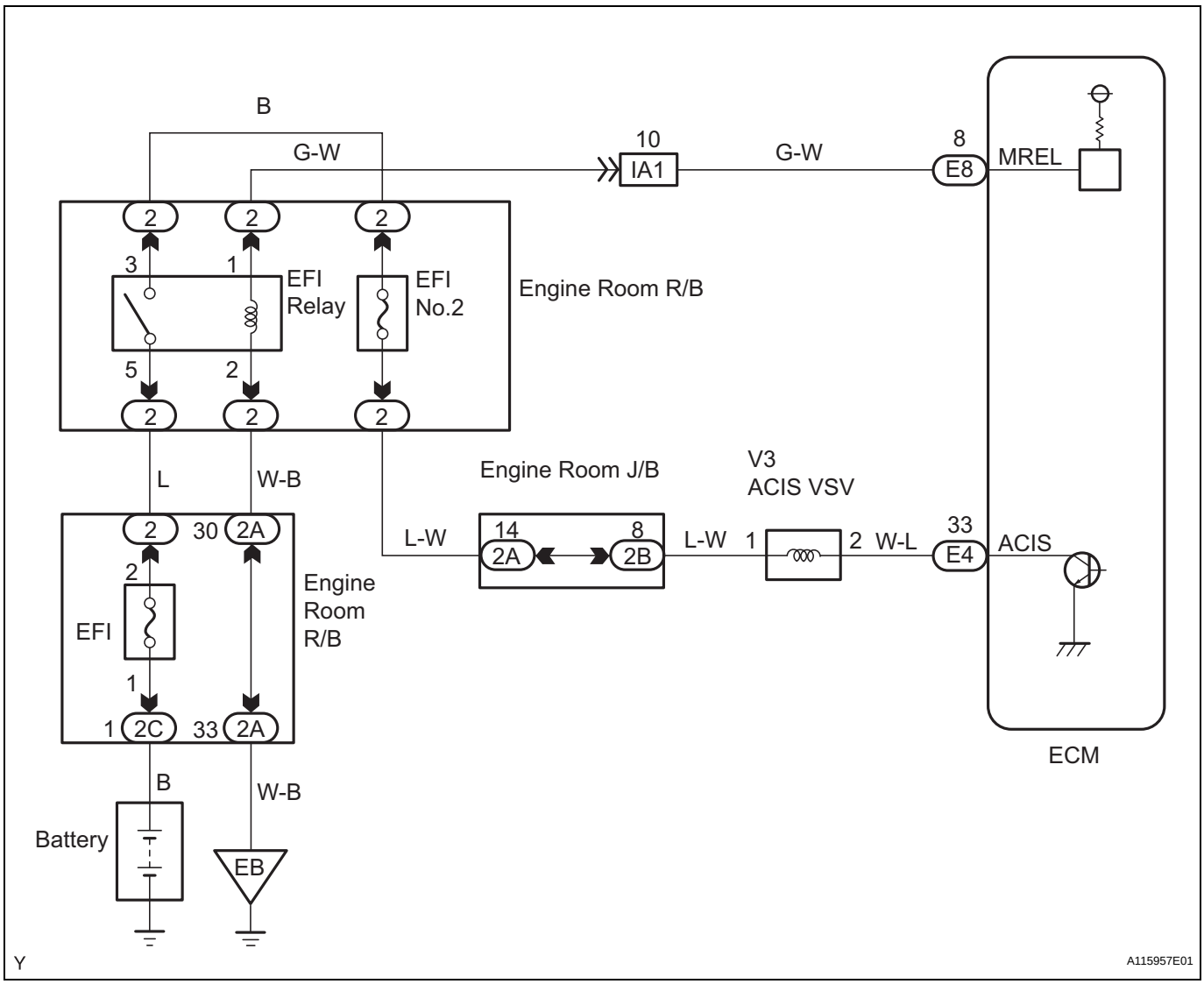
ACIS Control Circuit

DESCRIPTION

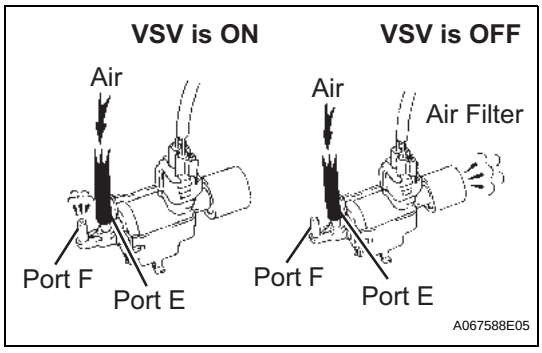
This circuit opens and closes the Intake Air Control Valve (IACV) in response to changes in the engine load in order to increase the intake efficiency (ACIS: Acoustic Control Induction System).
When the engine speed is between 2,200 rpm and 4,100 rpm and the throttle valve opening angle is 60° or more, the ECM supplies current to the VSV (ON status), to close the IACV. Under other conditions, the VSV is usually OFF and the IACV is open.



WIRING DIAGRAM



1	PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE VSV FOR ACIS)



(a) Disconnect the vacuum hose.
(b) Connect an intelligent tester to the DLC3.
(c) Turn the ignition switch ON and turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / INTAKE CTL VSV1. Operate the VSV for ACIS.
(e) Check the VSV operation when it is operated using an intelligent tester.

OK

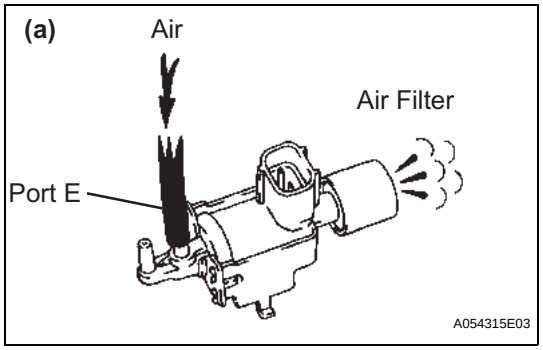
Tester Operations	Specified Conditions
VSV ON	Air from port E flows out through port F
VSV OFF	Air from port E flows out through air filter

(f) Reconnect the vacuum hose.

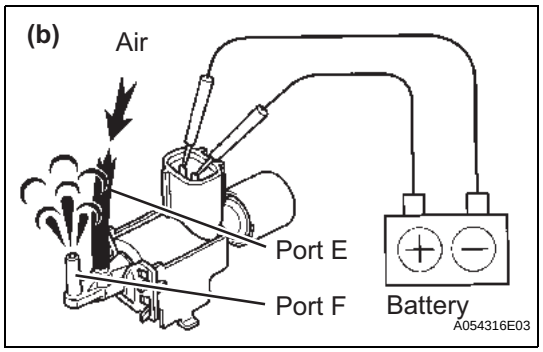
OK	Go to step 4

NG

2	CHECK VSV FOR ACIS (OPERATION)



(a) Check that air flows from port E to the air filter.



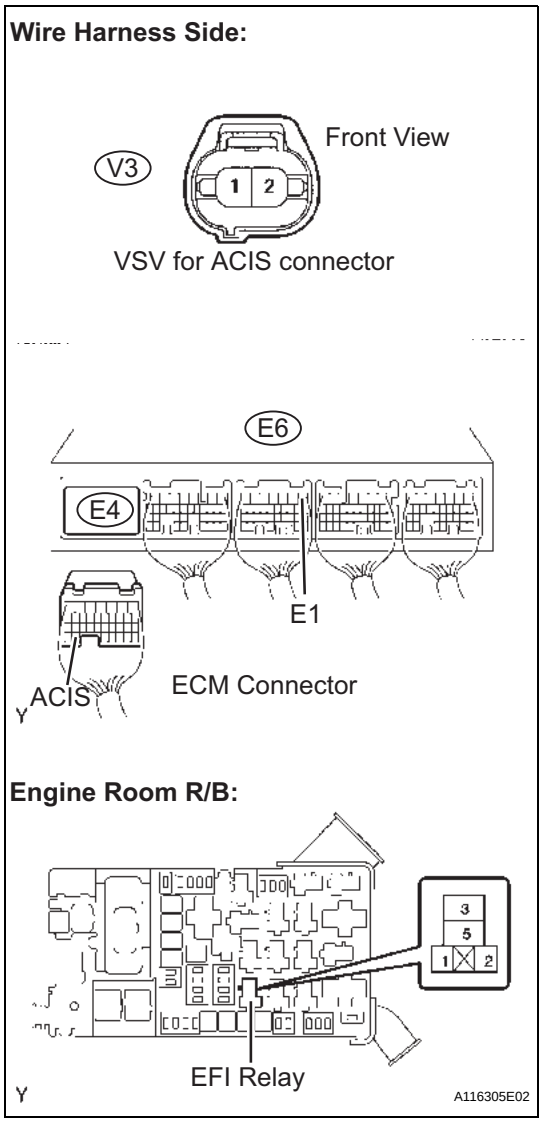
(b) Apply positive battery voltage across the terminals.
(c) Check that air flows from port E to port F.

NG → **REPLACE VSV FOR ACIS**

OK

ES

3	CHECK HARNESS AND CONNECTOR (VSV FOR ACIS - ECM, VSV FOR ACIS - EFI RELAY)



(a) Check the wire harness and connectors between the VSV for ACIS and ECM.
  (1) Disconnect the V3 VSV for ACIS connector.
  (2) Disconnect the E4 ECM connector.
  (3) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
VSV for ACIS (V3-2) - ACIS (E4-33)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
VSV for ACIS (V3-2) or ACIS (E4-33) - E1 (E6-1)	10 kΩ or higher

  (4) Reconnect the VSV for ACIS connector.
  (5) Reconnect the ECM connector.

(b) Check the wire harness between the VSV for ACIS and EFI relay.
  (1) Disconnect the V3 VSV for ACIS connector.
  (2) Remove the EFI relay from the engine room R/B.
  (3) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
VSV for ACIS (V3-1) - EFI relay terminal 3 of R/B	Below 1 Ω

  (4) Reconnect the VSV for ACIS connector.
  (5) Reinstall the EFI relay.

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

OK

4	CHECK VACUUM HOSES (INTAKE MANIFOLD - INTAKE AIR CONTROL VALVE, INTAKE AIR CONTR)

(a) Check that the vacuum hose is connected correctly.
(b) Check the vacuum hose for looseness and disconnection.
(c) Check the vacuum hose for cracks, holes and damage.

NG → **REPAIR OR REPLACE VACUUM HOSES**

OK

5	INSPECT INTAKE AIR CONTROL VALVE (INTAKE AIR SURGE TANK)

NG → REPLACE INTAKE AIR CONTROL VALVE (INTAKE AIR SURGE TANK)

OK

REPLACE ECM

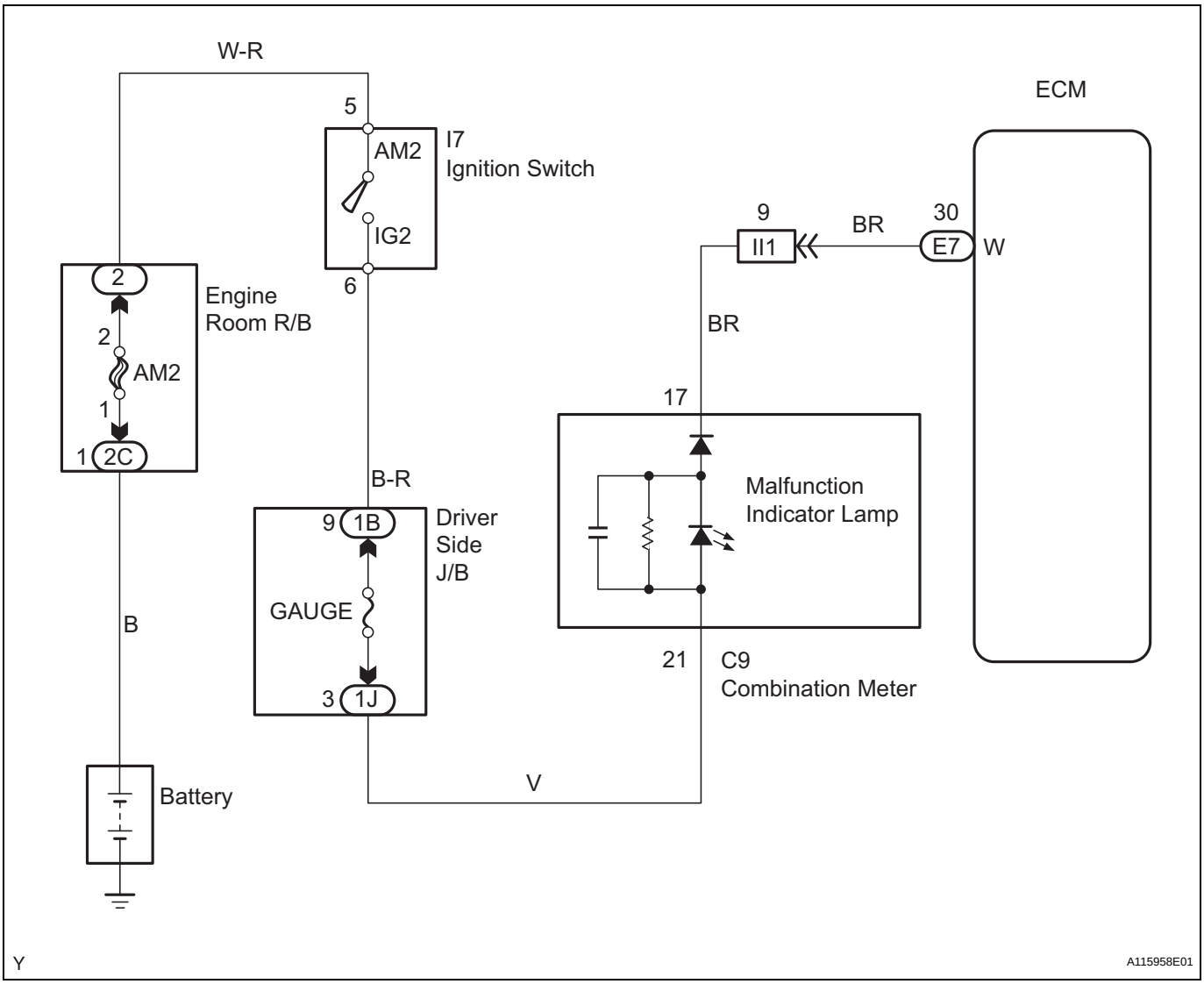
MIL Circuit

DESCRIPTION

The MIL (Malfunction Indicator Lamp) is used to indicate vehicle malfunction detections by the ECM.
By turning the ignition switch ON, power is supplied to the MIL circuit, and the ECM provides the circuit ground which illuminates the MIL.
The MIL operation can be checked visually: When the ignition switch is first turned ON, the MIL should be illuminated and should then turn OFF. If the MIL remains illuminated or is not illuminated, conduct the following troubleshooting procedure using an intelligent tester.

WIRING DIAGRAM

ES



1	CHECK THAT MIL IS ILLUMINATED

(a) Perform troubleshooting in accordance with the chart below.

Result

MIL Condition	Proceed To
MIL remains ON	A
MIL does not illuminate	B

B → **Go to step 4**

A

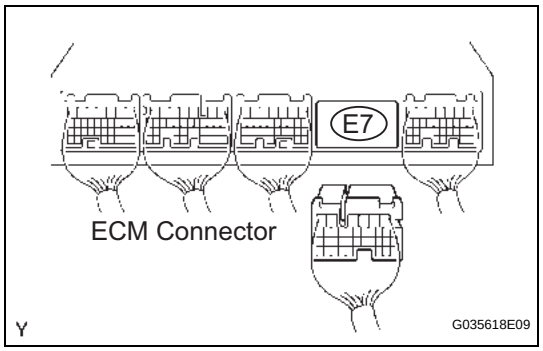
2 CHECK WHETHER MIL TURNS OFF

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Check whether any DTCs have been stored (See page ES-38). Note them down if necessary.
(e) Clear DTCs (See page ES-38).
(f) Check if the MIL turns off.
OK:
MIL should turn off.

OK → **REPAIR CIRCUIT INDICATED BY OUTPUT DTC**

NG

3 CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT IN WIRE HARNESS)



(a) Disconnect the E7 ECM connector.
(b) Turn the ignition switch ON.
(c) Check that MIL is not illuminated.
OK:
MIL is not illuminated.
(d) Reconnect the ECM connector.

OK → **REPLACE ECM**

NG

CHECK AND REPAIR HARNESS AND CONNECTOR (COMBINATION METER - ECM)

4 CHECK THAT MIL IS ILLUMINATED

(a) Check if the MIL is illuminated when the ignition switch is turns ON.
OK:
MIL should be illuminated.

OK → **SYSTEM OK**

NG

5	CHECK THAT ENGINE STARTS

(a) Turn the ignition switch ON.
(b) Start the engine.
Result

Result	Proceed To
Engine starts	A
Engine does not start*	B

HINT:
*: An intelligent tester cannot communicate with the ECM.

B → GO TO VC OUTPUT CIRCUIT

A

6	INSPECT COMBINATION METER ASSEMBLY (MIL CIRCUIT)

(a) See the combination meter troubleshooting procedure (See page ME-65).

NG → REPAIR OR REPLACE BULB OR COMBINATION METER ASSEMBLY

OK

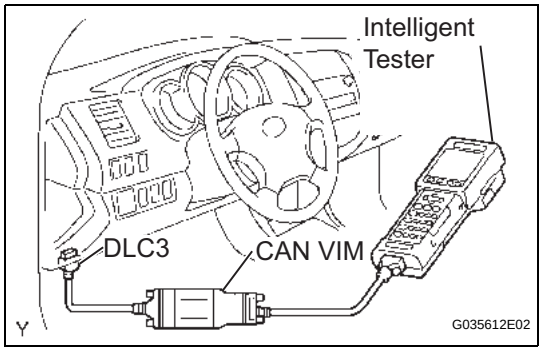
CHECK AND REPAIR HARNESS AND CONNECTOR (COMBINATION METER - ECM)

MASS AIR FLOW METER

ON-VEHICLE INSPECTION

NOTICE:

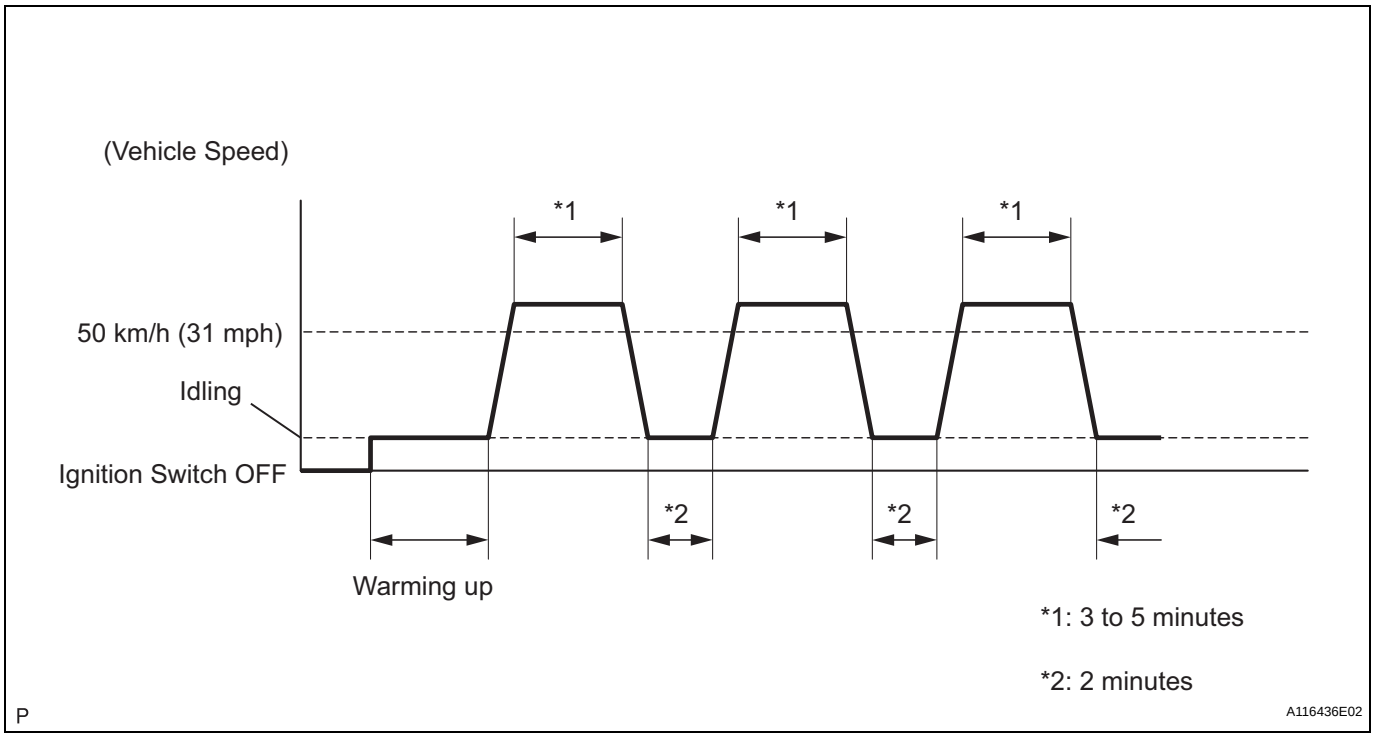
- **Perform the MAF meter inspection according to the procedures below.**
- **Only replace the MAF meter when both the LONG FT#1 value and MAF value in the DATA LIST (with the engine stopped) are not within the normal operating range.**



1. INSPECT MASS AIR FLOW METER

(a) Perform confirmation driving pattern.

(1) Connect the intelligent tester to the DLC3.
(2) Turn the ignition switch ON.
(3) Turn the tester ON.
(4) Clear the DTCs (see page ES-38).
(5) Start the engine and warm it up with all accessory switches OFF (until the engine coolant temperature is 75°C (167°F) or more).
(6) Drive the vehicle at 50 km/h (31 mph) or more for 3 or more *1.
(7) Let the engine idle (accelerator pedal fully released) for 2 minutes or more *2.
(8) Perform steps *1 and *2 at least 3 times.



(b) Read value using intelligent tester (LONG FT#1).

(1) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / LONG FT#1.
(2) Read the values displayed on the tester.
Standard value:
Within -15 to +15 %

If the result is not within the specified range, perform the inspection below.

(c) Read value using intelligent tester (MAF).

NOTICE:

- **Turn off the engine.**
- **Perform the inspection with the vehicle indoors and on a level surface.**
- **Perform the inspection of the MAF meter while it is installed to the air cleaner case (installed to the vehicle).**
- **During the test, do not use the exhaust air duct to perform suction on the exhaust pipe.**

(1) Turn the ignition switch to ACC.

(2) Turn the ignition switch ON (do not run the engine).

(3) Turn the tester ON.

(4) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / MAF.

(5) Wait 30 seconds, and read the values on the intelligent tester.

Standard condition:

Less than 0.72 g/s

- If the result is not as specified, replace the MAF meter.
- If the result is within the specified range, inspect the cause of the extremely rich or lean air fuel ratio (see page ES-146).

ES

REMOVAL

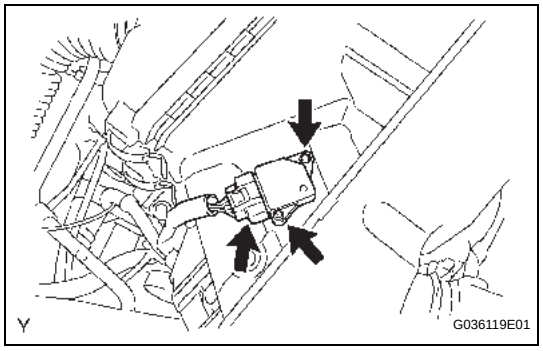
1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

2. REMOVE V-BANK COVER (See page ES-414)

3. REMOVE MASS AIR FLOW METER

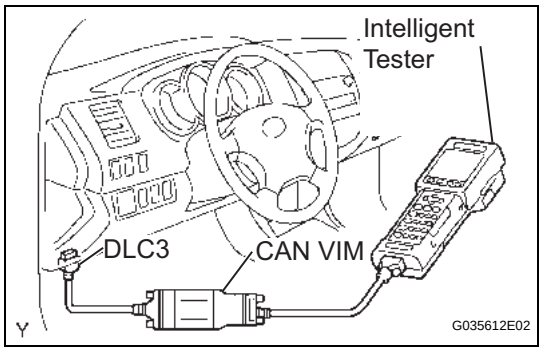
(a) Disconnect the connector.

(b) Remove the 2 screws, then remove the mass air flow meter.



INSTALLATION

1. **INSTALL MASS AIR FLOW METER**
2. **INSTALL V-BANK COVER (See page ES-416)**
3. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
   Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)



CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

ON-VEHICLE INSPECTION

1. INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

(a) Check the operation.

(1) Turn the ignition switch to ON.

(2) Turn the intelligent tester ON.

(3) Start the engine and warm it up.

(4) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1.

(5) Operate the OCV using the intelligent tester, then check the engine speed.

Standard

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Rough idling or engine stalls

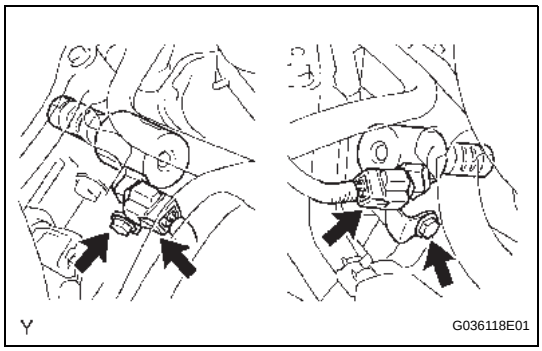
If the operation is not as specified, check the camshaft timing oil control valve, wire harness and ECM.

ES

ES

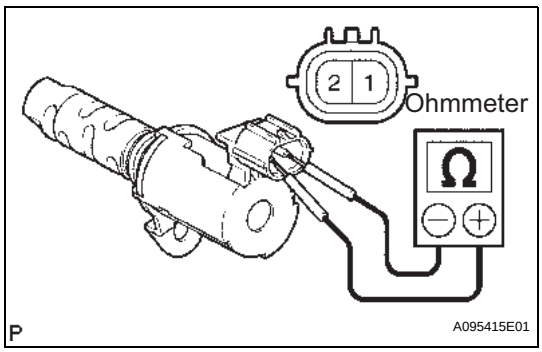
REMOVAL

1. **DRAIN ENGINE COOLANT (See page CO-3)**
2. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
3. **REMOVE V-BANK COVER (See page ES-414)**
4. **REMOVE AIR CLEANER ASSEMBLY (See page ES-415)**
5. **REMOVE INTAKE AIR SURGE TANK (See page FU-11)**
6. **REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   (a) Disconnect the 2 connectors.
   (b) Remove the 2 bolts, then remove the 2 camshaft timing oil control valves.



INSPECTION

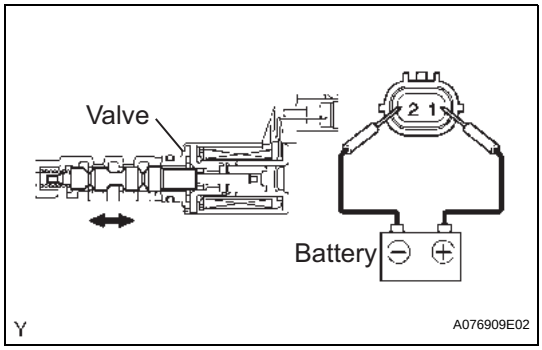
1. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   (a) Check the resistance.
      (1) Using an ohmmeter, measure the resistance between the terminals.
      Standard



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 camshaft timing oil control valve.

   (b) Check the operation.
      (1) Connect the positive (+) lead from the battery to terminal 1 and negative (-) lead to terminal 2, and check that the 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 leakage to the advance side, and a DTC may, be set.



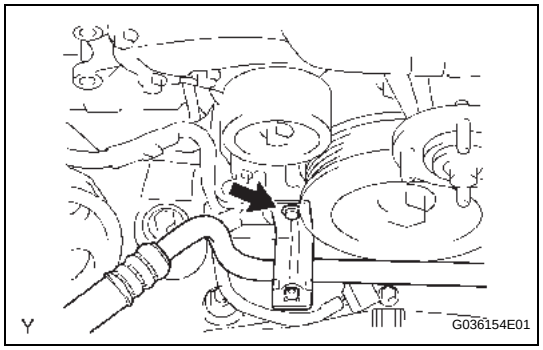
INSTALLATION

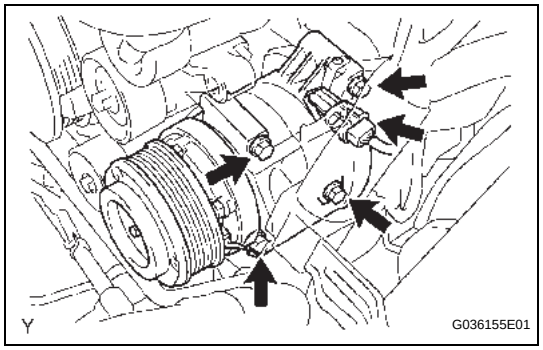
1. **INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   (a) Install the 2 camshaft timing oil control valves with the 2 bolts.
   Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)
   (b) Connect the 2 connectors.
2. **INSTALL INTAKE AIR SURGE TANK (See page FU-17)**
3. **INSTALL AIR CLEANER ASSEMBLY (See page ES-416)**
4. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
   Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)
5. **ADD ENGINE COOLANT (See page CO-3)**
6. **CHECK FOR ENGINE COOLANT LEAKAGE (See page CO-4)**
7. **INSTALL V-BANK COVER (See page ES-416)**

CRANKSHAFT POSITION SENSOR

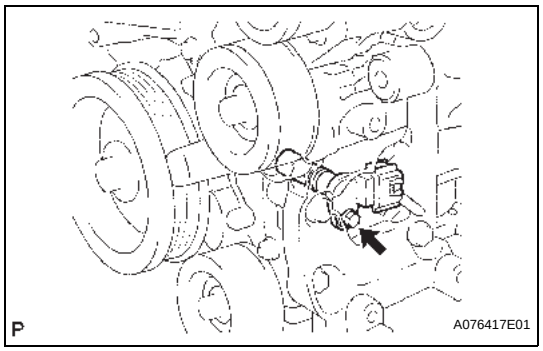
REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
2. **REMOVE V-BANK COVER (See page ES-414)**
3. **REMOVE FAN SHROUD (See page CO-15)**
4. **REMOVE GENERATOR ASSEMBLY (See page CH-7)**
5. **SEPARATE COOLER COMPRESSOR ASSEMBLY**
   (a) Remove the bolt, then separate the suction hose sub-assembly.





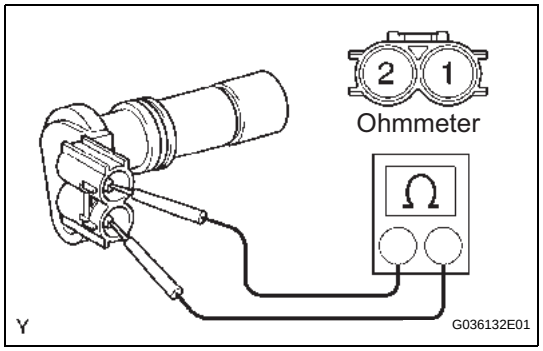
   (b) Disconnect the cooler compressor assembly connector.
   (c) Remove the 4 bolts, then separate the cooler compressor assembly from the V-ribbed belt tensioner assembly.



6. **REMOVE CRANKSHAFT POSITION SENSOR**
   (a) Disconnect the crankshaft position sensor connector.
   (b) Remove the bolt, then remove the crankshaft position sensor.

INSPECTION

1. **INSPECT CRANKSHAFT POSITION SENSOR**
   (a) Check the resistance.
      (1) Using an ohmmeter, measure the resistance between the terminals.
      Standard:
      1850 to 2450 Ω at 20°C (68°F)
      If the result is not as specified, replace the crankshaft position sensor.



INSTALLATION

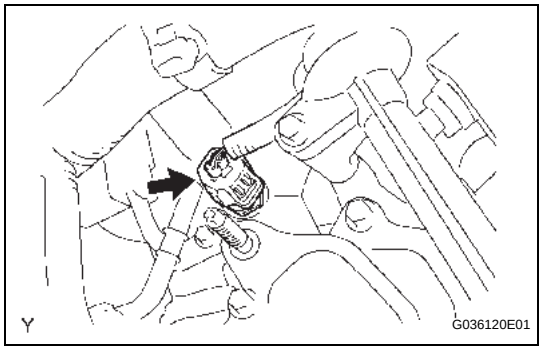
1. **INSTALL CRANKSHAFT POSITION SENSOR**
   (a) Apply a light coat of engine oil to the O-ring of the crankshaft position sensor.
   (b) Install the crankshaft position sensor with the bolt.
   Torque: 10 N*m (102 kgf*cm, 7.4 in.*lbf)
   (c) Connect the crankshaft position sensor connector.
2. **INSTALL COOLER COMPRESSOR ASSEMBLY**
   (a) Install the cooler compressor assembly with the 4 bolts.
   Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)
   (b) Connect the cooler compressor assembly connector.
   (c) Install the suction hose sub-assembly with the bolt.
   Torque: 8.0 N*m (82 kgf*cm, 71 in.*lbf)
3. **INSTALL GENERATOR ASSEMBLY (See page CH-13)**
4. **INSTALL FAN SHROUD (See page CO-20)**
5. **INSTALL V-BANK COVER (See page ES-416)**
6. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
   Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)

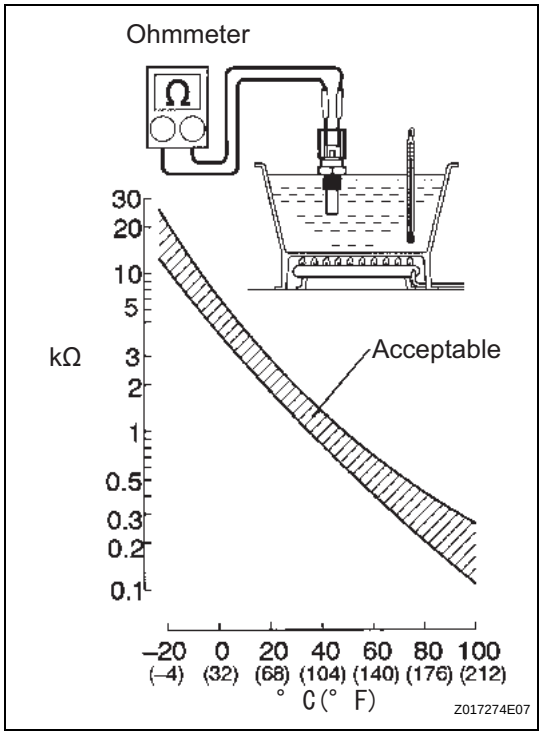
ES

ENGINE COOLANT TEMPERATURE SENSOR

REMOVAL

1. **DISCHARGE FUEL SYSTEM PRESSURE** (See page FU-1)
2. **DRAIN ENGINE COOLANT (See page CO-3)**
3. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
4. **REMOVE V-BANK COVER (See page ES-414)**
5. **REMOVE AIR CLEANER ASSEMBLY (See page ES-415)**
6. **REMOVE INTAKE AIR SURGE TANK (See page FU-11)**
7. **DISCONNECT FUEL PIPE SUB-ASSEMBLY NO.2 (See page FU-13)**
8. **REMOVE ENGINE COOLANT TEMPERATURE SENSOR**
   (a) Disconnect the connector.
   (b) Using a 19 mm deep socket wrench, remove the water temperature sensor and gasket.



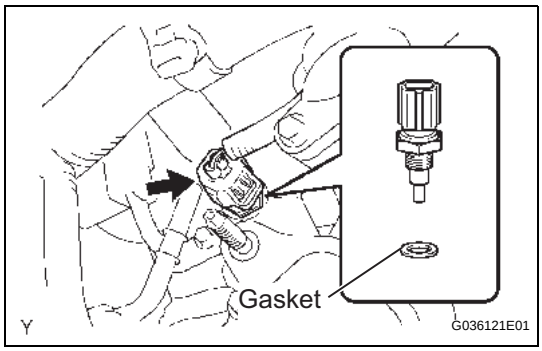


INSPECTION

1. **INSPECT ENGINE COOLANT TEMPERATURE SENSOR**
   (a) Check the resistance.
      (1) Using an ohmmeter, measure the resistance between the terminals.
      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 engine coolant temperature sensor in water, be careful not to allow water to enter the terminals. After checking, wipe the water off the engine coolant temperature sensor.
If the result is not as specified, replace the engine coolant temperature sensor.



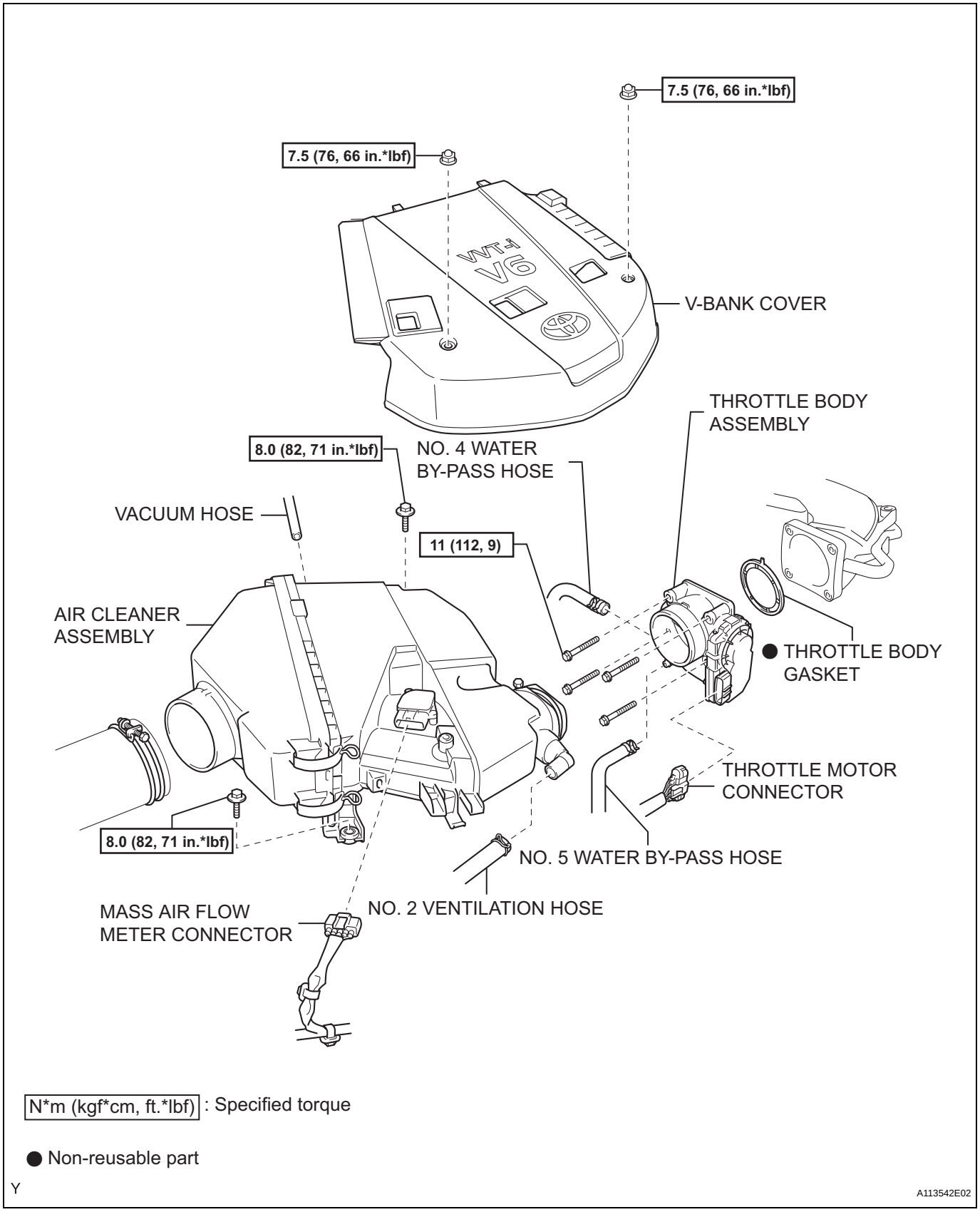
INSTALLATION

1. **INSTALL E.F.I. ENGINE COOLANT TEMPERATURE SENSOR**
   (a) Using a 19 mm deep socket wrench, install the water temperature sensor with a new gasket.
   Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)
   (b) Connect the connector.
2. **CONNECT FUEL PIPE SUB-ASSEMBLY NO.2 (See page FU-17)**
3. **INSTALL INTAKE AIR SURGE TANK (See page FU-17)**
4. **INSTALL AIR CLEANER ASSEMBLY**
5. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
   Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)
6. **ADD ENGINE COOLANT (See page CO-3)**
7. **CHECK FOR FUEL LEAKAGE**
8. **CHECK FOR ENGINE COOLANT LEAKAGE (See page CO-4)**
9. **INSTALL V-BANK COVER (See page ES-416)**

ES

THROTTLE BODY

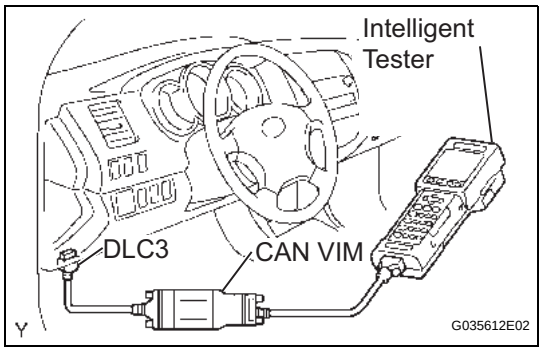
COMPONENTS



ON-VEHICLE INSPECTION

1. INSPECT THROTTLE BODY ASSEMBLY

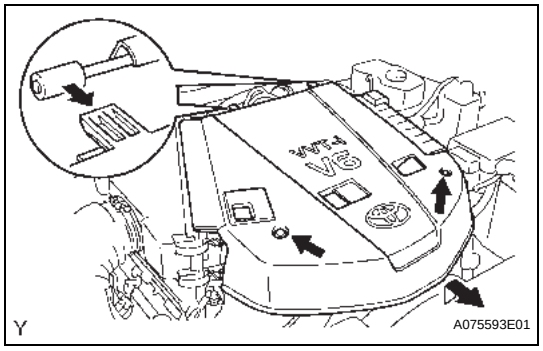
(a) Listen to the throttle control motor operating sounds.
  (1) Turn the ignition switch to ON.
  (2) When pressing the accelerator pedal, listen to the running sound of the motor. Make sure no friction noises come from the motor.
  If friction noises exist, check the throttle body, wire harness and ECM.



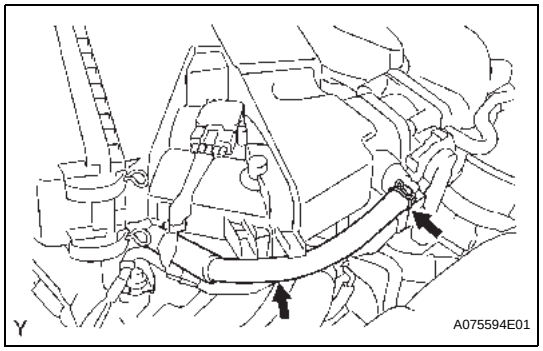
(b) Check the throttle position sensor.
  (1) Turn the ignition switch to ON.
  (2) Turn the intelligent tester ON.
  (3) Start the engine and warm it up.
  (4) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / THROTTLE POS .
  (5) Depress the accelerator pedal. When the throttle valve is fully open, check that the THROTTLE POS value is within the specification.
  Standard:
  60% or more
  NOTICE:
  When checking the standard throttle valve opening percentage, the transmission should be in the neutral position.
  If the result is not as specified, check the throttle body, wire harness and ECM.

REMOVAL

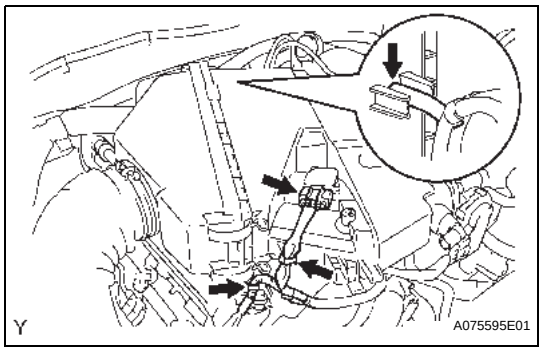
1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
2. **DRAIN ENGINE COOLANT (See page CO-3)**
3. **REMOVE V-BANK COVER**
   (a) Remove the 2 nuts, then remove the V-bank cover.



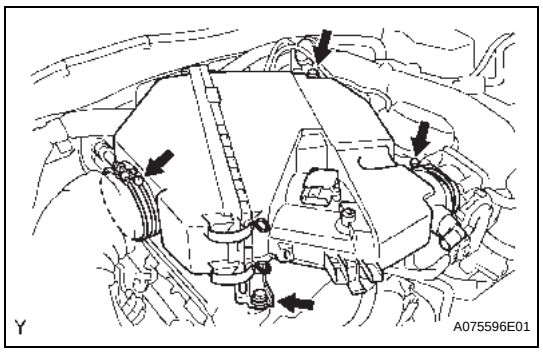
4. **REMOVE AIR CLEANER ASSEMBLY**
   (a) Disconnect the ventilation hose No. 2.



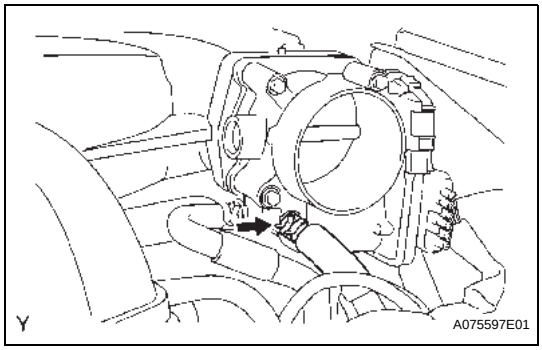
   (b) Disconnect the vacuum hose.
   (c) Disconnect the mass air flow meter connector.
   (d) Remove the 2 wire harness clamps.



   (e) Loosen the 2 hose clamps.
   (f) Remove the 2 bolts, then remove the air cleaner.

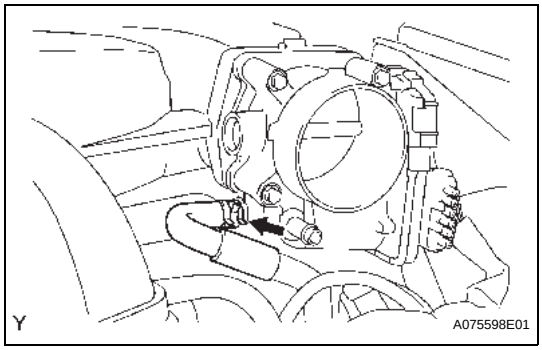


ES

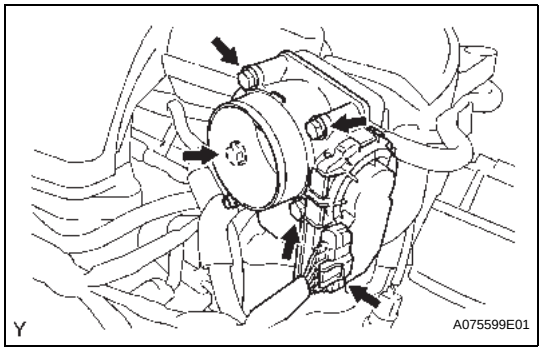


5. REMOVE THROTTLE WITH MOTOR BODY ASSEMBLY

(a) Disconnect the water by-pass hose No. 5.

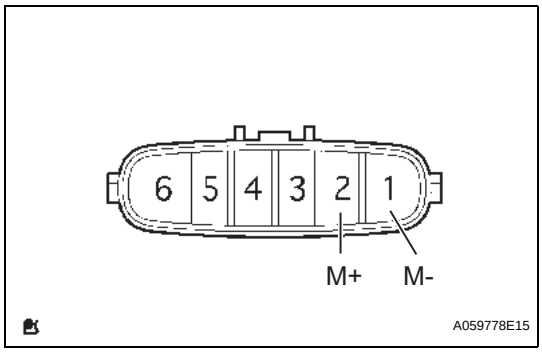


(b) Disconnect the water by-pass hose No. 4.



(c) Disconnect the throttle motor connector.

(d) Remove the 4 bolts, then remove the throttle w/ motor body and gasket.



INSPECTION

1. INSPECT THROTTLE WITH MOTOR BODY ASSEMBLY

(a) Check the resistance.

(1) Using an ohmmeter, measure the resistance between the terminals.

Standard

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 with motor body assembly.

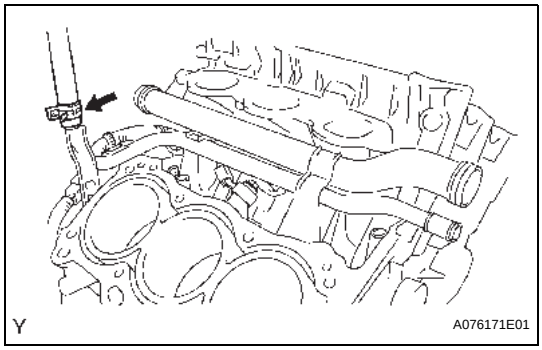
INSTALLATION

1. **INSTALL THROTTLE WITH MOTOR BODY ASSEMBLY**
   (a) Install a new gasket and the throttle with motor body with the 4 bolts.
   Torque: 11 N*m (112 kgf*cm, 9 ft.*lbf)
   (b) Connect the throttle motor connector.
   (c) Connect the water by-pass hose No. 4.
   (d) Connect the water by-pass hose No. 5.
2. **INSTALL AIR CLEANER ASSEMBLY**
   (a) Install the air cleaner with the 2 bolts.
   Torque: 8.0 N*m (82 kgf*cm, 71 in.*lbf)
   (b) Connect the ventilation hose No. 2.
3. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
   Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)
4. **ADD ENGINE COOLANT (See page CO-3)**
5. **CHECK FOR ENGINE COOLANT LEAKAGE (See page CO-4)**
6. **INSTALL V-BANK COVER**
   (a) Install the V-bank cover with the 2 nuts.
   Torque: 7.5 N*m (76 kgf*cm, 66 in.*lbf)

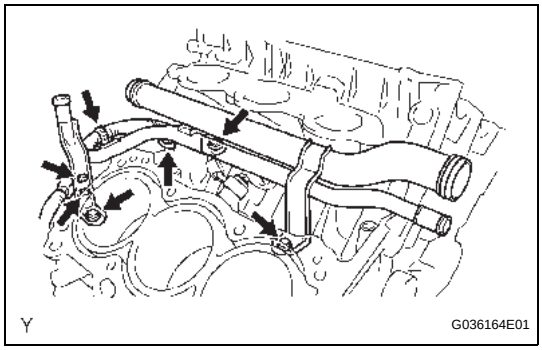
KNOCK SENSOR (for 2WD)

REMOVAL

1. **DISCHARGE FUEL SYSTEM PRESSURE**
   (See page FU-1)
2. **REMOVE BATTERY**
3. **DRAIN ENGINE COOLANT (See page CO-3)**
4. **DRAIN ENGINE OIL (See page LU-4)**
5. **REMOVE ENGINE ASSEMBLY**
   (See page EM-186)
6. **REMOVE TIMING CHAIN OR BELT COVER SUB-ASSEMBLY**
   (See page LU-17)
7. **REMOVE COOL AIR INLET NO.1**
   (a) Remove the 2 bolts, then remove the cool air inlet.
8. **REMOVE EXHAUST FRONT PIPE ASSEMBLY NO.2 (See page EX-3)**
9. **REMOVE EXHAUST PIPE ASSEMBLY FRONT (See page EX-3)**
10. **REMOVE MANIFOLD STAY**
    (a) Remove the 3 bolts, then remove the exhaust manifold stay.
11. **REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY RH**
    (a) Disconnect the air fuel ratio sensor connector.
    (b) Remove the 6 nuts, then remove the exhaust manifold and gasket.
12. **REMOVE INTAKE MANIFOLD (See page EM-93)**
13. **REMOVE WATER BY-PASS JOINT RR (See page EM-93)**
14. **REMOVE CHAIN VIBRATION DAMPER NO.1**
    (a) Remove the 2 bolts, then remove the chain vibration damper No. 1.
15. **REMOVE CAMSHAFT TIMING GEARS AND NO.2 CHAIN (RH BANK) (See page EM-94)**
16. **REMOVE CHAIN TENSIONER ASSEMBLY NO.2 (See page EM-62)**
17. **REMOVE CAMSHAFTS (See page EM-94)**
18. **REMOVE CAMSHAFT BEARING NO.2**
19. **REMOVE CYLINDER HEAD SUB-ASSEMBLY (See page EM-95)**

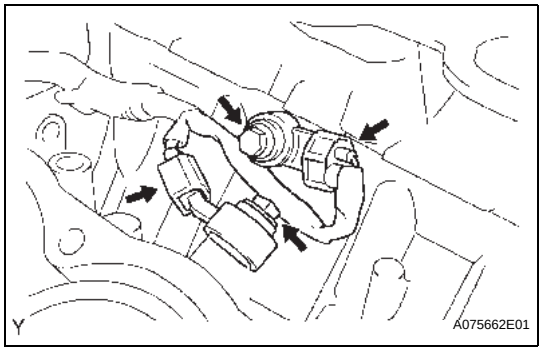


20. DISCONNECT HEATER WATER INLET HOSE



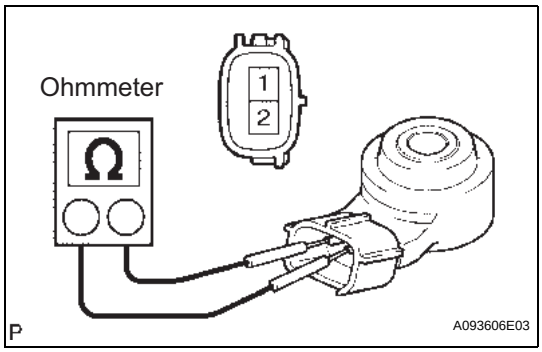
21. REMOVE WATER OUTLET PIPE NO.1

(a) Remove the 4 wire harness clamps.
(b) Remove the 3 bolts and water outlet pipe.



22. REMOVE KNOCK SENSOR

(a) Disconnect the 2 knock sensor connectors.
(b) Remove the 2 bolts and 2 knock sensors.



INSPECTION

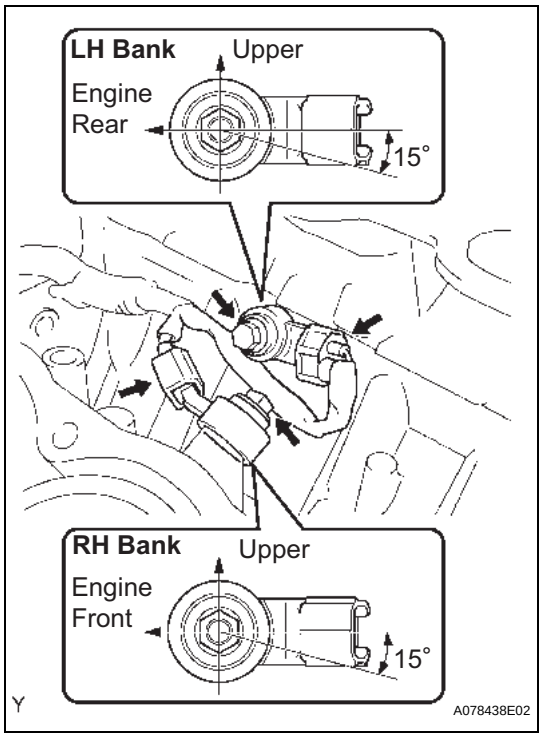
1. INSPECT KNOCK SENSOR

(a) Check the resistance.
(1) Using an ohmmeter, measure the resistance between the terminals.

Resistance Standard

Tester Connection	Specified Condition
1 (Ground) - 2 (Output)	120 to 180 Ω at 20°C (68°F)

If the result is not as specified, replace the knock sensor.



INSTALLATION

1. **INSTALL KNOCK SENSOR**
   (a) Install the 2 knock sensors with the 2 bolts as shown in the illustration.
   Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)
   (b) Connect the 2 knock sensor connectors.
2. **INSTALL WATER OUTLET PIPE NO.1**
   (a) Install the water outlet pipe with the 3 bolts.
   Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)
   (b) Install the 4 wire harness clamps.
3. **CONNECT HEATER WATER INLET HOSE**
4. **INSPECT CYLINDER HEAD SET BOLT (See page EM-95)**
5. **INSTALL CYLINDER HEAD SUB-ASSEMBLY (See page EM-96)**
6. **INSTALL CAMSHAFT BEARING NO.2**
7. **INSTALL CAMSHAFTS (See page EM-97)**
8. **INSTALL CHAIN TENSIONER ASSEMBLY NO.2 (See page EM-98)**
9. **INSTALL CAMSHAFT TIMING GEARS AND NO.2 CHAIN (RH BANK) (See page EM-99)**
10. **INSTALL CHAIN VIBRATION DAMPER NO.1 (See page EM-142)**
11. **INSTALL WATER BY-PASS JOINT RR (See page EM-99)**
12. **INSTALL INTAKE MANIFOLD (See page EM-99)**
13. **INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY RH (See page EM-99)**
14. **INSTALL MANIFOLD STAY (See page EM-100)**
15. **INSTALL EXHAUST PIPE ASSEMBLY FRONT (See page EX-3)**
16. **INSTALL EXHAUST FRONT PIPE ASSEMBLY NO.2 (See page EX-3)**
17. **INSTALL COOL AIR INLET NO.1**
    (a) Install the cool air inlet with the 2 bolts.
    Torque: 12 N*m (122 kgf*cm, 9.0 ft.*lbf)
18. **INSTALL CHAIN TENSIONER SLIPPER**
19. **INSTALL CHAIN TENSIONER ASSEMBLY NO.1 (See page EM-48)**
20. **INSTALL CHAIN SUB-ASSEMBLY (See page EM-27)**
21. **INSTALL TIMING CHAIN OR BELT COVER SUB-ASSEMBLY**
    (See page LU-20)

22. **INSTALL ENGINE ASSEMBLY**
(See page EM-190)
23. **INSTALL BATTERY**
24. **ADD ENGINE COOLANT (See page CO-3)**
25. **ADD ENGINE OIL (See page LU-5)**
26. **CHECK FOR ENGINE COOLANT LEAKAGE (See page CO-4)**
27. **CHECK FOR ENGINE OIL LEAKAGE**
28. **CHECK FOR FUEL LEAKAGE**
29. **CHECK FOR EXHAUST GAS LEAKAGE**
30. **INSPECT IGNITION TIMING (See page EM-1)**
31. **INSPECT ENGINE IDLING SPEED (See page EM-2)**
32. **INSPECT CO/HC (See page EM-3)**

KNOCK SENSOR (for 4WD and Pre-Runner)

REMOVAL

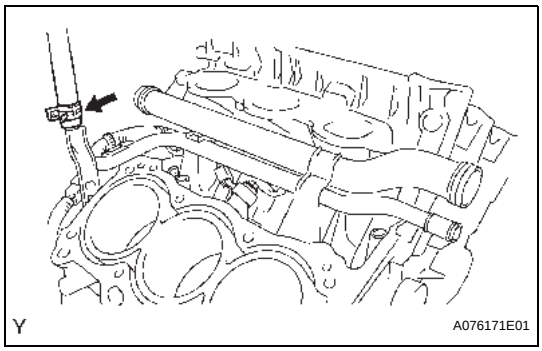
1. **DISCHARGE FUEL SYSTEM PRESSURE**
   (See page FU-1)
2. **REMOVE BATTERY**
3. **DRAIN ENGINE COOLANT (See page CO-3)**
4. **DRAIN ENGINE OIL (See page LU-4)**
5. **REMOVE POWER STEERING LINK ASSEMBLY**
   (See page PS-53)
6. **REMOVE DIFFERENTIAL CARRIER ASSEMBLY FRONT (4WD DRIVE TYPE)**
   (See page DF-19)
7. **REMOVE TIMING CHAIN OR BELT COVER SUB-ASSEMBLY**
   (See page LU-34)
8. **REMOVE CHAIN SUB-ASSEMBLY**
9. **REMOVE COOL AIR INLET NO.1**
   (a) Remove the 2 bolts, then remove the cool air inlet.
10. **REMOVE EXHAUST FRONT PIPE ASSEMBLY NO.2 (See page EX-3)**
11. **REMOVE EXHAUST PIPE ASSEMBLY FRONT (See page EX-3)**
12. **REMOVE MANIFOLD STAY**
    (a) Remove the 6 bolts, then remove the 2 exhaust manifold stays.
13. **REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY RH (See page EM-115)**
14. **DISCONNECT FUEL PIPE SUB-ASSEMBLY NO.1 (See page FU-13)**
15. **DISCONNECT FUEL PIPE SUB-ASSEMBLY NO.2 (See page FU-13)**
16. **REMOVE INTAKE MANIFOLD (See page EM-115)**
17. **REMOVE WATER BY-PASS JOINT RR (See page EM-115)**
18. **REMOVE CHAIN VIBRATION DAMPER NO.1 (See page EM-158)**
19. **REMOVE CAMSHAFT TIMING GEARS AND NO.2 CHAIN (RH BANK) (See page EM-116)**
20. **REMOVE CHAIN TENSIONER ASSEMBLY NO.2 (See page EM-116)**
21. **REMOVE CAMSHAFTS (See page EM-116)**

ES

22. REMOVE CAMSHAFT BEARING NO.2

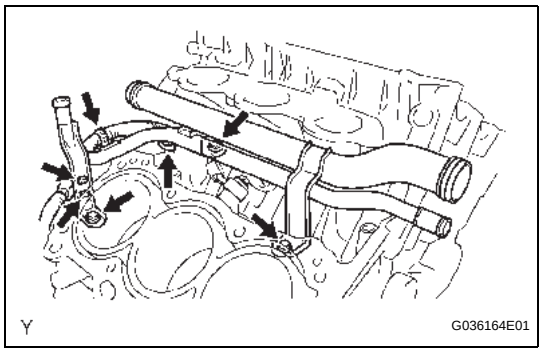
23. REMOVE CYLINDER HEAD SUB-ASSEMBLY (See page EM-117)

24. DISCONNECT HEATER WATER INLET HOSE



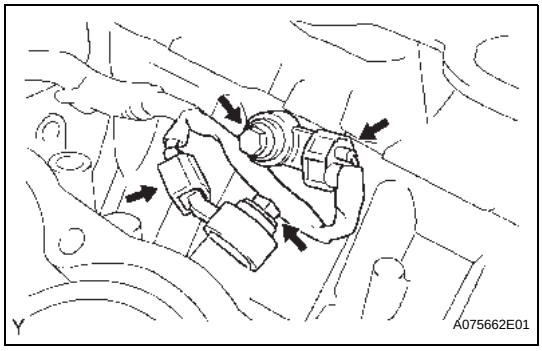
25. REMOVE WATER OUTLET PIPE NO.1

(a) Remove the 4 wire harness clamps.
(b) Remove the 3 bolts and water outlet pipe.



26. REMOVE KNOCK CONTROL SENSOR

(a) Disconnect the 2 knock sensor connectors.
(b) Remove the 2 bolts and 2 knock sensors.



INSPECTION

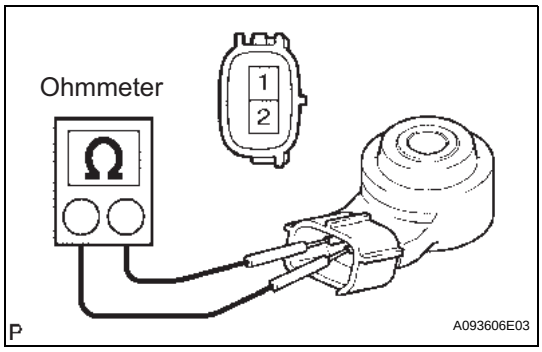
1. INSPECT KNOCK SENSOR

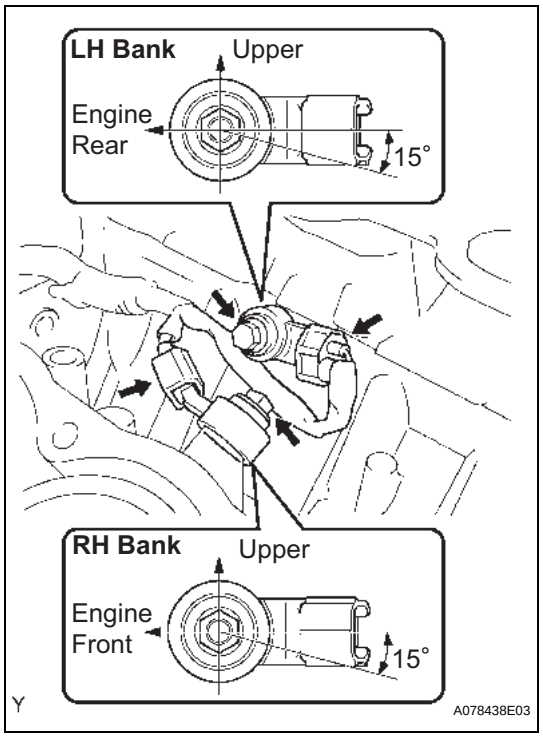
(a) Check the resistance.
(1) Using an ohmmeter, measure the resistance between the terminals.

Resistance Standard

Tester Connection	Specified Condition
1 (Ground) - 2 (Output)	120 to 180 Ω at 20°C (68°F)

If the result is not as specified, replace the knock sensor.

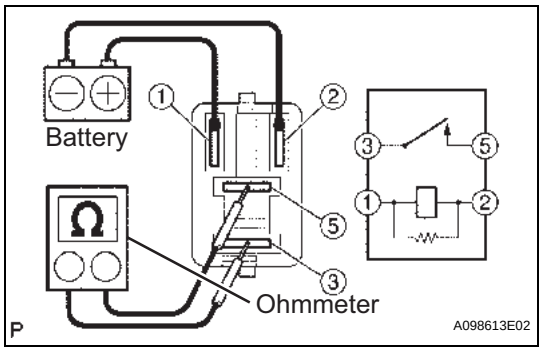




INSTALLATION

1. **INSTALL KNOCK CONTROL SENSOR**
   (a) Install the 2 knock sensors with the 2 bolts as shown in the illustration.
   Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)
   (b) Connect the 2 knock sensor connectors.
2. **INSTALL WATER OUTLET PIPE NO.1**
   (a) Install the water outlet pipe with the 3 bolts.
   Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)
   (b) Install the 4 wire harness clamps.
3. **CONNECT HEATER WATER INLET HOSE**
4. **INSPECT CYLINDER HEAD SET BOLT (See page EM-117)**
5. **INSTALL CYLINDER HEAD SUB-ASSEMBLY (See page EM-118)**
6. **INSTALL CAMSHAFT BEARING NO.2**
7. **INSTALL CAMSHAFTS (See page EM-119)**
8. **INSTALL CHAIN TENSIONER ASSEMBLY NO.2 (See page EM-120)**
9. **INSTALL CAMSHAFT TIMING GEARS AND NO.2 CHAIN (RH BANK) (See page EM-121)**
10. **INSTALL CHAIN VIBRATION DAMPER NO.1 (See page EM-164)**
11. **INSTALL WATER BY-PASS JOINT RR (See page EM-121)**
12. **INSTALL INTAKE MANIFOLD (See page EM-121)**
13. **CONNECT FUEL PIPE SUB-ASSEMBLY NO.2 (See page FU-17)**
14. **CONNECT FUEL PIPE SUB-ASSEMBLY NO.1 (See page FU-17)**
15. **INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY RH (See page EM-122)**
16. **INSTALL MANIFOLD STAY**
    (a) Install the 2 manifold stays with the 6 bolts.
    Torque: 40 N*m (408 kgf*cm, 30 ft.*lbf)
17. **INSTALL EXHAUST PIPE ASSEMBLY FRONT (See page EX-3)**
18. **INSTALL EXHAUST FRONT PIPE ASSEMBLY NO.2 (See page EX-3)**
19. **INSTALL COOL AIR INLET NO.1**
    (a) Install the cool air inlet with the 2 bolts.
20. **INSTALL CHAIN TENSIONER SLIPPER**
21. **INSTALL CHAIN TENSIONER ASSEMBLY NO.1 (See page EM-48)**

22. **INSTALL CHAIN SUB-ASSEMBLY (See page EM-48)**
23. **INSTALL TIMING CHAIN OR BELT COVER SUB-ASSEMBLY**
    (See page LU-38)
24. **INSTALL DIFFERENTIAL CARRIER ASSEMBLY FRONT (for 4WD)**
    (See page DF-38)
25. **INSTALL POWER STEERING LINK ASSEMBLY**
    (See page PS-67)
26. **INSTALL BATTERY**
27. **ADD ENGINE OIL (See page LU-5)**
28. **ADD ENGINE COOLANT (See page CO-3)**
29. **ADD DIFFERENTIAL OIL (for 4WD)**
30. **INSPECT DIFFERENTIAL OIL (for 4WD) (See page DF-8)**
31. **ADD POWER STEERING FLUID (See page PS-3)**
32. **BLEED POWER STEERING FLUID (See page PS-2)**
33. **CHECK FOR ENGINE OIL LEAKAGE**
34. **CHECK FOR ENGINE COOLANT LEAKAGE (See page CO-4)**
35. **CHECK FOR FUEL LEAKAGE**
36. **CHECK FOR EXHAUST GAS LEAKAGE**
37. **CHECK POWER STEERING FLUID LEAKAGE**
38. **INSPECT AND ADJUST FRONT WHEEL ALIGNMENT**
    (See page SP-7)
39. **INSTALL V-BANK COVER (See page ES-416)**
40. **INSPECT IGNITION TIMING (See page EM-1)**
41. **INSPECT ENGINE IDLING SPEED (See page EM-2)**
42. **INSPECT CO/HC (See page EM-3)**
43. **INSPECT COMPRESSION (See page EM-2)**



EFI RELAY

INSPECTION

1. INSPECT EFIRELAY

(a) Check the resistance.

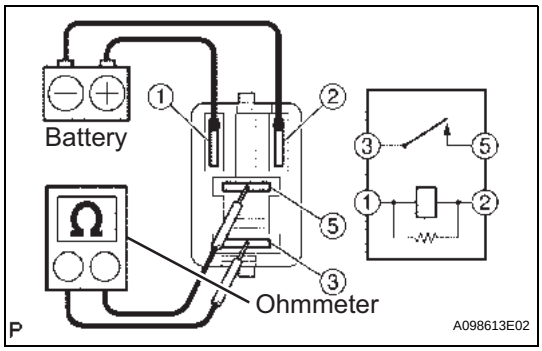
(1) Using an ohmmeter, measure the resistance between the terminals.

Standard

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

If the result is not as specified, replace the EFI relay.

ES



CIRCUIT OPENING RELAY

INSPECTION

1. INSPECT CIRCUIT OPENING RELAY ASSEMBLY

(a) Check the resistance.

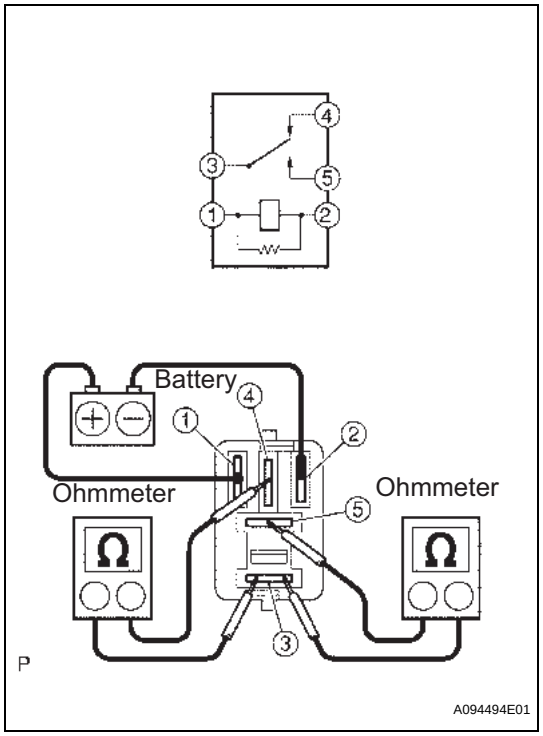
(1) Using an ohmmeter, measure the resistance between the terminals.

Standard

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

If the result is not as specified, replace the circuit opening relay.

ES



FUEL PUMP RELAY

INSPECTION

1. INSPECT FUEL PUMP RELAY ASSEMBLY

(a) Check the resistance.

(1) Using an ohmmeter, measure the resistance between the terminals.

Standard

Tester Connection	Specified Condition
3 - 4	Below 1 Ω
3 - 5	10 kΩ or higher
3 - 4	10 kΩ or higher (Apply battery voltage to terminals 1 and 2)
3 - 5	Below 1 Ω (Apply battery voltage to terminals 1 and 2)

If the result is not as specified, replace the fuel pump relay.

ES

ECM

REMOVAL

NOTICE:

- **Perform the RESET MEMORY (AT initialization) and when replacing the automatic transmission assembly, engine assembly or ECM (See page AT-17).**
- **Perform the REGISTRATION (VIN registration) when replacing the ECM (See page ES-14).**
- **If the ECM has replaced or RESET MEMORY (AT initialization) has been performed, set up the function of the ATF (Automatic Transmission Fluid) temperature warning lamp (See page AT-17).**

ES

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

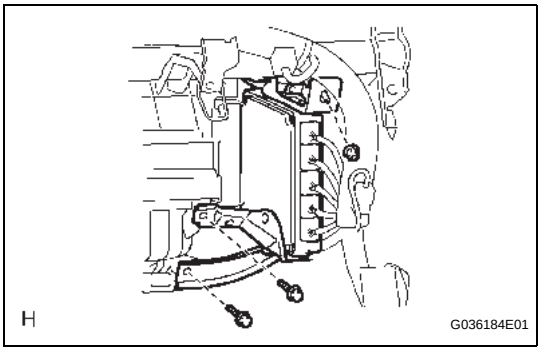
2. REMOVE GLOVE COMPARTMENT DOOR ASSEMBLY (See page IP-13)

3. REMOVE INSTRUMENT PANEL FINISH PANEL SUB-ASSEMBLY LOWER RH (See page IP-14)

4. REMOVE ECM

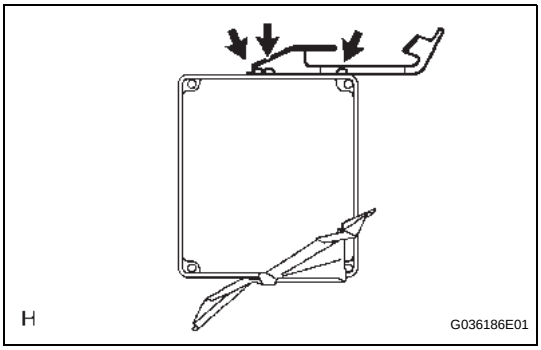
(a) Disconnect the 5 connectors.

(b) Remove the 2 bolts and nut, then remove the ECM.



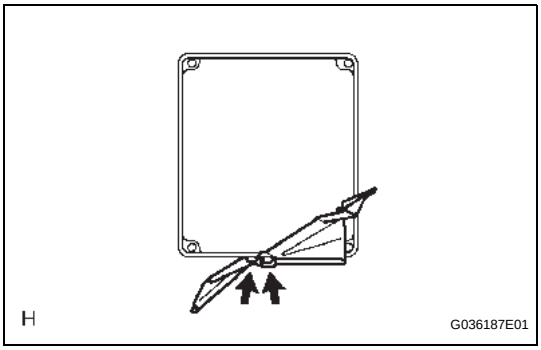
5. REMOVE ECM BRACKET

(a) Remove the 3 screws, then remove the ECM bracket.



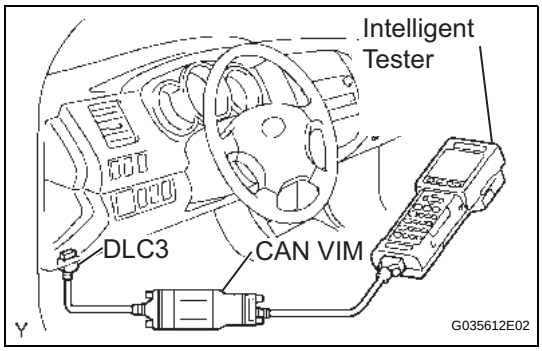
6. REMOVE ECM BRACKET NO.2

(a) Remove the 2 screws, then remove the ECM bracket No. 2.



INSTALLATION

1. **INSTALL ECM BRACKET NO.2**
   Torque: 3 N*m (32 kgf*cm, 28 in.*lbf)
2. **INSTALL ECM BRACKET**
   Torque: 3 N*m (32 kgf*cm, 28 in.*lbf)
3. **INSTALL ECM**
   Torque: 5 N*m (51 kgf*cm, 44 in.*lbf)
4. **INSTALL INSTRUMENT PANEL FINISH PANEL SUB-ASSEMBLY LOWER RH (See page IP-20)**
5. **INSTALL GLOVE COMPARTMENT DOOR ASSEMBLY (See page IP-20)**
6. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
   Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)



ACCELERATOR PEDAL

ON-VEHICLE INSPECTION

1. INSPECT ACCELERATOR PEDAL ROD

(a) Check the voltage.

(1) Turn the ignition switch to ON.

(2) Turn the intelligent tester ON.

(3) Start the engine and warm it up.

(4) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / ACCEL POS #1, ACCEL POS #2.

(5) Operate the accelerator pedal, then check that the ACCEL POS #1 and ACCEL POS #2 values are within the specifications.

Standard:

ACCELE POS #1

Accelerator Pedal Condition	Specified Condition
Released	0.5 to 1.1 V
Depressed	2.5 to 4.5 V

ACCELE 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 rod, wire harness and ECM.

ES

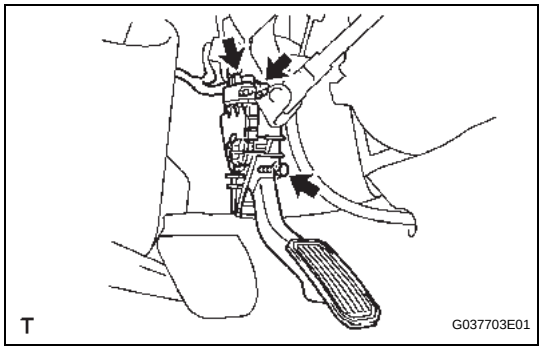
REMOVAL

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

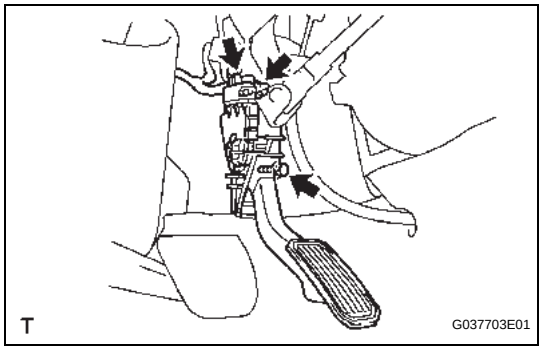
2. REMOVE ACCELERATOR PEDAL ROD ASSEMBLY

(a) Disconnect the accelerator position sensor connector.

(b) Remove the 2 bolts, then remove the accelerator pedal.



INSTALLATION



1. INSTALL ACCELERATOR PEDAL ROD ASSEMBLY

NOTICE:

- **Avoid any physical impact to the accelerator pedal assembly.**
- **Do not disassemble the accelerator pedal assembly.**

(a) Install the accelerator pedal with the 2 bolts.
Torque: 5 N*m (51 kgf*cm, 44 in.*lbf)

(b) Connect the accelerator position sensor connector.

2. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL
Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)

SFI SYSTEM

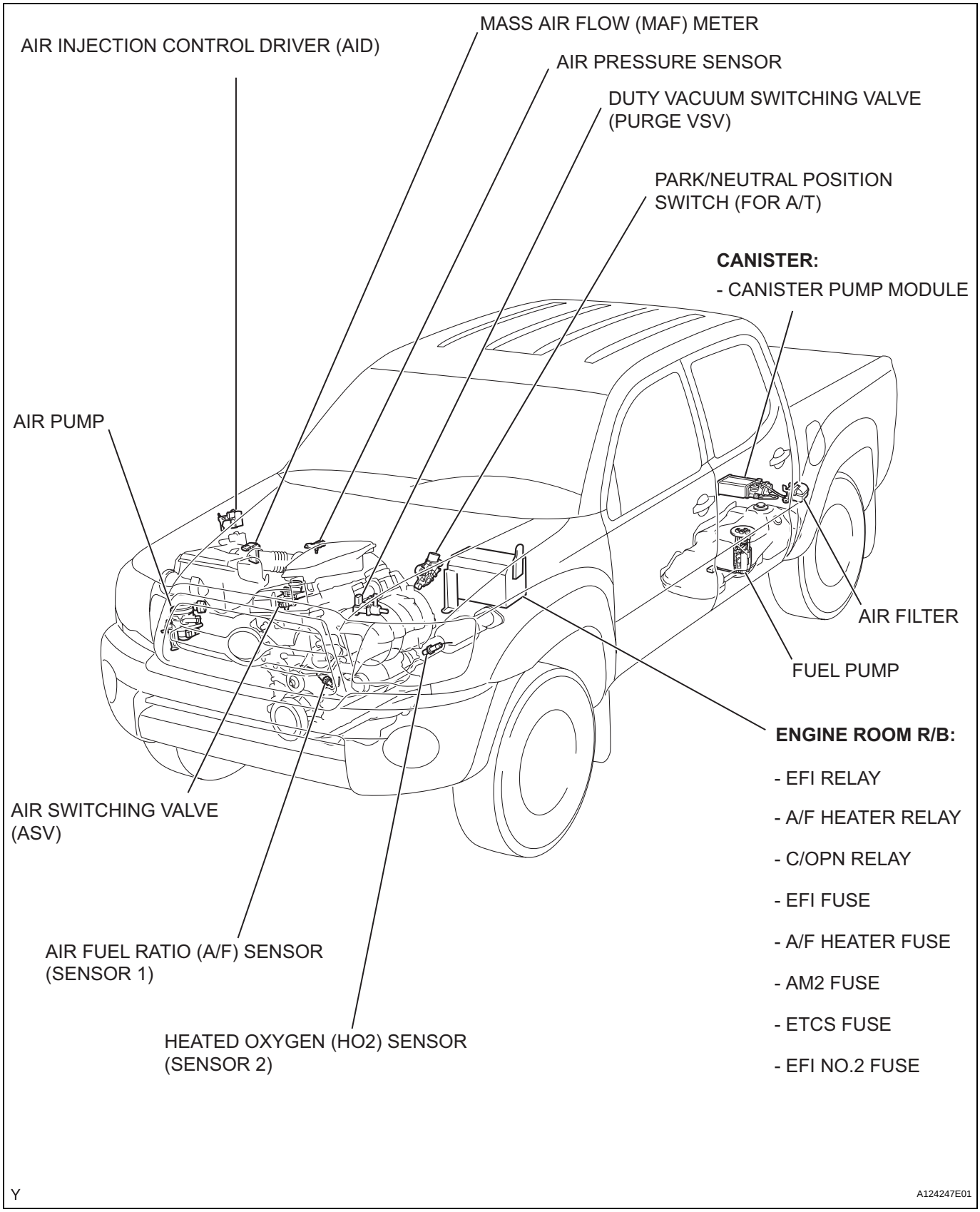
PRECAUTION

1. **INITIALIZATION**
   NOTICE:
   Perform the REGISTRATION (VIN registration) when replacing the ECM (see page ES-16).
2. **FOR USING INTELLIGENT TESTER**
   CAUTION:
   Observe the following items for safety reasons:
   - **Read its instruction books before using the tester.**
   - **Prevent the tester cable from being caught on the pedals, shift lever and steering wheel when driving with the tester connected to the vehicle.**
   - **When driving the vehicle for testing purposes using the tester, two persons are required. One is for driving the vehicle, and the other operates the tester.**

DEFINITION OF TERMS

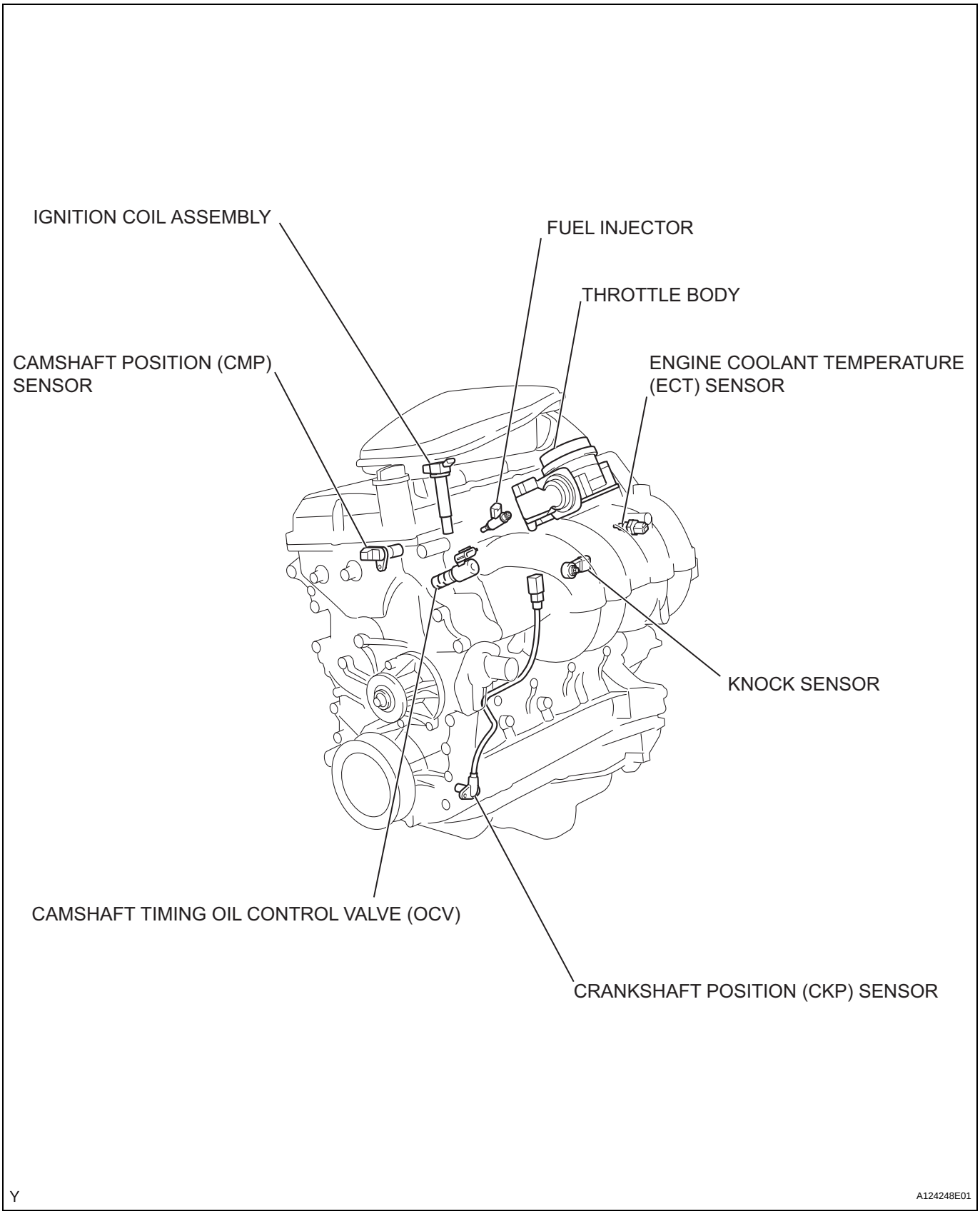
Terms	Definitions
Monitor Description	Description of what ECM monitors and how detects malfunctions (monitoring purpose and details)
Related DTCs	A group of diagnostic trouble codes that are output by ECM based on same malfunction detection logic.
Typical Enabling Conditions	Preconditions that allow 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 Sensors/Components	Sensors and components used by ECM to detect each malfunction.
Frequency of Operation	Number of times ECM checks for each malfunction during each driving cycle. "Once per driving cycle" means ECM only performs checks for that malfunction once during single driving cycle. "Continuous" means ECM performs checks for that malfunction whenever enabling conditions met.
Duration	Minimum time for which ECM must detect continuous deviation in monitored value(s) in order to set DTC. Timing begins when Typical Enabling Conditions are met.
Malfunction Thresholds	Value beyond which ECM determines malfunctions exist and sets DTCs.
MIL Operation	Timing of MIL illumination after defect detected. "Immediate" means ECM illuminates MIL as soon as malfunction detected. "2 driving cycles" means ECM illuminates MIL if same malfunction detected second time during next sequential driving cycle.

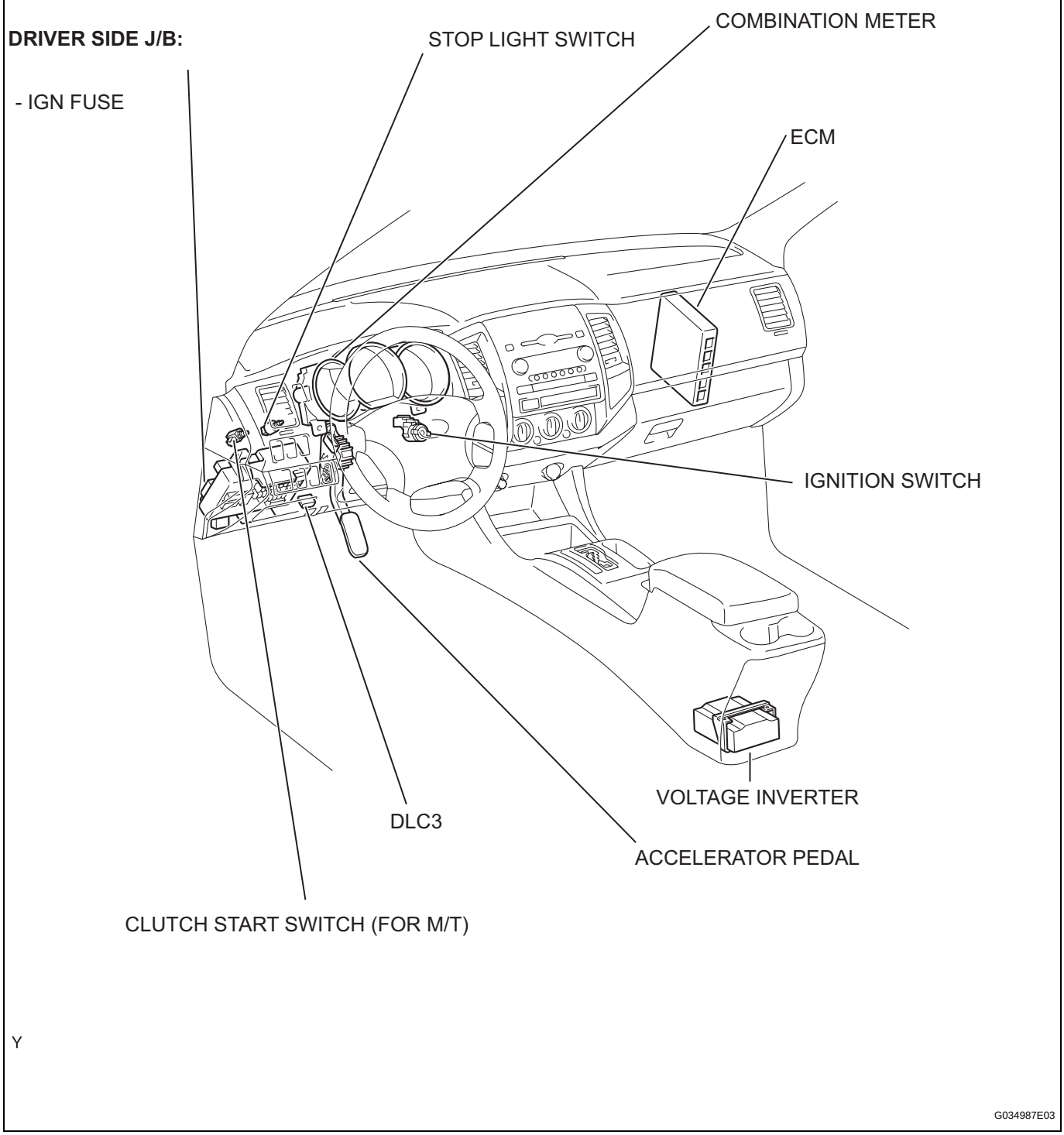
PARTS LOCATION



ES

ES

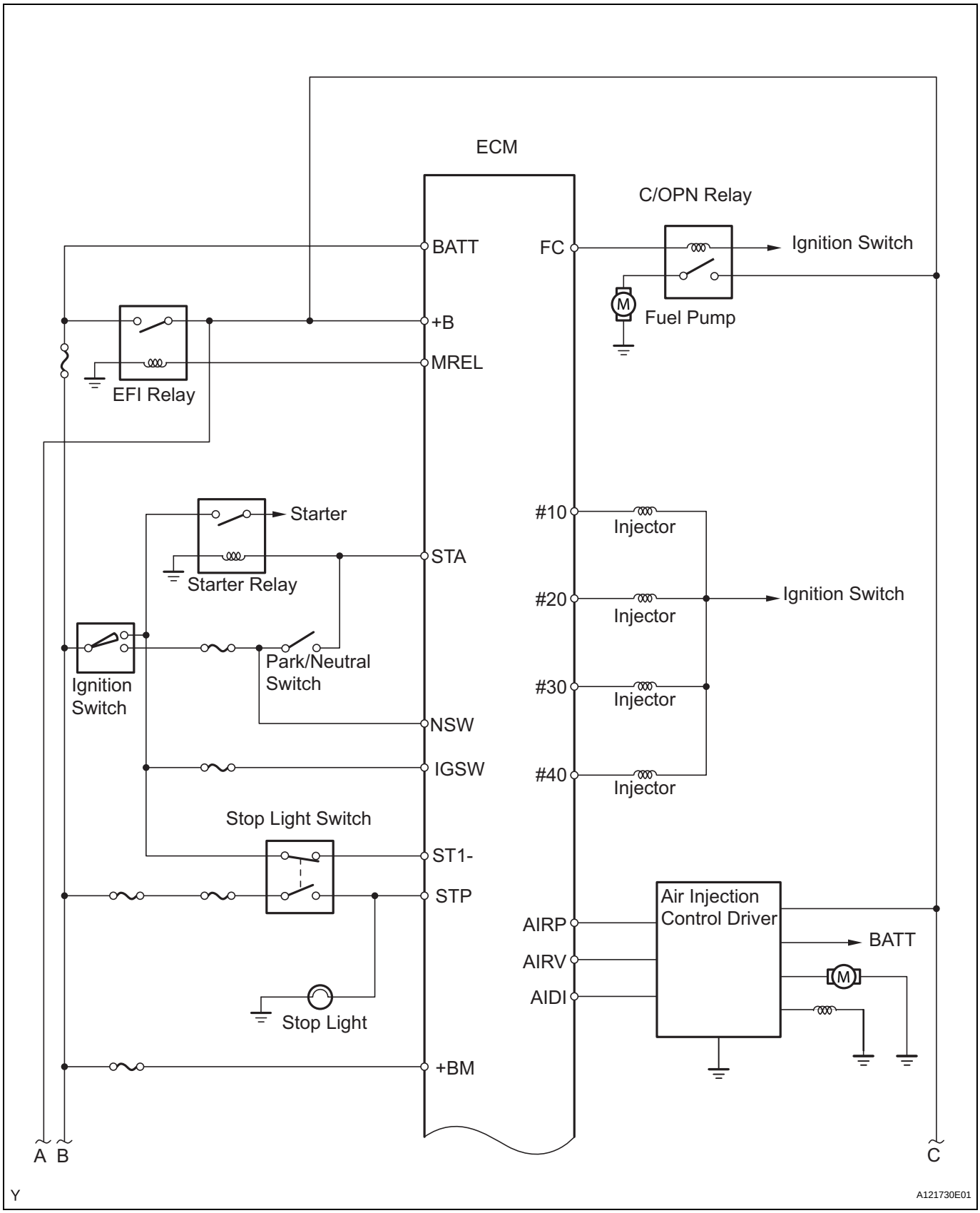

IGNITION COIL ASSEMBLY
FUEL INJECTOR
THROTTLE BODY
CAMSHAFT POSITION (CMP) SENSOR
ENGINE COOLANT TEMPERATURE (ECT) SENSOR
KNOCK SENSOR
CAMSHAFT TIMING OIL CONTROL VALVE (OCV)
CRANKSHAFT POSITION (CKP) SENSOR
Y
A124248E01

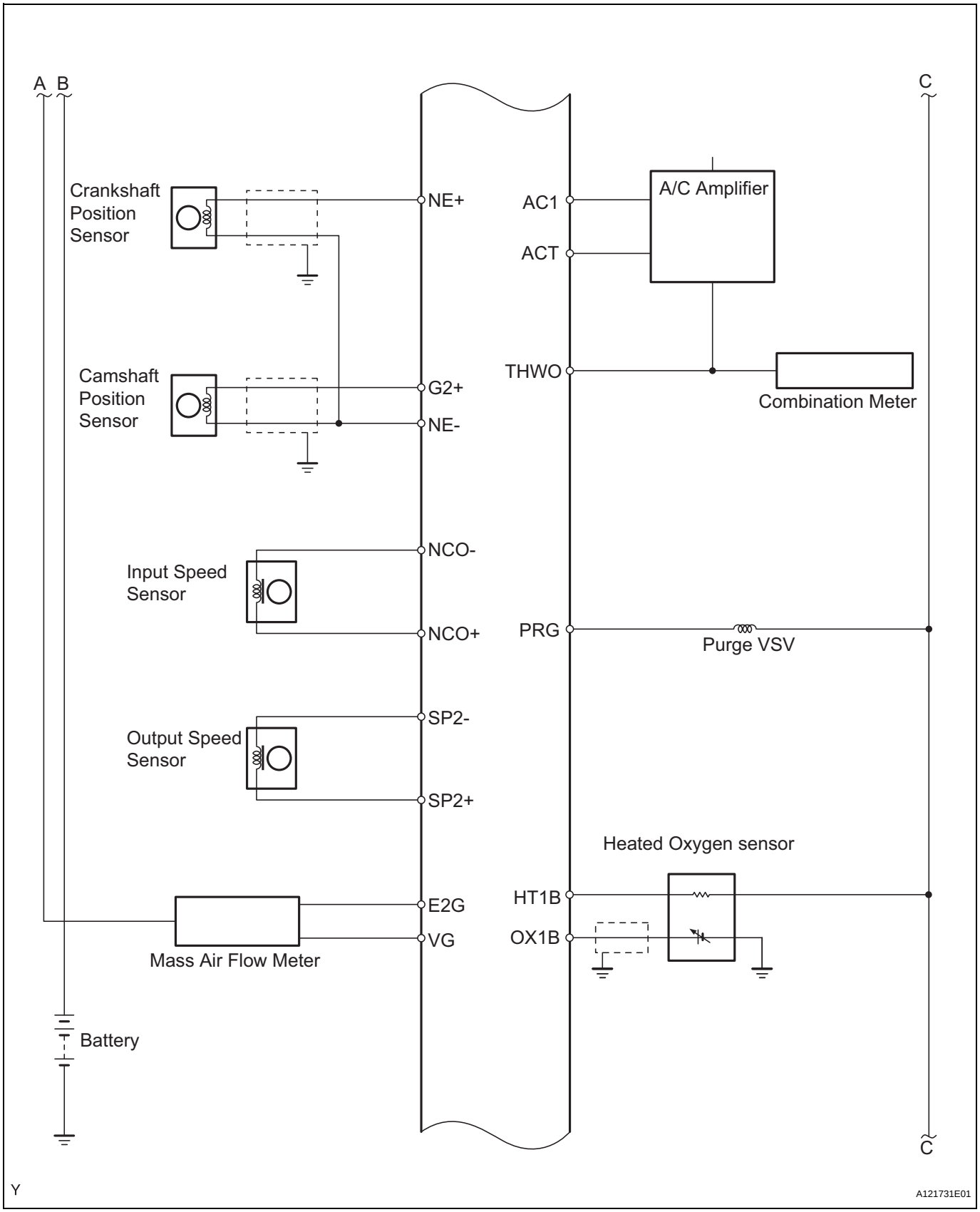

DRIVER SIDE J/B:
- IGN FUSE
STOP LIGHT SWITCH
COMBINATION METER
ECM
IGNITION SWITCH
VOLTAGE INVERTER
DLC3
ACCELERATOR PEDAL
CLUTCH START SWITCH (FOR M/T)
Y
G034987E03

ES

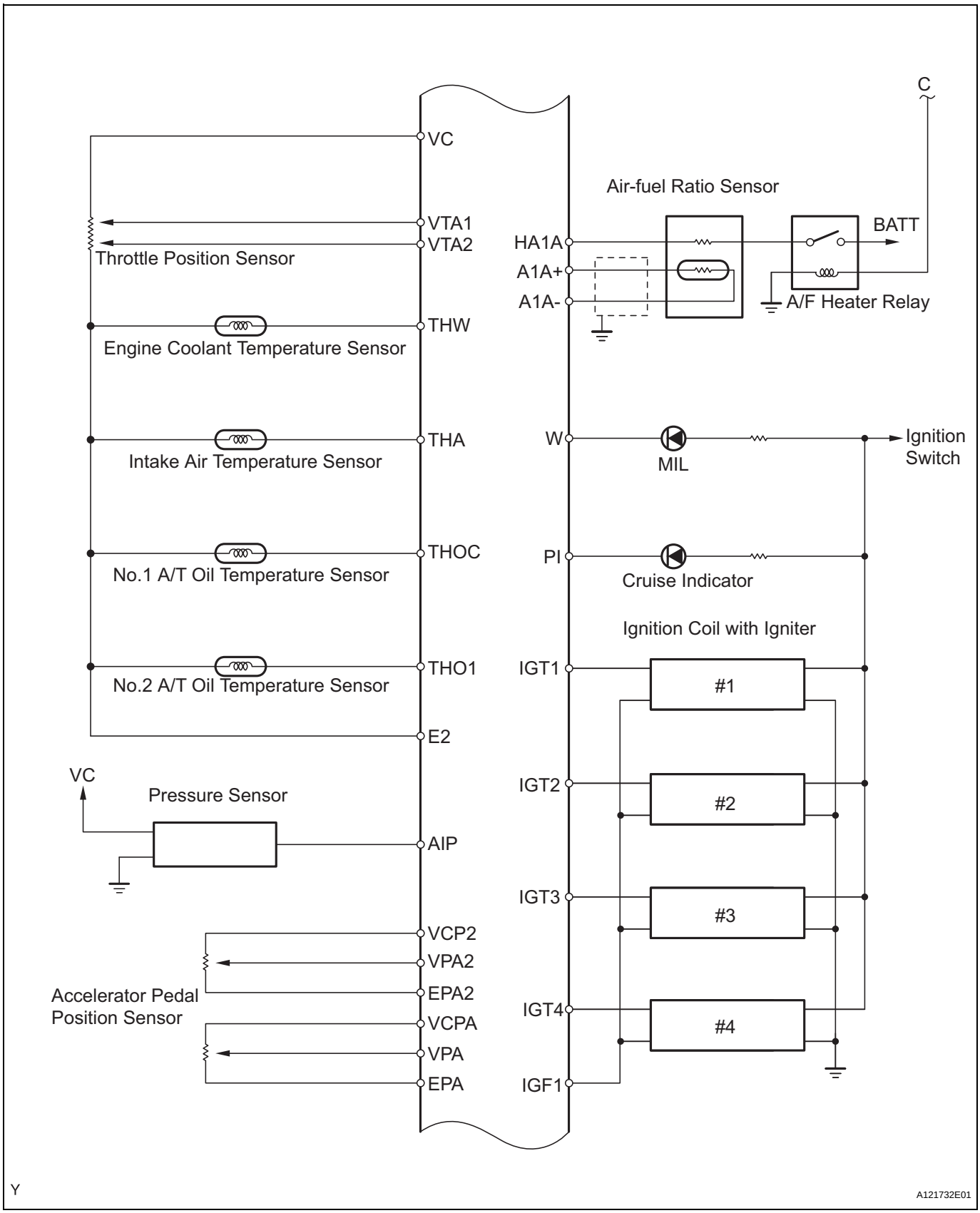
SYSTEM DIAGRAM

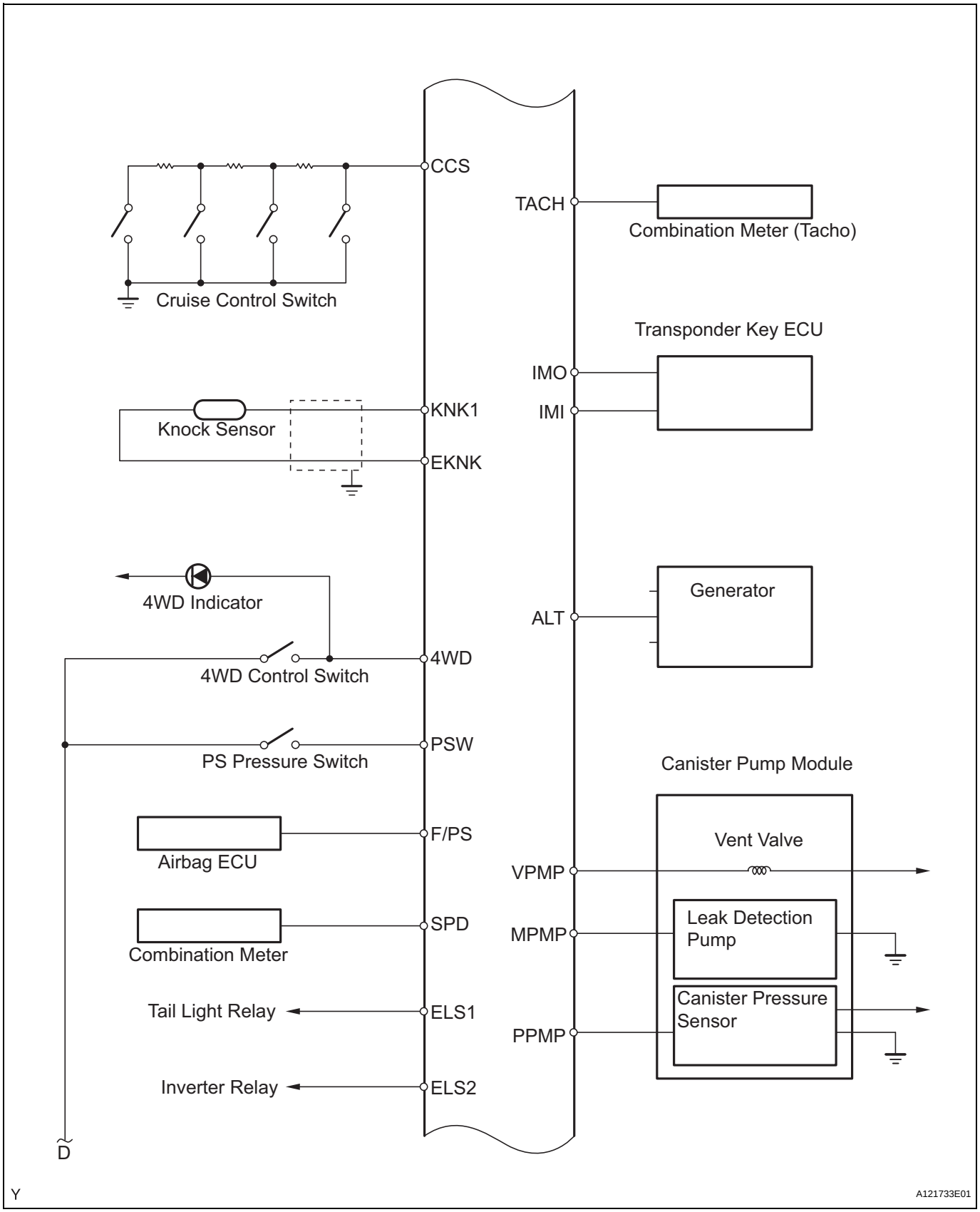
1. SYSTEM DIAGRAM



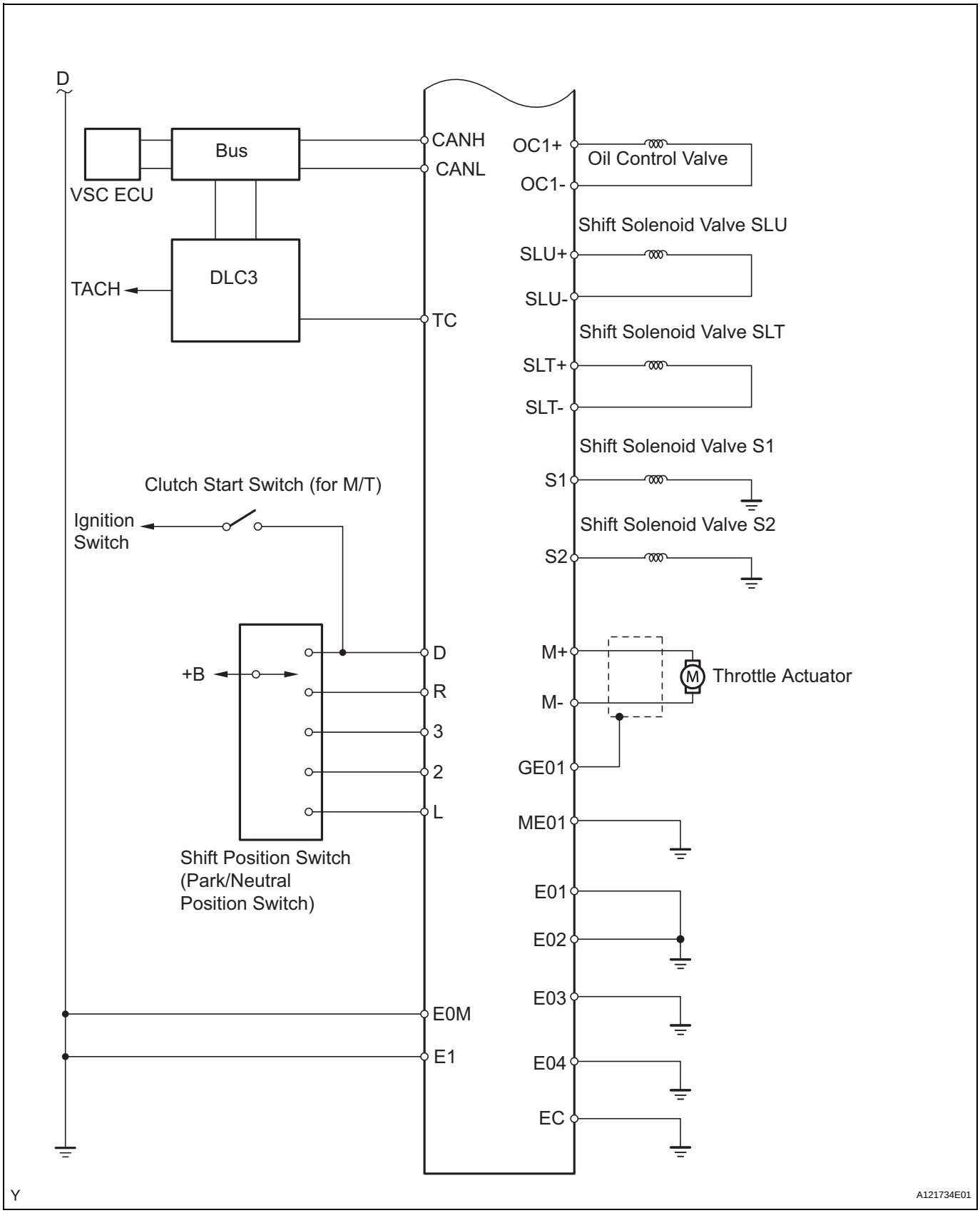

A B
C
Crankshaft Position Sensor
NE+
AC1
A/C Amplifier
ACT
Camshaft Position Sensor
G2+
NE-
THWO
Combination Meter
NCO-
Input Speed Sensor
NCO+
PRG
Purge VSV
SP2-
Output Speed Sensor
SP2+
Heated Oxygen sensor
HT1B
E2G
OX1B
VG
Mass Air Flow Meter
Battery
C
Y
A121731E01

ES

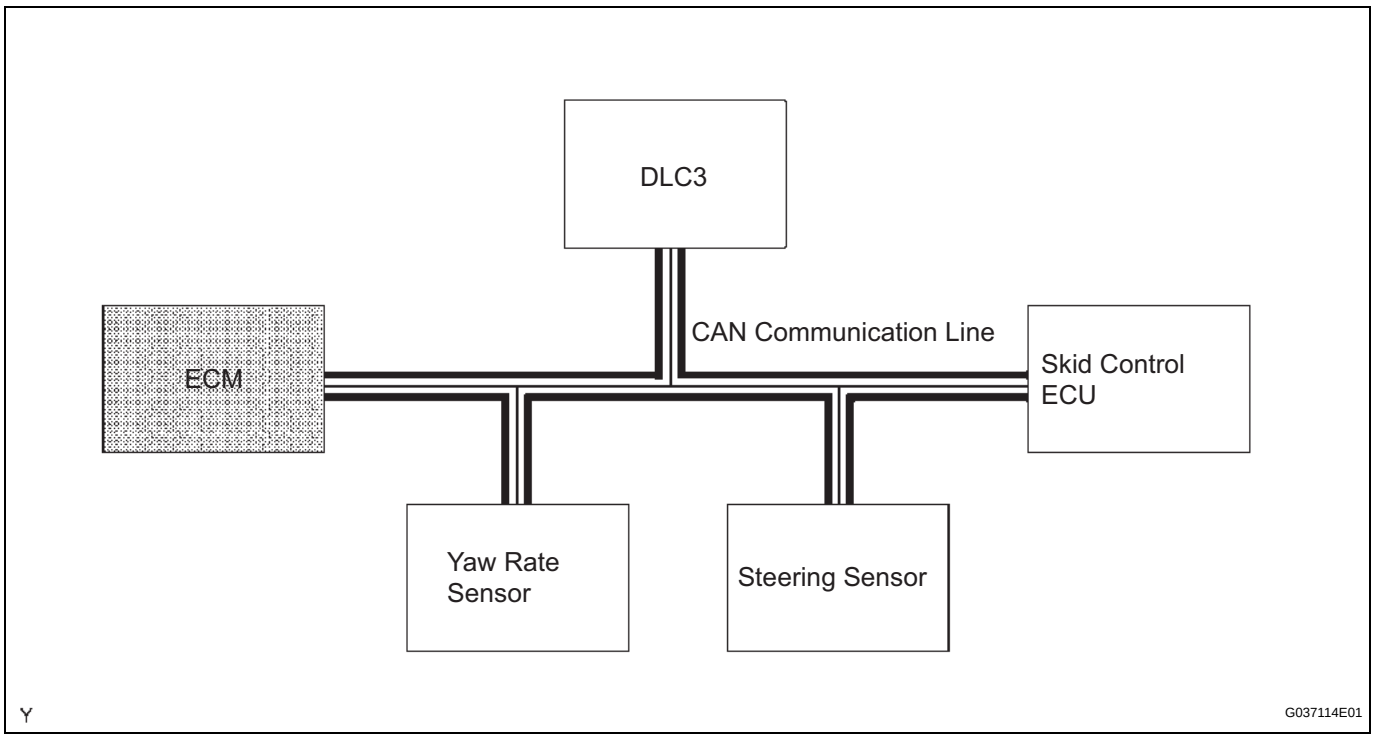

C
VC
Air-fuel Ratio Sensor
VTA1
VTA2
Throttle Position Sensor
HA1A
A1A+
A1A-
BATT
A/F Heater Relay
THW
Engine Coolant Temperature Sensor
THA
Intake Air Temperature Sensor
W
MIL
Ignition Switch
THOC
No.1 A/T Oil Temperature Sensor
PI
Cruise Indicator
Ignition Coil with Igniter
THO1
No.2 A/T Oil Temperature Sensor
IGT1
#1
E2
VC
Pressure Sensor
IGT2
#2
AIP
IGT3
#3
VCP2
VPA2
EPA2
Accelerator Pedal Position Sensor
IGT4
#4
VCPA
VPA
EPA
IGF1
Y
A121732E01


CCS
Cruise Control Switch
TACH
Combination Meter (Tacho)
Transponder Key ECU
IMO
IMI
KNK1
Knock Sensor
EKNK
4WD Indicator
Generator
ALT
4WD
4WD Control Switch
PSW
PS Pressure Switch
Canister Pump Module
Vent Valve
F/PS
Airbag ECU
VPMP
SPD
MPMP
Leak Detection Pump
Combination Meter
Canister Pressure Sensor
Tail Light Relay
ELS1
PPMP
Inverter Relay
ELS2
D
Y
A121733E01

ES


D
Bus
VSC ECU
DLC3
TACH
CANH
CANL
TC
OC1+
OC1-
Oil Control Valve
Shift Solenoid Valve SLU
SLU+
SLU-
Shift Solenoid Valve SLT
SLT+
SLT-
Shift Solenoid Valve S1
S1
Clutch Start Switch (for M/T)
Ignition Switch
Shift Solenoid Valve S2
S2
+B
D
R
3
2
L
M+
M-
Throttle Actuator
GE01
ME01
Shift Position Switch (Park/Neutral Position Switch)
E01
E02
E03
E0M
E1
E04
EC
Y
A121734E01

2. COMMUNICATION WITH OTHER COMPUTERS



HINT:
Refer to CAN COMMUNICATION SYSTEM (See page CA-4).

3. COMMUNICATION SIGNALS

Transmitter	Receiver	Signal	Communication Line
ECM	Skid Control ECU	• Intake air temperature signal • Check mode signal • Engine rpm signal • Throttle position signal • Cruise control operation signal • VSC prohibition requirement signal • Shift position signal • Destination signal • Engine system malfunction signal • Ignition timing signal	CAN
Skid Control ECU	ECM	• VSC/TRC operation signal • VSC/TRC system malfunction signal • Fuel cut requirement signal • Cruise control cancel requirement signal • Torque requirement signal	CAN

HINT:
Refer to CAN COMMUNICATION SYSTEM (See page CA-4).

HOW TO PROCEED WITH TROUBLESHOOTING

*: Use the intelligent tester.

1	VEHICLE BROUGHT TO WORKSHOP

NEXT

2	CUSTOMER PROBLEM ANALYSIS

NEXT

ES

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 (See page ES-40) and freeze frame data (See page ES-41), if necessary.

NEXT

5	CLEAR DTC AND FREEZE FRAME DATA*

HINT:
Refer to DTC Check / Clear (See page ES-40).

NEXT

6	CONDUCT VISUAL INSPECTION

NEXT

7	SET CHECK MODE DIAGNOSIS*

HINT:
Refer to Check Mode Procedure (See page ES-43).

NEXT

8	CONFIRM PROBLEM SYMPTOMS

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

Result	Proceed To
Malfunction does not occur	A
Malfunction occurs	B

B → GO TO STEP 10

A

9	SIMULATE SYMPTOMS

ES

NEXT

10	CHECK DTC*

HINT:
Refer to DTC Check / Clear (See page ES-40).

Result	Proceed To
Malfunction code	A
No code	B

B → GO TO STEP 12

A

11	REFER TO DTC CHART

HINT:
Refer to Diagnostic Trouble Code Chart (See page ES-54).

NEXT

GO TO STEP 14

12	CONDUCT BASIC INSPECTION

HINT:
Refer to Basic Inspection (See page ES-14).

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

B → GO TO STEP 17

A

13	REFER TO PROBLEM SYMPTOMS TABLE

HINT:
Refer to Problem Symptoms Table (See page ES-29).

Result	Proceed To
Malfunctioning circuit confirmed	A
Malfunctioning parts confirmed	B

B → GO TO STEP 17

A

14	CHECK ECM POWER SOURCE CIRCUIT

HINT:
Refer to ECM Power Source Circuit (See page ES-425).

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

HINT:
Refer to Check for Intermittent Problems (See page ES-14).

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 a 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 DTCs (see page ES-40).
2. Switch the ECM from normal mode to check mode using a intelligent tester (see page ES-43).
3. Perform a simulation test (see page IN-34).
4. Check and wiggle the harness(es), connector(s) and terminal(s) (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.

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 WILL CRANK

NG → **PROCEED TO PROBLEM SYMPTOMS TABLE**

OK

3 CHECK WHETHER ENGINE STARTS

NG → **GO TO STEP 6**

OK

4 CHECK AIR FILTER

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

NG → **REPLACE AIR FILTER**

OK

5 CHECK IDLING SPEED

HINT:
Refer to Engine Mechanical (See page EM-2).

NG → PROCEED TO PROBLEM SYMPTOMS TABLE

OK

6	CHECK FUEL PRESSURE

HINT:
Refer to Fuel System (See page FU-6).

NG → PROCEED TO FUEL SYSTEM AND CONTINUE TROUBLESHOOTING

OK

ES

7	CHECK FOR SPARK

HINT:
Refer to Ignition System (See page IG-3).

NG → PROCEED TO IGNITION SYSTEM AND CONTINUE TROUBLESHOOTING

OK

PROCEED TO PROBLEM SYMPTOMS TABLE

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. A intelligent tester is required to register the VIN.

1. DESCRIPTION

This registration section consists of three parts, Input Instructions, Read VIN and Write VIN.

(a) Input Instructions: Explains the general VIN input instructions using a intelligent tester.

(b) Read VIN: Explains the VIN reading process in a flowchart. This process allows the VIN stored in the ECM to be read, in order to confirm that the two VINs, provided with the vehicle and stored in the vehicle's ECM, are the same.

(c) Write VIN: Explains the VIN writing process in a flowchart. This process allows the VIN to be input into the ECM. If the ECM is changed, or the VIN and VIN do not match, the VIN can be registered, or overwritten in the ECM by following this procedure.

2. INPUT INSTRUCTIONS

(a) Intelligent tester
  (1) The arrow buttons (UP, DOWN, RIGHT and LEFT) and numerical buttons (0 to 9) are used, in order to input the VIN.

(b) Cursor Operation
  (1) To move the cursor around the tester screen, press the RIGHT and LEFT buttons.

(c) Alphabetical Character Input
  (1) Press the UP and DOWN buttons to select the desired alphabetical character.
  (2) After selection, the cursor should move.

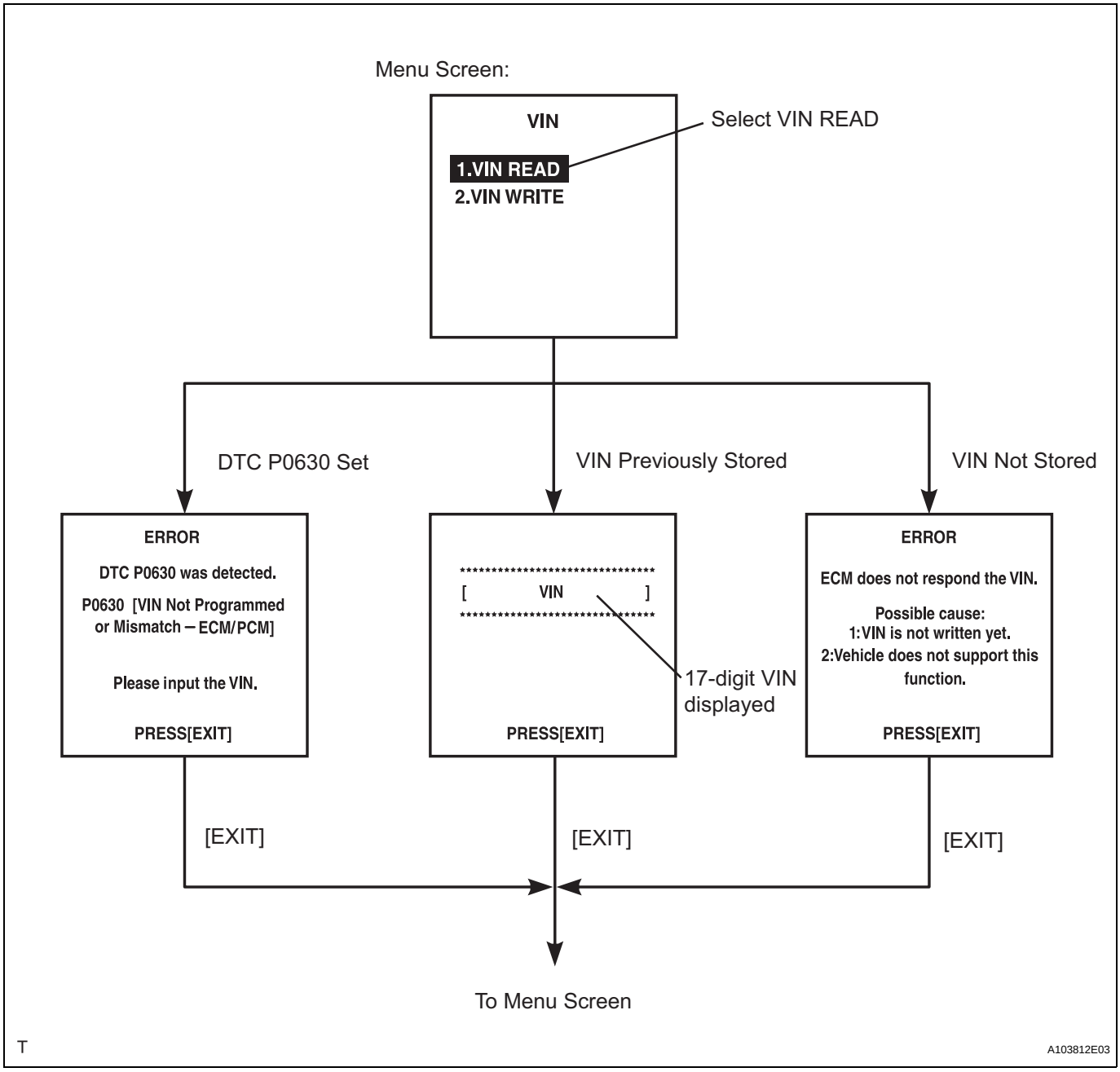
(d) Numeric Character Input
  (1) Press the numerical button corresponding to the number that you want to input.
  (2) After input, the cursor should move.
  HINT:
  Numerical characters can be selected by using the UP and DOWN buttons.

(e) Correction
  (1) When correcting the input character(s), put the cursor onto the character using the RIGHT or LEFT buttons.
  (2) Select or input the correct character using the UP/DOWN buttons, or the numerical buttons.

(f) Finishing Input Operation
  (1) Make sure that the input VIN matches the vehicle VIN after input.
  (2) Press the ENTER button on the tester.

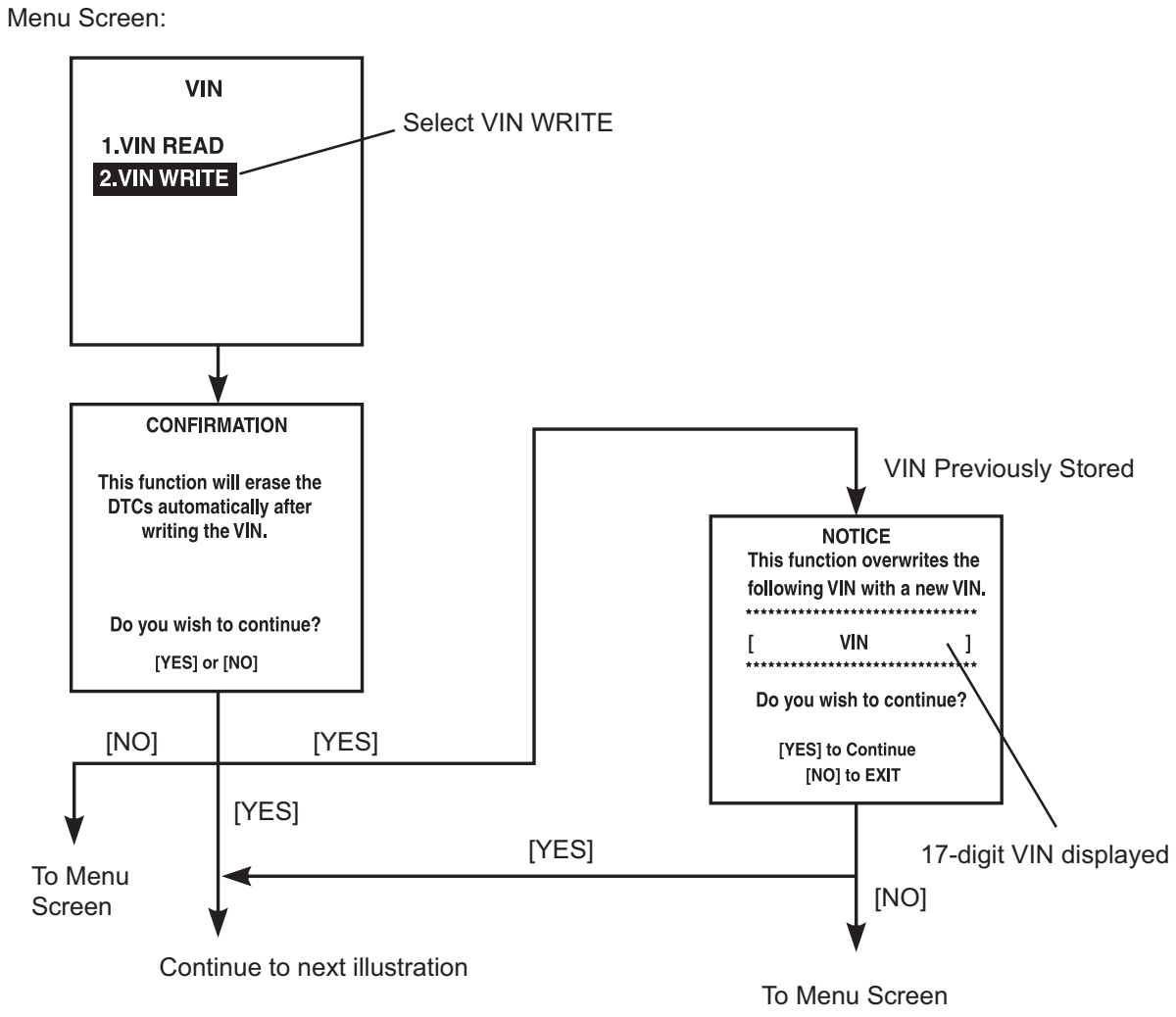
3. READ VIN

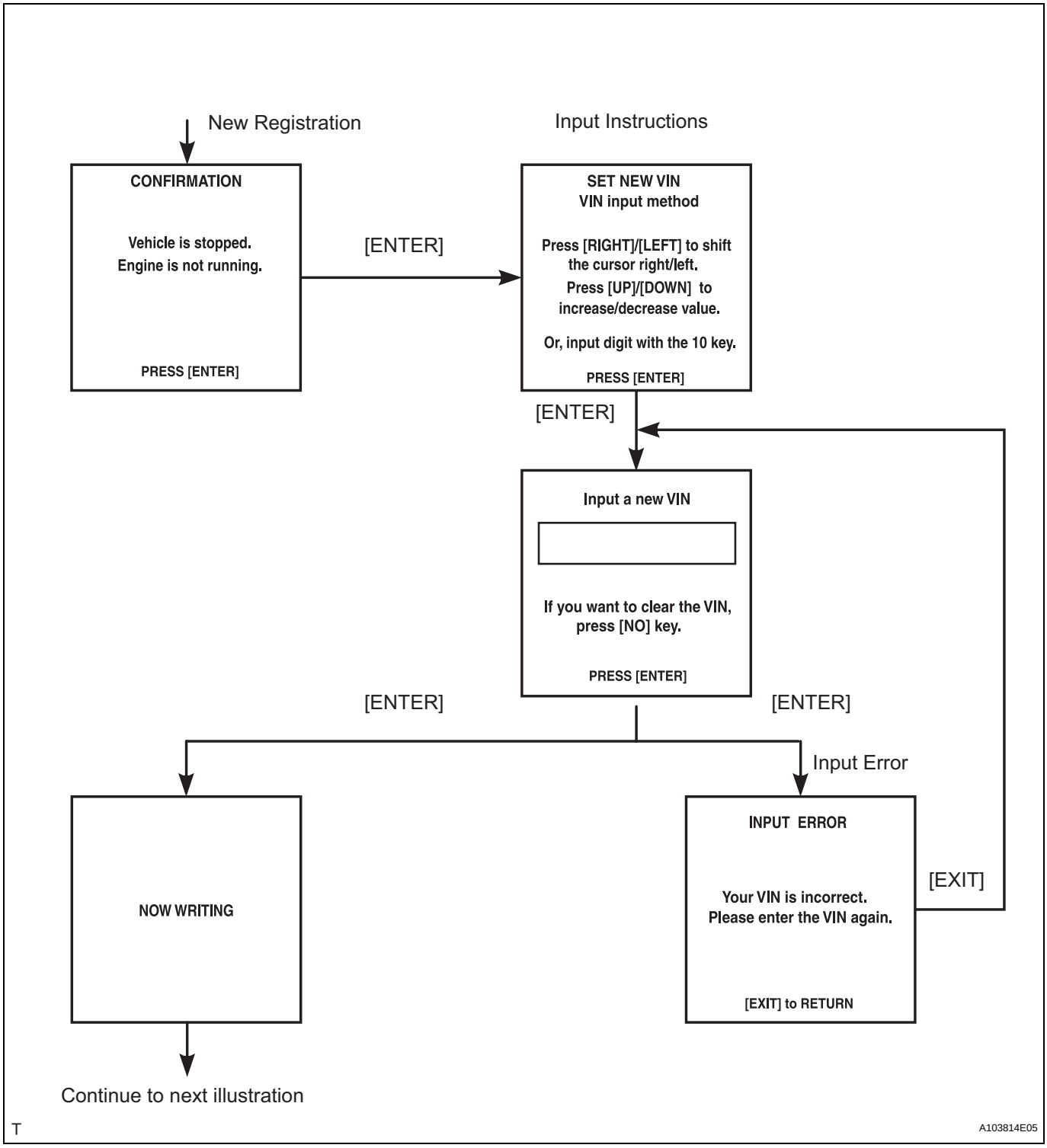
(a) Explains the VIN reading process in a flowchart. Reading the VIN stored in the ECM is necessary when comparing it to the VIN provided with the vehicle.
(b) Read VIN using the intelligent tester.
(c) Check the vehicle's VIN.
(d) Connect the intelligent tester to the DLC3.
(e) Turn the ignition switch to ON.
(f) Turn the tester ON.
(g) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / VIN.

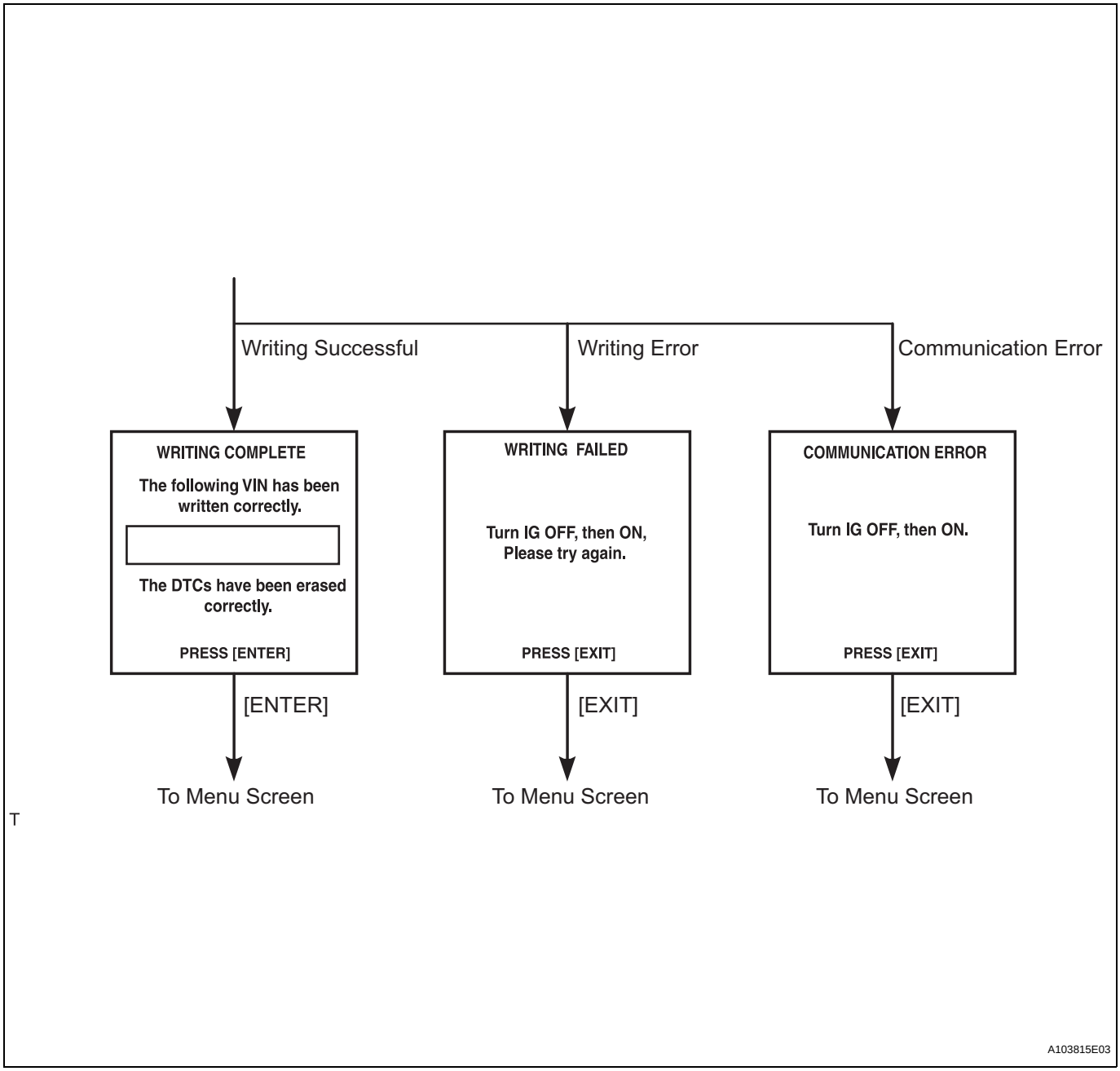


4. WRITE VIN

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




New Registration
Input Instructions
CONFIRMATION
Vehicle is stopped.
Engine is not running.
PRESS [ENTER]
[ENTER]
SET NEW VIN
VIN input method
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
A103814E05


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
A103815E03

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CHECKING MONITOR STATUS

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

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

When the test value is not between the minimum test limit and maximum test limit, the ECM (PCM) interprets this as a malfunction. When the component is not malfunctioning, if the difference of the test value and test limit is very small, the component will malfunction in the near future. Perform the following instructions to view the monitor status. Although these instructions refer 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 procedures.

1. PERFORM MONITOR DRIVE PATTERN

(a) Connect the intelligent tester to the DLC3.

(b) Turn the ignition switch and intelligent tester ON.

(c) Clear the DTCs (see page ES-40).

(d) Run the vehicle in accordance with the applicable drive pattern described in READINESS MONITOR DRIVE PATTERN (see page ES-25). 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 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) and maximum test limit (MAX).

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

4. MONITOR RESULT INFORMATION

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

A/F Sensor Bank 1

Monitor ID	Test ID	Scaling	Unit	Description
$01	$8E	Multiply by 0.001	V	Response rate deterioration level for bank 1 sensor 1
$01	$91	Multiply by 0.004	mA	A/F sensor current

HO2S Bank 1 Sensor 2

Monitor ID	Test ID	Scaling	Unit	Description
$02	$05	Multiply by 0.001	Seconds	Rich - Lean switch time
$02	$06	Multiply by 0.001	Seconds	Lean - Rich switch time
$02	$07	Multiply by 0.001	V	Minimum sensor voltage
$02	$08	Multiply by 0.001	V	Maximum sensor voltage
$02	$8A	Multiply by 1	Time	Frequency of sensor switching
$02	$8F	Multiply by 0.0003	Grams	Maximum oxygen storage capacity

Catalyst - Bank 1

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

EVAP

Monitor ID	Test ID	Scaling	Unit	Description
$3D	$C9	Multiply by 0.001	kPa	Test value for small leak (P0456)
$3D	$CA	Multiply by 0.001	kPa	Test value for gross leak (P0455)
$3D	$CB	Multiply by 0.001	kPa	Test value for leak detection pump 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)

Monitor ID	Test ID	Scaling	Unit	Description
$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)

Secondary Air Injection (AIR)

Monitor ID	Test ID	Scaling	Unit	Description
$71	$E1	Multiply by 0.01	Gram per second	Test value of AIR insufficient
$71	$E2	Multiply by 0.01	kPa	Test value of AIR pump stuck ON
$71	$E3	Multiply by 0.01	kPa	Test value of AIR pump stuck OFF
$71	$E4	Multiply by 0.01	kPa	Test value of AIR control valve ON
$71	$E5	Multiply by 0.01	kPa	Test value of AIR control valve OFF

Misfire

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

Monitor ID	Test ID	Scaling	Unit	Description
$A4	$0B	Multiply by 1	Time	EWMA misfire for cylinder 3: Misfire counts for last ten driving cycle - Total
$A4	$0C	Multiply by 1	Time	Misfire rate for cylinder 3: Misfire counts for last/ current driving cycles - Total
$A5	$0B	Multiply by 1	Time	EWMA misfire for cylinder 4: Misfire counts for last ten driving cycle - Total
$A5	$0C	Multiply by 1	Time	Misfire rate for cylinder 4: Misfire counts for last/ current driving cycles - Total

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 software must be version 9.0 or newer to view the Readiness Monitor status. To view the status, select the following menu items: 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 ll 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 emission 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.

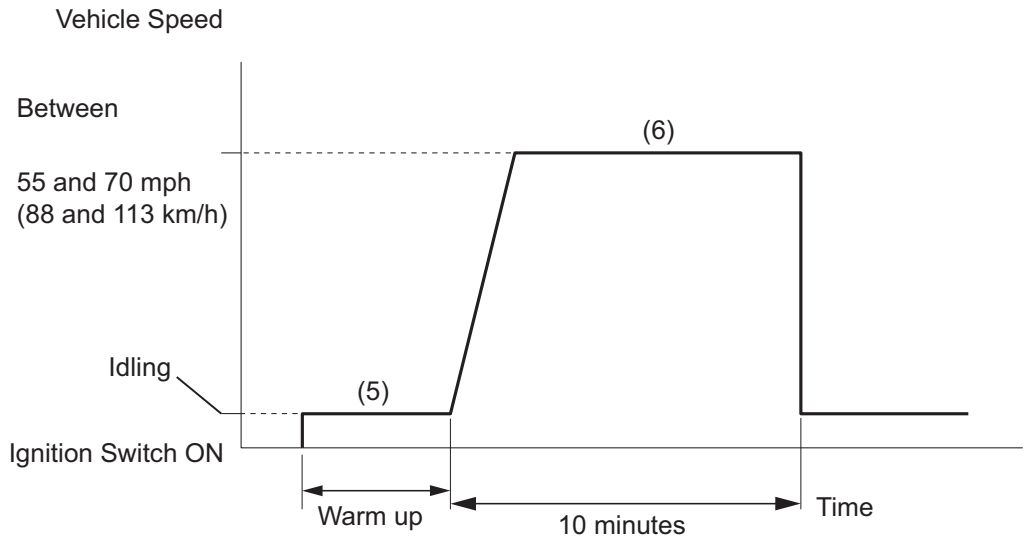
CAUTION:
Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.
NOTICE:
These drive patterns represent the fastest method of satisfying all conditions necessary to achieve complete status for each specific Readiness Monitor.
In the event of a drive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

Contents

Steps	Section Titles
2	Catalyst Monitor (Active Air-Fuel Ratio Control Type)

Steps	Section Titles
3	EVAP System Monitor (Key-Off Type)
4	Air-Fuel Ratio (A/F) and Heated Oxygen (HO2) Sensor Monitors (Active Air-Fuel Ratio Control Type)
5	Air-Fuel Ratio (A/F) and Heated Oxygen (HO2) Sensor Heater Monitors (Front A/F and Rear HO2 Sensor Type)

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



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

(b) Drive Pattern
(1) Connect a intelligent tester or OBD II scan tool to the DLC3.
(2) Turn the ignition switch to ON.
(3) Turn the tester or scan tool ON.
(4) Clear DTCs (where set) (see page ES-40).
(5) Start the engine and warm it up.
(6) Drive the vehicle at between 55 mph and 70 mph (88 km/h and 113 km/h) for at least 10 minutes.

(c) Monitor Status
(1) Check the Readiness Monitor status displayed on the tester or scan tool.
(2) If the status does not switch to COMPL (complete), extend the driving time.

3. EVAP SYSTEM MONITOR (KEY-OFF TYPE)

(a) Preconditions
The monitor will not run unless:
- The fuel tank is less than 90 % full.

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

(b) Monitor Conditions

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

HINT:

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

(c) Monitor Status

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

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 (ACTIVE AIR-FUEL RATIO CONTROL TYPE)

(a) Preconditions

The monitor will not run unless:

- 2 minutes or more have elapsed since the engine was started.
- The Engine Coolant Temperature (ECT) is 75°C (167°F) or more.
- Cumulative driving time at a vehicle speed of 30 mph (48 km/h) or more exceeds 6 minutes.
- Air-fuel ratio feedback control is performed.
- Fuel-cut control is performed for 8 seconds or more (for the Rear HO2 Sensor Monitor)

(b) Drive Pattern for front A/F sensor and HO2 sensor

(1) Connect a intelligent tester to the DLC3.
(2) Turn the ignition switch to ON.
(3) Turn the tester ON.
(4) Clear DTCs (see page ES-40).
(5) Start the engine, and warm it up until the ECT reaches 75°C (167°F) or higher.
(6) Drive the vehicle at between 38 mph (60 km/h) and 75 mph (120 km/h) for at least 10 minutes.
(7) Change the transmission to 2nd gear.
(8) Accelerate the vehicle to 40 mph (64 km/h) or more by depressing the accelerator pedal for at least 10 seconds.

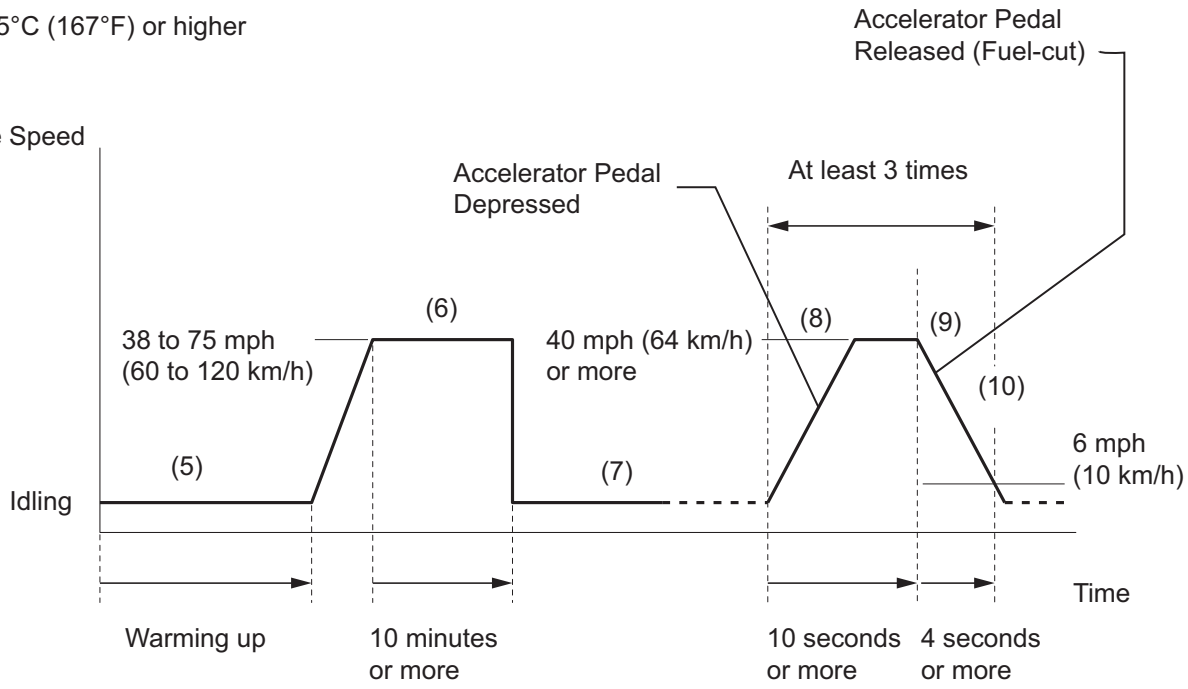
(9) Soon after performing step (8) above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal, in order to execute fuel-cut control.
(10) Allow the vehicle to decelerate until the vehicle speed declines to less than 6 mph (10 km/h).
(11) Repeat steps from (8) through (10) above at least 3 times in one driving cycle.

(c) Monitor Status
(1) Check the Readiness Monitor status displayed on the tester.
(2) If the status does not switch to COMPL (complete), make sure that the preconditions have been met, and then perform steps from (5) through (11) in Drive Pattern above.

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Monitor Drive Pattern

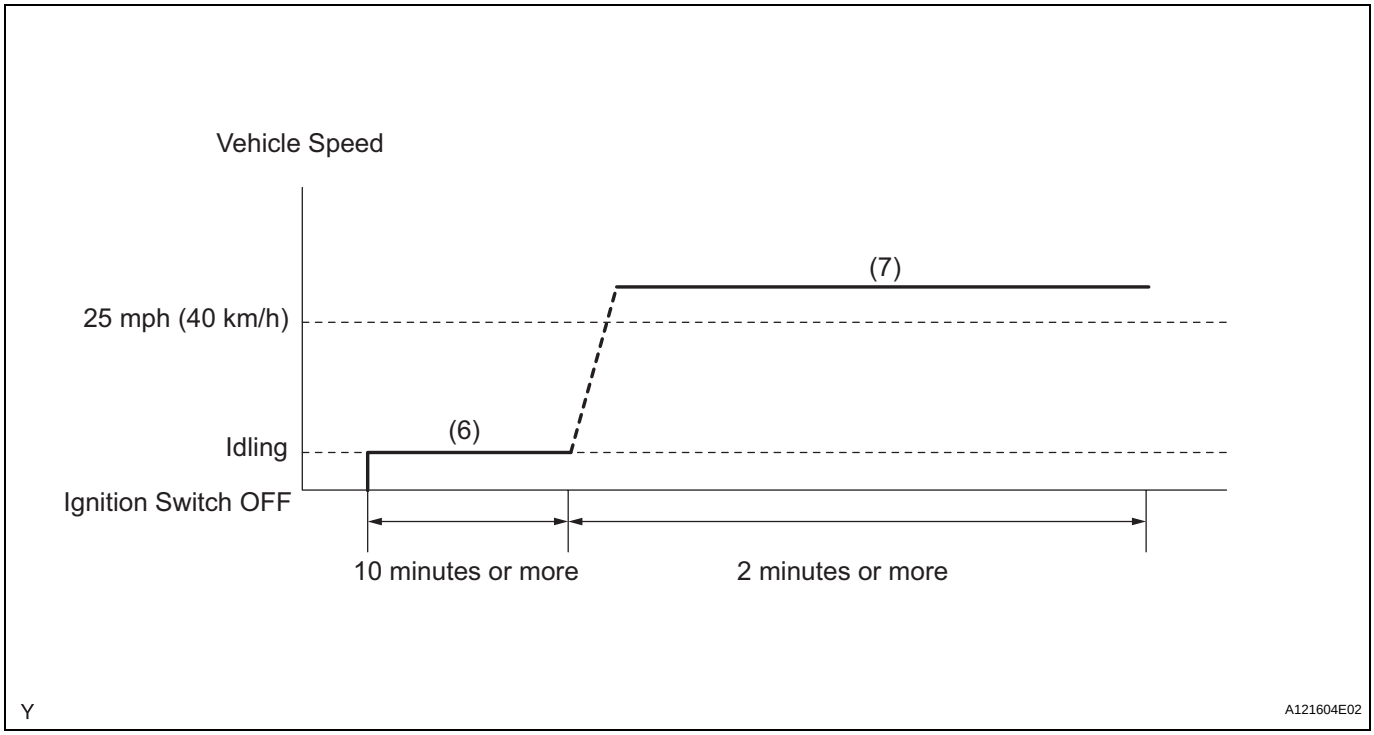
ETC: 75°C (167°F) or higher



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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
(1) Connect a intelligent tester or the OBD II scan tool to the DLC3.
(2) Turn the ignition switch to ON.
(3) Turn the tester or scan tool ON.
(4) Clear DTCs (where set) (see page ES-40).
(5) Start the engine.
(6) Allow the engine to idle for 10 minutes or more.
(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 or scan tool.

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

PROBLEM SYMPTOMS TABLE

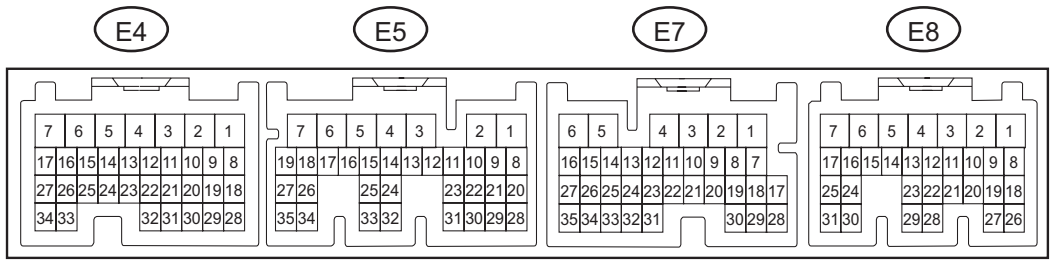
HINT:
Use the table below to help determine the cause of the problem symptom. The potential cases of the symptoms are listed in order of probability in the "Suspected Area" column of the table. Check each symptom by checking the suspected areas in the order they are listed. Replace parts as necessary.

Symptom	Suspected area	See page
Engine does not crank (Does not start)	1. Immobilizer system	EI-3
	2. Starter	ST-6
	3. STARTER relay	ST-12
No initial combustion (Does not start)	1. ECM power source circuit	ES-425
	2. Fuel pump control circuit	ES-433
	3. VC output circuit	ES-430
	4. ECM	ES-467
Engine cranks normally but difficult to start	1. Fuel pump control circuit	ES-433
	2. Compression	EM-3
Difficult to start with cold engine	1. Starter signal circuit	ES-262
	2. Fuel pump control circuit	ES-433
	3. Spark plug	IG-4
	4. Ignition system	IG-3
	5. Injector	FU-13
Difficult to start with warm engine	1. Starter signal circuit	ES-262
	2. Fuel pump control circuit	ES-433
	3. Spark plug	IG-4
	4. Ignition system	IG-3
	5. Injector	FU-13
High engine idling speed (Poor idling)	1. A/C signal circuit (compressor circuit)	AC-5
	2. ECM power source circuit	ES-425
	3. Electronic throttle control system	ES-452
	4. Air induction system	IT-3
	5. PCV hose	EC-23
Low engine idling speed (Poor idling)	1. A/C signal circuit (compressor circuit)	AC-5
	2. Fuel pump control circuit	ES-433
	3. Electronic throttle control system	ES-452
	4. Air induction system	IT-3
	5. PCV hose	EC-23
Rough idling (Poor idling)	1. Compression	EM-3
	2. Fuel pump control circuit	ES-433
	3. Electronic throttle control system	ES-452
	4. Air induction system	IT-3
	5. PCV hose	EC-23
	6. Mass air flow meter	ES-442

Symptom	Suspected area	See page
Hunting (Poor idling)	1. ECM power source circuit	ES-425
	2. Fuel pump control circuit	ES-433
	3. Spark plug	IG-4
	4. Ignition system	IG-3
	5. Injector	FU-13
	6. Electronic throttle control system	ES-452
	7. Air induction system	IT-3
	8. PCV hose	EC-23
Hesitation/Poor acceleration (Poor driveability)	1. Fuel pump control circuit	ES-433
	2. A/T faulty*	AT-8
	3. Spark plug	IG-4
	4. Ignition system	IG-3
	5. Injector	FU-13
	6. Mass air flow meter	ES-442
Surging (Poor driveability)	1. Fuel pump control circuit	ES-433
	2. Spark plug	IG-4
	3. Ignition system	IG-3
	4. Injector	FU-13
	5. Mass air flow meter	ES-442
Engine stalls soon after starting	1. Fuel pump control circuit	ES-433
	2. Spark plug	IG-4
	3. Ignition system	IG-3
	4. Injector	FU-13
Engine stalls during A/C operation	1. A/C signal circuit (Compressor circuit)	AC-5
	2. ECM	ES-467
Unable/difficult to refuel	1. Refueling valve (canister)	EC-20

*: Automatic Transmission models only

TERMINALS OF ECM



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

Symbols (Terminals No.)	Wiring Colors	Terminal Descriptions	Conditions	STD Voltages
BATT (E8-3) - E1 (E4-3)	L - BR	Battery (for measuring battery voltage and for ECM memory)	Always	9 to 14 V
+BM (E8-7) - E1 (E4-3)	LG - BR	Power source of throttle motor	Always	9 to 14 V
IGSW (E8-9) - E1 (E4-3)	O - BR	Ignition switch	Ignition switch ON	9 to 14 V
+B (E8-1) - E1 (E4-3)	B - BR	Power source of ECM	Ignition switch ON	9 to 14 V
MREL (E8-8) - E1 (E4-3)	G-W - BR	EFI relay	Ignition switch ON	9 to 14 V
VC (E4-18) - E2 (E4-28)	L - BR	Power source of sensor (specific voltage)	Ignition switch ON	4.5 to 5.0 V
VTA1 (E4-20) - E2 (E4-28)	G-B - BR	Throttle position sensor (for engine control)	Ignition switch ON, Accelerator pedal fully released	0.5 to 1.1 V
VTA1 (E4-20) - E2 (E4-28)	G-B - BR	Throttle position sensor (for engine control)	Ignition switch ON, Accelerator pedal fully depressed	3.3 to 4.9 V
VTA2 (E4-19) - E2 (E4-28)	G-W - BR	Throttle position sensor (for sensor malfunction detection)	Ignition switch ON, Accelerator pedal fully released	2.1 to 3.1 V
VTA2 (E4-19) - E2 (E4-28)	G-W - BR	Throttle position sensor (for sensor malfunction detection)	Ignition switch ON, Accelerator pedal fully depressed	4.5 to 5.0 V
VPA (E8-18) - EPA (E8-20)	R-Y - LG-B	Accelerator pedal position sensor (for engine control)	Ignition switch ON, Accelerator pedal fully released	0.5 to 1.1 V
VPA (E8-18) - EPA (E8-20)	R-Y - LG-B	Accelerator pedal position sensor (for engine control)	Ignition switch ON, Accelerator pedal fully depressed	2.6 to 4.5 V
VPA2 (E8-19) - EPA2 (E8-21)	GR-B - R-B	Accelerator pedal position sensor (for sensor malfunction detection)	Ignition switch ON, Accelerator pedal fully released	1.2 to 2.0 V
VPA2 (E8-19) - EPA2 (E8-21)	GR-B - R-B	Accelerator pedal position sensor (for sensor malfunction detection)	Ignition switch ON, Accelerator pedal fully depressed	3.4 to 5.0 V
VCPA (E8-26) - EPA (E8-20)	R - LG-B	Power source of accelerator pedal position sensor (for VPA)	Ignition switch ON	4.5 to 5.0 V
VCP2 (E8-27) - EPA2 (E8-21)	L-W - R-B	Power source of accelerator pedal position sensor (for VPA2)	Ignition switch ON	4.5 to 5.0 V

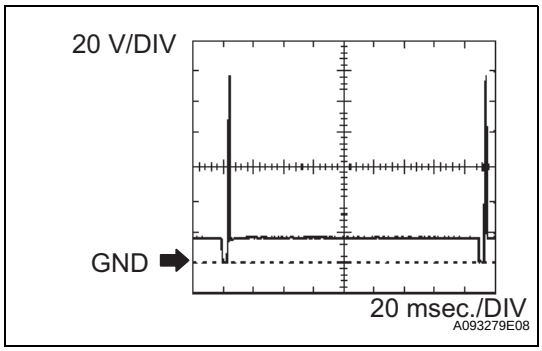
Symbols (Terminals No.)	Wiring Colors	Terminal Descriptions	Conditions	STD Voltages
VG (E5-28) - E2G (E5-30)	R-Y - R-W	Mass air flow meter	Idling, Shift position P or N, A/C switch OFF	0.5 to 3.0 V
THA (E5-29) - E2 (E4-28)	R-L - BR	Intake air temperature sensor	Idling, Intake air temperature 20°C (68°F)	0.5 to 3.4 V
THW (E4-32) - E2 (E4-28)	Y-B - BR	Engine coolant temperature sensor	Idling, Engine coolant temperature 80°C (176°F)	0.2 to 1.0 V
#10 (E5-6) - E01 (E4-7) #20 (E5-5) - E01 (E4-7) #30 (E5-2) - E01 (E4-7) #40 (E5-1) - E01 (E4-7)	R-L - W-B B - W-B R - W-B G - W-B	Injector	Ignition switch ON	9 to 14 V
#10 (E5-6) - E01 (E4-7) #20 (E5-5) - E01 (E4-7) #30 (E5-2) - E01 (E4-7) #40 (E5-1) - E01 (E4-7)	R-L - W-B B - W-B R - W-B G - W-B	Injector	Idling	Pulse generation (see waveform 1)
IGT1 (E4-17) - E1 (E4-3) IGT2 (E4-16) - E1 (E4-3) IGT3 (E4-15) - E1 (E4-3) IGT4 (E4-14) - E1 (E4-3)	P - BR P-L - BR LG - BR LG-B - BR	Ignition coil with igniter (ignition signal)	Idling	Pulse generation (see waveform 2)
IGF1 (E4-23) - E1 (E4-3)	W-R - BR	Ignition coil with igniter (ignition confirmation signal)	Ignition switch ON	4.5 to 5.0 V
IGF1 (E4-23) - E1 (E4-3)	W-R - BR	Ignition coil with igniter (ignition confirmation signal)	Idling	Pulse generation (see waveform 2)
G2 (E4-26) - NE- (E4-34)	L - G	Camshaft position sensor	Idling	Pulse generation (see waveform 3)
NE+ (E4-27) - NE- (E4-34)	R - G	Crankshaft position sensor	Idling	Pulse generation (see waveform 3)
FC (E8-25) - E1 (E4-3)	L-B - BR	Fuel pump control	Ignition switch ON	9 to 14 V
FC (E8-25) - E1 (E4-3)	L-B - BR	Fuel pump control	Idling	Below 1.5 V
M+ (E4-5) - ME01 (E5-3)	P - W-B	Throttle actuator	Idling with warm engine	Pulse generation (see waveform 4)
M- (E4-4) - ME01 (E5-3)	L - W-B	Throttle actuator	Idling with warm engine	Pulse generation (see waveform 5)
A1A+ (E4-21) - E1 (E4-3)	P - BR	A/F sensor	Always (Ignition switch ON)	3.3 V*1
A1A- (E4-31) - E1 (E4-3)	L - BR	A/F sensor	Always (Ignition switch ON)	3.0 V*1
OX1B (E4-25) - E2 (E4-28)	W - BR	Heated oxygen sensor	Engine speed maintained 2,500 rpm for 2 minutes after warming up sensor	Pulse generation (see waveform 6)
HA1A (E4-1) - E04 (E5-7)	R - W-B	A/F sensor heater	Idling	Below 3.0 V
HA1A (E4-1) - E04 (E5-7)	R - W-B	A/F sensor heater	Ignition switch ON	9 to 14 V
HT1B (E4-2) - E03 (E5-4)	G - W-B	Heated oxygen sensor heater	Idling	Below 3.0 V
HT1B (E4-2) - E03 (E5-4)	G - W-B	Heated oxygen sensor heater	Ignition switch ON	9 to 14 V
KNK1 (E4-29) - EKNK (E4-30)	B - W	Knock sensor	Maintain engine speed 4,000 rpm after warming up engine	Pulse generation (see waveform 7)
OC1+ (E4-13) - OC1- (E4-12)	L-W - W	Camshaft timing oil control valve (OCV)	Idling	Pulse generation (see waveform 8)
PRG (E5-23) - E01 (E4-7)	Y - W-B	Purge VSV	Ignition switch ON	9 to 14 V
PRG (E5-23) - E01 (E4-7)	Y - W-B	Purge VSV	Idling	Pulse generation (see waveform 9)
VPMP (E8-5) - E1 (E4-3)	V-W - BR	Vent valve (built into canister pump module)	Ignition switch ON	9 to 14 V

Symbols (Terminals No.)	Wiring Colors	Terminal Descriptions	Conditions	STD Voltages
MPMP (E8-6) - E1 (E4-3)	G - BR	Leak detection pump (built into canister pump module)	• Leak detection pump OFF	0 to 3 V
MPMP (E8-6) - E1 (E4-3)	G - BR	Leak detection pump (built into canister pump module)	• Leak detection pump ON	9 to 14 V
PPMP (E8-31) - E2 (E4-28)	GR - BR	Canister pressure sensor (built into canister pump module)	Ignition switch ON	3 to 3.6 V
STA (E8-12) - E1 (E4-3)	B-Y - BR	Starter signal	Shift position N, Ignition switch START	5.5 V or more
STP (E7-4) - E1 (E4-3)	L - BR	Stop light switch	Brake pedal depressed	7.5 to 14 V
STP (E7-4) - E1 (E4-3)	L - BR	Stop light switch	Brake pedal released	Below 1.5 V
ST1- (E8-16) - E1 (E4-3)	V-W - BR	Stop light switch	Ignition switch ON, Brake pedal depressed	Below 1.5 V
ST1- (E8-16) - E1 (E4-3)	V-W - BR	Stop light switch	Ignition switch ON, Brake pedal released	7.5 to 14 V
W (E7-30) - E01 (E4-7)	BR - W-B	MIL	Idling	9 to 14 V
W (E7-30) - E01 (E4-7)	BR - W-B	MIL	Ignition switch ON	Below 3.5 V
ELS (E8-15) - E1 (E4-3)	G - BR	Electric load	Tail light switch ON	7.5 to 14 V
ELS (E8-15) - E1 (E4-3)	G - BR	Electric load	Tail light switch OFF	0 to 1.5 V
ELS2 (E7-20) - E1 (E4-3)	B-W - BR	Electric load	Vehicle stationary, Voltage inverter outputs more than 100 W	9 to 14 V
ELS2 (E7-20) - E1 (E4-3)	B-W - BR	Electric load	Vehicle stationary, Voltage inverter outputs 100 W or less	0 to 1.5 V
TACH (E7-1) - E1 (E4-3)	B-W - BR	Engine speed	Idling	Pulse generation (see waveform 10)
SPD (E7-8) - E1 (E4-3)	V-W - BR	Speed signal from combination meter	Driving at 12 mph (20 km/h)	Pulse generation (see waveform 11)
TC (E7-17) - E1 (E4-3)	P-B - BR	Terminal TC of DLC 3	Ignition switch ON	9 to 14 V
PSW (E5-32) - E1 (E4-3)	G-W - BR	Power steering oil pressure switch	While turning steering wheel	Below 1.5 V
F/PS (E7-32) - E1 (E4-3)	R - BR	Airbag sensor assembly	Idling with warm engine	Pulse generation (see waveform 12)
NSW (E8-30) - E1 (E4-3)	V - BR	Park/Neutral switch signal	IG switch ON and shift lever P or N position	Below 1 V
NSW (E8-30) - E1 (E4-3)	V - BR	Park/Neutral switch signal	IG switch ON and shift lever except P and N	9 to 14 V
*2 CANH (E7-33) - E1 (E4-3)	B - BR	Communication signal with other components	Ignition switch ON	Pulse generation (see waveform 13)
*2 CANL (E7-34) - E1 (E4-3)	W - BR	Communication signal with other components	Ignition switch ON	Pulse generation (see waveform 14)
AIRV (E4-24) - E1 (E4-3)	R-W - BR	Air switching valve for secondary air injection system	Idling	9 to 14 V
AIRP (E4-11) - E1 (E4-3)	Y-R - BR	Air pump control	Idling	9 to 14 V
AIDI (E5-20) - E1 (E4-3)	G-R - BR	Diagnostic information signal for air injection system	Air injection system operates	Pulse generation (see waveform 15)
AIP (E5-22) - E2 (E4-28)	GR - BR	Secondary air injection system pressure signal	Ignition switch ON	4.5 to 5.0 V

*1: The ECM terminal voltage is constant regardless of the output voltage from the sensor.

*2: Only for the vehicle equipped with VSC (see page CA-22).

ES

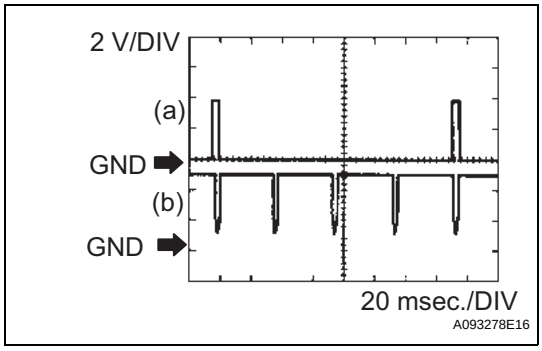


1. WAVEFORM 1

Fuel injector

ECM Terminal Names	Between #10 (to 40) and E01
Tester Ranges	20 V/DIV, 20 msec./DIV
Conditions	Idling

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

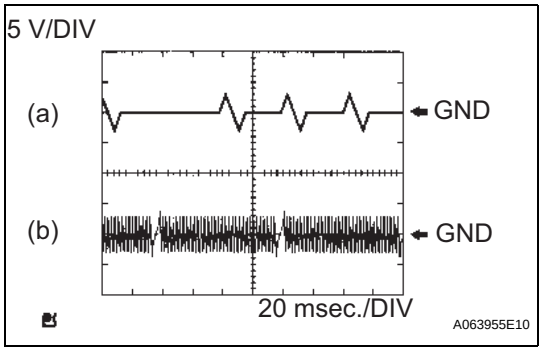


2. WAVEFORM 2

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

ECM Terminal Names	(a) Between IGT (1 to 4) and E1 (b) Between IGF1 and E1
Tester Ranges	2 V/DIV, 20 msec./DIV
Conditions	Idling

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

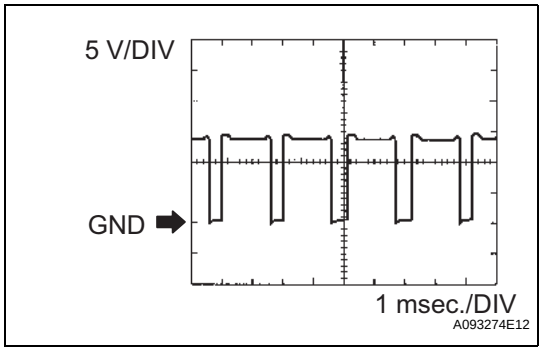


3. WAVEFORM 3

(a) Camshaft position sensor
(b) Crankshaft position sensor

ECM Terminal Names	(a) Between G2+ and NE- (b) Between NE+ and NE-
Tester Ranges	5 V/DIV, 20 msec./DIV
Conditions	Idling

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

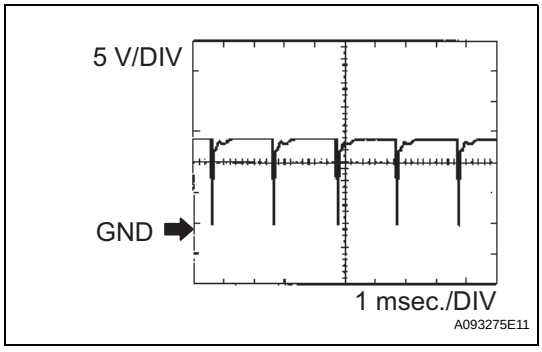


4. WAVEFORM 4

Throttle actuator positive terminal

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.

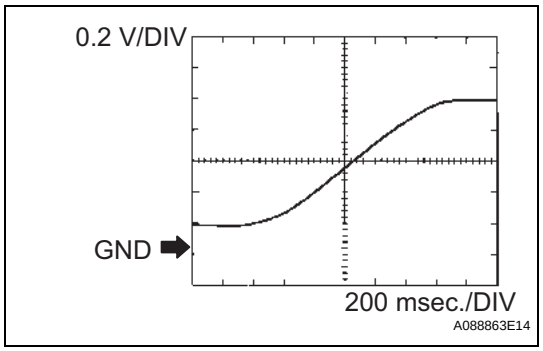


5. WAVEFORM 5

Throttle actuator negative terminal

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.

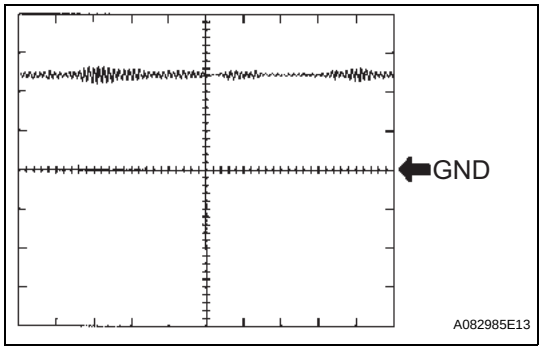


6. WAVEFORM 6

Heated oxygen sensor

ECM Terminal Names	Between OX1B and E2
Tester Ranges	0.2 V/DIV, 200 msec./DIV
Conditions	Engine speed maintained 2,500 rpm for 2 minutes after warming up engine

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

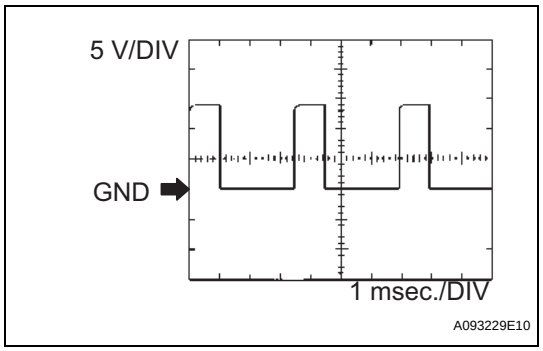


7. WAVEFORM 7

Knock sensor

ECM Terminal Names	Between KNK1 and EKNK
Tester Ranges	0.01 to 10 V/DIV, 0.01 to 10 msec./DIV
Conditions	Engine speed maintained 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.

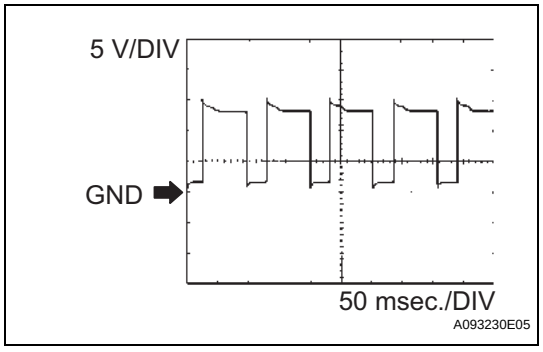


8. WAVEFORM 8

Camshaft timing oil control valve (OCV)

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.



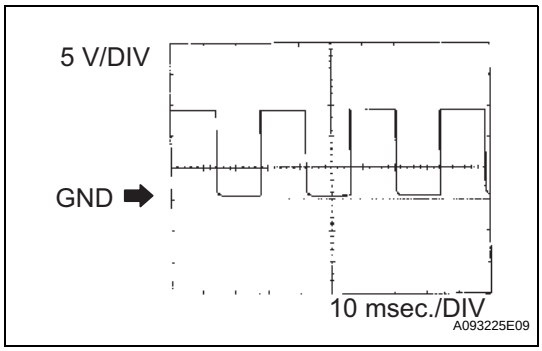
9. WAVEFORM 9

EVAP VSV

ECM Terminal Names	Between PRG and E01
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

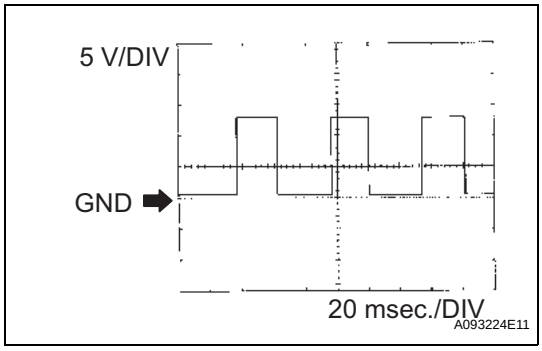


10. WAVEFORM 10

Engine speed signal

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.

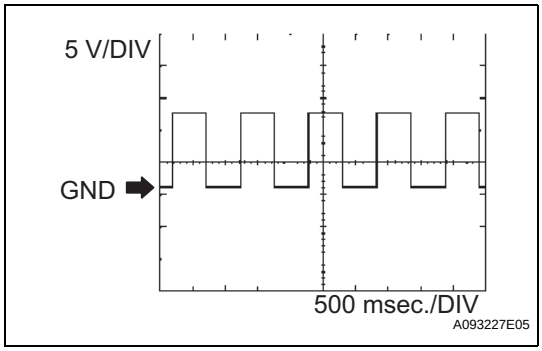


11. WAVEFORM 11

Vehicle speed signal

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

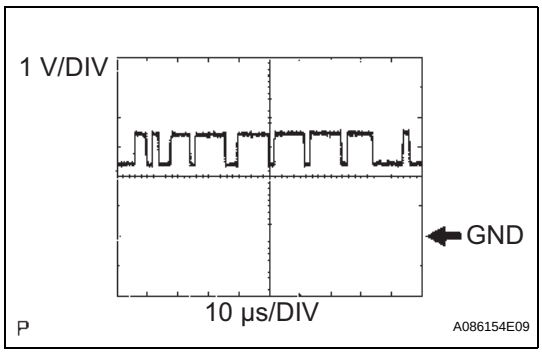
HINT:
The wavelength becomes shorter as the vehicle speed increases.



12. WAVEFORM 12

Airbag sensor assembly

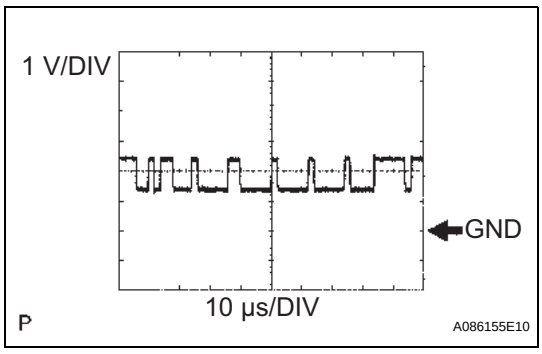
ECM Terminal Names	Between F/PS and E1
Tester Ranges	5 V/DIV, 500 msec./DIV
Conditions	Idling with warm engine



13. WAVEFORM 13

CAN communication signal (reference)

ECM Terminal Names	Between CANH and E1
Tester Ranges	1 V/DIV, 10 µs/DIV
Conditions	Ignition switch ON

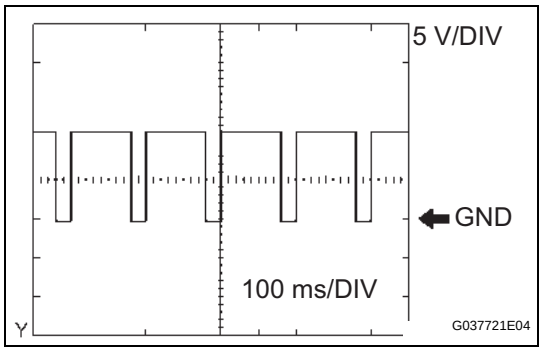


14. WAVEFORM 14

CAN communication signal (reference)

ECM Terminal Names	Between CANL and E1
Tester Ranges	1 V/DIV, 10 µs/DIV
Conditions	Ignition switch ON

ES



15. WAVEFORM 15

Terminal DI of air injection control driver

ECM Terminal Names	Between AIDI and E1
Tester Ranges	5 V/DIV, 100 ms/DIV
Conditions	Performing ACTIVE TEST using intelligent tester (air injection system)

HINT:

The wavelength changes when the air injection control driver detects malfunctions in the air injection system (see page ES-193).

ES

DIAGNOSIS SYSTEM

1. DESCRIPTION

When troubleshooting OBD II (On-Board Diagnostics) vehicles, a 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 illuminates the MIL (Malfunction Indicator Lamp) on the instrument panel when the computer detects a malfunction in:

(a) The emission control systems and components

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

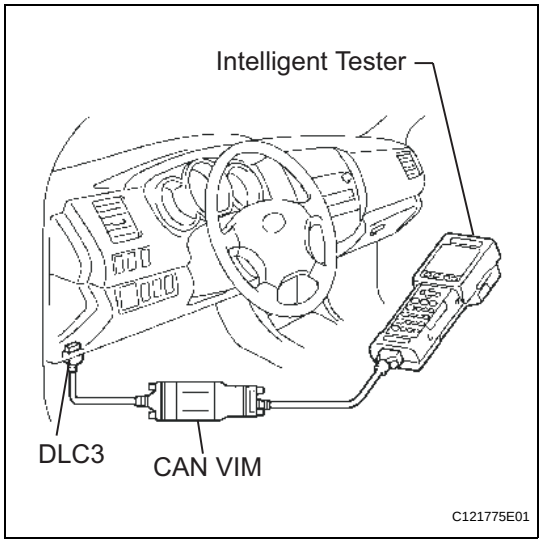
(c) The computer itself

In addition, the applicable DTCs (Diagnostic Trouble Codes) prescribed by SAE J2012 are recorded on 3 consecutive trips, the MIL turns off automatically but the DTCs remain recorded in the ECM memory.

To check DTCs, connect a intelligent tester to the DLC3. The tester displays DTCs, freeze frame data, and a variety of engine data. The DTCs and freeze frame data can be erased with the tester (see page ES-40).

In order to enhance OBD function on vehicles and develop the Off-Board diagnosis system, CAN communication is introduced in this system (CAN: Controller Area Network). It minimizes a 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 to simplify the wire harness connection.

Since this system is equipped with the CAN communication, connecting the CAN VIM (VIM: Vehicle Interface Module) with intelligent tester is necessary to display any information from the ECM. (Also the communication between the intelligent tester and the ECM uses CAN communication signal.) 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-43).

3. 2 TRIP DETECTION LOGIC

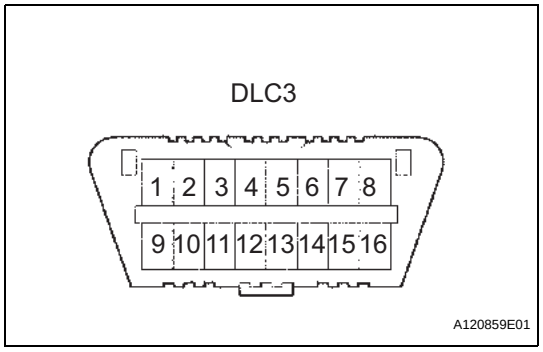
When a malfunction is first detected, the malfunction is temporarily stored in the ECM memory (1st trip). If the same malfunction is detected during the next subsequent drive cycle, the MIL is illuminated (2nd trip).

4. FREEZE FRAME DATA

Freeze frame data record the engine conditions (fuel system, calculated load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc.) 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.

5. DLC3 (Data Link Connector 3)

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



Symbols	Terminal No.	Name	Reference terminal	Result	Condition
SIL	7	Bus "+" line	5 - Signal ground	Pulse generation	During transmission
CG	4	Chassis ground	Body ground	1 Ω or less	Always
SG	5	Signal ground	Body ground	1 Ω or less	Always
BAT	16	Battery positive	Body ground	9 to 14 V	Always
CANH	6	CAN "High" line	CANL	54 to 69 Ω	Ignition switch OFF
CANH	6	CAN "High" line	Battery positive	1 MΩ or higher	Ignition switch OFF
CANH	6	CAN "High" line	CG	1 kΩ or higher	Ignition switch OFF
CANL	4	CAN "Low" line	Battery positive	1 MΩ or higher	Ignition switch OFF
CANL	4	CAN "Low" line	CG	1 kΩ or higher	Ignition switch OFF

HINT:

The DLC3 is the interface prepared for reading various data from the vehicle's ECM. After connecting the cable of a intelligent tester, turn the ignition switch to ON 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 impossible: The problem is probably with 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 the battery before proceeding.

7. MIL (Malfunction Indicator Lamp)

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

(b) The MIL should turn off when the engine is started. If the MIL remains illuminated, the diagnosis system has detected a malfunction or abnormality in the system.

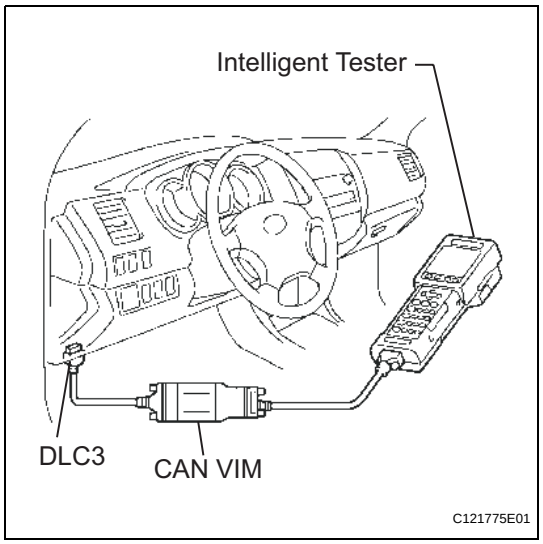
HINT:

If the MIL is not illuminated when the ignition switch is first turned to ON, check the MIL circuit (see page ES-439).

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:

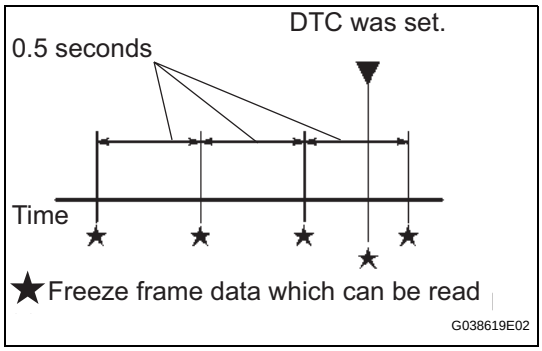
- DTCs which are stored in the ECM can be displayed on a intelligent tester. A intelligent tester can display current and pending DTCs.
- Some DTCs are not set if the ECM does not detect the same malfunction again during a second consecutive driving cycle. However, such malfunctions, detected on only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



1. CHECK DTC (Using a intelligent tester)
(a) Connect a intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES or PENDING CODES.
(e) Check DTCs and freeze frame data, and then write them down.
(f) Proceed to Diagnosis Trouble Code Chart to check the details of the DTCs (See page ES-54).

2. CLEAR DTC (Using the intelligent tester)
(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the tester ON.
(d) Select the following menu items: 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 (R/B) located inside the engine compartment for more than 1 minute.



FREEZE FRAME DATA

1. DESCRIPTION

Freeze frame data record 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 replicate the problem even though a DTC is detected, confirm the freeze frame data.

The ECM records engine conditions in the form of freeze frame data every 0.5 seconds. Using the intelligent tester, five separate sets of freeze frame data, including the data values at the time when the DTC was set, can be checked.

- 3 data sets before the DTC was set
- 1 data set when the DTC was set
- 1 data set after the DTC was set

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

2. LIST OF FREEZE FRAME DATA

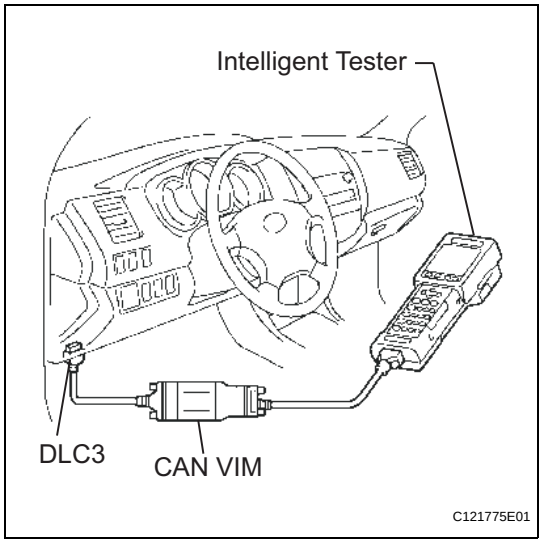
LABEL (Intelligent Tester Display)	Measurement Item/Range	Diagnostic Note
INJECTOR	Injector	-
IGN ADVANCE	Ignition advance	-
CALC LOAD	Calculate load	Calculated load by ECM
VEHICLE LOAD	Vehicle load	-
MAF	Mass air flow volume	If value approximately 0.0 g/sec: • Mass air flow meter power source circuit open or short • VG circuit open or short If value 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 value -40°C, sensor circuit open If value 140°C, sensor circuit shorted
INTAKE AIR	Intake air temperature	If value -40°C, sensor circuit open If value 140°C, sensor circuit shorted
AIR-FUEL RATIO	Air-fuel ratio	-
PURGE DENSITY	Learning value of purge density	-
PURGE FLOW	Purge flow	-
EVAP PURGE VSV	EVAP purge VSV duty ratio	-
EVAP VAPOR PRES	EVAP vapor pressure	-
KNOCK CRRT VAL	Correction learning value of knocking	-
KNOCK FB VAL	Feedback value of knocking	-
ACCEL POS #1	Absolute No. 1 Accelerator Pedal Position (APP)	-

LABEL (Intelligent Tester Display)	Measurement Item/Range	Diagnostic Note
ACCEL POS #2	Absolute No. 2 APP	-
THROTTLE POS	Throttle position	Read value with ignition switch ON (Do not start engine)
THROTTLE POS	Throttle sensor position	Read value with ignition switch ON (Do not start engine)
THROTTLE POS #2	Throttle sensor position #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 voltage output of sensor
AFS B1 S1	A/F sensor output	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check voltage output 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 value
FUEL SYS #1	Fuel system status (Bank1)	• OL (Open Loop): Has not yet satisfied conditions to go closed loop • CL (Closed Loop): Using heated oxygen sensor as feedback for fuel control. • OL DRIVE: Open loop due to driving conditions (fuel enrichment) • OL FAULT: Open loop due to detected system fault • CL FAULT: Closed loop but heated oxygen sensor, which used for fuel control, malfunctioning
O2FT B1 S2	Fuel trim at heated oxygen sensor	-
AF FT B1 S1	Fuel trim at A/F sensor	-
CAT TEMP B1 S1	Catalyst temperature	-
CAT TEMP B1 S2	Catalyst temperature	-
INI COOL TEMP	Initial engine coolant temperature	-
INI INTAKE TEMP	Initial intake air temperature	-
INJ VOL	Injection volume	-
AIR PMP PRS	Air pump pressure	(See page ES-354)
AIR PMP PLS PRS	Air pump pulsation pressure	(See page ES-354)
STARTER SIG	Starter signal	-
PS SW	Power steering signal	-
PS SIGNAL	Power steering signal (history)	This signal status usually ON until battery terminals disconnected
CTP SW	Closed throttle position switch	-
A/C SIG	A/C signal	-
ELECT LOAD SIG	Electrical load signal	-
STOP LIGHT SW	Stop light switch	-
BATTERY VOLTAGE	Battery voltage	-
ATM PRESSURE	Atmospheric pressure	-
SECOND AIR VSV	Secondary air injection system status	-
ACT VSV	A/C cut status for Active Test	-
EVAP VSV	EVAP purge VSV	VSV for EVAP controlled by ECM (ground side duty control)
FUEL PUMP / SPD	Fuel pump speed status	-

LABEL (Intelligent Tester Display)	Measurement Item/Range	Diagnostic Note
VVT CTRL B1	VVT control status	-
VACUUM PUMP	Key-off EVAP system pump status	(See page ES-390)
EVAP VENT VAL	Key-off EVAP system vent valve status	-
TC/TE1	TC and TE1 terminal of DLC3	-
AI STATUS	Secondary air injection system operation prohibit	(See page ES-354)
VVTL AIM ANGL #1	VVT aim angle	-
VVT CHNG ANGL #1	VVT change angle	-
VVT OCV DUTY B1	VVT OCV operation duty	-
FC IDL	Idle fuel cut	ON: when throttle valve fully closed and engine speed over 1,500 rpm
FC TAU	FC TAU	Fuel cut being performed under very light load to prevent engine combustion from becoming incomplete
IGNITION	Ignition	-
CYL #1	Cylinder #1 misfire rate	Displayed in only idling
CYL #2	Cylinder #2 misfire rate	Displayed in only idling
CYL #3	Cylinder #3 misfire rate	Displayed in only idling
CYL #4	Cylinder #4 misfire rate	Displayed in only idling
CYL ALL	All cylinder misfire rate	Displayed in only idling
MISFIRE RPM	Misfire RPM	-
MISFIRE LOAD	Misfire load	-
MISFIRE MARGIN	Misfire monitoring	-
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	-
MODEL CODE	Identifying model code	TRN2###
FAN MOTOR	Electric fan motor	-
VAPOR PRESS	Vapor pressure	EVAP system pressure as read by canister pressure sensor
ENG OIL PRES SW	Engine oil pressure switch signal	Always ON while engine running
ENGINE TYPE	Identifying engine type	2TR
CYLINDER NUMBER	Identifying cylinder number	4 or 6
DESTINATION	Identifying destination	A (America)
MODEL YEAR	Identifying model year	200#
SYSTEM	Identifying engine system	GASOLINE (gasoline engine)

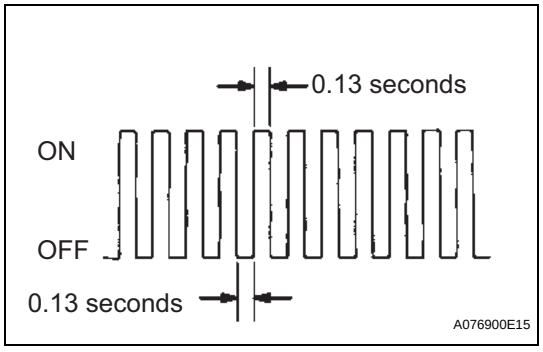
CHECK MODE PROCEDURE

HINT:
Intelligent tester only:
Compared to 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 to ACC 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 (Using the intelligent tester)

(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 positions
  (4) A/C switched OFF
(b) Turn the ignition switch to OFF.
(c) Connect a intelligent tester to the DLC3.
(d) Turn the ignition switch to ON.
(e) Turn the tester ON.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / CHECK MODE.
(g) Switch the ECM from normal mode to check mode.



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

FAIL-SAFE CHART

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

DTCs	Components	Fail-Safe Operations	Fail-Safe Deactivation Conditions
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
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

NOTE:

* 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 a 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 of 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 to OFF
(c) Connect a intelligent tester to the DLC3.
(d) Turn the ignition switch to ON.
(e) Turn the tester ON.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST.
(g) Check the values by referring to the table below.

Intelligent Tester Display	Measurement Item: Range (Display)	Normal Condition *	Diagnostic Note
INJECTOR	Injection period of No. 1 cylinder: Min.: 0 ms, Max.: 32.64 ms	1.8 to 3.8 ms: Idling	-
IGN ADVANCE	Ignition timing advance for No. 1 cylinder: Min.: -64 deg., Max.: 63.5 deg.	BTDC 4 to 17°: Idling	-
CALC LOAD	Calculated load by ECM: Min.: 0 %, Max.: 100 %	• 11 to 26 %: Idling • 12 to 27 %: Running without load (2,500 rpm)	-
VEHICLE LOAD	Vehicle load: Min.: 0 %, Max.: 25700 %	Actual vehicle load	-
MAF	Air flow rate from MAF meter: Min.: 0 g/sec, Max.: 655.35 g/sec	2.0 to 4.5 g/sec: Idling	If value approximately 0.0 g/sec: • Mass air flow meter power source circuit open • VG circuit open or short If value 160.0 g/sec or more: • E2G circuit open
ENGINE SPD	Engine speed: Min.: 0 rpm, Max.: 16,383.75 rpm	650 +- 50 rpm: Idling	-
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 value -40°C (-40°F): sensor circuit open • If value 140°C (284°F): sensor circuit shorted
INTAKE AIR	Intake air temperature: Min.: -40°C, Max.: 140°C	Equivalent to ambient air temperature	• If value -40°C (-40°F): sensor circuit open • If value 140°C (284°F): sensor circuit shorted
SECONDARY AIR	Secondary air injection system status: ON or OFF	ON: Secondary air system operation	-
AIR-FUEL RATIO	Air-fuel ratio: Min.: 0, Max.: 1.999	0.8 to 1.2: Idling	-

Intelligent Tester Display	Measurement Item: Range (Display)	Normal Condition *	Diagnostic Note
PURGE DENSITY	Learning value of purge density: Min.: -50, Max.: 350	-40 to 0 %: Idling	Service data
PURGE FLOW	Purge flow: Min.: 0 %, Max.: 102.4 %	0 to 100 %: Idling	-
EVAP PURGE VSV	EVAP (Purge) VSV control duty: Min.: 0 %, Max.: 100 %	0 to 100 %: During idling	Order signal from ECM
VAPOR PRESS	Vapor pressure: Min.: 33.853 kPa, Max.: 125.596 kPa	Approximately 100 kPa: Ignition switch ON	EVAP system pressure monitored by canister pressure sensor
VAPOR PRESS CALC	Calculated EVAP system pressure: Min.: -5.632 kPa, Max.: 715.264 kPa	Approximately 100 kPa: Ignition switch ON	-
KNOCK CRRT VAL	Correction learning value of knocking: Min.: -64 °CA, Max.: 1,984 °CA	0 to 19 °CA: Driving, 44 mph (70 km/h)	Service data
KNOCK FB VAL	Feedback value of knocking: Min.: -64 °CA, Max.: 1,984 °CA	-19 to 0 °CA Driving, 44 mph (70 km/h)	Service data
EVAP VAPOR PRES	EVAP vapor pressure: Min.: 0 kPa, Max.: 327.675 kPa	Approximately 100 kPa: Ignition switch ON	-
ACCEL POS #1	Absolute No. 1 Accelerator Pedal Position (APP): Min.: 0 %, Max.: 100 %	10 to 22 %: Accelerator pedal released 54 to 86 %: Accelerator pedal fully depressed	-
ACCEL POS #2	Absolute No. 2 APP: Min.: 0 %, Max.: 100 %	12 to 42 %: Accelerator pedal released 66 to 98 %: Accelerator pedal fully depressed	-
ACCEL POS #1	No. 1 APP sensor voltage: Min.: 0 V, Max.: 4.98 V	-	ETCS freeze data
ACCEL POS #2	No. 2 APP sensor voltage: Min.: 0 V, Max.: 4.98 V	-	ETCS freeze data
ACCEL POS #1	No. 1 APP sensor voltage: Min.: 0 V, Max.: 5 V	0.5 to 1.1 V: accelerator pedal released 2.6 to 4.5 V: or pedal fully depressed	-
ACCEL POS #2	No. 2 APP sensor voltage: Min.: 0 V, Max.: 5 V	1.2 to 2.0 V: accelerator pedal released 3.4 to 5.3 V: accelerator pedal fully depressed.	-
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	No.1 Accelerator fully closed value (AD): Min.: 0 V, Max.: 4.9804 V	-	ETCS service data
ACCEL LRN VAL#1	No.1 Accelerator fully closed learning value: Min.: 0, Max.: 124.512	-	ETCS service data
ACCEL LRN VAL#2	No.2 Accelerator fully closed learning value: Min.: 0, Max.: 124.512	-	ETCS service data
FAIL #1	Whether or not fail safe function executed: ON or OFF	ON: ETCS has failed	-
FAIL #2	Whether or not fail safe function executed: ON or OFF	ON: ETCS has failed	-
ST1	Starter signal: ON or OFF	ON: Cranking	-

Intelligent Tester Display	Measurement Item: Range (Display)	Normal Condition *	Diagnostic Note
SYSGUARD JUDGE	System guard: ON or OFF	-	ETCS service data
OPN MALFUNCTION	Open side malfunction: ON or OFF	-	ETCS service data
THROTTLE POS	Absolute throttle position sensor: Min.: 0 %, Max.: 100 %	• 10 to 24 %: Throttle fully closed • 64 to 96 %: Throttle fully open	Read value with intrusive operation (active test)
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 sensor positioning: Min.: 0 % Max.: 100 %	0 to 10 %: Idling	Calculated value based on VTA1
THROTTLE POS #2	Throttle sensor positioning #2: Min.: 0 %, Max.: 100 %	-	Calculated value based on VTA2
THROTTLE POS #1	No. 1 Throttle position sensor output voltage: Min.: 0 V, Max.: 4.9 V	-	ETCS freeze data
THROTTLE POS #2	No.2 Throttle position sensor output voltage: Min.: 0 V, Max.: 4.9 V	-	ETCS freeze data
THROTTLE POS #1	No. 1 Throttle position: Min.: 0 V, Max.: 5 V	• 0.5 to 1.2 V: Throttle fully closed • 3.2 to 4.8 V: Throttle fully opened	-
THROTTLE POS #2	No. 2 Throttle position: Min.: 0 V, Max.: 5 V	• 2.0 to 2.9 V: Throttle fully closed • 4.6 to 5.5 V: Throttle fully open	Read value with intrusive operation (active test)
THRTL COMND VAL	Throttle position command value: Min.: 0 V, Max.: 4.9804 V	0.5 to 4.8 V	ETCS service data
THROTTLE SSR #1	No. 1 Throttle sensor opener position: Min.: 0 V, Max.: 4.9804 V	0.6 to 1.0 V	ETCS service data
THROTTLE SSR #2	No. 2 Throttle sensor opener position: Min.: 0 V, Max.: 4.9804 V	2.0 to 2.6 V	ETCS service data
THRTL SSR #1 AD	No.1 Throttle sensor opener position (AD): Min.: 0 V, Max.: 4.9804 V	0.6 to 0.9 V	ETCS service data
THROTTLE MOT	Whether or not throttle motor control permitted: ON or OFF	ON: Idling	Read value with ignition switch ON (Do not start engine)
THROTTLE MOT	Throttle motor current: Min.: 0 A, Max.: 80 A	0 to 3.0 A: Idling	-
THROTTLE MOT	Throttle motor: Min.: 0 % Max.: 100 %	0.5 to 40 %: Idling	-
THROTTLE MOT	Throttle motor current: Min.: 0 A, Max.: 19.92 A	0 to 3.0 A: Idling	-
THROTL OPN DUTY	Throttle motor opening duty ratio: Min.: 0 %, Max.: 100 %	0 to 40 %: Idling	When accelerator pedal depressed, duty ratio increased
THROTL CLS DUTY	Throttle motor closed duty ratio:: Min.: 0 %, Max.: 100 %	0 to 40 %: Idling	When accelerator pedal released quickly, duty ratio increased
THRTL MOT (OPN)	Throttle motor duty ratio (open): Min.: 0 %, Max.: 100 %	-	ETCS service data
THRTL MOT (CLS)	Throttle motor duty ratio (close): Min.: 0 %, Max.: 100 %	-	ETCS service data

Intelligent Tester Display	Measurement Item: Range (Display)	Normal Condition *	Diagnostic Note
O2S B1 S2	Heated oxygen sensor output voltage for bank 1 sensor 2: Min.: 0 V, Max.: 1.275 V	0 to 0.9 V: Driving 44 mph (70 km/h)	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check voltage output of sensor
AFS B1 S1	A/F sensor output voltage for bank 1 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 voltage output of sensor
TOTAL FT #1	Total fuel trim of bank 1 Average value for fuel trim system of bank 1: Min.: -0.5, Max.: 0.496	-0.2 to 0.2: Idling	-
SHORT FT #1	Short-term fuel trim of bank 1: Min.: -100 %, Max.: 99.2%	0 +- 20 %	Short-term fuel compensation used to maintain air-fuel ratio at stoichiometric air-fuel ratio
LONG FT #1	Long-term fuel trim of bank 1: Min.: -100 %, Max.: 99.2 %	0 +- 20 %	Overall fuel compensation carried out in long-term to compensate continual deviation of short-term fuel trim from central value
FUEL SYS #1	Fuel system status (Bank1): 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 heated oxygen sensor as feedback for fuel control • OL DRIVE: Open loop due to driving conditions (fuel enrichment) • OL FAULT: Open loop due to detected system fault • CL FAULT: Closed loop but heated oxygen sensor, which used for fuel control malfunctioning
O2FT B1 S2	Short-term fuel trim associated with bank 1 sensor 2: Min.: -100 %, Max.: 99.2 %	-	-
AF FT B1 S1	Short-term fuel trim associated with bank 1 sensor 1: Min.: 0, Max.: 1.999	• Value less than 1 (0.000 to 0.999) = Lean • Stoichiometric air-fuel ratio=1 • Value greater than 1 (1.001 to 1.999) = Rich	-
CAT TEMP B1S1	Catalyst temperature (Bank 1, Sensor 1): Min.: -40, Max.: 6,513.5°C	-	-
CAT TEMP B1S2	Catalyst temperature (Bank 1, Sensor 2): Min.: -40, Max.: 6,513.5°C	-	-
INI COOL TEMP	Initial engine coolant temperature: Min.: -40°C, Max.: 140°C	Engine coolant temperature when engine started	Service data
INI INTAKE TEMP	Initial intake air temperature: Min.: -40°C, Max.: 140°C	Intake air temperature when engine started	Service data
INJ VOL	Injection volume (cylinder 1): Min.: 0 ml, Max.: 2.048 ml	0 to 0.5 ml	Quantity of fuel injection volume for 10 times
AIR PMP PRS(A)	Air pump pressure (absolute): Min.: 0 kPa, Max.: 320 kPa	Atmospheric pressure +2.5 kPa or more: Air pump ON, Air switching valve open Close to atmospheric pressure: Air pump OFF, Air switching valve close	(See page ES-354)

Intelligent Tester Display	Measurement Item: Range (Display)	Normal Condition *	Diagnostic Note
AIR PMP PLS PRS	Air pump pulsation pressure: Min.: 0 kPa, Max.: 639.9 kPa	-	Cumulative pulsation pressure calculated by ECM (See page ES-354)
STARTER SIG	Starter signal: ON or OFF	ON: Cranking	-
PS SW	Power steering signal: ON or OFF	ON: Power steering operation	-
PS SIGNAL	Power steering signal: ON or OFF	ON: When steering wheel first turned after battery terminals connected	This 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 SIG	A/C signal: ON or OFF	ON: A/C ON	-
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 electronic throttle control system power input: ON or OFF	ON: Idling	-
+BM VOLTAGE	+BM voltage: Min.: 0, Max.: 19.92	10 to 15 V: Idling	ETCS service data
BATTERY VOLTAGE	Battery voltage: Min.: 0 V, Max.: 65.535 V	9 to 14 V: Idling	-
ACTUATOR POWER	Actuator power supply: ON or OFF	ON: Idling	ETCS service data
ATM PRESSURE	Atmospheric pressure: Min.: 0 kPa, Max.: 150 kPa	Equivalent to atmospheric pressure (absolute pressure)	-
SECOND AIR VSV	Secondary air injection system status	ON: Secondary air injection system operation	-
ACT VSV	A/C cut status for Active Test: ON or OFF	-	Active Test support data
EVAP (Purge) VSV	VSV status for EVAP control: ON or OFF	-	Active Test support data
FUEL PUMP / SPD	Fuel pump/speed status: ON or OFF	-	Active Test support data
VVT CTRL B1	VVT control status: ON or OFF	-	Active Test support data
VACUUM PUMP	Key-off EVAP system 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
TC/TE1	TC and TE1 terminals of DLC3: ON or OFF	-	-
AI STATUS	Secondary air injection system operation prohibition: OK or NG	-	(See page ES-354)
VVTL AIM ANGL #1	VVT aim angle (bank 1): Min.: 0 %, Max.: 100 %	0 %: Idling	VVT duty signal value during intrusive operation
VVT CHNG ANGL #1	VVT change angle: Min.: 0°FR, Max.: 60°FR	0 to 5 °FR: Idling	Displacement angle during intrusive operation
VVT OCV DUTY B1	VVT OCV operation duty: Min.: 0 %, Max.: 100 %	0 %: Idling	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 2,800 rpm

Intelligent Tester Display	Measurement Item: Range (Display)	Normal Condition *	Diagnostic Note
FC TAU	Fuel cut TAU: Fuel cut during very light load: ON or OFF	ON: Fuel cut operation	Fuel cut being performed under very light load to prevent engine combustion from becoming incomplete
IGNITION	Ignition counter: Min.: 0, Max.: 400	0 to 400	-
CYL #1, #2, #3, #4	Misfire ratio of cylinder 1 to 4: Min.: 0, Max.: 255	0 %	This item displayed in only idling
CYL ALL	All cylinders misfire rate: Min.: 0, Max.: 255	0 to 35	-
MISFIRE RPM	Engine RPM for first misfire range: Min.: 0 rpm, Max.: 6,375 rpm	0 rpm: Misfire 0	-
MISFIRE LOAD	Engine load for first misfire range: Min.: 0 g/rev, Max.: 3.98 g/rev	0 g/rev: Misfire 0	-
MISFIRE MARGIN	Misfire monitoring: MIn.: -100 %, Max.: 99.22 %	-100 to 99.2 %	Misfire detecting margin
#CODES	#Codes: Min.: 0, Max.: 255	-	Number of detected DTCs
CHECK MODE	Check mode: ON or OFF	ON: Check mode ON	(See page ES-43)
SPD TEST	Check mode result for vehicle speed sensor: COMPL or INCOMPL	-	-
AS TEST	Check mode result for secondary air injection system: COMPL or INCOMPL	-	-
MISFIRE TEST	Check mode result for misfire monitor: COMPL or INCOMPL	-	-
OXS1 TEST	Check mode result for HO2 sensor : COMPL or INCOMPL	-	-
A/F SSR TEST B1	Check mode result for air-fuel ratio sensor : COMPL or INCOMPL	-	-
MIL	MIL status: ON or OFF	ON: MIL ON	-
MIL ON RUN DIST	MIL ON Run Distance: Min.: 0 second, Max.: 65,535 seconds	Distance after DTC detected	-
MIL ON RUN TIME	Running time from MIL ON: Min.: 0 minute, Max.: 65,535 minutes	Equivalent to running time after MIL ON	-
ENG RUN TIME	Engine run time: Min.: 0 second, Max.: 65,535 seconds	Time after engine start	Service data
TIME DTC CLEAR	Time after DTC cleared: Min.: 0 minute, Max.: 65,535 minutes	Equivalent to time after DTCs erased	-
DIST DTC CLEAR	Distance after DTC cleared: Min.: 0 km/h, Max.: 65535 km/h	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
MODEL CODE	Model code:	-	Identifying model code: TRN2###
ENGINE TYPE	Engine type:	-	Identifying engine type: 2TR
CYLINDER NUMBER	Cylinder number: Min.: 0, Max.: 255	-	Identifying cylinder number: 4 or 6
TRANSMISSION	Transmission type:	-	Identifying transmission type: MT, ECT(5AT) or ECT(4AT)

Intelligent Tester Display	Measurement Item: Range (Display)	Normal Condition *	Diagnostic Note
DESTINATION	Destination	-	Identifying destination: A (America)
MODEL YEAR	Model year: Min.: 0, Max.: 255	-	Identifying model year: 200#
SYSTEM	System identification	-	Identifying engine system: GASLIN (gasoline engine)

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

2. ACTIVE TEST

HINT:

Performing 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 a intelligent tester. Performing an ACTIVE TEST as the first step of troubleshooting is one method of shortening diagnostic time.

DATA LIST can be displayed during ACTIVE TESTs.

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

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Intelligent Tester Displays	Test Details	Control Ranges	Diagnostic Notes
INJ VOL	Change injection volume	Between -12 % and 25 %	• All injectors tested at same time • Perform test at less than 3,000 rpm • Injection volume can be changed in 1 % graduations within control range
A/F CONTROL	Change injection volume	Lower by 12.5 % or increase by 25 %	• 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, and press YES and ENTER followed by F4
EVAP VSV (ALONE)	Activate EVAP VSV control	ON/OFF	-
VVT CTRL B1	Turn on and off OCV (Oil Control Valve)	ON/OFF	• Engine stalls or idles roughly when OCV turned ON • Normal engine running or idling when OCV off
A/C CUT SIG	Control A/C cut signal	ON/OFF	-
FUEL PUMP/SPD	Activate fuel pump (C/OPN Relay)	ON/OFF	-

Intelligent Tester Displays	Test Details	Control Ranges	Diagnostic Notes
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	-
ETCS OPEN SLOW	Throttle actuator	ON: throttle valve opens slowly	Test possible when following conditions met: • Ignition switch ON • Engine does not start • Fully depressing accelerator pedal (APP: 58 degrees or more)
ETCS CLOSE SLOW	Throttle actuator	ON: throttle valve closes slowly	Same as above
ETCS OPEN FAST	Throttle actuator	ON: throttle valve opens fast	Same as above
ETCS CLOSE FAST	Throttle actuator	ON: throttle valve closes fast	Same as above
FUEL CUT #1	Cylinder #1 injector fuel cut	ON/OFF	Test possible during vehicle stopping and engine idling
FUEL CUT #2	Cylinder #2 injector fuel cut	ON/OFF	Same as above
FUEL CUT #3	Cylinder #3 injector fuel cut	ON/OFF	Same as above
FUEL CUT #4	Cylinder #4 injector fuel cut	ON/OFF	Same as above
VVT B1	VVT actuator	-128 to 127% OCV control duty ratio can be set to any value within this range 100%: Maximum advance -100%: Maximum retard	Engine stalls or idles roughly when VVT actuator is operated at 100 % or more. This test is possible while idling.
VENT VALVE (ALONE)	Activate vent valve (built into canister pump module)	ON/OFF	-
VCUUM PUMP	Activate leak detection pump (built into canister pump module)	ON/OFF	-

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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 (PENDING CODES) are set, and can detect potential malfunctions in the system. SYSTEM CHECK can be performed with a intelligent tester.

(a) Connect a intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK.
(d) Perform the SYSTEM CHECK by referring to the table below.
(e) Turn the ignition switch to OFF.

Intelligent Tester Displays	Test Details	Recommended Vehicle Conditions	Diagnostic Notes
EVAP SYS CHECK (AUTOMATIC OPERATION)	Perform 5 steps in order to operate EVAP key-off monitor automatically	Fuel temperature 35°C (95°F) or less	• If no DTCs in PENDING CODE after performing this test, system functioning normally • Refer to EVAP Inspection Procedure (See page ES-390)
EVAP SYS CHECK (MANUAL OPERATION)	Perform 5 steps in order to operate EVAP key-off monitor manually	Fuel temperature 35°C(95°F) or less	• Used to detect malfunctioning parts • Refer to EVAP Inspection Procedure (See page ES-390)

Intelligent Tester Displays	Test Details	Recommended Vehicle Conditions	Diagnostic Notes
AIR INJ CHECK (AUTOMATIC OPERATION)	Perform secondary air injection system operation automatically	With warm engine, ignition switch turned OFF once	• If no DTCs in PENDING CODE after performing this test, system functioning normally • Refer to inspection procedure for secondary air injection system DTCs • When performing AIR INJ CHECK operation after battery cable has been reconnected, wait for 7 minutes with ignition switch turned to ON or engine running • Turn ignition switch to OFF when SYSTEM CHECK finished
AIR INJ CHECK (MANUAL OPERATION)	Perform secondary air injection system operation manually Select monitor item 1, 2 or 3 1. Air pump: ON Air switching valve: OPEN 2. Air pump: OFF Air switching valve: CLOSE 3. Air pump: ON Air switching valve: CLOSE	With warm engine, ignition switch turned OFF once	• Used to detect malfunctioning parts • Refer to inspection procedure for secondary air injection system DTCs • When performing AIR INJ CHECK operation after battery cable has been reconnected, wait for 7 minutes with ignition switch turned to ON or engine running • Turn ignition switch to OFF when SYSTEM CHECK finishes

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.
*: MIL flashes when a catalyst damaged misfire is detected.

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0010	Camshaft Position "A" Actuator Circuit (Bank 1)	- Open or short in Oil Control Valve (OCV) circuit - OCV - ECM	Comes on	DTC stored	ES-66
P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)	- Valve timing - Oil Control Valve (OCV) - OCV filter - Camshaft timing gear assembly - ECM	Comes on	DTC stored	ES-71
P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)	- Same as DTC P0011	Comes on	DTC stored	ES-71
P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)	- Mechanical system (Timing chain has jumped tooth or chain stretched) - ECM	Comes on	DTC stored	ES-76
P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)	- Open in Air-Fuel Ratio (A/F) sensor heater circuit - A/F sensor heater - A/F HEATER relay - ECM	Comes on	DTC stored	ES-78
P0032	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)	- Short in Air-Fuel Ratio (A/F) sensor heater circuit - A/F sensor heater - A/F HEATER relay - ECM	Comes on	DTC stored	ES-78
P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)	- Open or short in Heated Oxygen (HO2) sensor heater circuit - HO2 sensor heater - EFI relay - ECM	Comes on	DTC stored	ES-83
P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	- Open or short in Heated Oxygen (HO2) sensor heater circuit - HO2 sensor heater - EFI relay - ECM	Comes on	DTC stored	ES-83
P0100	Mass or Volume Air Flow Circuit	- Open or short in Mass Air Flow (MAF) meter circuit - MAF meter - ECM	Comes on	DTC stored	ES-88
P0101	Mass Air Flow Circuit Range / Performance Problem	- Mass Air Flow (MAF) meter	Comes on	DTC stored	ES-95

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0102	Mass or Volume Air Flow Circuit Low Input	- Open or short in Mass Air Flow (MAF) meter circuit - MAF meter - ECM	Comes on	DTC stored	ES-88
P0103	Mass or Volume Air Flow Circuit High Input	- Open or short in Mass Air Flow (MAF) meter circuit - MAF meter - ECM	Comes on	DTC stored	ES-88
P0110	Intake Air Temperature Circuit	- Open or short in Intake Air Temperature (IAT) sensor circuit - IAT sensor (built into MAF meter) - ECM	Comes on	DTC stored	ES-97
P0112	Intake Air Temperature Circuit Low Input	- Short in Intake Air Temperature (IAT) sensor circuit - IAT sensor (built into MAF meter) - ECM	Comes on	DTC stored	ES-97
P0113	Intake Air Temperature Circuit High Input	- Open in Intake Air Temperature (IAT) sensor circuit - IAT sensor (built into MAF meter) - ECM	Comes on	DTC stored	ES-97
P0115	Engine Coolant Temperature Circuit	- Open or short in Engine Coolant Temperature (ECT) sensor circuit - ECT sensor - ECM	Comes on	DTC stored	ES-102
P0116	Engine Coolant Temperature Circuit Range / Performance Problem	- Engine Coolant Temperature (ECT) sensor	Comes on	DTC stored	ES-107
P0117	Engine Coolant Temperature Circuit Low Input	- Short in Engine Coolant Temperature (ECT) sensor circuit - ECT sensor - ECM	Comes on	DTC stored	ES-102
P0118	Engine Coolant Temperature Circuit High Input	- Open in Engine Coolant Temperature (ECT) sensor circuit - ECT sensor - ECM	Comes on	DTC stored	ES-102
P0120	Throttle / Pedal Position Sensor / Switch "A" Circuit	- Throttle Position (TP) sensor (built into throttle body) - ECM	Comes on	DTC stored	ES-110
P0121	Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem	- Throttle Position (TP) sensor (built into throttle body)	Comes on	DTC stored	ES-118
P0122	Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input	- Throttle Position (TP) sensor (built into throttle body) - Short in VTA1 circuit - Open in VC circuit - ECM	Comes on	DTC stored	ES-110

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0123	Throttle / Pedal Position Sensor / Switch "A" Circuit High Input	- Throttle Position (TP) sensor (built into throttle body) - Open in VTA1 circuit - Open in E2 circuit - Short between VC and VTA1 circuits - ECM	Comes on	DTC stored	ES-110
P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control	- Cooling system - Engine coolant temperature sensor - Thermostat	Comes on	DTC stored	ES-120
P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	- Thermostat - Cooling system - Engine coolant temperature sensor - ECM	Comes on	DTC stored	ES-123
P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	- Open or short in Heated Oxygen (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	Comes on	DTC stored	ES-126
P0137	Heated Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	- Open in Heated Oxygen (HO2) sensor (sensor 2) circuit - HO2 sensor (sensor 2) - HO2 sensor heater (sensor 2) - EFI relay - Gas leakage from exhaust system	Comes on	DTC stored	ES-126
P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)	- Short in Heated Oxygen (HO2) sensor (sensor 2) circuit - HO2 sensor (sensor 2) - ECM internal circuit malfunction	Comes on	DTC stored	ES-126

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0171	System Too Lean (Bank 1)	- 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 Air-Fuel Ratio (A/F) sensor (sensor 1) circuit - A/F sensor (sensor 1) - A/F sensor heater (sensor 1) - A/F HEATER relay - A/F sensor heater and A/F HEATER relay circuits - PCV valve and hose - PCV hose connections - ECM	Comes on	DTC stored	ES-144
P0172	System Too Rich (Bank 1)	- Injector leakage or blockage - Mass Air Flow (MAF) meter - Engine Coolant Temperature (ECT) sensor - Ignition system - Fuel pressure - Gas leakage from exhaust system - Open or short in Air-Fuel Ratio (A/F) sensor (sensor 1) circuit - A/F sensor (sensor 1) - A/F sensor heater (sensor 1) - A/F HEATER relay - A/F sensor heater and A/F HEATER relay circuits - ECM	Comes on	DTC stored	ES-144
P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit	- Throttle Position (TP) sensor (built into throttle body) - ECM	Comes on	DTC stored	ES-110
P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input	- Throttle Position (TP) sensor (built into throttle body) - Short in VTA2 circuit - Open in VC circuit - ECM	Comes on	DTC stored	ES-110

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0223	Throttle / Pedal Position Sensor / Switch "B" Circuit High Input	- Throttle Position (TP) sensor (built into throttle body) - Open in VTA2 circuit - Open in E2 circuit - Short between VC and VTA2 circuits - ECM	Comes on	DTC stored	ES-110
P0300	Random / Multiple Cylinder Misfire Detected	- Open or short in engine wire harness - Connector connection - Vacuum hose connections - Ignition system - Injector - Fuel pressure - Mass Air Flow (MAF) meter - Air induction system - Engine Coolant Temperature (ECT) sensor - Compression pressure - Valve clearance - Valve timing - PCV valve and hose - PCV hose connections - ECM	Comes on*	DTC stored	ES-156
P0301	Cylinder 1 Misfire Detected	- Same as P0300	Comes on*	DTC stored	ES-156
P0302	Cylinder 2 Misfire Detected	- Same as P0300	Comes on*	DTC stored	ES-156
P0303	Cylinder 3 Misfire Detected	- Same as P0300	Comes on*	DTC stored	ES-156
P0304	Cylinder 4 Misfire Detected	- Same as P0300	Comes on*	DTC stored	ES-156
P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	- Short in knock sensor circuit - Knock sensor - ECM	Comes on	DTC stored	ES-167
P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	- Open in knock sensor circuit - Knock sensor - ECM	Comes on	DTC stored	ES-167
P0335	Crankshaft Position Sensor "A" Circuit	- Open or short in Crankshaft Position (CKP) sensor circuit - CKP sensor - Sensor plate (CKP sensor plate) - ECM	Comes on	DTC stored	ES-171
P0339	Crankshaft Position Sensor "A" Circuit Intermittent	- Same as P0335	-	DTC stored	ES-171
P0340	Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)	- Open or short in Camshaft Position (CMP) sensor circuit - CMP sensor - Camshaft - Jumped tooth of timing chain - ECM	Comes on	DTC stored	ES-176

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0341	Camshaft Position Sensor "A" Circuit Range / Performance (Bank 1 or Single Sensor)	- Same as DTC P0340	Comes on	DTC stored	ES-176
P0351	Ignition Coil "A" Primary / Secondary Circuit	- 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	Comes on	DTC stored	ES-180
P0352	Ignition Coil "B" Primary / Secondary Circuit	- Same as DTC P0351	Comes on	DTC stored	ES-180
P0353	Ignition Coil "C" Primary / Secondary Circuit	- Same as DTC P0351	Comes on	DTC stored	ES-180
P0354	Ignition Coil "D" Primary / Secondary Circuit	- Same as DTC P0351	Comes on	DTC stored	ES-180
P0412	Secondary Air Injection System Switching Valve "A" Circuit	- Open in Air Switching Valve (ASV) drive circuit - Short between ASV drive circuit and +B circuit - Short between ASV drive circuit and body ground - Air Injection Control Driver (AID) - ASV - ECM	Comes on	DTC stored	ES-189
P0418	Secondary Air Injection System Control "A" Circuit	- Open in air pump drive circuit - Short between air pump drive circuit and +B circuit - Short between air pump drive circuit and body ground - Air pump - Air Injection Control Driver (AID) - ECM	Comes on	DTC stored	ES-199
P0420	Catalyst System Efficiency Below Threshold (Bank 1)	- Front exhaust pipe (TWC) - Gas leakage from exhaust system - Air-Fuel Ratio (A/F) sensor (sensor 1) - Heated Oxygen (HO2) sensor (sensor 2)	Comes on	DTC stored	ES-206
P043E	Evaporative Emission System Reference Orifice Clog Up	- Canister pump module - Connector/Wire harness (Canister pump module - ECM) - ECM - Leakage from EVAP system	Comes on	DTC stored	ES-213

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P043F	Evaporative Emission System Reference Orifice High Flow	- Canister pump module - Connector/Wire harness (Canister pump module - ECM) - ECM - Leakage from EVAP system	Comes on	DTC stored	ES-213
P0441	Evaporative Emission Control System Incorrect Purge Flow	- Purge VSV - Connector/wire harness (Purge VSV - ECM) - Canister pump module - Leakage from EVAP line (Purge VSV - Intake manifold) - Leakage from EVAP system - ECM	Comes on	DTC stored	ES-220
P0450	Evaporative Emission Control System Pressure Sensor / Switch	- Canister pump module - ECM	Comes on	DTC stored	ES-228
P0451	Evaporative Emission Control System Pressure Sensor Range / Performance	- Canister pump module - Connector/Wire harness (Canister pump module - ECM) - ECM	Comes on	DTC stored	ES-228
P0452	Evaporative Emission Control System Pressure Sensor / Switch Low Input	- Canister pump module - Connector/Wire harness (Canister pump module - ECM) - ECM	Comes on	DTC stored	ES-228
P0453	Evaporative Emission Control System Pressure Sensor / Switch High Input	- Canister pump module - Connector/Wire harness (Canister pump module - ECM) - ECM	Comes on	DTC stored	ES-228
P0455	Evaporative Emission Control System Leak Detected (Gross 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	Comes on	DTC stored	ES-237
P0456	Evaporative Emission Control System Leak Detected (Very Small Leak)	- Same as DTC P0455	Comes on	DTC stored	ES-237
P0500	Vehicle Speed Sensor "A"	- Open or short in speed signal circuit - Combination meter - ECM - Skid control ECU	Comes on	DTC stored	ES-243

ES

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0503	Vehicle Speed Sensor "A" Intermittent / Erratic / High	- Open or short in speed signal circuit - Combination meter - ECM - Skid control ECU	-	DTC stored	ES-243
P0504	Brake Switch "A" / "B" Correlation	- Short in stop light switch signal circuit - STOP fuse - Stop light switch - ECM	-	DTC stored	ES-247
P0505	Idle Control System Malfunction	- Electronic Throttle Control System (ETCS) - Air induction system - PCV hose connection - ECM	Comes on	DTC stored	ES-252
P0560	System Voltage	- Open in back up power source circuit - EFI fuse - ECM	Comes on	DTC stored	ES-256
P0604	Internal Control Module Random Access Memory (RAM) Error	- ECM	Comes on	DTC stored	ES-260
P0606	ECM / PCM Processor	- ECM	-	DTC stored	ES-260
P0607	Control Module Performance	- ECM	Comes on	DTC stored	ES-260
P0617	Starter Relay Circuit High	- Park/Neutral Position (PNP) switch (for A/T) - Clutch start switch (for M/T) - Starter relay circuit - Ignition switch - ECM	Comes on	DTC stored	ES-262
P0630	VIN not Programmed or Mismatch - ECM / PCM	- ECM	Comes on	DTC stored	ES-268
P0657	Actuator Supply Voltage Circuit / Open	- ECM	Comes on	DTC stored	ES-260
P1500	AC Inverter Malfunction	- Open in speed signal circuit - Short between idle-up signal circuit and +B circuit - Voltage inverter - ECM	Comes on	DTC stored	ES-270

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P1613	Secondary Air Injection Driver Malfunction	- Air Injection Control Driver (AID) - Open in AID ground circuit - Short in diagnostic information signal circuit (AID - ECM) - Open or short in air pump or air switching valve command signal circuit (AID - ECM) - Open or short in AID power source circuit - Open in diagnostic information signal circuit (AID - ECM) - AID - ECM	Comes on	DTC stored	ES-274
P2102	Throttle Actuator Control Motor Circuit Low	- Open in throttle actuator circuit - Throttle actuator - ECM	Comes on	DTC stored	ES-286
P2103	Throttle Actuator Control Motor Circuit High	- Short in throttle actuator circuit - Throttle actuator - Throttle valve - Throttle body assembly - ECM	Comes on	DTC stored	ES-286
P2111	Throttle Actuator Control System - Stuck Open	- Throttle actuator - Throttle body assembly - Throttle valve	Comes on	DTC stored	ES-290
P2112	Throttle Actuator Control System - Stuck Closed	- Throttle actuator - Throttle body assembly - Throttle valve	Comes on	DTC stored	ES-290
P2118	Throttle Actuator Control Motor Current Range / Performance	- Open in Electronic Throttle Control System (ETCS) power source circuit - ETCS fuse - ECM	Comes on	DTC stored	ES-293
P2119	Throttle Actuator Control Throttle Body Range / Performance	- Electronic Throttle Control System (ETCS) - ECM	Comes on	DTC stored	ES-298
P2120	Throttle / Pedal Position Sensor / Switch "D" Circuit	- Accelerator pedal position sensor - ECM	Comes on	DTC stored	ES-301
P2121	Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance	- Accelerator pedal position sensor circuit - Accelerator pedal position sensor - ECM	Comes on	DTC stored	ES-309
P2122	Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input	- Accelerator pedal position sensor - Open in VCP1 circuit - Open or ground short in VPA circuit - ECM	Comes on	DTC stored	ES-301

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P2123	Throttle / Pedal Position Sensor / Switch "D" Circuit High Input	- Accelerator pedal position sensor - Open in EPA1 circuit - ECM	Comes on	DTC stored	ES-301
P2125	Throttle / Pedal Position Sensor / Switch "E" Circuit	- Accelerator pedal position sensor - ECM	Comes on	DTC stored	ES-301
P2127	Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input	- Accelerator pedal position sensor - Open in VCP2 circuit - Open or ground short in VPA2 circuit - ECM	Comes on	DTC stored	ES-301
P2128	Throttle / Pedal Position Sensor / Switch "E" Circuit High Input	- Accelerator pedal position sensor - Open in EPA2 circuit - ECM	Comes on	DTC stored	ES-301
P2135	Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation	- Short between VTA1 and VTA2 circuits - TP sensor (built into throttle body) - ECM	Comes on	DTC stored	ES-110
P2138	Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation	- Short between VPA and VPA2 circuits - Accelerator pedal position sensor - ECM	Comes on	DTC stored	ES-301
P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)	- Open or short in Air-Fuel Ratio (A/F) sensor (sensor 1) circuit - A/F sensor (sensor 1) - A/F sensor (sensor 1) heater - A/F HEATER relay - A/F sensor heater and relay circuits - Air induction system - Fuel pressure - Injector - ECM	Comes on	DTC stored	ES-312
P2196	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)	- Open or short in Air-Fuel Ratio (A/F) sensor (sensor 1) circuit - A/F sensor (sensor 1) - A/F sensor (sensor 1) heater - A/F HEATER relay - A/F sensor heater and relay circuits - Air induction system - Fuel pressure - Injector - ECM	Comes on	DTC stored	ES-312

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)	- Open or short in Air-Fuel Ratio (A/F) sensor (sensor 1) circuit - A/F sensor (sensor 1) - A/F sensor heater - A/F HEATER relay - A/F sensor heater and relay circuits - ECM	Comes on	DTC stored	ES-328
P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)	- Same as DTC P2238	Comes on	DTC stored	ES-328
P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)	- Same as DTC P2238	Comes on	DTC stored	ES-328
P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)	- Same as DTC P2238	Comes on	DTC stored	ES-328
P2401	Evaporative Emission Leak Detection Pump Stuck OFF	- Canister pump module - Connector/Wire harness (Canister pump module - ECM) - ECM - Leakage from EVAP system	Comes on	DTC stored	ES-334
P2402	Evaporative Emission Leak Detection Pump Stuck ON	- Canister pump module - Connector/Wire harness (Canister pump module - ECM) - ECM	Comes on	DTC stored	ES-334
P2419	Evaporative Emission System Switching Valve Control Circuit Low	- Canister pump module - Connector/Wire harness (Canister pump module - ECM) - ECM	Comes on	DTC stored	ES-341
P2420	Evaporative Emission System Switching Valve Control Circuit High	- Canister pump module - Connector/Wire harness (Canister pump module - ECM) - ECM - Leakage from EVAP system	Comes on	DTC stored	ES-341
P2430	Secondary Air Injection System Air Flow / Pressure Sensor Circuit Bank1	- Pressure sensor - Open or short in pressure sensor circuit - ECM	Comes on	DTC stored	ES-348
P2431	Secondary Air Injection System Air Flow / Pressure Sensor Circuit Range / Performance Bank1	- Pressure sensor - Open or short in pressure sensor circuit - ECM	Comes on	DTC stored	ES-348

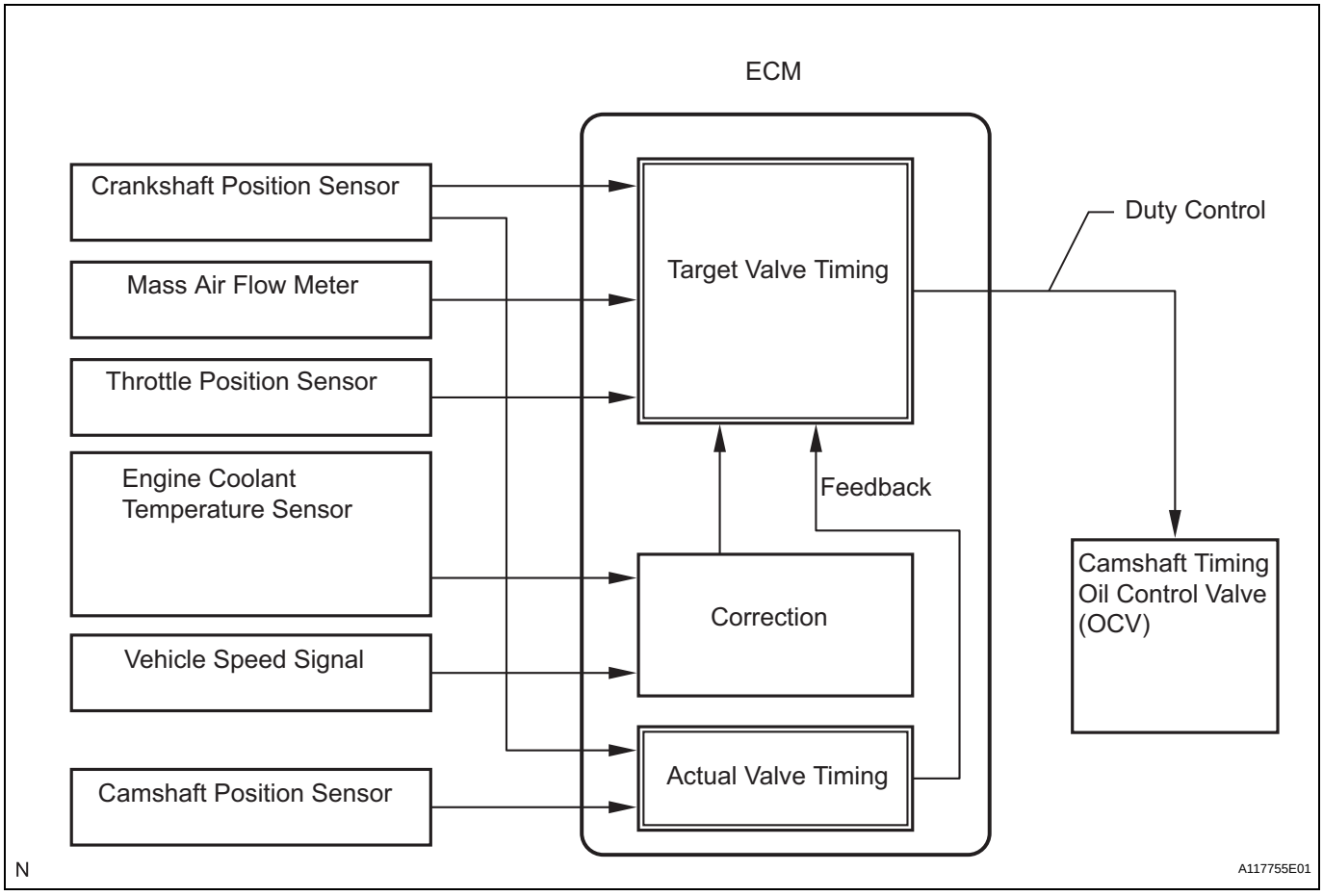
DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P2432	Secondary Air Injection System Air Flow / Pressure Sensor Circuit Low Bank1	- Pressure sensor - Open or short in pressure sensor circuit - ECM	Comes on	DTC stored	ES-348
P2433	Secondary Air Injection System Air Flow / Pressure Sensor Circuit High Bank1	- Pressure sensor - Open or short in pressure sensor circuit - ECM	Comes on	DTC stored	ES-348
P2440	Secondary Air Injection System Switching Valve Stuck Open Bank1	- Air switching valve (ASV) - Open or short in ASV circuit - Pressure sensor - Pressure sensor circuit - Air Injection Control Driver (AID) - ECM	Comes on	DTC stored	ES-354
P2441	Secondary Air Injection System Switching Valve Stuck Close Bank1	- Air switching valve (ASV) - Open or short in ASV circuit - Vacuum hose (ASV - pressure sensor) - Air injection hose - Pressure sensor - Pressure sensor circuit - Air Injection Control Driver (AID) - ECM	Comes on	DTC stored	ES-354
P2444	Secondary Air Injection System Pump Stuck On Bank1	- Short in air pump circuit - Air pump - Open or short in pressure sensor circuit - Pressure sensor - Air Injection Control Driver (AID) - ECM	Comes on	DTC stored	ES-368
P2445	Secondary Air Injection System Pump Stuck Off Bank1	- Air pump - Open in air pump circuit - Air injection system piping - Vacuum hose - Pressure sensor - Open or short in pressure sensor circuit - Air Injection Control Driver (AID) - ECM	Comes on	DTC stored	ES-368
P2610	ECM / PCM Internal Engine Off Timer Performance	- ECM	Comes on	DTC stored	ES-380
P2A00	A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)	- Open or short in air-fuel ratio sensor circuit - Air-Fuel Ratio (A/F) sensor - ECM	Comes on	DTC stored	ES-382

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

HINT:
This DTC relates to the Oil Control Valve (OCV).

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.



DTC No.	DTC Detection Conditions	Trouble Areas
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
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

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

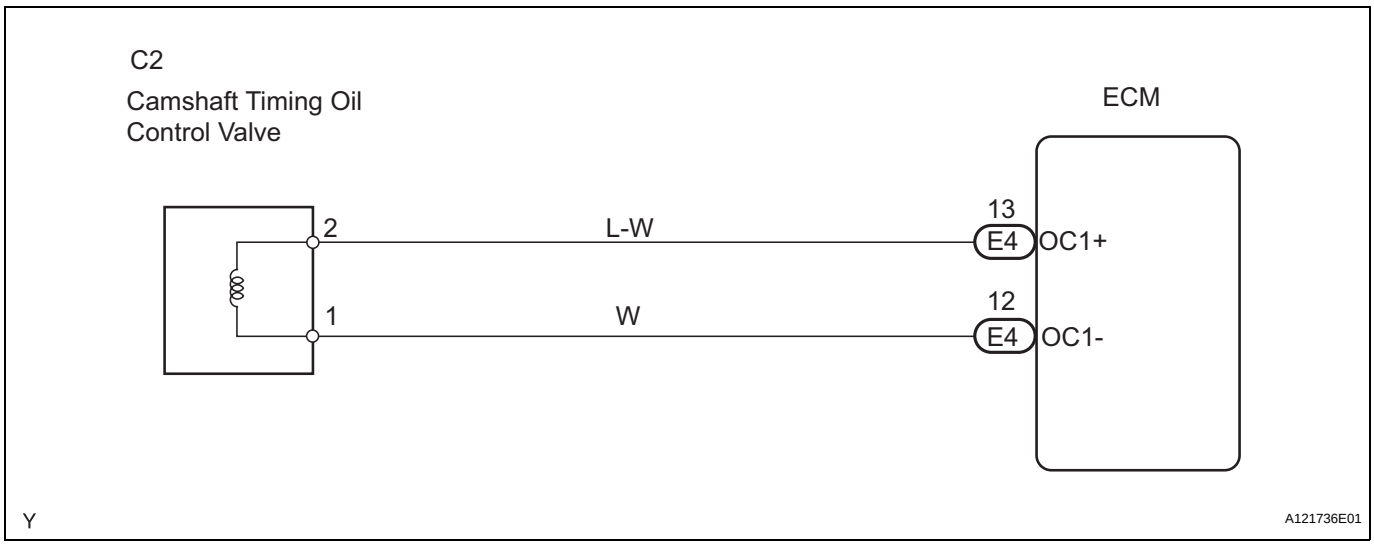
TYPICAL MALFUNCTION THRESHOLDS

One of following conditions met	-
A. All of following conditions met	-
Battery voltage	11 to 13 V
Target duty ratio	Less than 70 %
Output signal duty ratio	100 %
B. All of following conditions met	-
Battery voltage	13 V or more
Target duty ratio	Less than 80 %
Output signal duty ratio	100 %
C. All of following conditions 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

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.

1	PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

(a) Connect an 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 CTRL B1.
(e) Check the engine speed while operating the Oil Control Valve (OCV) using the tester.

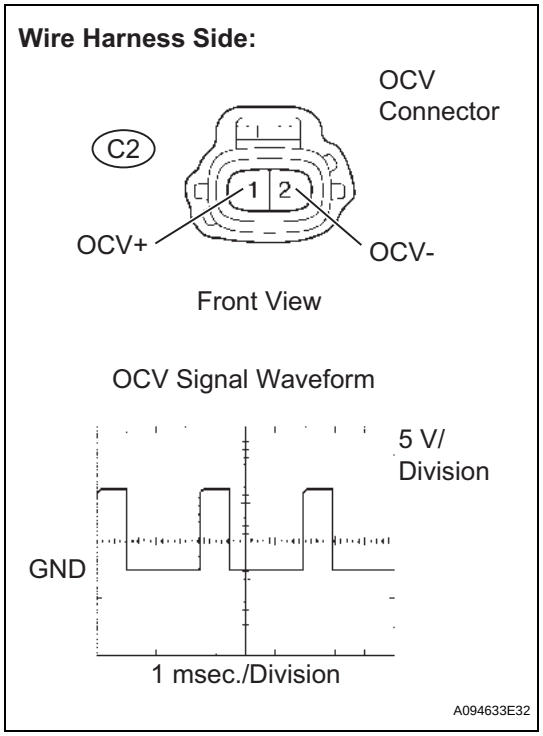
Result

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

OK → CHECK FOR INTERMITTENT PROBLEMS

NG

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



(a) Disconnect the C2 OCV connector.
(b) While idling, check the waveform between the terminals of the OCV connector using an oscilloscope.
Standard

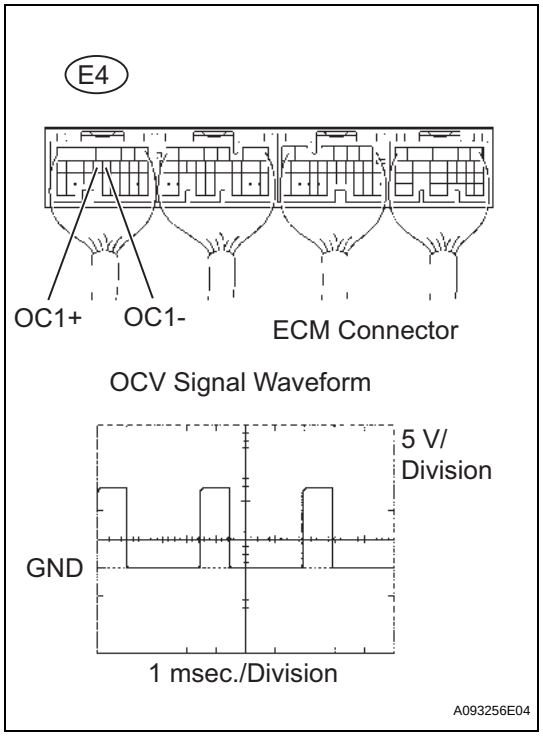
Tester Connections	Specified Conditions
OCV+ (C2-1) - OCV- (C2-2)	Correct waveform shown

(c) Reconnect the OCV connector.

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

NG

3 INSPECT ECM (OCV SIGNAL)



(a) Inspect the ECM using an oscilloscope.
(b) While idling, check the waveform between the terminals of the ECM connector.
Standard

Tester Connections	Specified Conditions
OC1+ (E4-13) - OC1- (E4-12)	Correct waveform shown

NG → **REPLACE ECM**

ES

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)

HINT:
If DTC P0011 or P0012 is present, check the VVT (Variable Valve Timing) system.

DESCRIPTION

Refer to DTC P0010 (See page ES-66).

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

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, the 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 is set when the following conditions 1), 2) and 3) are met:
1) The difference between the target and actual intake valve timings is more than 5°CA (Crankshaft Angle).
2) It takes 1 second or more to change the valve timing by 1°CA.
3) After above conditions 1) and 2) are met, the OCV is forcibly activated certain times (63 times for P0011, 12 times for P0012) or more.
DTC P0011 (Advanced Cam Timing) is subject to 1 trip detection logic.
DTC P0012 (Retarded Cam Timing) is subject to 2 trip detection logic.
These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.
The monitor will not run unless the following conditions are met:
- The engine is warm (the engine coolant temperature is 70°C [158°F] or more).
- The vehicle has been driven at more than 40 mph (64 km/h) for 3 minutes.
- The engine has idled for 3 minutes.

MONITOR STRATEGY

Related DTCs	P0011: Advance camshaft timing P0012: Retard 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	P0011: Immediate P0012: 2 driving cycles
Sequence of Operation	None

ES

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0100 - P0103 (MAF meter) 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
Throttle position learning	Completed
Engine RPM	550 to 4,000 rpm
Engine coolant temperature	70 to 100°C (167 to 212°F)

TYPICAL MALFUNCTION THRESHOLDS

Advance:

Both of the following conditions are met	-
(a) Deviation of valve timing	More than 5° CA (crankshaft angle)
(b) Valve timing	No change at advanced valve timing

Retarded:

Both of the following conditions are met	-
(a) Deviation of valve timing	More than 5° CA (crankshaft angle)
(b) 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 (Variable Valve Timing) actuator.
Then, the ECM monitors the camshaft timing change for 5 seconds.

WIRING DIAGRAM

Refer to DTC P0010 (See page ES-68).

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 an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

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

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

Result

Display (DTC output)	Proceed To
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 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) On the tester, 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.

Result

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 4

OK

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

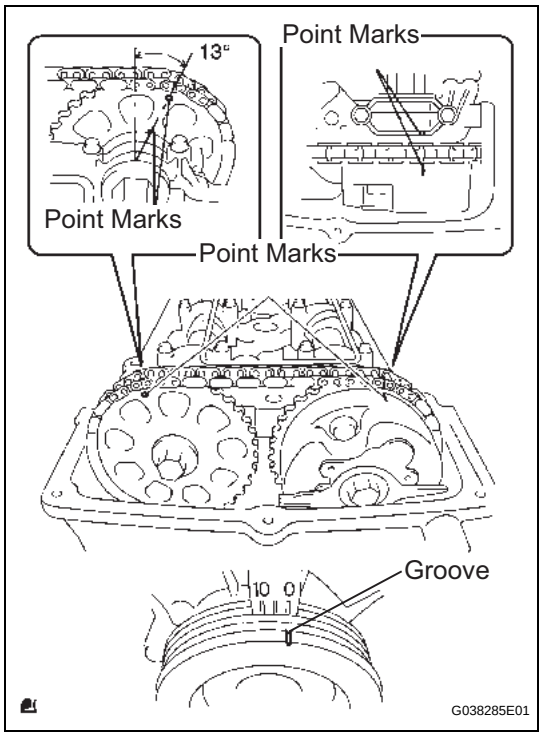
(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Clear DTCs (see page ES-40).
(d) Start the engine and warm it up.
(e) Switch the ECM from normal mode to check mode using the tester (see page ES-43).
(f) Drive the vehicle for more than 10 minutes.
(g) Read DTCs using the tester.

OK:
No DTC output.

OK → **END**

NG

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

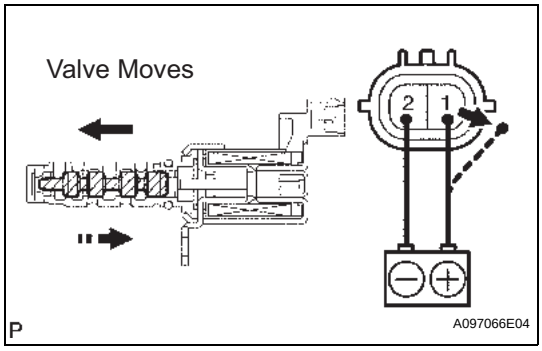


(a) Remove the cylinder head cover (see page EM-23).
(b) Turn the crankshaft pulley, and align its groove with the timing mark "0" on the timing chain cover.
(c) Check that the point marks on the camshaft timing gears are as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°) and align the marks as above.
OK:
Point marks on the camshaft timing gears are aligned as shown in illustration.
(d) Reinstall the cylinder head cover (see page EM-32).

NG → **ADJUST VALVE TIMING**

OK

5 INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

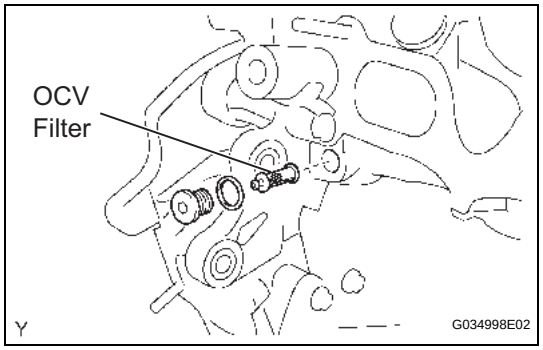


(a) Remove the OCV.
(b) Measure the resistance between the terminals of the OCV.
Standard Resistance:
6.9 to 7.9 Ωat 20°C (68°F)
(c) Apply the positive battery voltage to terminal 1 and negative battery voltage to terminal 2. Check the valve operation.
OK:
Valve moves quickly.
(d) Reinstall the OCV.

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

OK

6	INSPECT OIL CONTROL VALVE FILTER



(a) Remove the OCV filter.
(b) Check that the filter is not clogged.
OK:
Filter is not clogged.
(c) Reinstall the OCV filter.

NG → **CLEAN OIL CONTROL VALVE FILTER**

OK

REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

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

DESCRIPTION

Refer to DTC P0335 (See page ES-171).

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 33°CA, or more than 51°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 jumped a tooth.

This monitor begins to run after the engine has idled for 5 minutes.

MONITOR STRATEGY

Related DTCs	P0016: Camshaft timing (bank 1) misalignment
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 60 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0011 (VVT system 1 - advance) P0012 (VVT system 1 - retard) P0115 - P0118 (ECT sensor)
Engine RPM	550 to 1,000 rpm

TYPICAL MALFUNCTION THRESHOLDS

Valve timing when camshaft retarded maximum	Less than 33°, or more than 51°

WIRING DIAGRAM

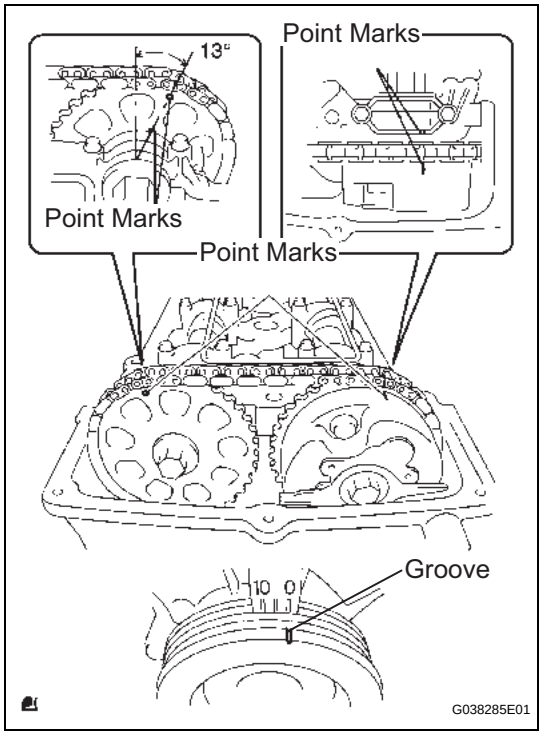
Refer to DTC P0335 (See page ES-173).

HINT:

- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.
- After replacing the ECM or adjusting intake valve timing, confirm that the DTC output does not recur.
  (a) Connect an intelligent tester to the DLC3.
  (b) Turn the ignition switch to ON.
  (c) Turn the tester ON.
  (d) Clear DTCs (see page ES-40).
  (e) Switch the ECM from normal mode to check mode using the tester (see page ES-43).
  (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.

ES

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



(a) Remove the cylinder head cover.
(b) Turn the crankshaft pulley, and align its groove with the timing mark "0" on the timing chain cover.
(c) Check that the point marks on the camshaft timing gears are as shown in the illustration.

If not, turn the crankshaft 1 revolution (360°) and align the marks as above.

OK:

Point marks on camshaft timing gears are aligned as shown in illustration.

(d) Reinstall the cylinder head cover.

NG → **ADJUST VALVE TIMING**

OK ↓

REPLACE ECM

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

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

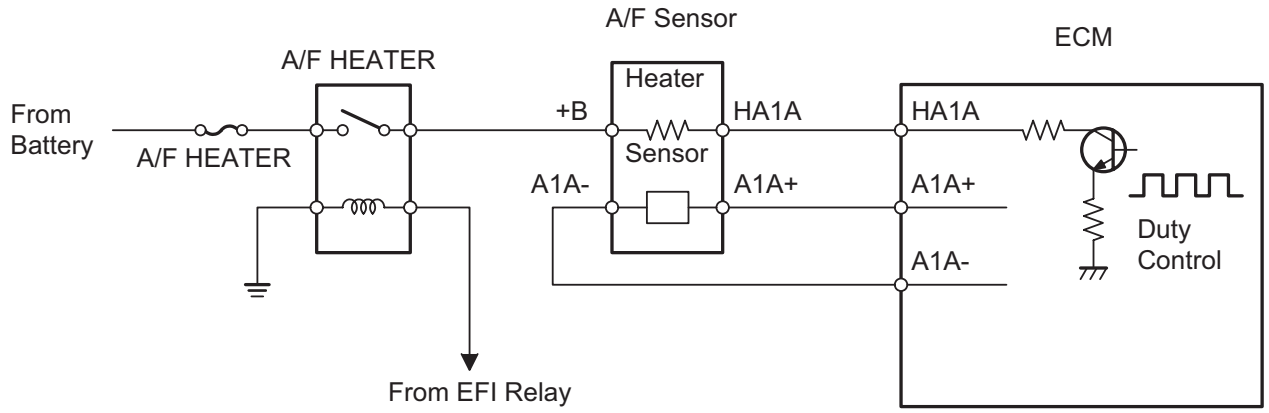
HINT:
- Although the DTC titles say the oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.

DESCRIPTION

ES

Refer to DTC P2195 (See page ES-312).
HINT:
- When either 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 to 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 (Bank 1 Sensor 1 System Diagram)



P

A118002E04

DTC No.	DTC Detection Conditions	Trouble Areas
P0031	Air-Fuel Ratio (A/F) sensor heater current less than 0.8 A (1 trip detection logic)	• Open in A/F sensor heater circuit • A/F sensor heater • A/F HEATER relay • ECM
P0032	Air-Fuel Ratio (A/F) sensor heater current more than 10 A (1 trip detection logic)	• Short in A/F sensor heater circuit • A/F sensor heater • A/F HEATER 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 range check (Low current) P0032: A/F sensor heater range check (High current)
Required Sensors/Components (Main)	A/F sensor heater
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	10 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0031:

Monitor runs whenever following DTCs 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 following DTCs 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	1.8 to 3.4 A at 20°C (68°F)

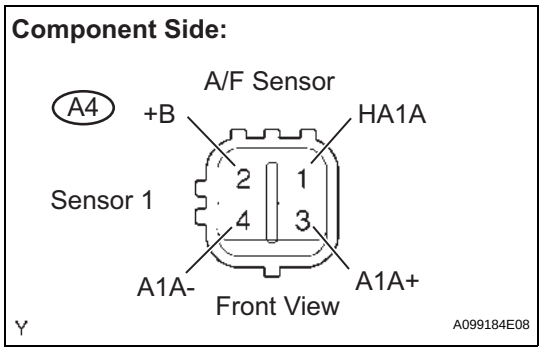
WIRING DIAGRAM

Refer to DTC P2195 (See page ES-316).

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

ES

1 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the A4 Air-Fuel Ratio (A/F) sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor connector.
Standard Resistance

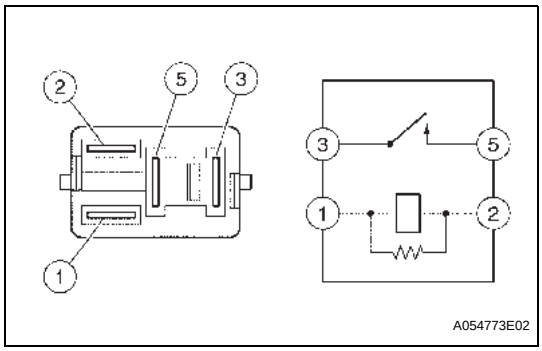
Tester Connections	Specified Conditions
HA1A (1) - +B (2)	1.8 Ωto 3.4 Ω at 20°C (68°F)
HA1A (1) - A1A- (4)	10 kΩ or higher

(c) Reconnect the A/F sensor connector.

NG → REPLACE AIR FUEL RATIO SENSOR

OK

2 INSPECT AIR FUEL RATIO SENSOR HEATER RELAY (A/F HEATER RELAY)



(a) Remove the A/F HEATER relay from the engine room R/B.
(b) Check the A/F HEATER relay resistance.
Standard Resistance

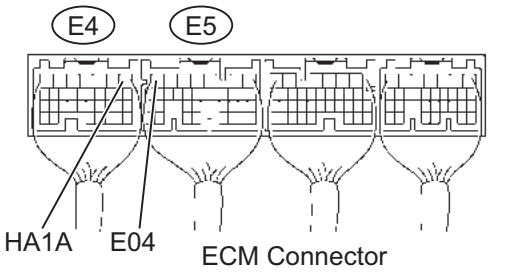
Tester Connections	Specified Conditions
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the A/F HEATER relay.

NG → REPLACE AIR FUEL RATIO SENSOR HEATER RELAY

OK

3 INSPECT ECM (HA1A VOLTAGE)



(a) Turn the ignition switch to ON.
(b) Measure the voltage between the terminals of the E4 and E5 ECM connectors.

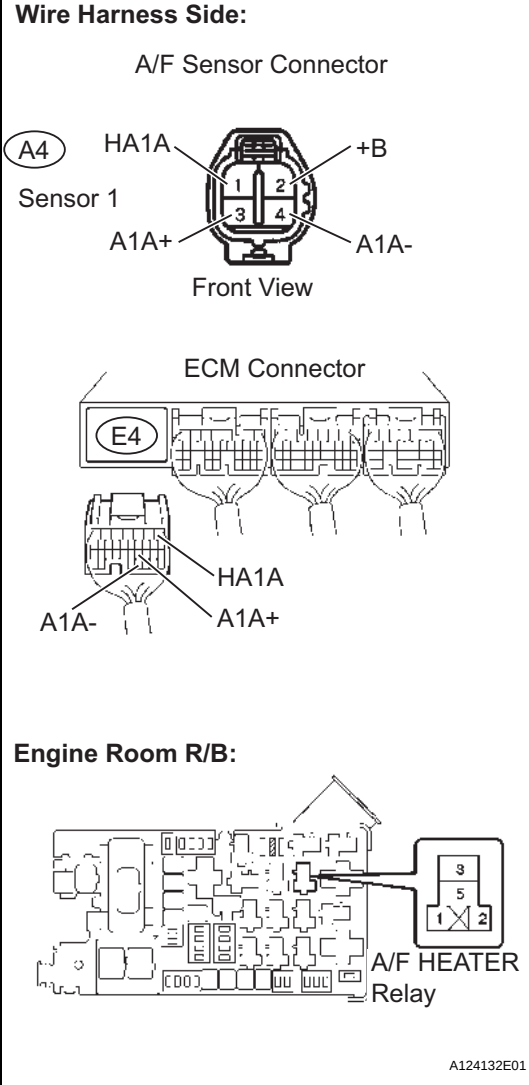
Standard Voltage

Tester Connections	Specified Conditions
HA1A (E4-1) - E04 (E5-7)	9 to 14 V

OK → **REPLACE ECM**

NG

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



(a) Check the harness and connectors between the ECM and A/F sensor.
  (1) Disconnect the A4 A/F sensor connector.
  (2) Disconnect the E4 ECM connector.
  (3) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
HA1A (A4-1) - HA1A (E4-1)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
HA1A (A4-1) or HA1A (E4-1) - Body ground	10 kΩor higher

  (4) Reconnect the A/F sensor connector.
  (5) Reconnect the ECM connector.

(b) Check the harness and connector between the A/F sensor and A/F HEATER relay.
  (1) Disconnect the A4 A/F sensor connector.
  (2) Remove the A/F HEATER relay from the engine room R/B.
  (3) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
+B (A4-2) - A/F HEATER relay (3)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
+B (A4-2) or A/F HEATER relay (3) - Body ground	10 kΩor higher

  (4) Reconnect the A/F sensor connector.
  (5) Reinstall the A/F HEATER relay.

OK → **REPLACE ECM**

ES

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

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

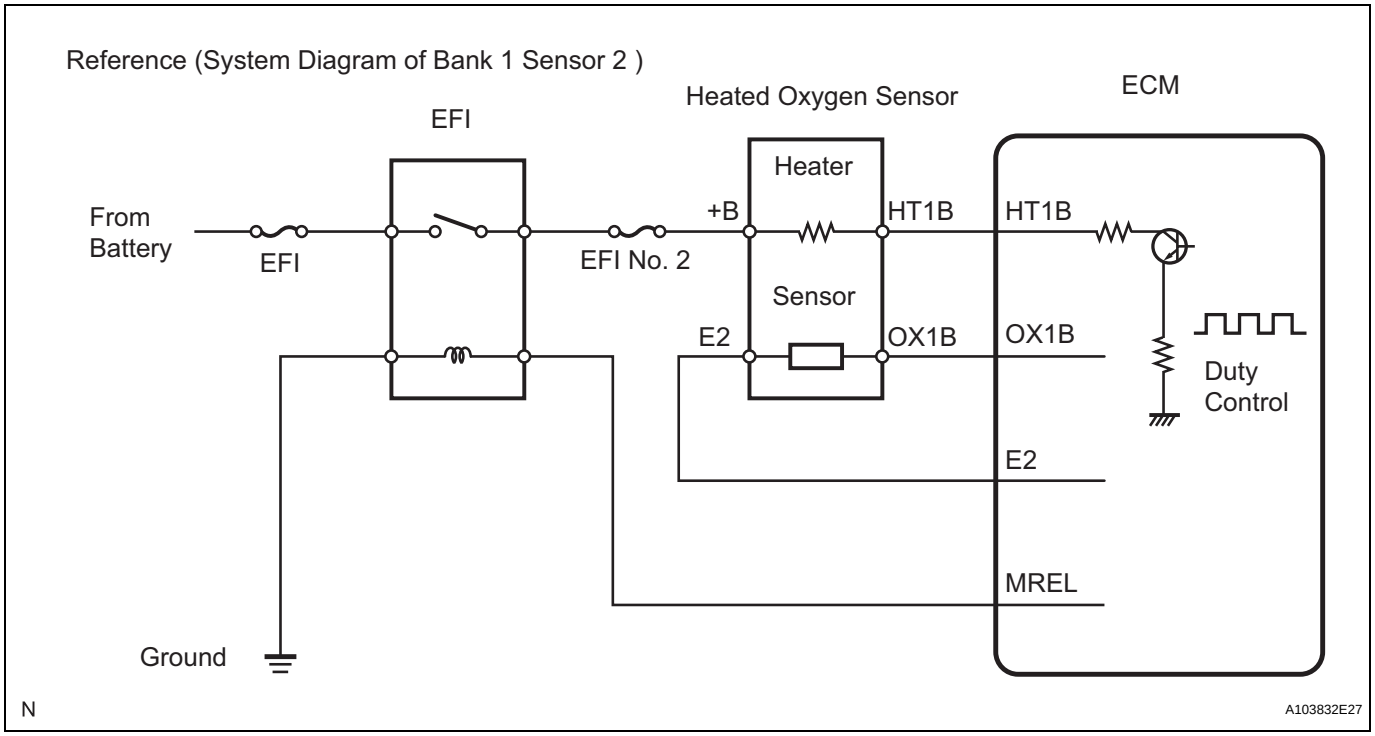
DTC	P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

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

DESCRIPTION

Refer to DTC P0136 (See page ES-126).
HINT:

- When either of these DTCs are set, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned to OFF.
- The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the B+ side of the circuit.



DTC No.	DTC Detection Conditions	Trouble Areas
P0037	Heated Oxygen (HO2) sensor heater current less than 0.3 A (1 trip detection logic)	• Open or short in HO2 sensor heater circuit • HO2 sensor heater • EFI relay • ECM
P0038	Heated Oxygen (HO2) sensor heater current more than 2 A (1 trip detection logic)	• Open or short in HO2 sensor heater circuit • HO2 sensor heater • 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

Related DTCs	P0037: Heated oxygen sensor heater range check (Low current) P0038: Heated oxygen sensor heater range check (High current)
Required Sensors/Components (Main)	Heated oxygen sensor heater
Required Sensors/Components (Related)	Vehicle speed sensor
Frequency of Operation	Continuous
Duration	P0037: 0.5 seconds P0038: 0.3 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0037:

Monitor runs whenever following DTCs not present	None
Battery voltage	10.5 V or more
All heaters turned OFF and intrusive heating operated when following conditions met:	(a) and (b)
(a) Heater	ON
(b) Heater current	Less than 0.3 A

P0038 Case 1:

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

P0038 Case 2:

Monitor runs whenever following DTCs not present	None
Battery voltage	10.5 V or more
All heaters turned OFF and intrusive heating operated when following conditions met:	(a) and (b)
(a) Heater	ON
(b) Heater current	More than 2 A

TYPICAL MALFUNCTION THRESHOLDS

P0037:

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

P0038 Case 1:

Heated oxygen sensor heater current	More than 2 A

P0038 Case 2:

Heated oxygen sensor heater current during intrusive heating	2 A or more

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)

WIRING DIAGRAM

Refer to DTC P0136 (See page ES-133).

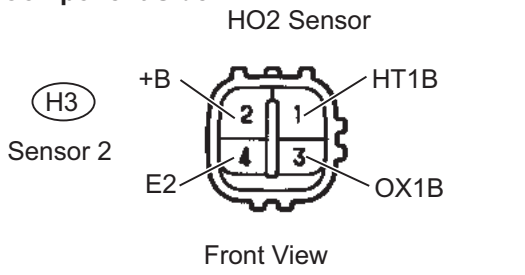
HINT:

- 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 a intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

ES

1 INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

Component Side:



(a) Disconnect the H3 Heated Oxygen (HO2) sensor connector.

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

Standard Resistance

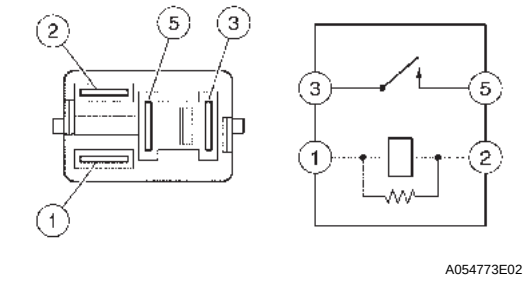
Tester Connections	Specified Conditions
HT1B (1) - +B (2)	11 to 16 Ωat 20°C (68°F)
HT1B (1) - E2 (4)	10 kΩ or higher

(c) Reconnect the HO2 sensor connector.

NG → **REPLACE HEATED OXYGEN SENSOR**

OK

2 INSPECT EFI RELAY



(a) Remove the EFI relay from the engine room R/B.

(b) Check the EFI relay resistance.

Standard Resistance

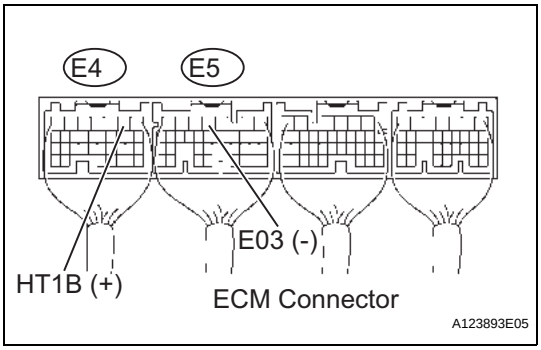
Tester Connections	Specified Conditions
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the EFI relay.

NG → **REPLACE EFI RELAY**

OK

3	INSPECT ECM (HT1B VOLTAGE)



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

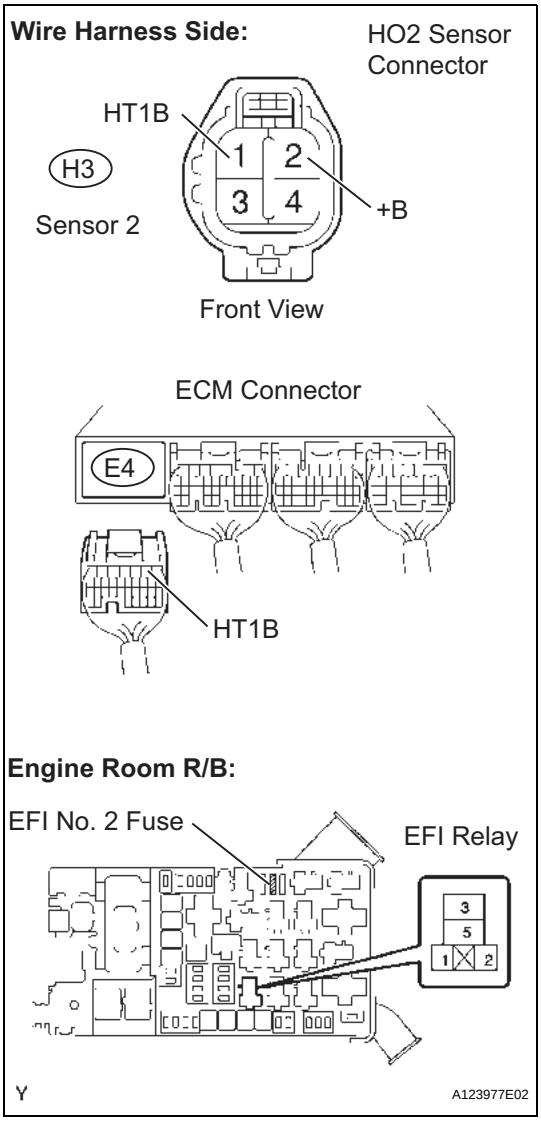
Standard Voltage

Tester Connections	Specified Conditions
HT1B (E4-2) - E03 (E5-4)	9 to 14 V

OK → REPLACE ECM

NG

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



(a) Check the harness and connectors between the ECM and HO2 sensor.
  (1) Disconnect the H3 HO2 sensor connector.
  (2) Disconnect the E4 ECM connector.
  (3) Check the resistance.

Standard Resistance (Check for open):

Tester Connections	Specified Conditions
HT1B (H3-1) - HT1B (E4-2)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
HT1B (H3-1) or HT1B (E4-2) - Body ground	10 kΩ or higher

  (4) Reconnect the HO2 sensor connector.
  (5) Reconnect the ECM connector.

(b) Check the harness and connector between the HO2 sensor and EFI relay.
  (1) Inspect the EFI No. 2 fuse.
    • Remove the EFI No. 2 fuse from the engine room R/B.
    • Check the EFI No. 2 fuse resistance.
      Standard Resistance:
      Below 1 Ω
    • Reinstall the EFI No. 2 fuse.
  (2) Disconnect the H3 HO2 sensor connector.
  (3) Remove the EFI relay from the engine room R/B.
  (4) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
+B (H3-2) - EFI relay (3)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
+B (H3 - 2) or EFI relay (3) - Body ground	10 kΩ or higher

(5) Reconnect the HO2 sensor connector.
(6) Reinstall the EFI relay.

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

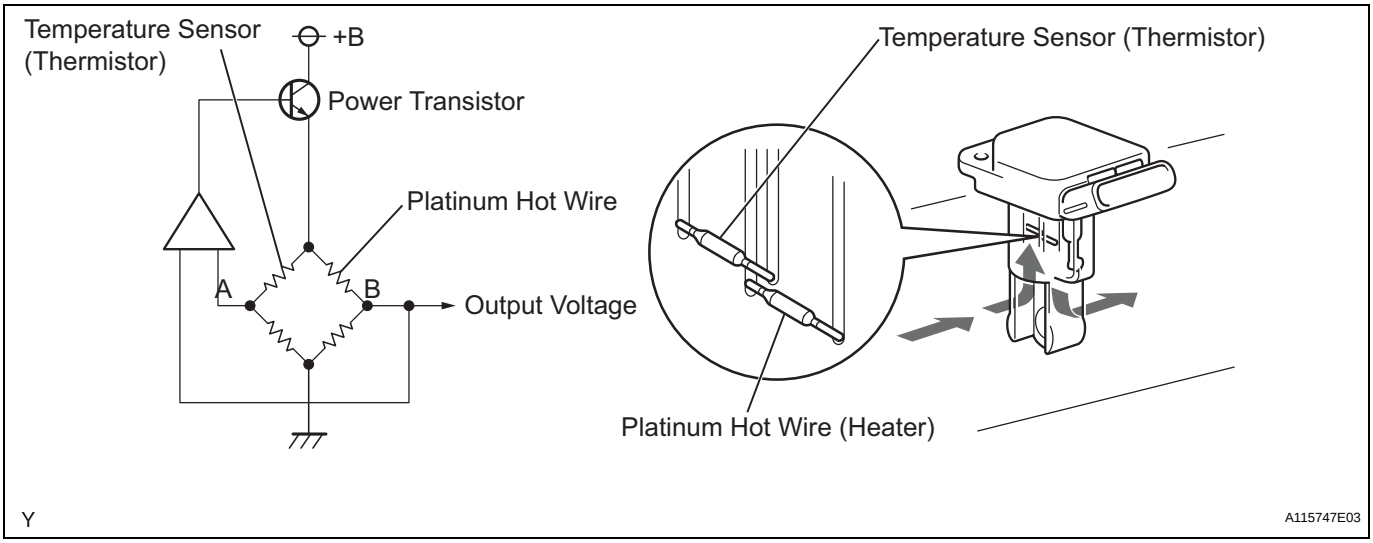
The Mass Air Flow (MAF) meter is a sensor that measures the amount of air flowing through the throttle valve.

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 Conditions	Trouble Areas
P0100	Mass Air Flow (MAF) meter voltage less than 0.2 V, or more than 4.9 V for 3 seconds	• Open or short in MAF meter circuit • MAF meter • ECM
P0102	Mass Air Flow (MAF) meter voltage less than 0.2 V for 3 seconds	• Open or short in MAF meter circuit • MAF meter • ECM
P0103	Mass Air Flow (MAF) meter more than 4.9 V for 3 seconds	• Open or short in MAF meter circuit • MAF meter • ECM

HINT:

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

Mass Air Flow Rate (g/sec)	Malfunctions
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 following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0100:

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

P0102:

MAF meter voltage	Less than 0.2 V

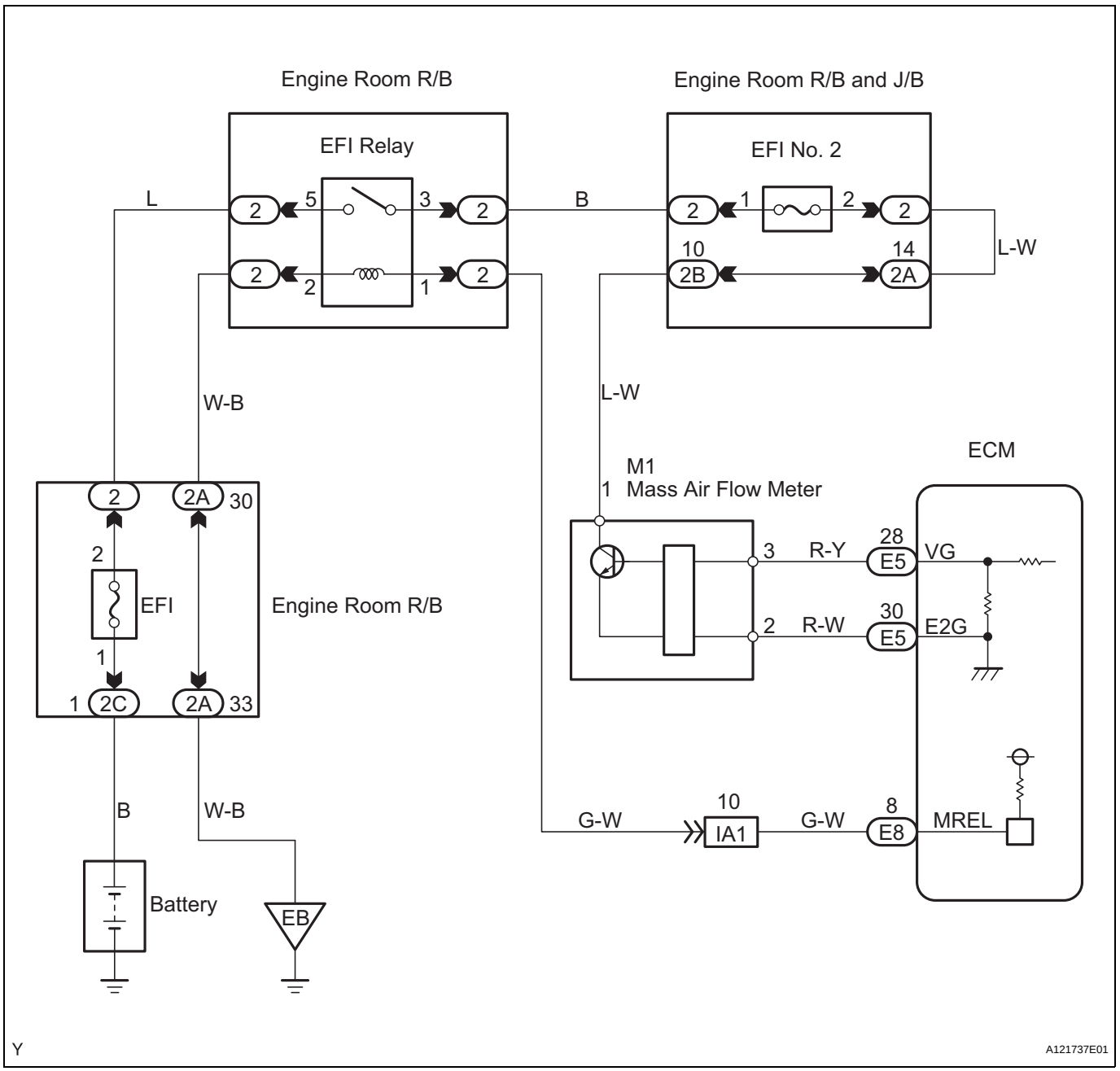
P0103:

MAF meter voltage	More than 4.9 V

COMPONENT OPERATING RANGE

MAF meter voltage	Between 0.4 V and 2.2 V

WIRING DIAGRAM



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

1	READ DATA LIST (MASS AIR FLOW RATE)

(a) Connect an intelligent tester to the DLC3.
(b) Start the engine.
(c) Turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / MAF.

(e) Read the values displayed on the tester.
Result

Mass Air Flow Rate (g/sec)	Proceed To
0.0	A
271.0 or more	B
Between 1.0 and 270.0 (*1)	C

*1: The value must be changed when the throttle valve is open or closed.

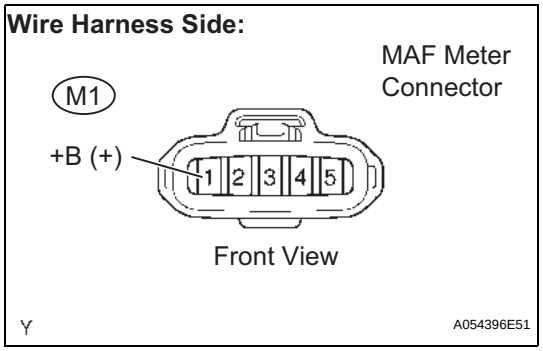
B → Go to step 6

C → CHECK FOR INTERMITTENT PROBLEMS

A

ES

2 INSPECT MASS AIR FLOW METER (POWER SOURCE VOLTAGE)



(a) Disconnect the M1 Mass Air Flow (MAF) meter connector.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between the terminal of the wire harness side connector and body ground.
Standard Voltage

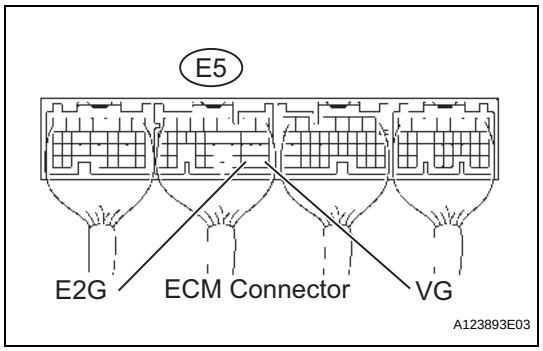
Tester Connections	Specified Conditions
+B (M1-1) - Body ground	9 to 14 V

(d) Reconnect the MAF meter connector.

NG → Go to step 5

OK

3 INSPECT ECM (VG VOLTAGE)



(a) Start the engine.
(b) Measure the voltage between the terminals of the ECM connector.
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

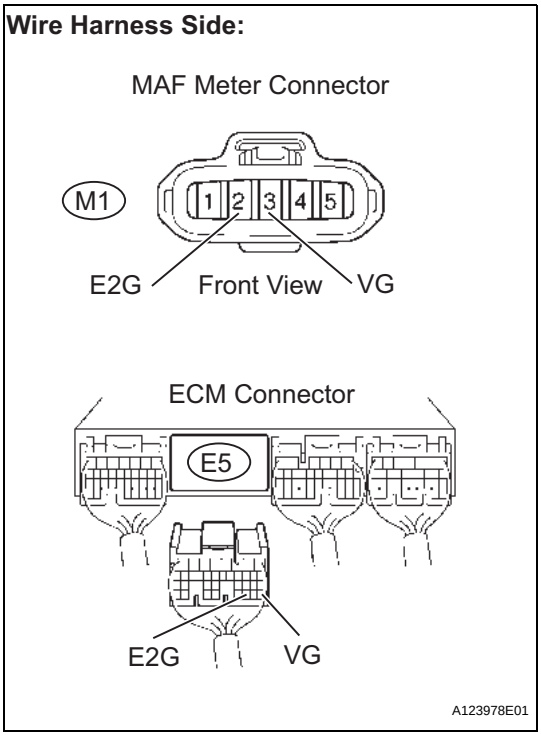
Tester Connections	Engine Conditions	Specified Conditions
VG (E5-28) - E2G (E5-30)	Engine idling	0.5 to 3.0 V

OK → REPLACE ECM

NG

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

Wire Harness Side:



(a) Disconnect the M1 MAF meter connector.
(b) Disconnect the E5 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
VG (M1-3) - VG (E5-28)	Below 1 Ω
E2G (M1-2) - E2G (E5-30)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
VG (M1-3) or VG (E5-28) - Body ground	10 kΩ or higher

(d) Reconnect the MAF meter connector.
(e) Reconnect the ECM connector.

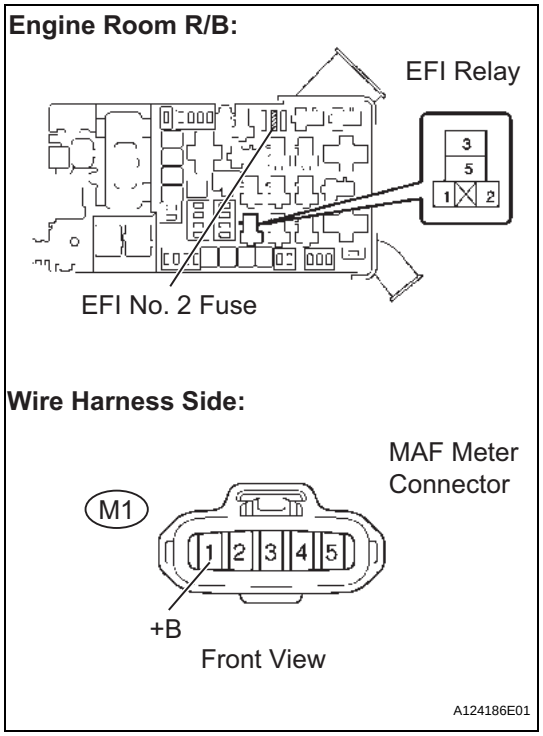
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

REPLACE MASS AIR FLOW METER

ES

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



(a) Inspect the EFI No. 2 fuse.
  (1) Remove the EFI No. 2 fuse from the engine room R/B.
  (2) Check the EFI No. 2 fuse resistance.
    Standard Resistance:
    Below 1Ω
  (3) Reinstall the EFI No. 2 fuse.
(b) Remove the EFI relay from the engine room R/B.
(c) Disconnect the M1 MAF meter connector.
(d) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
+B (M1-1) - EFI relay (3)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
+B (M1-1) or EFI relay (3) - Body ground	10 kΩ or higher

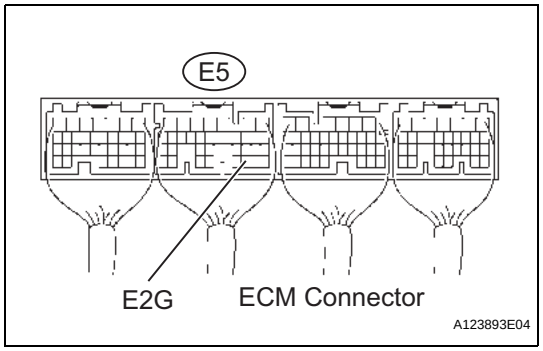
(e) Reconnect the MAF meter connector.
(f) Reinstall the EFI relay.

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

OK

INSPECT ECM POWER SOURCE CIRCUIT

6 INSPECT ECM (SENSOR GROUND)



(a) Check the resistance.

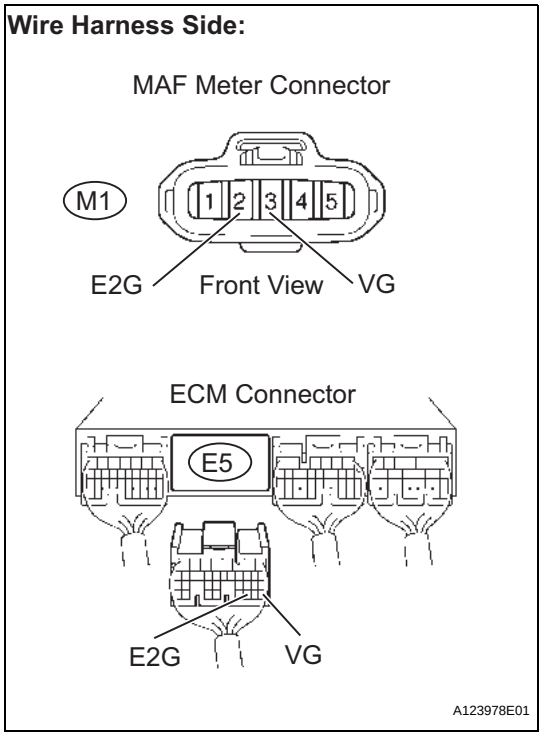
Standard Resistance

Tester Connections	Specified Conditions
E2G (E5-30) - Body ground	Below 1 Ω

NG → **REPLACE ECM**

OK

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



(a) Disconnect the M1 MAF meter connector.
(b) Disconnect the E5 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
VG (M1-3) - VG (E5-28)	Below 1 Ω
E2G (M1-2) - E2G (E5-30)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
VG (M1-3) or VG (E5-28) - Body ground	10 kΩ or higher

(d) Reconnect the MAF meter connector.
(e) Reconnect the ECM connector.

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

OK

REPLACE MASS AIR FLOW METER

DTC	P0101	Mass Air Flow Circuit Range / Performance Problem

DESCRIPTION

Refer to DTC P0100 (See page ES-88).

DTC No.	DTC Detection Conditions	Trouble Area
P0101	High voltage: Conditions (a), (b) and (c) continue for more than 10 seconds (2 trip detection logic): (a) Engine speed less than 2,000 rpm (b) Engine coolant temperature 70°C (158°F) or higher (c) Voltage output of Mass Air Flow (MAF) meter more than 2.2 V (varies with Throttle Position [TP] sensor voltage) Low voltage: Conditions (a) and (b) continue for more than 10 seconds (2 trip detection logic): (a) Engine speed more than 300 rpm (b) Voltage output of MAF meter less than 0.93 V (varies with TP sensor voltage)	MAF meter

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 0.93 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, 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 following DTCs not present	P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (insufficient ECT for closed loop) P0335 (CKP sensor) P0340, P0341 (CMP sensor)

Mass air flow meter rationality (High voltage)

Engine speed	Less than 2,000 rpm

Engine coolant temperature	70°C (158°F) or more

Mass air flow meter rationality (Low voltage)

Engine speed	More than 300 rpm
Mass air flow meter voltage	0.2 V or more
Fuel cut	OFF

TYPICAL MALFUNCTION THRESHOLDS

Mass air flow meter rationality (High voltage)

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

Mass air flow meter rationality (Low voltage)

Mass air flow meter voltage	Less than 0.93 V (varies with throttle position sensor voltage)

ES

WIRING DIAGRAM

Refer to DTC P0100 (See page ES-90).

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.

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

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

Result

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

HINT:
If any 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

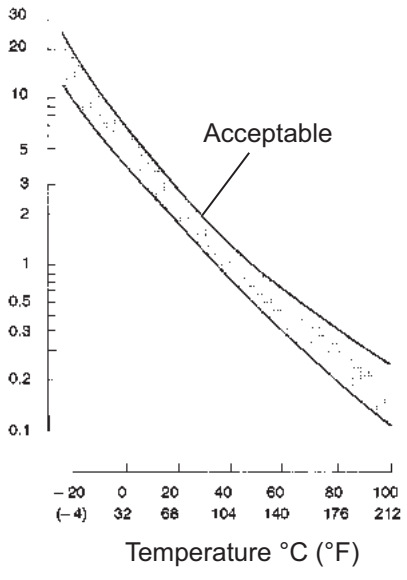
The Intake Air Temperature (IAT) sensor, built into the Mass Air Flow (MAF) meter, monitors the intake air temperature. The IAT sensor has a thermistor that varies its resistance depending on the intake air temperature. When the intake air temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. The variations in resistance are reflected as voltage changes to the ECM terminal (see Fig. 1).

The IAT sensor is connected to the ECM. The 5 V power source voltage in the ECM is applied to the IAT sensor from terminal THA via resistor R.

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

ES

Fig. 1



HINT:

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

DTC No.	Proceed To	DTC Detection Conditions	Trouble Areas
P0110	Step 1	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	Step 4	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	Step 2	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 Intake Air Temperature (IAT) by selecting the following menu items on an intelligent tester: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.

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

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the intake air temperature. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the IAT sensor and sets a DTC.
Example:
If the sensor voltage output is more than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the IAT sensor circuit, and sets DTC P0113. Conversely, if the voltage output is less than 0.18 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and sets DTC P0112.
If the malfunction is not repaired successfully, a DTC is set 0.5 seconds after the engine is next started.

ES

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Monitor will run whenever these 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 [intake air temperature]	Less than 0.18 V [more than 140°C (284°F)]

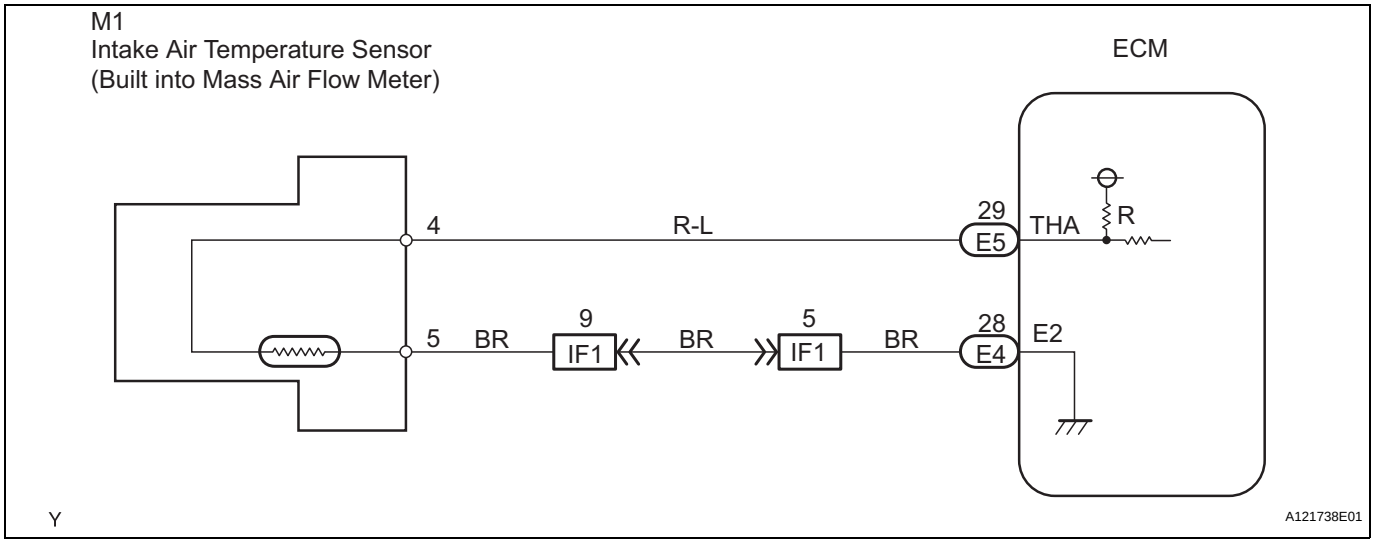
P0113:

IAT sensor voltage [intake air temperature]	More than 4.91 V [less than -40°C (-40°F)]

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM



ES

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. 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.

1	READ DATA LIST (INTAKE AIR TEMPERATURE)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the intelligent tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(d) Read the values displayed on the tester.

Standard:

Same value as actual IAT.

Result

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

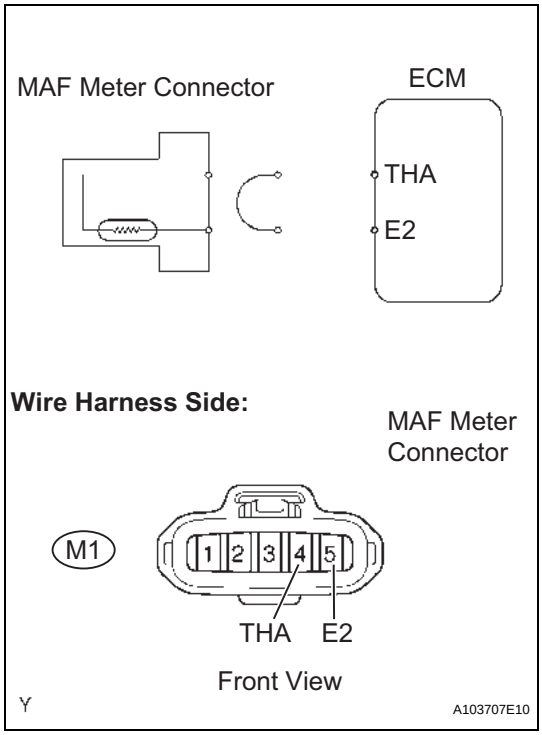
HINT:

- 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).

B	Go to step 4
C	CHECK FOR INTERMITTENT PROBLEMS

A

2	READ DATA LIST (CHECK FOR OPEN IN WIRE HARNESS)

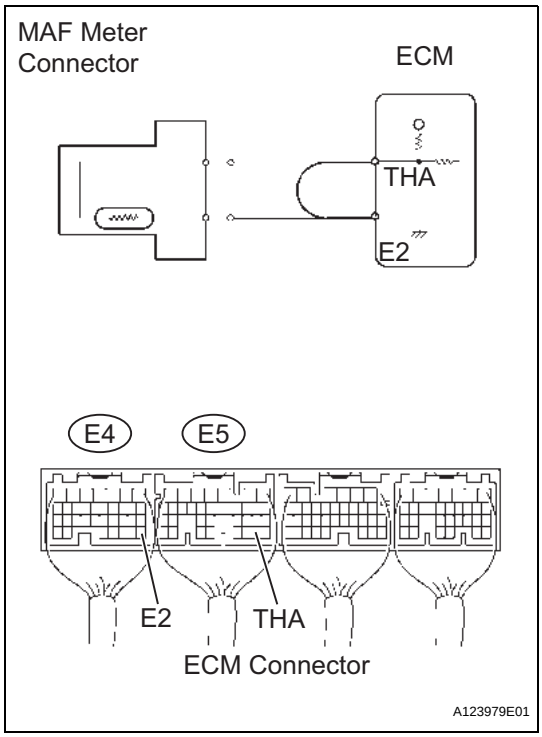


(a) Disconnect the M1 MAF meter connector.
(b) Connect terminals THA and E2 of the MAF meter wire harness side connector.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the intelligent tester ON.
(e) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(f) Read the value displayed on the tester.
Standard:
140°C (284°F)
(g) Reconnect the MAF meter connector.

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

NG

3	READ DATA LIST (CHECK FOR OPEN IN ECM)



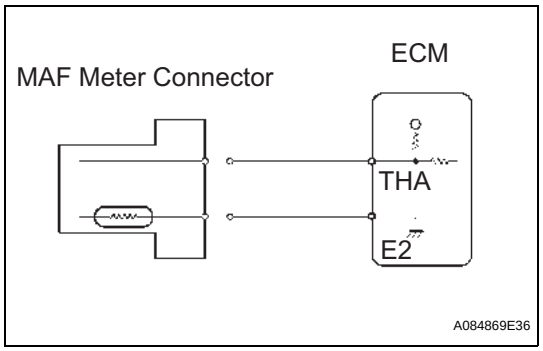
(a) Disconnect the M1 MAF meter connector.
(b) Connect terminals THA and E2 of the ECM connector.
HINT:
Before checking, do a visual and contact pressure check for the ECM connector.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the intelligent tester ON.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

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

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

4 READ DATA LIST (CHECK FOR SHORT IN WIRE HARNESS)

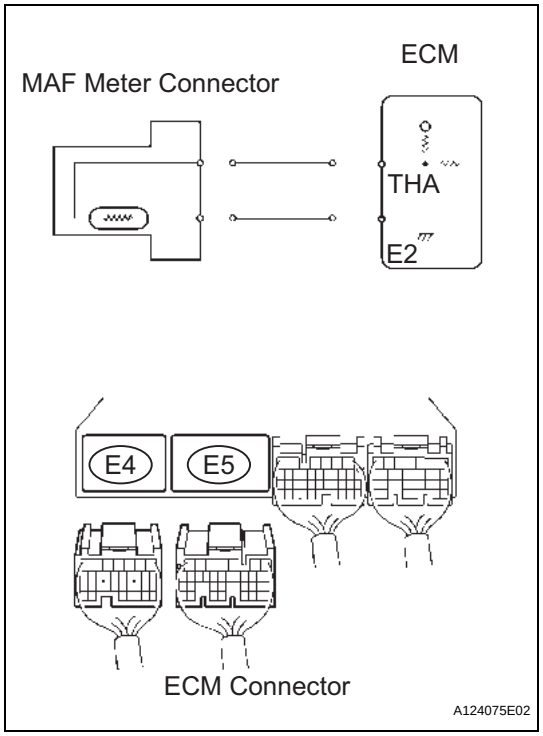


(a) Disconnect the M1 MAF meter connector.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch to ON and turn the intelligent tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(e) Read the value displayed on the tester.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

OK → **REPLACE MASS AIR FLOW METER**

NG

5 READ DATA LIST (CHECK FOR SHORT IN ECM)



(a) Disconnect the E4 and E5 ECM connector.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch to ON and turn the intelligent tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(e) Read the value displayed on the tester.
Standard:
-40°C (-40°F)
(f) Reconnect the ECM connectors.

NG → **REPLACE ECM**

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

ES

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 connection to the ECM is the same as 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.

ES

DTC No.	Proceed To	DTC Detection Condition	Trouble Area
P0115	Step 1	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	Step 4	Short in ECT sensor circuit for 0.5 seconds (1 trip detection logic)	• Short in ECT sensor circuit • ECT sensor • ECM
P0118	Step 2	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 an intelligent tester: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.

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

MONITOR DESCRIPTION

The ECT sensor is used to monitor the engine coolant temperature. The ECT sensor has a thermistor that varies its resistance depending on the temperature of the engine coolant. When the coolant temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. The variations in resistance are reflected in the voltage output from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the 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 more than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the ECT sensor circuit, and sets DTC P0118. Conversely, if the voltage output is less than 0.14 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and sets DTC P0117.
If the malfunction is not repaired successfully, a DTC is set 0.5 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0115: ECT sensor range check (Fluctuating) P0117: ECT sensor range check (Low voltage) P0118: ECT sensor range check (High voltage)
Required Sensors/Components (Main)	ECT sensor

Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0115:

ECT sensor voltage [Engine coolant temperature]	Less than 0.14 V or more than 4.91 V

P0117:

ECT sensor voltage [Engine coolant temperature]	Less than 0.14 V [more than 140°C (284°F)]

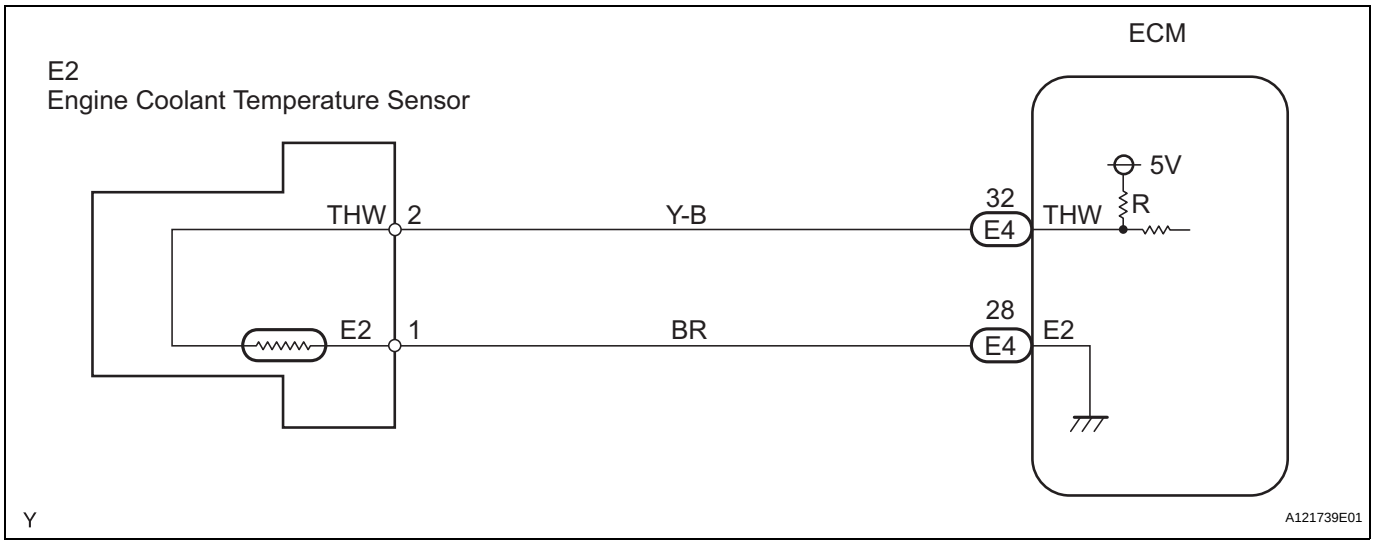
P0118:

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

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM



HINT:

- If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	READ DATA LIST (ENGINE COOLANT TEMPERATURE)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the intelligent tester ON.
(c) Select the following menus items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(d) Read the value displayed on the tester.

Standard:

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

Result

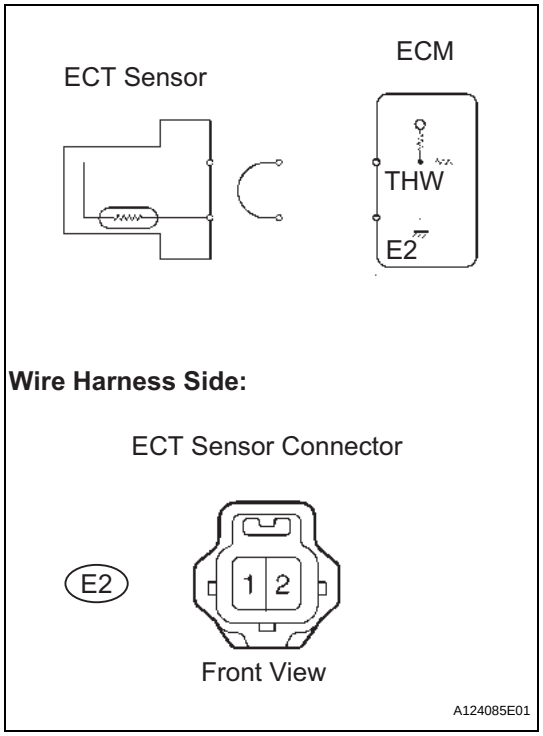
Temperature Displayed	Proceed to
-40°C (-40°F)	A
140°C (284°F)	B
Between 80°C and 97°C (176°F and 207°F)	C

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).

B	Go to step 4
C	CHECK FOR INTERMITTENT PROBLEMS

A

2 READ DATA LIST (CHECK FOR OPEN IN WIRE HARNESS)

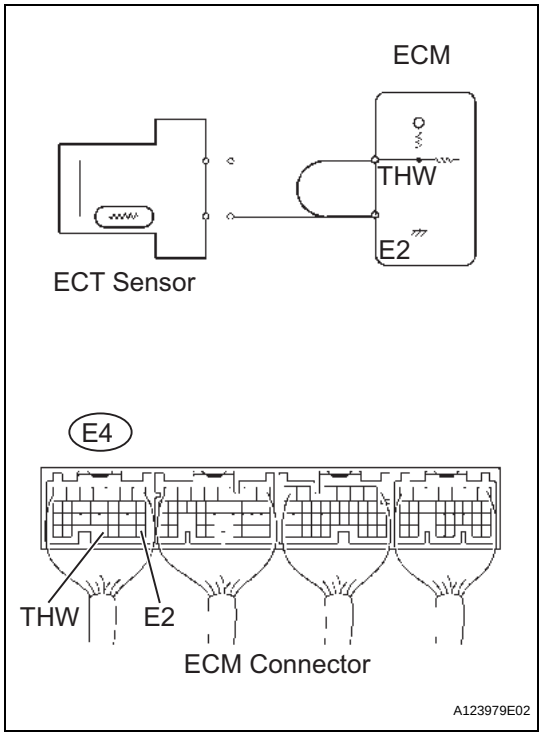


(a) Disconnect the E2 Engine Coolant Temperature (ECT) sensor connector.
(b) Connect terminals 1 and 2 of the ECT sensor connector on the wire harness side.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the intelligent tester ON.
(e) Select the following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

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

NG

3 READ DATA LIST (CHECK FOR OPEN IN ECM)



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

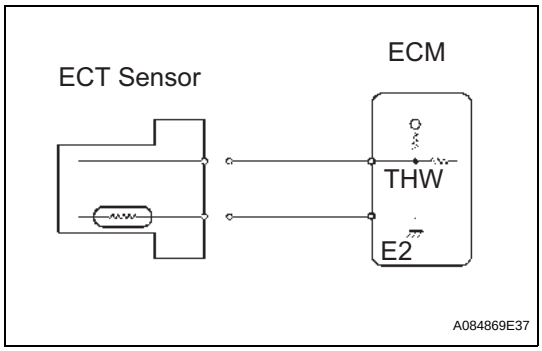
NG → **CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM**

ES

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

4	READ DATA LIST (CHECK FOR SHORT IN WIRE HARNESS)

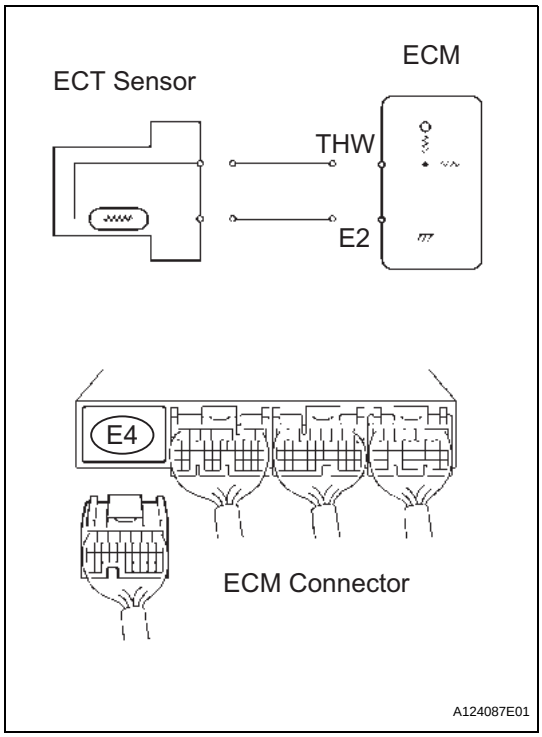


(a) Disconnect the E2 ECT sensor connector.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch to ON and turn the intelligent tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(e) Read the value displayed on the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

OK → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

NG

5	READ DATA LIST (CHECK FOR SHORT IN ECM)



(a) Disconnect the E4 ECM sensor connector.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch to ON and turn the intelligent tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(e) Read the value displayed on the tester.
Standard:
-40°C (-40°F)
(f) Reconnect the ECM sensor connector.

NG → **REPLACE ECM**

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

DTC	P0116	Engine Coolant Temperature Circuit Range / Performance Problem

DESCRIPTION

Refer to DTC P0115 (See page ES-102).

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

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

MONITOR STRATEGY

Related DTCs	P0116: Engine coolant temperature sensor output stuck at low engine coolant temperature P0116: Engine coolant temperature sensor output stuck at high engine coolant temperature
Required Sensors/Components (Main)	ECT sensor
Required Sensors/Components (Related)	Crankshaft position sensor, IAT sensor, MAF meter
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	2 driving cycles: ECT sensor stuck (low ECT) 6 driving cycles: ECT sensor stuck (high ECT)
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0100 - P0103 (MAF meter)

ECT sensor stuck (low ECT):

Cumulative idle off period	250 seconds or more
Speed increase of 30 km/h (19 mph) or more	10 times or more

ECT	35 to 60°C (95 to 140°F)
IAT	-6.7°C (20°F) or more

ECT sensor stuck (high ECT):

ECT	60°C (140°F) or more
IAT	-6.7°C (20°F) or more
Stop and go*1	Once or more
Steady driving and stop*2	Once or more
Engine running time after engine start	0.3 seconds or more

HINT:

*1: Vehicle is stopped for 20 seconds or more and accelerated to more than 70 km/h (44 mph) within 40 seconds.

*2: Follow these steps: 1) vehicle is driven at 65 km/h (40 mph) or more for 30 seconds or more and the vehicle speed reaches 70 km/h (44 mph); 2) vehicle is decelerated from 65 km/h (40 mph) to 3 km/h (2 mph) or less within 35 seconds; and 3) vehicle is stopped for 10 seconds.

ES

TYPICAL MALFUNCTION THRESHOLDS

ECT sensor stuck (low ECT):

ECT change	Less than 3°C (5.4°F)

ECT sensor stuck (high ECT):

ECT change	1°C (1.8°F) or less

COMPONENT OPERATING RANGE

ECT	Varies with actual ECT

WIRING DIAGRAM

Refer to DTC P0115 (See page ES-103).

HINT:

- If any of DTCs P0115, P0117, P0118 or P0125 are set simultaneously with DTC P0116, the ECT sensor may have an open or a short circuit. Troubleshoot those DTCs first.
- Read freeze frame data using the intelligent tester. 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.

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

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

Result

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

HINT:
If any DTCs other than P0116 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART

A

REPLACE ENGINE COOLANT TEMPERATURE SENSOR

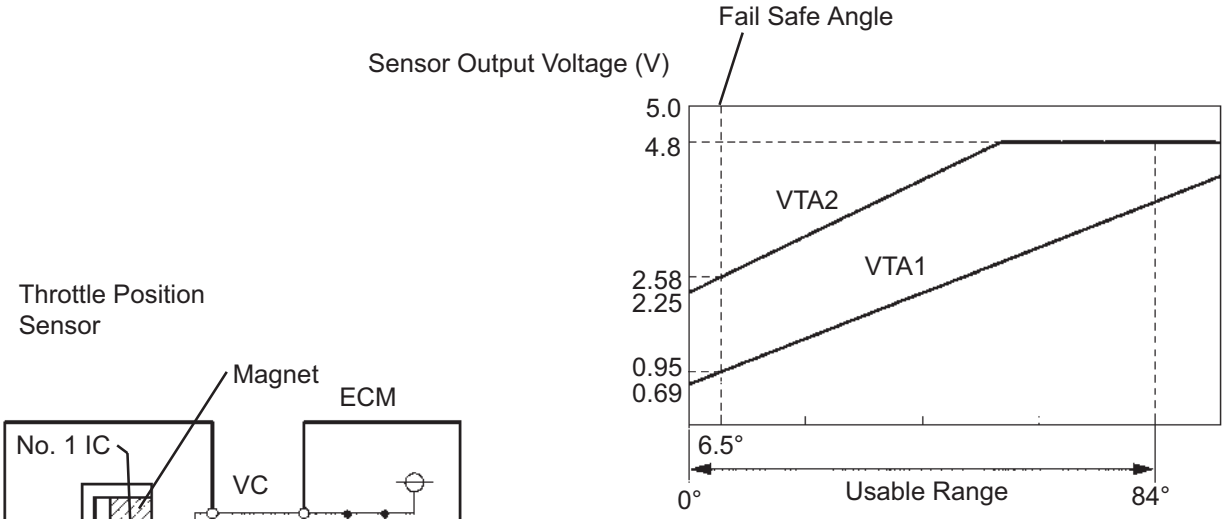
DTC	P0120	Throttle / Pedal Position Sensor / Switch "A" Circuit
DTC	P0122	Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input
DTC	P0123	Throttle / Pedal Position Sensor / Switch "A" Circuit High Input
DTC	P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit
DTC	P0222	Throttle / Pedal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

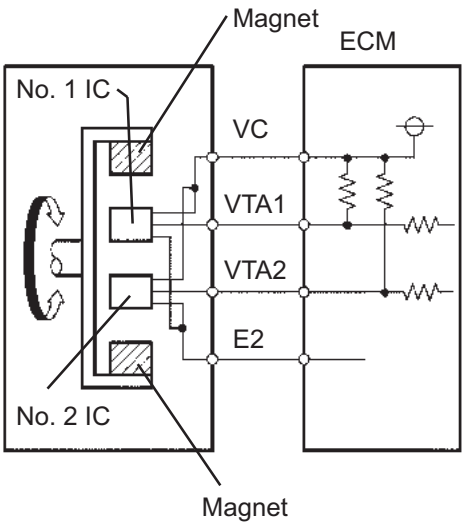
ES

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

DESCRIPTION

HINT:
The Throttle Position (TP) sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type, and uses Hall-effect elements, in order to yield accurate signals, even in extreme driving conditions, such as at high speeds as well as very low speeds. The TP sensor has two sensor circuits which each transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel-cut control.





Note:

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

Between 10 % and 22 %: Throttle valve fully closed

Between 66 % 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 (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 (1 trip detection logic)	• Throttle position (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 (1 trip detection logic)	• Throttle position (TP) sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuit • ECM
P0220	Output voltage of VTA2 quickly fluctuates beyond lower and upper malfunction thresholds for 2 seconds (1 trip detection logic)	• Throttle position (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 (1 trip detection logic)	• Throttle position (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 when VTA1 between 0.2 V and 2.02 V (1 trip detection logic)	• Throttle position sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit Short between VC and VTA2 circuit • ECM
P2135	Either condition (a) or (b) 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 circuit • Throttle position sensor (built into throttle body) • ECM

HINT:

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

Reference (Normal condition):

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
THROTTLE POS	10 to 22%	66 to 99%
THROTTLE POS #2	2.1 to 3.1 V	4.5 to 5.0 V

MONITOR DESCRIPTION

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

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

If the malfunction is not repaired successfully, a DTC is set 10 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) Within 0.5 seconds: P2135
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0120:

VTA1 voltage	0.2 V or less or 4.535 V or more

P0122:

VTA1 voltage	0.2 V or less

P0123:

VTA1 voltage	4.535 V or more

P0220:

VTA2 voltage	1.75 V or less or 4.8 V or more

P0222:

VTA2 voltage	1.75 V or less

P0223:

VTA2 voltage when the VTA1 is 0.2 to 2.02 V	4.8 V or more

P2135:

Either of the following condition A or B is met	-
Condition A	-
Difference between VTA1 and VTA2 voltage	0.02 V or less
Condition B	-
VTA1 voltage	0.2 V or less
VTA2 voltage	1.75 V or less

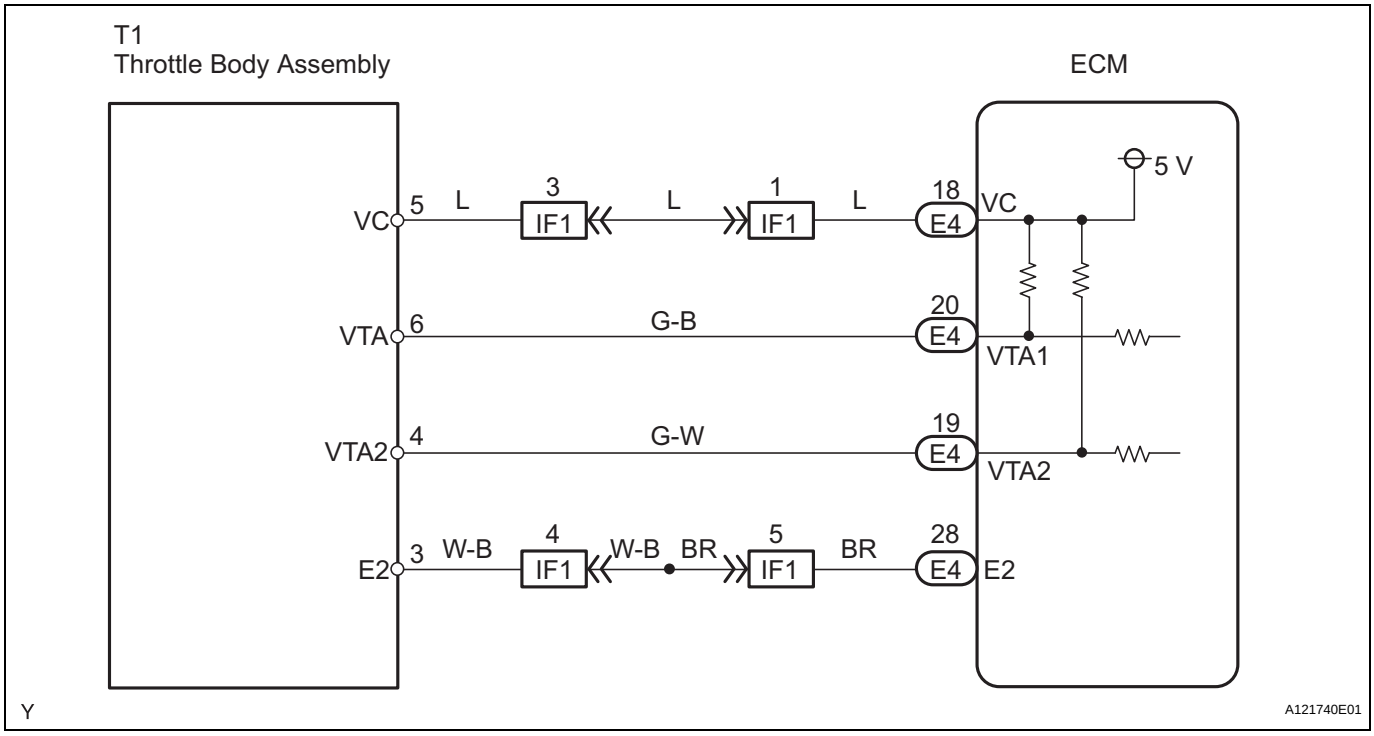
COMPONENT OPERATING RANGE

VTA1 voltage	0.69 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 to OFF.

WIRING DIAGRAM



HINT:

- If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	READ DATA LIST (THROTTLE POS #1, THROTTLE POS #2)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the intelligent tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ETCS / THROTTLE POS #1 and THROTTLE POS #2.
(d) Check the values displayed on the tester.

Result

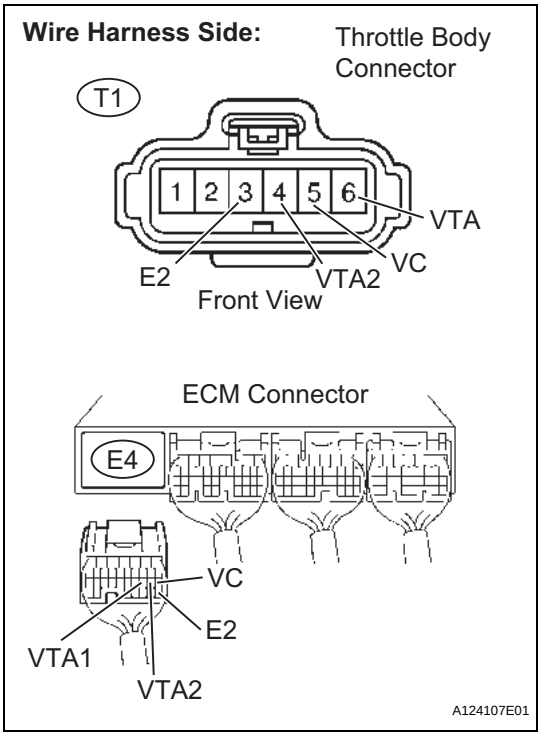
Throttle position expressed as percentage and voltage				Trouble Area	Proceed to
Accelerator pedal released		Accelerator pedal depressed			
THROTTLE POS #1 (VTA1)	THROTTLE POS #2 (VTA2)	THROTTLE POS #1 (VTA1)	THROTTLE POS #2 (VTA2)		
0%	0 to 0.2 V	0%	0 to 0.2 V	VC circuit open	A
100%	4.5 to 5.0 V	100%	4.5 to 5.0 V	E2 circuit open	A
0% or 100%	2.1 to 3.1 V (fail-safe)	0% or 100%	2.1 to 3.1 V (fail-safe)	VTA1 circuit open or ground short	A
about 19% (fail-safe)	0 to 0.2 or 4.5 to 5.0 V	about 19% (fail-safe)	0 to 0.2 or 4.5 to 5.0 V	VTA2 circuit open or ground short	A
10 to 22%	2.1 to 3.1 V	66 to 98% (does not fail-safe)	4.5 to 5.0 V (does not fail-safe)	TP sensor circuit is normal	B

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

B → Go to step 5

A

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



(a) Disconnect the T1 throttle body connector.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connection	Specified Condition
T1-5 (VC) - E4-18 (VC)	Below 1 Ω
T1-6 (VTA) - E4-20 (VTA1)	Below 1 Ω
T1-4 (VTA2) - E4-19 (VTA2)	Below 1 Ω
T1-3 (E2) - E4-28 (VTA2)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connection	Specified Condition
T1-5 (VC) or E4-18 (VC) - Body ground	10 kΩ or higher
T1-6 (VTA1) or E4-20 (VTA1) - Body ground	10 kΩ or higher
T1-4 (VTA2) or E4-19 (VTA2) - Body ground	10 kΩ or higher

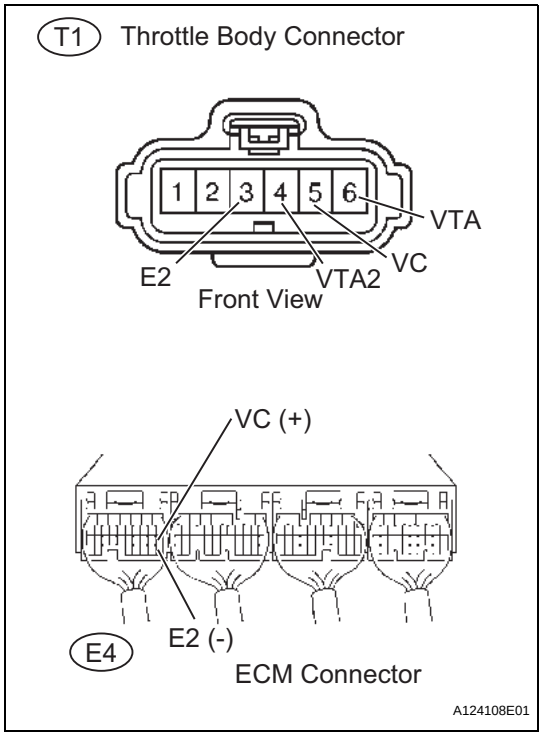
(d) Reconnect the throttle body connector.
(e) Reconnect the ECM connector.

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

ES

3	INSPECT ECM (VC VOLTAGE)



(a) Disconnect the T1 throttle body connector.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between the terminals of the ECM connector.

Standard Voltage

Tester Connections	Specified Conditions
E4-18 (VC) - E4-28 (E2)	4.5 to 5.5 V

(d) Reconnect the throttle body connector.

NG → **REPLACE ECM**

OK

4	REPLACE THROTTLE BODY ASSEMBLY

NEXT

5	CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the intelligent tester ON.
(c) Clear the DTC.
(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 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

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

DESCRIPTION

Refer to DTC P0120 (See page ES-110).

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

ES

MONITOR DESCRIPTION

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

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Either of following conditions A or B set	-
A. Ignition switch	ON
B. ETCS power	ON
TP sensor open/short malfunction (P0120, P0122, P0123, P0220, P0222, P0223 and P2135)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

TP sensor 1 - [TP sensor 2 x 0.8 (corrected by learning value)]	Less than 0.8 V, or more than 1.6 V

FAIL-SAFE

When this DTC, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6.5° 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 to OFF.

WIRING DIAGRAM

Refer to DTC P0120 (See page ES-114).

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.

ES

1	CHECK ANY OTHER DTC OUTPUT (IN ADDITION TO DTC P0121)

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

Result

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

HINT:
If any DTCs other than P0121 are output, troubleshoot those DTCs 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-102).

DTC No.	DTC Detection Condition	Trouble Area
P0125	Engine coolant temperature hardly changes for 70 seconds after engine start (2 trip detection logic)	• Engine Coolant Temperature (ECT) sensor • Cooling system • Thermostat
P0125	Engine coolant temperature hardly changes for 114 seconds after engine start (2 trip detection logic)	
P0125	Engine coolant temperature hardly changes for 1,200 seconds after engine start (2 trip detection logic)	

ES

MONITOR DESCRIPTION

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 70 seconds 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	Continuous
Duration	70 seconds: -0.34°C (31.38°F) or more 114 seconds: -11.45 to -0.34°C (11.39 to 31.38°F) 1200 seconds: Less than -11.45°C (11.39°F)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All

Monitor will run whenever these DTCs are not present	P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor)

Case 1

Engine coolant or intake air temperature at engine start	-0.34°C (31.38°F) or more
Engine	Running
Fuel cut	OFF

Case 2

Engine coolant or intake air temperature at engine start	Between -11.45°C (11.39°F) and -0.34°C (31.38°F)

Engine	Running
Fuel cut	OFF

Case 3

Engine coolant or intake air temperature at engine start	Lower than -11.45°C (11.39°F)
Engine	Running
Fuel cut	OFF
Idle	OFF

TYPICAL MALFUNCTION THRESHOLDS

Engine coolant temperature sensor output	Less than 8°C (46°F)

WIRING DIAGRAM

Refer to DTC P0115 (See page ES-103).

HINT:

- If any of DTCs P0115, P0116, P0117 or P0118 are set simultaneously with DTC P0125, the Engine Coolant Temperature (ECT) sensor may have an open or a short circuit. Troubleshoot those DTCs first.
- Read freeze frame data using the intelligent tester. 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.

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

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

Result

Display (DTC output)	Proceed to
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-7).
(b) Check the valve opening temperature of the thermostat.

Standard:
80 to 84°C (176 to 183°F)

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

(c) Reinstall the thermostat (See page CO-8).

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)

HINT:
This DTC relates to the thermostat.

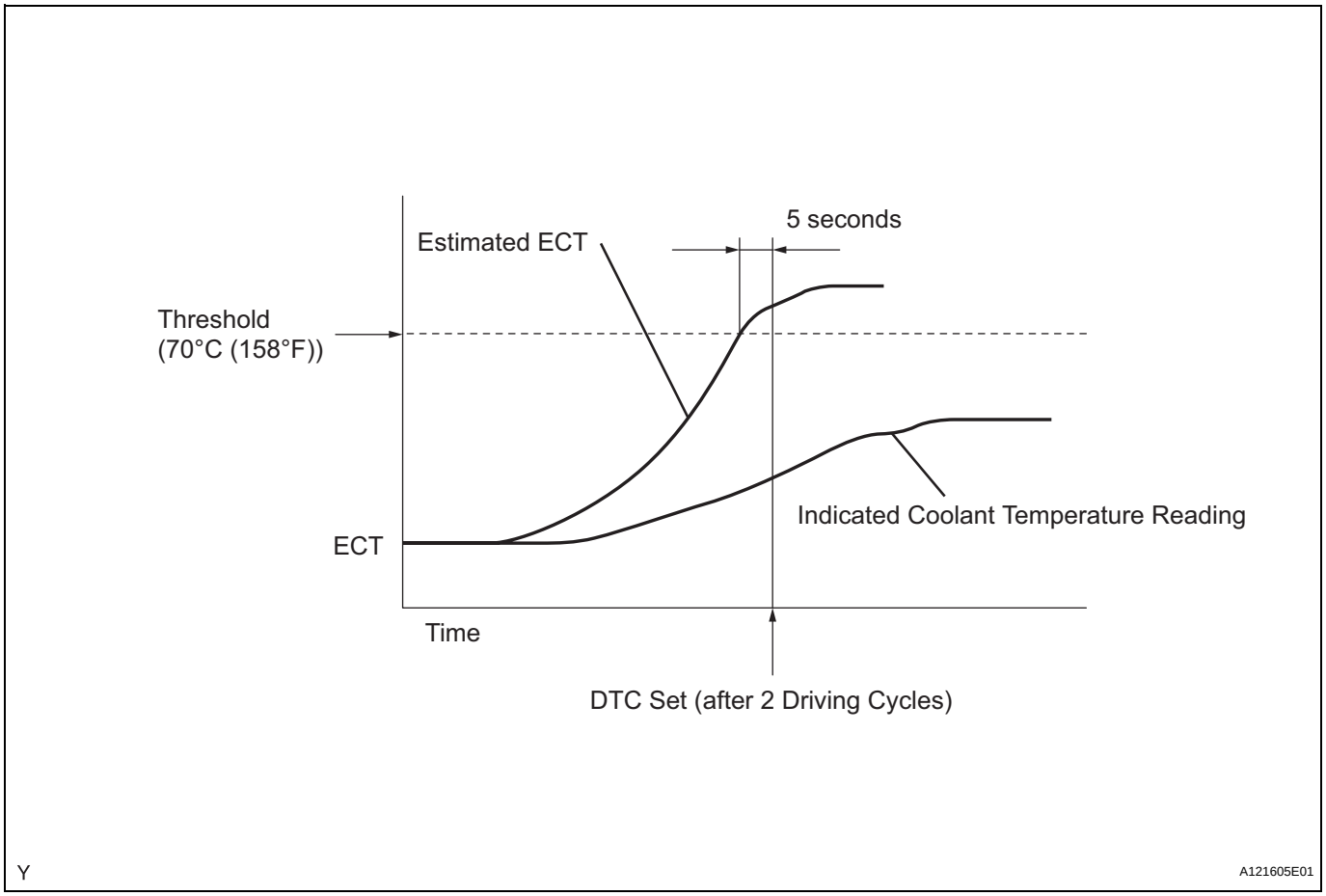
DESCRIPTION

This DTC is set when the Engine Coolant Temperature (ECT) does not reach 70°C (158°F) despite sufficient engine warm-up time.

DTC No.	DTC Detection Conditions	Trouble Areas
P0128	Conditions (a), (b) and (c) met for 5 seconds (2 trip detection logic): (a) Cold start (b) Engine warmed up (c) Engine Coolant Temperature (ECT) less than 70°C (158°F)	• Thermostat • Cooling system • ECT sensor • ECM

ES

MONITOR DESCRIPTION



The ECM estimates the ECT based on the starting temperature, engine loads, and engine speeds. The ECM then compares the estimated temperature with the actual ECT. When the estimated ECT reaches 70°C (158°F), the ECM checks the actual ECT. If the actual ECT is less than 70°C (158°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 Sensor / 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 following DTCs not present	P0010, (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) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0125 (Insufficient ECT for closed loop) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351 - P0358 (igniter) P0500 (VSS) P2196 (A/F sensor - rationality) P2A00 (A/F sensor - slow response)
Battery voltage	11 V or more
Throttle valve position learning	Completed
Either of following conditions 1 or 2 met:	-
1. All of following conditions (a), (b) and (c) 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 51°C (14°to 133°F)
(c) IAT at engine start	-10°to 51°C (14°to 133°F)
2. All of following conditions (d), (e) and (f) met:	-
(d) ECT at engine start - IAT at engine start	More than 7°C (12.6°F)
(e) ECT at engine start	51°C (133°F) or less
(f) IAT at engine start	-10°C (14°F) or more
Accumulated time at 80 mph (128 km/h) or more of vehicle speed	Less than 20 seconds

TYPICAL MALFUNCTION THRESHOLDS

Duration that following conditions A and B met	5 seconds or more
A. Simulated ECT	70°C (158°F) or more
B. Actual ECT	Below 70°C (158°F)

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

1	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0128)**

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

(c) Turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read DTCs.

Result:

Display (DTC Output)	Proceed To
P0128	A
P0128 and other DTCs	B

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

B → **GO TO DTC CHART**

A

ES

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-7).
(b) Check the valve opening temperature of the thermostat.
Standard:
80° to 84°C (176° to 183°F)
HINT:
In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.
(c) Reinstall the thermostat (see page CO-8).

NG → **REPLACE THERMOSTAT**

OK

REPLACE ECM

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

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

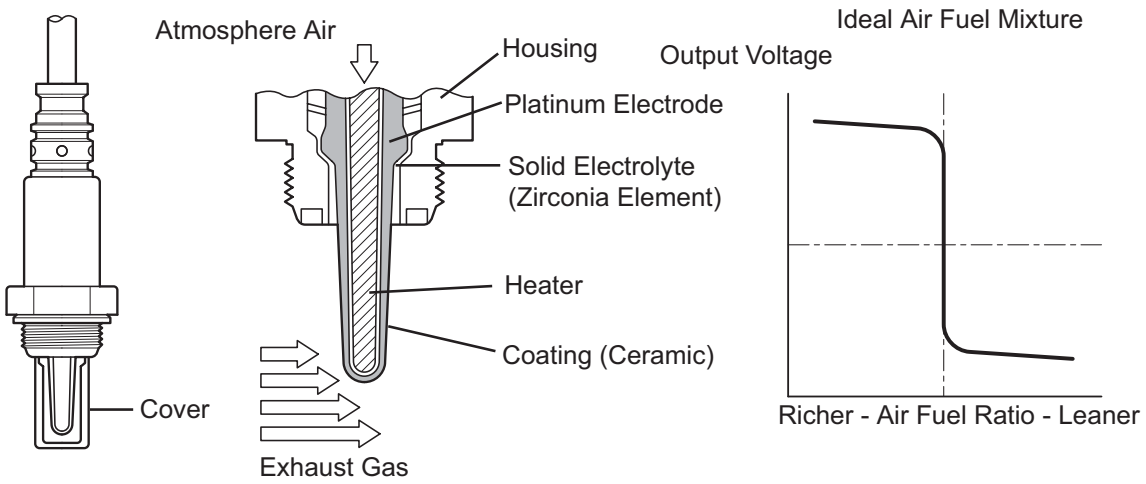
DTC	P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)

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

ES

DESCRIPTION

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric air-fuel level. For the purpose of helping the ECM to deliver accurate air-fuel ratio control, a Heated Oxygen (HO2) sensor is used.
The HO2 sensor is located behind the TWC, and detects the oxygen concentration in the exhaust gas. Since the 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.



DTC No.	DTC Detection Conditions	Trouble Areas
P0136	• Abnormal voltage output (active air-fuel ratio control): During active air-fuel ratio control, following conditions (a) and (b) met for certain period of time (1 trip detection logic): (a) Heated Oxygen (HO2) sensor voltage does not decrease to less than 0.21 V (b) HO2 sensor voltage does not increase to more than 0.59 V • Low impedance: Sensor impedance less than 5 Ωfor more than 30 seconds when ECM presumes sensor to being warmed up and operating normally (1 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 (1 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 being warmed up and operating normally (1 trip detection logic)	• Open in HO2 sensor (sensor 2) circuit • HO2 sensor (sensor 2) • HO2 sensor (sensor 2) heater • 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 (1 trip detection logic): (a) HO2 sensor voltage output less than 0.59 V or more (b) Target air-fuel ratio lean • Extremely high voltage (short) : HO2 sensor voltage output exceeds 1.2 V for more than 10 seconds (1 trip detection logic)	• Short in HO2 sensor (sensor 2) circuit • HO2 sensor (sensor 2) • ECM internal circuit malfunction

MONITOR DESCRIPTION

Active Air-Fuel Ratio Control

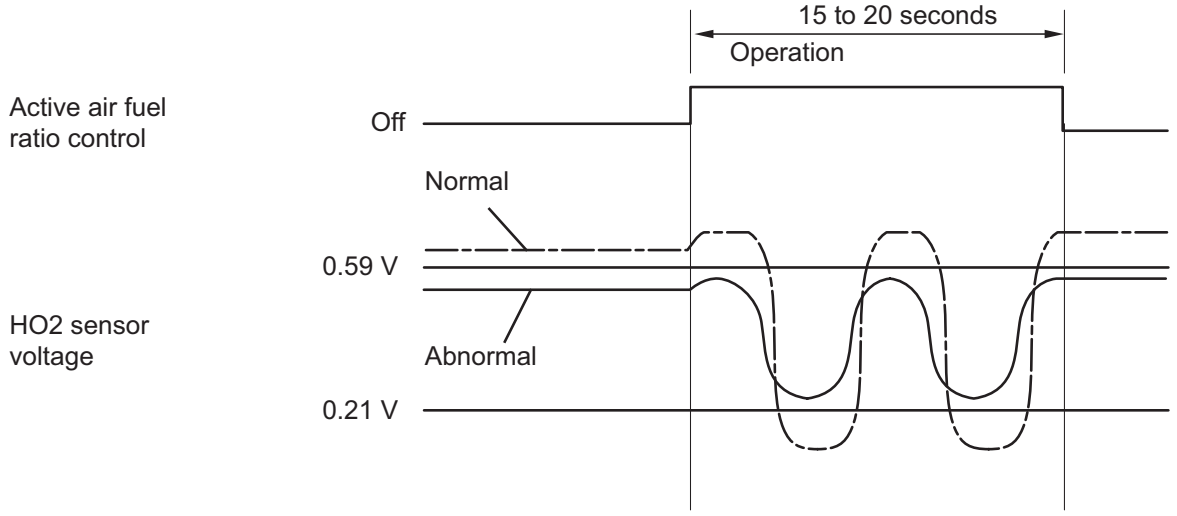
- The ECM usually performs air-fuel ratio feedback control so that the Air-Fuel Ratio (A/F) sensor output indicates a near stoichiometric air-fuel level. This vehicle includes active air-fuel ratio control in addition to regular air-fuel ratio control. The ECM performs active air-fuel ratio control to detect any deterioration in the Three-Way Catalytic Converter (TWC) and Heated Oxygen (HO2) sensor malfunctions (refer to the diagram below).
- Active air-fuel ratio control is performed for approximately 15 to 20 seconds while driving with a warm engine. During active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become lean or rich by the ECM. If the ECM detects a malfunction, one of the following DTCs is set: DTC P0136 (abnormal voltage output), P0137 (open circuit) and P0138 (short circuit).

Abnormal Voltage Output of HO2 Sensor (DTC P0136)

- While the ECM is performing active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become rich or lean. If the sensor is not functioning properly, the voltage output variation is small. For example, when the HO2 sensor voltage does not decrease to less than 0.21 V and does not increase to more than 0.59 V during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormal and sets DTC P0136.

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HO2 SENSOR CIRCUIT MALFUNCTION (P0136: ABNORMAL VOLTAGE)

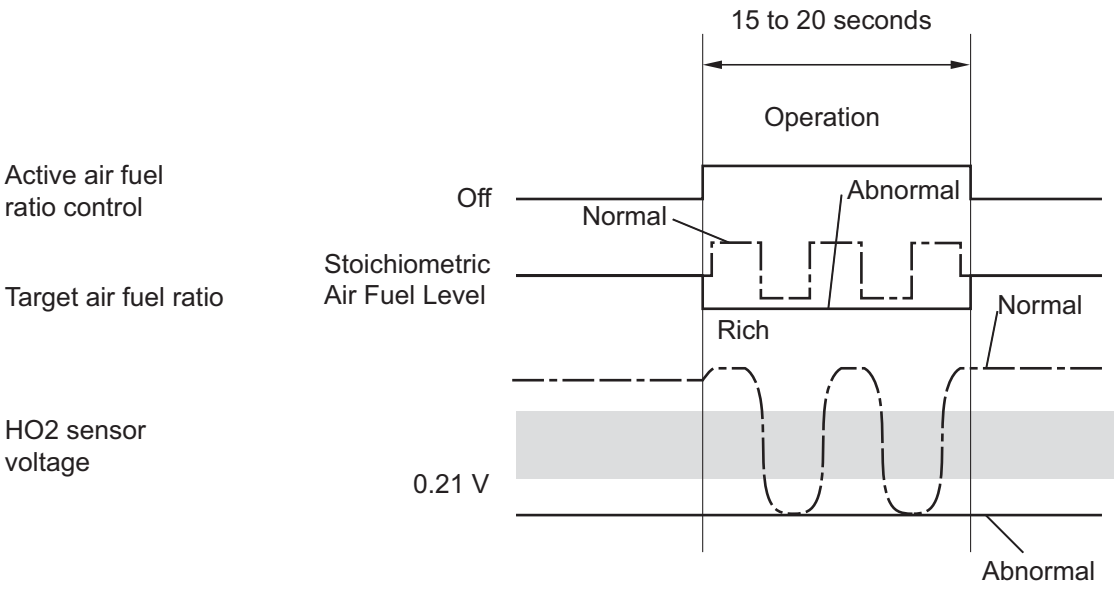


Open or Short in Heated Oxygen (HO2) Sensor Circuit (DTC P0137 or P0138)

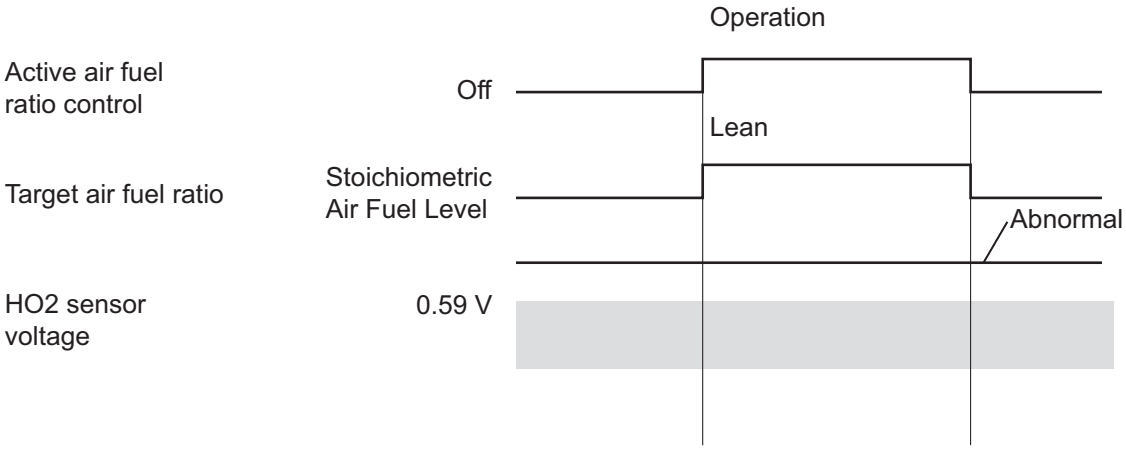
- During active air-fuel ratio control, the ECM calculates the Oxygen Storage Capacity (OSC)* of the Three- Way Catalytic Converter (TWC) by forcibly regulating the air-fuel ratio to become rich or lean. If the HO2 sensor has an open or short, or the voltage output of the sensor noticeably decreases, the OSC indicates an extraordinarily high value. Even if the ECM attempts to continue regulating the air-fuel ratio to become rich or lean, the HO2 sensor output does not change.
- While performing active air-fuel ratio control, when the target air-fuel ratio is rich and the HO2 sensor voltage output is 0.21 V or less (lean), the ECM interprets this as an abnormally low sensor output voltage and sets DTC P0137. When the target air-fuel ratio is lean and the voltage output is 0.59 V or more (rich) during active air-fuel ratio control, the ECM determines that the sensor voltage output is abnormally high, and sets DTC P0138.
  HINT:
  DTC P0138 is also set if the HO2 sensor voltage output is more than 1.2 V for 10 seconds or more.

*: The TWC has the capability to store oxygen. The OSC and the emission purification capacity of the TWC are mutually related. The ECM determines whether the catalyst has deteriorated, based on the calculated OSC value (see page ES-206).

HO2 SENSOR CIRCUIT LOW VOLTAGE (P0137: OPEN)



HO2 SENSOR CIRCUIT HIGH VOLTAGE (P0138: SHORT)

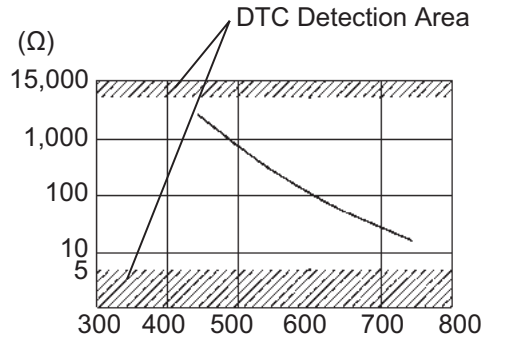


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High or Low Impedance of Heated Oxygen (HO2) Sensor (DTC P0136 or P0137)

Relationship between element temperature and impedance:



ES

- During normal air-fuel ratio feedback control, there are small variations in the exhaust gas oxygen concentration. In order to continuously monitor the slight variation of the HO2 sensor signal while the engine is running, the impedance* of the sensor is measured by the ECM. The ECM determines that there is a malfunction in the sensor when the measured impedance deviates from the standard range.
- *: The effective resistance in an alternating current electrical circuit.
  HINT:
  - The impedance cannot be measured using an ohmmeter.
  - DTC P0136 indicates the deterioration of the HO2 sensor. The ECM sets the DTC by calculating the impedance of the sensor when the typical enabling conditions are satisfied (1 driving cycle).
  - DTC P0137 indicates an open or short circuit in the HO2 sensor (1 driving cycle). The ECM sets the DTC when the impedance of the sensor exceeds the threshold 15 kΩ.

MONITOR STRATEGY

Related DTCs	P0136: Heated oxygen sensor output voltage (Output voltage) P0136: Heated oxygen sensor impedance (Low) P0137: Heated oxygen sensor output voltage (Low voltage) P0137: Heated oxygen sensor impedance (High) 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: Others
Duration	90 seconds: Heated oxygen sensor impedance (High) Within 20 seconds: Active air-fuel ratio control detection 30 seconds: Heated oxygen sensor impedance (Low) 10 seconds: Output voltage (High stuck)
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs not present	P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0037, P0038, P0057, P0058 (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 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0442 - P0456 (EVAP system) P0500 (VSS) P2196, P2198 (A/F sensor - rationality) P2440 (A/R control valve stuck open) P2441 (A/R control valve stuck close) P2444 (AIP stuck ON) P2445 (AIP stuck OFF) P2A00, P2A03 (A/F sensor - slow response)

ES

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

Active air-fuel ratio control	Executing
Active air-fuel ratio control begins when all of following conditions met:	-
Battery voltage	11 V or more
Engine coolant temperature	70°C (158°F) or more
Idling	OFF
Engine RPM	Less than 4,000 rpm
A/F sensor status	Activated
Fuel cut	OFF (for 5 seconds or more)
Engine load	10 to 80 %
Shift position	4th or 5th (for M/T) 3rd, 4th or 5th (for A/T)

Heated Oxygen Sensor Impedance (Low):

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

Heated Oxygen Sensor Impedance (High):

Battery voltage	11 V or more
Estimated sensor temperature	More than 450°C(842°F)
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 (Output voltage):

Either of following conditions met:	1 or 2
1. All of the following conditions (a), (b) and (c) 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)	2.5 g or more
2. All of the following conditions (d), (e) and (f) met	-

(d) Commanded air-fuel ratio	14.9 or more
(e) Rear HO2 sensor voltage	0.21 to 0.59 V
(f) OSC (Oxygen Storage Capacity of Catalyst)	2.5 g or more

Heated Oxygen Sensor Output Voltage (Low output voltage):

All of the following conditions (a), (b) and (c) met	-
(a) Commanded air-fuel ratio	14.3 or less
(b) Rear HO2 sensor voltage	Less than 0.21 V
(c) OSC (Oxygen Storage Capacity of Catalyst)	2.5 g or more

Heated Oxygen Sensor Output Voltage (High output voltage):

All of the following conditions (a), (b) and (c) met	-
(a) Commanded air-fuel ratio	14.9 or more
(b) Rear HO2 sensor voltage	More than 0.59 V
(c) OSC (Oxygen Storage Capacity of Catalyst)	2.5 g or more

ES

Heated Oxygen Sensor Impedance (Low):

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

Heated Oxygen Sensor Impedance (High):

Duration of following condition met	90 seconds or more
Heated oxygen sensor impedance	15 kΩ or more

Heated Oxygen Sensor Impedance (Extremely High):

Duration of following condition met	10 seconds or more
Heated oxygen sensor impedance	1.2 V or more

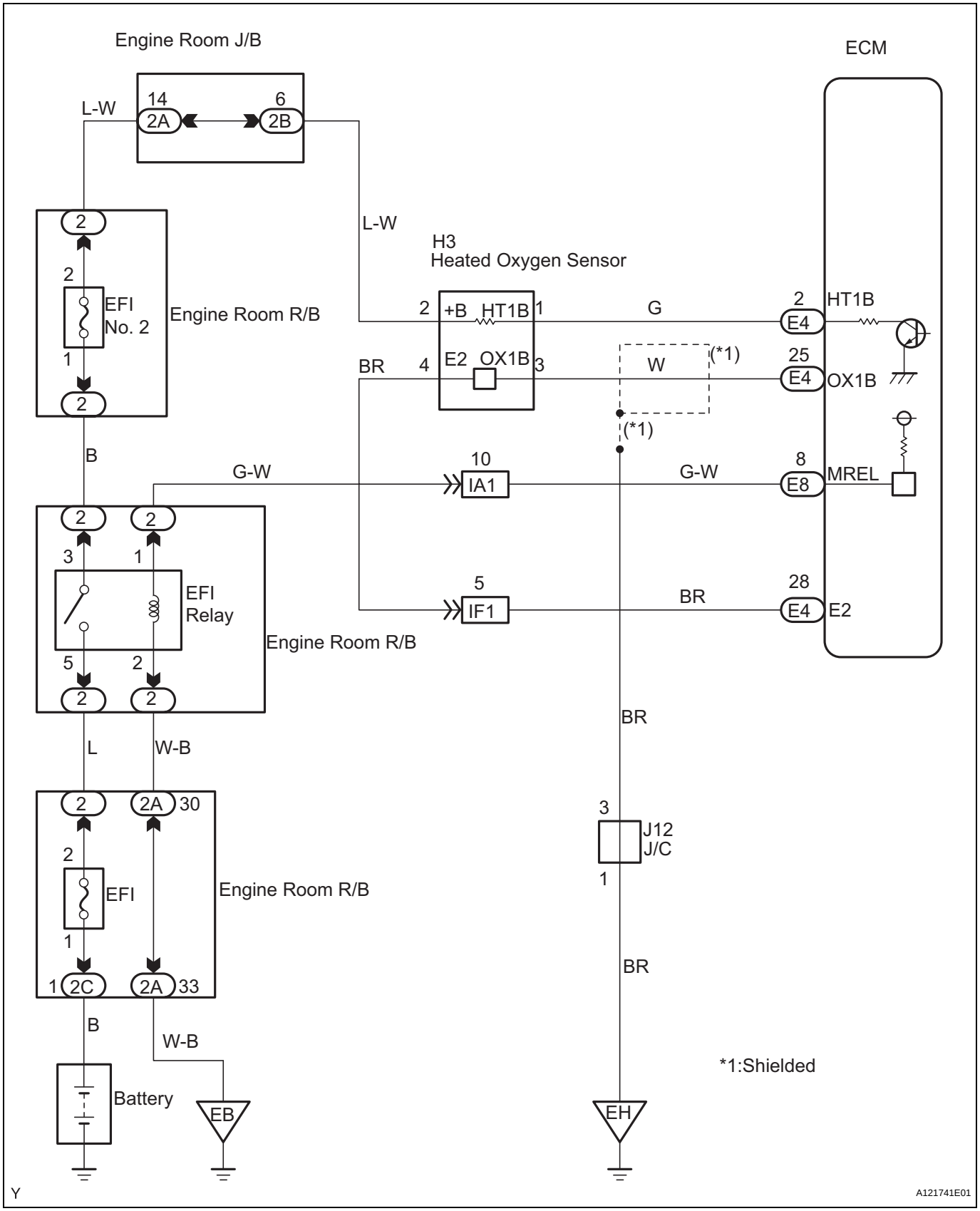
COMPONENT OPERATING RANGE

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

MONITOR RESULT

Refer to Checking Monitor Status (See page ES-21).

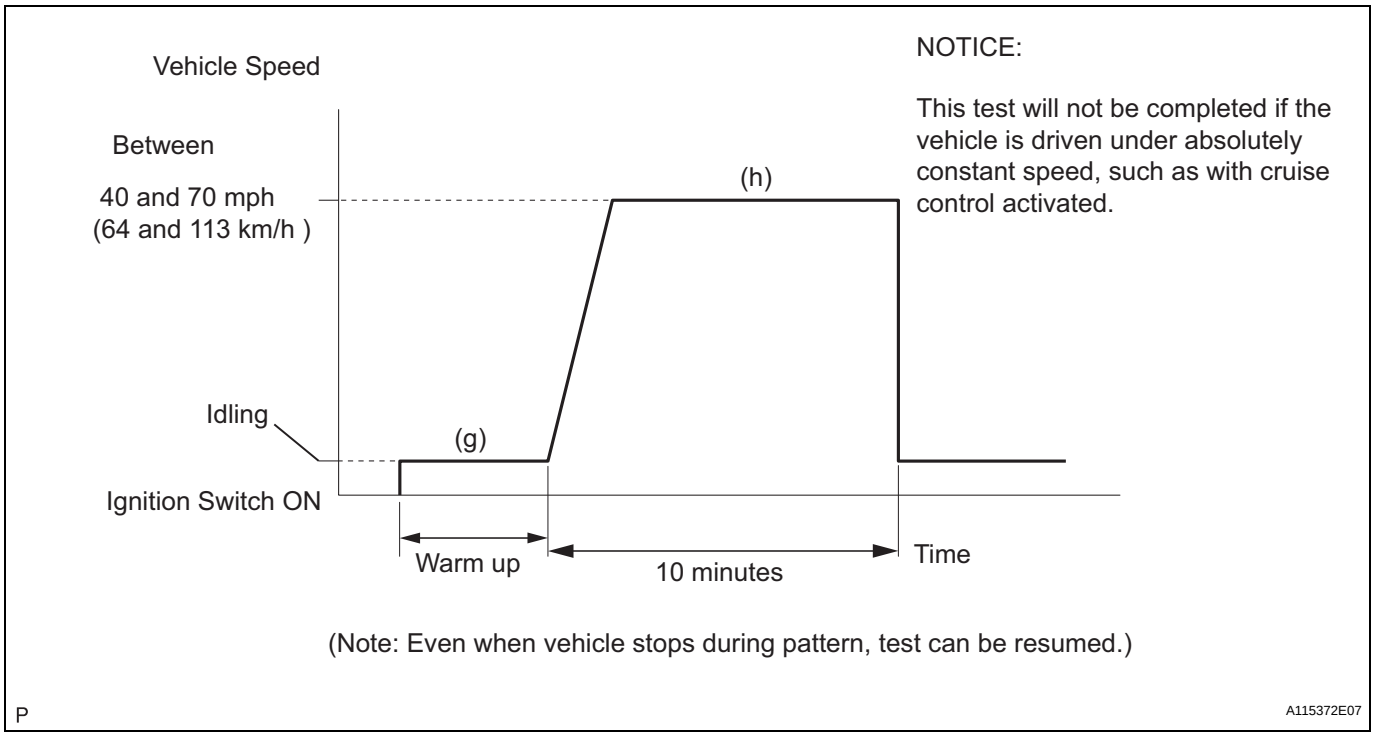
WIRING DIAGRAM

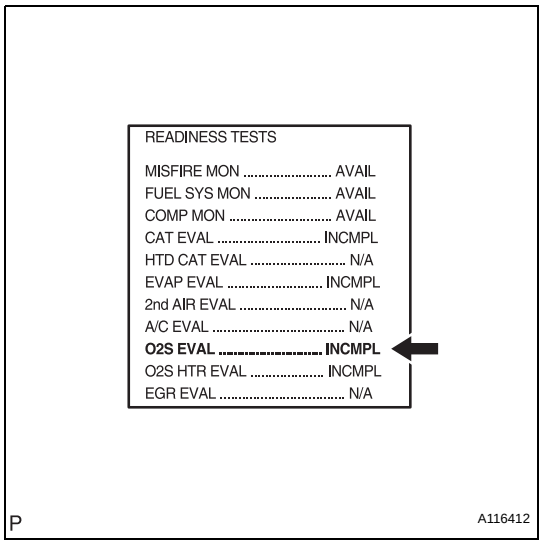


CONFIRMATION DRIVING PATTERN

HINT:

- This confirmation driving pattern is used in the "PERFORM CONFIRMATION DRIVING PATTERN" procedure of the following diagnostic troubleshooting procedure.
- Performing this confirmation pattern will activate the Heated Oxygen (HO2) sensor monitor. (The catalyst monitor is performed simultaneously.) This is very useful for verifying the completion of a repair.





(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the tester or scan tool ON.
(d) Clear DTCs (where set) (See page ES-40).
(e) If using an intelligent tester, select the following menu items: DIAGNOSIS / CARB OBD II / READINESS TESTS.
(f) Check that O2S EVAL is INCMPL (incomplete).
(g) Start the engine and warm it up.
(h) Drive the vehicle at between 40 mph and 70 mph (64 km/h and 113 km/h) for at least 10 minutes.

(i) Note the state of the Readiness Tests items. Those items will change to COMPL (complete) as O2S EVAL monitor operates.
(j) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES and check if any DTCs (any pending DTCs) are set.
HINT:
If O2S EVAL does not change to COMPL, and any pending DTCs fail to set, extend the driving time.

HINT:
Intelligent tester only :
Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.
The following instructions describe how to conduct the A/F CONTROL operation using an intelligent tester.
(a) Connect an 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 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 Voltage

Tester Display (Sensor)	Injection Volumes	Status	Voltages
AFS B1S1 (A/F)	+25%	Rich	Less than 3.0
AFS B1S1 (A/F)	-12.5%	Lean	More than 3.35
O2S B1S2	+25%	Rich	More than 0.5
O2S B1S2	-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		

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage Almost no reaction		
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• Fuel 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		

ES

- 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 an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.
- 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 an intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(d) Read DTCs.

Result

Display (DTC output)	Proceed to
P0138	A
P0137	B
P0136	C

B → Go to step 14

C → Go to step 7

A

2	READ DATA LIST (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

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

(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / O2S B1S2.
(d) Allow the engine to idle.
(e) Read the Heated Oxygen (HO2) sensor output voltage while idling.
Result

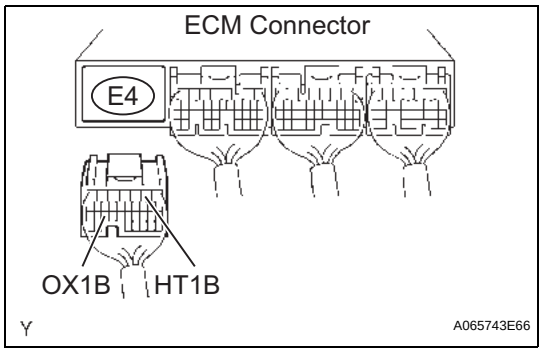
HO2 Sensor Output Voltages	Proceed to
More than 1.2 V	A
Less than 1.0 V	B

B → **Go to step 5**

A

ES

3 CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)



(a) Turn the ignition switch to OFF and wait for 5 minutes.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance.
Standard Resistance

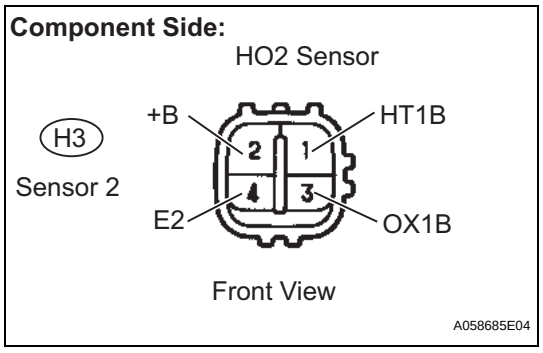
Tester Connection	Specified Condition
HT1B (E4-2) - OX1B (E4-25)	10 kΩ or higher

(d) Reconnect the ECM connector.

OK → **REPLACE ECM**

NG

4 INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)



(a) Disconnect the H3 HO2 sensor connector.
(b) Check the resistance.
Standard Resistance

Tester Connections	Specified Conditions
+B (H3-2) - E2 (H3-4)	10 kΩ or higher
+B (H3-2) - OX1B (H3-3)	10 kΩ or higher

(c) Reconnect the HO2 sensor connector.

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)

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

Display (DTC Output)	Proceed To
P0138	A
No output	B

B → CHECK FOR INTERMITTENT PROBLEMS

A

REPLACE HEATED OXYGEN SENSOR

7	READ DATA LIST (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Start the engine.
(d) Select the following menu items: 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 Voltage:
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) On the intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(b) Read 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

NEXT

12	CHECK WHETHER DTC OUTPUT RECURS (DTC P0136)

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

Result

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

B → REPAIR COMPLETED

A

13	PERFORM ACTIVE TEST USING 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) Select 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 intelligent testers.

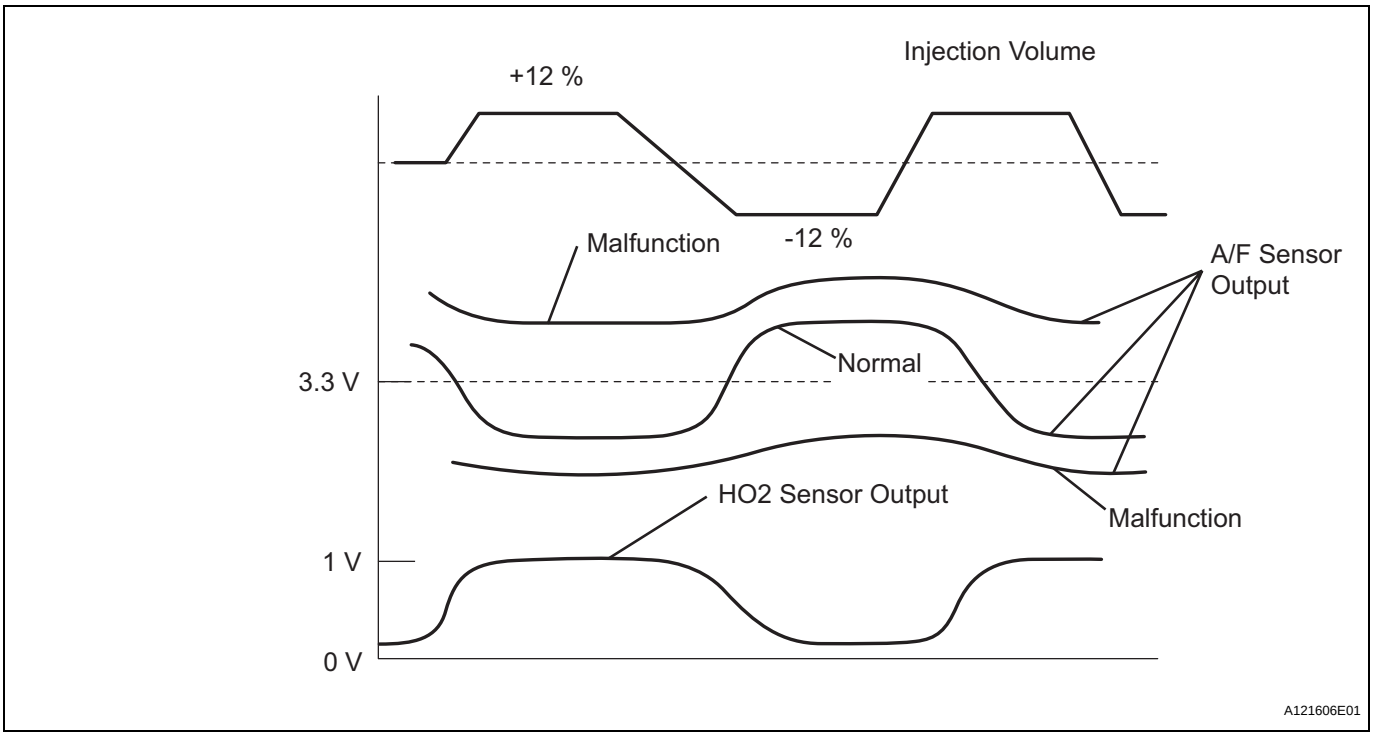
Result

Display (DTC Output)	Voltage Variations	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

ES

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

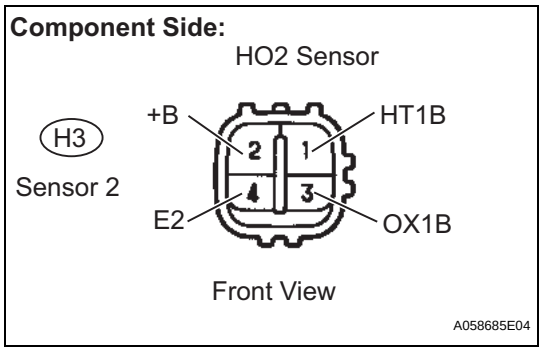
14 CHECK FOR EXHAUST GAS LEAKAGE

OK:
No gas leakage.

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

OK

15 INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)



(a) Disconnect the H3 HO2 sensor connector.
(b) Measure the resistance between the terminals of the HO2 sensor connector.
Standard Resistance

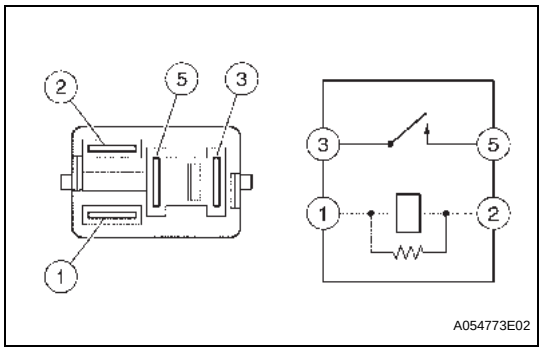
Tester Connections	Specified Conditions
HT1B (H3-1) - +B (H3-2)	11 to 16 Ω at 20°C (68°F)
HT1B (H3-1) - E2 (H3-4)	10 kΩ or higher

(c) Reconnect the HO2 sensor connector.

NG → **REPLACE HEATED OXYGEN SENSOR**

OK

16 INSPECT EFI RELAY



(a) Remove the EFI relay from the engine room R/B.
(b) Check the EFI relay resistance.
Standard Resistance

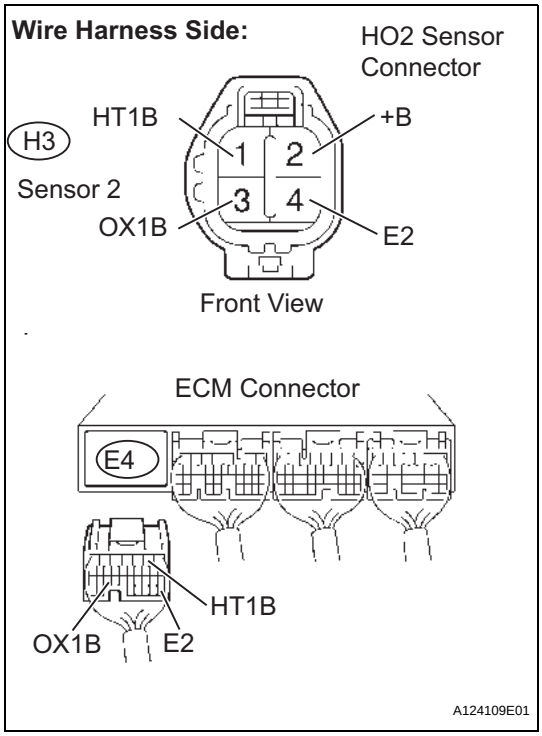
Tester Connections	Specified Conditions
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the EFI relay.

NG → **REPLACE EFI RELAY**

OK

17	CHECK HARNESS OR CONNECTOR (HEATED OXYGEN SENSOR - ECM)



(a) Disconnect the H3 HO2 sensor connector.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between the +B terminal of the HO2 sensor connector and body ground.

Standard Voltage

Tester Connections	Specified Conditions
+B (H3-1) - Body ground	9 to 14 V

(d) Turn the ignition switch to OFF.
(e) Disconnect the E4 ECM connector.
(f) Check the resistance.

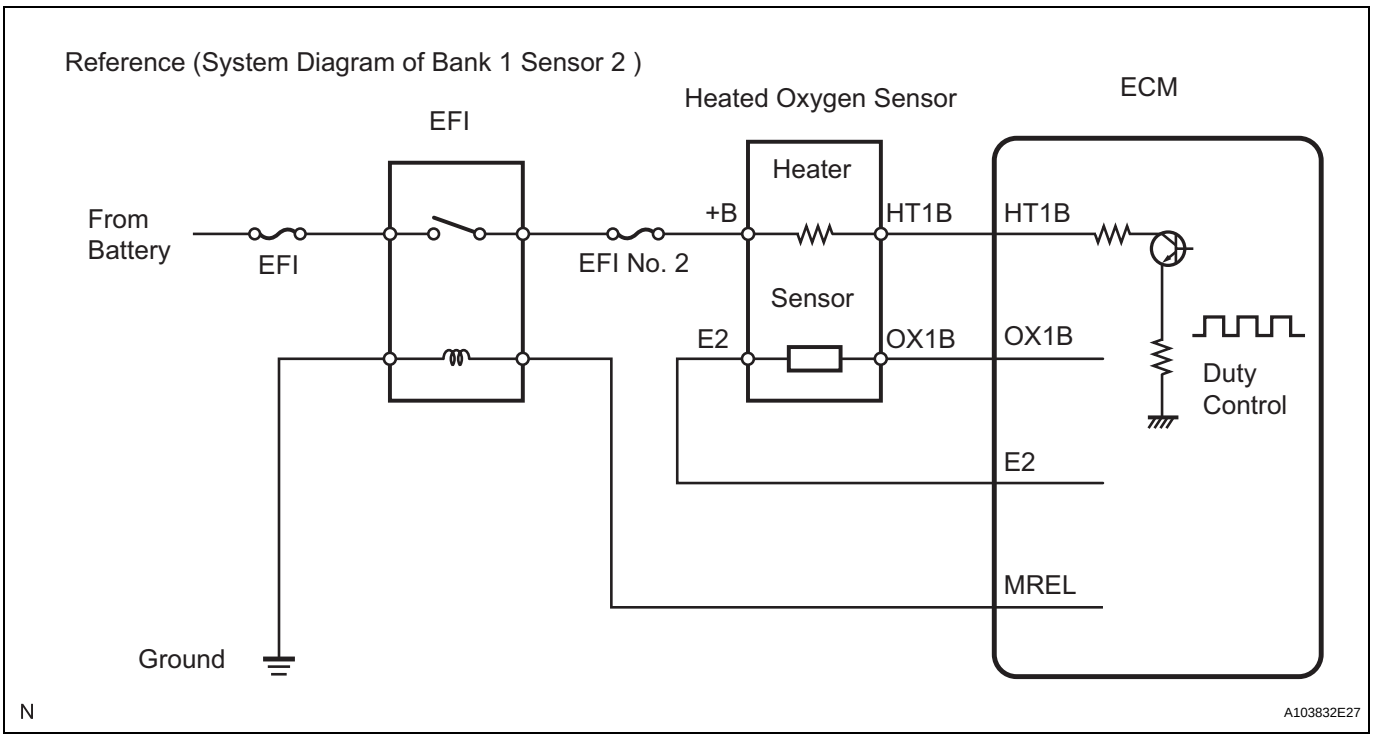
Standard Resistance (Check for open)

Tester Connections	Specified Conditions
HT1B (H3-1) - HT1B (E4-2)	Below 1 Ω
OX1B (H3-3) - OX1B (E4-25)	Below 1 Ω
E2 (H3-4) - E2 (E4-28)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
HT1B (H3-1) or HT1B (E4-2) - Body ground	10 kΩ or higher
OX1B (H3-3) or OX1B (E4-25) - Body ground	10 kΩ or higher
E2 (H3-4) or E2 (E4-28) - Body ground	10 kΩ or higher

(g) Reconnect the HO2 sensor connector.
(h) Reconnect the ECM connectors.



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.

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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.

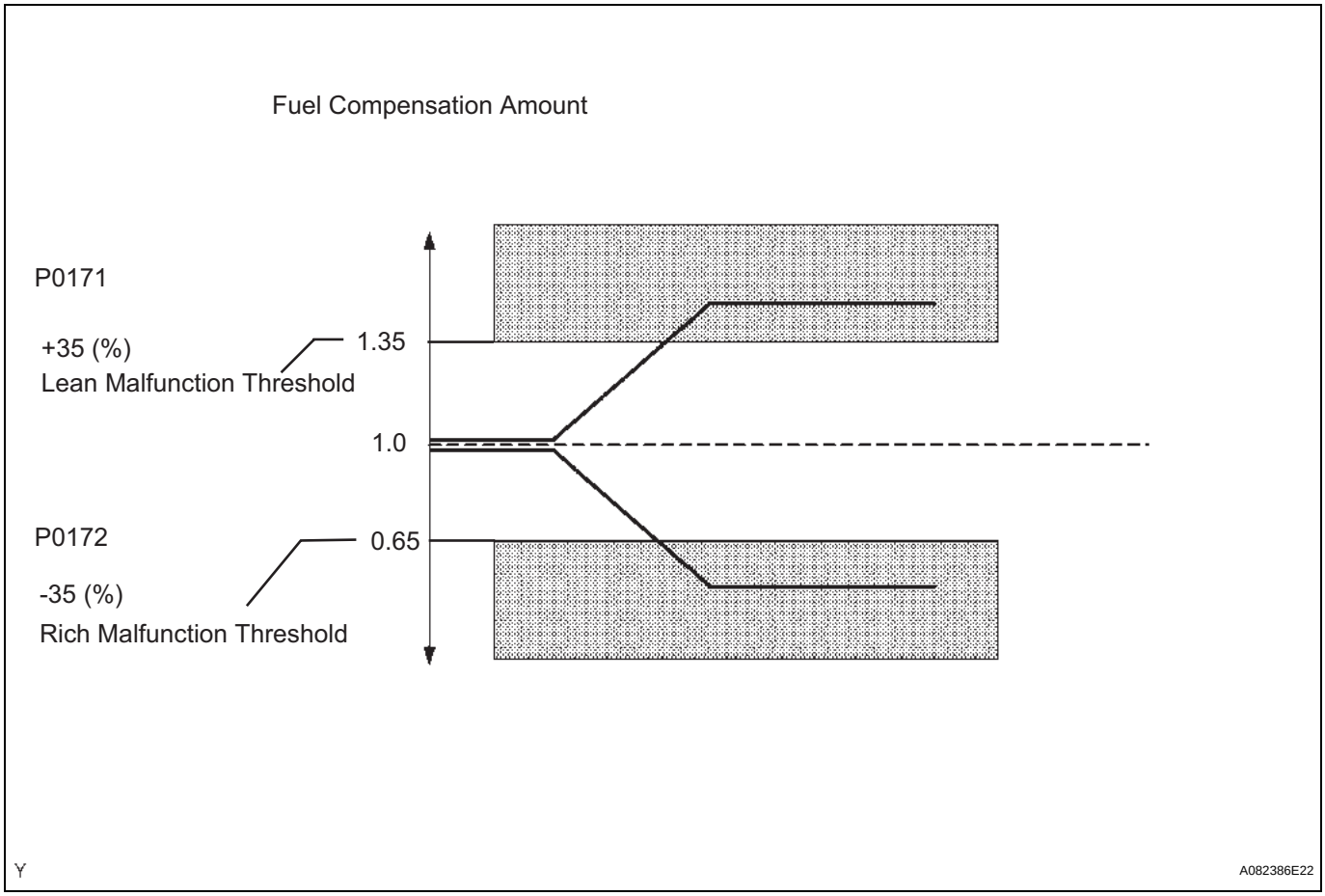
DTC No.	DTC Detection Conditions	Trouble Areas
P0171	With warm engine and stable air-fuel ratio feedback, fuel trim considerably in error to lean side (2 trip detection logic)	• Air induction system • Injector blockage • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Fuel pressure • Gas leakage from exhaust system • Open or short in Air-Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater (sensor 1) • A/F HEATER relay • A/F sensor heater and A/F HEATER 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 • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Ignition system • Fuel pressure • Gas leakage from exhaust system • Open or short in Air-Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor1) • A/F sensor heater (sensor1) • A/F HEATER relay • A/F sensor heater and A/F HEATER 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.



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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

Fuel-trim:

Monitor runs whenever following DTCs not present	P0010, P0020 (OCV Bank 1, 2) P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0021 (VVT System 2 - Advance) P0022 (VVT System 2 - Retard) P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0500 (VSS) P2440 (A/R control valve stuck open) P2441 (A/R control valve stuck close) P2444 (AIP stuck ON) P2445 (AIP stuck OFF)
Fuel system status	Closed-loop
Battery voltage	11 V or more
Throttle position leaning	Completed
Either of following conditions A or B set	-
A. Engine RPM	Below 1,100 rpm
B. Intake air amount per revolution	0.22 g/rev. or more

ES

TYPICAL MALFUNCTION THRESHOLDS

Fuel-trim :

Purge-cut	Executing
Either of following conditions 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-316).

HINT:
Intelligent tester only:
Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.
The following instructions describe how to conduct the A/F CONTROL operation using an intelligent tester.

1. Connect an 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 %.

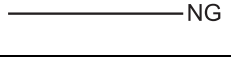
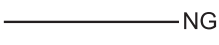
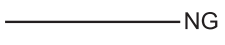
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard

Tester Display (Sensor)	Injection Volumes	Status	Voltages
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 0.5
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.

ES

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Areas
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.5 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 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 an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.
- 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 an intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(d) Read DTCs.

Result

Display (DTC Output)	Proceed To
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.

ES

Standard Voltage

Tester Display (Sensor)	Injection Volumes	Status	Voltages
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 0.5
OS2 B1S2 (HO2)	-12.5 %	Lean	Less than 0.4

Result

Status AFS B1S1	Status O2S B1S2	A/F Condition and A/F Sensor Condition	Misfires	Suspected Trouble Areas	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 0.5 V.
Lean/Rich: During A/F CONTROL of the ACTIVE TEST, the output voltage of the heated oxygen sensor alternates correctly.

B	**Go to step 11**
C	**Go to step 15**

A

ES

5 READ DATA LIST (COOLANT TEMP)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(d) Read the COOLANT TEMP twice, when the engine is both cold and warmed up.
Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 75°C and 95°C (167°F and 203°F)

NG	**REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

OK

6 READ DATA LIST (MAF)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / MAF and COOLANT TEMP.
(d) Allow the engine to idle until the COOLANT TEMP reaches 75°C (167°F) or more.
(e) Read the MAF with the engine in an idling condition and at an engine speed of 2,500 rpm.
Standard:
MAF while engine idling: Between 2.0 g/sec and 4.5 g/sec (shift position: N, A/C: OFF).
MAF at engine speed of 2,500 rpm: Between 8.0 g/sec and 14.7 g/sec (shift position: N, A/C: OFF).

NG	**REPLACE MASS AIR FLOW METER**

OK

7	CHECK FUEL PRESSURE

(a) Check the fuel pressure.

NG → REPAIR OR REPLACE FUEL SYSTEM

OK

8	CHECK FOR EXHAUST GAS LEAKAGE

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 an intelligent tester. Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / MISFIRE / CYL #1 (to CYL #4).

NG → REPAIR OR REPLACE IGNITION SYSTEM

OK

10	INSPECT FUEL INJECTOR ASSEMBLY (INJECTION AND VOLUME)

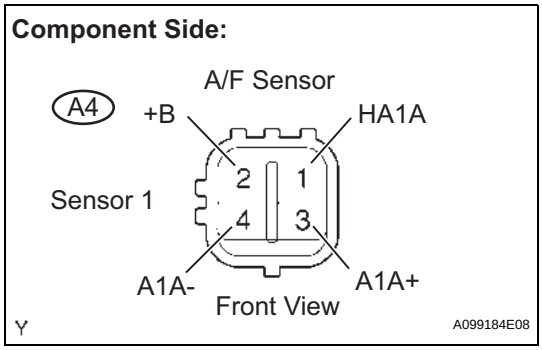
HINT:
If the injectors malfunction, engine misfire may occur. The misfire count can be read using an intelligent tester. Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / MISFIRE / CYL #1 (to CYL #4).

NG → REPLACE FUEL INJECTOR ASSEMBLY

OK

ES

11 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the A4 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor connector.
Standard Resistance

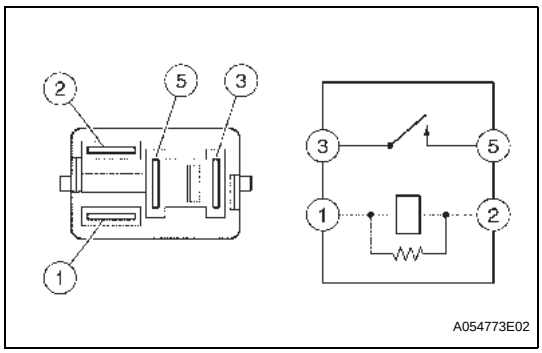
Tester Connections	Specified Conditions
HA1A (1) - +B (2)	1.8 to 3.4 Ωat 20°C (68°F)
HA1A (1) - A1A- (4)	10 kΩ or higher

(c) Reconnect the A/F sensor connector.

NG → REPLACE AIR FUEL RATIO SENSOR

OK

12 INSPECT AIR FUEL RATIO SENSOR HEATER RELAY



(a) Remove the A/F HEATER relay from the engine room R/B.
(b) Check the A/F HEATER relay resistance.
Standard Resistance

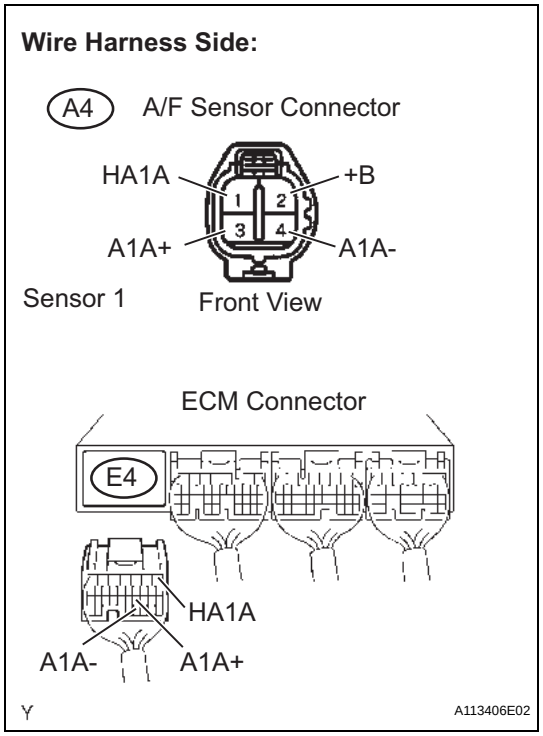
Tester Connections	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

(c) Reinstall the A/F HEATER relay.

NG → REPLACE AIR FUEL RATIO SENSOR HEATER RELAY

OK

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



(a) Disconnect the A4 A/F sensor connector.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between the +B terminal of the A/F sensor connector and body ground.

Standard Voltage

Tester Connection	Specified Condition
+B (A4-2) - Body ground	9 to 14 V

(d) Turn the ignition switch to OFF.
(e) Disconnect the E4 ECM connector.
(f) Check the resistance.

Standard Resistance (Check for open)

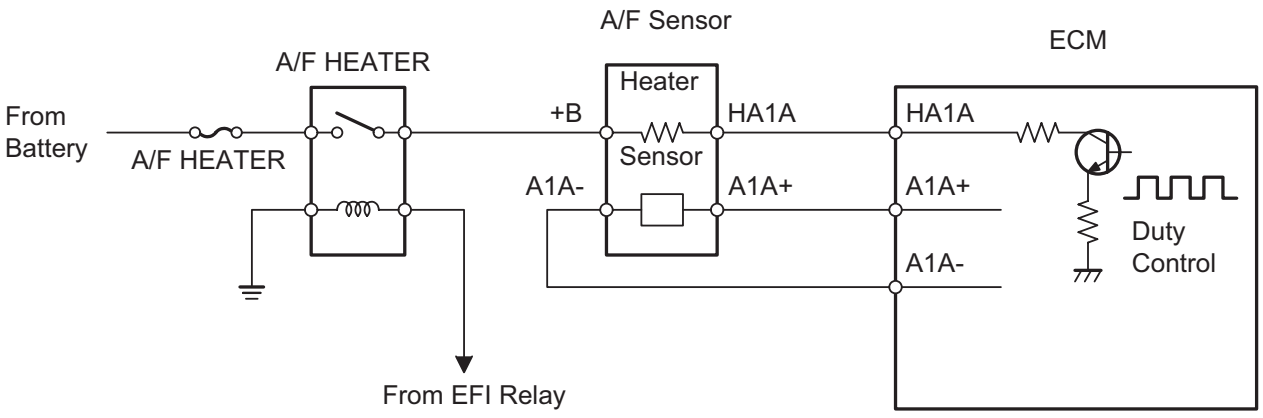
Tester Connections	Specified Conditions
HA1A (A4-1) - HA1A (E4-1)	Below 1 Ω
A1A+ (A4-3) - A1A+ (E4-21)	Below 1 Ω
A1A- (A4-4) - A1A- (E4-31)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
HA1A (A4-1) or HA1A (E4-1) - Body ground	10 kΩ or higher
A1A+ (A4-3) or A1A+ (E4-21) - Body ground	10 kΩ or higher
A1A- (A4-4) or A1A- (E4-31) - Body ground	10 kΩ or higher

(g) Reconnect the ECM connector.
(h) Reconnect the A/F sensor connector.

Reference (Bank 1 Sensor 1 System Diagram)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

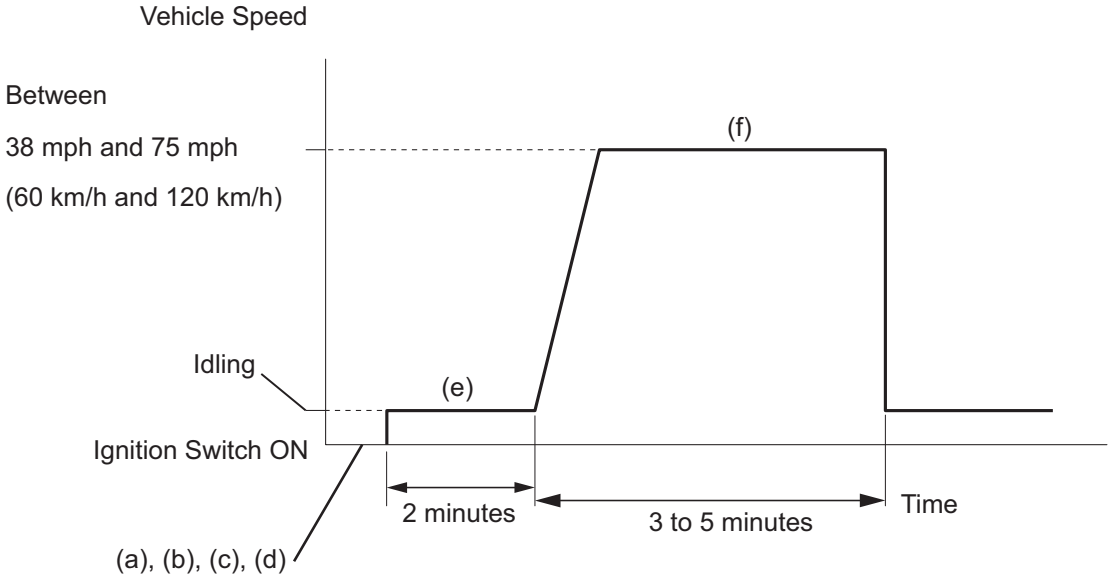
OK

14	REPLACE AIR FUEL RATIO SENSOR

NEXT

15	PERFORM CONFIRMATION DRIVING PATTERN

ES



(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Clear DTCs (see page ES-40).
(d) Switch the ECM from normal mode to check mode using the tester (see page ES-43).
(e) Start the engine and warm it up with all the accessories switched OFF.
(f) Drive the vehicle at between 38 mph and 75 mph (60 km/h and 120 km/h) and at an engine speed of between 1,400 rpm and 3,200 rpm for 3 to 5 minutes.
HINT:
If the system is still malfunctioning, the MIL will be illuminated during step (f).
NOTICE:
If the conditions in this test are not strictly followed, no malfunction will be detected.

NEXT

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

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

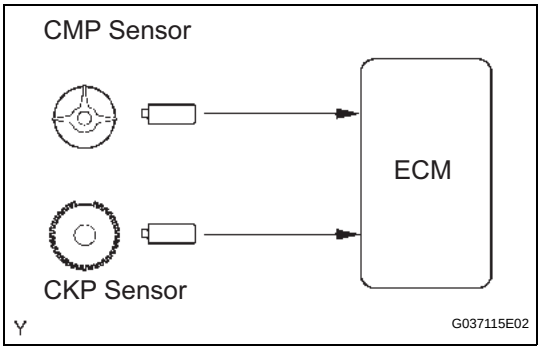
DTC	P0303	Cylinder 3 Misfire Detected

DTC	P0304	Cylinder 4 Misfire Detected

DESCRIPTION

ES

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



If the misfire exceeds the threshold levels, and could cause emission deterioration, the ECM illuminates the MIL and sets a DTC.

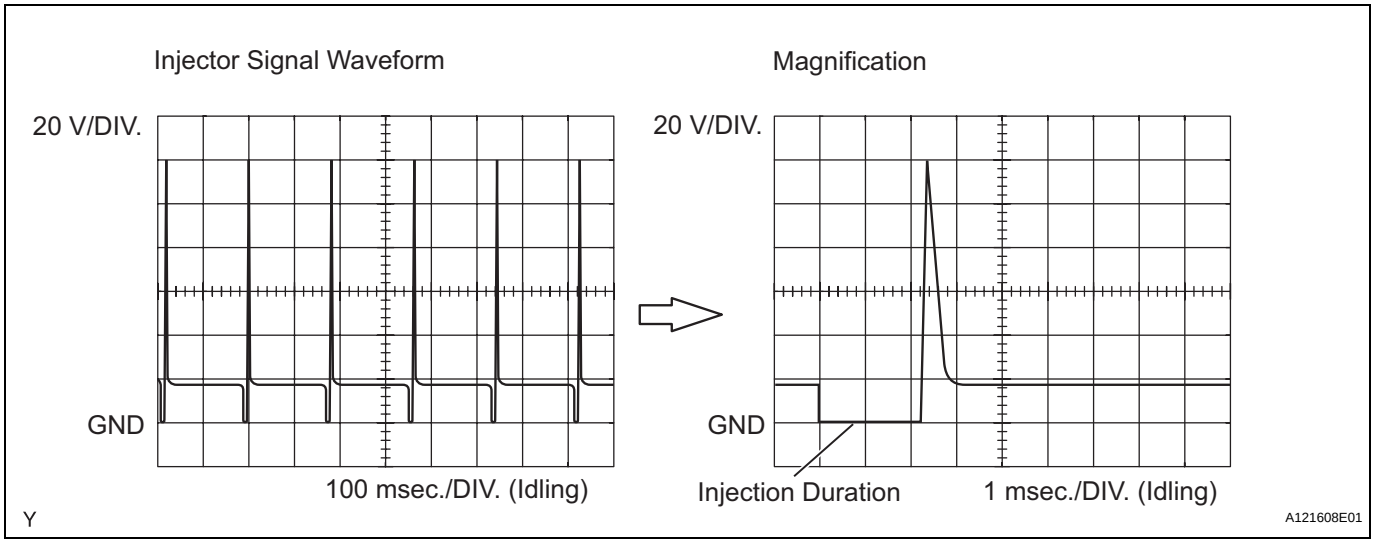
DTC No.	DTC Detection Conditions	Trouble Areas
P0300	Simultaneous misfiring of several cylinders detected (2 trip detection logic)	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Injector • Fuel pressure • Mass Air Flow (MAF) meter • Air induction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

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

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 #10 to #40 and E01 of the ECM connectors.

Items	Contents
Terminals	# 10 to # 40 - E01
Equipment Settings	20 V/Division, 100 or 1 ms/Division
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 50 misfires per 1,000 crankshaft revolutions) occurs 4 times in sequential crankshaft revolutions.

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

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

MONITOR STRATEGY

Related DTCs	P0300: Multiple cylinder misfire P0301: Cylinder 1 misfire P0302: Cylinder 2 misfire P0303: Cylinder 3 misfire P0304: Cylinder 4 misfire
Required Sensors/Components (Main)	Injector, Ignition coil, Spark plug
Required Sensors/Components (Related)	Crankshaft, Camshaft, Engine coolant temperature and intake air temperature sensors and Mass air flow meter
Frequency of Operation	Continuous
Duration	1,000 to 4,000 crankshaft revolutions: Emission related misfire 200 to 600 crankshaft revolutions: Catalyst damaged misfire
MIL Operation	2 driving cycles: Emission related misfire MIL flashes immediately: Catalyst damaged misfire
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Misfire:

Monitor runs whenever following DTCs not present	
Battery voltage	8 V or more
Throttle position learning	Completed
VVT system	Not operated by scan tool
Engine RPM	400 to 5,800 rpm
Both of following conditions A and B met	-
A. Engine coolant Temperature (ECT)	-10°C (14°F) or more
B. Either of following conditions 1 or 2 met	-
1. ECT at engine start	More than -7°C (19°F)
2. ECT	More than 20°C (68°F)

TYPICAL MALFUNCTION THRESHOLDS

Monitor Period of Emission-related-misfire:

Misfire rate	1.538 % or more
Either of following conditions (a) or (b) met	-
(a) First 1,000 revolutions after engine start or check mode	Crankshaft 1,000 revolutions
(b) Except above	Crankshaft 1,000 revolutions x 4

Monitor Period of Catalyst-damaged-misfire (MIL blinks):

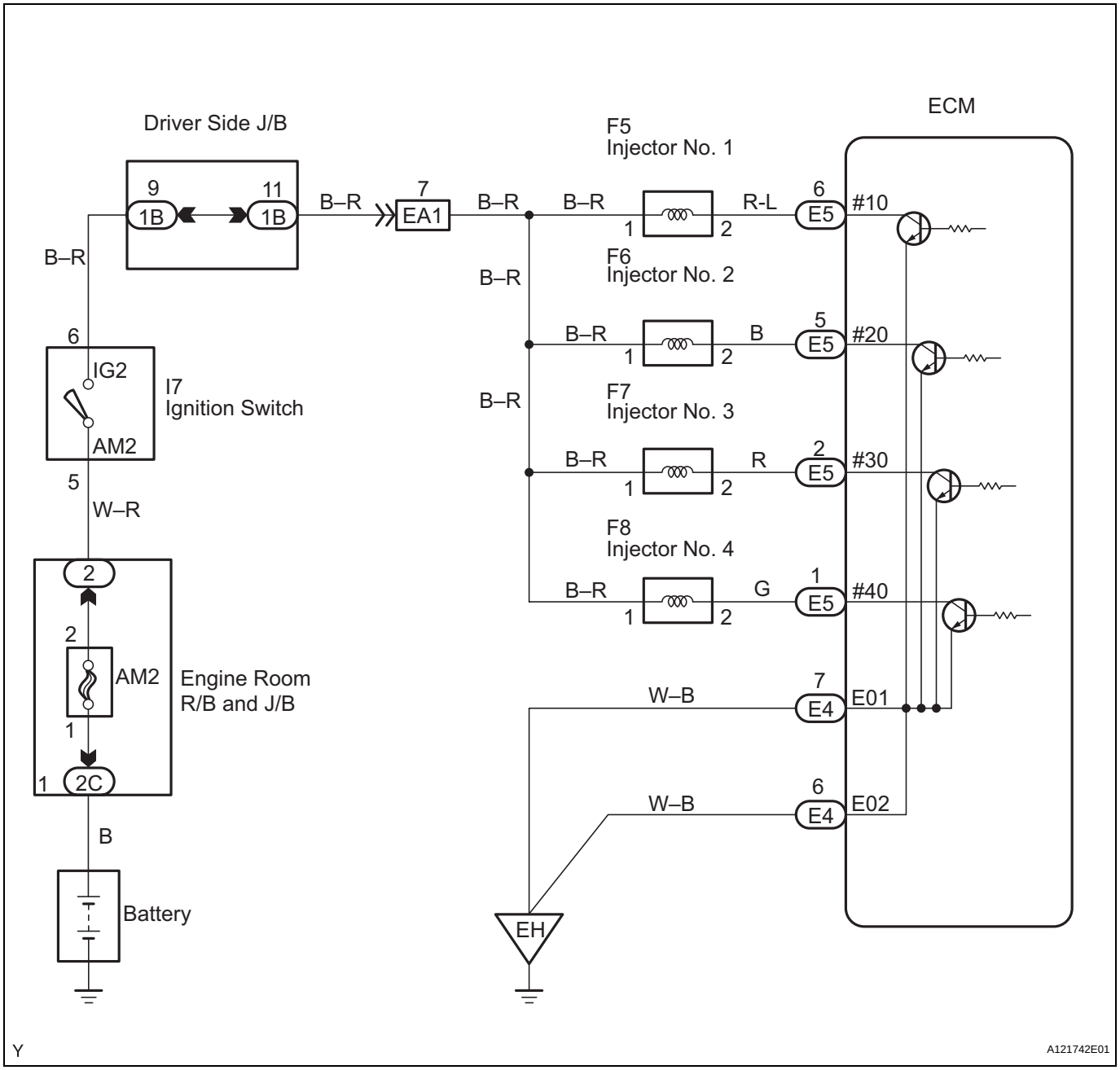
Number of misfire per 200 revolutions	97.14 or more (varies with intake air amount and engine RPM)
Either of following conditions (a) or (b) met	-
(a) All of following conditions A, B and C met	Crankshaft 200 revolutions x 3
A. Driving cycles	1st
B. Check mode	OFF
C. Engine RPM	Below 2,200 rpm
(b) Except above	Crankshaft 200 revolutions

MONITOR RESULT

Refer to Checking Monitor Status (See page ES-21).

WIRING DIAGRAM

Refer to DTC P0351 for the wiring diagram of the ignition system (See page ES-184).



CONFIRMATION DRIVING PATTERN

1. Connect an intelligent tester to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the tester ON.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode.
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.

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. Check whether misfires have occurred by checking DTCs and freeze frame data.
   HINT:
   Do not turn the ignition switch to OFF until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be erased.
9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the ignition switch to OFF and wait for at least 5 seconds.

ES

HINT:
- If any DTCs other than the misfire DTCs are output, troubleshoot those DTCs first.
- Read freeze frame data using the intelligent tester. Freeze frame data record the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.
- 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:
  (a) The fuel tank is low full.
  (b) Improper fuel is used.
  (c) The spark plugs have been contaminated.
  (d) 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:
  (a) Clear the DTC (see page ES-40).
  (b) Start the engine and conduct the confirmation driving pattern.
  (c) Read the misfiring rates of each cylinder or DTC(s) using the tester or scan tool.
  (d) Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.
  (e) 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.

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

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

(c) Turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read DTCs.

Result

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

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

B → **GO TO DTC CHART**

A

2 READ DATA LIST (MISFIRE RPM AND MISFIRE LOAD)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: 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)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the tester ON.
(d) Clear DTCs (see page ES-40).
(e) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / MISFIRE / CYL #1, #2, #3 and #4.
(f) Allow the engine to idle.
(g) Read each value of CYL #1 to #4 displayed on the tester.
If no misfire counts occur in any cylinders, perform the following operations:

(1) Shift the gear selector lever to the D position.
(2) Repeat steps (e) to (g).
(3) Check the CYL #1 to #4.
(4) If misfire counts are still not displayed, perform steps (h) and (i) 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

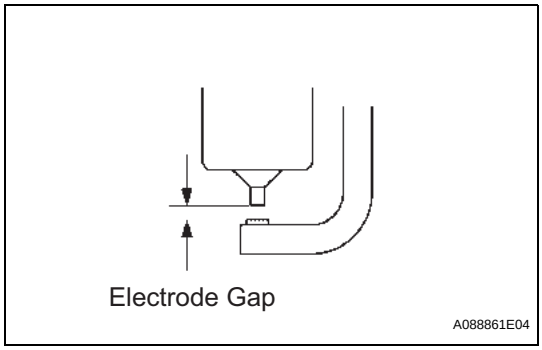
Misfire Count	Proceed To
One or two cylinders have misfire counts	A
Three cylinders or more have misfire counts	B

B → **Go to step 13**

ES

A

5 CHECK SPARK PLUG



(a) Remove the ignition coil and the spark plug of the misfiring cylinder.
(b) Measure the spark plug electrode gap.
Standard:
Between 1.0 mm and 1.3 mm (0.039 in. and 0.051 in.)
(c) Check the electrode for carbon deposits.
Recommended spark plug

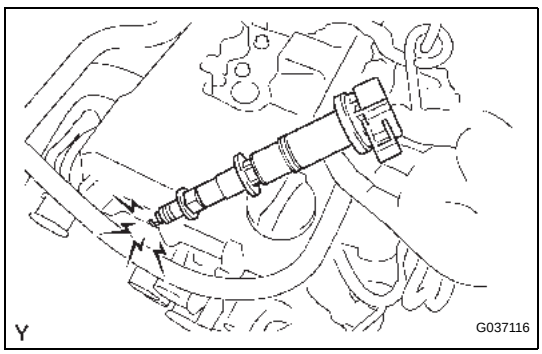
Manufacturers	Products
DENSO	SK20HR11
NGK	ILFR6C11

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 set bolt.
(d) Crank the engine for less than 2 seconds and check the spark.
OK:
Sparks jump across electrode gap
(e) Reconnect the injector connectors.

NG → **Go to step 8**

OK

7	CHECK CYLINDER COMPRESSION PRESSURE ON MISFIRING CYLINDER

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

OK → Go to step 9

NG

REPAIR OR REPLACE ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

ES

8	CHANGE NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

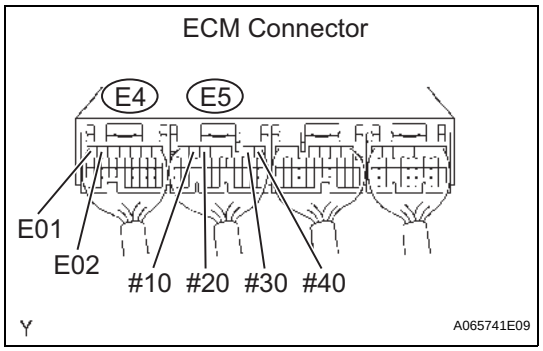
(a) Change the installed spark plug to a spark plug that functions normally.
(b) Perform a spark test.
CAUTION:
Always disconnect each injector connector.
NOTICE:
Do not crank the engine for more than 2 seconds.
(1) Install the spark plug to the ignition coil and connect the ignition coil connector.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

OK → REPLACE SPARK PLUG

NG

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

9	INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30,AND/OR #40 VOLTAGE)



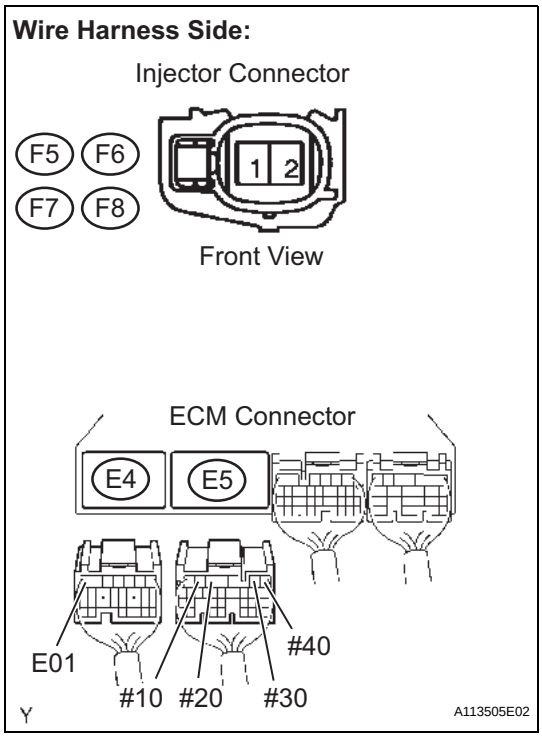
(a) Turn the ignition switch to ON.
(b) Measure the voltage between the terminals of the ECM connector.
Standard Voltage

Tester Connections	Specified Conditions
#10 (E5-6) - E01 (E4-7)	9 to 14 V
#20 (E5-5) - E01 (E4-7)	9 to 14 V
#30 (E5-2) - E01 (E4-7)	9 to 14 V
#40 (E5-1) - E01 (E4-7)	9 to 14 V

OK → Go to step 11

NG

10 CHECK HARNESS AND CONNECTOR (INJECTOR - ECM)



(a) Disconnect the injector connector (of the misfiring cylinder).
(b) Disconnect the E4 and E5 ECM connectors.
(c) Turn the ignition switch to ON.
(d) Measure the resistance and voltage between the injector and the ECM connector terminals.

Standard Resistance and Standard Voltage (No.1 Cylinder)

Tester Connections	Specified Conditions
F5-1 - Ground	11 to 14 V
F5-2 - Ground	10 kΩ or higher
F5-2 - #10 (E5-6)	Below 1 Ω

Standard Resistance and Standard Voltage (No.2 Cylinder)

Tester Connections	Specified Conditions
F6-1 - Ground	11 to 14 V
F6-2 - Ground	10 kΩ or higher
F6-2 - #20 (E5-5)	Below 1 Ω

Standard Resistance and Standard Voltage (No.3 Cylinder)

Tester Connections	Specified Conditions
F7-1 - Ground	11 to 14 V
F7-2 - Ground	10 kΩ or higher
F7-2 - #30 (E5-2)	Below 1 Ω

Standard Resistance and Standard Voltage (No.4 Cylinder)

Tester Connections	Specified Conditions
F8-1 - Ground	11 to 14 V
F8-2 - Ground	10 kΩ or higher
F8-2 - #40 (E5-1)	Below 1 Ω

(e) Reconnect the injector connector.
(f) Reconnect the ECM connector.

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

11 CHECK FUEL INJECTOR (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 (VALVE CLEARANCE OF MISFIRING CYLINDER)

NG → ADJUST VALVE CLEARANCE

OK

13 CHECK AIR INDUCTION SYSTEM

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

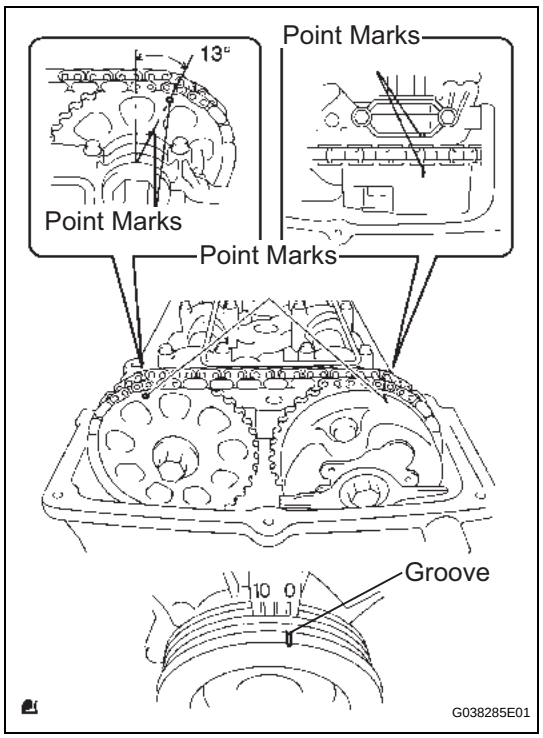
OK:

No leakage from air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

14 CHECK VALVE TIMING



(a) Remove the cylinder head cover (see page EM-23).

(b) Turn the crankshaft pulley, and align its groove with the timing mark "0" on the timing chain cover.

(c) Check that the point marks on the camshaft timing gears are as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°) and align the marks as above.

OK:

Point marks on camshaft timing gears are aligned as shown in illustration.

(d) Reinstall the cylinder head cover (see page EM-32).

NG → ADJUST VALVE TIMING

OK

15 CHECK FUEL PRESSURE

(a) Check the fuel pressure.

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

OK

16	READ DATA LIST (COOLANT TEMP)

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

Standard:

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

NG → REPLACE ENGINE COOLANT TEMPERATURE SENSOR

OK

17	READ DATA LIST (MAF)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / 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 2.0 g/sec and 4.5 g/sec (shift position: N, A/C: OFF).
MAF at engine speed of 2,500 rpm: Between 8.0 g/sec and 14.7 g/sec (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)

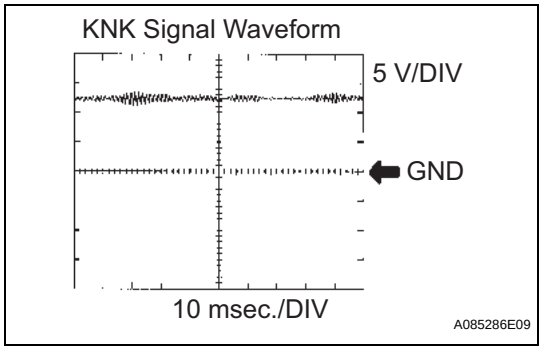
DESCRIPTION

A flat type knock sensor (non-resonant type) has a structure that can detect vibrations over a wide band of frequencies: between approximately 6 kHz and 15 kHz.
Knock sensors are fitted onto the engine block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed. The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

ES

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 to OFF.



Reference: Inspection using an oscilloscope
The correct waveform is shown.

Items	Contents
Terminals	KNK1 - EKNK
Equipment Settings	0.01 to 10 V/Division, 0.01 to 10 msec./Division
Conditions	Keep engine speed at 4,000 rpm with warm engine

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, any of 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 following DTCs not present	None
Battery voltage	10.5 V or more
Time after engine start	5 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

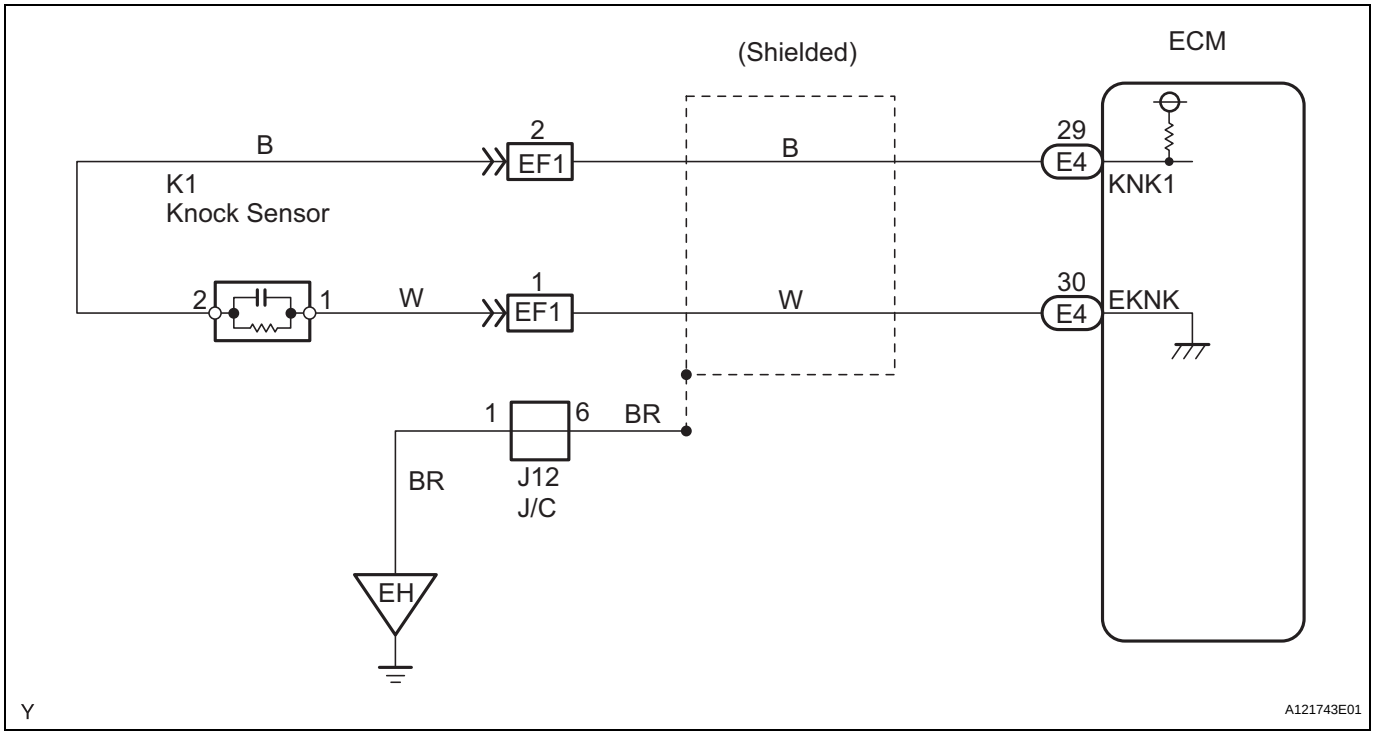
Knock Sensor Range Check (Low voltage) P0327:

Knock sensor voltage	Less than 0.5 V

Knock Sensor Range Check (High voltage) P0328:

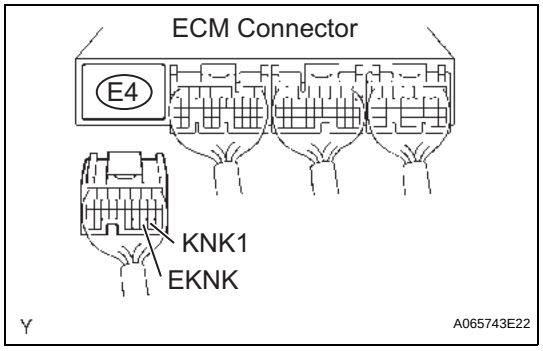
Knock sensor voltage	More than 4.5 V

WIRING DIAGRAM



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

1 CHECK HARNESS AND CONNECTOR (ECM - KNOCK SENSOR)



(a) Disconnect the E4 ECM connector.
(b) Measure the resistance between the terminals of the ECM connector.
Standard Resistance

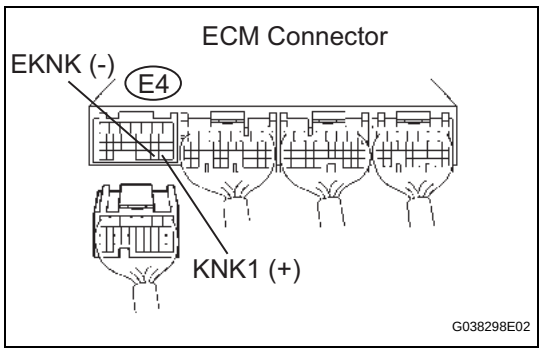
Tester Connections	Specified Conditions
KNK1 (E4-29) - EKNK (E4-30)	120 to 280 kΩ at 20 °C (68°F)

(c) Reconnect the ECM connector.

NG → **Go to step 3**

OK

2 INSPECT ECM (KNK1 VOLTAGE)



(a) Disconnect the ECM connector.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between the ECM terminals.
Standard Voltage

Tester Connections	Specified Conditions
KNK1 (E4-29) - EKNK (E4-30)	4.5 to 5.5 V

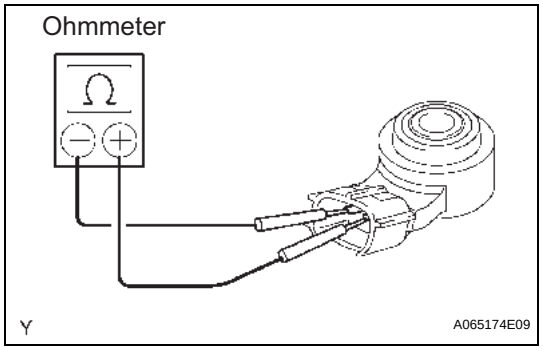
(d) Reconnect the ECM connector.

NG → **REPLACE ECM**

OK

CHECK FOR INTERMITTENT PROBLEMS

3 INSPECT KNOCK SENSOR



(a) Remove the knock sensor.
(b) Measure the resistance between the terminals.
Standard Resistance

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

(c) Reinstall the knock sensor.

NG → **REPLACE KNOCK SENSOR**

ES

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

DTC	P0335	Crankshaft Position Sensor "A" Circuit

DTC	P0339	Crankshaft Position Sensor "A" Circuit Intermittent

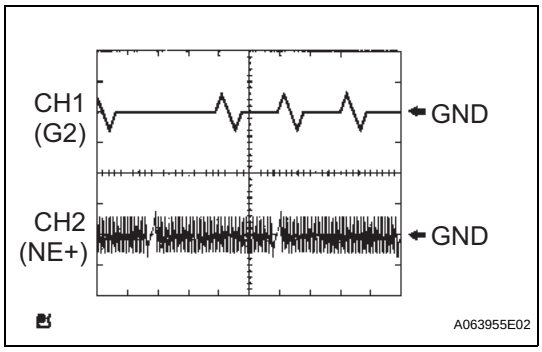
DESCRIPTION

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 Conditions	Trouble Areas
P0335	• No Crankshaft Position (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 Crankshaft Position (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 elapsed 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 on the left.
- G2 stands for the Camshaft Position (CMP) sensor signal, and NE+ stands for the CKP sensor signal.

Items	Contents
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 despite the engine revolving, the ECM interprets this as a malfunction of the sensor.

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

MONITOR STRATEGY

Related DTCs	P0335: Crankshaft position sensor range check during cranking P0335: Crankshaft position sensor range check during engine running
Required Sensors/Components (Main)	Crankshaft Position (CKP) sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	Conditions met for 3 times
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

ES

Crankshaft Position Sensor Range Check during Cranking P0335:

Starter	ON
Minimum battery voltage while starter ON	Less than 11 V
Number of camshaft position sensor signal pulse	6 or more

Crankshaft Position Sensor Range Check during Engine Running P0335:

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

TYPICAL MALFUNCTION THRESHOLDS

Crankshaft Position Sensor Range Check during Cranking P0335:

Number of crankshaft position sensor signal pulse	132 or less, or 174 or more

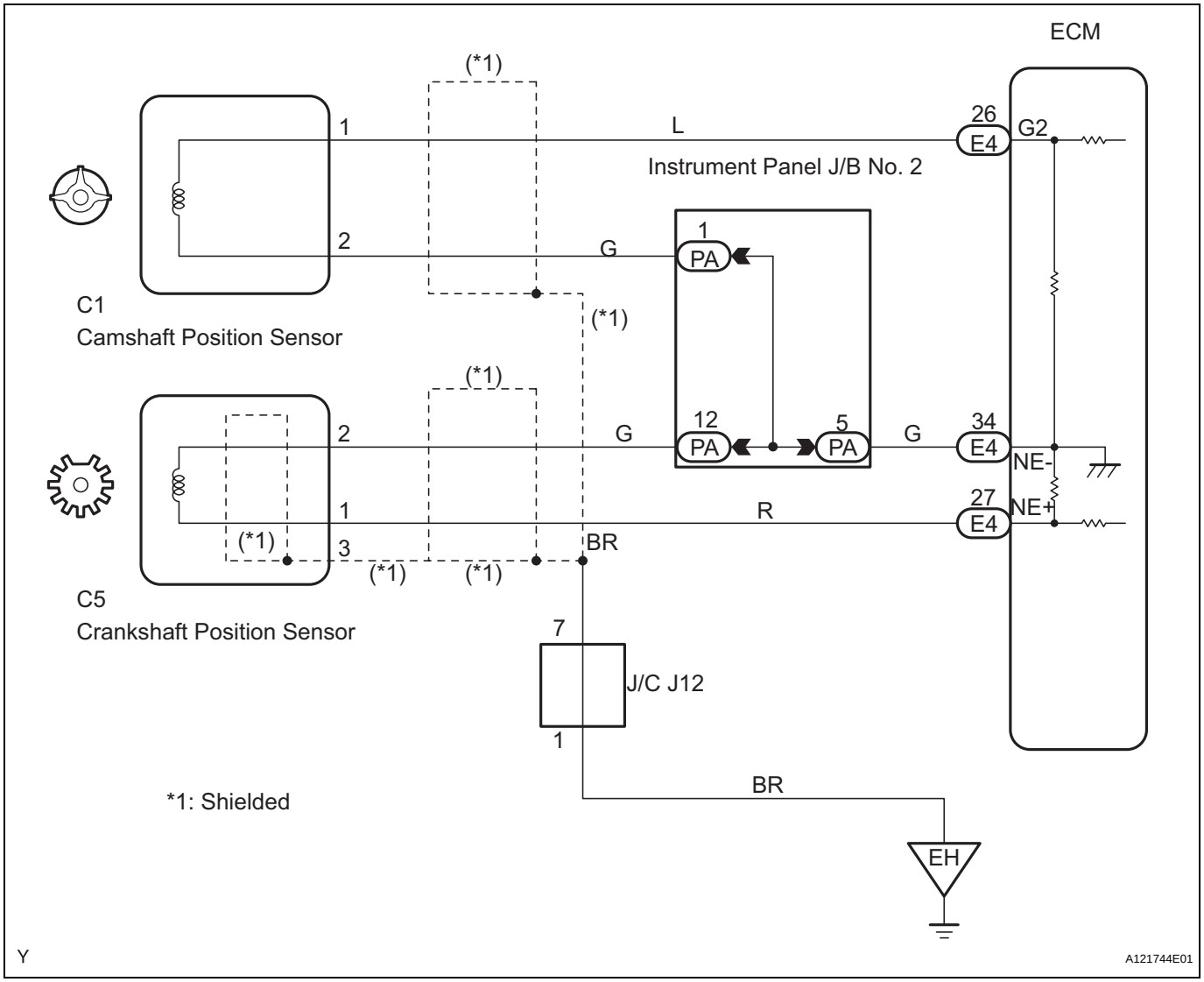
Crankshaft Position Sensor Range Check during Engine Running P0335:

CKP sensor signal	No signal

COMPONENT OPERATING RANGE

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

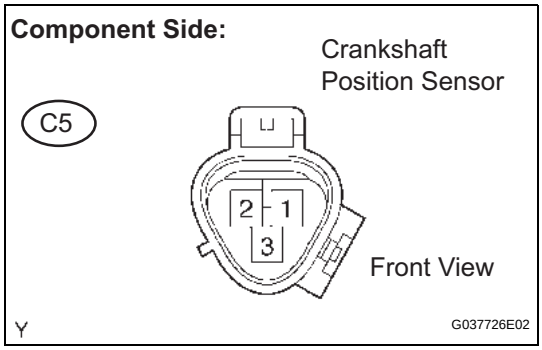
WIRING DIAGRAM



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 an intelligent tester. To check, follow the operation below:
  (a) Connect an intelligent tester to the DLC3.
  (b) Start the engine.
  (c) Turn the tester ON.
  (d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / ENGINE SPD.
  The engine speed may be indicated as zero despite the engine revolving normally. This is caused by a lack of NE signals from the Crankshaft Position (CKP) sensor. Alternatively, the engine speed may be indicated as lower than the actual engine speed, if the CKP sensor voltage output is insufficient.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	INSPECT CRANKSHAFT POSITION SENSOR (RESISTANCE)



(a) Disconnect the C5 Crankshaft Position (CKP) sensor connector.
(b) Measure the resistance between terminals 1 and 2.

Standard Resistance

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

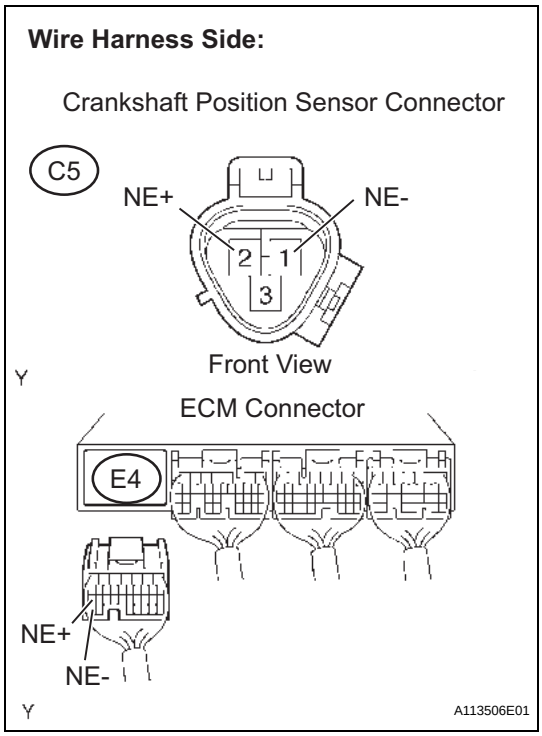
HINT:
Terms cold and hot refer to the temperature of the coils.
Cold means approximately -10° to 50°C (14°to 122°F).
Hot means approximately 50° to 100°C (122° to 212°F).

(c) Reconnect the CKP sensor connector.

NG → **REPLACE CRANKSHAFT POSITION SENSOR**

OK

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



(a) Disconnect the C5 CKP sensor connector.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
NE+ (C5-1) - NE+ (E4-27)	Below 1 Ω
NE- (C5-2) - NE- (E4-34)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
NE+ (C5-1) or NE+ (E4-27) - Body ground	10 kΩ or higher
NE- (C5-2) or NE- (E4-34) - Body ground	10 kΩ or higher

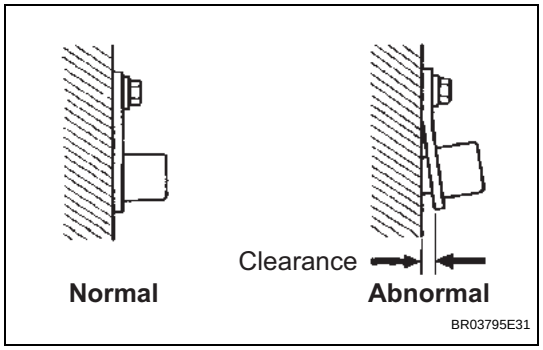
(d) Reconnect the ECM connector.
(e) Reconnect the CKP sensor connector.

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

OK

ES

3	CHECK CRANKSHAFT POSITION SENSOR (SENSOR INSTALLATION)



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

NG → **SECURELY REINSTALL SENSOR**

OK

4	CHECK CRANKSHAFT TIMING PULLEY (TEETH OF PLATE)

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

NG → **REPLACE CRANKSHAFT POSITION SENSOR PLATE**

OK

REPLACE ECM

ES

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

DTC	P0341	Camshaft Position Sensor "A" Circuit Range / Performance (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.

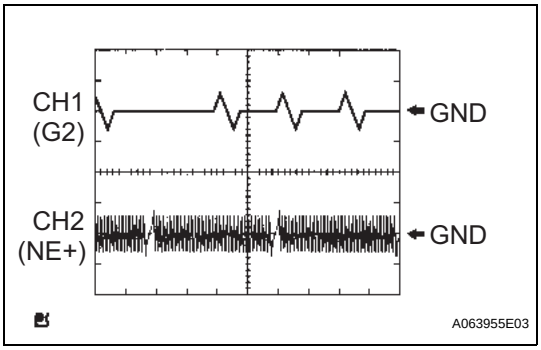
ES

DTC No.	DTC Detection Conditions	Trouble Areas
P0340	Case 1 • No Camshaft Position (CMP) sensor signal to ECM while cranking (2 trip detection logic) Case 2 • No CMP sensor signal to ECM 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
P0341	When crankshaft rotates twice, Camshaft Position (CMP) sensor signal input to ECM 12 times 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).
- DTC P0341 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 above.
- G2 stands for the CMP sensor signal, and NE+ stands for the Crankshaft Position (CKP) sensor signal.

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

MONITOR DESCRIPTION

If no signal is transmitted by the CMP sensor despite the engine revolving, or the rotation of the camshaft and the crankshaft is not synchronized, the ECM interprets this as a malfunction of the sensor.
If the malfunction is not repaired successfully, 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 P0341: Camshaft position sensor malfunction
Required Sensors/Components (Main)	Camshaft Position (CMP) sensor
Required Sensors/Components (Related)	Crankshaft Position (CKP) sensor
Frequency of Operation	Continuous
Duration	5 seconds
MIL Operation	2 driving cycles: CMP sensor range check Immediate: Camshaft position/crankshaft position misalignment and CMP sensor malfunction
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

Camshaft Position Sensor Range Check P0340:

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

Camshaft Position/Crankshaft Position Misalignment P0340:

Engine speed	600 rpm or more
Starter	OFF

Camshaft Position Sensor Malfunction P0341:

Starter	After OFF to ON timing

TYPICAL MALFUNCTION THRESHOLDS

Camshaft Position Sensor Range Check P0340:

CMP sensor signal	No signal

Camshaft Position/Crankshaft Position Misalignment P0340:

Camshaft position and crankshaft position phase	Misaligned

Camshaft Position Sensor Malfunction P0341:

Camshaft position and crankshaft position phase	Misaligned
CMP sensor signal per 2 crankshaft revolutions	12 signals or more

COMPONENT OPERATING RANGE

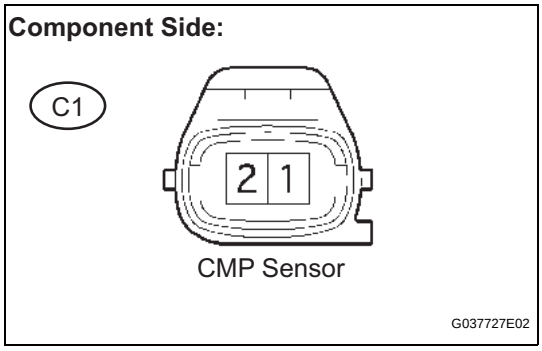
CMP sensor	• CMP sensor output voltage fluctuates while camshaft revolving • 3 CMP sensor signals per 2 crankshaft revolutions

WIRING DIAGRAM

Refer to DTC P0335 (See page ES-173).

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

1 INSPECT CAMSHAFT POSITION SENSOR (RESISTANCE)



(a) Disconnect the C1 Camshaft Position (CMP) sensor connector.
(b) Measure the resistance between terminals 1 and 2.

Standard Resistance

Tester Connections	Specified Conditions
1 - 2	835 to 1,400 Ω at cold
1 - 2	1,060 to 1,645 Ω at hot

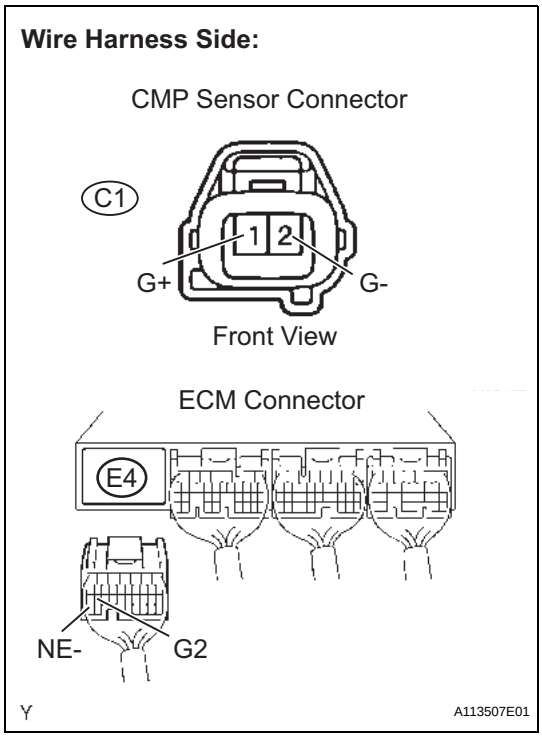
HINT:
Terms cold and hot refer to the temperature of the coils. Cold means approximately -10° to 50°C (14° to 122°F). Hot means approximately 50° to 100°C (122° to 212°F).

(c) Reconnect the CMP sensor connector.

NG → **REPLACE CAMSHAFT POSITION SENSOR**

OK

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



(a) Disconnect the C1 CMP sensor connector.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
G+ (C1-1) - G2 (E4-26)	Below 1 Ω
G- (C1-2) - NE- (E4-34)	Below 1 Ω

Standard Resistance (Check for short)

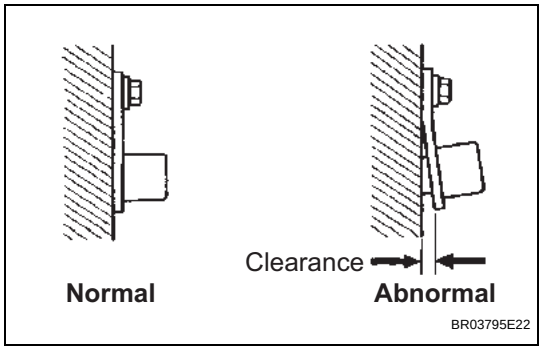
Tester Connections	Specified Conditions
G+ (C1-1) or G2 (E4-26) - Body ground	10 kΩ or higher
G- (C1-2) or NE- (E4-34) - Body ground	10 kΩ or higher

(d) Reconnect the ECM connector.
(e) Reconnect the CMP sensor connector.

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 → **SECURELY REINSTALL SENSOR**

OK

4	CHECK CAMSHAFT TIMING GEAR ASSEMBLY (TEETH OF SENSOR PLATE)

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

NG → **REPLACE CAMSHAFT TIMING GEAR ASSEMBLY**

OK

REPLACE ECM

ES

DTC	P0351	Ignition Coil "A" Primary / Secondary Circuit

DTC	P0352	Ignition Coil "B" Primary / Secondary Circuit

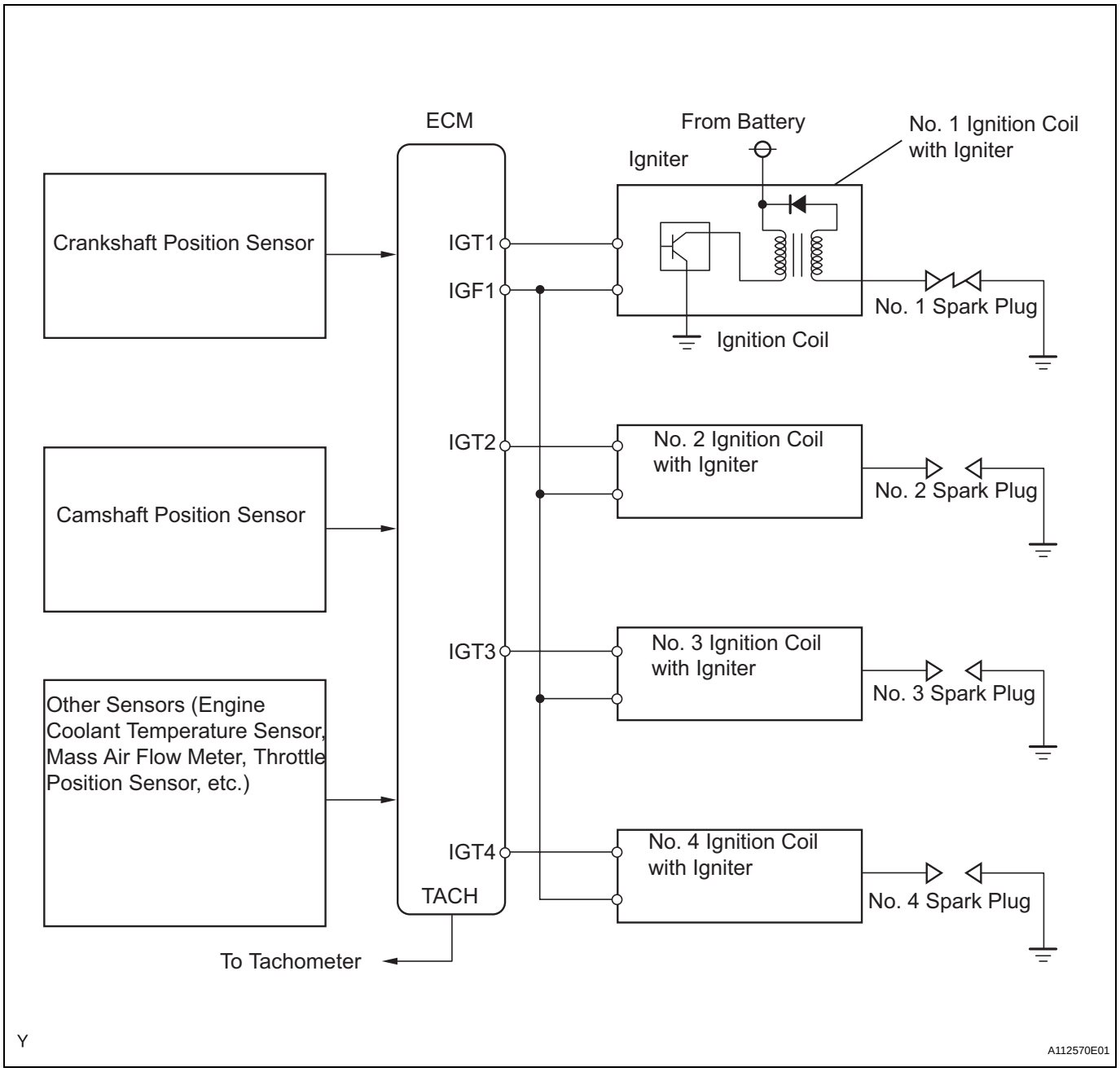
DTC	P0353	Ignition Coil "C" Primary / Secondary Circuit

DTC	P0354	Ignition Coil "D" Primary / Secondary Circuit

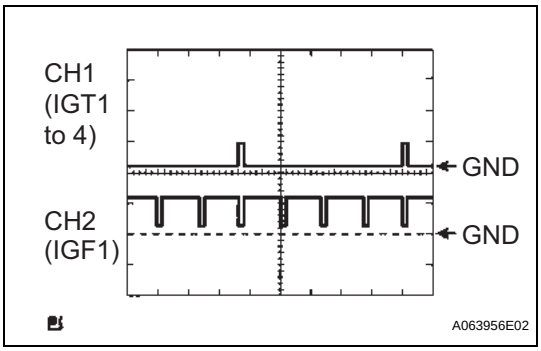
HINT:
- These DTCs indicate malfunctions relating to the primary circuit.
- If DTC P0351 is set, check No.1 ignition coil with igniter circuit.
- If DTC P0352 is set, check No.2 ignition coil with igniter circuit.
- If DTC P0353 is set, check No.3 ignition coil with igniter circuit.
- If DTC P0354 is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

DESCRIPTION

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 Conditions	Trouble Areas
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

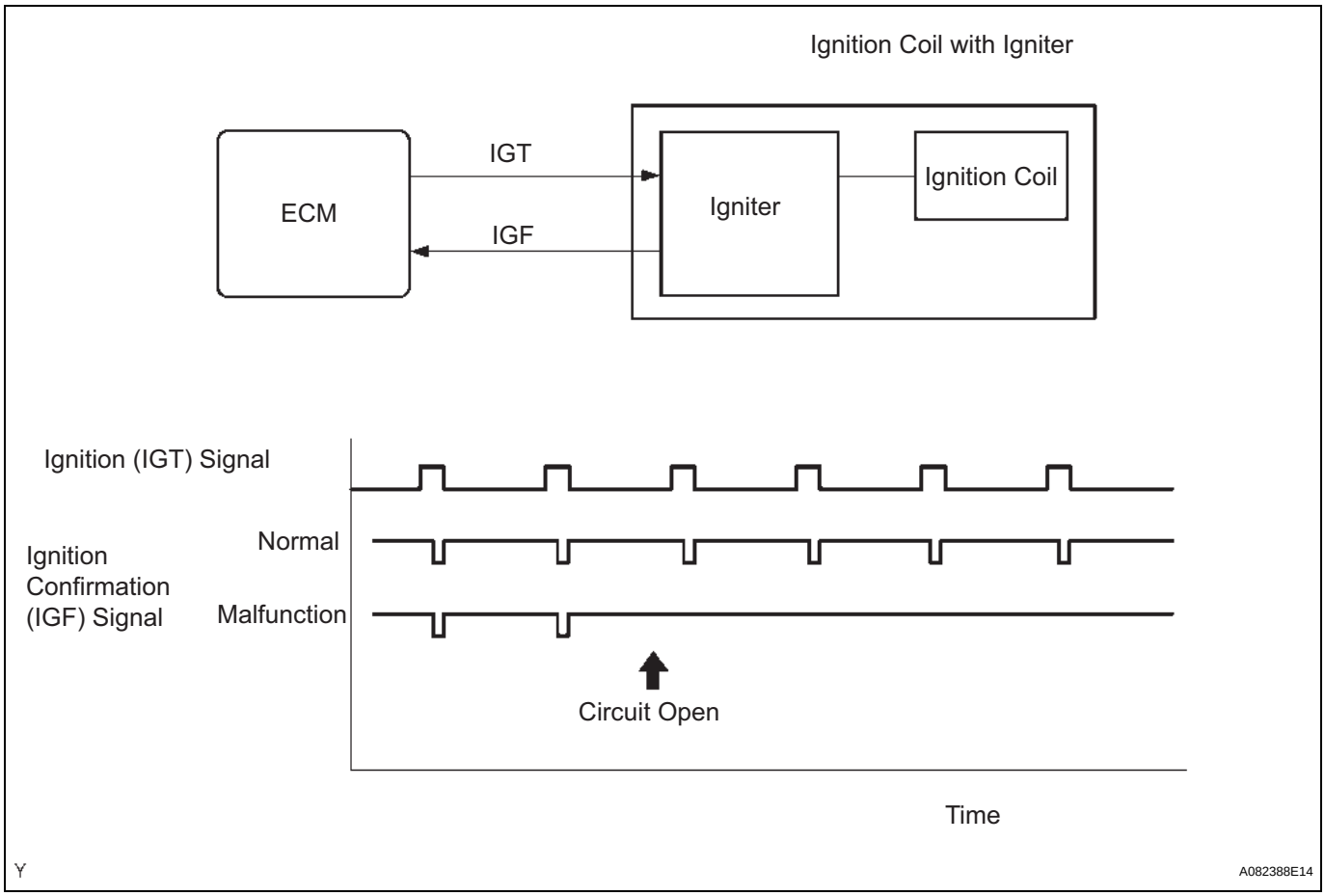


Reference: Inspection using an oscilloscope.
While cranking or idling, check the waveform between terminals IGT(1 to 4) and E1, and IGF1 and E1 of the ECM connector.

ES

Items	Contents
Terminals	CH1: IGT1, IGT2, IGT3, IGT4 - E1 CH2: IGF1 - E1
Equipment Settings	2 V/Division, 20 ms/Division
Conditions	Cranking or idling

MONITOR DESCRIPTION



If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and sets a DTC.
If the malfunction is not repaired successfully, a DTC is set 1second 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 and 4 sparks
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Either of following conditions met	-
Engine RPM	1,500 rpm or less
Starter	OFF

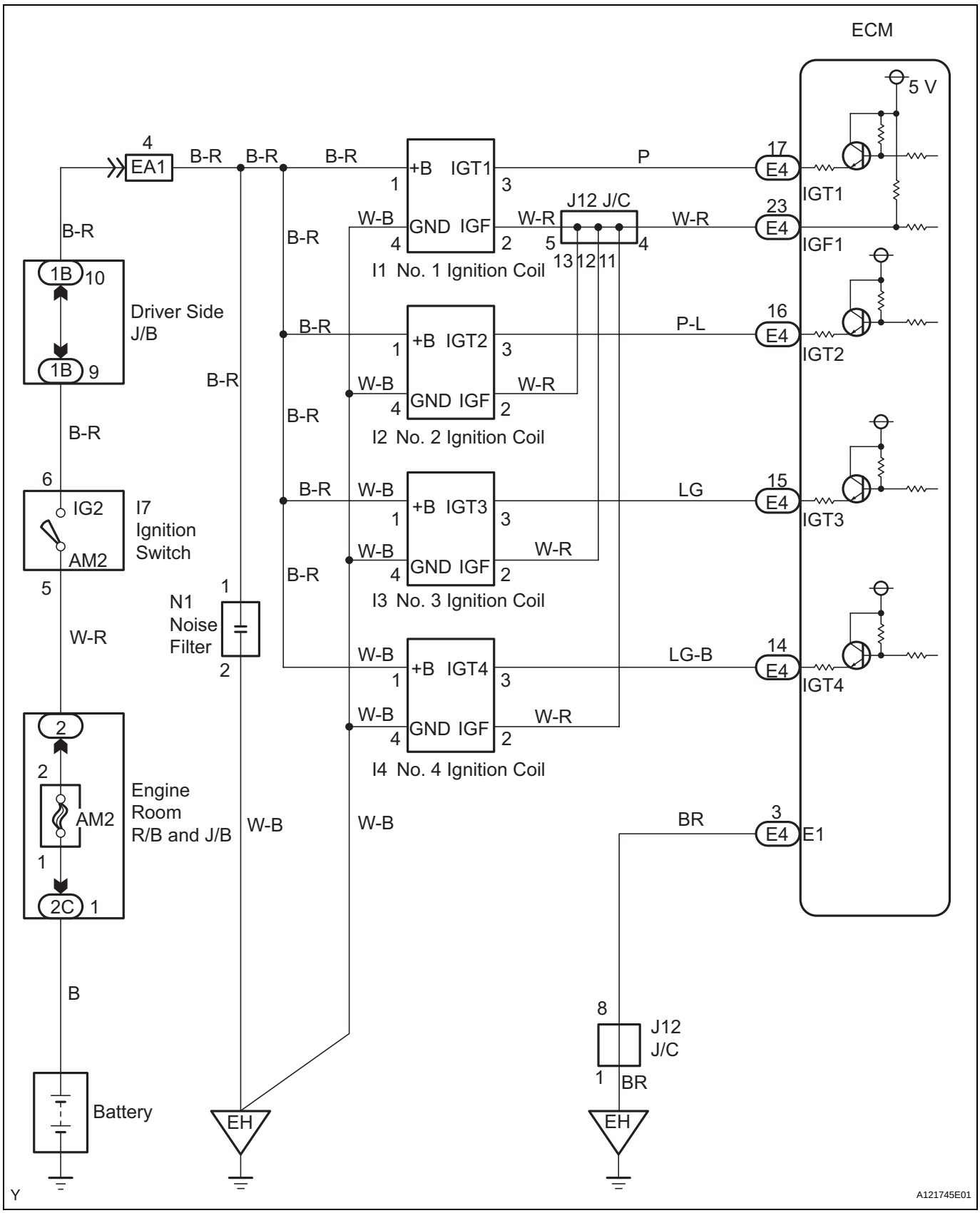
TYPICAL MALFUNCTION THRESHOLDS

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



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

1 CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353 OR P0354)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the tester ON.
(d) Clear DTCs (see page ES-40).
(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 DTCs displayed on the tester.

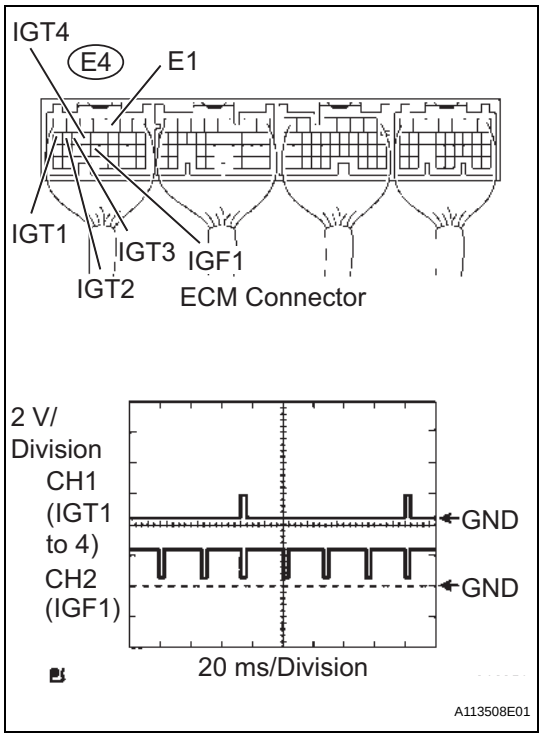
Result

Display (DTC Output)	Proceed To
Same DTC output	A
Other ignition coil DTC output	B

B → **REPLACE IGNITION COIL ASSEMBLY**

A

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



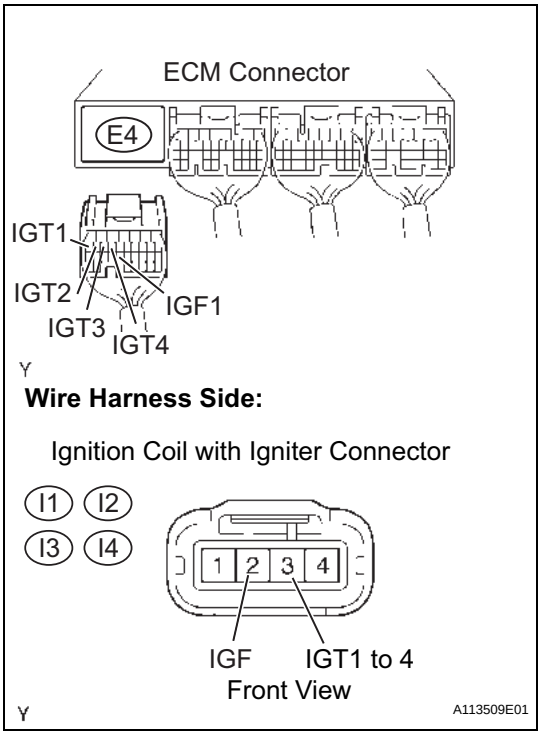
(a) Inspect the ECM using an oscilloscope.
(b) While cranking or idling, check the waveform between the terminals of the E4 ECM connector.
Standard

Tester Connections	Specified Conditions
IGT1 (E4-17) - E1 (E4-3)	Correct waveform shown
IGT2 (E4-16) - E1 (E4-3)	Correct waveform shown
IGT3 (E4-15) - E1 (E4-3)	Correct waveform shown
IGT4 (E4-14) - E1 (E4-3)	Correct waveform shown
IGF1 (E4-23) - E1 (E4-3)	Correct waveform shown

NG → **REPLACE ECM**

OK

3	CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)



(a) Disconnect the ignition coil with igniter connector.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
IGF (I1-2) - IGF1 (E4-23)	Below 1 Ω
IGF (I2-2) - IGF1 (E4-23)	Below 1 Ω
IGF (I3-2) -IGF1 (E4-23)	Below 1 Ω
IGF (I4-2) - IGF1 (E4-23)	Below 1 Ω

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
IGT1 (I1-3) - IGT1 (E4-17)	Below 1 Ω
IGT2 (I2-3) - IGT2 (E4-16)	Below 1 Ω
IGT3 (I3-3) - IGT3 (E4-15)	Below 1 Ω
IGT4 (I4-3) - IGT4 (E4-14)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
IGF (I1-2) or IGF1 (E4-23) - Body ground	10 kΩ or higher
IGF (I2-2) or IGF1 (E4-23) - Body ground	10 kΩ or higher
IGF (I3-2) or IGF1 (E4-23) - Body ground	10 kΩ or higher
IGF (I4-2) or IGF1 (E4-23) - Body ground	10 kΩ or higher

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
IGT1 (I1-3) or IGT1 (E4-17) - Body ground	10 kΩ or higher
IGT2 (I2-3) or IGT2 (E4-16) - Body ground	10 kΩ or higher
IGT3 (I3-3) or IGT3 (E4-15) - Body ground	10 kΩ or higher
IGT4 (I4-3) or IGT4 (E4-14) - Body ground	10 kΩ or higher

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

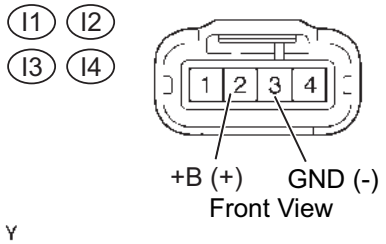
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

ES

4 INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)

Wire Harness Side:
Ignition Coil with Igniter Connector



(a) Disconnect the ignition coil with igniter connector.
(b) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
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 ON.
(d) Measure the voltage between the terminals of the wire harness side connector.

Standard Voltage

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

(e) Reconnect the ignition coil with igniter connector.

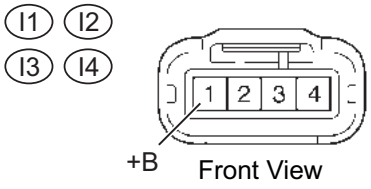
OK → **REPLACE IGNITION COIL ASSEMBLY**

NG

5 CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - IGNITION SWITCH)

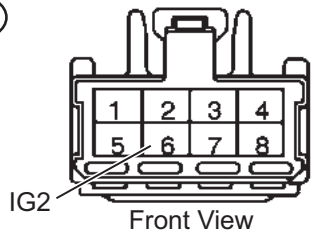
Wire Harness Side:

Ignition Coil with Igniter Connector



Wire Harness Side:

Ignision Switch Connector



A113662E02

(a) Disconnect the ignition coil with igniter connector.
(b) Disconnect the I7 ignition switch connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
+B (I1-1) -IG2 (I7-6)	Below 1 Ω
+B (I2-1) - IG2 (I7-6)	Below 1 Ω
+B (I3-1) - IG2 (I7-6)	Below 1 Ω
+B (I4-1) - IG2 (I7-6)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
+B (I1-1) or IG2 (I7-6) - Body ground	10 kΩ or higher
+B (I2-1) or IG2 (I7-6) - Body ground	10 kΩ or higher
+B (I3-1) or IG2 (I7-6) - Body ground	10 kΩ or higher
+B (I4-1) or IG2 (I7-6) - Body ground	10 kΩ or higher

(d) Reconnect the ignition coil with igniter connector.
(e) Reconnect the ignition switch connector.

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

ES

OK

REPLACE IGNITION COIL ASSEMBLY

DTC	P0412	Secondary Air Injection System Switching Valve "A" Circuit

DESCRIPTION

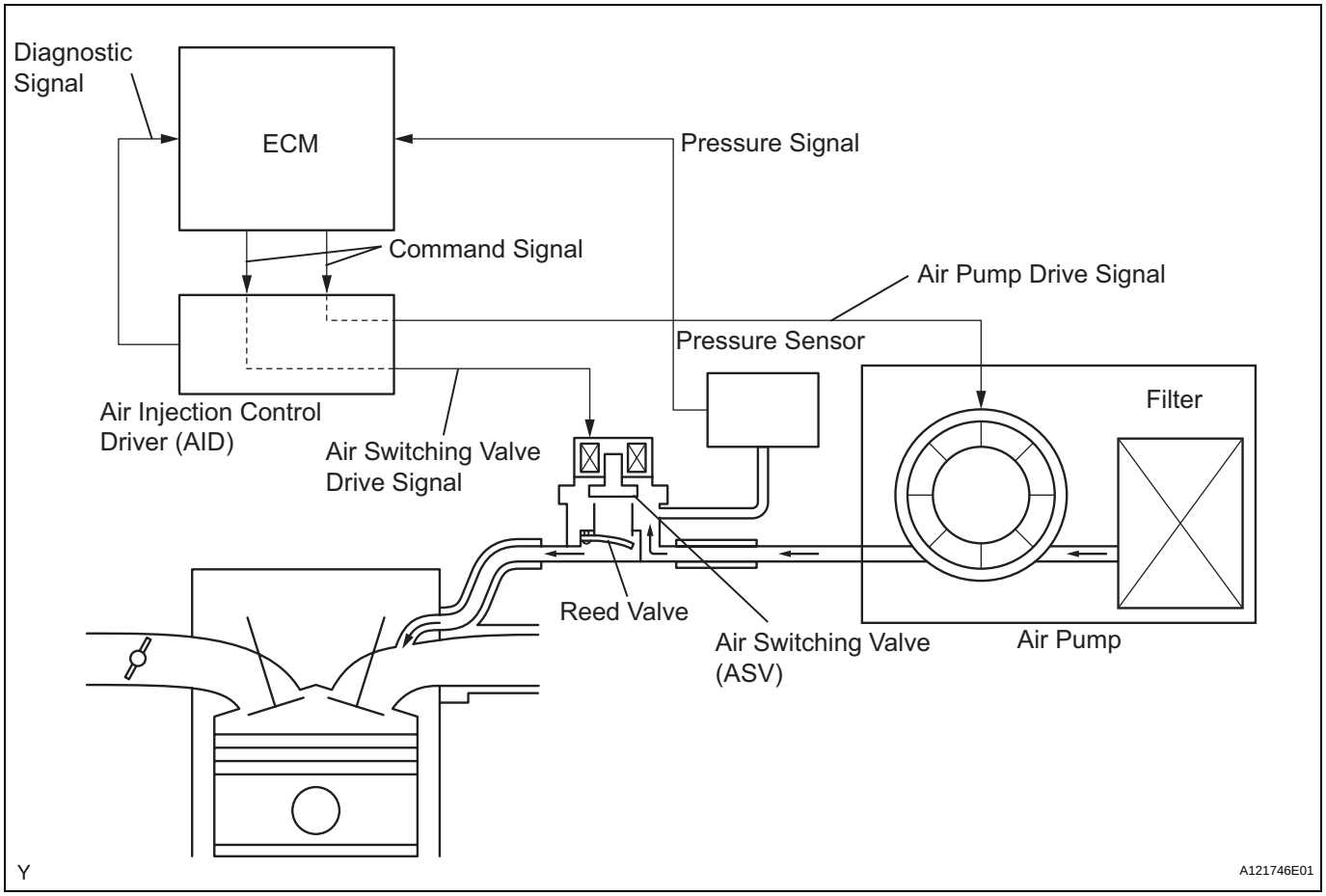
The Secondary Air Injection (AIR) system consists of an air pump, the Air Switching Valve (ASV), a pressure sensor, the Air Injection Control Driver (AID) and the ECM. For a short time after cold engine starts, the AIR system pumps secondary air to the exhaust port of the cylinder head to purify the exhaust emissions. The secondary air is supplied by the air pump and is pumped to the exhaust port through the ASV.

The AID drives the ASV and the air pump according to command signals transmitted by the ECM. The pressure sensor detects the pressure in the secondary air passage when the AIR system is ON and OFF, and transmits pressure signal to the ECM.

The AID is not only equipped to drive the pump and valve, but also with a diagnosis function to detect malfunctions in the AIR system circuit.

HINT:

As a large current is required to drive the air pump and ASV, an AID has been added to the previous system.



DTC No.	DTC Detection Conditions	Trouble Areas
P0412	After cold engine starts, all of following conditions met (1 trip detection logic): (a) Air Injection (AIR) system not operating (air pump OFF, Air Switching Valve [ASV] OFF) (b) Diagnostic signal from Air Injection Control Driver (AID) 40 % (c) Battery voltage 8 V or more	• Open in ASV drive circuit • Short between ASV drive and +B circuits • AID • ASV • ECM

DTC No.	DTC Detection Conditions	Trouble Areas
P0412	After cold engine starts, all of following conditions met (1 trip detection logic): (a) Air Injection (AIR) system operating (air pump ON, Air Switching Valve [ASV] ON) (b) Diagnostic signal from Air Injection Control Driver (AID) 40 % (c) Battery voltage 8 V or more	• Short between ASV drive circuit and body ground • AID • ASV • ECM

MONITOR DESCRIPTION

The Air Injection Control Driver (AID) detects open and short circuits according to the voltages of the air pump terminal (VB) and the Air Switching Valve (ASV) terminal (VV), and transmits diagnostic information as a signal to the ECM.

For a short time after cold engine starts, the ECM transmits command signals to the AID to drive the air pump and ASV.

ES

The AID transmits an ASV malfunction signal to the ECM if either of the following conditions is met:

- The voltage at the AID terminal relating to the ASV is low despite the AID receiving command signals from the ECM to drive the ASV.
- The voltage at the AID terminal relating to the ASV is high despite the AID receiving no command signals from the ECM to drive the ASV.

The ECM sets the DTC based on diagnostic signals from the AID.

MONITOR STRATEGY

Related DTCs	P0412: Secondary air injection system air switching valve circuit range check
Required Sensors/Components (Main)	Air injection control driver
Required Sensors/Components (Related)	Air switching valve
Frequency of Operation	Once per drive cycle
Duration	3 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Case 1:

Monitor runs whenever following DTCs not present	-
Secondary air injection system	Operating
Battery voltage	8 V or more
Ignition switch	ON
Time after ignition switch OFF to ON	0.5 seconds or more
Starter	OFF
Time after starter turned from ON to OFF	0.5 seconds or more

Case 2:

Monitor runs whenever following DTCs not present	-
Secondary air injection system	Not operating
Battery voltage	8 V or more
Ignition switch	ON
Time after ignition switch OFF to ON	0.5 seconds or more
Starter	OFF
Time after starter turned from ON to OFF	0.5 seconds or more

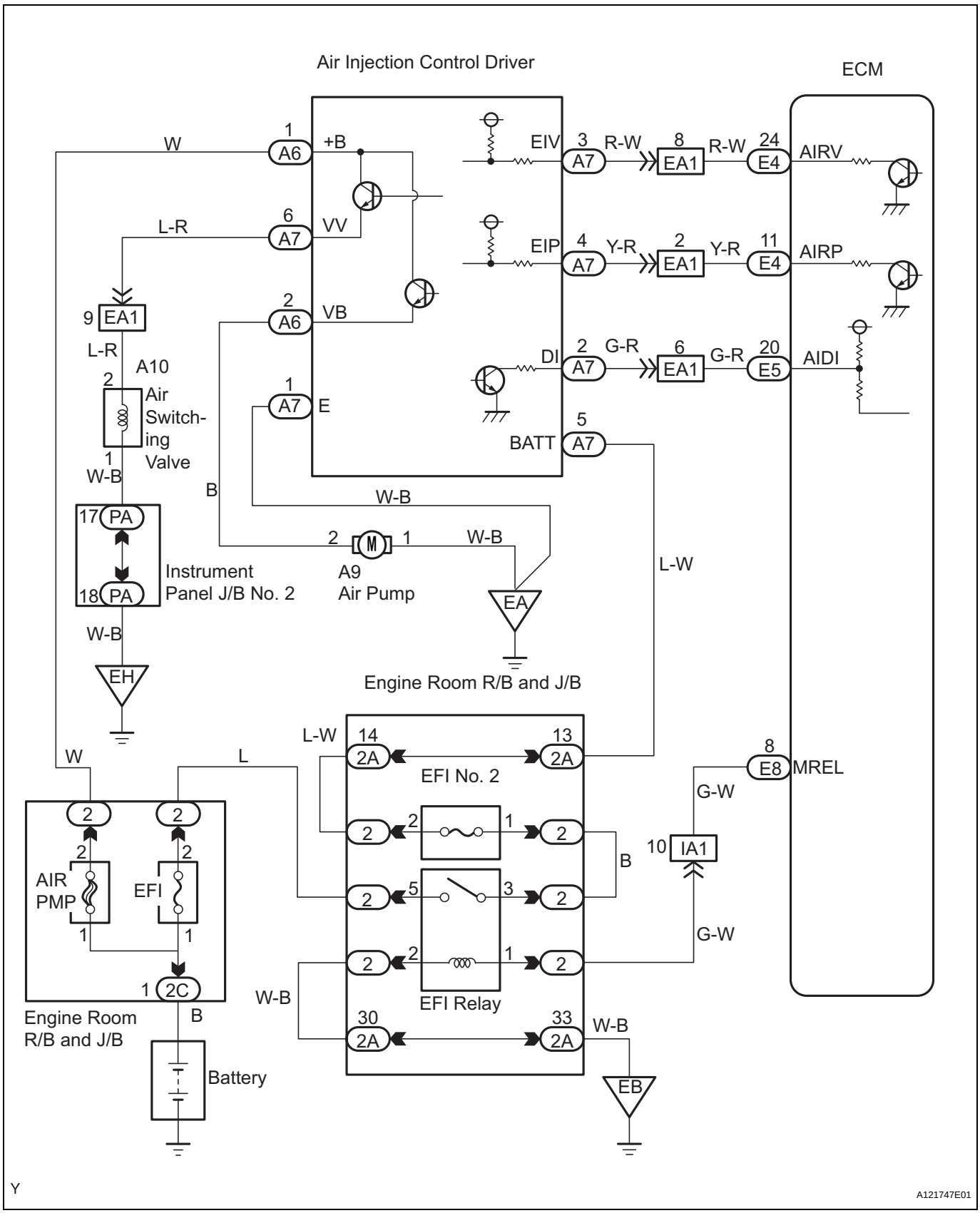
TYPICAL MALFUNCTION THRESHOLDS

Diagnostic signal duty ratio from air injection control driver	31 % or more, and 48 % or less

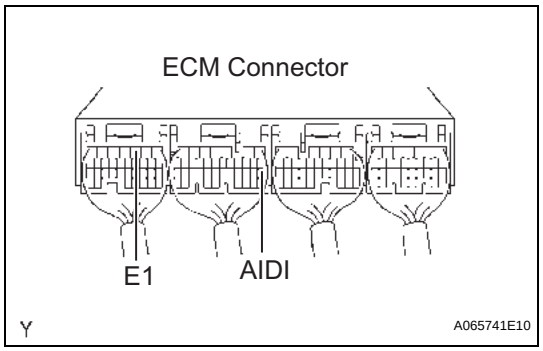
COMPONENT OPERATING RANGE

Diagnostic signal duty ratio from air injection control driver	70 % or more, and 90 % or less when secondary air injection system operating. 0 % when secondary air injection system not operating.

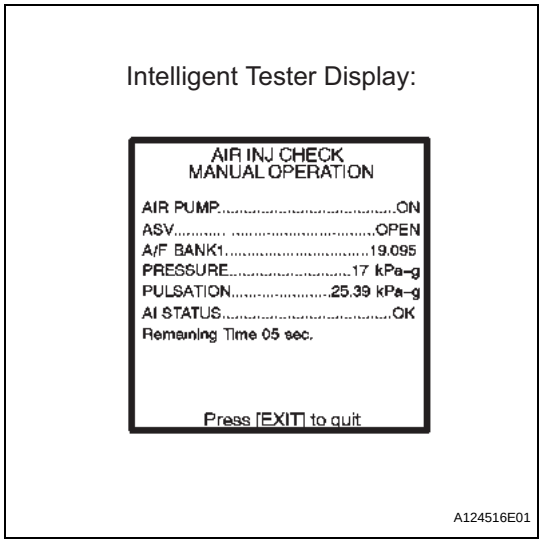
WIRING DIAGRAM



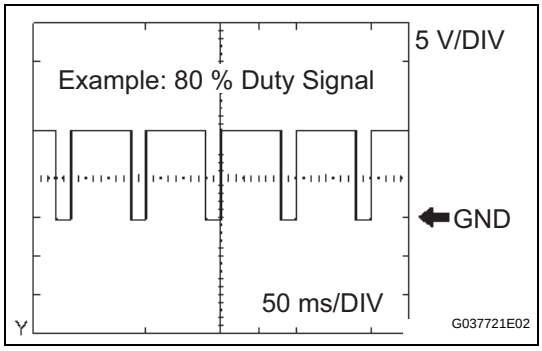
HINT:
Diagnostic information output by the AID can be confirmed by connecting an oscilloscope to the diagnostic information terminal of the AID. Reading the waveform while performing the AIR system intrusive operation provided in the SYSTEM CHECK function, allows the possible trouble areas to be narrowed down.
(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect an intelligent tester to the DLC3.
(d) Connect oscilloscope probes to the AIDI and E1 terminals of the ECM.



(e) Turn the ignition switch to ON and turn the tester ON.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV: OPEN and AP: OFF, ASV CLOSE.
HINT:
When MANUAL OPERATION is selected, the tester initialization (atmospheric pressure measurement) is performed automatically. The initialization takes 10 seconds. After the initialization, AP and ASV operation can be selected.
(g) Start the engine.
(h) Perform the AIR system intrusive operation while the engine is idling.



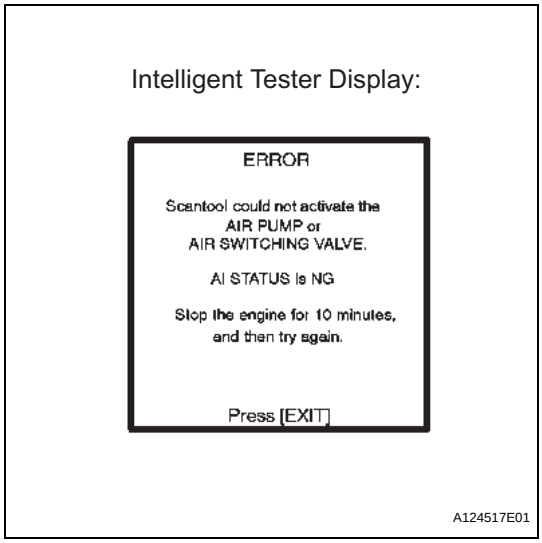
(i) Monitor the AID voltage output (duty ratio signal).



Oscilloscope range

Items	Contents
Terminals	CH1: AIDI - E1
Equipment Settings	5 V/Division, 20 to 50 ms/Division
Conditions	Idling

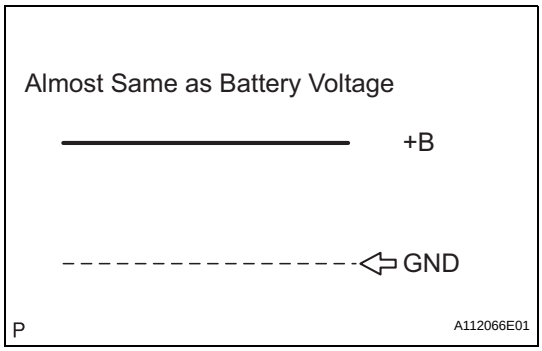
(j) Turn the ignition switch to OFF.



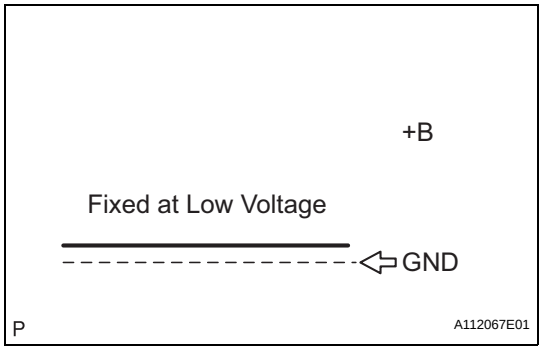
NOTICE:

- **This AIR INJECTION CHECK only allows technicians to operate the AIR system for a maximum of 5 seconds. Furthermore, the check can only be performed up to 4 times per trip. If the test is repeated, intervals of at least 30 seconds are required between checks. While AIR system operation using the intelligent tester is prohibited, the tester display indicates the prohibition (WAIT or ERROR).**
  If an ERROR as shown in the illustration is displayed on the tester during the test, stop the engine for 10 minutes, and then try again.
- **Performing the AIR INJ CHECK repetitively may cause damage to the AIR system. If necessary, leave an interval of several minutes between SYSTEM CHECK operations to prevent the system from overheating.**
- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

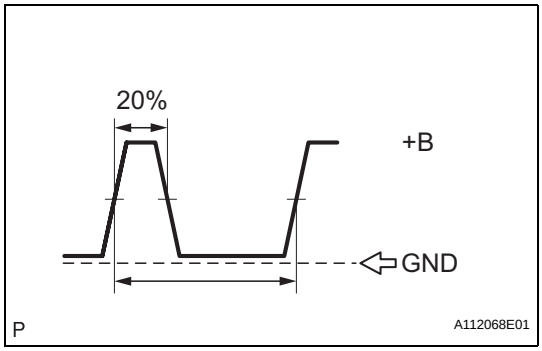
AID Diagnostic Signal Waveforms	ECM Commands	DTCs (ECM Output)	Suspected Trouble Areas
100 % Duty Ratio See waveform 1	Any Air Injection (AIR) System operation	P1613	• Open in diagnostic signal circuit • Air Injection Control Driver (AID) • Open in AID+B circuit (AID power source) • Short between +B and diagnostic signal circuits
0 % Duty Ratio See waveform 2	AIR System: ON (Air pump ON, ASV ON)	P1613	• Open or short in air pump or Air Switching Valve (ASV) command signal circuit (ECM-AID) • Open in AID ground circuit • Short between diagnostic signal circuit and body ground • AID • ECM
	AIR System: OFF (Air pump OFF, ASV OFF)	-	Normal
20 % Duty Ratio See waveform 3	Air Pump: ON	P0418	Short between air pump drive circuit and body ground • Harness and connector (AID-Pump) • Air pump • AID • ECM
	Air Pump: OFF	P0418	Open in air pump drive circuit (AID-Pump), or short between air pump drive circuit and +B • Harness and connector (AID-Pump) • Air pump • AID • ECM
40 % Duty Ratio See waveform 4	ASV: ON	P0412	Short between ASV drive circuit and body ground • Harness and connector (AID-ASV) • ASV • AID • ECM
	ASV: OFF	P0412	Open in ASV drive circuit (AID-ASV), or short between ASV drive circuit and +B • Harness and connector (AID-ASV) • AID • ASV • ECM
80 % Duty Ratio See waveform 5	AIR System: OFF (Air pump OFF, ASV OFF)	P1613	• AID • ECM
	AIR System: ON (Air pump ON, ASV ON)	-	Normal
Other than above (other than 0, 20, 40, 80 and 100 % duty)	-	P1613	• AID • Open in AID ground circuit



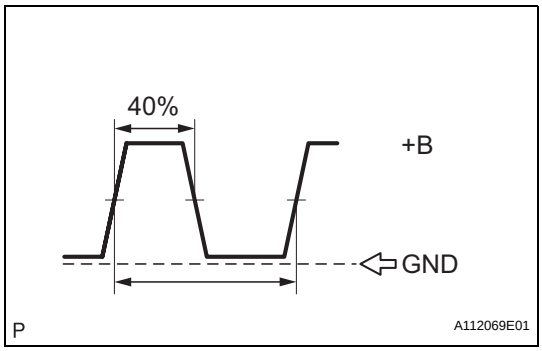
1. Waveform 1
100 % Duty Ratio



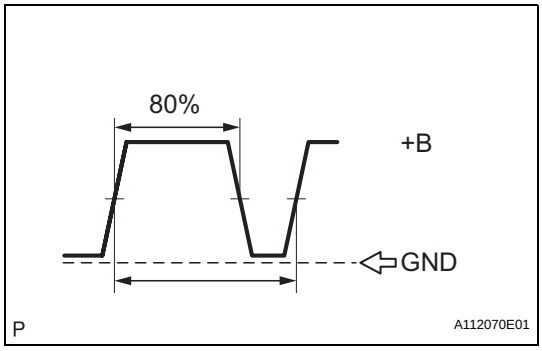
2. Waveform 2
0 % Duty Ratio



3. Waveform 3
20 % Duty Ratio



4. Waveform 4
40 % Duty Ratio

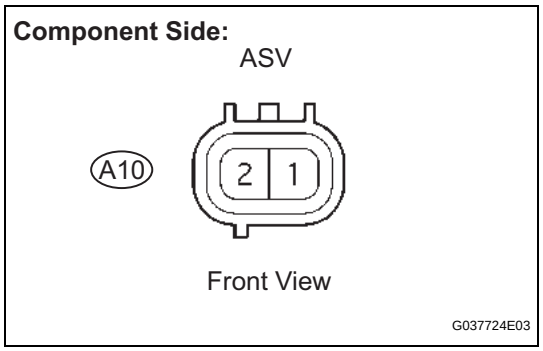


5. Waveform 5
80 % Duty Ratio

HINT:

- By using an intelligent tester to perform the AIR INJ CHECK operation in the SYSTEM CHECK, the air-fuel ratio and the pressure in the secondary air injection system passage can be checked while the secondary air injection system is operating. This helps technicians to troubleshoot the system when it malfunctions.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1 INSPECT AIR SWITCHING VALVE ASSEMBLY



(a) Disconnect the A10 ASV connector.
(b) Measure the ASV resistance.
Standard Resistance

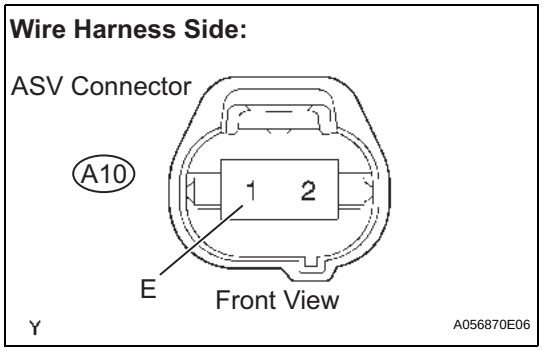
Tester Connections	Specified Conditions
ASV (A10-1) - ASV (A10-2)	3 to 10 Ω at 20°C (68°F)

(c) Reconnect the ASV connector.

NG → **REPLACE AIR SWITCHING VALVE ASSEMBLY**

OK

2 CHECK HARNESS AND CONNECTOR (AIR SWITCHING VALVE - BODY GROUND)



(a) Disconnect the A10 ASV connector.
(b) Check the resistance.
Standard Resistance

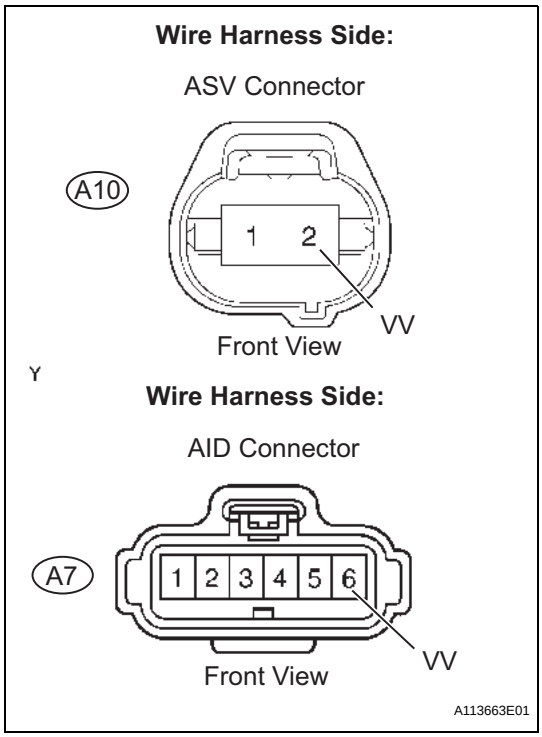
Tester Connections	Specified Conditions
ASV (A10-1) - Body ground	Below 1 Ω

(c) Reconnect the ASV connector.

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

OK

3	CHECK HARNESS AND CONNECTOR (AIR SWITCHING VALVE - AIR INJECTION CONTROL DRIVER)



(a) Disconnect the A10 ASV connector.
(b) Disconnect the A7 AID connector.
(c) Check the resistance.

Standard Resistance

Tester Connections	Specified Conditions
ASV (A10-2) - AID (A7-6)	Below 1 Ω

(d) Reconnect the ASV connector.
(e) Reconnect the AID connector.

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

OK

REPLACE AIR INJECTION CONTROL DRIVER

DTC	P0418	Secondary Air Injection System Control "A" Circuit

DESCRIPTION

Refer to DTC P0412 (See page ES-189).

DTC No.	DTC Detection Conditions	Trouble Areas
P0418	After cold engine starts, all of following conditions met (1 trip detection logic): (a)Air Injection (AIR) system not operating (air pump OFF, Air Switching Valve [ASV] OFF) (b)Diagnostic signal from Air Injection Control Driver (AID) 20 % (c)Battery voltage 8 V or more	• Open in air pump drive circuit • Short between air pump drive and +B circuits • Air pump • AID • ECM
P0418	After cold engine starts, all of following conditions met (1 trip detection logic): (a)Air Injection (AIR) system operating (air pump ON, Air Switching Valve [ASV] ON) (b)Diagnostic signal from Air Injection Control Driver (AID) 20 % (c)Battery voltage 8 V or more	• Short between air pump drive circuit and body ground • Air pump • AID • ECM

ES

MONITOR DESCRIPTION

The Air Injection Control Driver (AID) detects open and short circuits according to the voltages of the air pump terminal (VB) and the Air Switching Valve (ASV) terminal (VV), and transmits diagnostic information as a signal to the ECM.

For a short time after cold engine starts, the ECM transmits command signals to the AID to drive the air pump and ASV.

The AID transmits an air pump malfunction signal to the ECM if either of the following conditions is met:

- The voltage at the AID terminal relating to the air pump is low despite the AID receiving command signals from the ECM to drive the air pump.
- The voltage at the AID terminal relating to the air pump is high despite the AID receiving no command signals from the ECM to drive the air pump.

The ECM sets the DTC based on diagnostic signals from the AID.

MONITOR STRATEGY

Related DTCs	P0418: Secondary air injection system air pump circuit range check
Required Sensors/Components (Main)	Air injection control driver
Required Sensors/Components (Related)	Air pump
Frequency of Operation	Once per drive cycle
Duration	3 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Case 1:

Monitor runs whenever following DTCs not present	-
Secondary air injection system	Operating
Battery voltage	8 V or more
Ignition switch	ON
Time after ignition switch OFF to ON	0.5 seconds or more
Starter	OFF
Time after starter turned from ON to OFF	0.5 seconds or more

Case 2:

Monitor runs whenever following DTCs not present	-
Secondary air injection system	Not operating
Battery voltage	8 V or more
Ignition switch	ON
Time after ignition switch OFF to ON	0.5 seconds or more
Starter	OFF
Time after starter turned from ON to OFF	0.5 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

Diagnostic signal duty ratio from air injection control driver	11 % or more, and 29 % or less

ES

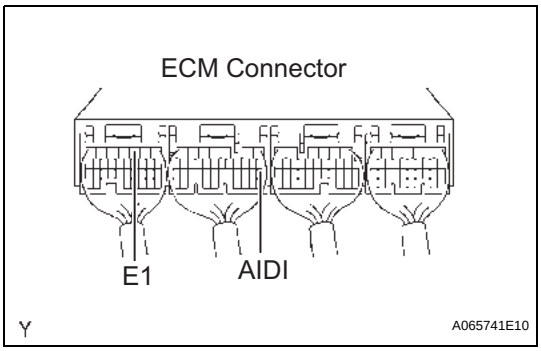
COMPONENT OPERATING RANGE

Diagnostic signal duty ratio from air injection control driver	70 % or more, and 90 % or less when secondary air injection system operating. 0 % when secondary air injection system not operating.

WIRING DIAGRAM

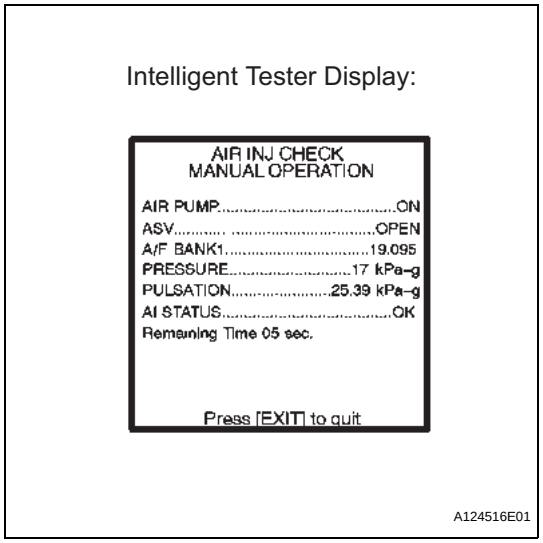
Refer to DTC P0412 (See page ES-192).

HINT:
Diagnostic information output by the AID can be confirmed by connecting an oscilloscope to the diagnostic information terminal of the AID. Reading the waveform while performing the AIR system intrusive operation provided in the SYSTEM CHECK function, allows the possible trouble areas to be narrowed down.
(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect an intelligent tester to the DLC3.
(d) Connect oscilloscope probes to the AIDI and E1 terminals of the ECM.

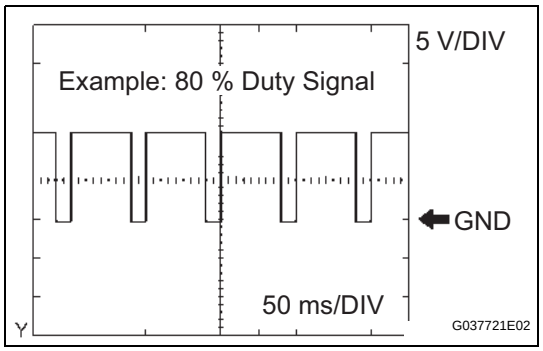


(e) Turn the ignition switch to ON and turn the tester ON.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV: OPEN and AP: OFF, ASV CLOSE.
HINT:
When MANUAL OPERATION is selected, the tester initialization (atmospheric pressure measurement) is performed automatically. The initialization takes 10 seconds. After the initialization, AP and ASV operation can be selected.
(g) Start the engine.

(h) Perform the AIR system intrusive operation while the engine is idling.



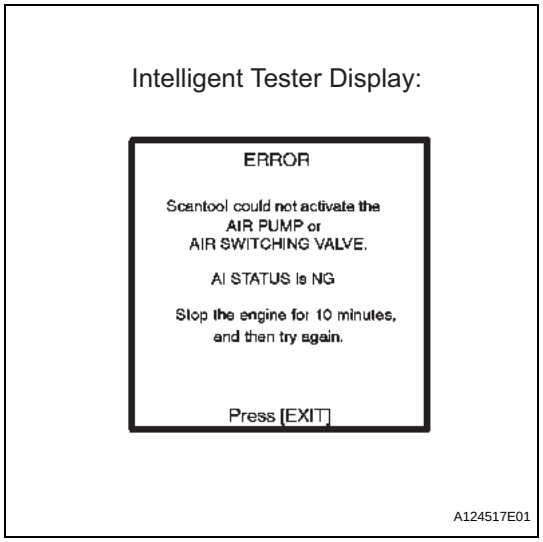
(i) Monitor the AID voltage output (duty ratio signal).



Oscilloscope range

Items	Contents
Terminals	CH1: AIDI - E1
Equipment Settings	5 V/Division, 20 to 50 ms/Division
Conditions	Idling

(j) Turn the ignition switch to OFF.



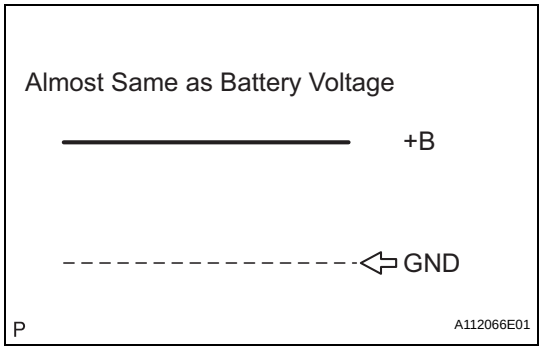
ES

NOTICE:

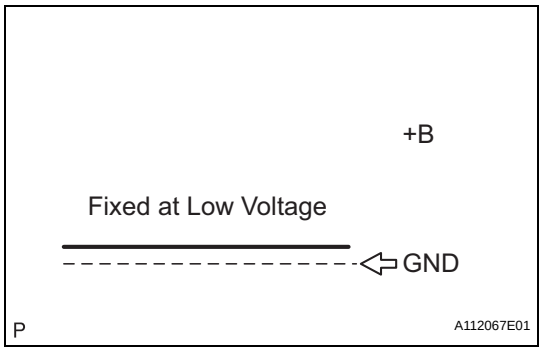
- **This AIR INJECTION CHECK only allows technicians to operate the AIR system for a maximum of 5 seconds. Furthermore, the check can only be performed up to 4 times per trip. If the test is repeated, intervals of at least 30 seconds are required between checks. While AIR system operation using the intelligent tester is prohibited, the tester display indicates the prohibition (WAIT or ERROR).**
  If an ERROR as shown in the illustration is displayed on the tester during the test, stop the engine for 10 minutes, and then try again.
- **Performing the AIR INJ CHECK repetitively may cause damage to the AIR system. If necessary, leave an interval of several minutes between SYSTEM CHECK operations to prevent the system from overheating.**
- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

AID Diagnostic Signal Waveforms	ECM Commands	DTCs (ECM Output)	Suspected Trouble Areas
100 % Duty Ratio See waveform 1	Any Air Injection (AIR) System operation	P1613	• Open in diagnostic signal circuit • Air Injection Control Driver (AID) • Open in AID+B circuit (AID power source) • Short between +B and diagnostic signal circuits
0 % Duty Ratio See waveform 2	AIR System: ON (Air pump ON, ASV ON)	P1613	• Open or short in air pump or Air Switching Valve (ASV) command signal circuit (ECM-AID) • Open in AID ground circuit • Short between diagnostic signal circuit and body ground • AID • ECM
	AIR System: OFF (Air pump OFF, ASV OFF)	-	Normal
20 % Duty Ratio See waveform 3	Air Pump: ON	P0418	Short between air pump drive circuit and body ground • Harness and connector (AID-Pump) • Air pump • AID • ECM
	Air Pump: OFF	P0418	Open in air pump drive circuit (AID-Pump), or short between air pump drive circuit and +B • Harness and connector (AID-Pump) • Air pump • AID • ECM

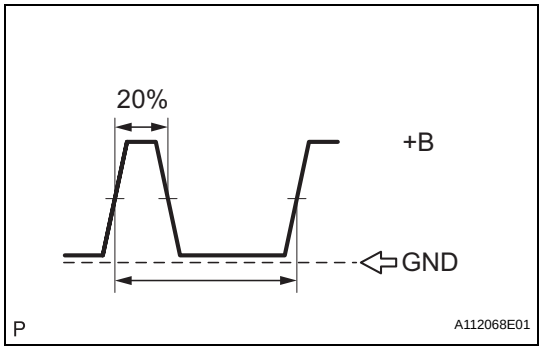
AID Diagnostic Signal Waveforms	ECM Commands	DTCs (ECM Output)	Suspected Trouble Areas
40 % Duty Ratio See waveform 4	ASV: ON	P0412	Short between ASV drive circuit and body ground • Harness and connector (AID-ASV) • ASV • AID • ECM
	ASV: OFF	P0412	Open in ASV drive circuit (AID-ASV), or short between ASV drive circuit and +B • Harness and connector (AID-ASV) • AID • ASV • ECM
80 % Duty Ratio See waveform 5	AIR System: OFF (Air pump OFF, ASV OFF)	P1613	• AID • ECM
	AIR System: ON (Air pump ON, ASV ON)	-	Normal
Other than above (other than 0, 20, 40, 80 and 100 % duty)	-	P1613	• AID • Open in AID ground circuit



1. Waveform 1
100 % Duty Ratio

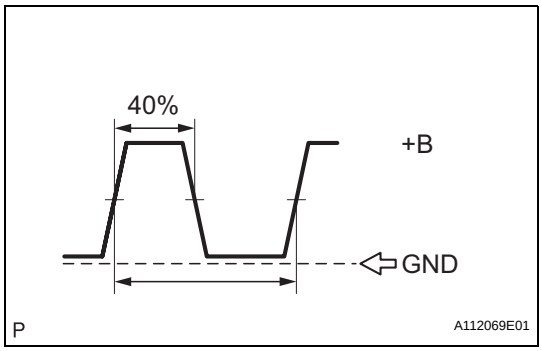


2. Waveform 2
0 % Duty Ratio

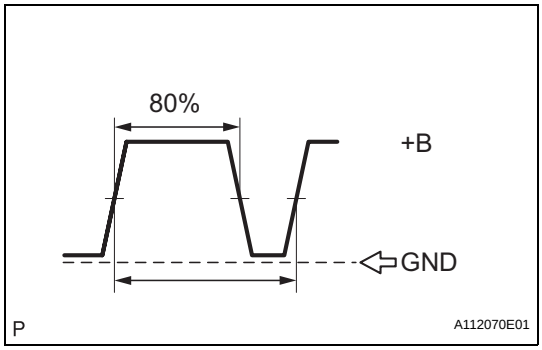


3. Waveform 3
20 % Duty Ratio

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4. Waveform 4
40 % Duty Ratio



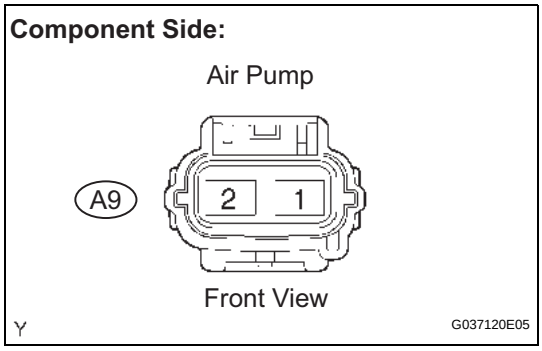
5. Waveform 5
80 % Duty Ratio

ES

HINT:

- By using an intelligent tester to perform the AIR INJ CHECK operation in the SYSTEM CHECK, the air-fuel ratio and the pressure in the secondary air injection system passage can be checked while the secondary air injection system is operating. This helps technicians to troubleshoot the system when it malfunctions.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	INSPECT AIR PUMP ASSEMBLY



(a) Disconnect the A9 air pump connector.
(b) Measure the air pump resistance.
Standard Resistance

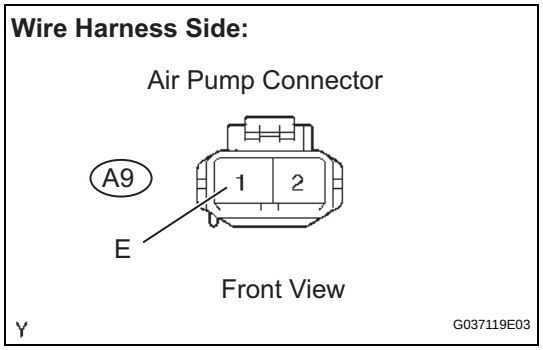
Tester Connections	Specified Conditions
Air pump (A9-1) - Air pump (A9-2)	0.4 to 10 Ω at 20°C (68°F)

(c) Reconnect the air pump connector.

NG → **REPLACE AIR PUMP ASSEMBLY**

OK

2 CHECK HARNESS AND CONNECTOR (AIR PUMP - BODY GROUND)



(a) Disconnect the A9 air pump connector.
(b) Check the resistance.
Standard Resistance

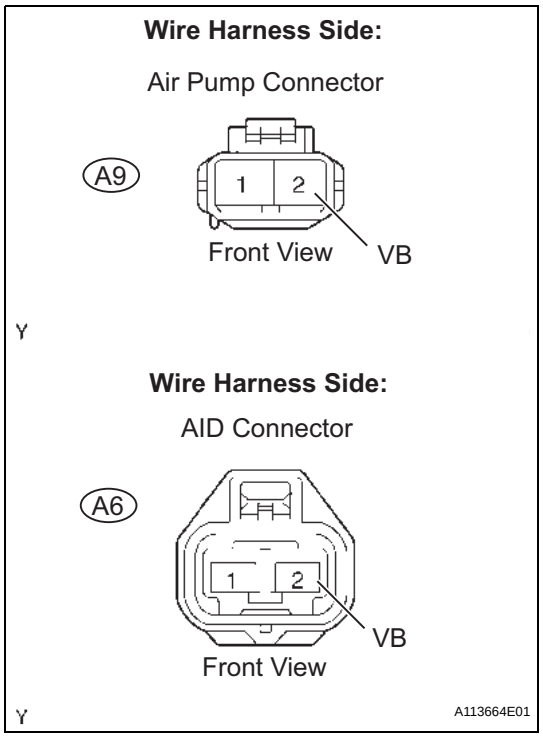
Tester Connections	Specified Conditions
Air Pump (A9-1) - Body ground	Below 1 Ω

(c) Reconnect the air pump connector.

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

OK

3 CHECK HARNESS AND CONNECTOR (AIR PUMP - AIR INJECTION CONTROL DRIVER)



(a) Disconnect the A9 air pump connector.
(b) Disconnect the A6 AID connector.
(c) Check the resistance.
Standard Resistance

Tester Connections	Specified Conditions
Air Pump (A9-2) - AID (A6-2)	Below 1 Ω

(d) Reconnect the air pump connector.
(e) Reconnect the AID connector.

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

OK

REPLACE AIR INJECTION CONTROL DRIVER

ES

DTC	P0420	Catalyst System Efficiency Below Threshold (Bank 1)

MONITOR DESCRIPTION

The ECM uses sensors mounted in front of and behind the Three-Way Catalytic Converter (TWC) to monitor its efficiency.
The first sensor, the Air-Fuel Ratio (A/F) sensor, sends pre-catalyst information to the ECM. The second sensor, the Heated Oxygen (HO2) sensor, sends post-catalyst information to the ECM.
In order to detect any deterioration in the TWC, the ECM calculates the Oxygen Storage Capacity (OSC) of the TWC. This calculation is based on the voltage output of the HO2 sensor while performing active air-fuel ratio control, rather than the conventional detecting method, which uses the locus ratio.
The OSC value is an indication of the oxygen storage capacity of the TWC. When the vehicle is being driven with a warm engine, active air-fuel ratio control is performed for approximately 15 to 20 seconds. When it is performed, the ECM deliberately sets the air-fuel ratio to lean or rich levels. If a rich-lean cycle of the HO2 sensor is long, the OSC becomes greater. There is a direct correlation between the OSCs of the HO2 sensor and the TWC.
The ECM uses the OSC value to determine the state of the TWC. If any deterioration has occurred, it illuminates the MIL and sets the DTC.

DTC No.	DTC Detection Conditions	Trouble Areas
P0420	OSC value smaller than standard value under active air-fuel ratio control (2 trip detection logic)	• Front exhaust pipe • Gas leakage from exhaust system • Air-Fuel Ratio (A/F) sensor (sensor 1) • Heated Oxygen (HO2) sensor (sensor 2)

MONITOR STRATEGY

Related DTCs	P0420: Catalyst Deterioration
Required Sensors/Components (Main)	TWC
Required Sensors/Components (Related)	A/F sensor, HO2 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	20 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0021 (VVT System 2 - Advance) P0022 (VVT System 2 - Retard) P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0037, P0038, P0057, P0058 (HO2 sensor heater - Sensor 2) P0100 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0136, P0156 (HO2 Sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351 - P0356 (Ignitor) P0500 (VSS) P2196, P2198 (A/F sensor - rationality) P2440 (A/R control valve stuck open) P2441 (A/R control valve stuck close) P2444 (AIP stuck ON) P2445 (AIP stuck OFF) P2A00, P2A03 (A/F sensor - slow response)
Battery voltage	11 V or more
Engine coolant temperature sensor	70°C (158°F) or more
Idling	OFF
Engine RPM	Less than 4,000 rpm
A/F sensor status	Activated
Fuel system status	Closed loop
A/F sensor monitor	Completed
Heated oxygen sensor monitor	Completed
Engine load	10 to 80 %
Mass air flow rate	6.0 to 35 g/sec
Estimated catalyst temperature	Front catalyst: 650° to 840°C (1,202° to 1,544°F) Rear catalyst: 400° to 760°C (752° to 1,400°F)
Shift position	4th or 5th (for M/T) 3rd, 4th or 5th (for A/T)

TYPICAL MALFUNCTION THRESHOLDS

Oxygen Storage Capacity (OSC) of Three-Way Catalytic Converter (TWC)	Less than 0.08 g

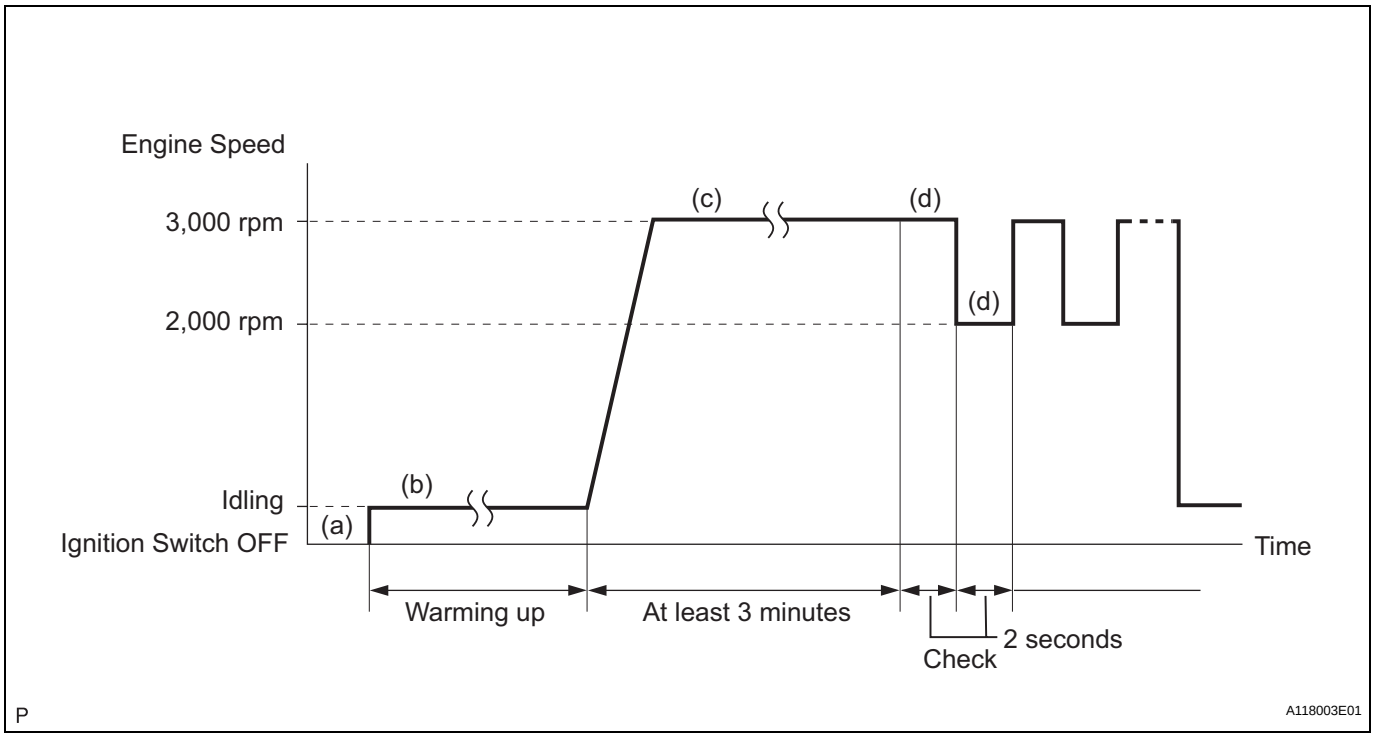
MONITOR RESULT

Refer to Checking Monitor Status (See page ES-21).

CONDITIONING FOR SENSOR TESTING

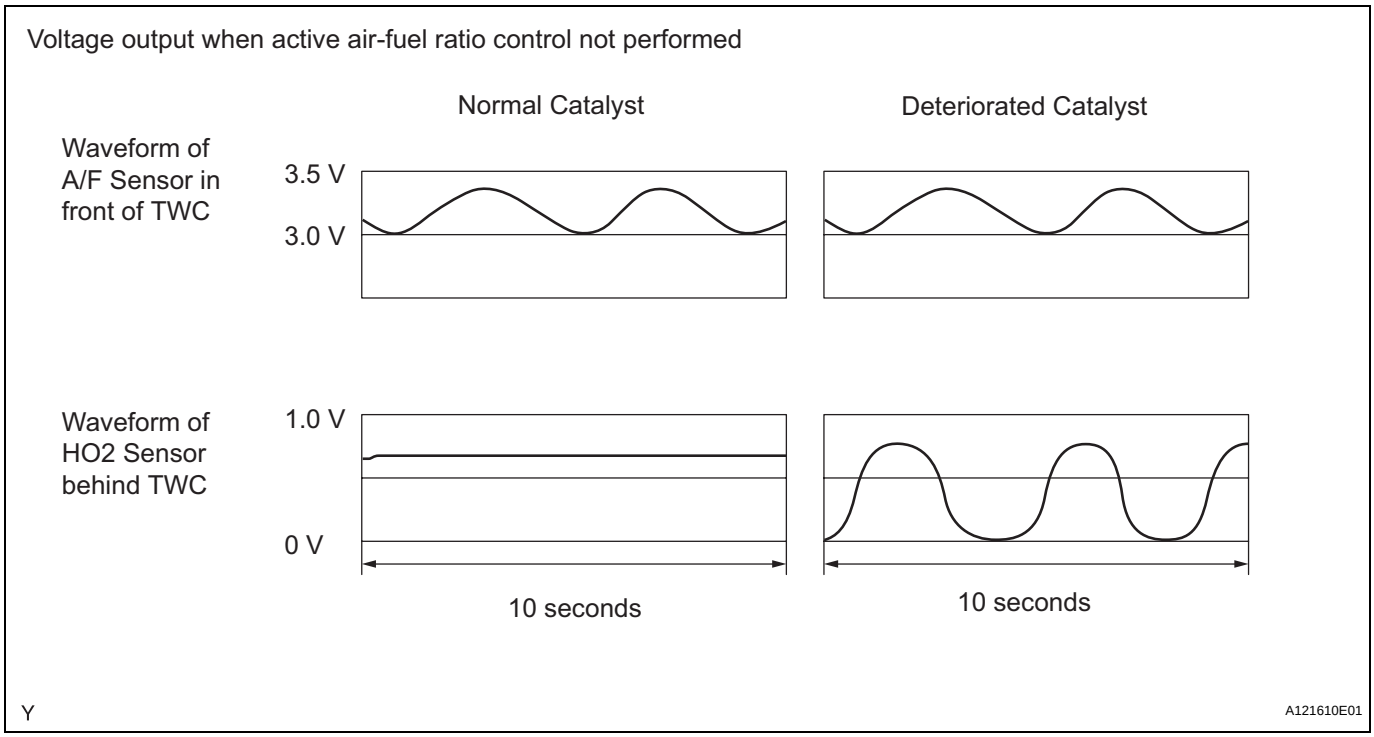
HINT:

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 an intelligent tester to the DLC3.
(b) Start the engine and warm it up with all the accessories switched OFF, until the engine coolant temperature stabilizes.
(c) Run the engine at an engine speed of between 2,500 rpm and 3,000 rpm for at least 3 minutes.
(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 (refer to Conditioning for Sensor Testing).
HINT:

- If either of the voltage outputs of the Air-Fuel Ratio (A/F) or Heated Oxygen (HO2) sensor does not fluctuate, or either of the sensors makes a noise, the sensor may be malfunctioning.
- If the voltage outputs of both the sensors remain lean or rich, the air-fuel ratio may be extremely lean or rich. In such cases, perform the following A/F CONTROL using an intelligent tester.
- If the Three-Way Catalytic Converter (TWC) has deteriorated, the HO2 sensor (located behind the TWC) voltage output fluctuates up and down frequently, even under normal driving conditions (active air-fuel ratio control is not performed).



CONDITIONING FOR SENSOR TESTING

HINT:

- Intelligent tester only:
- Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.
- The following instructions describe how to conduct the A/F CONTROL operation using an intelligent tester.

(a) Connect an 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 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 Voltage

Tester Display (Sensor)	Injection Volumes	Status	Voltages
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 0.5
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 Areas
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.5 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 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 an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

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

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

Result

Display (DTC Output)	Proceed To
P0420	A

Display (DTC Output)	Proceed To
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 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 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.

ES

Standard Voltage

Tester Display (Sensor)	Injection Volumes	Status	Voltages
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 0.5
O2S B1S2 (HO2)	-12.5 %	Lean	Less than 0.4

Result

Status AFS B1S1	Status O2S B1S2	A/F Condition and A/F and HO2 Sensors Condition	Misfires	Main Suspected Trouble Areas	Proceed To
Lean/Rich	Lean/Rich	Normal	-	• Three-Way Catalytic Converter (TWC) • Gas leakage from exhaust system	A
Lean	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	B

Status AFS B1S1	Status O2S B1S2	A/F Condition and A/F and HO2 Sensors Condition	Misfires	Main Suspected Trouble Areas	Proceed To
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

ES

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 0.5 V.
Lean/Rich: During A/F CONTROL of the ACTIVE TEST, the output voltage of the HO2 sensor alternates correctly.

B → **CHECK AND REPLACE AIR FUEL RATIO SENSOR**

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

A

3 CHECK FOR EXHAUST GAS LEAKAGE

OK:
No gas leakage.

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

OK

REPLACE THREE-WAY CATALYTIC CONVERTER

DTC	P043E	Evaporative Emission System Reference Orifice Clog Up

DTC	P043F	Evaporative Emission System Reference Orifice High Flow

DTC SUMMARY

DTCs	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timings	Detection Logic
P043E	Reference orifice clogged	Leak detection pump creates negative pressure through reference orifice, and EVAP system pressure measured to determine leak pressure standard. 0.02 inch leak criterion measured at start and at end of leak check. If system pressure lower than -4.85 kPa (-36.38 mmHg)*, ECM determines that reference orifice has clogging malfunction.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM • Leakage from EVAP system	While ignition switch OFF	2 trip
P043F	Reference orifice high-flow	Leak detection pump creates negative pressure through reference orifice, and EVAP system pressure measured to determine leak pressure standard. 0.02 inch leak criterion measured at start and at end of leak check. If system pressure higher than -1.06 kPa (-7.95 mmHg)*, ECM determines that reference orifice has high-flow malfunction.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM • Leakage from EVAP system	While ignition switch OFF	2 trip

*: The threshold values vary according to the atmospheric pressure measured at the beginning of the EVAP system monitor. The values described in the table above are based on an atmospheric pressure of 100 kPa (750.1 mmHg) (absolute pressure).
HINT:
The reference orifice is located inside the canister pump module.

DESCRIPTION

The circuit description can be found in the EVAP (Evaporative Emission) System (see page ES-392).

Refer to the EVAP System (see page ES-397).

MONITOR DESCRIPTION

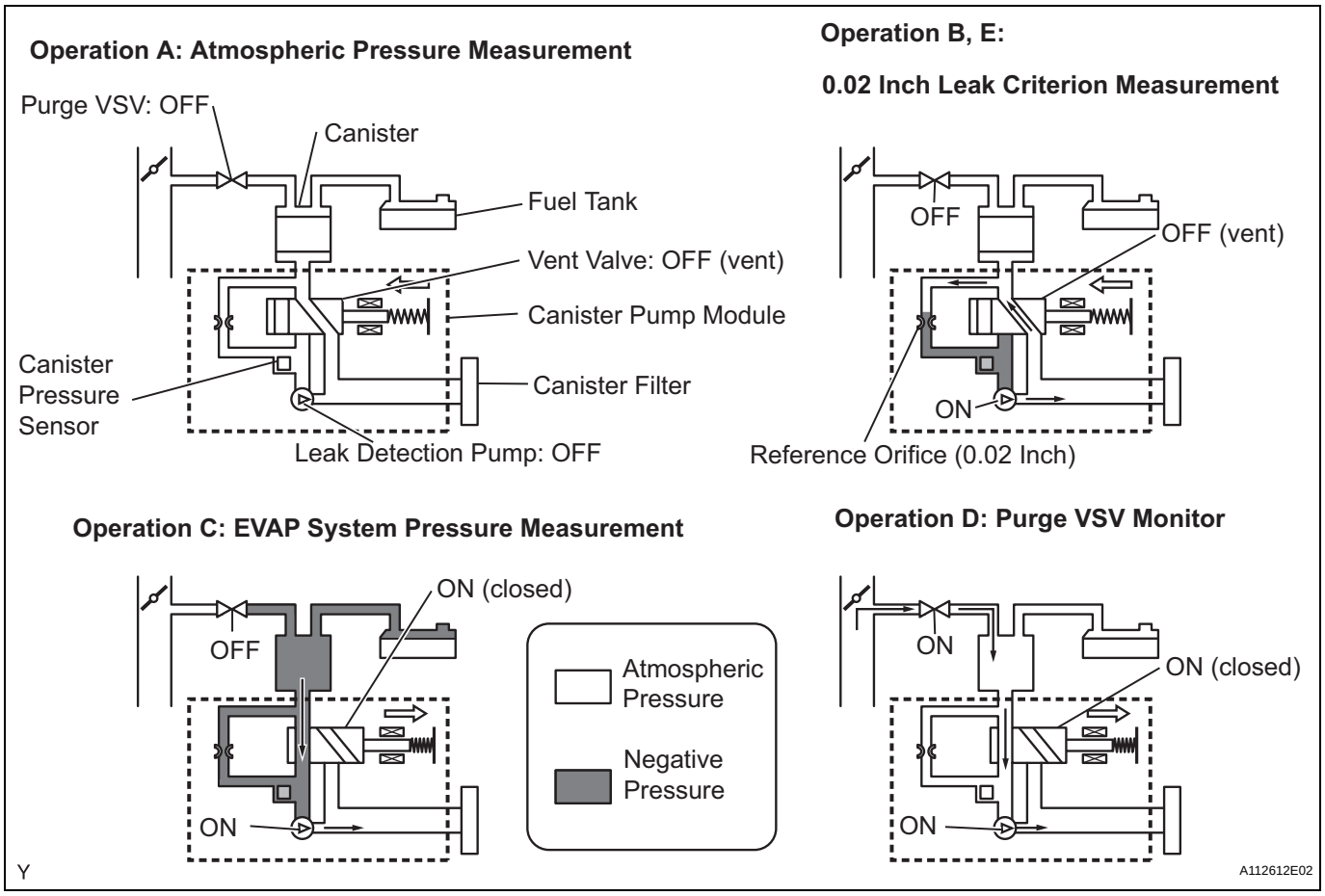
5 hours* after the ignition switch is turned to OFF, the electric leak detection pump creates negative pressure (vacuum) in the EVAP (Evaporative Emission) system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

*: 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 turned to OFF.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak criterion (reference pressure) measurement	In order to determine 0.02 inch leak criterion, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as they will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes*
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak criterion (reference pressure) measurement	After second 0.02 inch leak pressure measurement, leak check performed by comparing first and second 0.02 inch leak criterion. If stabilized system pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system leaking.	60 seconds
F	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

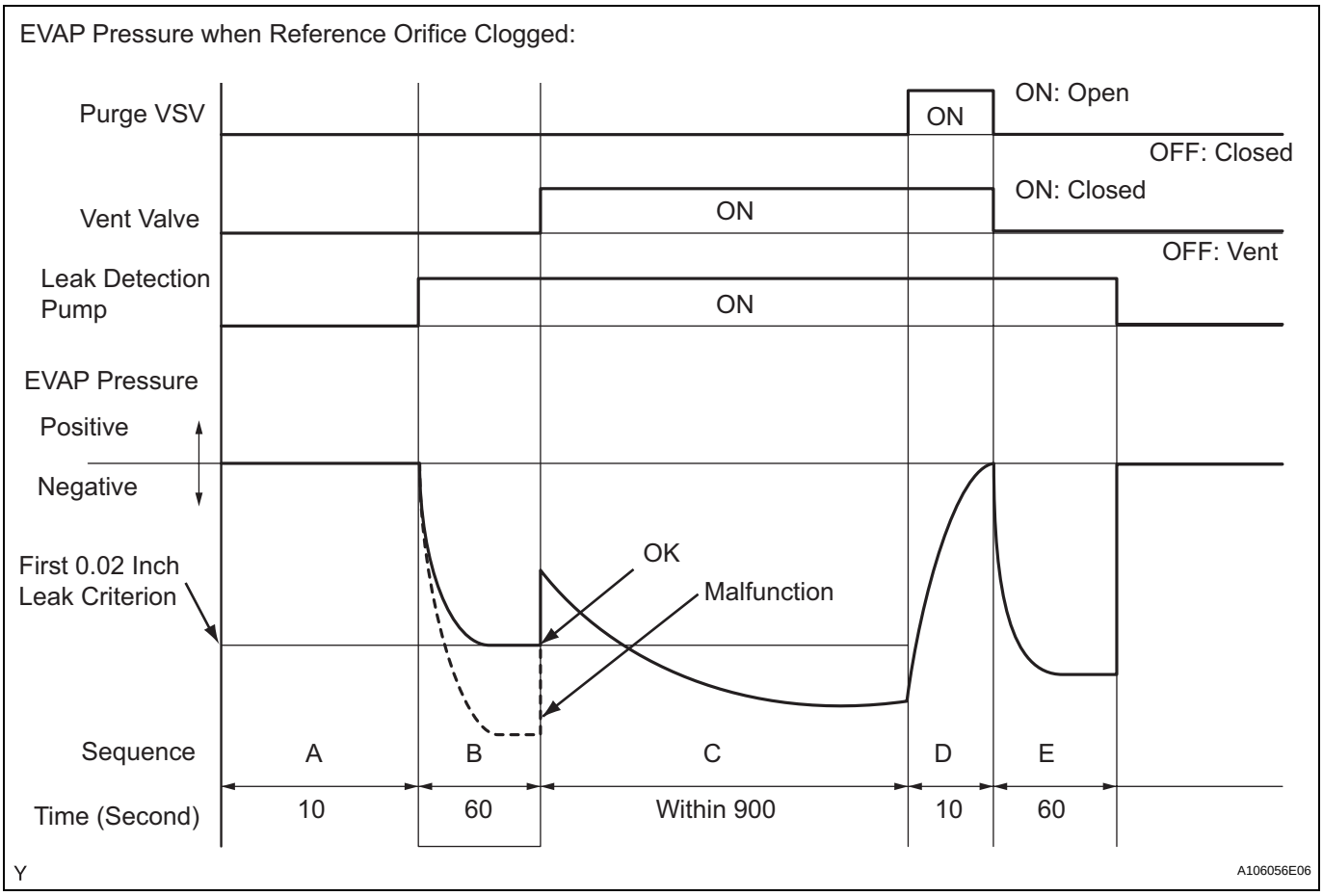
* If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.



(a) P043E: Reference orifice clogged

In operation B, the leak detection pump creates negative pressure (vacuum) through the reference orifice. The EVAP system pressure is then measured by the ECM, using the pressure sensor, to determine the 0.02 inch leak criterion. If the pressure is lower than -4.85 kPa (-36.38 mmHg)*, the ECM interprets this as a clog malfunction in the reference orifice, and stops the EVAP (Evaporative Emission) system monitor. The ECM then illuminates the MIL and sets the DTC (2 trip detection logic).

*: The threshold varies according to the atmospheric pressure measured in operation A. The value described above is based on an atmospheric pressure of 100 kPa (750.1 mmHg): absolute pressure.

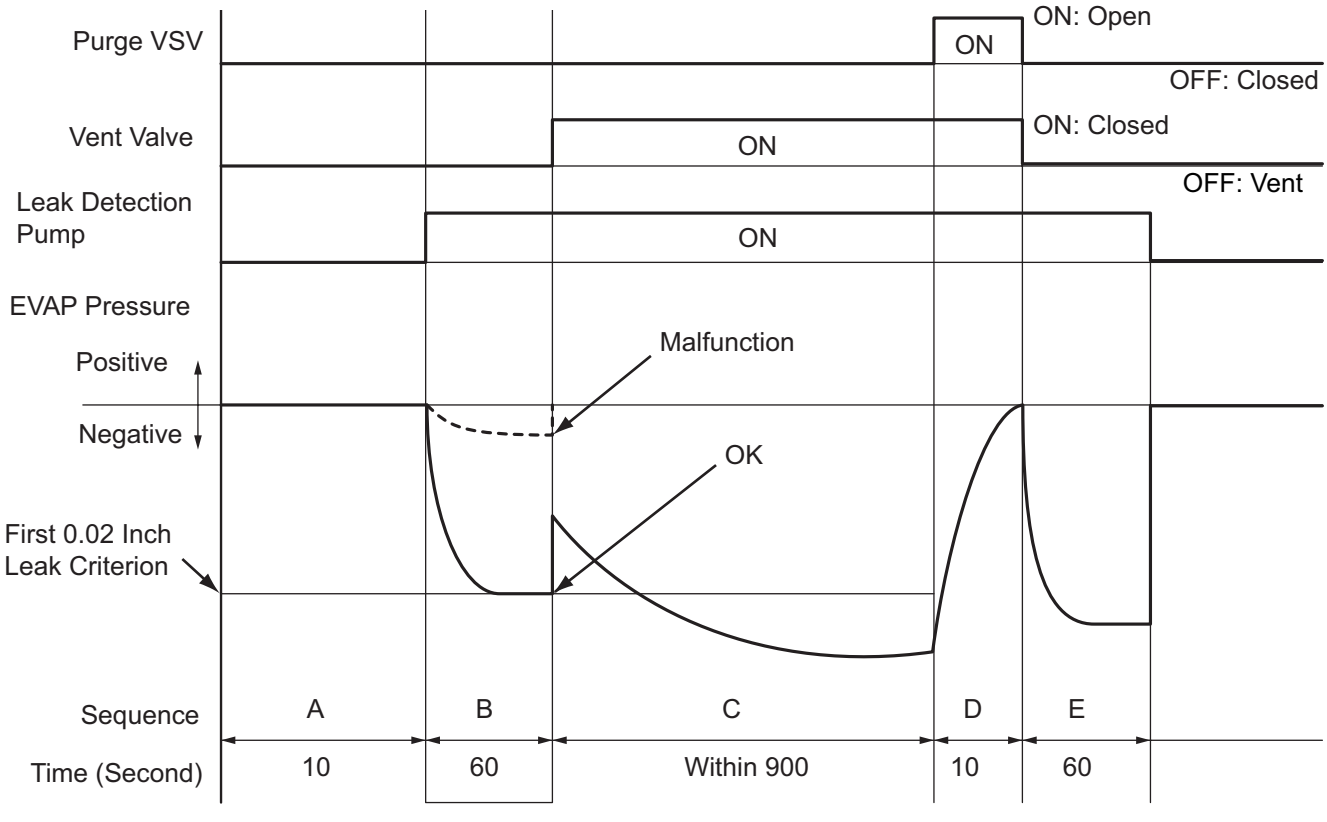


(b) P043F: Reference orifice high-flow

In operation B, the leak detection pump creates negative pressure (vacuum) through the reference orifice. The EVAP system pressure is then measured by the ECM using the canister pressure sensor to determine the 0.02 inch leak criterion. If the pressure is higher than -1.06 kPa (-7.95 mmHg)*, the ECM interprets this as a high-flow malfunction in the reference orifice, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (2 trip detection logic).

*: The threshold varies according to the atmospheric pressure measured in operation A. The value described above is based on a atmospheric pressure of 100 kPa (750.1 mmHg): absolute pressure.

EVAP Pressure when Reference Orifice High-flow Malfunction:



OBD II MONITOR SPECIFICATIONS

MONITOR STRATEGY

Required Sensors/Components	Canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes (varies with amount of fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Vehicle speed	Below 2.5 mph (4 km/h)
Ignition switch	OFF
FTP sensor malfunction (P0450, P0451, P0452 and P0453)	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before IG switch OFF	Conditions 1 and 2
1. Duration that vehicle driven	5 minutes or more
2. Purge flow	Executed

ECT	4.4° to 35°C (40° to 95°F)
IAT	4.4° to 35°C (40° to 95°F)
Time after engine stopped	5 hours

Example of restart time

First time	7 hours
Second time	9 hours and 30 minutes

1. Key-off monitor sequence 1 to 8

1. Atmospheric pressure

Next sequence is run if following condition set	-
Atmospheric pressure change for 10 second	Less than 0.3 kPa (2.25 mmHg) for 1 second

2. First reference pressure

Next sequence is run if all of following conditions set	Condition 1, 2 and 3
1. FTP when 4 seconds after reference pressure measurement	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.057 kPa (-33.38 to -7.93 mmHg)
3. Reference pressure	Saturated within 60 seconds

3. Vent valve stuck closed check

Next sequence is run if following condition set	-
FTP change for 10 seconds after vent valve ON (closed)	0.3 kPa (2.25 mmHg) or more

4. Vacuum introduction and leak

Next sequence is run if both of following conditions set	Condition 1 and 2
1. Vacuum introduction time	12 minutes or less
2. FTP	Saturated within 12 minutes

5. Purge VSV stuck closed check

Next sequence is run if following condition set	-
FTP change for 10 seconds after purge VSV ON (open)	0.3 kPa (2.25 mmHg) or more

6. Second reference pressure measurement

Next sequence is run if all of following conditions set	Condition 1, 2, 3 and 4
1. FTP when 4 seconds after reference pressure measurement	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.057 kPa (-36.4 to -7.92 mmHg)
3. Reference pressure	Saturated within 60 seconds
4. Reference pressure difference between first and second	0.7 kPa (5.25 mmHg) or less

7. Leak check

Next sequence is run if following condition set	-
FTP when vacuum introduction was complete	Second reference pressure or less

8. Atmospheric pressure

Monitor is complete if following condition set	-
Atmospheric pressure difference between sequence 1 and 8	0.3 kPa (2.25 mmHg) or less

TYPICAL MALFUNCTION THRESHOLDS

"Saturated" indicates that the EVAP pressure change is less than 0.1 kPa (0.75 mmHg) in 30 seconds.

One of following conditions met	-
EVAP pressure just after reference pressure measurement start	More than -1 kPa (-7.5 mmHg)
Reference pressure	Less than -4.85 kPa (-36.4 mmHg)
Reference pressure	-1.057 kPa (-7.9 mmHg) or more
Reference pressure	Not saturated within 60 seconds

Difference between first and second reference pressure	0.7 kPa (5.3 mmHg) or more

MONITOR RESULT

Refer to Checking Monitor Status (See page ES-21) or (See page ES-422).

DTC	P0441	Evaporative Emission Control System Incorrect Purge Flow

DTC SUMMARY

DTCs.	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timings	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. 0.02 inch leak criterion measured at start and at end of leak check. If stabilized pressure higher than [second 0.02 inch leak criterion x 0.2], ECM determines that purge VSV stuck open	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • ECM • Canister pump module • Leakage from EVAP system	While 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. 0.02 inch leak criterion measured at start and at end of the check. If pressure does not return to near atmospheric pressure, ECM determines that purge VSV stuck closed	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • ECM • Canister pump module • Leakage from EVAP system	While ignition switch OFF	2 trip
P0441	Purge flow	While engine running, following conditions successively met: • Negative pressure not created in EVAP system when purge VSV turned ON (open) • EVAP system pressure change less than 0.5 kPa (3.75 mmHg) when vent valve turned ON (closed) • Atmospheric pressure change before and after purge flow monitor less than 0.1 kPa (0.75 mmHg)	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • Leakage from EVAP line (Purge VSV - Intake manifold) • ECM	While engine running	2 trip

DESCRIPTION

The circuit description can be found in the EVAP (Evaporative Emission) System (see page ES-392).

Refer to the EVAP System (see page ES-397).

MONITOR DESCRIPTION

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

1. KEY-OFF MONITOR

   5 hours* after the ignition switch is turned to OFF, the electric leak detection 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:

   *: 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 turned to OFF.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak criterion (reference pressure) measurement	In order to determine 0.02 inch leak criterion, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as they will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes*
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds

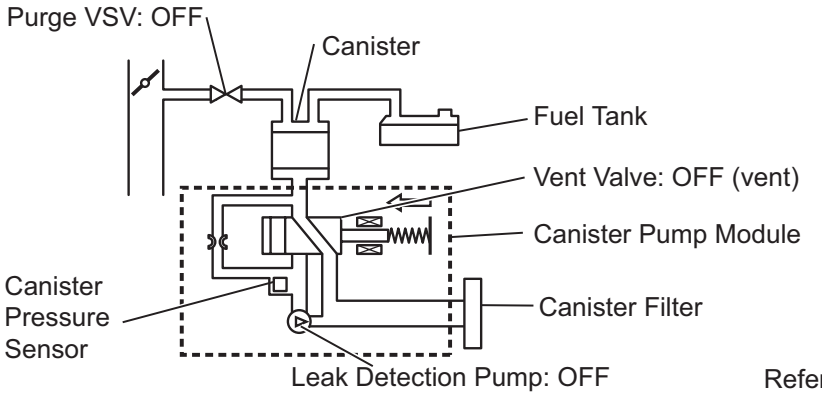
Sequence	Operations	Descriptions	Duration
E	Second 0.02 inch leak criterion (reference pressure) measurement	After second 0.02 inch leak criterion measurement, leak check performed by comparing first and second 0.02 inch leak criterion. If stabilized system pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system leaking.	60 seconds
F	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

HINT:

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

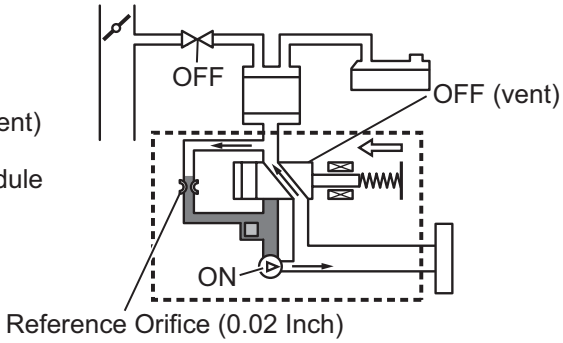
ES

Operation A: Atmospheric Pressure Measurement

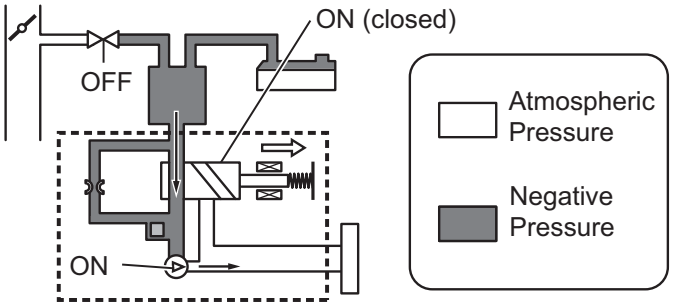


Operation B, E:

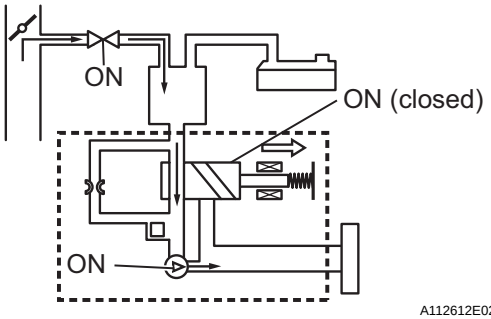
0.02 Inch Leak Criterion Measurement



Operation C: EVAP System Pressure Measurement



Operation D: Purge VSV Monitor

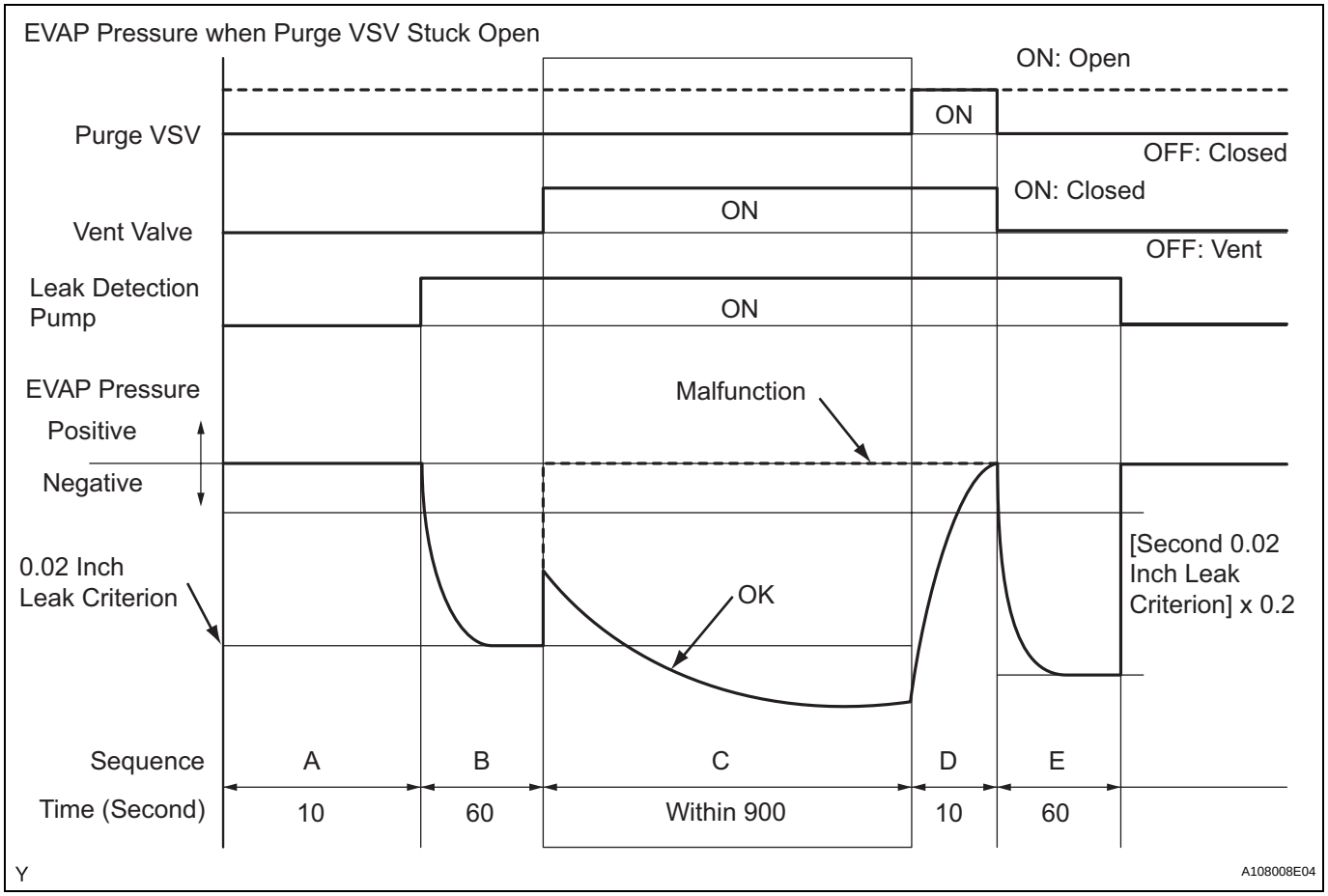


Y

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(a) Purge VSV stuck open

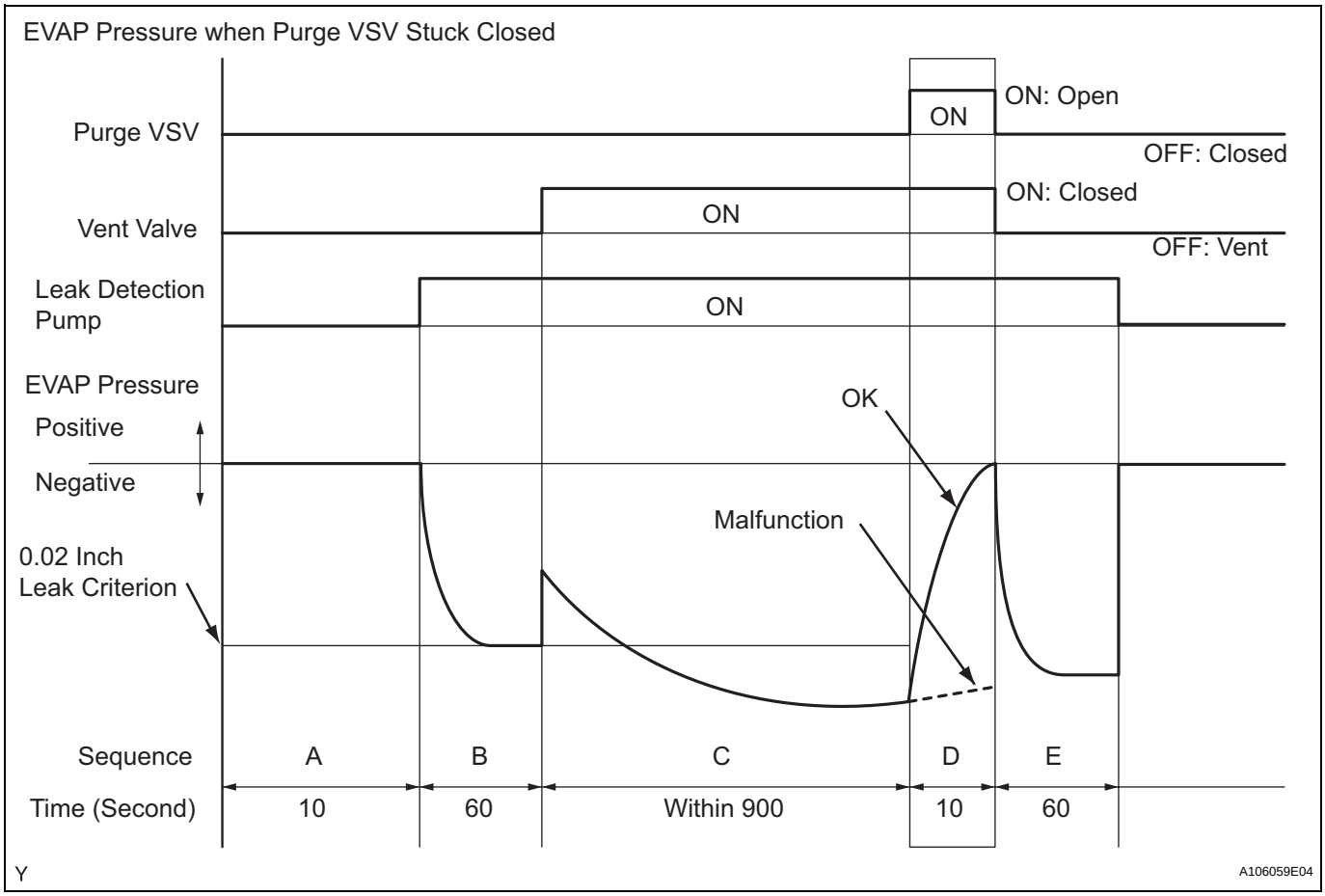
In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP (Evaporative Emission) system. The EVAP system pressure is then measured by the ECM using the canister pressure sensor. If the stabilized system pressure is higher than [second 0.02 inch leak criterion x 0.2], the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



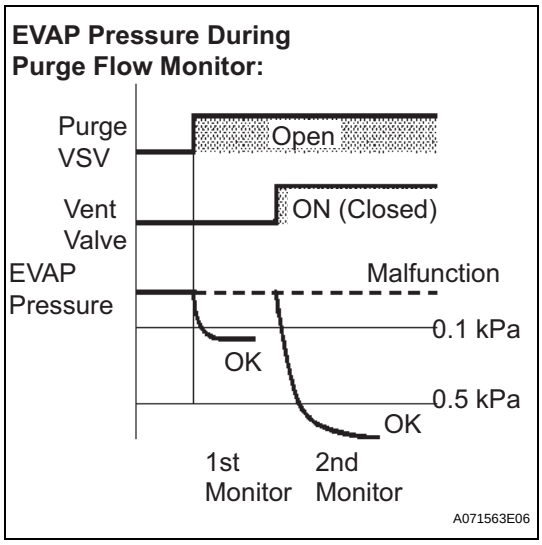
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(b) Purge VSV stuck closed

In operation D, the canister pressure sensor measures the EVAP (Evaporative Emission) system pressure. The pressure measurement for purge VSV monitor is begun when the purge VSV is turned ON (open) after the EVAP leak check. When the measured pressure indicates an increase of 0.3 kPa (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).



2. PURGE FLOW MONITOR



The purge flow monitor consists of the two 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 (Vacuum Switching Valve) is ON (open), the ECM monitors the purge flow by measuring the EVAP pressure change. If negative pressure is not created, the ECM begins the 2nd monitor.
- The 2nd monitor
  The vent valve is turned ON (closed) and the EVAP pressure is 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 pressures, before and after conduction of the purge flow monitor, is measured by the ECM.

OBD II MONITOR SPECIFICATIONS

1. Key-off Monitor

Monitor Strategy

Required Sensors/Components	Purge VSV and Canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes (varies with fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

Typical Enabling Conditions

Monitor runs whenever following DTCs not present	None
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Vehicle speed	Below 2.5 mph (4 km/h)
Ignition switch	OFF
FTP sensor malfunction (P0450, P0451, P0452 and P0453)	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before IG switch OFF	Conditions 1 and 2
1. Duration that vehicle driven	5 minutes or more
2. Purge flow	Executed
ECT	4.4° to 35°C (40° to 95°F)
IAT	4.4° to 35°C (40° to 95°F)
Time after engine stopped	5 hours

Example of restart time

First time	7 hours
Second time	9 hours and 30 minutes

2. Key-off monitor sequence 1 to 8

1. Atmospheric pressure

Next sequence is run if following condition set	-
Atmospheric pressure change for 10 second	Less than 0.3 kPa (2.25 mmHg) for 1 second

2. First reference pressure

Next sequence is run if all of following conditions set	Condition 1, 2 and 3
1. FTP when 4 seconds after reference pressure measurement	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.057 kPa (-33.38 to -7.93 mmHg)
3. Reference pressure	Saturated within 60 seconds

3. Vent valve stuck closed check

Next sequence is run if following condition set	-
FTP change for 10 seconds after vent valve ON (closed)	0.3 kPa (2.25 mmHg) or more

4. Vacuum introduction and leak

Next sequence is run if both of following conditions set	Condition 1 and 2
1. Vacuum introduction time	12 minutes or less
2. FTP	Saturated within 12 minutes

5. Purge VSV stuck closed check

Next sequence is run if following condition set	-
FTP change for 10 seconds after purge VSV ON (open)	0.3 kPa (2.25 mmHg) or more

6. Second reference pressure measurement

Next sequence is run if all of following conditions set	Condition 1, 2, 3 and 4
1. FTP when 4 seconds after reference pressure measurement	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.057 kPa (-36.4 to -7.92 mmHg)
3. Reference pressure	Saturated within 60 seconds
4. Reference pressure difference between first and second	0.7 kPa (5.25 mmHg) or less

7. Leak check

Next sequence is run if following condition set	-
FTP when vacuum introduction was complete	Second reference pressure or less

8. Atmospheric pressure

Monitor is complete if following condition set	-
Atmospheric pressure difference between sequence 1 and 8	0.3 kPa (2.25 mmHg) or less

Typical Malfunction Thresholds

Purge VSV stuck open	-
FTP when vacuum introduction complete	Higher than reference pressure x 0.2
Purge VSV stuck closed	-
FTP change for 10 seconds after purge VSV ON (open)	Less than 0.3 kPa (2.25 mmHg)

"Saturated" indicates that the EVAP pressure change is less than 0.1 kPa (0.75 mmHg) in 30 seconds.

OBD II MONITOR SPECIFICATIONS

1. Purge Flow Monitor

Monitor Strategy

Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 30 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

Typical Enabling Conditions

Monitor runs whenever following DTCs not present	None
Engine	Running
ECT	4.4°C (40°F) or more
IAT	4.4°C (40°F) or more
FTP sensor malfunction	Not detected
Purge VSV	Not operated by scan tool
EVAP system check	Not operated by scan tool
Battery voltage	10 V or more

Purge duty cycle	8 % or more

Typical Malfunction Thresholds

Both of following conditions are met	Conditions 1 or 2
1. FTP change when purge operation started	Less than 0.1 kPa (0.75 mmHg)
2. FTP change during purge operation when vent valve closed	Less than 0.5 kPa (3.75 mmHg)

MONITOR RESULT

Refer to Checking Monitor Status (See page ES-422) or (See page ES-21).

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	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timings	Detection Logic
P0450	Canister pressure sensor voltage abnormal fluctuation	Sensor output rapidly fluctuates beyond upper and lower malfunction thresholds for 0.5 seconds.	• Canister pump module • ECM	• EVAP monitoring (ignition OFF) • Ignition ON	1 trip
P0451	Canister pressure sensor noise	Sensor output voltage fluctuates frequently in certain time period.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM	• EVAP monitoring (ignition OFF) • Engine running	2 trip
P0451	Canister pressure sensor voltage fixed	Sensor output voltage does not vary in certain time period.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM	• EVAP monitoring (ignition OFF)	2 trip
P0452	Canister pressure sensor voltage low	Sensor output less than 42.1 kPa for 0.5 seconds.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM	• Ignition ON • EVAP monitoring (ignition OFF)	1 trip
P0453	Canister pressure sensor voltage high	Sensor output more than 123.8 kPa for 0.5 seconds.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM	• Ignition ON • EVAP monitoring (ignition OFF)	1 trip

HINT:
The canister pressure sensor is built into the canister pump module.

DESCRIPTION

The circuit description can be found in the EVAP (Evaporative Emission) System (see page ES-392).

MONITOR DESCRIPTION

1. DTC P0450: Canister pressure sensor output abnormal fluctuation
   If the canister pressure sensor output rapidly fluctuates between less than 42.1 kPa and more than 123.8 kPa, the ECM interprets this as an open or short circuit malfunction in the canister pressure sensor or its circuit, and stops the EVAP (Evaporative Emission) system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).
2. DTC P0451: Canister pressure sensor noise 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 the malfunctions are detected by 2 trip detection logic).
3. DTC P0452: Canister pressure sensor output low
   If the canister pressure sensor output is below 42.1 kPa, the ECM interprets this as an open or short circuit malfunction in the canister pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).
4. DTC P0453: Canister pressure sensor output high
   If the canister pressure sensor output is 123.8 kPa or more, the ECM interprets this as an open or short circuit malfunction in the canister pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).

MONITOR STRATEGY

Required Sensors/Components	Canister pump module
Frequency of Operation	Once per driving cycle: P0451 sensor fixed Continuous: P0451 sensor noise, P0450, P0452 and P0453
Duration	-
MIL Operation	Immediate: P0450, P0452 and P0453 2 driving cycles: P0451
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0451 (Noise monitor):

Monitor runs whenever these DTCs not present	None
Atmospheric pressure (absolute pressure)	70 kPa (525 mmHg) or more, less than 110 kPa (825 mmHg)
Battery voltage	10.5 V or more
Intake air temperature	4.4°to 35°C (40° to 95°F)
Either of following conditions met	A or B
A. Engine	Running
B. Soak time (ignition switch OFF time)	5 hours

Example of restart time

First time	7 hours
Second time	9 hours and 30 minutes

P0451 (Stuck monitor):

Monitor runs whenever these DTCs not present	None
Atmospheric pressure (absolute pressure)	Less than 70 kPa (525 mmHg), or 110 kPa (825 mmHg) or more
Battery voltage	10.5 V or more
Intake air temperature	4.4°to 35°C (40° to 95°F)
Soak time (ignition switch OFF time)	5 hours

Example of restart time

First time	7 hours
Second time	9 hours and 30 minutes

P0450, P0452 and P0453:

Monitor runs whenever these DTCs not present	None
Either of following conditions met	(a) or (b)
(a) Ignition switch	ON
(b) Soak timer	ON

TYPICAL MALFUNCTION THRESHOLDS

P0450: Canister pressure sensor chattering	-
Canister pressure sensor output	Less than 42.1 kPa, or more than 123.8 kPa

ES

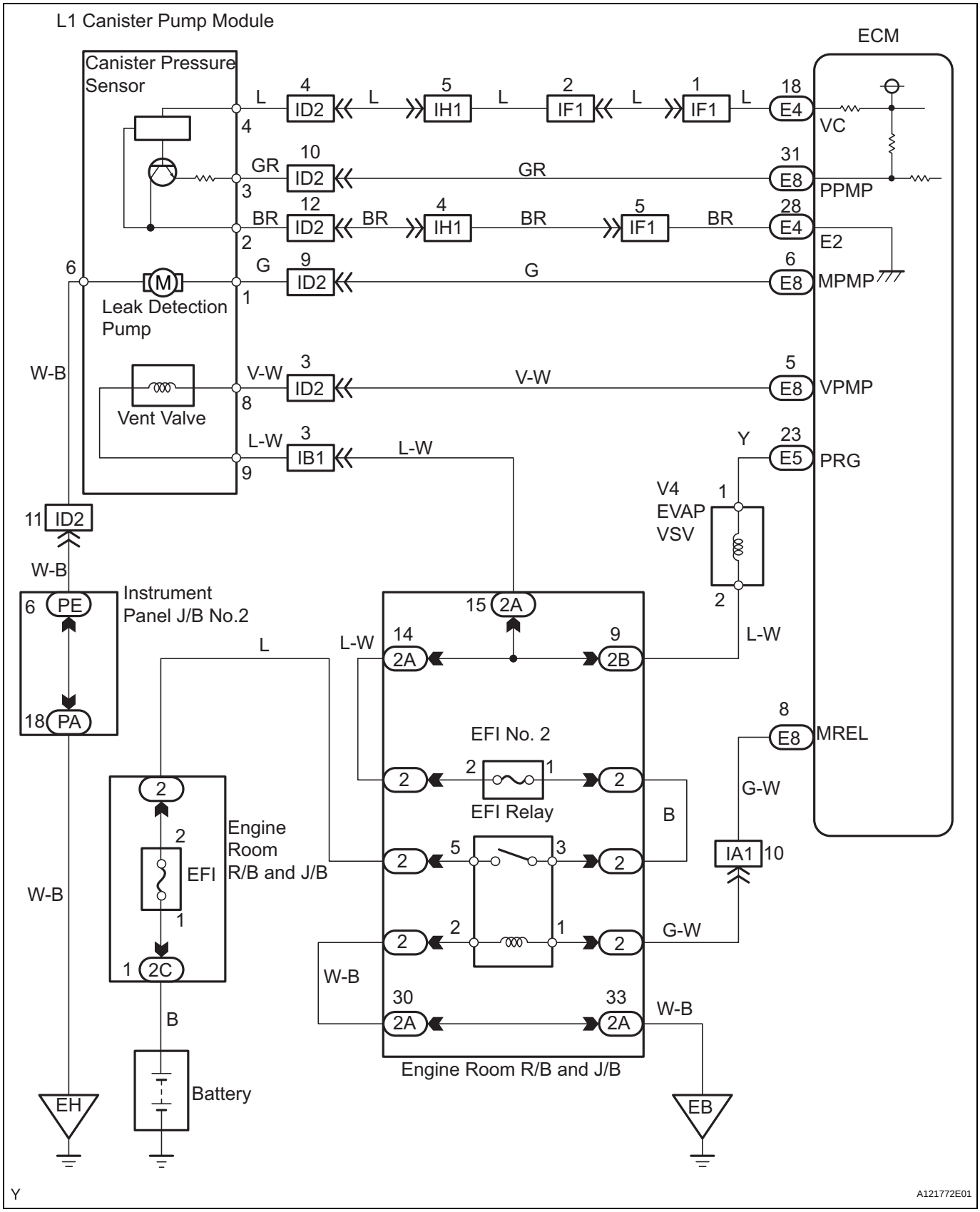
P0451: Canister pressure sensor noise	-
Pressure variation indicated by Canister pressure sensor in 10 seconds	More than +- 0.3 kPa (+- 2.25 mmHg) 10 times

P0451: Canister pressure sensor fixed	-
0.02 inch leak criterion variation indicated by canister pressure sensor in 10 seconds	Less than 0.65 kPa (4.87 mmHg)

P0452: Canister pressure sensor low	-
Canister pressure sensor output	Less than 42.1 kPa

P0453: Canister pressure sensor high	-
Canister pressure sensor output	More than 123.8 kPa

WIRING DIAGRAM



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.**
- **An intelligent tester is required to conduct the following diagnostic troubleshooting procedure.**

1	CONFIRM DTC AND EVAP PRESSURE

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch to ON (do not start the engine).
(c) Turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read DTCs.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / EVAP / VAPOR PRESS.
(g) Read the EVAP (Evaporative Emission) pressure displayed on the tester.

ES

Result

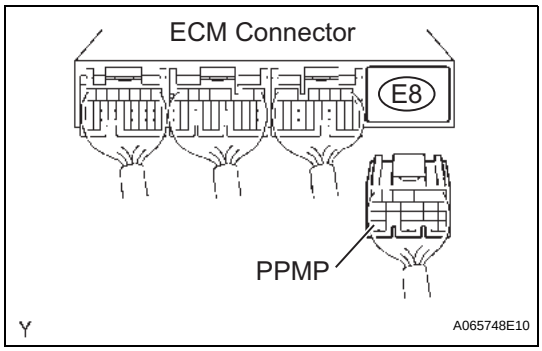
Display (DTC Output)	Test Results	Suspected Trouble Areas	Proceed To
P0451	-	Canister pressure sensor	C
P0452	Less than 45 kpa (430 mmHg)	• Wire harness/connector (ECM - Canister pressure sensor) • Canister pressure sensor • Short in ECM circuit	A
P0453	More than 120 kPa (900 mmHg)	• Wire harness/connector (ECM - Canister pressure sensor) • Canister pressure sensor • Open in ECM circuit	B

B → Go to step 4

C → GO TO EVAP SYSTEM (EVAP SYSTEM INSPECTION PROCEDURE)

A

2	CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - ECM)



(a) Turn the ignition switch to OFF.
(b) Disconnect the E8 ECM connector.
(c) Measure the resistance between PPMP terminal of the ECM connector and the body ground.

Result

Test Results	Suspected Trouble Areas	Proceed To
10 Ω or less	• Wire harness/connector (ECM - Canister pressure sensor) • Short in canister pressure sensor circuit	A
10 kΩ or more	• Wire harness/connector (ECM - Canister pressure sensor) • Short in ECM circuit	B

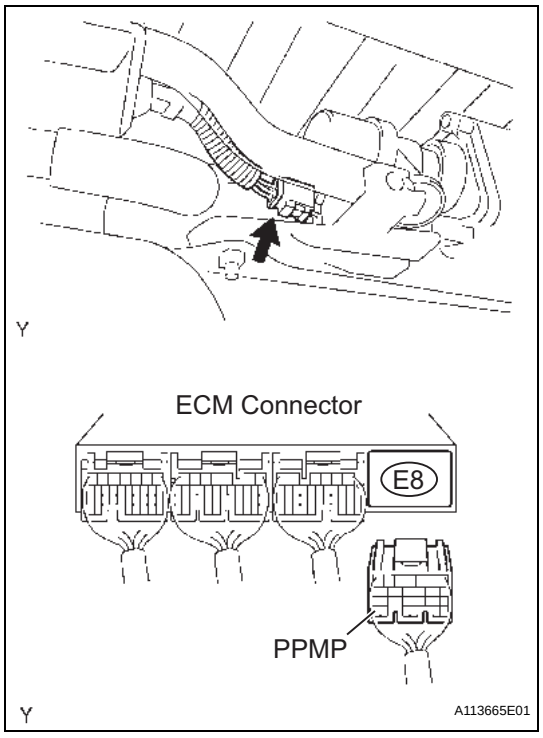
(d) Reconnect the ECM connector.

B → **Go to step 7**

A

ES

3 CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - ECM)



(a) Disconnect the L1 canister connector.
(b) Disconnect the E8 ECM connector.
(c) Check the resistance between PPMP terminal of the ECM connector and the body ground.

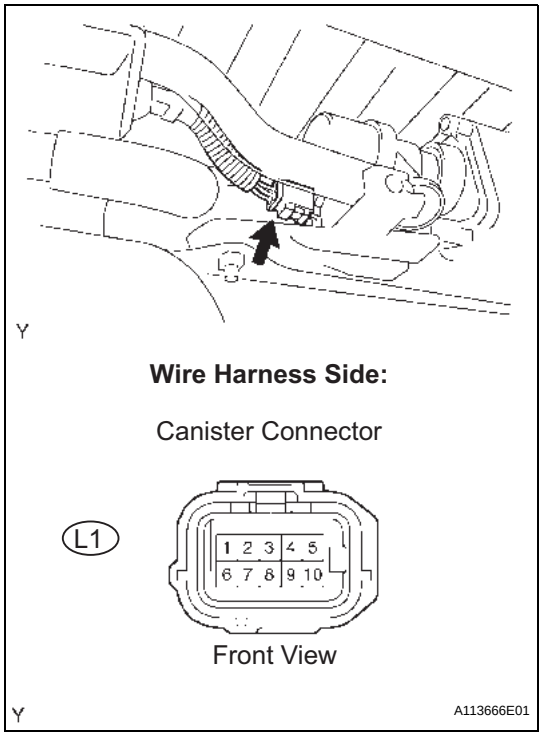
Result

Test Results	Suspected Trouble Areas	Proceed To
10 kΩ or more	Short in canister pressure sensor circuit	A
10 Ω or less	Short in wire harness/connector (ECM - Canister pressure sensor)	B

A → **Go to step 5**

B → **Go to step 6**

4	CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - ECM)



(a) Disconnect the L1 canister connector.
(b) Turn the ignition switch to ON.
(c) Measure the voltage and resistance of the canister connector.

Standard Voltage and Standard Resistance

Tester Connections	Specified Conditions
L1-4 - Body ground	4.5 to 5.0 V
L1-3 - Body ground	4.5 to 5.0 V
L1-2 - Body ground	100 Ω or less

Result

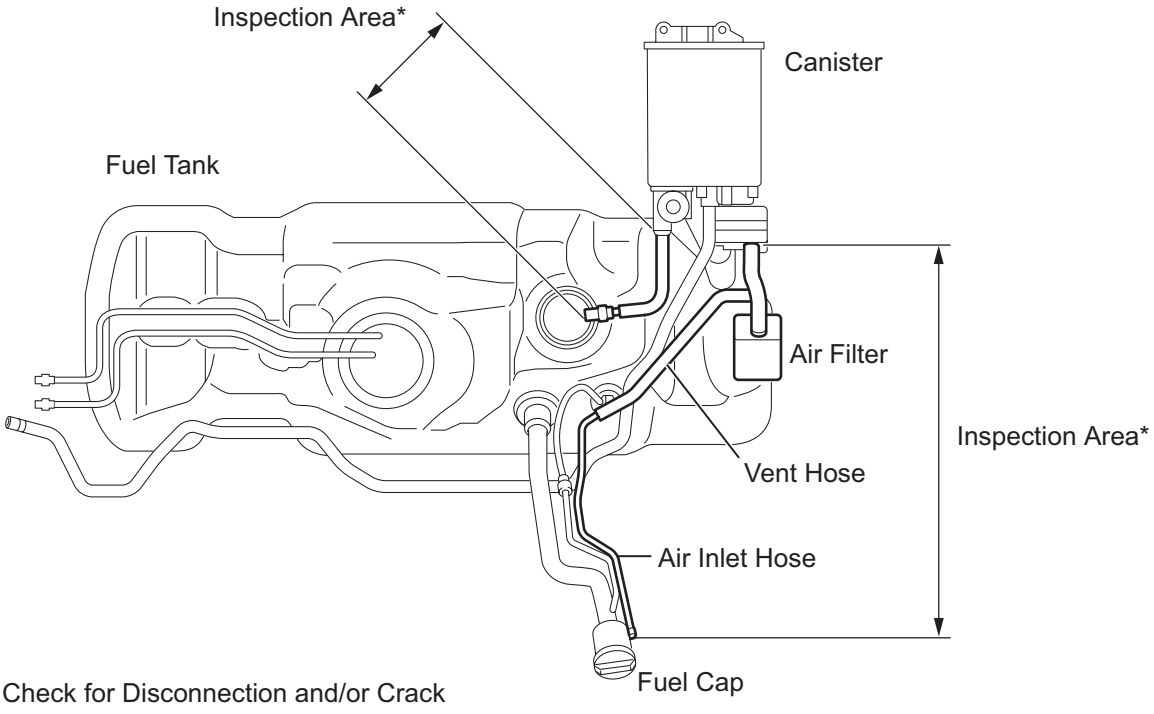
Test Results	Suspected Trouble Areas	Proceed To
Voltage and resistance within standard ranges	Open in canister pressure sensor circuit	A
Voltage and resistance outside standard ranges	Open in wire harness/connector (ECM - Canister pressure sensor)	B

(d) Reconnect the canister connector.

A	Go to step 5
B	Go to step 6

5	REPLACE CHARCOAL CANISTER ASSEMBLY

(a) Replace the canister assembly.



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

NEXT	Go to step 8

6	REPAIR OR REPLACE WIRE HARNESS AND CONNECTOR

HINT:
If the exhaust tail pipe has been removed, go to the next step before reinstalling it.

NEXT	Go to step 8

7	REPLACE ECM

(a) Replace the ECM (See page ES-467).

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 ON 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.

NEXT

ES

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	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timings	Detection Logic
P0455	EVAP gross leak	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. 0.02 inch leak criterion measured at start and at end of leak check. If stabilized pressure higher than [second 0.02 inch leak criterion x 0.2], ECM determines that EVAP system has large leakage.	• Fuel cap (loose) • Leakage from EVAP line (Canister - Fuel tank) • Leakage from EVAP line (Purge VSV - Canister) • Canister pump module • Leakage from fuel tank • Leakage from canister	While ignition switch OFF	2 trip
P0456	EVAP small leak	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. 0.02 inch leak criterion measured at start and at end of leak check. If stabilized pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system has small leakage.	Same above	While ignition switch OFF	2 trip

DESCRIPTION

The circuit description can be found in the EVAP (Evaporative Emission) System (see page ES-392).

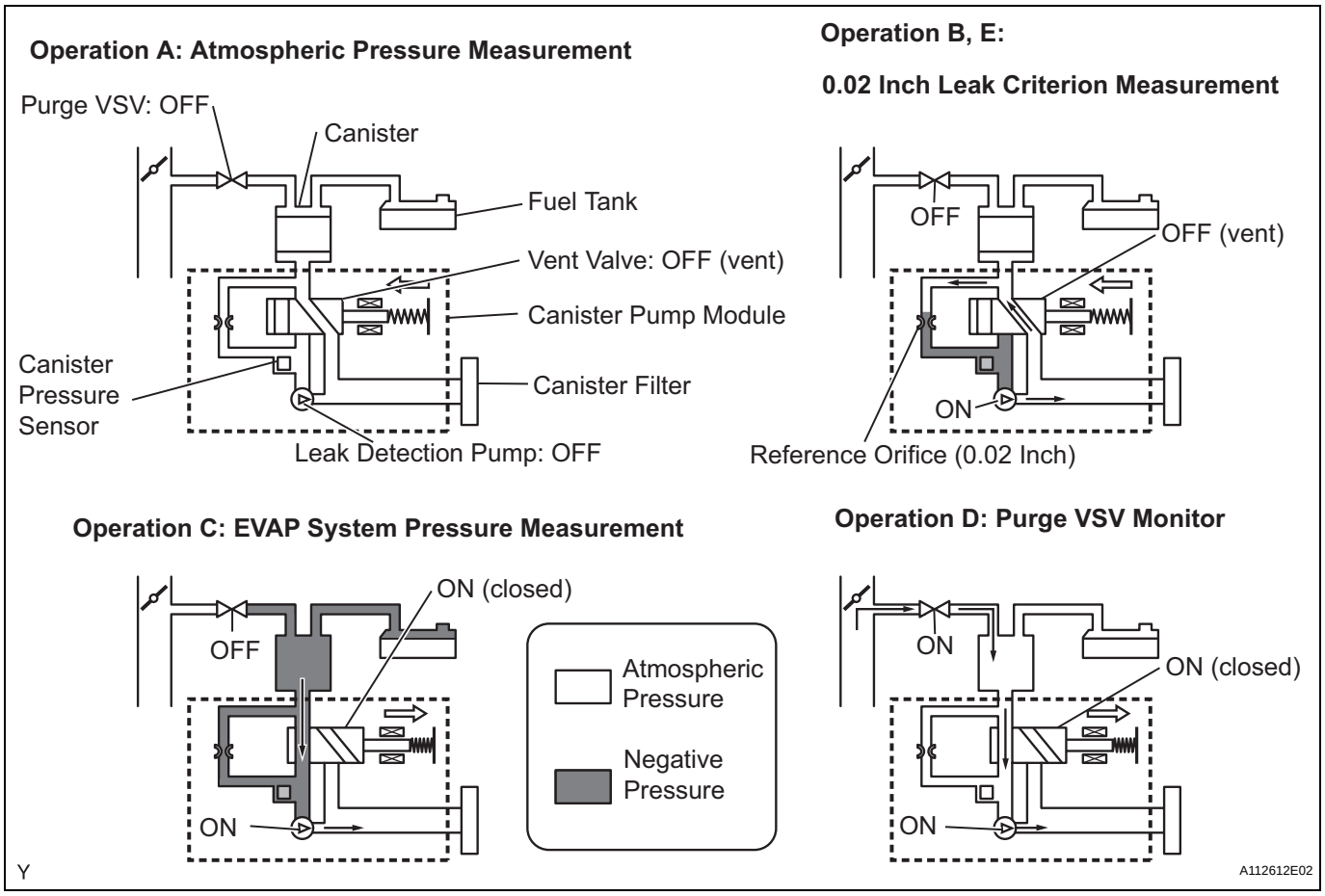
Refer to the EVAP System (see page ES-397).

MONITOR DESCRIPTION

5 hours* after the ignition switch is turned to OFF, the electric leak detection 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:
*: 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 turned to OFF.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak criterion (reference pressure) measurement	In order to determine 0.02 inch leak criterion, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as they will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes*
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak criterion (reference pressure) measurement	After second 0.02 inch leak criterion measurement, leak check performed by comparing first and second 0.02 inch leak criterion. If stabilized system pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system leaking.	60 seconds
F	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

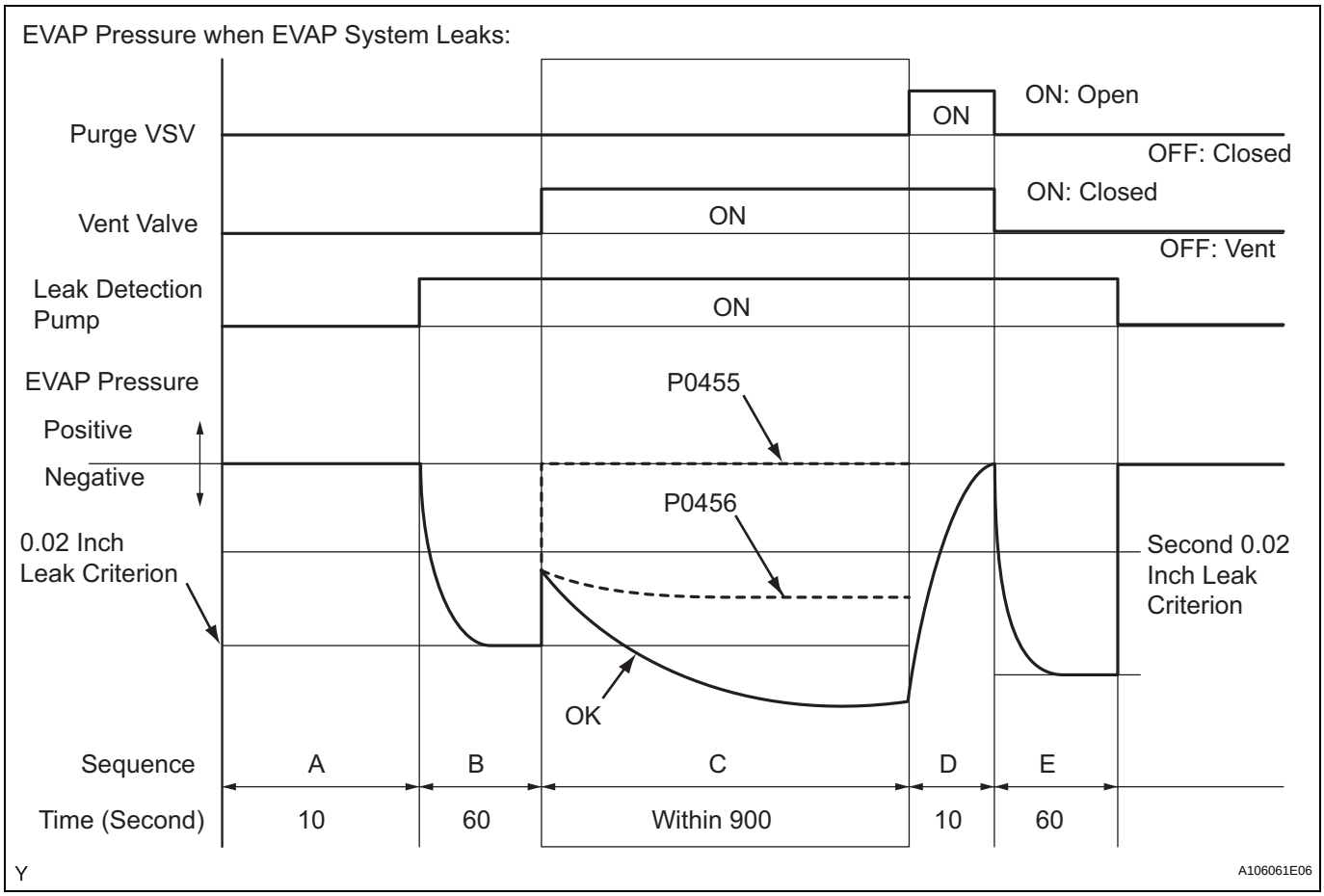
* If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.



ES

1. P0455: EVAP (Evaporative Emission) gross leak
   In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system and the EVAP system pressure is measured. If the stabilized system pressure is higher than [second 0.02 inch leak criterion x 0.2] (near atmospheric pressure), the ECM determines that the EVAP system has a large leakage, illuminates the MIL and sets the DTC (2 trip detection logic).

2. P0456: EVAP very small leak
In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system and the EVAP system pressure is measured. If the stabilized system pressure is higher than second 0.02 inch leak criterion, the ECM determines that the EVAP system has a small leakage, illuminates the MIL and sets the DTC (2 trip detection logic).



MONITOR STRATEGY

Required Sensors/Components	Purge VSV and Canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes (varies with amount of fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Vehicle speed	Below 2.5 mph (4 km/h)
Ignition switch	OFF
FTP sensor malfunction (P0450, P0451, P0452 and P0453)	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool

Both of following conditions met before IG switch OFF	Conditions 1 and 2
1. Duration that vehicle driven	5 minutes or more
2. Purge flow	Executed
ECT	4.4° to 35°C (40° to 95°F)
IAT	4.4° to 35°C (40° to 95°F)
Time after engine stopped	5 hours

Example of restart time

First time	7 hours
Second time	9 hours and 30 minutes

1. Key-off monitor sequence 1 to 8

1. Atmospheric pressure

Next sequence is run if following condition set	-
Atmospheric pressure change for 10 second	Less than 0.3 kPa (2.25 mmHg) for 1 second

ES

2. First reference pressure

Next sequence is run if all of following conditions set	Condition 1, 2 and 3
1. FTP when 4 seconds after reference pressure measurement	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.057 kPa (-33.38 to -7.93 mmHg)
3. Reference pressure	Saturated within 60 seconds

3. Vent valve stuck closed check

Next sequence is run if following condition set	-
FTP change for 10 seconds after vent valve ON (closed)	0.3 kPa (2.25 mmHg) or more

4. Vacuum introduction and leak

Next sequence is run if both of following conditions set	Condition 1 and 2
1. Vacuum introduction time	12 minutes or less
2. FTP	Saturated within 12 minutes

5. Purge VSV stuck closed check

Next sequence is run if following condition set	-
FTP change for 10 seconds after purge VSV ON (open)	0.3 kPa (2.25 mmHg) or more

6. Second reference pressure measurement

Next sequence is run if all of following conditions set	Condition 1, 2, 3 and 4
1. FTP when 4 seconds after reference pressure measurement	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.057 kPa (-36.4 to -7.92 mmHg)
3. Reference pressure	Saturated within 60 seconds
4. Reference pressure difference between first and second	0.7 kPa (5.25 mmHg) or less

7. Leak check

Next sequence is run if following condition set	-
FTP when vacuum introduction was complete	Second reference pressure or less

8. Atmospheric pressure

Monitor is complete if following condition set	-
Atmospheric pressure difference between sequence 1 and 8	0.3 kPa (2.25 mmHg) or less

2. Typical Malfunction Thresholds

"Saturated" indicates that the EVAP pressure change is less than 0.1 kPa (0.75 mmHg) in 30 seconds.

P0455: EVAP gross leak	-
FTP when vacuum introduction complete	Higher than reference pressure x 0.2

P0456: EVAP small leak	-
FTP when vacuum introduction complete	Between 1 and 2
Condition 1.	Higher than second reference pressure
Condition 2.	Lower than reference pressure x 0.2
Atmospheric pressure (absolute pressure)	70 kPa (525 mmHg) or more, and less than 110 kPa (825 mmHg)

MONITOR RESULT

Refer to Checking Monitor Status (See page ES-21) or (See page ES-422).

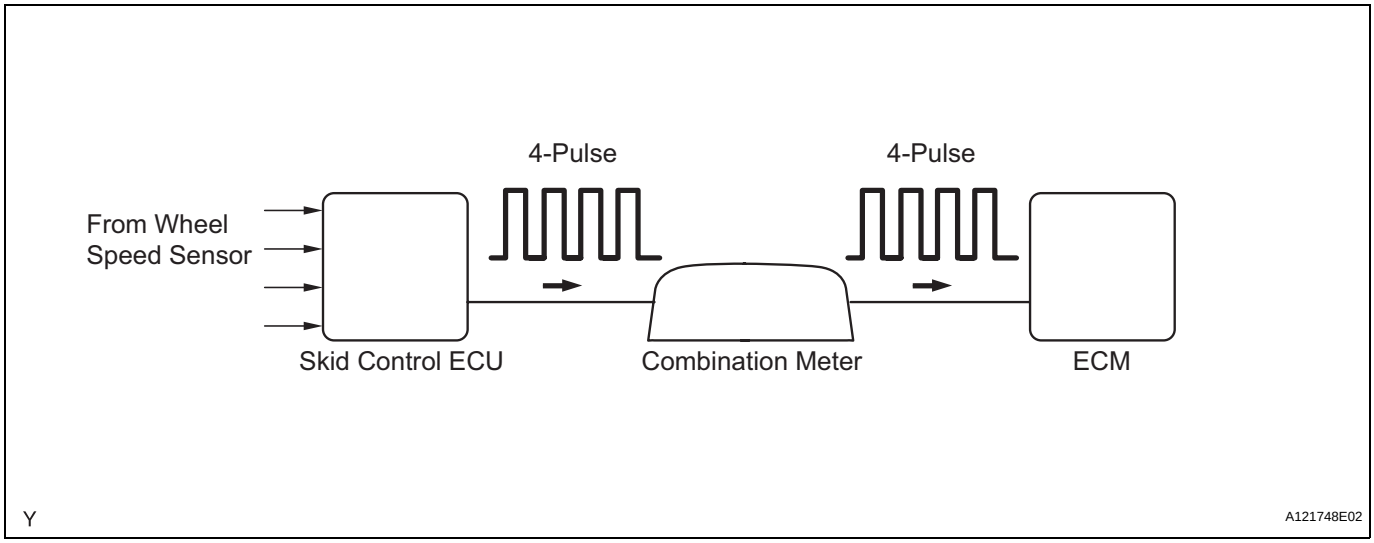
DTC	P0500	Vehicle Speed Sensor "A"

DTC	P0503	Vehicle Speed Sensor "A" Intermittent / Erratic / High

DESCRIPTION

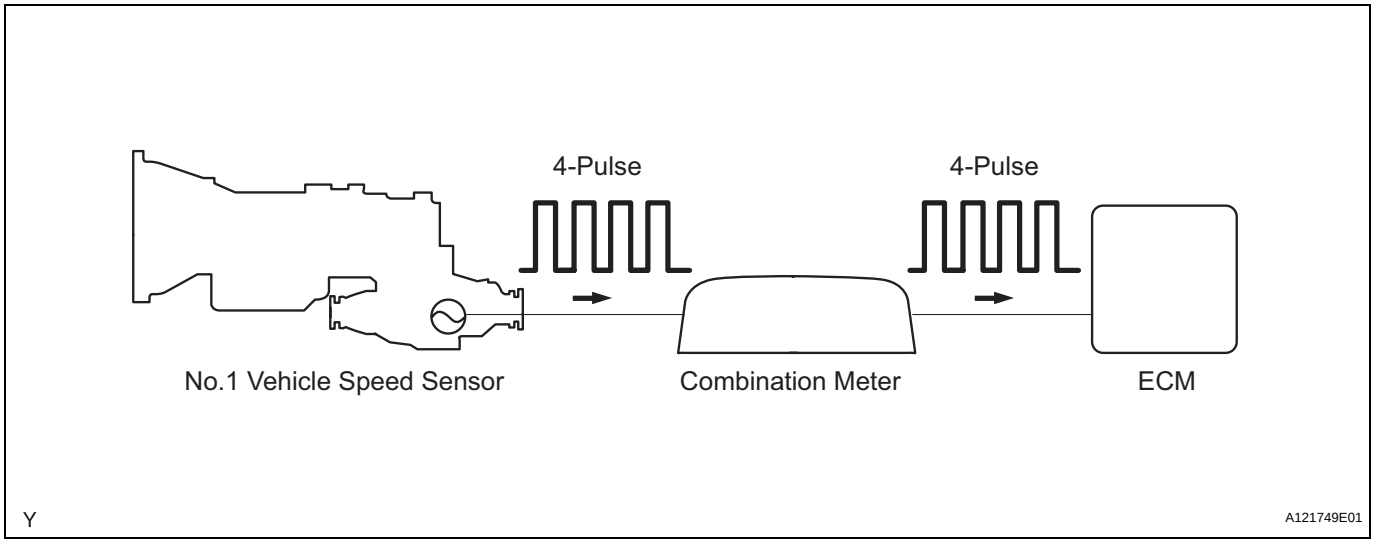
Automatic Transaxle Models:

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.



Manual Transaxle Models:

Vehicles, which are equipped with manual transaxle, detect the vehicle speed using the No. 1 vehicle speed sensor. The No. 1 vehicle speed sensor transmits a 4-pulse signal for every revolution of the rotor shaft, which is rotated by the transaxle or transfer output shaft via the driven gear. The 4-pulse signal is converted into a more precise rectangular waveform by the waveform shaping circuit inside the combination meter. The signal is then transmitted to the ECM. The ECM determines the vehicle speed based on the frequency of the pulse signal.



DTC No.	DTC Detection Conditions	Trouble Areas
P0500	Automatic transmission: ECM detects following conditions simultaneously 500 times (1 trip detection logic) • No speed sensor signal while ECM detects No. 2 speed sensor signal • Vehicle speed 6 mph (9 km/h) or more for 4 seconds • Park/Neutral position switch OFF (shift lever other than P and N positions) Manual transmission: ECM detects following conditions simultaneously for 8 seconds or more (2 trip detection logic) • No speed sensor signal input • Engine speed 2,000 rpm or more • ECM detects high engine load • Transfer lever in other than N position (4WD)	• Open or short in speed signal circuit • Combination meter • ECM • Skid control ECU
P0503	Momentary interruption and noise are detected when a rapid change of vehicle speed occurs	• Open or short in speed signal circuit • Combination meter • ECM • Skid control ECU

ES

MONITOR DESCRIPTION

Automatic 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 combination meter, despite the ECM detecting the speed signal from the No. 2 speed sensor, the ECM interprets this as a malfunction in the speed signal circuit. The ECM then illuminates the MIL and sets the DTC.
Manual Transaxle Models:
The ECM assumes that the vehicle is being driven, when the indicated engine speed is more than 2,000 rpm and the engine load calculated by the ECM is more than certain level. If there is no signal from the vehicle speed sensor, despite these conditions being met, the ECM interprets this as a malfunction in the speed signal circuit. The ECM then illuminates the MIL and sets the DTC.

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)	Park/neutral Position (PNP) switch, Engine Coolant Temperature (ECT) sensor, Crankshaft Position (CKP) sensor and Mass Air Flow (MAF) meter
Frequency of Operation	Continuous
Duration	8 seconds: Manual transmission Conditions met 500 times: Automatic transmission
MIL Operation	2 driving cycles: Manual transmission 1 driving cycle: Automatic transmission
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

With Manual Transmission:

Engine coolant temperature	70°C (158°F) or more
Engine speed	2,000 rpm or more
Engine load	100 % when engine speed 2,000 rpm (threshold varies with engine speed)
Fuel cut at high engine speed	Not executing

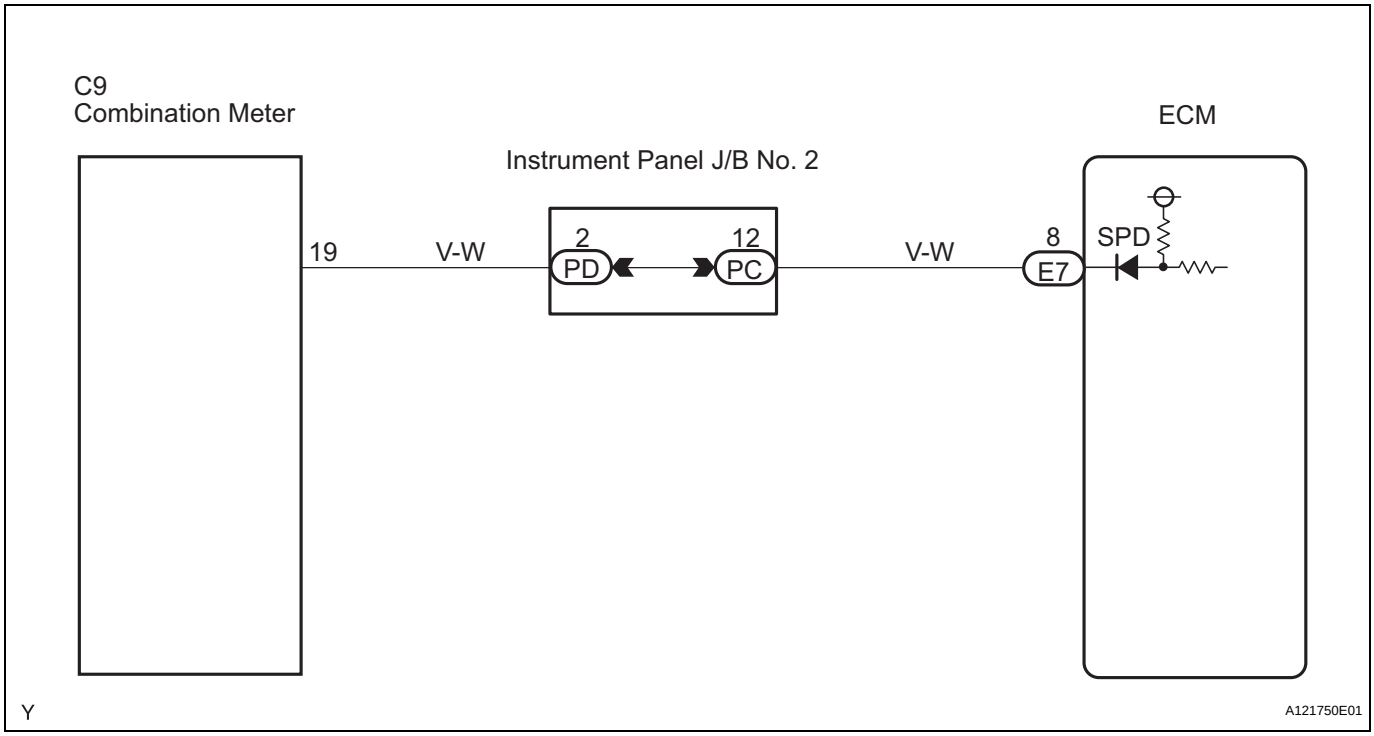
With Automatic Transmission:

Vehicle speed sensor output	48 pulses or more
Time after following conditions met:	4 seconds or more
Ignition switch	ON
Park/neutral position switch	OFF
Vehicle speed	5.59 mph (9 km/h)
Time after ignition switch turned to ON	0.5 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

Vehicle speed sensor signal	No pulse input

WIRING DIAGRAM



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

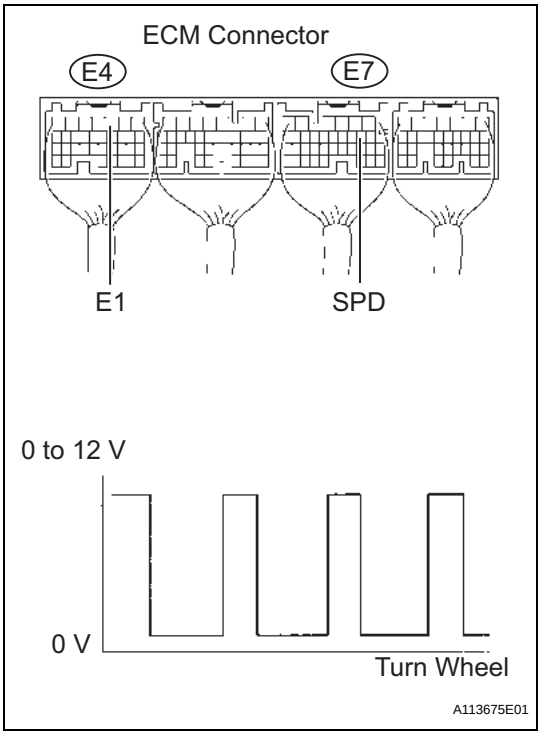
1	**CHECK OPERATION OF SPEEDOMETER**

(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 ON.
(d) Check the voltage between the terminals of the ECM connectors as the wheel is turned slowly.

Standard Voltage

Tester Connections	Specified Conditions
SPD (E7-8) - E1 (E4-3)	Voltage generated intermittently

HINT:
The output voltage should fluctuate up and down similarly to the diagram on the left when the wheel is turned slowly.

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

OK

REPLACE ECM

ES

DTC	P0504	Brake Switch "A" / "B" Correlation

DESCRIPTION

The stop light switch is a duplex system that transmits two signals: STP and ST1-. These two signals are used by the ECM to monitor whether or not the brake system is working properly. If the signals, which indicate the brake pedal is being depressed and released, are detected simultaneously, the ECM interprets this as a malfunction in the stop light switch and sets the DTC.

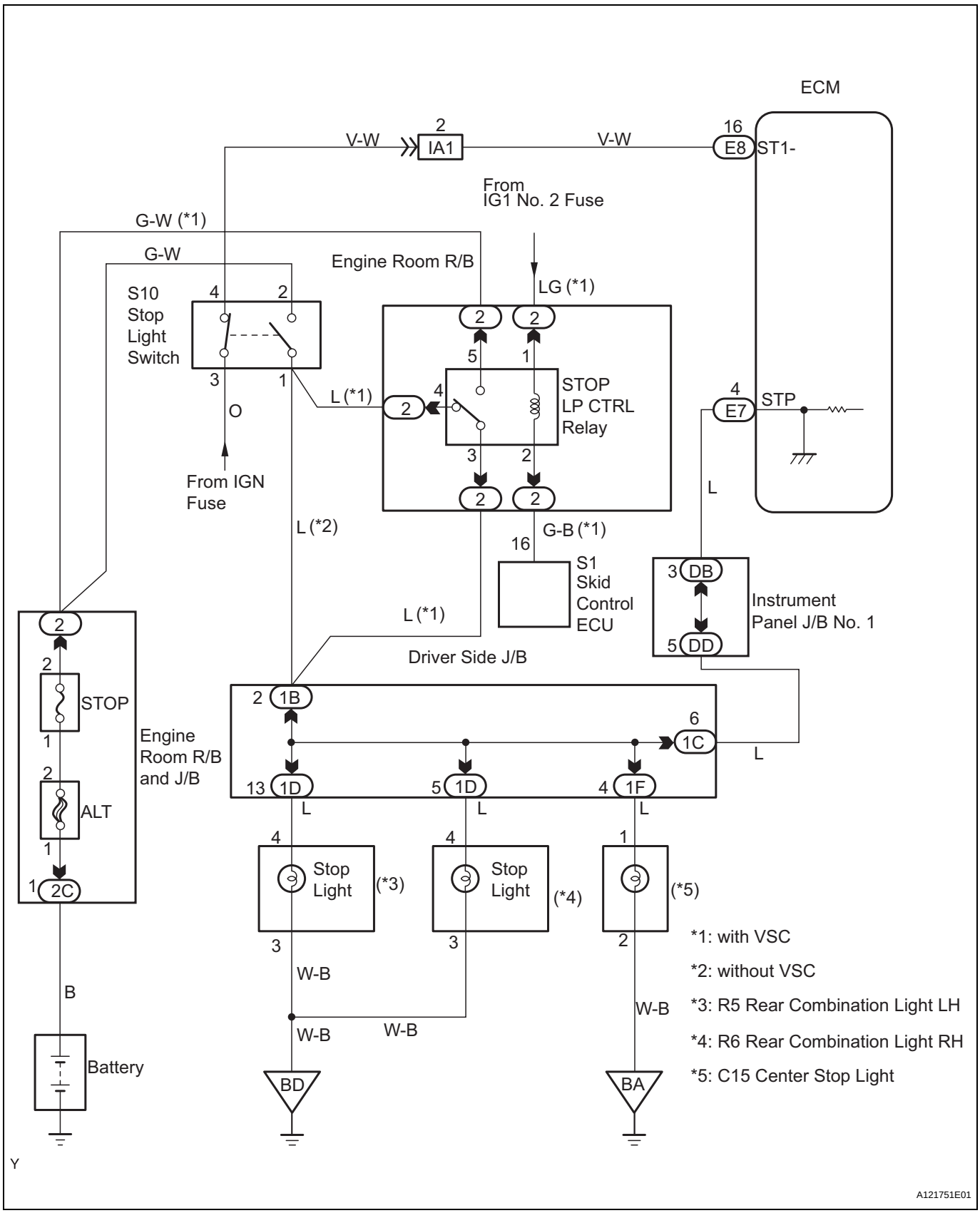
HINT:

The normal conditions are as shown in the table below. The signals can be read using an intelligent tester.

Signals	Brake Pedal Released	In Transition	Brake Pedal Depressed
STP	OFF	ON	ON
ST1-	ON	ON	OFF

DTC No.	DTC Detection Conditions	Trouble Areas
P0504	Conditions (a), (b) and (c) continue for 0.5 seconds or more (1 trip detection logic): (a) Ignition switch ON (b) Brake pedal released (c) STP signal OFF when ST1- signal OFF	• Short in stop light switch signal circuit • STOP fuse • Stop light switch • ECM

WIRING DIAGRAM



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

1 CHECK OPERATION OF STOP LIGHT

(a) Check whether the stop lights turn on and off normally when the brake pedal is depressed and released.

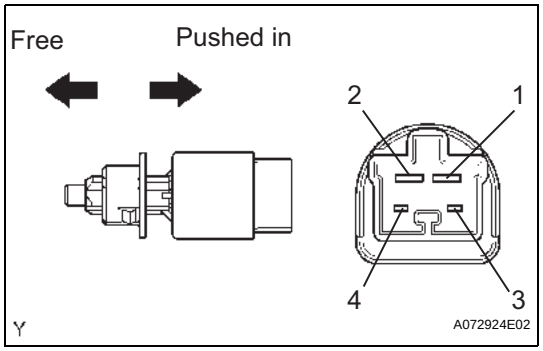
OK:

Stop lights turn ON when brake pedal is depressed.

NG → **REPAIR OR REPLACE STOP LIGHT SWITCH CIRCUIT**

OK

2 INSPECT STOP LIGHT SWITCH ASSEMBLY



(a) Remove the stop light switch assembly.

(b) Check the resistance.

Standard Resistance

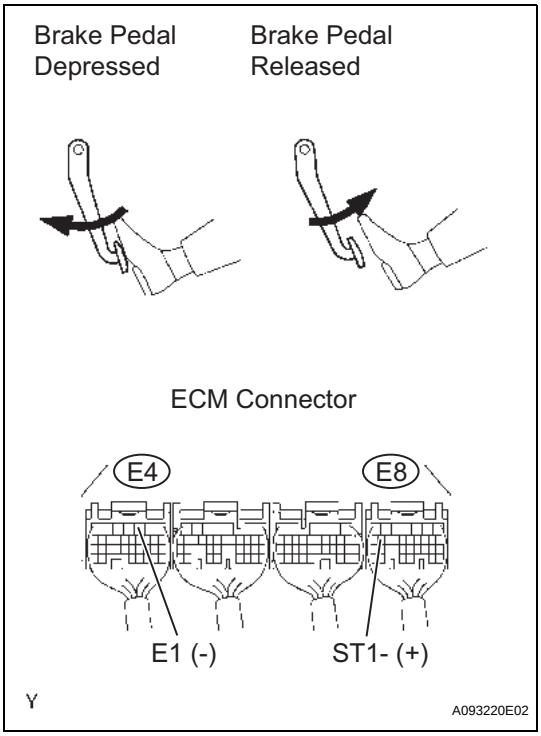
Switch Positions	Tester Connections	Specified Conditions
Switch pin free	1 - 2	Below 1 Ω
Switch pin free	3 - 4	10 kΩ or higher
Switch pin pushed in	1 - 2	10 kΩ or higher
Switch pin pushed in	3 - 4	Below 1 Ω

(c) Reinstall the stop light switch assembly.

NG → **REPLACE STOP LIGHT SWITCH ASSEMBLY**

OK

3 READ DATA LIST (STP SIGNAL AND ST1 - VOLTAGE)



(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / STOP LIGHT SW.
(d) Check the STP signal when the brake pedal is depressed and released.

Standard

Brake Pedal Operations	Specified Conditions
Depressed	STP signal ON
Released	STP signal OFF

(e) Measure the voltage between the terminals of the ECM connectors.

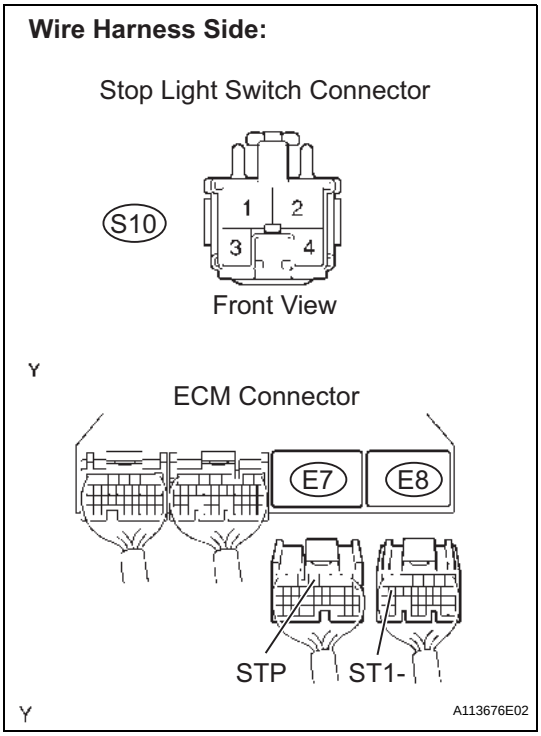
Standard Voltage

Tester Connections	Brake Pedal Operations	Specified Conditions
ST1- (E8-16) - E1 (E4-3)	Depressed	Below 1.5 V
ST1- (E8-16) - E1 (E4-3)	Released	7.5 to 14 V

OK → **CHECK FOR INTERMITTENT PROBLEMS**

NG

4 CHECK HARNESS AND CONNECTOR (STOP LIGHT SWITCH - ECM)



(a) Disconnect the S10 stop light switch connector.
(b) Disconnect the E7 and E8 ECM connectors.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
Stop light switch (S10-1) - STP (E7-4)	Below 1 Ω
Stop light switch (S10-4) - ST1- (E8-16)	Below 1 Ω

(d) Reconnect the stop light switch connector.
(e) Reconnect the ECM connector.

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

OK

REPLACE ECM

DTC	P0505	Idle Control System Malfunction

DESCRIPTION

The idling speed is controlled by the ETCS (Electronic Throttle Control System). The ETCS is comprised of: 1) the one valve type throttle body; 2) the throttle actuator, which operates the throttle valve; 3) the Throttle Position (TP) sensor, which detects the opening angle of the throttle valve; 4) the Accelerator Pedal Position (APP) sensor, which detects the accelerator pedal position; and 5) the ECM, which controls the ETCS. Based on the target idling speed, the ECM controls the throttle actuator to provide the proper throttle valve opening angle.

DTC No.	DTC Detection Conditions	Trouble Areas
P0505	Idling speed continues to vary greatly from target idling speed (2 trip detection logic)	• Electronic Throttle Control System (ETCS) • Air induction system • PCV hose connection • 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 apply:
HINT:

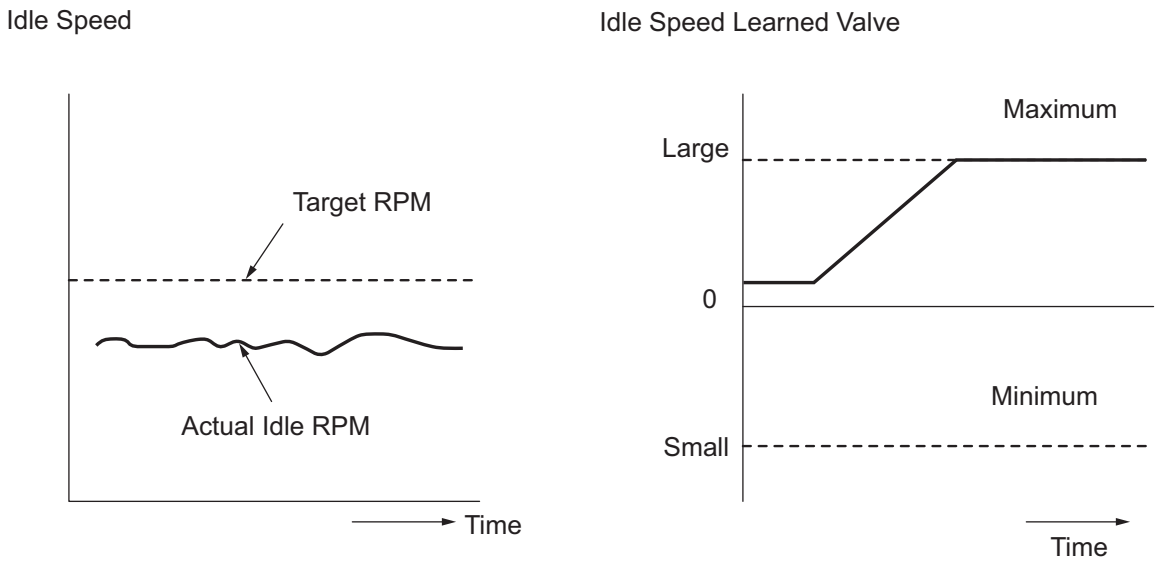
- The learned idling air flow volume remains at the maximum or minimum volume 5 times or more during a drive cycle.
- While driving at 6 mph (10 km/h) or more, the actual engine idling speed varies from the target idling speed by between 100 rpm and 150 rpm, 5 times or more during a drive cycle.

Example:

If the actual idling speed varies from the target idling speed by more than 200 rpm* 5 times during a drive cycle, the ECM illuminates the MIL and sets the DTC.
HINT:

*: Threshold idling speed varies with engine load.

Example



Y A121611E01

ES

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Engine	Running

TYPICAL MALFUNCTION THRESHOLDS

Following conditions met:	A and B
A. Frequency that both of following conditions 1 and 2 met:	5 times or more
1. Deviation in engine speed	Less than -100 rpm or more than 150 rpm (when shift position D and A/C OFF)
2. Vehicle condition	Stop after vehicle was driven by 6 mph (10 km/h) or more
B. Frequency that both of following conditions 3 and 4 met:	Once
3. Deviation in engine speed	Less than -100 rpm or more than 150 rpm (when shift position D and A/C OFF)

4. IAC flow rate learning value	0.5 L/sec or less, 6.4 L/sec or more

HINT:
- The following conditions may also cause DTC P0505 to be set: (1) The floor carpet overlapping slightly onto the accelerator pedal, causing the accelerator pedal to be slightly depressed and therefore the throttle valve position to be slightly open. (2) The accelerator pedal being not fully released.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1 CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0505)

ES

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

Result

Display (DTC Output)	Proceed To
P0505	A
P0505 and other DTCs	B

HINT:
If any DTCs other than P0505 are output, troubleshoot those DTCs first.

B → **GO TO DTC CHART**

A

2 CHECK CONNECTION OF PCV HOSE

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

NG → **REPAIR OR REPLACE PCV HOSE**

OK

3 CHECK AIR INDUCTION SYSTEM

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

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

OK

4	CHECK THROTTLE VALVE

(a) Check the throttle valve condition.

NG → REPLACE THROTTLE BODY ASSEMBLY

OK

REPLACE ECM

DTC	P0560	System Voltage

MONITOR DESCRIPTION

The battery supplies electricity to the ECM even when the ignition switch is in the OFF position. This power allows the ECM to store data such as DTC history, freeze frame data and fuel trim values. If the battery voltage falls below a minimum level, 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 Conditions	Trouble Areas
P0560	Open in ECM back up power source circuit (1 trip detection logic)	• Open in back up power source circuit • EFI fuse • ECM

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

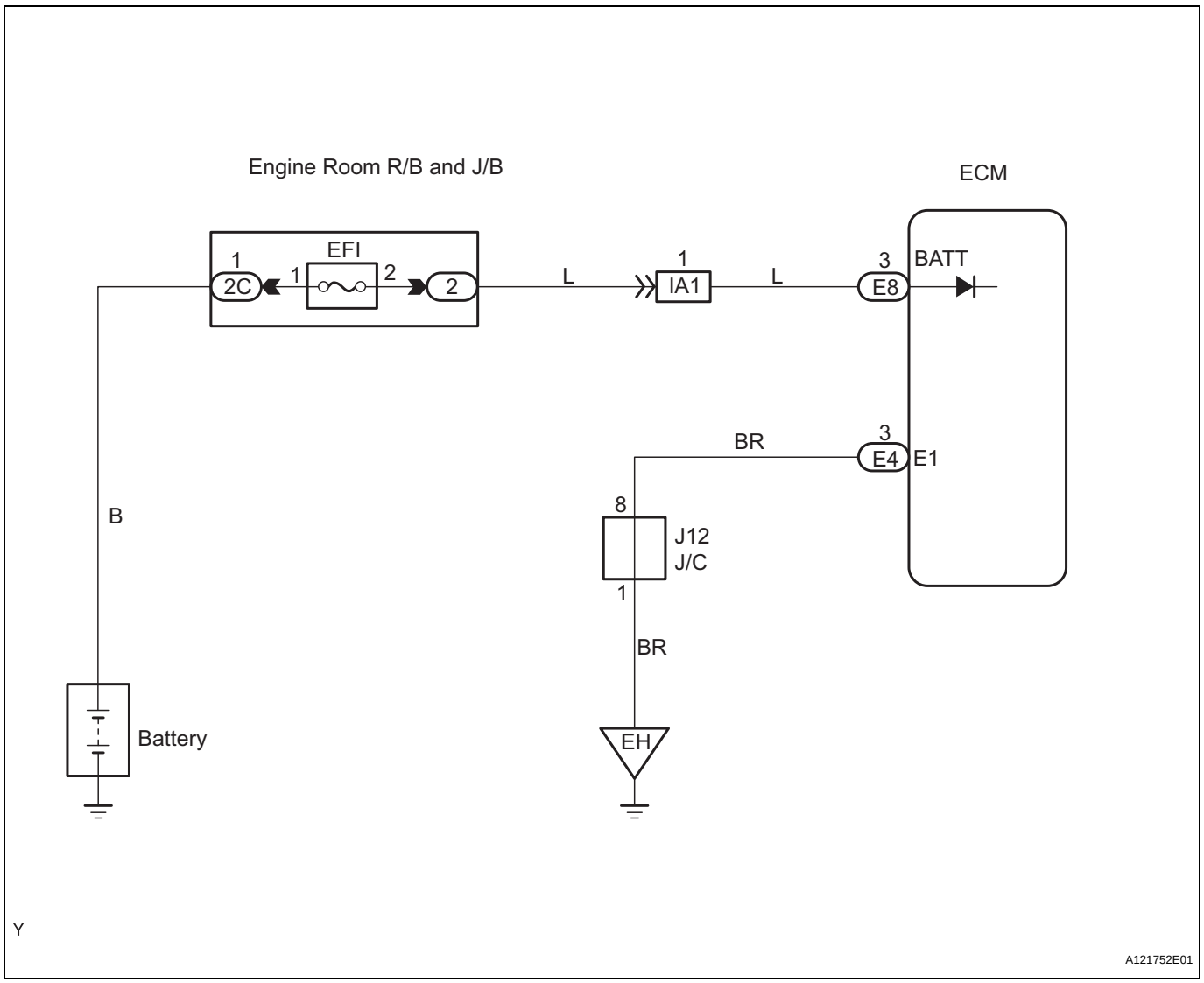
TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

ECM power source	Less than 3.5 V

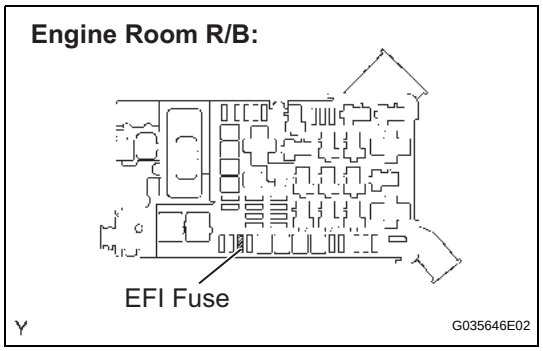
WIRING DIAGRAM



ES

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

1	CHECK FUSE (EFI FUSE)

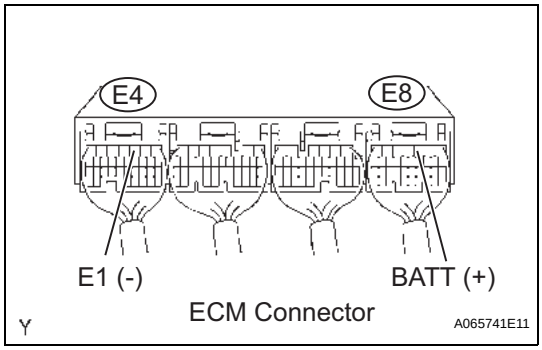


(a) Remove the EFI fuse from the engine room R/B.
(b) Check the resistance.
Standard Resistance:
Below 1 Ω
(c) Reinstall the EFI fuse.

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

OK

2	INSPECT ECM (BATT VOLTAGE)



(a) Measure the voltage between the terminals of the ECM connectors.

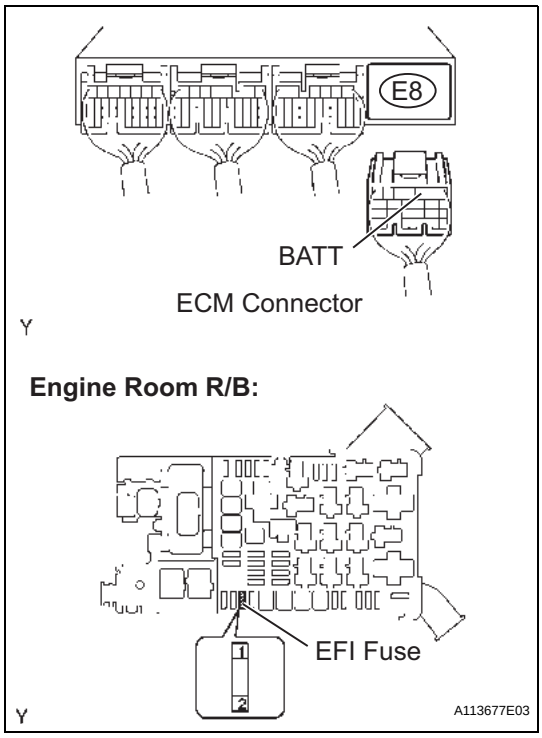
Standard Voltage

Tester Connections	Specified Conditions
BATT (E8-3) - E1 (E4-3)	9 to 14 V

OK → **REPLACE ECM**

NG

3	CHECK HARNESS AND CONNECTOR (ECM - EFI FUSE, EFI FUSE - BATTERY)



(a) Check the harness and the connector between the EFI fuse and ECM.
  (1) Remove the EFI fuse from the engine room R/B.
  (2) Disconnect the E8 ECM connector.
  (3) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
EFI fuse (2) - BATT (E8-3)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
EFI fuse (2) or BATT (E8-3) - Body ground	10 kΩ or higher

  (4) Reconnect the ECM connector.
  (5) Reinstall the EFI fuse.

(b) Check the harness and the connector between the EFI fuse and battery.
  (1) Remove the EFI fuse from the engine room R/B.
  (2) Disconnect the positive battery terminal.
  (3) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
Battery positive terminal - EFI fuse (1)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
Battery positive terminal or EFI fuse (1) - Body ground	10 kΩ or higher

  (4) Reconnect the positive battery terminal.
  (5) Reinstall the EFI fuse.

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 ASSEMBLY

DTC	P0604	Internal Control Module Random Access Memory (RAM) Error

DTC	P0606	ECM / PCM Processor

DTC	P0607	Control Module Performance

DTC	P0657	Actuator Supply Voltage Circuit / Open

MONITOR DESCRIPTION

ES

The ECM continuously monitors its own internal memory status, internal circuits, and output signals transmitted to the throttle actuator. This self-check ensures that the ECM is functioning properly. If any malfunction is detected, the ECM sets the appropriate DTC and illuminates the MIL.
The ECM memory status is diagnosed by internal mirroring of the main CPU and the sub CPU to detect Random Access Memory (RAM) errors. The two CPUs also perform continuous mutual monitoring. The ECM illuminates the MIL and sets a DTC if: 1) outputs from the two CPUs are different or deviate from the standards, 2) the signals sent to the throttle actuator deviate from the standards, 3) a malfunction is found in the throttle actuator supply voltage, and 4) any other ECM malfunction is found.

DTC No.	DTC Detection Conditions	Trouble Areas
P0604 P0606 P0607 P0657	ECM internal error (1 trip detection logic)	ECM

MONITOR STRATEGY

Related DTCs	P0604: ECM RAM error P0606: ECM range check P0607: ECM CPU malfunction P0657: ETCS power supply
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	P0604: Conditions met for 6 times P0606: 1 second P0607 and P0657: Within 1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

ECM RAM errors (P0604):

RAM mirror check	Fail

ECM CPU range check (P0606):

Either of following conditions met:	-
Difference between throttle valve position of main CPU and throttle valve position of sub CPU	0.3 V or more

Difference between accelerator pedal position of main CPU and accelerator pedal position of sub CPU	0.3 V or more

ECM CPU malfunction (P0607):

CPU reset	Occurred

Electronic throttle control system power supply function of ECM malfunctions (P0657):

ETCS (Electronic Throttle Control System) power supply when ignition switch turned to ON	7 V or more

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

ES

1	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0604, P0606, P0607 OR P0657)**

Result

Display (DTC output)	Proceed To
P0604 or P0606 or P0607 or P0657	A
P0604 or P0606 or P0607 or P0657 and other DTCs	B

B → **GO TO DTC CHART**

A → **REPLACE ECM**

DTC	P0617	Starter Relay Circuit High

DESCRIPTION

While the engine is being 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 Conditions	Trouble Areas
P0617	When conditions (a), (b) and (c) met, positive (+B) battery voltage 10.5 V or more applied to ECM for 20 seconds (1 trip detection logic): (a) Vehicle speed more than 12.4 mph (20 km/h) (b) Engine speed more than 1,000 rpm (c) STA signal ON	• Park/Neutral Position (PNP) switch (A/T*) • Clutch start switch (M/T*) • Starter relay circuit • Ignition switch • ECM

ES

*: 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

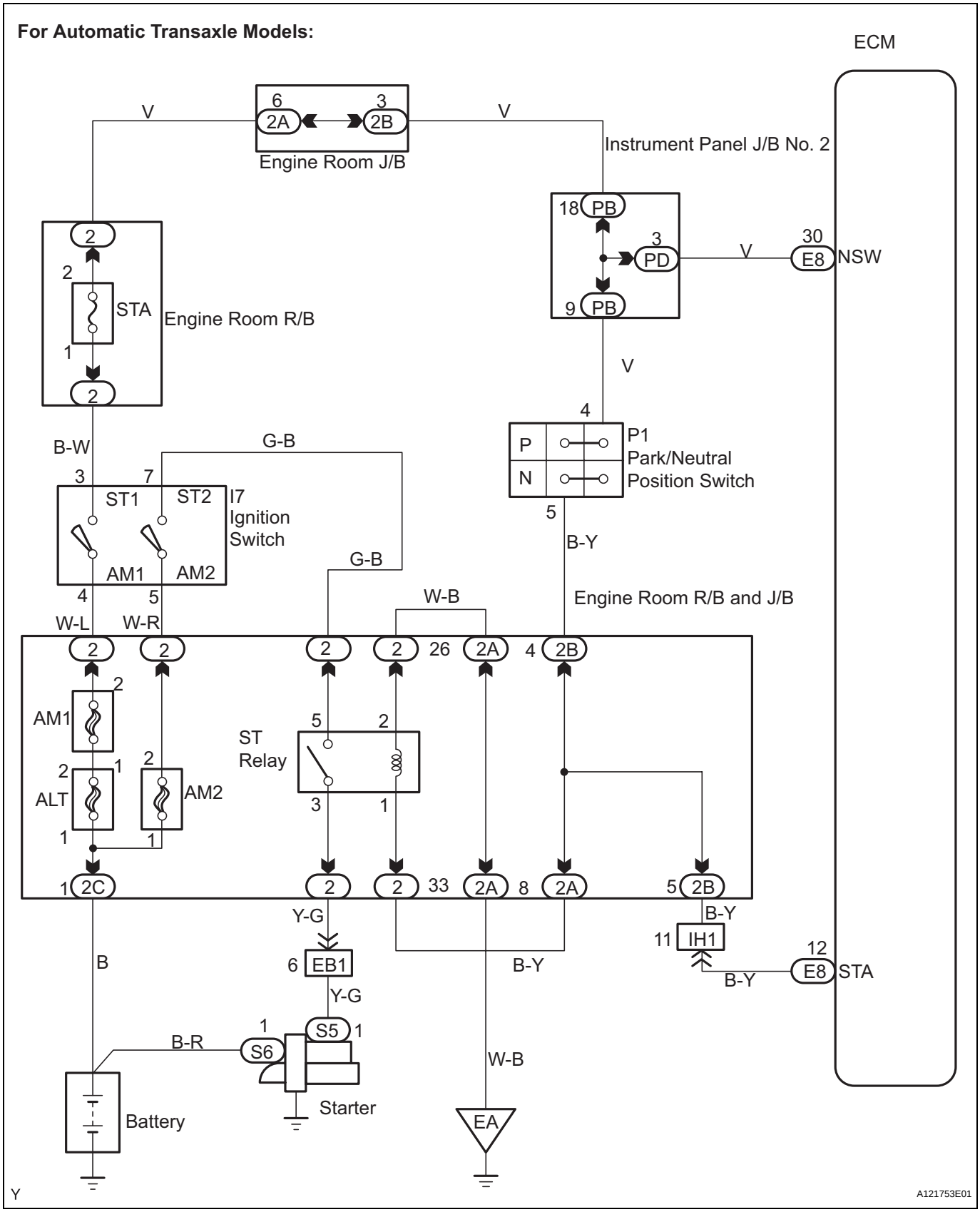
Monitor runs whenever following DTCs not present	None
Battery voltage	10.5 V or more
Vehicle speed	12.4 mph (20 km/h) or more
Engine speed	1,000 rpm or more

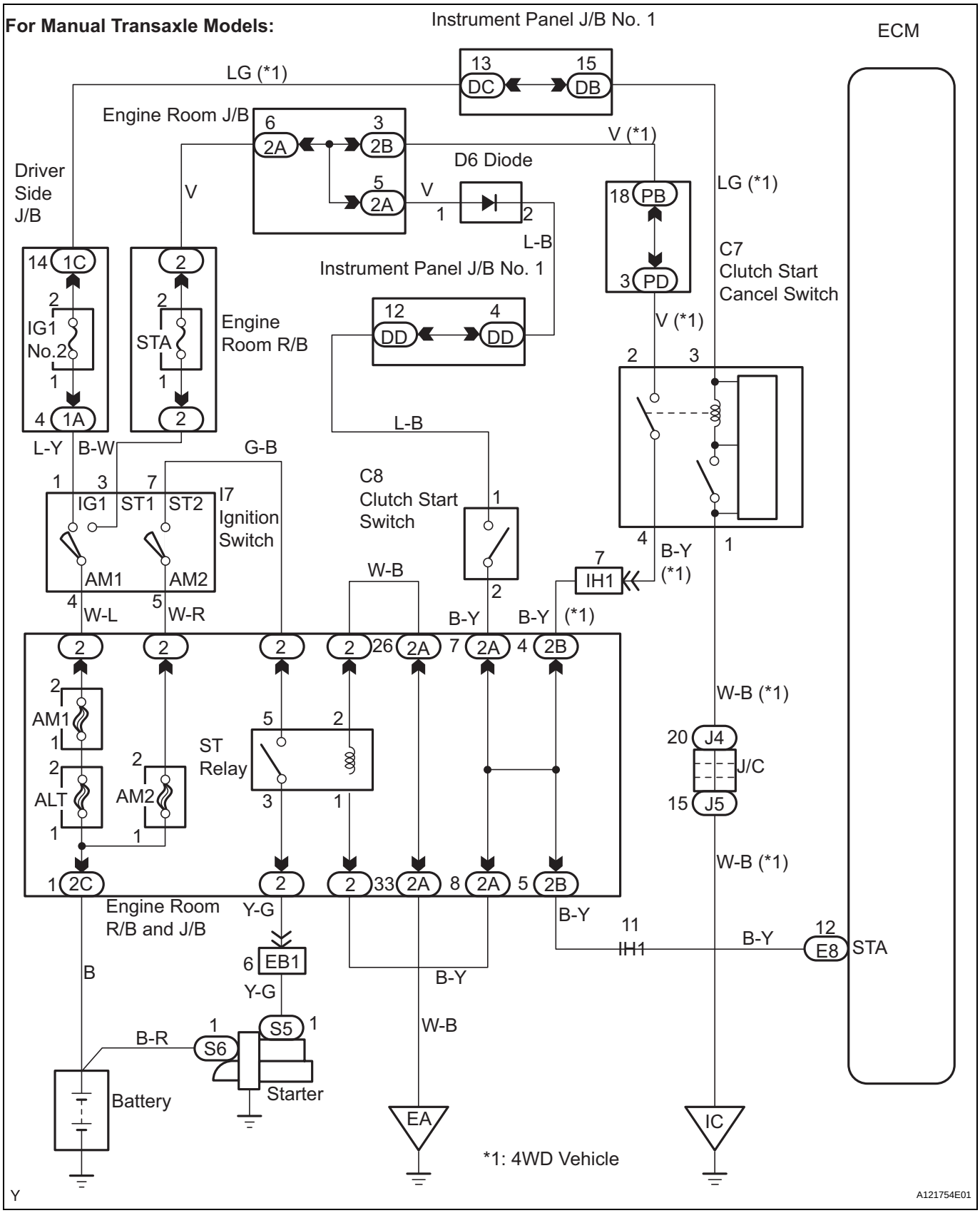
TYPICAL MALFUNCTION THRESHOLDS

Starter signal	ON

WIRING DIAGRAM

For Automatic Transaxle Models:





HINT:

- The following troubleshooting flowchart is based on the premise that the engine is cranked normally. If the engine will not crank, proceed to the problem symptoms table (See page ES-29).

- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1 READ DATA LIST (STARTER SIGNAL)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / STARTER SIG.
(d) Check the value displayed on the tester when the ignition switch is turned to the ON and START positions.

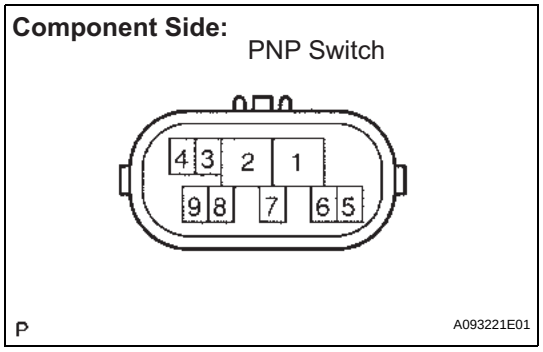
Result

Ignition Switch Positions	STARTER SIG
ON	OFF
START	ON

OK → REPLACE ECM

NG

2 INSPECT PARK / NEUTRAL POSITION SWITCH OR CLUTCH START SWITCH ASSEMBLY

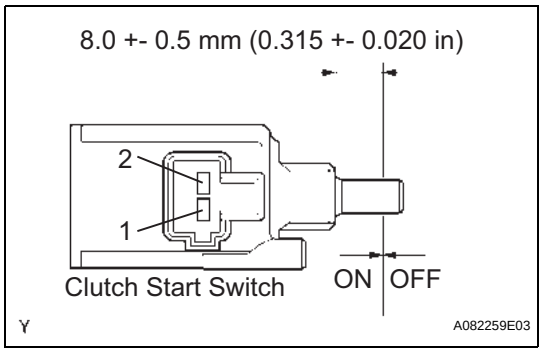


(a) Inspect the Park/Neutral Position (PNP) switch (for A/T models).
(1) Disconnect the P1 PNP switch connector.
(2) Check the resistance when the transmission gear selector lever is moved to each position.

Standard Resistance

Gear Selector Lever Positions	Tester Connections	Specified Conditions
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

(3) Reconnect the PNP switch connector.



(b) Inspect the clutch start switch (for M/T models).
(1) Disconnect the C8 clutch start switch connector.
(2) Check the resistance when the clutch start switch is ON and OFF.

Standard Resistance

Ignition Switch Positions	Tester Connections	Specified Conditions
ON (pushed)	1 - 2	Below 1 Ω
OFF (free)	1 - 2	10 kΩ or higher

(3) Reconnect the clutch start switch connector.

NG → REPLACE PARK / NEUTRAL POSITION SWITCH OR CLUTCH START SWITCH ASSEMBLY (GO TO STEP 3 AFTER REPLACEMENT)

OK

3 READ DATA LIST (STARTER SIGNAL)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / STARTER SIG.
(d) Check the value displayed on the tester when the ignition switch is turned to the ON and START positions.

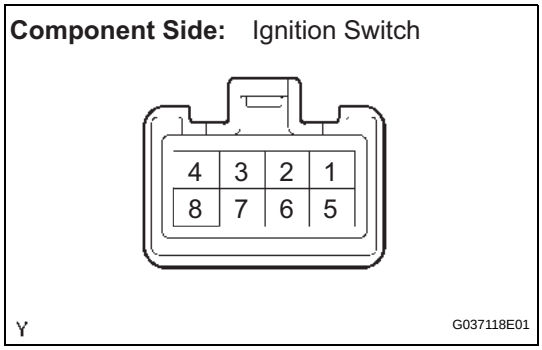
Result

Ignition Switch Positions	STARTER SIG
ON	OFF
START	ON

OK → SYSTEM OK

NG

4 INSPECT IGNITION OR STARTER SWITCH ASSEMBLY



(a) Disconnect the I7 ignition switch connector.
(b) Check the resistance.

Standard Resistance

Ignition Switch Positions	Tester Connections	Specified Conditions
LOCK	All Terminals	10 kΩ or higher
ACC	2-4	Below 1 Ω
ON	1-4, 1-6, 2-4, 3-4, 5-6	Below 1 Ω
START	1-4, 3-4, 5-6, 5-7	Below 1 Ω

(c) Reconnect the ignition switch connector.

NG → REPLACE IGNITION OR STARTER SWITCH ASSEMBLY (GO TO STEP 5 AFTER REPLACEMENT)

OK

5	READ DATA LIST (STARTER SIGNAL)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / 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 Positions	STARTER SIG
ON	OFF
START	ON

OK → **SYSTEM OK**

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

DTC	P0630	VIN not Programmed or Mismatch - ECM / PCM

DESCRIPTION

DTC P0630 is set when the Vehicle Identification Number (VIN) is not stored in the Engine Control Module (ECM) or the input VIN is not accurate. Input the VIN with the intelligent tester.

DTC No.	DTC Detection Conditions	Trouble Areas
P0630	• VIN not stored in ECM • Input VIN in ECM not accurate	ECM

MONITOR STRATEGY

Related DTCs	P0630: VIN not programmed
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	Conditions met 5 times
MIL Operation	Immediate
Sequence of Operation	None

ES

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

1	READ OUTPUT DTC (CURRENT DTC)

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

Result

Display (DTC Output)	Proceed To
P0630	**A**
P0630 and other DTCs	**B**

If any DTCs other than P0630 are output, troubleshoot those DTCs first.

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.

B	GO TO DTC CHART

A

2	INPUT VIN WITH INTELLIGENT TESTER

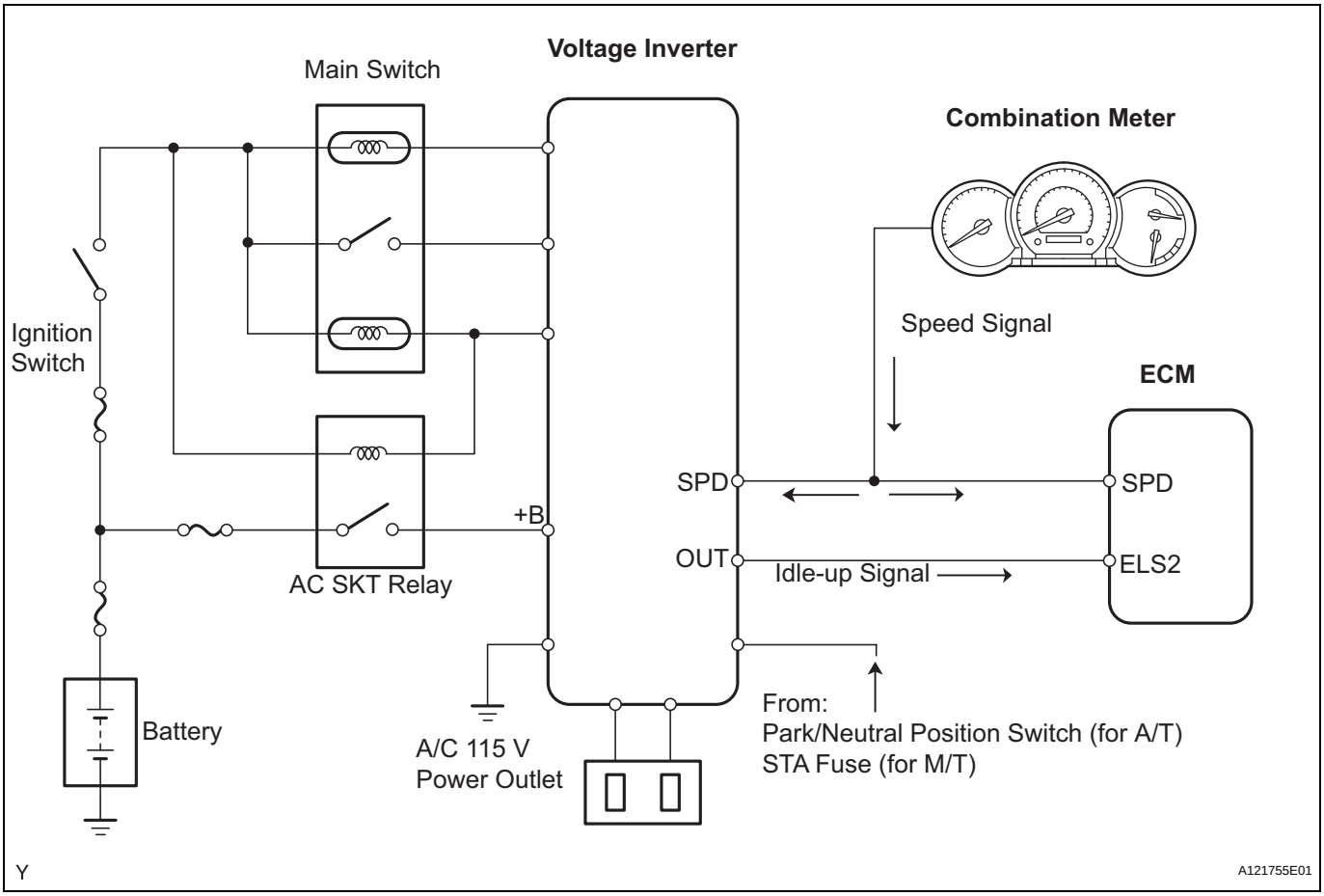
NEXT

END

DTC	P1500	AC Inverter Malfunction

DESCRIPTION

This vehicle is equipped with a voltage inverter, which supplies power to various electrical appliances. When the main switch of the voltage inverter is turned ON, the inverter relay turns ON, and the inverter then converts the 12 V Direct Current (DC) of the battery into an 115 V Alternating Current (AC). The voltage inverter can output a maximum of 400W from an outlet.
When the AC 115 V is output, a load is applied to the engine. The ECM controls the engine idling speed according to the vehicle speed and engine load. A speed signal is input to the inverter and an idle-up signal is transmitted to the ECM.



DTC No.	DTC Detection Conditions	Trouble Areas
P1500	While vehicle running, idling-up signal input into ECM for 10 seconds	• Open in speed signal circuit • Short between idle-up signal and +B circuits • Voltage inverter • ECM

MONITOR DESCRIPTION

While the engine is idling, the ECM performs idle up according to the power supply of the inverter to stabilize the engine idling speed.
When the vehicle is stationary and the inverter input exceeds 8.3 A, the inverter sends an idle-up signal from the OUT terminal of the inverter to the ELS2 terminal of the ECM.
If the idle-up signal is input into the ECM for 10 seconds while the vehicle is running, the ECM interprets this as a malfunction in the inverter circuit and sets the DTC.

MONITOR STRATEGY

Related DTCs	P1500: Voltage inverter performance
Required Sensors/Components (Main)	Voltage inverter
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

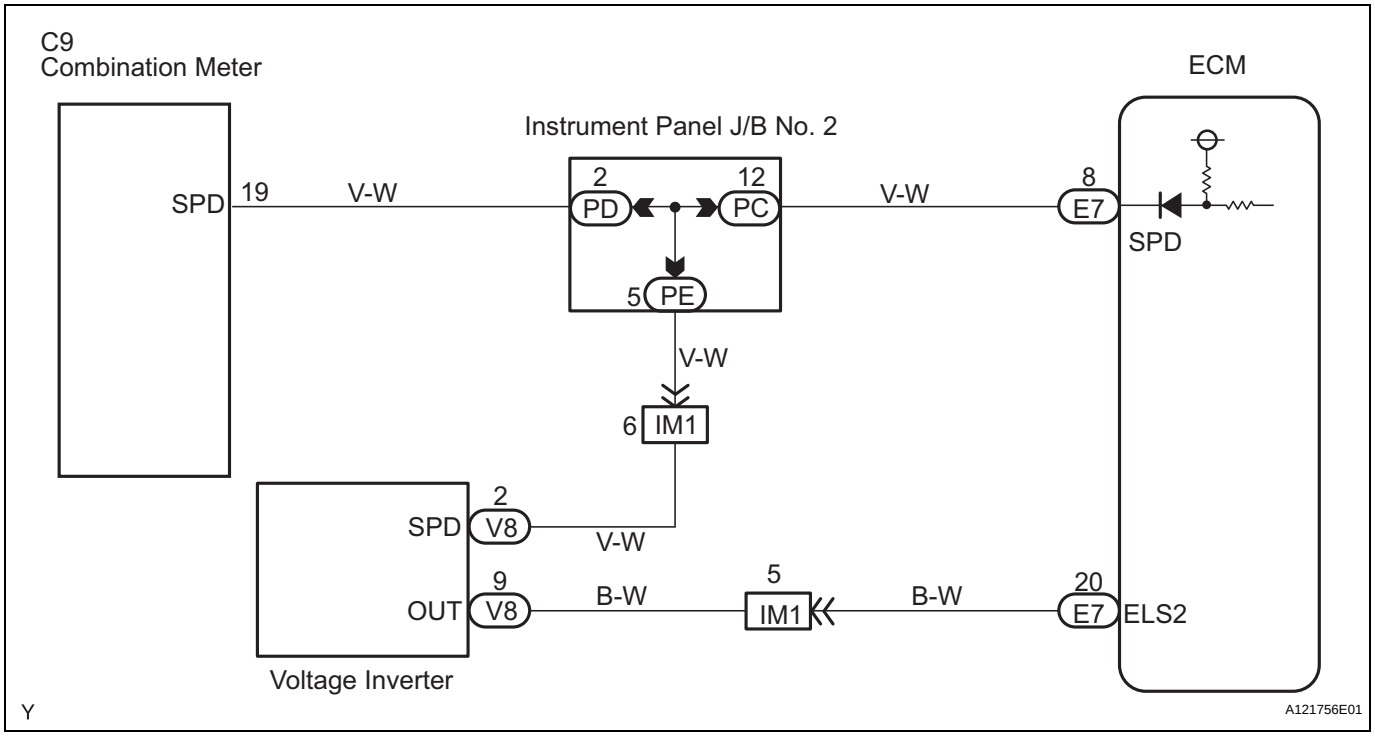
TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Vehicle speed	3.11 mph (5 km/h) or more
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

Electric load signal 2	ON

WIRING DIAGRAM



Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P1500)

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

Result

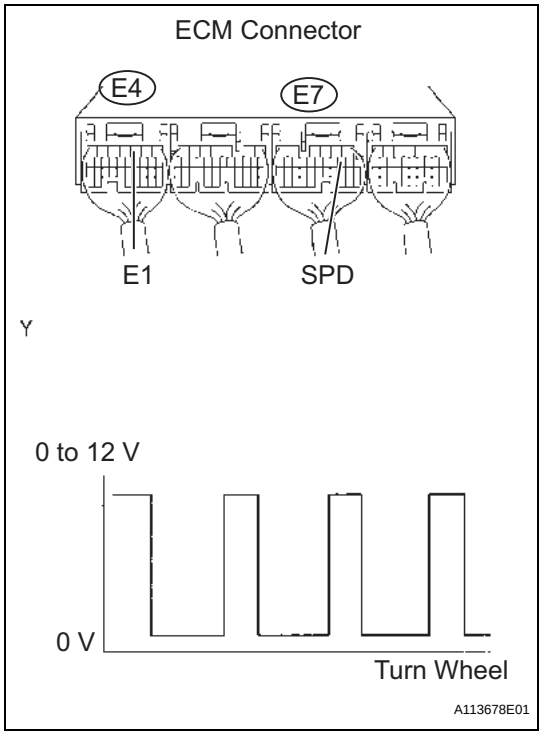
Display (DTC output)	Proceed To
P1500	A
P1500 and other DTCs.	B

If any DTCs other than P1500 are output, troubleshoot those DTCs first.

B → **GO TO DTC CHART**

A

2	INSPECT VOLTAGE INVERTER ASSEMBLY (SPD SIGNAL)



(a) Shift the transmission gear selector lever to the neutral position.
(b) Jack up the vehicle.
(c) Turn the ignition switch to ON.
(d) Check the voltage between the terminals of the ECM connectors as the wheel is turned slowly.

Standard Voltage

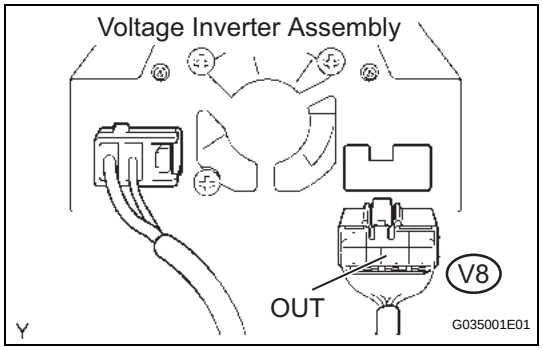
Tester Connections	Specified Conditions
SPD (E7--8) - E1 (E4-3)	Voltage generated intermittently

HINT:
The output voltage should fluctuate up and down similarly to the diagram on the left when the wheel is turned slowly.

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

OK

3 **INSPECT ECM (ELS VOLTAGE)**



(a) Disconnect the V8 inverter connector.
(b) Start the engine.
(c) Measure the voltage between the OUT terminal of inverter and the body ground.
Standard Voltage

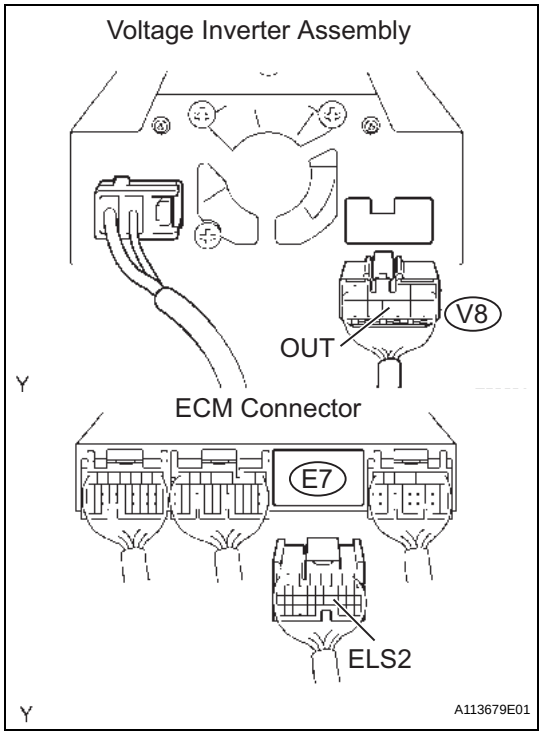
Tester Connections	Specified Conditions
OUT (V8-9) - Body ground	1 V or less

(d) Reconnect the inverter connector.

OK → **REPLACE VOLTAGE INVERTER ASSEMBLY**

NG

4 **CHECK HARNESS AND CONNECTOR (ECM - INVERTER, INVERTER - POWER SOURCE)**



(a) Disconnect the V8 inverter connector.
(b) Disconnect the E7 ECM connector.
(c) Turn the ignition to ON.
(d) Measure the voltage between the terminals of the wire harness and body ground.
Standard Voltage (Check for short in idling up signal circuit)

Tester Connections	Specified Conditions
OUT (V8-9) or ELS2 (E7-20) - Body ground	1 V or less

(e) Reconnect the inverter connector and the ECM connector.

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

OK

REPLACE ECM

ES

DTC	P1613	Secondary Air Injection Driver Malfunction

DESCRIPTION

Refer to DTC P0412 (See page ES-189).

DTC No.	DTC Detection Conditions	Trouble Areas
P1613	Either of following conditions (1) or (2) met (1) All of following conditions met (1 trip detection logic): • Either of air pump or air switching valve not operating • Diagnostic signal from Air Injection Control Driver (AID) 80 % • Battery voltage 8 V or more (2) Both of following conditions met (1 trip detection logic): • Battery voltage 8 V or more • Diagnostic signal from AID abnormal (duty signal other than 0, 20, 40, 80 and 100 %)	• AID • Open in AID ground circuit
P1613	All of following conditions met (1 trip detection logic): (a) Air injection system operating (Air Switching Valve [ASV] ON and air pump ON) (b) Diagnostic signal from Air Injection Control Driver (AID) 0 % (c) Battery voltage 8 V or more	• Short in diagnostic information signal circuit (AID - ECM) • Open or short in air pump and air switching valve command signal circuit (AID - ECM) • Open in AID ground circuit • AID • ECM
P1613	Both of following conditions met (1 trip detection logic): (a) Battery voltage 8 V or more (b) Diagnostic signal from Air Injection Control Driver (AID) 100 %	• Open or short in AID power source circuit • Open in diagnostic information signal circuit (AID - ECM) • AID • ECM

MONITOR DESCRIPTION

For a short time after cold engine starts, the ECM transmits command signals to the Air Injection Control Driver (AID) to drive the air pump and the Air Switching Valve (ASV). The AID detects open and short circuits according to the voltages at the AID terminals to the air pump and ASV, and the circuit voltage of the AID power source, and transmits diagnostic information as a signal to the ECM.
If the Secondary Air Injection (AIR) system circuit or the AID itself malfunctions, the AID sends a malfunction signal (duty signal) as diagnostic information to the ECM (when the system is normal, a system normal signal is sent). The ECM sets the DTC based on the diagnostic information from the AID.
EXAMPLE:

1. The duty ratio of the diagnostic signal from the AID is 0 or 100 % (remains at 0 V or the same as battery voltage).
2. The duty ratio of the diagnostic signal from the AID shows an impossible ratio (other than 0, 20, 40, 80 and 100 %).
3. The AID outputs the normal signal (normal duty signal: 80 %) while the system is not operating.

MONITOR STRATEGY

Related DTCs	P1613: Secondary air injection system air injection control driver circuit range check
Required Sensors/Components (Main)	Air injection control driver
Required Sensors/Components (Related)	Air switching valve
Frequency of Operation	Once per drive cycle
Duration	3 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Case 1 and 4:

Monitor runs whenever following DTCs not present	None
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

Case 2:

Monitor runs whenever following DTCs not present	None
Either a or b met:	-
a. Air pump	Not operating
b. Air switching valve	Not operating
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

Case 3:

Monitor runs whenever following DTCs not present	None
Following conditions (a) and (b) met	-
a. Air pump	Operating
b. Air switching valve	Operating
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

Case 1:

One of following conditions met:	A, B, C or D
A. Diagnostic signal duty ratio from air injection control driver	1 % or more, and 10 % or less
B. Diagnostic signal duty ratio from air injection control driver	30 %
C. Diagnostic signal duty ratio from air injection control driver	49 %
D. Diagnostic signal duty ratio from air injection control driver	91 % or more, and 99 % or less

Case 2:

Diagnostic signal duty ratio from air injection control driver	70 % or more, and 90 % or less

Case 3:

Diagnostic signal duty ratio from air injection control driver	0 %

Case 4:

Diagnostic signal duty ratio from air injection control driver	100 %

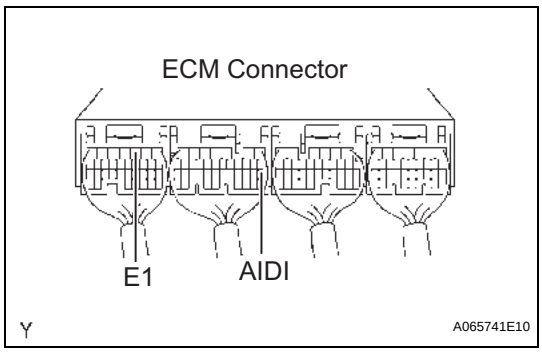
COMPONENT OPERATING RANGE

Diagnostic signal duty ratio from air injection control driver	70 % or more, and 90 % or less when secondary air injection system operating. 0 % when secondary air injection system not operating.

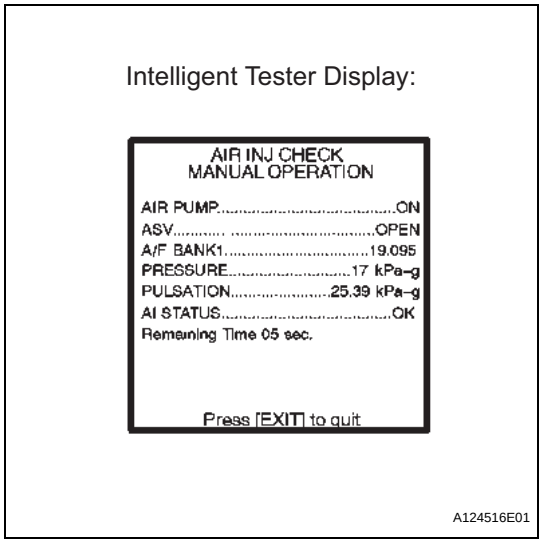
WIRING DIAGRAM

Refer to DTC P0412 (See page ES-192).

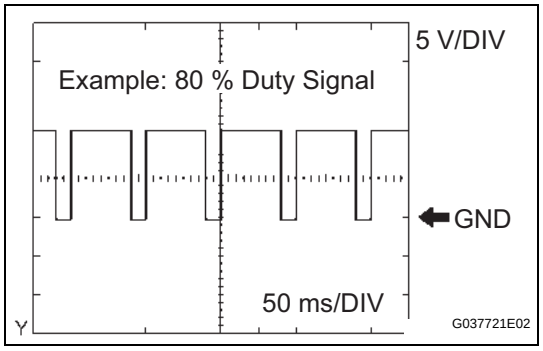
HINT:
Diagnostic information output by the AID can be confirmed by connecting an oscilloscope to the diagnostic information terminal of the AID. Reading the waveform while performing the AIR system intrusive operation provided in the SYSTEM CHECK function, allows the possible trouble areas to be narrowed down.
(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect an intelligent tester to the DLC3.



(d) Connect oscilloscope probes to the AIDI and E1 terminals of the ECM.
(e) Turn the ignition switch to ON and turn the tester ON.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV: OPEN and AP: OFF, ASV CLOSE.
HINT:
When MANUAL OPERATION is selected, the tester initialization (atmospheric pressure measurement) is performed automatically. The initialization takes 10 seconds. After the initialization, AP and ASV operation can be selected.
(g) Start the engine.
(h) Perform the AIR system intrusive operation while the engine is idling.



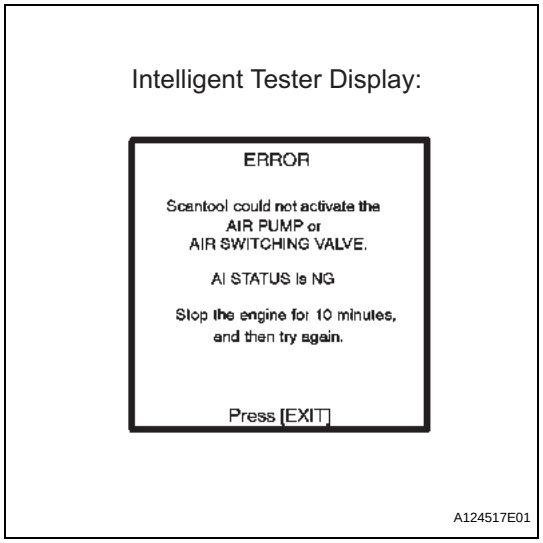
(i) Monitor the AID voltage output (duty ratio signal).



Oscilloscope range

Items	Contents
Terminals	CH1: AIDI - E1
Equipment Settings	5 V/Division, 20 to 50 ms/Division
Conditions	Idling

(j) Turn the ignition switch to OFF.

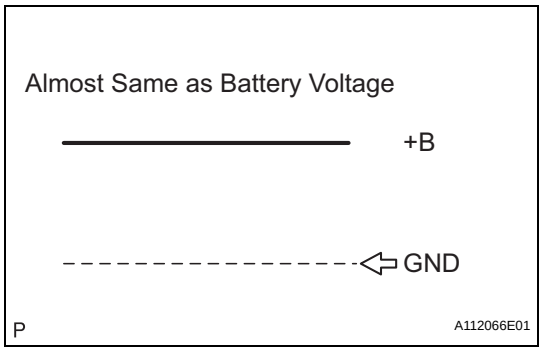


NOTICE:

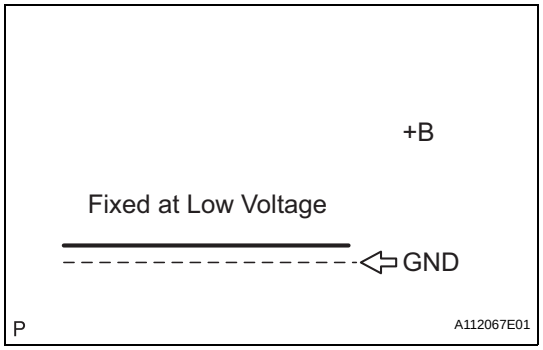
- **This AIR INJECTION CHECK only allows technicians to operate the AIR system for a maximum of 5 seconds. Furthermore, the check can only be performed up to 4 times per trip. If the test is repeated, intervals of at least 30 seconds are required between checks. While AIR system operation using the intelligent tester is prohibited, the tester display indicates the prohibition (WAIT or ERROR).**
  If an ERROR as shown in the illustration is displayed on the tester during the test, stop the engine for 10 minutes, and then try again.
- **Performing the AIR INJ CHECK repetitively may cause damage to the AIR system. If necessary, leave an interval of several minutes between SYSTEM CHECK operations to prevent the system from overheating.**
- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

AID Diagnostic Signal Waveforms	ECM Commands	DTCs (ECM Output)	Suspected Trouble Areas
100 % Duty Ratio See waveform 1	Any Air Injection (AIR) System operation	P1613	• Open in diagnostic signal circuit • Air Injection Control Driver (AID) • Open in AID+B circuit (AID power source) • Short between +B and diagnostic signal circuits
0 % Duty Ratio See waveform 2	AIR System: ON (Air pump ON, ASV ON)	P1613	• Open or short in air pump or Air Switching Valve (ASV) command signal circuit (ECM-AID) • Open in AID ground circuit • Short between diagnostic signal circuit and body ground • AID • ECM
	AIR System: OFF (Air pump OFF, ASV OFF)	-	Normal
20 % Duty Ratio See waveform 3	Air Pump: ON	P0418	Short between air pump drive circuit and body ground • Harness and connector (AID-Pump) • Air pump • AID • ECM
	Air Pump: OFF	P0418	Open in air pump drive circuit (AID-Pump), or short between air pump drive circuit and +B • Harness and connector (AID-Pump) • Air pump • AID • ECM
40 % Duty Ratio See waveform 4	ASV: ON	P0412	Short between ASV drive circuit and body ground • Harness and connector (AID-ASV) • ASV • AID • ECM
	ASV: OFF	P0412	Open in ASV drive circuit (AID-ASV), or short between ASV drive circuit and +B • Harness and connector (AID-ASV) • AID • ASV • ECM
80 % Duty Ratio See waveform 5	AIR System: OFF (Air pump OFF, ASV OFF)	P1613	• AID • ECM
	AIR System: ON (Air pump ON, ASV ON)	-	Normal
Other than above (other than 0, 20, 40, 80 and 100 % duty)	-	P1613	• AID • Open in AID ground circuit

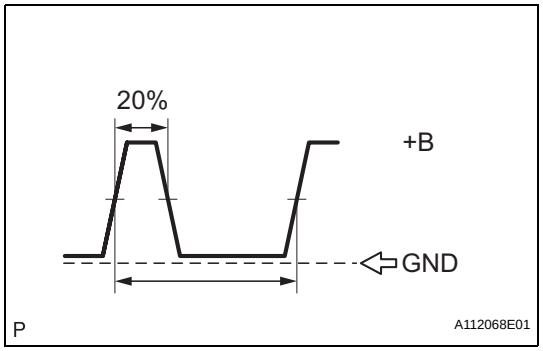
ES



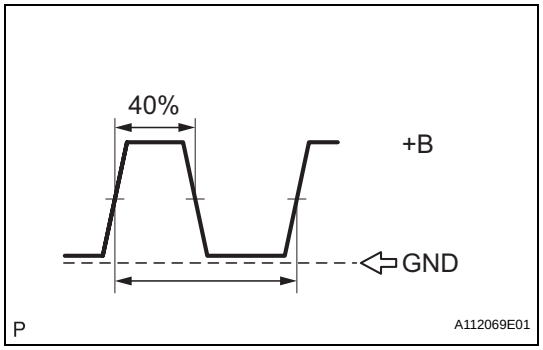
1. Waveform 1
100 % Duty Ratio



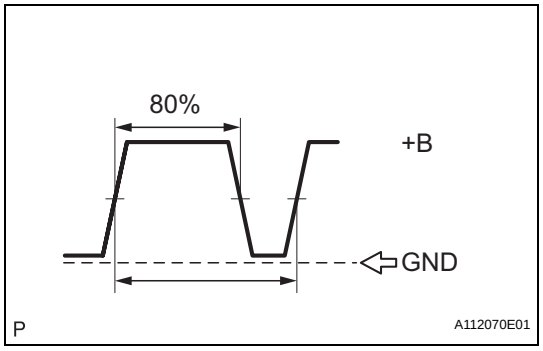
2. Waveform 2
0 % Duty Ratio



3. Waveform 3
20 % Duty Ratio



4. Waveform 4
40 % Duty Ratio



5. Waveform 5
80 % Duty Ratio

ES

HINT:

- By using an intelligent tester to perform the AIR INJ CHECK operation in the SYSTEM CHECK, the air-fuel ratio and the pressure in the secondary air injection system passage can be checked while the secondary air injection system is operating. This helps technicians to troubleshoot the system when it malfunctions.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P1613)

ES

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

Result

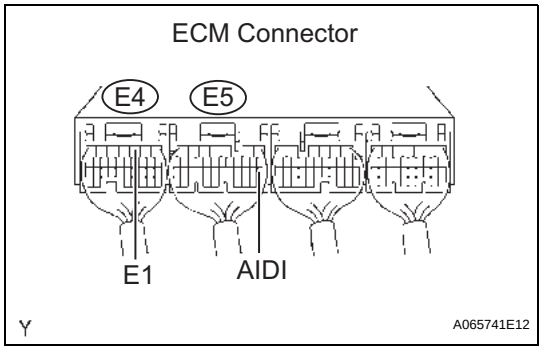
Display (DTC Output)	Proceed To
P1613	A
P1613 and other DTCs	B

If any DTCs other than P1613 are output, troubleshoot those DTCs first.

NG → GO TO DTC CHART

OK

2	PERFORM ACTIVE TEST USING INTELLIGENT TESTER (AIDI VOLTAGE)



(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Select the following menu items:
DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV: OPEN and AP: OFF, ASV CLOSE.
HINT:
When MANUAL OPERATION is selected, the tester initialization (atmospheric pressure measurement) is performed automatically. The initialization takes 10 seconds. After the initialization, AP and ASV operation can be selected.
(f) Start the engine.
(g) Perform the AIR system intrusive operation while the engine is idling.
(h) Measure the voltage between the AIDI and E1 terminals of the ECM connector when the AIR system is ON and OFF.
(i) Turn the ignition switch to OFF.

NOTICE:

- **Do not perform the SYSTEM CHECK operation repetitively. It may cause the damage in the system. If necessary, leave an interval of several minutes between SYSTEM CHECK operations.**
- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

Result

Results	Suspected Trouble Areas	Proceed To
Fixed at low (1.6 V or less) even when AIR system ON (Air pump ON, ASV OPEN)	• Short between air pump or air switching valve command signal circuit and body ground • Open in air pump command signal circuit (between ECM and AID) • Open in ASV command signal circuit (between ECM and AID) • Open in AID ground circuit (between AID and body ground) • Diagnostic signal circuit ground short • AID • ECM	A
Fixed at high (12 V or more) even when AIR system OFF (Air pump OFF, ASV CLOSE)	• Open in diagnostic signal circuit (ECM - AID) • Short between +B and diagnostic signal circuits (ECM - AID) • Open in AID power source circuit • AID • ECM	B
Other than above: Fluctuating (duty signal other than 20, 40 and 80 %)	• AID • Open in AID ground circuit (between AID and body ground)	C

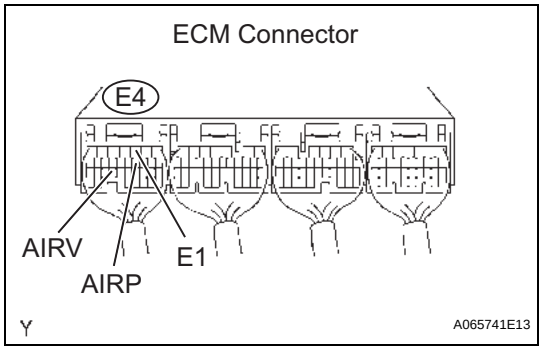
ES

B → **Go to step 5**

C → **Go to step 8**

A

3 INSPECT ECM (AIRP AND AIRV VOLTAGE)



(a) Turn the ignition switch to ON.

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

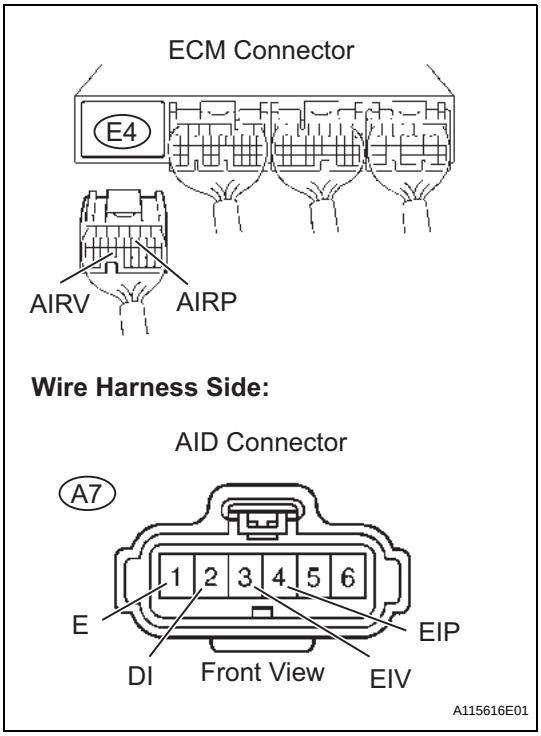
Standard Voltage

Tester Connections	Specified Conditions
AIRP (E4-11) - E1 (E4-3)	9 to 14 V (near battery voltage)
AIRV (E4-24) - E1 (E4-3)	9 to 14 V (near battery voltage)

OK → **REPLACE ECM**

NG

4	CHECK HARNESS AND CONNECTOR (ECM - AID, AID - BODY GROUND)



(a) Check for short in harness and connectors between the ECM and AID.
  (1) Disconnect the E4 ECM connector.
  (2) Disconnect the A7 AID connector.
  (3) Check the resistance.
  Standard Resistance (check for short)

Tester Connections	Specified Conditions
AIRP (E4-11) or EIP (A7-4) - Body ground	10 kΩ or higher
AIRV (E4-24) or EIV (A7-3) - Body ground	10 kΩ or higher

  (4) Reconnect the ECM connector and the AID connector.

(b) Check for open in harness and connector between the AID and body ground.
  (1) Disconnect the A7 AID connector.
  (2) Check the resistance.
  Standard Resistance (check for open)

Tester Connections	Specified Conditions
E (A7-1) - Body ground	Below 1 Ω

  (3) Reconnect the AID connector.

(c) Check for short in harness and connector between the diagnostic signal circuit and body ground.
  (1) Disconnect the A7 AID connector.
  (2) Turn the ignition switch to ON.
  (3) Measure the voltage between the terminals of the AID connector.
  Standard Voltage (check for short)

Tester Connections	Specified Conditions
DI (A7-2) - E (A7-1)	9 to 14 V (near battery voltage)

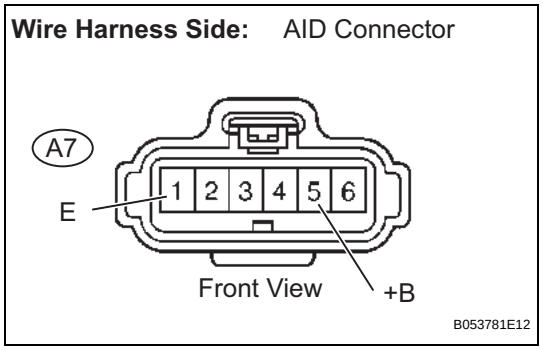
  (4) Reconnect the AID connector.

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

OK

REPLACE AIR INJECTION CONTROL DRIVER

5 CHECK AIR INJECTION CONTROL DRIVER POWER SOURCE CIRCUIT



(a) Disconnect the A7 AID connector.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between the terminal of the AID and the body ground.
Standard Voltage

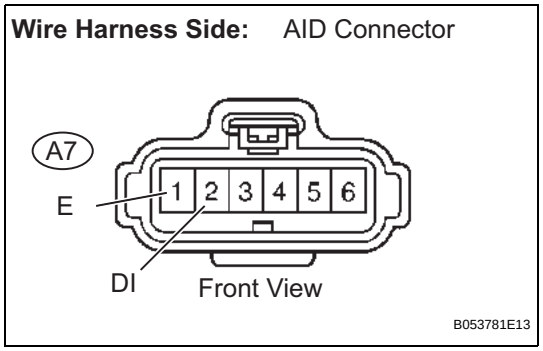
Tester Connections	Specified Conditions
+B (A7-5) - Body ground	9 to 14 V (near battery voltage)

(d) Reconnect the AID connector.

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

OK

6 INSPECT AIR INJECTION CONTROL DRIVER (DI TERMINAL VOLTAGE)



(a) Disconnect the A7 AID connector.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between the terminals of the AID connector.
Standard Voltage

Tester Connections	Specified Conditions
DI (A7-2) - E (A7-1)	9 to 14 V (near battery voltage)

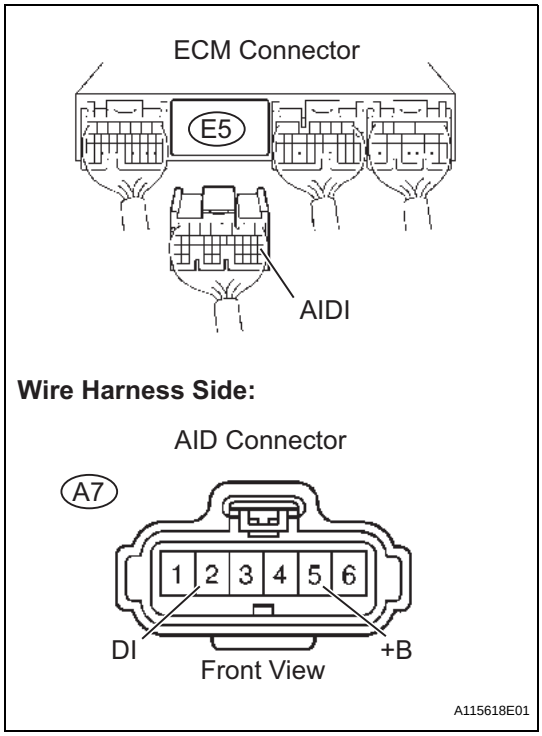
(d) Reconnect the AID connector.

OK → **REPLACE AIR INJECTION CONTROL DRIVER**

NG

ES

7	CHECK HARNESS AND CONNECTOR (ECM - AID)



(a) Disconnect the E5 ECM connector.
(b) Disconnect the A7 AID connector.
(c) Check the resistance.

Standard Resistance (check for open)

Tester Connections	Specified Conditions
DI (A7-2) - AIDI (E5-20)	Below 1 Ω

Standard Resistance (check for short)

Tester Connections	Specified Conditions
DI (A7-2) or AIDI (E5-20) - +B (A7-5)	10 kΩ or higher

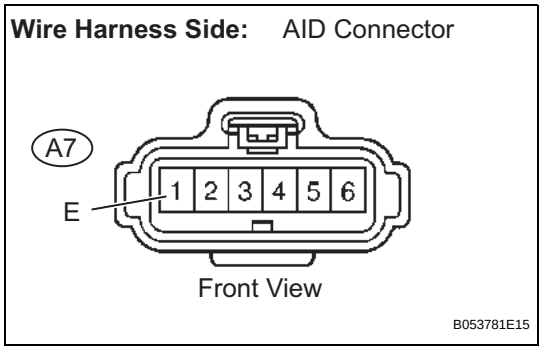
(d) Reconnect the ECM and AID connector.

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

OK

REPLACE ECM

8	CHECK HARNESS OR CONNECTOR (AID - BODY GROUND)



(a) Disconnect the A7 AID connector.
(b) Check the resistance.

Standard Resistance (check for open)

Tester Connections	Specified Conditions
E (A7-1) - Body ground	Below 1 Ω

(c) Reconnect the AID connector.

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

OK

9	REPLACE AIR INJECTION CONTROL DRIVER

NEXT

10	CHECK WHETHER DTC OUTPUT RECURS (SYSTEM CHECK AUTOMATIC OPERATION)

(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Clear DTCs (where set) (see page ES-40).
(f) Select the following menu items:
DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / AUTOMATIC OPERATION.
(g) Start the engine after the tester initialization is finished.
(h) Perform the SYSTEM CHECK operation by pressing ENTER.
(i) After operating the AIR system, press the ENTER button to confirm the AIR system pending codes.
(j) Check PENDING DTCs.
(k) Turn the ignition switch to OFF.

OK:

No pending DTC output.

NOTICE:

- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

ES

NEXT

END

DTC	P2102	Throttle Actuator Control Motor Circuit Low

DTC	P2103	Throttle Actuator Control Motor Circuit High

DESCRIPTION

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

HINT:

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

DTC No.	DTC Detection Conditions	Trouble Areas
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 following conditions met: • Hybrid IC diagnosis signal fail • Hybrid IC current limiter port fail	• 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.

FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6.5° 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 to OFF.

MONITOR STRATEGY

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

MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

P2102:

Duty ratio to open throttle actuator	80 % or more
Throttle actuator power supply	8 V or more

P2103:

Throttle actuator power supply	8 V or more

TYPICAL MALFUNCTION THRESHOLDS

ES

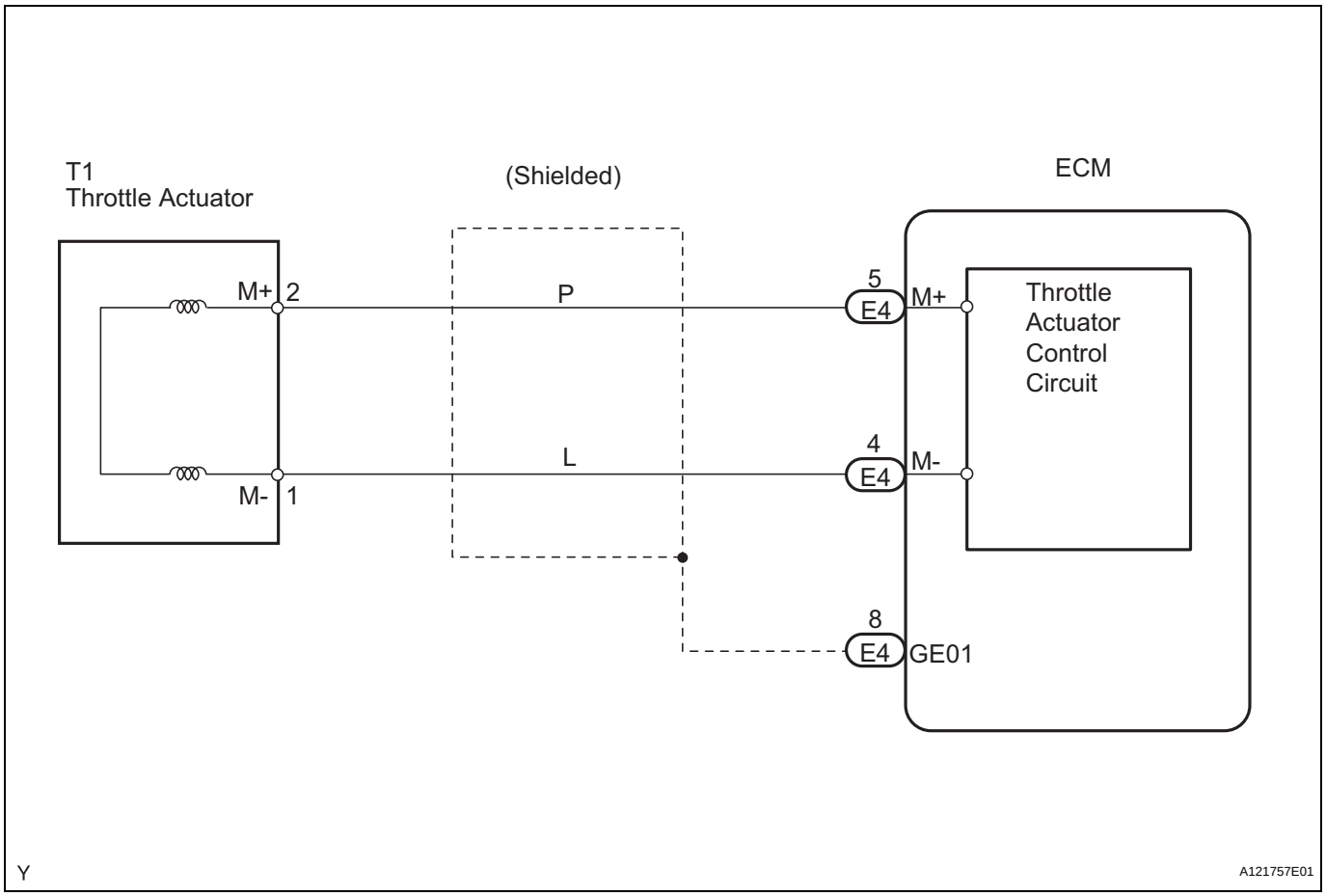
P2102:

Throttle actuator current	Less than 0.5 A

P2103:

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

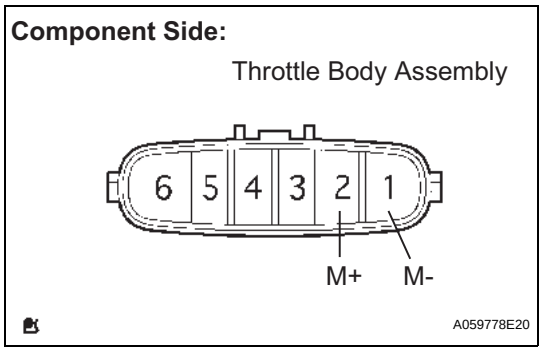
WIRING DIAGRAM



HINT:

- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.
- The throttle actuator current (THROTTLE MOT) and the throttle actuator duty ratio (THROTTLE OPN / THROTTLE CLS) can be read using an intelligent tester. However the ECM shuts off the throttle actuator current when the ETCS malfunctions.

1 INSPECT THROTTLE BODY ASSEMBLY (THROTTLE ACTUATOR RESISTANCE)



(a) Disconnect the T1 throttle body connector.
(b) Measure the resistance between the terminals of the throttle body.

Standard Resistance

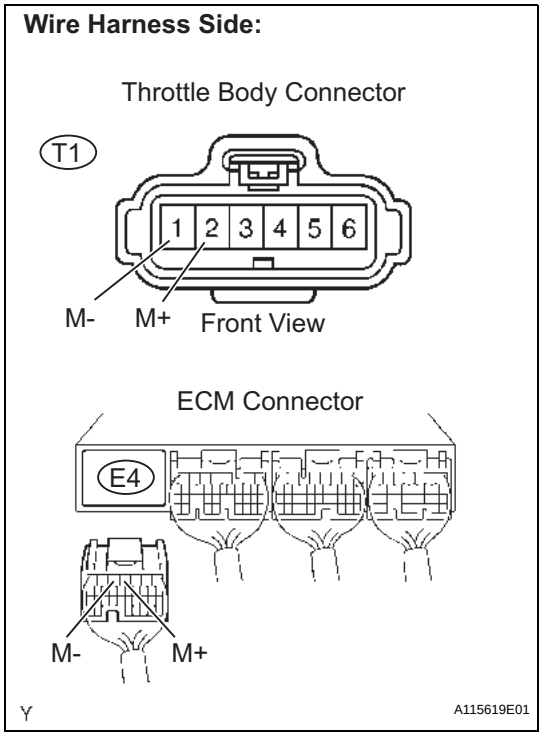
Tester Connections	Specified Conditions
M+ (2) - M- (1)	0.3 to 100 Ω at 20°C (68°F)

(c) Reconnect the throttle body connector.

NG → **REPLACE THROTTLE BODY**

OK

2 CHECK HARNESS AND CONNECTOR (THROTTLE ACTUATOR - ECM)



(a) Disconnect the T1 throttle body connector.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
M+ (T1-2) - M+ (E4-5)	Below 1 Ω
M- (T1-1) - M- (E4-4)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
M+ (T1-2) or M+ (E4-5) - Body ground	10 kΩ or higher
M- (T1-1) or M- (E4-4) - Body ground	10 kΩ or higher

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

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

OK

3	INSPECT THROTTLE BODY

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

DTC No.	DTC Detection Conditions	Trouble Areas
P2111	ECM signals throttle actuator to close, but stuck (1 trip detection logic)	• Throttle actuator circuit • Throttle body assembly • Throttle valve
P2112	ECM signals throttle actuator to open, but stuck (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 following DTCs not present	None

P2111 (Throttle actuator stuck open):

All of following conditions 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 following conditions met	-
System guard*	ON
Throttle actuator current	2 A or more

Throttle actuator open duty-cycle	80 % or more
* System guard set when following conditions 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 either of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6.5° 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 to OFF.

WIRING DIAGRAM

Refer to DTC P2102 (See page ES-287).

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

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

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

Result

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

HINT:
If any 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.

NG → REPLACE THROTTLE BODY ASSEMBLY

ES

OK

3 CHECK WHETHER DTC OUTPUT RECURS (DTC P2111 OR P2112)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the tester ON.
(d) Clear DTCs (see page ES-40).
(e) Start the engine, and fully depress and release the accelerator pedal quickly (to fully open and close the throttle valve).
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Read DTCs.

Result

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

B → REPLACE ECM

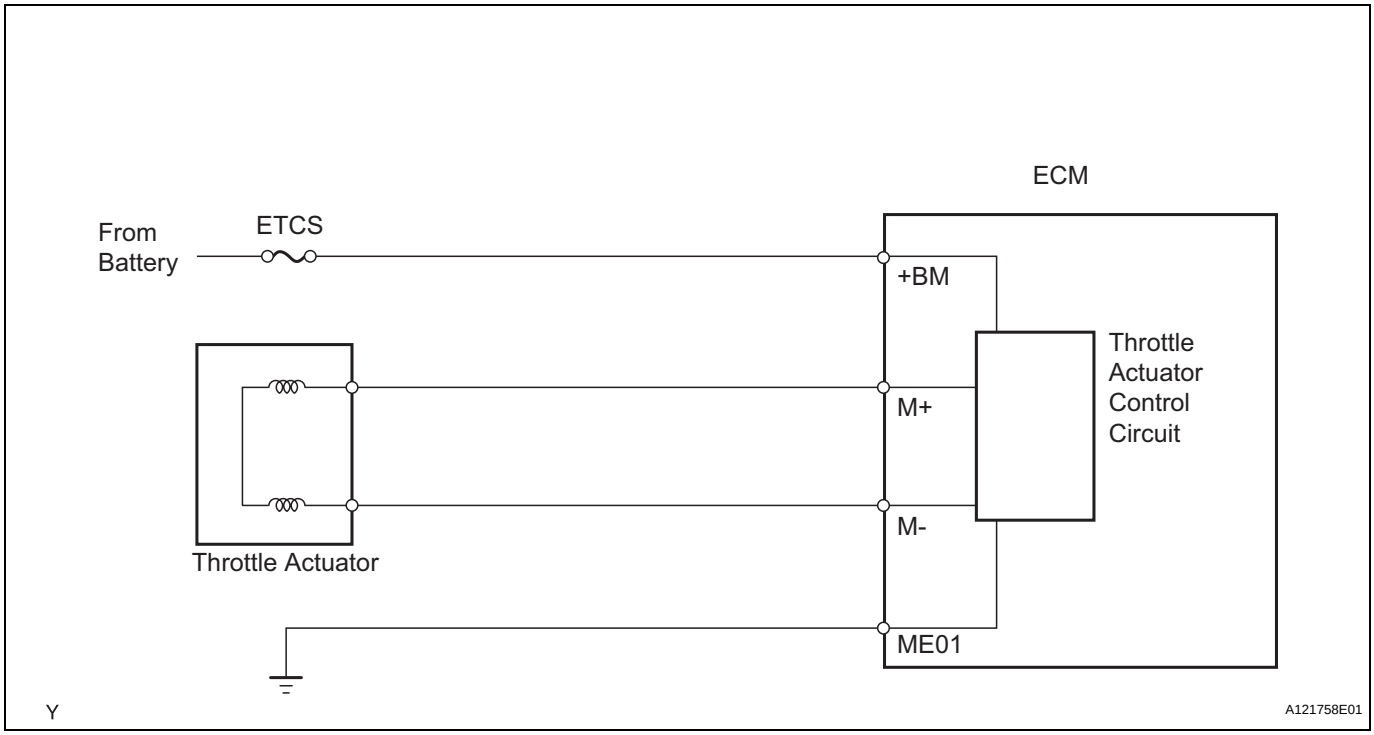
A

CHECK FOR INTERMITTENT PROBLEMS

DTC	P2118	Throttle Actuator Control Motor Current Range / Performance

DESCRIPTION

The ETCS (Electronic Throttle Control System) has a dedicated power supply circuit. The voltage (+BM) is monitored and when it is low (less than 4 V), the ECM determines that there is a malfunction in the ETCS and cuts off the current to the throttle actuator.
When the voltage becomes unstable, the ETCS itself becomes unstable. For this reason, when the voltage is low, the current to the throttle actuator is cut. If repairs are made and the system returns to normal, turn the ignition switch to OFF. The ECM then allows the current to flow to the throttle actuator so that it can be restarted.
HINT:
The ETCS does not use a throttle cable.



DTC No.	DTC Detection Conditions	Trouble Areas
P2118	Open in Electronic Throttle Control System (ETCS) power source (+BM) circuit (1 trip detection logic)	• Open in ETCS power source circuit • ETCS fuse • ECM

MONITOR DESCRIPTION

The ECM monitors the battery supply voltage applied to the throttle actuator.
When the power supply voltage (+BM) drops below 4 V for 0.8 seconds or more, the ECM interprets this as an open in the power supply circuit (+BM). The ECM illuminates the MIL and sets the DTC.
If the malfunction is not repaired successfully, the DTC is set 5 seconds after the engine is next started.

MONITOR STRATEGY

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

MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Battery voltage	More than 8 V

TYPICAL MALFUNCTION THRESHOLDS

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

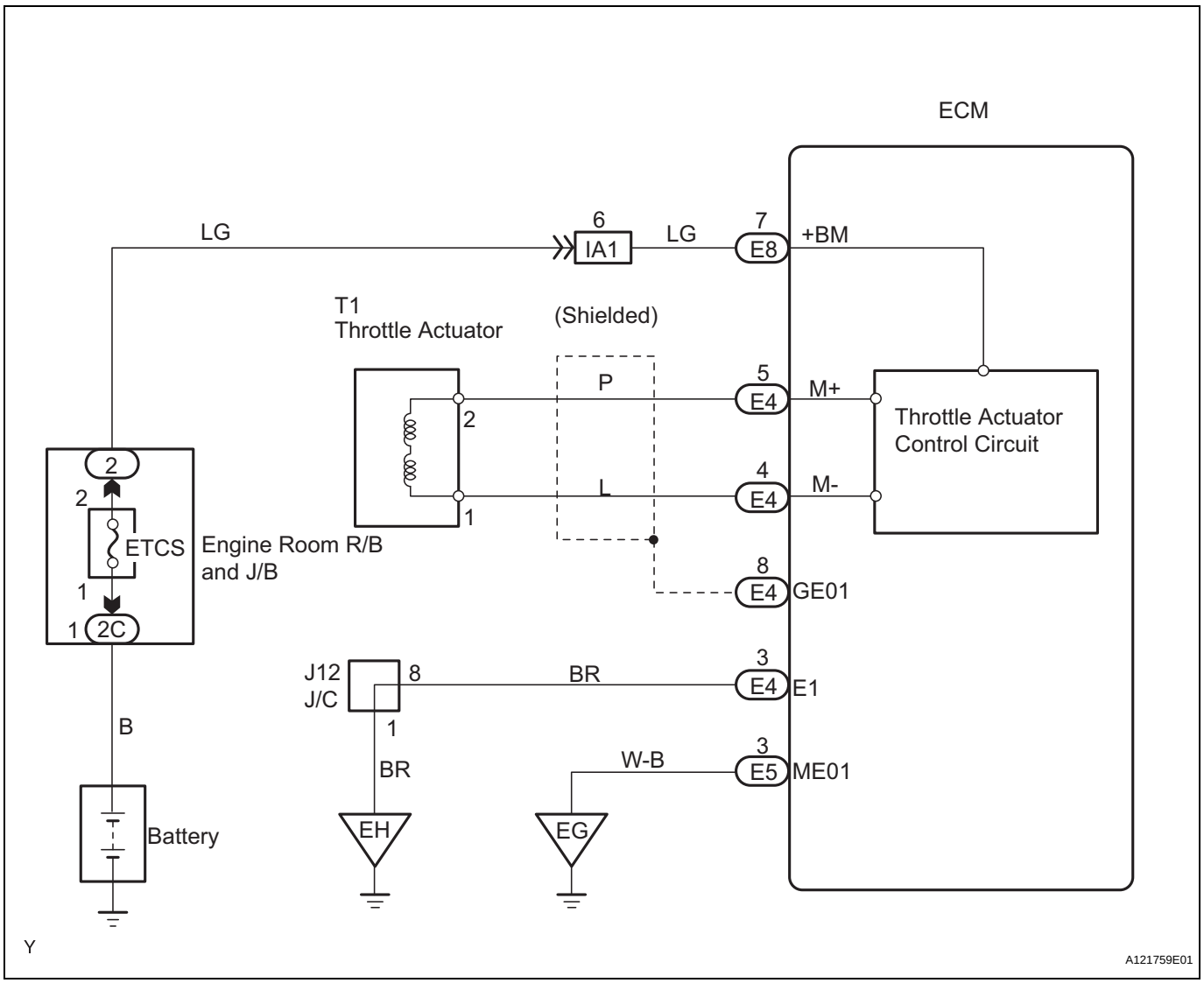
COMPONENT OPERATING RANGE

Throttle actuator power supply voltage	9 to 14 V

FAIL-SAFE

When this DTC, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6.5° 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 to OFF.

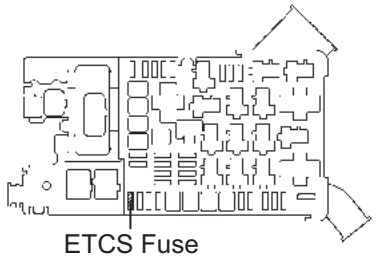
WIRING DIAGRAM



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

1	CHECK FUSE (ETCS)

Engine Room R/B:

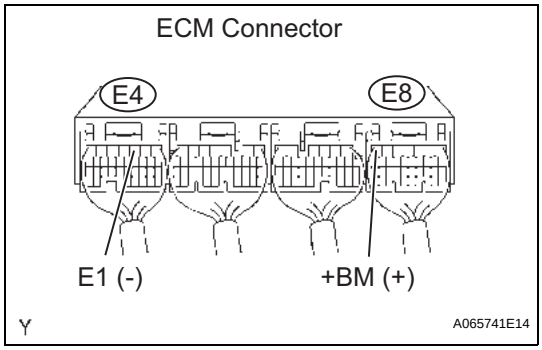


(a) Remove the ETCS fuse from the engine room R/B.
(b) Check the ETCS fuse resistance.
Standard Resistance:
Below 1 Ω
(c) Reinstall the ETCS fuse.

NG → **CHECK FOR SHORT IN ALL HARNESS AND COMPONENTS CONNECTED TO FUSE**

OK

2 INSPECT ECM (+BM VOLTAGE)



(a) Measure the voltage between the terminals of the ECM connectors.

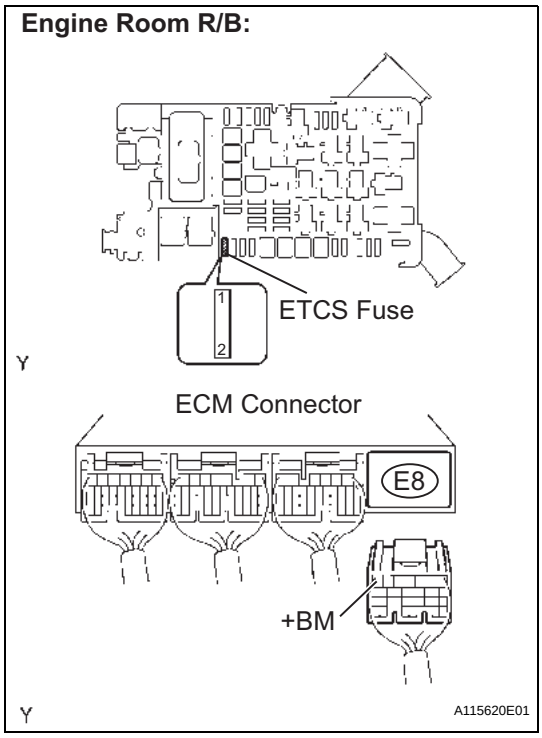
Standard Voltage

Tester Connections	Specified Conditions
+BM (E8-7) - E1 (E4-3)	9 to 14 V

OK → CHECK FOR INTERMITTENT PROBLEMS

NG

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



(a) Check the harness and connector between the ETCS fuse and ECM.
(1) Remove the ETCS fuse from the engine room R/B.
(2) Disconnect the E8 ECM connector.
(3) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
ETCS fuse (2) - +BM (E8-7)	Below 1 Ω

Standard Resistance (Check for short):

Tester Connections	Specified Conditions
ETCS fuse (2) or +BM (E8-7) - Body ground	10 kΩ or higher

(4) Reinstall the ETCS fuse.
(5) Reconnect the ECM connector.

(b) Check the harness and connector between the ETCS fuse and positive battery cable.
(1) Remove the ETCS fuse from the engine room R/B.
(2) Disconnect the positive battery cable.
(3) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
Positive battery cable - ETCS fuse (1)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
Positive battery cable or ETCS fuse (1) - Body ground	10 kΩ or higher

(4) Reinstall the ETCS fuse.
(5) Reconnect the positive battery cable.

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 Conditions	Trouble Areas
P2119	Throttle valve opening angle continues to vary greatly from target opening angle (1 trip detection logic)	• Electronic Throttle Control System (ETCS) • ECM

ES

MONITOR DESCRIPTION

The ECM determines the actual opening angle of the throttle valve from the TP sensor signal. The actual opening angle is compared to the target opening angle commanded by the ECM. If the difference between these two values is outside the standard range, the ECM interprets this as a malfunction in the ETCS. The ECM then illuminates the MIL and sets the DTC.
If the malfunction is not repaired successfully, the DTC is set when the accelerator pedal is quickly released (to close the throttle valve) after the engine speed reaches 5,000 rpm by the accelerator pedal being fully depressed (fully open the throttle valve).

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 following DTCs not present	None
System guard*	ON
*System guard set when following conditions 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 following conditions A or B met	-
A. Commanded closed TP - current closed TP	0.3 V or more for 1 second
B. Commanded open TP - current open TP	0.3 V or more for 0.6 seconds

FAIL-SAFE

When this DTC, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6.5° 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 to OFF.

WIRING DIAGRAM

Refer to DTC P2102 (See page ES-287).

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

ES

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

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

Result

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

HINT:
If any 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 ON.
(c) Turn the tester ON.
(d) Clear DTCs (see page ES-40).
(e) Allow the engine to idle for 15 seconds.
CAUTION:
Exercise extreme care and take precautions at steps (f) and (g) 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.

(g) While depressing the brake pedal securely, fully depress the accelerator pedal for 5 seconds.
(h) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(i) Read DTCs.
HINT:
The voltage output of the throttle position sensor can be checked during step (g) using an intelligent tester. Variations in the voltage output indicate that the throttle actuator is in operation. To check the voltage output using the intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ETCS / THROTTLE POS #1.

OK:

No DTC output.

NG → **REPLACE THROTTLE BODY**

OK

SYSTEM OK

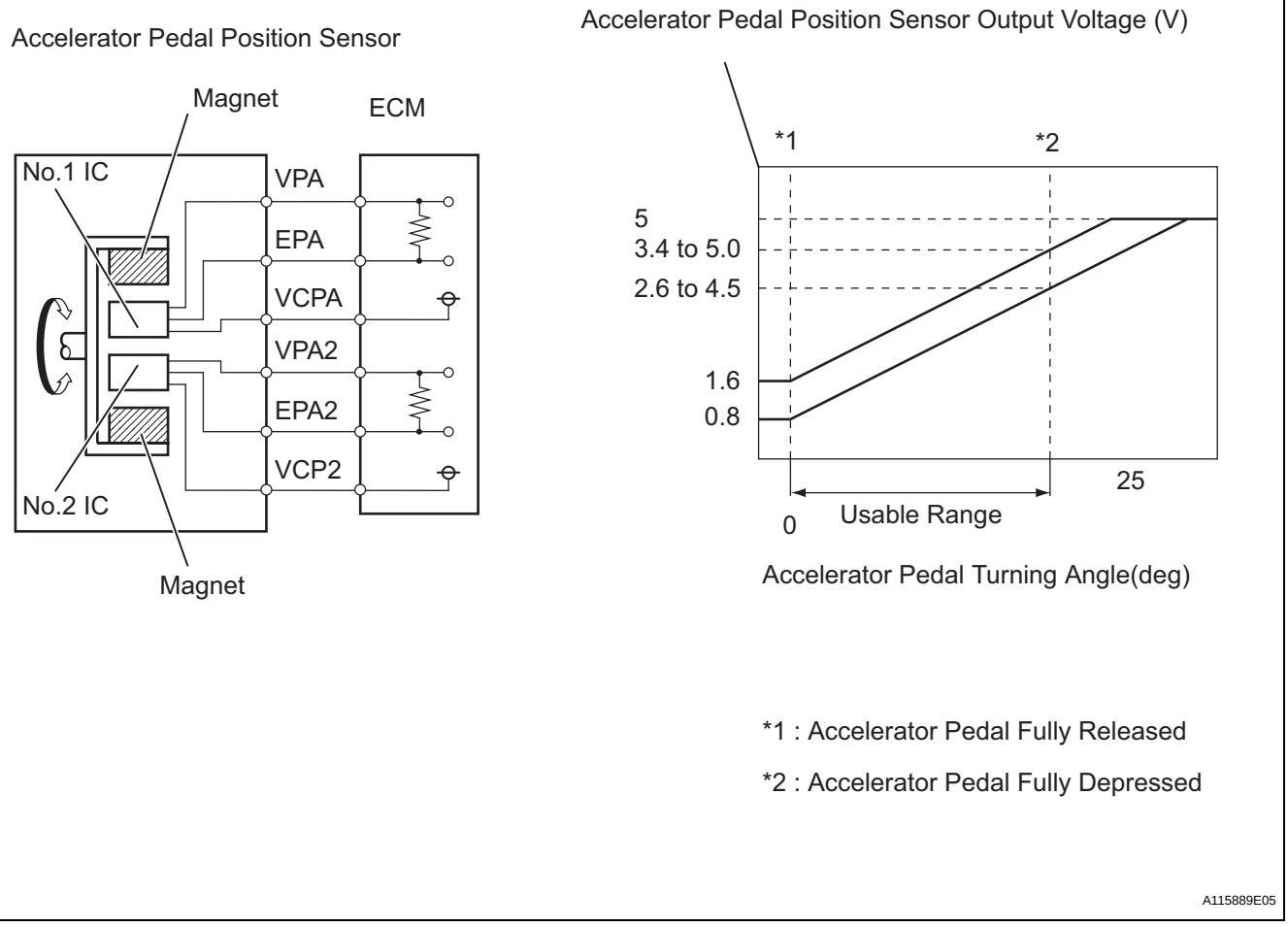
DTC	P2120	Throttle / Pedal Position Sensor / Switch "D" Circuit
DTC	P2122	Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input
DTC	P2123	Throttle / Pedal Position Sensor / Switch "D" Circuit High Input
DTC	P2125	Throttle / Pedal Position Sensor / Switch "E" Circuit
DTC	P2127	Throttle / Pedal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

HINT:
These DTCs relate to the Accelerator Pedal Position (APP) sensor.

DESCRIPTION

HINT:

- This ETCS (Electronic Throttle Control System) does not use a throttle cable.
- The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type, and uses Hall-effect elements, in order to yield accurate signals, even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0 V and 5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.
- The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



DTC No.	DTC Detection Conditions	Trouble Areas
P2120	VPA fluctuates rapidly beyond upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic)	• Accelerator Pedal Position (APP) sensor • ECM
P2122	VPA 0.4 V or less for 0.5 seconds or more when accelerator pedal fully released (1 trip detection logic)	• APP sensor • Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA 4.8 V or more for 2.0 seconds or more (1 trip detection logic)	• 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) VPA between 0.4 V and 3.45 V	• APP sensor • Open in EPA2 circuit • ECM

DTC No.	DTC Detection Conditions	Trouble Areas
P2138	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) Difference between VPA and VPA2 0.02 V or less (b) VPA 0.4 V or less and VPA2 1.2 V or less	• Short in between VPA 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 an intelligent tester: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ETCS / ACCEL POS #1 and ACCEL POS #2.

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

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

MONITOR DESCRIPTION

When either of the voltage outputs of VPA 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 VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is set.
If the malfunction is not repaired successfully, a DTC is set 2 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P2120: Accelerator pedal position sensor 1 (VPA) range check (fluctuating) P2122: Accelerator pedal position sensor 1 (VPA) range check (low voltage) P2123: Accelerator pedal position sensor 1 (VPA) range check (high voltage) P2125: Accelerator pedal position sensor 2 (VPA2) range check (fluctuating) P2127: Accelerator pedal position sensor 2 (VPA2) range check (low voltage) P2128: Accelerator pedal position sensor 2 (VPA2) range check (high voltage) P2138: Accelerator pedal position sensor correlation range check
Required Sensors/Components (Main)	Accelerator pedal position sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds: P2120, P2122, P2125 and P2127 2 seconds: P2123, P2128 and P2138
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Ignition switch	ON

TYPICAL MALFUNCTION THRESHOLDS

P2120:

VPA voltage	0.4 V or less or 4.8 V or more

P2122:

VPA voltage	0.4 V or less (when accelerator pedal fully released)

P2123:

VPA voltage	4.8 V or more

P2125:

VPA2 voltage	1.2 V or less or 4.8 V or more

P2127:

VPA2 voltage	1.2 V or less (when accelerator pedal fully released)

P2128:

Both of following conditions met:	A & B
A. VPA voltage	0.4 V or more and 3.45 V or less
B. VPA2 voltage	4.8 V or more

P2138:

Either of following condition met	A or B
A. Difference between VPA and VPA2 voltages	0.02 V or less
B. Both following conditions are met:	(1) & (2)
(1) VPA voltage	0.4 V or less
(2) VPA2 voltage	1.2 V or less

COMPONENT OPERATING RANGE

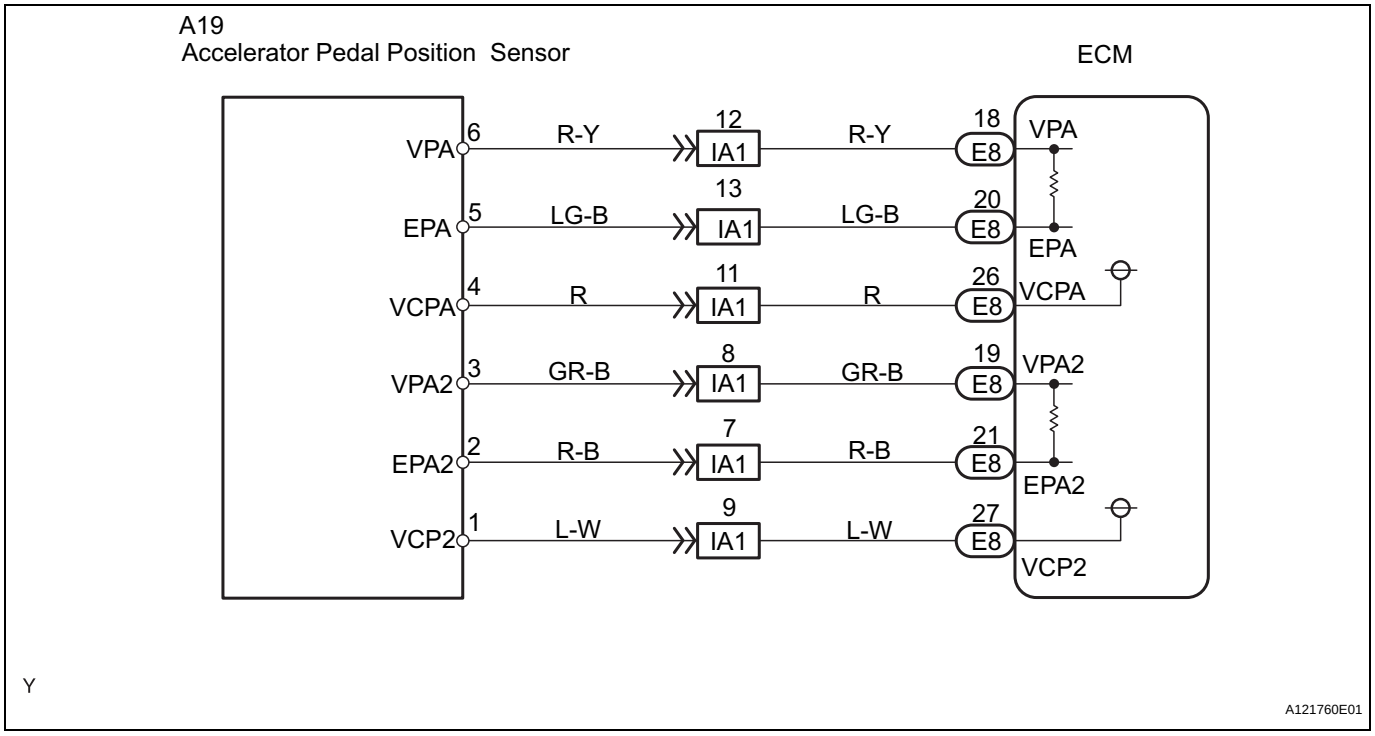
Parameter	Standard Value
VPA voltage	More than 0.4 V and less than 4.8 V
VPA2 voltage	More than 1.2 V and less than 4.8 V
Difference between VPA and VPA2 voltages	More than 0.02 V

FAIL-SAFE

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

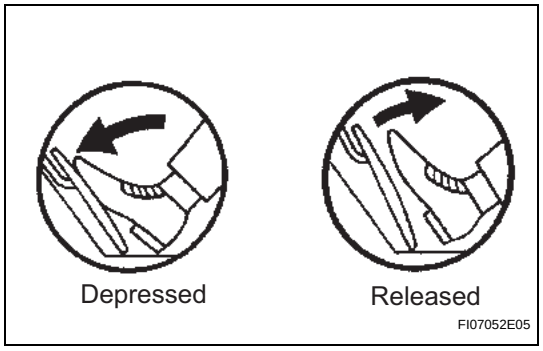
Fail-safe mode continues until a pass condition is detected, and the ignition switch is turned to OFF.

WIRING DIAGRAM



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

1	READ DATA LIST (ACCEL POS #1 AND ACCEL POS #2)



(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ETCS /ACCEL POS #1 and ACCEL POS #2.
(d) Read the values displayed on the tester.

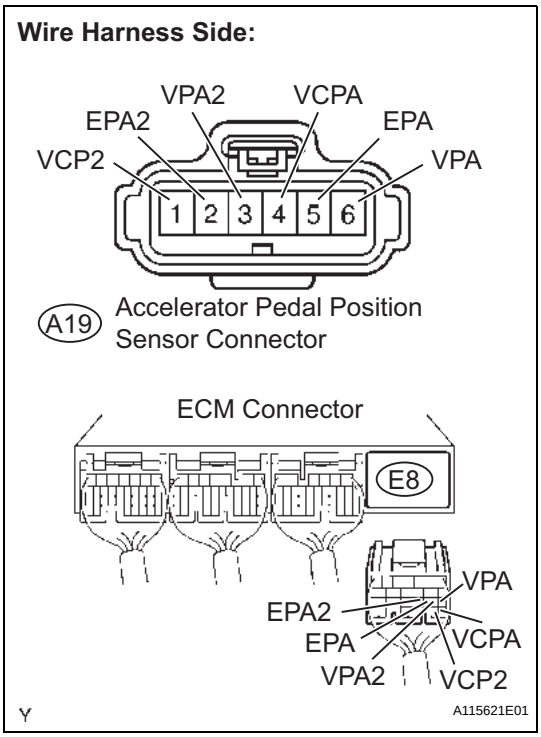
Standard Voltage

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

OK → **Go to step 5**

NG

2	CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)



(a) Disconnect the A19 Accelerator Pedal Position (APP) sensor connector.
(b) Disconnect the E8 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
VPA (A19-6) - VPA (E8-18)	Below 1 Ω
EPA (A19-5) - EPA (E8-20)	Below 1 Ω
VCPA (A19-4) - VCPA (E8-26)	Below 1 Ω
VPA2 (A19-3) - VPA2 (E8-19)	Below 1 Ω
EPA2 (A19-2) - EPA2 (E8-21)	Below 1 Ω
VCP2 (A19-1) - VCP2 (E8-27)	Below 1 Ω

Standard Resistance (Check for short)

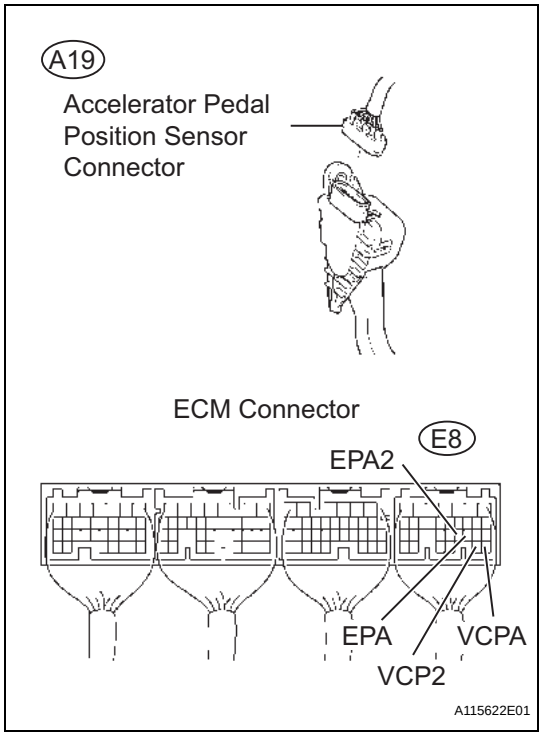
Tester Connections	Specified Conditions
VPA (A19-6) or VPA (E8-18) - Body ground	10 kΩ or higher
EPA (A19-5) or EPA (E8-20) - Body ground	10 kΩ or higher
VCPA (A19-4) or VCPA (E8-26) - Body ground	10 kΩ or higher
VPA2 (A19-3) or VPA2 (E8-19) - Body ground	10 kΩ or higher
EPA2 (A19-2) or EPA2 (E8-21) -Body ground	10 kΩ or higher
VCP2 (A19-1) or VCP2 (E8-27) - Body ground	10 kΩ or higher

(d) Reconnect the APP sensor connector.
(e) Reconnect the ECM connector.

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

OK

3 INSPECT ECM (VCPA AND VCP2 VOLTAGE)



(a) Disconnect the APP sensor connector.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between the terminals of the ECM connector.

Standard Voltage

Tester Connections	Specified Conditions
VCPA (E8-26) - EPA (E8-20)	4.5 to 5.0 V
VCP2 (E8-27) - EPA2 (E8-21)	4.5 to 5.0 V

(d) Reconnect the APP sensor connector.

NG → **REPLACE ECM**

OK

4 REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

NEXT

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

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Clear DTCs (see page ES-40).
(d) Allow the engine to idle for 15 seconds.
(e) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(f) Read DTCs.

Result

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

B → **SYSTEM OK**

ES

A

REPLACE ECM

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

HINT:
This DTC relates to the Accelerator Pedal Position (APP) sensor.

DESCRIPTION

Refer to DTC P2120 (See page ES-301).

DTC No.	DTC Detection Condition	Trouble Area
P2121	Difference between VPA and VPA2 exceeds threshold for 0.5 seconds	• Accelerator pedal position sensor circuit • Accelerator pedal position sensor • ECM

MONITOR DESCRIPTION

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

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

Either of following conditions met:	
Difference between VTA sensor 1 voltage (learned value) and VTA2 sensor 2 voltage (learned value)	Less than 0.4 V, or more than 1.2 V

FAIL-SAFE

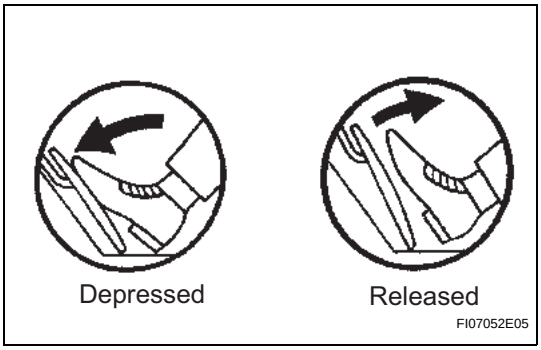
The accelerator pedal position sensor has two (main and sub) sensor circuits. If a malfunction occurs in either of the sensor circuits, the ECM detects the abnormal signal voltage difference between the two sensor circuits and switches to limp mode. In limp mode, the functioning circuit is used to calculate the accelerator pedal opening angle to allow the vehicle to continue driving. If both circuits malfunction, the ECM regards the opening angle of the accelerator pedal as being fully closed. In this case, the throttle valve remains closed as if the engine is idling.
If a pass condition is detected and then the ignition switch is turned to OFF, the fail-safe operation stops and the system returns to a normal condition.

WIRING DIAGRAM

Refer to DTC P2120 (See page ES-305).

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

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



(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ETCS / ACCEL POS #1 and ACCEL POS #2.
(d) Read the values displayed on the tester.

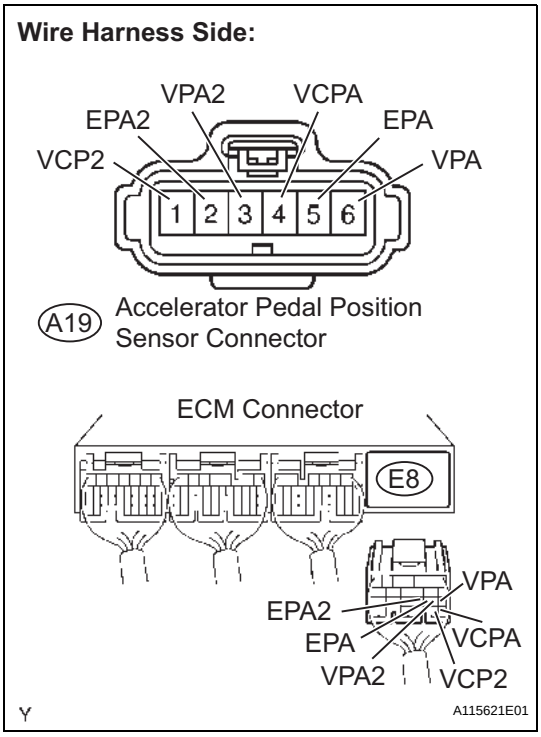
Standard Voltage

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

OK → **Go to step 3**

NG

2	CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)



(a) Disconnect the A19 Accelerator Pedal Position (APP) sensor connector.
(b) Disconnect the E8 ECM connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
VPA (A19-6) - VPA (E8-18)	Below 1 Ω
EPA (A19-5) - EPA (E8-20)	Below 1 Ω
VCPA (A19-4) - VCPA (E8-26)	Below 1 Ω
VPA2 (A19-3) - VPA2 (E8-19)	Below 1 Ω
EPA2 (A19-2) - EPA2 (E8-21)	Below 1 Ω
VCP2 (A19-1) - VCP2 (E8-27)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
VPA (A19-6) or VPA (E8-18) - Body ground	10 kΩ or higher
EPA (A19-5) or EPA (E8-20) - Body ground	10 kΩ or higher
VCPA (A19-4) or VCPA (E8-26) - Body ground	10 kΩ or higher
VPA2 (A19-3) or VPA2 (E8-19) - Body ground	10 kΩ or higher

Tester Connections	Specified Conditions
EPA2 (A19-2) or EPA2 (E8-21) - Body ground	10 kΩ or higher
VCP2 (A19-1) or VCP2 (E8-27) - Body ground	10 kΩ or higher

(d) Reconnect the APP sensor connector.
(e) Reconnect the ECM connector.

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

OK

3	REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

NEXT

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

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Clear the DTC (see page ES-40).
(d) Start the engine.
(e) Allow the engine to idle for 15 seconds.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Read DTCs.

Result

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

B → **SYSTEM OK**

A

REPLACE ECM

DTC	P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)

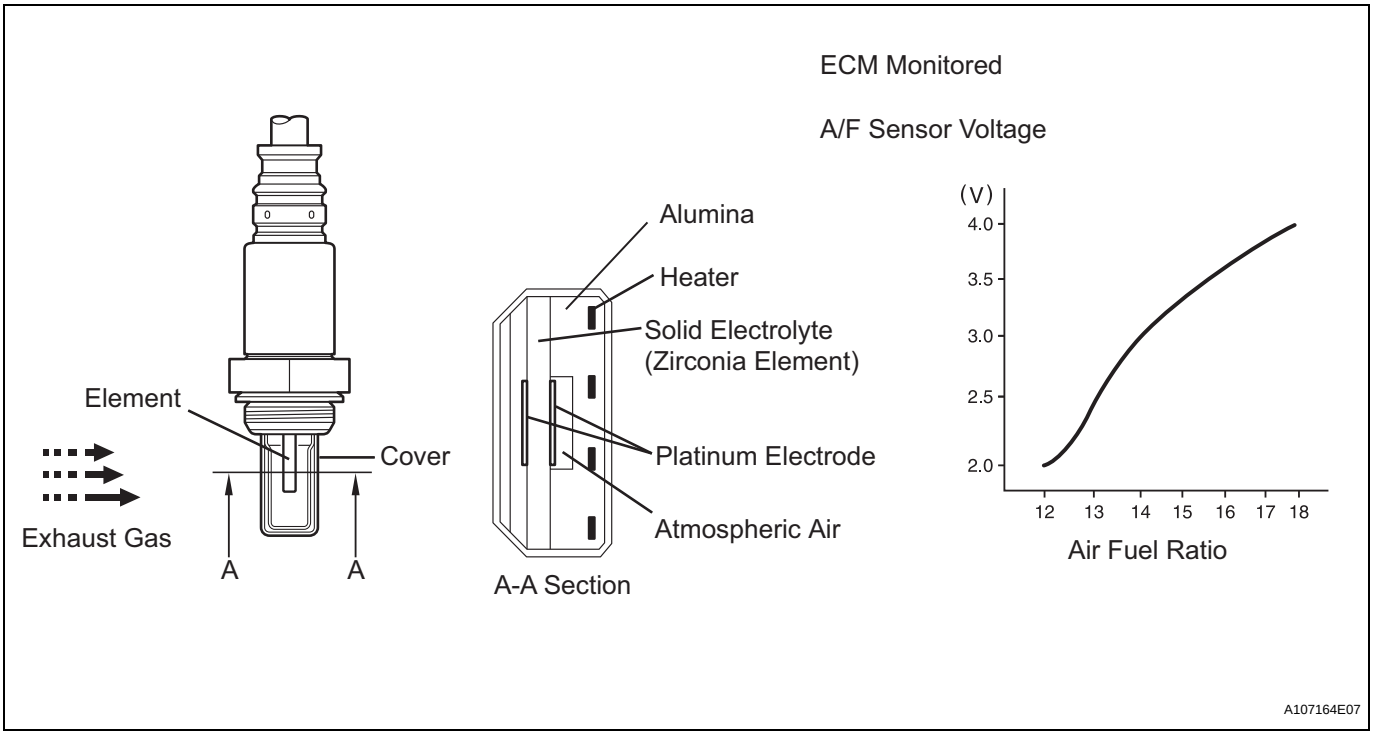
DTC	P2196	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)

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

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 air-fuel ratio 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.
In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric level.
*: Value changes inside the ECM. Since the A/F sensor is the current output element, a current is converted 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 Conditions	Trouble Areas
P2195	Conditions (a) and (b) continue for 10 seconds or more (2 trip detection logic): (a) Air-Fuel Ratio (A/F) sensor voltage more than 3.8 V (b) Heated Oxygen (HO2) sensor voltage 0.15 V or more	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor (sensor 1) heater • A/F HEATER relay • A/F sensor heater and relay circuits • Air induction system • Fuel pressure • Injector • ECM
P2195	While fuel-cut operation performed (during vehicle deceleration), Air-Furl Ratio (A/F) sensor current 3.6 mA or more for 3 seconds. (2 trip detection logic)	• A/F sensor • ECM
P2196	Conditions (a) and (b) continue for 10 seconds or more (2 trip detection logic): (a) Air-Furl Ratio (A/F) sensor voltage less than 2.8 V (b) Heated Oxygen (HO2) sensor voltage less than 0.60 V	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor (sensor 1) heater • A/F HEATER relay • A/F sensor heater and relay circuits • Air induction system • Fuel pressure • Injector • ECM
P2196	While fuel-cut operation performed (during vehicle deceleration), Air-Furl Ratio (A/F) sensor current less than 1.0 mA for 3 seconds. (2 trip detection logic)	• A/F sensor • ECM

HINT:

- When either of theses DTCs is set, check the A/F sensor voltage output by selecting the following menu items on an intelligent tester: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / AFS B1S1.
- Short-term fuel trim values can also be read using an intelligent tester.
- The ECM regulates the voltages at the A1A+ and A1A- terminals of the ECM to a constant level. Therefore, the A/F sensor voltage output cannot be confirmed without using an intelligent tester.
- If the A/F sensor is malfunctioning, the ECM sets the DTC P2195 or P2196.

MONITOR DESCRIPTION

1. Sensor voltage detection monitor

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.

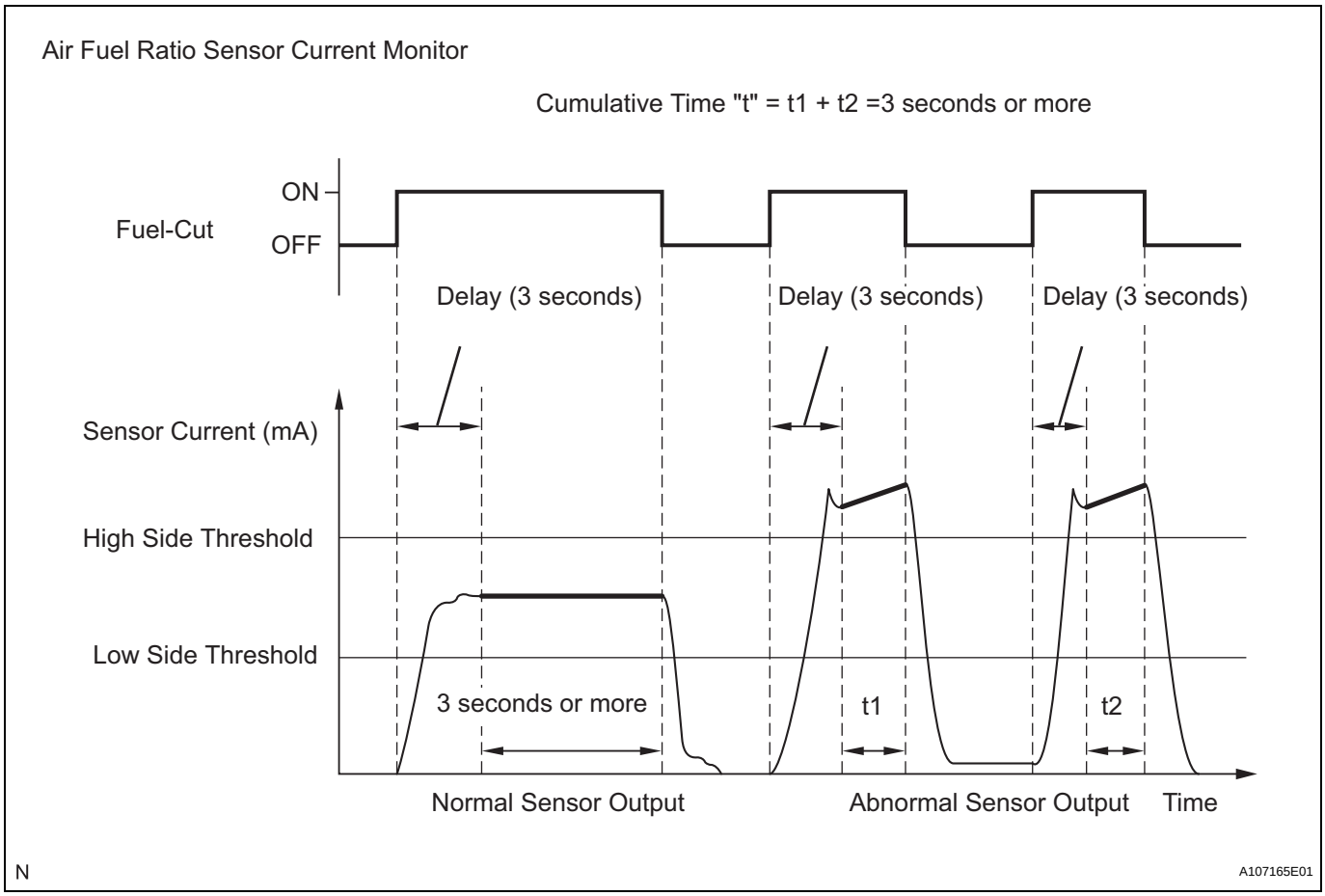
Example:

If the A/F sensor voltage output is less than 2.8 V (very rich condition) for 10 seconds, despite the rear HO2 sensor voltage output being less than 0.60 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 rear HO2 sensor voltage output being 0.15 V or more, DTC P2195 is set.

2. Sensor current detection monitor

A rich air-fuel mixture causes a low A/F sensor current, and a lean air-fuel mixture causes a high A/F sensor current. Therefore, the sensor output becomes low during acceleration, and it becomes high during deceleration with the throttle valve fully closed. The ECM monitors the A/F sensor current during fuel-cut and detects any abnormal current values.

If the A/F sensor output is 3.6 mA or more for more than 3 seconds of cumulative time, the ECM interprets this as a malfunction in the A/F sensor and sets DTC P2195 (high-side stuck). If the A/F sensor output is 1.0 mA or less for more than 3 seconds of cumulative time, the ECM sets DTC P2196 (low-side stuck).



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	Within 10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0037, P0038, P0057, P0058 (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, P0156 (O2 Sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0500 (VSS) P2440 (A/R control valve stuck open) P2441 (A/R control valve stuck close) P2444 (AIP stuck ON) P2445 (AIP stuck OFF)

ES

Sensor voltage detection monitor (Lean side malfunction P2195):

Time while all of following conditions met	2 seconds or more
Rear HO2 sensor voltage	0.15 V or more
Time after engine start	30 seconds or more
A/F sensor status	Activated
Fuel system status	Closed-loop
Engine	Running

Sensor voltage detection monitor (Rich side malfunction P2196):

Time while all of following conditions met	2 seconds or more
Rear HO2 sensor voltage	Below 0.6 V
Time after engine start	30 seconds or more
A/F sensor status	Activated
Fuel system status	Closed-loop
Engine	Running

Sensor current detection monitor (P2195, P2196)

Battery voltage	11 V or more
Atmospheric pressure	75 kPa (570 mmHg) or higher
Air-fuel ratio sensor status	Activated
Engine coolant temperature	70°C (158°F) or more
Continuous time of fuel cut	3 seconds or more, and less than 10 seconds

TYPICAL MALFUNCTION THRESHOLDS

Sensor voltage detection monitor (Lean side malfunction P2195):

A/F sensor voltage	More than 3.8 V

Sensor voltage detection monitor (Rich side malfunction P2196):

A/F sensor voltage	Less than 2.8 V

Sensor current detection monitor (High side malfunction P2195):

Following condition met for:	3 seconds or more
Air-fuel ratio sensor current during fuel cut	3.6 mA or more

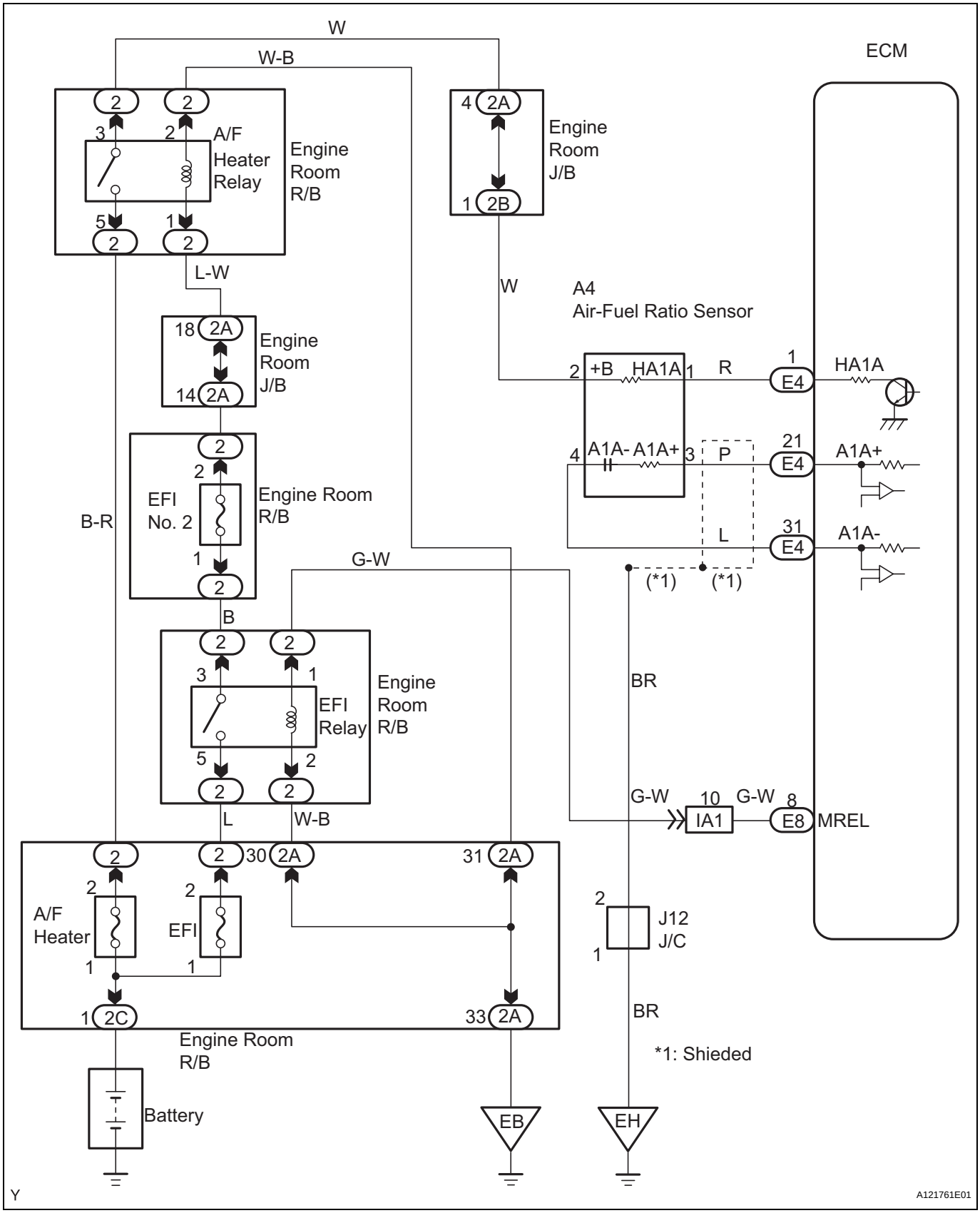
Sensor current detection monitor (Rich side malfunction P2196):

Following condition met for:	3 seconds or more
Air-fuel ratio sensor current during fuel cut	Less than 1 mA

MONITOR RESULT

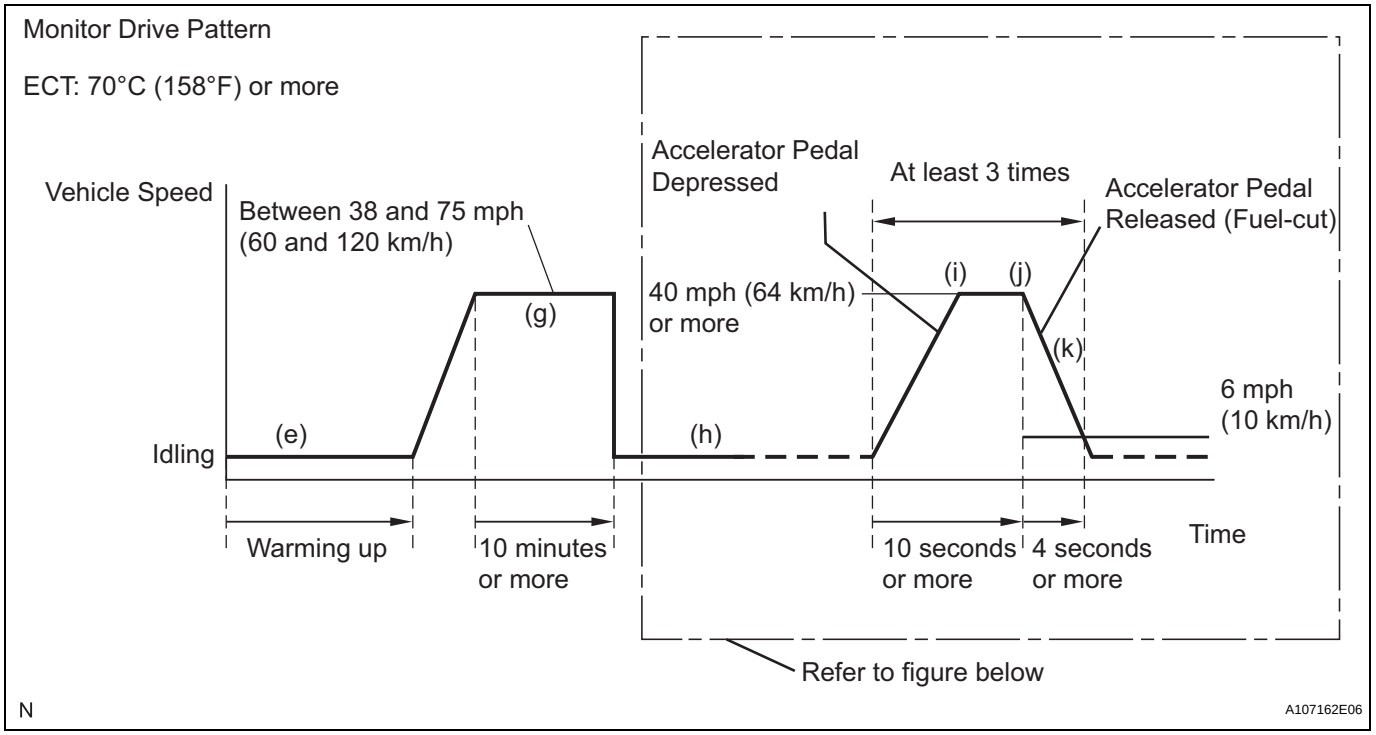
Refer to Checking Monitor Status (See page ES-21).

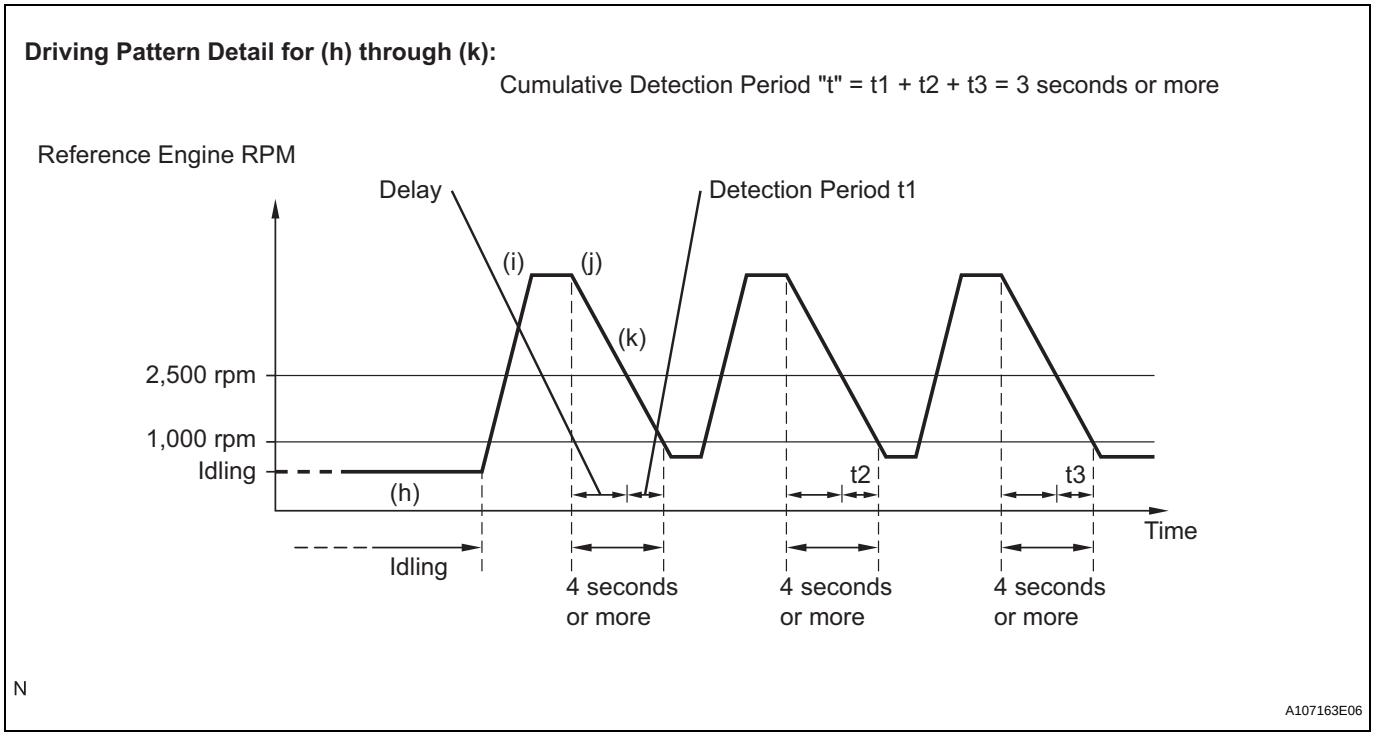
WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN

This confirmation driving pattern is used in the "PERFORM CONFIRMATION DRIVING PATTERN" procedure of the following diagnostic troubleshooting procedure.





(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the tester ON.
(d) Clear DTCs (See page ES-40).
(e) Start the engine, and warm it up until the ECT reaches 70°C (158°F) or higher.
(f) On the intelligent tester, select the following menu items to check the fuel-cut status: DIAGNOSIS / ENHANCED OBD II / DATA LIST / USER DATA / FC IDLE.

(g) Drive the vehicle at between 38 mph (60 km/h) and 75 mph (120 km/h) for at least 10 minutes.
(h) Change the transmission to 2nd gear.
(i) Drive the vehicle at proper vehicle speed to perform fuel-cut operation (refer to the following HINT).
HINT:
Fuel-cut is performed when the following conditions are met:
- Accelerator pedal fully released.
- Engine speed is 2,500 rpm or more (fuel injection returns at 1,000 rpm).

(j) Accelerate the vehicle to 40 mph (64 km/h) or more by depressing the accelerator pedal for at least 10 seconds.
(k) Soon after performing step (j) above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal, in order to execute fuel-cut control.
(l) Allow the vehicle to decelerate until the vehicle speed declines to less than 6 mph (10 km/h).
(m) Repeat steps from (h) through (k) above at least 3 times in one driving cycle.
HINT:
Completion of all A/F sensor monitors is required to change the value in TEST RESULT.

ES

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

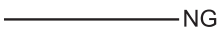
HINT:
Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.
The following instructions describe how to conduct the A/F CONTROL operation using an intelligent tester.
1. Connect an 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.

   NOTICE:
   - **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

Tester Display (Sensor)	Injection Volumes	Status	Voltages
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 0.5
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 Areas
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.5 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 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:

- DTC P2A00 may be set, when the air-fuel ratio is stuck rich or lean.
- A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P2195 OR P2196)

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

ES

Result

Display (DTC Output)	Proceed To
P2195 or P2196	A
P2195 or P2196 and other DTCs	B

If any DTCs relating to the A/F sensor (DTCs for the A/F sensor heater or A/F sensor admittance) are output, troubleshoot those DTCs first.

B → GO TO DTC CHART

A

2 READ DATA LIST (TEST VALUE OF A/F SENSOR)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Clear DTCs (see page ES-40).
(d) Allow the vehicle to drive in accordance with the drive pattern described in the CONFIRMATION DRIVING PATTERN.
(e) Select the following menu items on the tester: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / MONITOR STATUS.
(f) Check that the status of O2S MON is COMPL.
If the status is still INCMPL, drive the vehicle according to the driving pattern again.
HINT:
- AVAIL indicates that the component has not been monitored yet.
- COMPL indicates that the component is functioning normally.
- INCMPL indicates that the component is malfunctioning.

(g) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / TEST RESULT / RANGE B1S1, then press the ENTER button.
(h) Check the test value of the A/F sensor output current during fuel-cut.

Result

Test Value	Proceed To
Within normal range (1.0 mA or more, and less than 3.6 mA)	A
Outside normal range (Less than 1.0 mA, or 3.6 mA or more)	B

B → Go to step 20

A

3 READ DATA LIST (OUTPUT VOLTAGE OF A/F SENSOR)

(a) Connect an intelligent tester to the DLC3.
(b) Start the engine.
(c) Turn the tester ON.

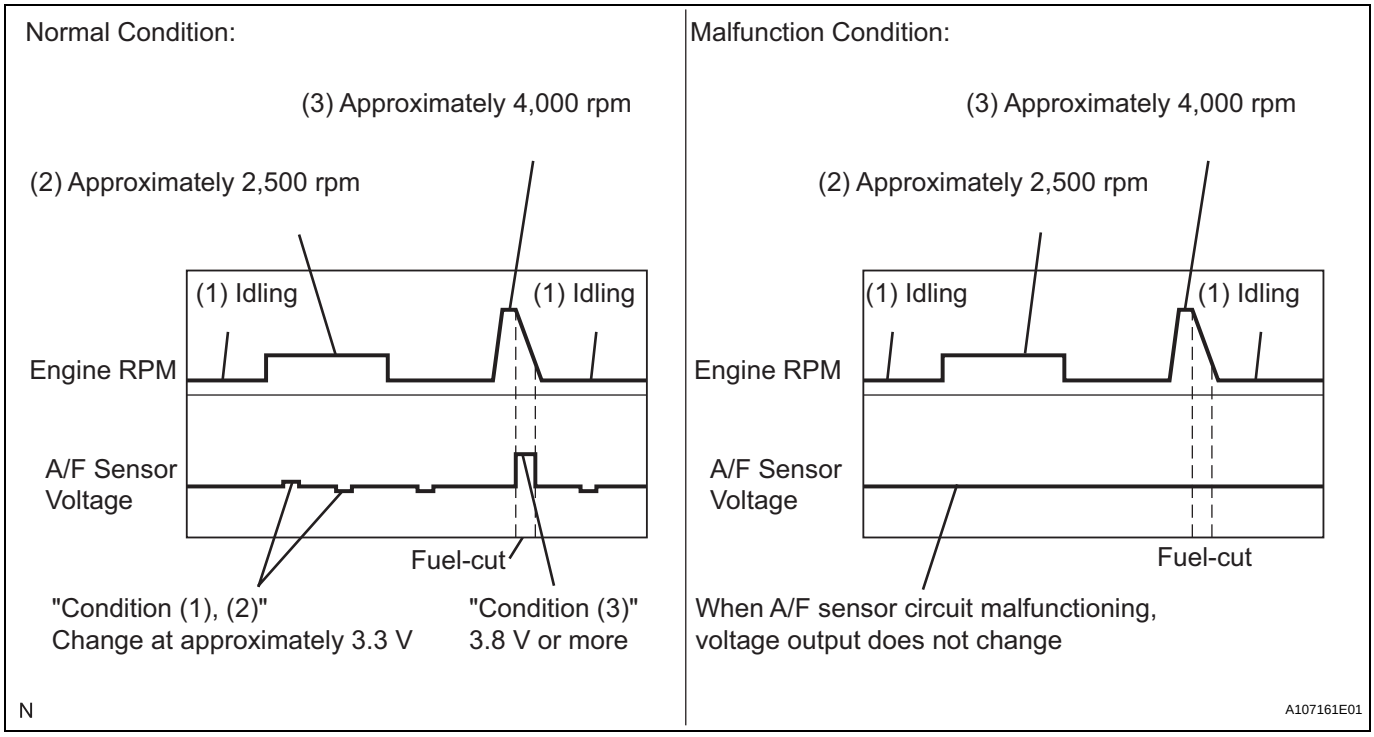
(d) Warm up the A/F sensor at an engine speed of 2,500 rpm for 90 seconds.
(e) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / USER DATA / AFS B1S1 and ENGINE SPD.
(f) Check the A/F sensor voltage three times, when the engine is in each of the following conditions:
  (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

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

ES

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.

ES

NG → **Go to step 10**

OK

4	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

5	CHECK WHETHER DTC OUTPUT RECURS (DTC P2195 OR P2196)

(a) Read DTCs using the intelligent tester.
(b) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.

Result

Display (DTC Output)	Proceed To
P2195 or P2196	A
No output	B

B → **Go to step 9**

A

6	REPLACE AIR-FUEL RATIO SENSOR

NEXT

7	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

8	CHECK WHETHER DTC OUTPUT RECURS (DTC P2195 OR P2196)

(a) Read DTCs using the intelligent tester.
(b) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.

Result

Display (DTC Output)	Proceed To
No output	A
P2195 or P2196	B

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

A

9	CONFIRM WHETHER VEHICLE HAS RUN OUT OF FUEL IN PAST

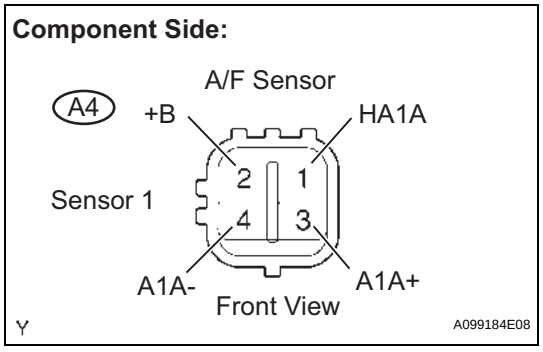
NO → **CHECK FOR INTERMITTENT PROBLEMS**

YES

DTC CAUSED BY RUNNING OUT OF FUEL

10	INSPECT AIR-FUEL RATIO SENSOR (HEATER RESISTANCE)

Component Side:



(a) Disconnect the A4 Air-Fuel Ratio (A/F) sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor connector.

Standard Resistance

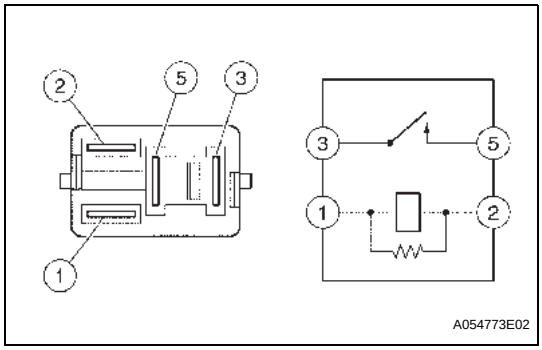
Tester Connections	Specified Conditions
HA1A (1) - +B (2)	1.8 Ω to 3.4 Ω at 20°C (68°F)
HA1A (1) - A1A- (4)	10 kΩ or higher

(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR-FUEL RATIO SENSOR**

OK

11 INSPECT AIR FUEL RATIO SENSOR (A/F HEATER RELAY)



(a) Remove the A/F HEATER relay from the engine room R/B.
(b) Check the A/F HEATER relay resistance.
Standard Resistance

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

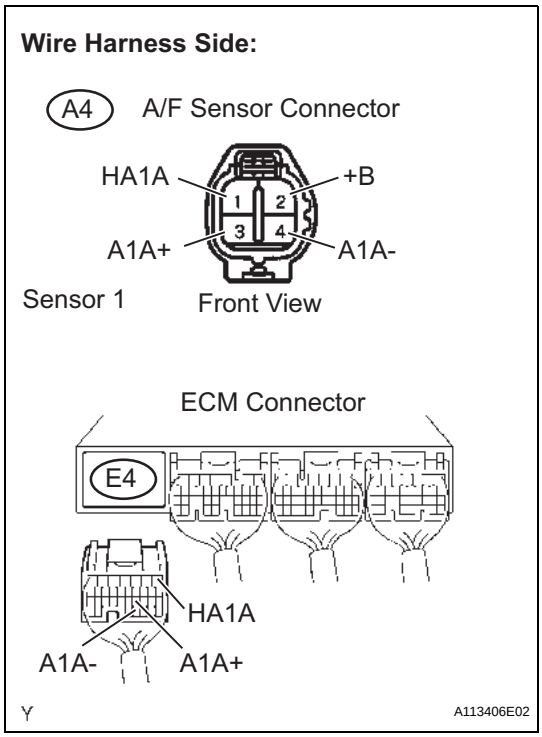
(c) Reinstall the A/F HEATER relay.

ES

NG → **REPLACE AIR FUEL RATIO SENSOR HEATER RELAY**

OK

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



(a) Disconnect the A4 air-fuel ratio sensor connector.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between the +B terminal of the air-fuel ratio sensor connector and body ground.
Standard Voltage

Tester Connections	Specified Conditions
+B (A4-2) - Body ground	9 to 14 V

(d) Turn the ignition switch to OFF.
(e) Disconnect the E4 ECM connector.
(f) Check the resistance.
Standard Resistance (Check for open)

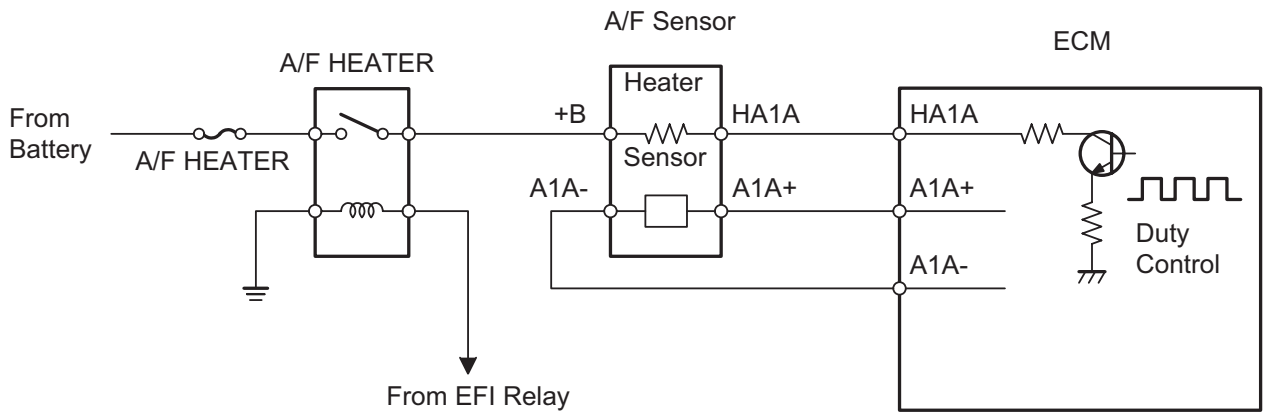
Tester Connections	Specified Conditions
HA1A (A4-1) - HA1A (E4-1)	Below 1 Ω
A1A+ (A4-3) - A1A+ (E4-21)	Below 1 Ω
A1A- (A4-4) - A1A- (E4-31)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
HA1A (A4-1) or HA1A (E4-1) - Body ground	10 kΩ or higher
A1A+ (A4-3) or A1A+ (E4-21) - Body ground	10 kΩ or higher
A1A- (A4-4) or A1A- (E4-31) - Body ground	10 kΩ or higher

(g) Reconnect the ECM connector.
(h) Reconnect the air-fuel ratio sensor connector.

Reference (Bank 1 Sensor 1 System Diagram)



P A118002E04

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

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

14	CHECK FUEL PRESSURE

(a) Check the fuel pressure.

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

15	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**

ES

OK

16	REPLACE AIR-FUEL RATIO SENSOR

NEXT

17	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

ES

18	CHECK WHETHER DTC OUTPUT RECURS (DTC P2195 OR P2196)

(a) Read DTCs using the intelligent tester.
(b) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.

Result

Display (DTC Output)	Proceed To
No output	A
P2195 or P2196	B

B → REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN

A

19	CONFIRM WHETHER VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → CHECK FOR INTERMITTENT PROBLEMS

YES

DTC CAUSED BY RUNNING OUT OF FUEL

20	REPLACE AIR FUEL RATIO SENSOR

NEXT

21	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

22	CHECK WHETHER DTC OUTPUT RECURS (DTC P2195 OR P2196)

(a) Connect the intelligent tester to the DLC3.

(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.
(d) Read pending DTCs.

Result

Display (DTC Output)	Proceed To
No output	A
P2195 or P2196 (A/F sensor pending DTCs)	B

B → **REPLACE ECM**

A

END

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)

ES

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

Refer to DTC P2195 (See page ES-312).

DTC No.	DTC Detection Conditions	Trouble Areas
P2238	• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (2 trip detection logic) (a) A1A+ voltage 0.5 V or less (b) (A1A+) - (A1A-) = 0.1 V or less • Case 2: A/F sensor admittance: Less than 0.022 1/Ω (2 trip detection logic)	• Open or short in Air-Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater • A/F HEATER relay • A/F sensor heater and relay circuits • ECM
P2239	A1A+ voltage more than 4.5 V for 5.0 seconds or more (2 trip detection logic)	• Open or short in Air-Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater • A/F HEATER relay • A/F sensor heater and relay circuits • ECM
P2252	A1A- voltage 0.5 V or less for 5.0 seconds or more (2 trip detection logic)	• Open or short in Air-Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater • A/F HEATER relay • A/F sensor heater and relay circuits • ECM
P2253	A1A- voltage more than 4.5 V for 5.0 seconds or more (2 trip detection logic)	• Open or short in Air-Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater • A/F HEATER relay • A/F sensor heater and relay circuits • ECM

MONITOR DESCRIPTION

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

MONITOR STRATEGY

Related DTCs	P2238: A/F sensor open circuit between A1A+ and A1A- P2238: A/F sensor short circuit between A1A+ and A1A- P2238: A/F sensor short circuit between A1A+ and GND P2239: A/F sensor short circuit between A1A+ and +B P2252: A/F sensor short circuit between A1A- and GND P2253: A/F sensor short circuit between A1A- and +B
Required Sensors/Components (Main)	A/F sensor
Required Sensors/Components (Related)	Engine Coolant Temperature (ECT) sensor, Crankshaft position sensor
Frequency of Operation	Once per driving cycle
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

P2238 (open circuit between A1A+ and A1A-):

Duration while all following conditions met	20 seconds or more
A1A+ terminal voltage	0.5 to 4.5 V
A1A- terminal voltage	0.5 to 4.5 V
Difference between A1A+ and A1A- terminal voltages	0.1 to 0.8 V
ECT	8°C (46°F) or more: closed loop fuel control enable temperature
Engine condition	Running
Time after engine start	20 seconds or more
Fuel-cut	OFF (for 25 seconds or more)
A/F sensor heater duty ratio	0 % or more
Time after A/F sensor heating	20 seconds or more
Battery voltage	10.5 V or more
Ignition switch	ON (for 5 seconds or more)

Others:

Battery voltage	10.5 V or more
Ignition switch	ON (for 5 seconds or more)

TYPICAL MALFUNCTION THRESHOLDS

P2238 (Open circuit between A1A+ and A1A-):

A/F sensor admittance	Below 0.022 1/Ω

P2238 (Short circuit between A1A+ and GND):

A1A+ terminal voltage	0.5 V or less

P2238 (Short circuit between A1A+ and A1A-):

Difference between A1A+ and A1A- terminal voltages	0.1 V or less

P2239 (Short circuit between A1A+ and +B):

A1A+ terminal voltage	More than 4.5 V

P2252 (Short circuit between A1A- and GND):

A1A- terminal voltage	0.5 V or less

P2253 (Short circuit between A1A- and +B):

A1A- terminal voltage	More than 4.5 V

WIRING DIAGRAM

Refer to DTC P2195 (See page ES-316).

HINT:
Intelligent tester only:
Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.
The following instructions describe how to conduct the A/F CONTROL operation using an intelligent tester.

1. Connect an 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 Voltage

Tester Display (Sensor)	Injection Volumes	Status	Voltages
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 0.5
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 Areas
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.5 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		

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Areas
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		

ES

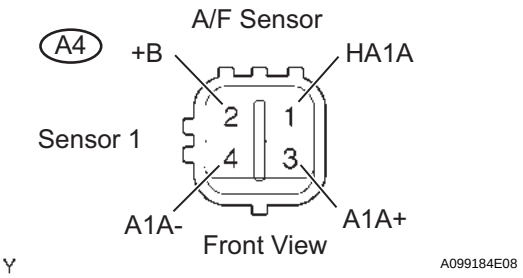
- Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, select the following menu items on the tester: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2, and press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

HINT:

- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

Component Side:



(a) Disconnect the A4 Air-Fuel Ratio (A/F) sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor connector.

Standard Resistance

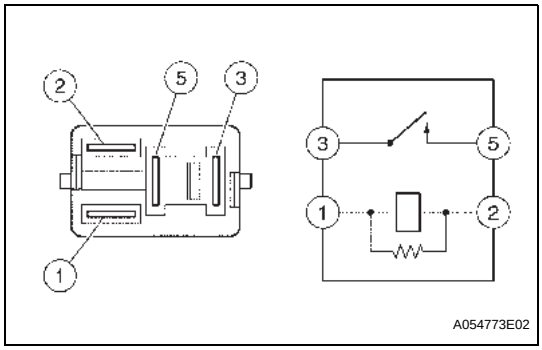
Tester Connections	Specified Conditions
HA1A (1) - +B (2)	1.8 to 3.4 Ω at 20°C (68°F)
HA1A (1) - A1A- (4)	10 kΩ or higher

(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

2 INSPECT AIR FUEL RATIO SENSOR HEATER RELAY (A/F HEATER RELAY)



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

Standard Resistance

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

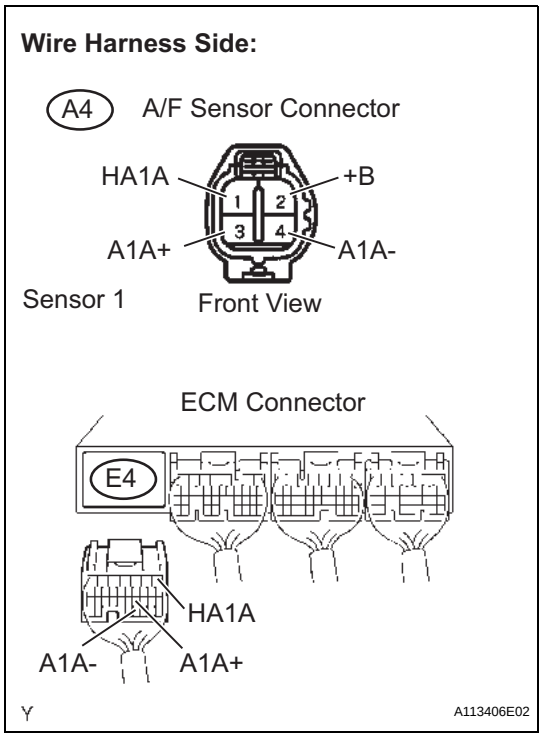
(c) Reinstall the A/F HEATER relay.

ES

NG → **REPLACE AIR FUEL RATIO SENSOR HEATER RELAY**

OK

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



(a) Disconnect the A4 A/F sensor connector.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between the +B terminal of the A/F sensor connector and body ground.

Standard Voltage

Tester Connections	Specified Conditions
+B (A4-2) - Body ground	9 to 14 V

(d) Turn the ignition switch to OFF.
(e) Disconnect the E4 ECM connector.
(f) Check the resistance.

Standard Resistance (Check for open)

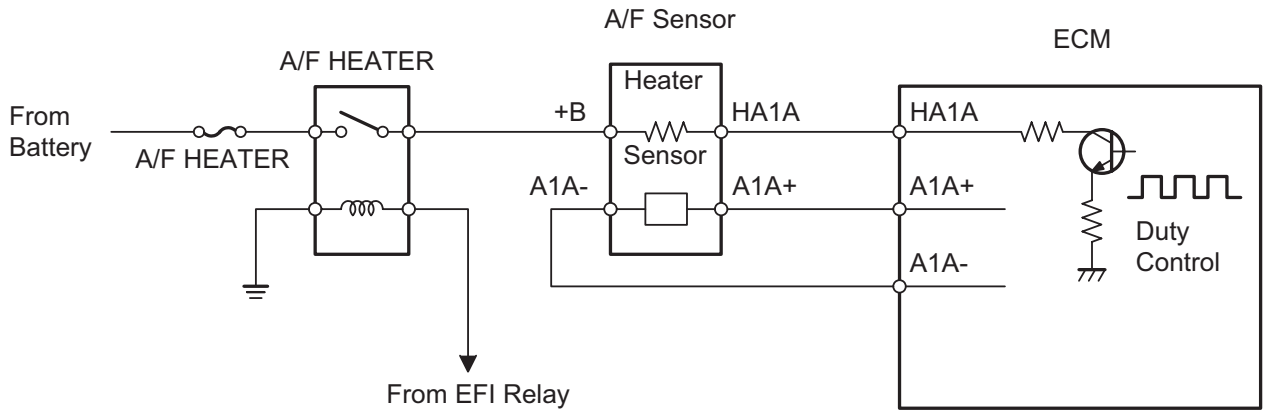
Tester Connections	Specified Conditions
HA1A (A4-1) - HA1A (E4-1)	Below 1 Ω
A1A+ (A4-3) - A1A+ (E4-21)	Below 1 Ω
A1A- (A4-4) - A1A- (E4-31)	Below 1 Ω

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
HA1A (A4-1) or HA1A (E4-1) - Body ground	10 kΩ or higher
A1A+ (A4-3) or A1A+ (E4-21) - Body ground	10 kΩ or higher
A1A- (A4-4) or A1A- (E4-31) - Body ground	10 kΩ or higher

(g) Reconnect the ECM connector.
(h) Reconnect the A/F sensor connector.

Reference (Bank 1 Sensor 1 System Diagram)



P A118002E04

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

OK

REPLACE ECM

ES

DTC	P2401	Evaporative Emission Leak Detection Pump Stuck OFF

DTC	P2402	Evaporative Emission Leak Detection Pump Stuck ON

DTC SUMMARY

DTC No.	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timings	Detection Logic
P2401	Leak detection pump stuck OFF	Leak detection pump creates negative pressure through reference orifice, and EVAP system pressure measured to determine 0.02 inch leak criterion. 0.02 inch leak criterion measured at start and at end of leak check. If system pressure higher than -1.06 kPa (-7.95 mmHg)*, or lower than -4.85 kPa (-36.38 mmHg)*, ECM determines that leak detection pump stuck OFF.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM • Leakage from EVAP system	While ignition switch OFF	2 trip
P2402	Leak detection pump stuck ON	Leak detection pump creates negative pressure through reference orifice, and EVAP system pressure measured to determine 0.02 inch leak criterion. If system pressure higher than -1.06 kPa (-7.95 mmHg)*, or lower than -4.85 kPa (-36.38 mmHg)*, ECM determines that leak detection pump stuck ON.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM	While ignition switch OFF	2 trip

*: The threshold values vary according to the atmospheric pressure measured in operation A. The values described in the table above are based on an atmospheric pressure of 100 kPa (750.1 mmHg).

HINT:

The leak detection pump is built into the canister pump module.

DESCRIPTION

The circuit description can be found in the EVAP (Evaporative Emission) System (see page ES-392).

Refer to the EVAP System (see page ES-397).

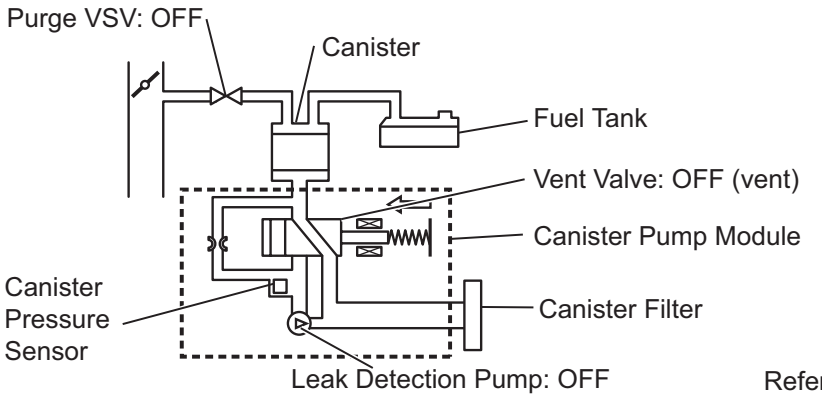
MONITOR DESCRIPTION

5 hours* after the ignition switch is turned to OFF, the electric leak detection 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:
*: 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 turned to OFF.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak criterion (reference pressure) measurement	In order to determine 0.02 inch leak criterion, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as they will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes*
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak criterion (reference pressure) measurement	After second 0.02 inch leak criterion measurement, leak check performed by comparing first and second 0.02 inch leak criterion. If stabilized system pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system leaking.	60 seconds
F	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

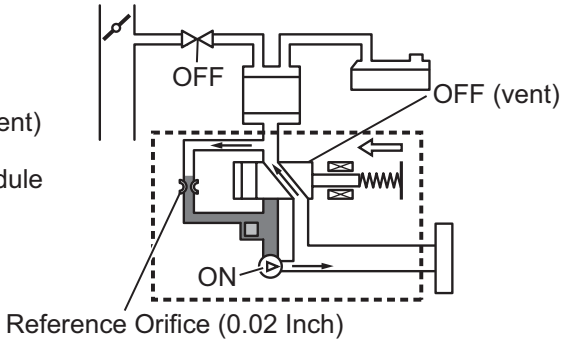
* If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.

Operation A: Atmospheric Pressure Measurement



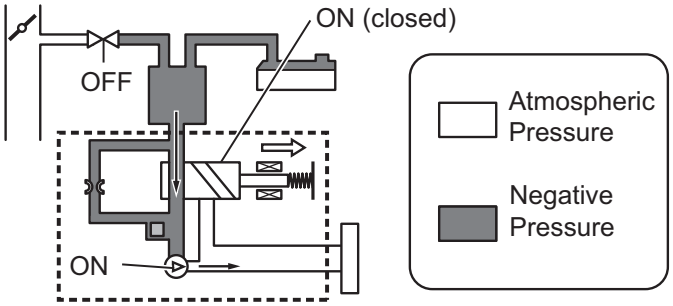
Operation B, E:

0.02 Inch Leak Criterion Measurement

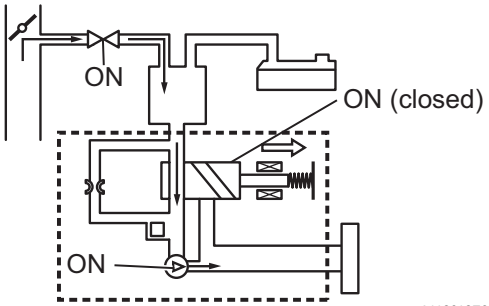


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Operation C: EVAP System Pressure Measurement



Operation D: Purge VSV Monitor

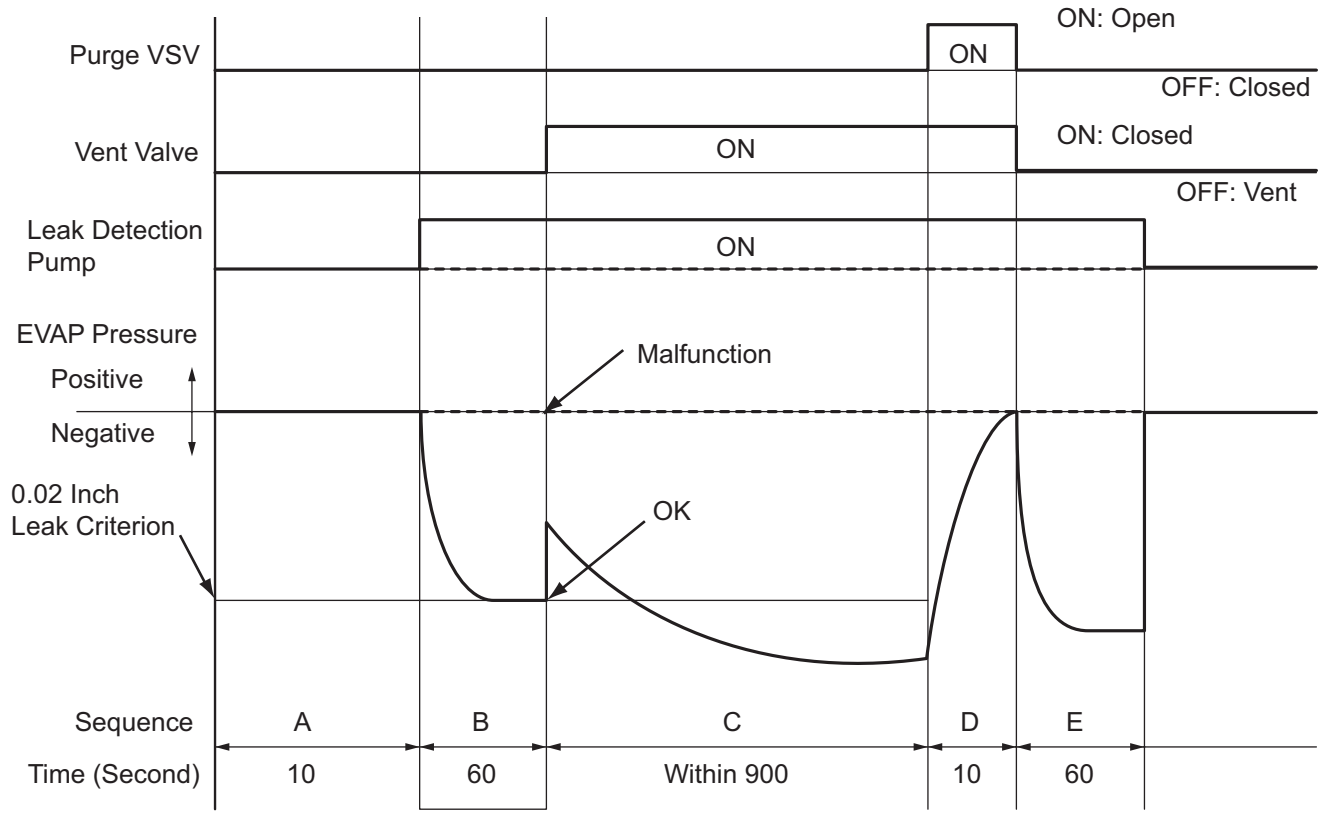


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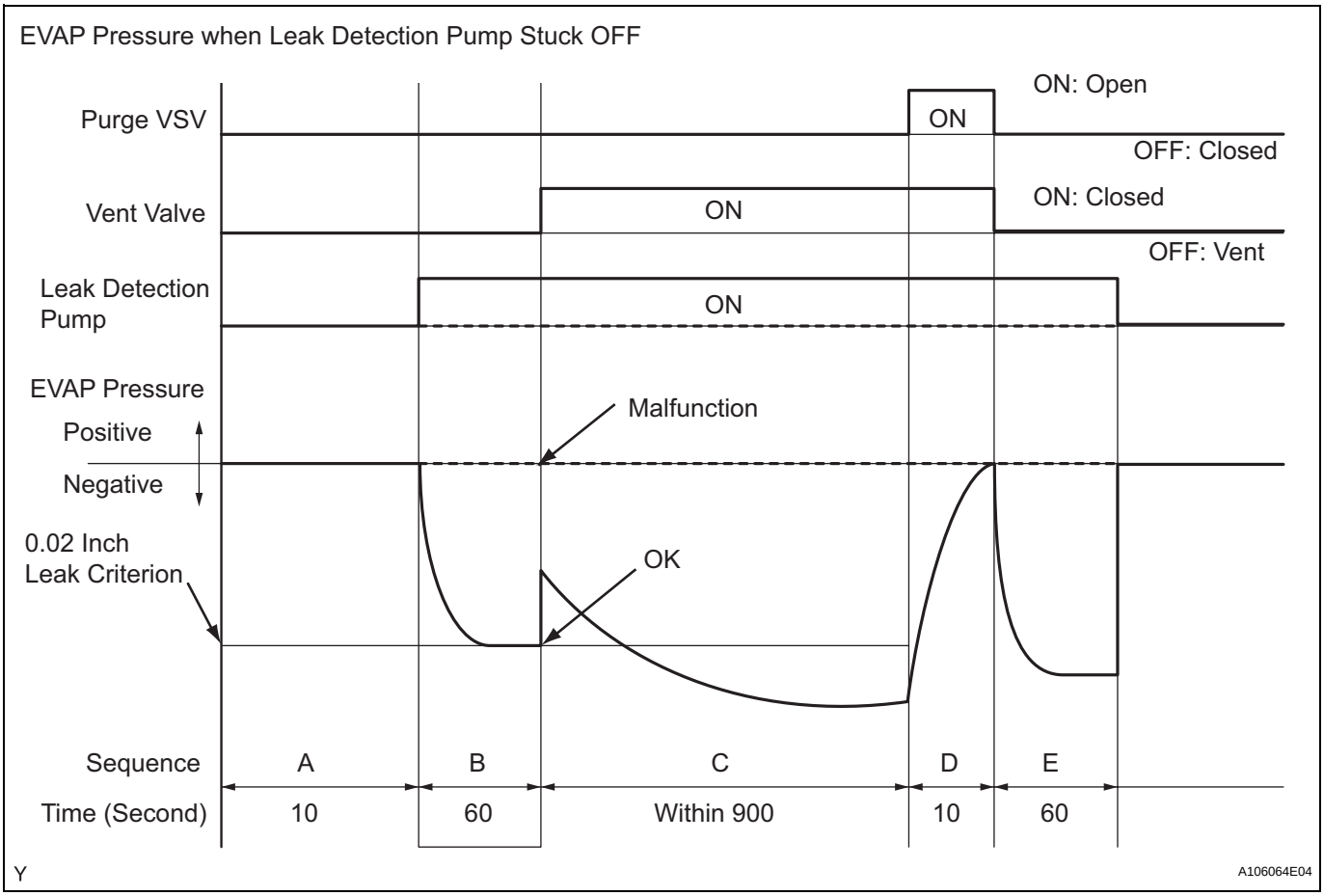
1. P2401: Leak detection pump stuck OFF
   In operation B, the leak detection pump creates negative pressure (a vacuum) through the reference orifice. The EVAP (Evaporative Emission) system pressure is then measured by the ECM, using the canister pressure sensor, to determine the 0.02 inch leak criterion. If the pressure is higher than -1.06 kPa (-7.95 mmHg)*, or lower than -4.85 kPa (-36.38 mmHg)*, the ECM interprets this as the leak detection pump being stuck OFF (not operating). The ECM illuminates the MIL and sets the DTC (2 trip detection logic).
   *: The thresholds vary according to the atmospheric pressure measured in operation A. The values described above are based on an atmospheric pressure of 100 kPa (750.1 mmHg): absolute pressure.

EVAP Pressure when Leak Detection Pump Stuck OFF



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2. P2402: Leak detection pump stuck ON
In operation B, the leak detection pump creates negative pressure (a vacuum) through the reference orifice. The EVAP (Evaporative Emission) system pressure is then measured by the ECM, using the canister pressure sensor, to determine the 0.02 inch leak criterion. If the pressure is higher than -1.06 kPa (-7.95 mmHg)*, or lower than -4.85 kPa (-36.38 mmHg)*, the ECM interprets this as the leak detection pump being stuck ON (remaining ON all the time). The ECM illuminates the MIL and sets the DTC (2 trip detection logic).
*: The thresholds vary according to the atmospheric pressure measured in operation A. The values described above are based on an atmospheric pressure of 100 kPa (750.1 mmHg): absolute pressure.



HINT:
The detection logic of DTCs P2401 and P2402 is the same because in both cases the 0.02 inch leak criterion measured in operation B is compared to the atmospheric pressure registered in operation A. The ECM calculates the difference between these pressures by deducting [the 0.02 inch leak criterion] from [the stored atmospheric pressure], and uses this to monitor the EVAP system pressure change.

MONITOR STRATEGY

Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes (varies with amount of fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Typical Enabling Conditions

Monitor runs whenever following DTCs not present	None

EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Vehicle speed	Below 2.5 mph (4 km/h)
Ignition switch	OFF
FTP sensor malfunction (P0450, P0451, P0452 and P0453)	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before IG switch OFF	Conditions 1 and 2
1. Duration that vehicle driven	5 minutes or more
2. Purge flow	Executed
ECT	4.4° to 35°C (40° to 95°F)
IAT	4.4° to 35°C (40° to 95°F)
Time after engine stopped	5 hours

Example of restart time

First time	7 hours
Second time	9 hours and 30 minutes

1. Key-off monitor sequence 1 to 8

1. Atmospheric pressure

Next sequence is run if following condition set	-
Atmospheric pressure change for 10 second	Less than 0.3 kPa (2.25 mmHg) for 1 second

2. First reference pressure

Next sequence is run if all of following conditions set	Condition 1, 2 and 3
1. FTP when 4 seconds after reference pressure measurement	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.057 kPa (-33.38 to -7.93 mmHg)
3. Reference pressure	Saturated within 60 seconds

3. Vent valve stuck closed check

Next sequence is run if following condition set	-
FTP change for 10 seconds after vent valve ON (closed)	0.3 kPa (2.25 mmHg) or more

4. Vacuum introduction and leak

Next sequence is run if both of following conditions set	Condition 1 and 2
1. Vacuum introduction time	12 minutes or less
2. FTP	Saturated within 12 minutes

5. Purge VSV stuck closed check

Next sequence is run if following condition set	-
FTP change for 10 seconds after purge VSV ON (open)	0.3 kPa (2.25 mmHg) or more

6. Second reference pressure measurement

Next sequence is run if all of following conditions set	Condition 1, 2, 3 and 4
1. FTP when 4 seconds after reference pressure measurement	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.057 kPa (-36.4 to -7.92 mmHg)
3. Reference pressure	Saturated within 60 seconds
4. Reference pressure difference between first and second	0.7 kPa (5.25 mmHg) or less

7. Leak check

Next sequence is run if following condition set	-
FTP when vacuum introduction was complete	Second reference pressure or less

8. Atmospheric pressure

Monitor is complete if following condition set	-
Atmospheric pressure difference between sequence 1 and 8	0.3 kPa (2.25 mmHg) or less

TYPICAL MALFUNCTION THRESHOLDS

One of following conditions met	-
FTP when 4 seconds after reference pressure measurement began	More than -1 kPa (-7.5 mmHg)
Reference pressure	Less than -4.85 kPa (-36.4 mmHg)
Reference pressure	-1.057 kPa (-7.9 mmHg) or more
Reference pressure	Not saturated within 60 seconds
Reference pressure difference between first and second	0.7 kPa (5.2 mmHg) or more

"Saturated" indicates that the EVAP pressure change is less than 0.1 kPa (0.75 mmHg) in 30 seconds.

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MONITOR RESULT

Refer to Checking Monitor Status (See page ES-21) or (See page ES-422).

DTC	P2419	Evaporative Emission System Switching Valve Control Circuit Low

DTC	P2420	Evaporative Emission System Switching Valve Control Circuit High

DTC SUMMARY

DTCs	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timings	Detection Logic
P2419	Vent valve stuck closed	Leak detection pump creates negative pressure through reference orifice and EVAP system pressure measured to determine leak criterion. If system pressure higher than -1.06 kPa (-7.95 mmHg)* 4 seconds after leak detection pump turned ON, ECM determines that vent valve stuck closed.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM	While ignition switch OFF	2 trip
P2420	Vent valve stuck open (vent)	leak detection pump creates negative pressure through reference orifice and EVAP system pressure measured to determine leak criterion. 0.02 inch leak criterion measured at start and at end of leak check. If system pressure does not increase by more than 0.3 kPa (2.25 mmHg) within 10 seconds when vent valve turned ON, ECM determines that vent valve stuck close.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM • Leakage from EVAP system	While ignition switch OFF	2 trip

*: The threshold value varies according to the atmospheric pressure measured in operation A. The value described above is based on an atmospheric pressure of 100 kPa (750.1 mmHg): absolute pressure.
HINT:
The vent valve is built into the canister pump module.

DESCRIPTION

The circuit description can be found in the EVAP (Evaporative Emission) System (see page ES-392).

Refer to the EVAP System (see page ES-397).

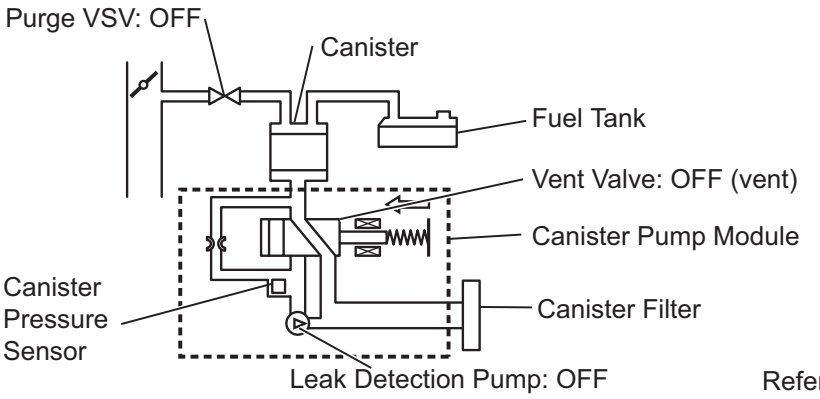
MONITOR DESCRIPTION

5 hours* after the ignition switch is turned to OFF, the electric leak detection 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:
*: 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 turned to OFF.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak criterion (reference pressure) measurement	In order to determine 0.02 inch leak criterion, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as they will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes*
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak criterion (reference pressure) measurement	After second 0.02 inch leak criterion measurement, leak check performed by comparing first and second 0.02 inch leak criterion. If stabilized system pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system leaking.	60 seconds
F	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

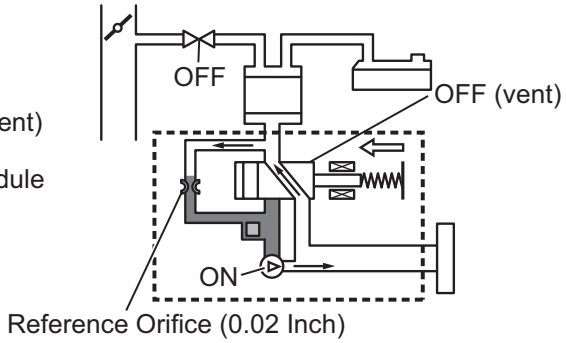
* If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.

Operation A: Atmospheric Pressure Measurement

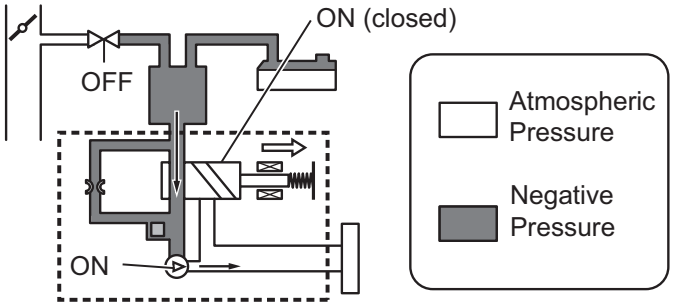


Operation B, E:

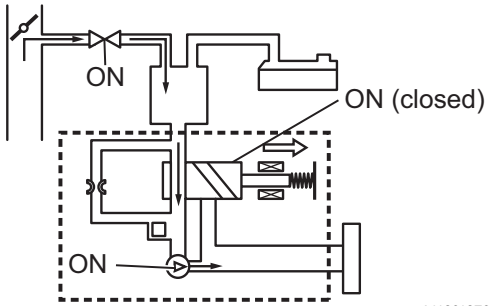
0.02 Inch Leak Criterion Measurement



Operation C: EVAP System Pressure Measurement



Operation D: Purge VSV Monitor

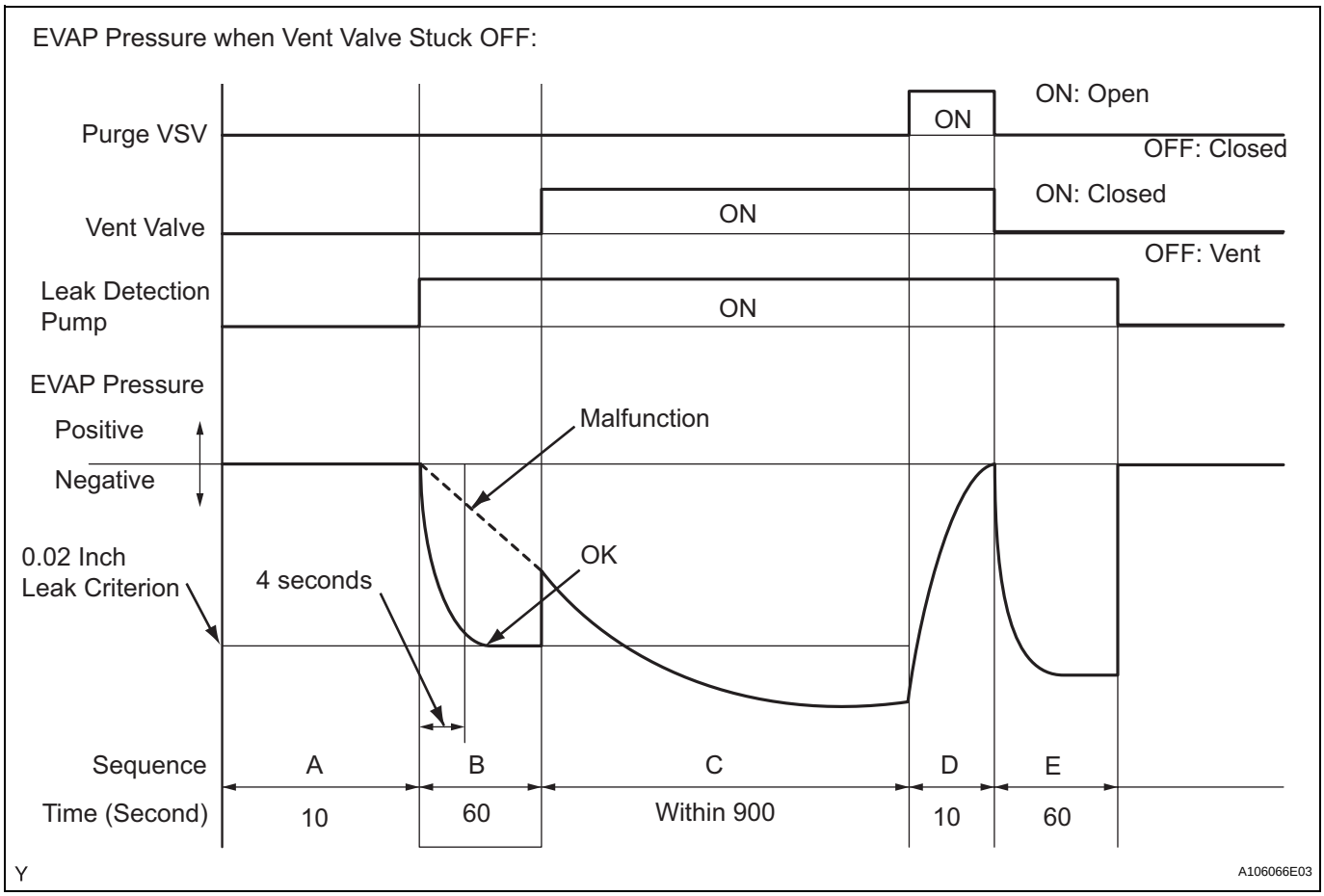


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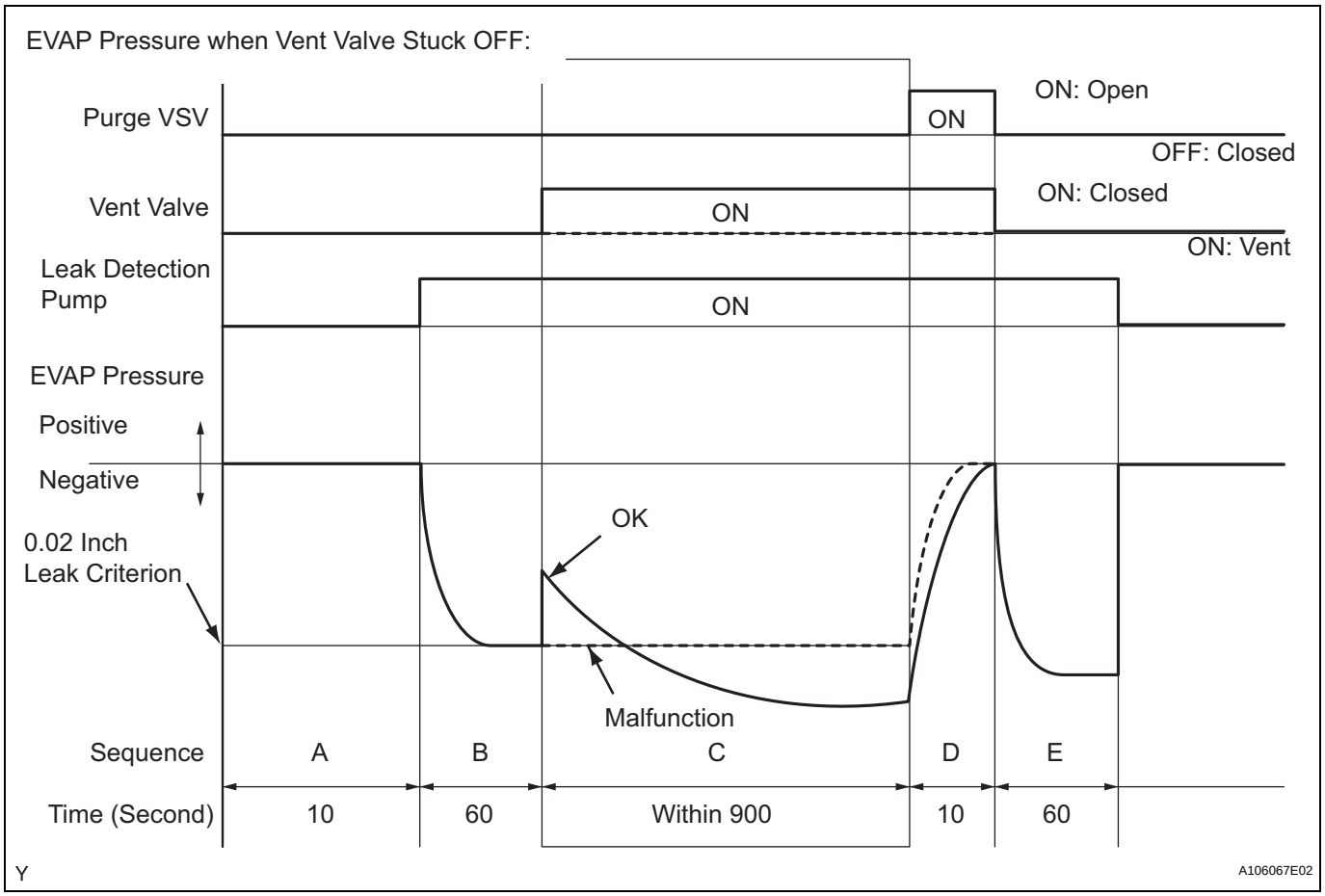
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1. P2419: Vent valve stuck closed
   In operation B, the leak detection pump creates negative pressure (a vacuum) through the reference orifice. The EVAP (Evaporative Emission) system pressure is then measured by the ECM, using the canister pressure sensor, to determine the 0.02 inch leak criterion. If the pressure exceeds -1.06 kPa (-7.95 mmHg)* 4 seconds after the leak detection pump is turned ON, the ECM interprets this as the vent valve being stuck closed.
   The ECM illuminates the MIL and sets the DTC (2 trip detection logic).
   *: The threshold varies according to the atmospheric pressure measured in operation A. The value described above is based on an atmospheric pressure of 100 kPa (750.1 mmHg): absolute pressure.



2. P2420: Vent valve stuck open (vent)
In operation C, the vent valve turns ON (closes) and the EVAP (Evaporative Emission) system pressure is then measured by the ECM, using the canister pressure sensor, to conduct an EVAP leak check. If the pressure does not increase when the vent valve is open, the ECM interprets this as the vent valve being stuck open. The ECM illuminates the MIL and sets the DTC.



ES

OBD II MONITOR SPECIFICATIONS

MONITOR STRATEGY

Required Sensors/Components	Purge VSV and Canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes (varies with amount of fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Vehicle speed	Below 2.5 mph (4 km/h)
Ignition switch	OFF
FTP sensor malfunction (P0450, P0451, P0452 and P0453)	Not detected
Purge VSV	Not operated by scan tool

Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before IG switch OFF	Conditions 1 and 2
1. Duration that vehicle driven	5 minutes or more
2. Purge flow	Executed
ECT	4.4° to 35°C (40° to 95°F)
IAT	4.4° to 35°C (40° to 95°F)
Time after engine stopped	5 hours

Example of restart time

First time	7 hours
Second time	9 hours and 30 minutes

1. Key-off monitor sequence 1 to 8

1. Atmospheric pressure

Next sequence is run if following condition set	-
Atmospheric pressure change for 10 second	Less than 0.3 kPa (2.25 mmHg) for 1 second

2. First reference pressure

Next sequence is run if all of following conditions set	Condition 1, 2 and 3
1. FTP when 4 seconds after reference pressure measurement	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.057 kPa (-33.38 to -7.93 mmHg)
3. Reference pressure	Saturated within 60 seconds

3. Vent valve stuck closed check

Next sequence is run if following condition set	-
FTP change for 10 seconds after vent valve ON (closed)	0.3 kPa (2.25 mmHg) or more

4. Vacuum introduction and leak

Next sequence is run if both of following conditions set	Condition 1 and 2
1. Vacuum introduction time	12 minutes or less
2. FTP	Saturated within 12 minutes

5. Purge VSV stuck closed check

Next sequence is run if following condition set	-
FTP change for 10 seconds after purge VSV ON (open)	0.3 kPa (2.25 mmHg) or more

6. Second reference pressure measurement

Next sequence is run if all of following conditions set	Condition 1, 2, 3 and 4
1. FTP when 4 seconds after reference pressure measurement	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.057 kPa (-36.4 to -7.92 mmHg)
3. Reference pressure	Saturated within 60 seconds
4. Reference pressure difference between first and second	0.7 kPa (5.25 mmHg) or less

7. Leak check

Next sequence is run if following condition set	-
FTP when vacuum introduction was complete	Second reference pressure or less

8. Atmospheric pressure

Monitor is complete if following	-
Atmospheric pressure difference between sequence 1 and 8	0.3 kPa (2.25 mmHg) or less

TYPICAL MALFUNCTION THRESHOLDS

P2419: Vent valve stuck closed

One of the following conditions set	-

EVAP pressure just after reference pressure measurement start	-1 kPa (-7.5 mmHg) or more
Reference pressure	Less than -4.85 kPa (-36.4 mmHg)
Reference pressure	-1.057 kPa (-7.9 mmHg) or more
0.02 inch leak criterion	Not saturated within 60 seconds
Difference between first reference pressure and second reference pressure	More than 0.7 kPa (5.25 mmHg)

P2420: Vent valve stuck open (vent)

EVAP pressure change in 10 seconds when vent valve turned ON after measurement of 0.02 inch leak criterion	Less than 0.3 kPa (2.25 mmHg)

"Saturated" indicates that the EVAP pressure change is less than 0.286 kPa (2.14 mmHg) in 60 seconds.

MONITOR RESULT

Refer to Checking Monitor Status (See page ES-21) or (See page ES-422).

DTC	P2430	Secondary Air Injection System Air Flow / Pressure Sensor Circuit Bank1
DTC	P2431	Secondary Air Injection System Air Flow / Pressure Sensor Circuit Range / Performance Bank1
DTC	P2432	Secondary Air Injection System Air Flow / Pressure Sensor Circuit Low Bank1
DTC	P2433	Secondary Air Injection System Air Flow / Pressure Sensor Circuit High Bank1

ES

DESCRIPTION

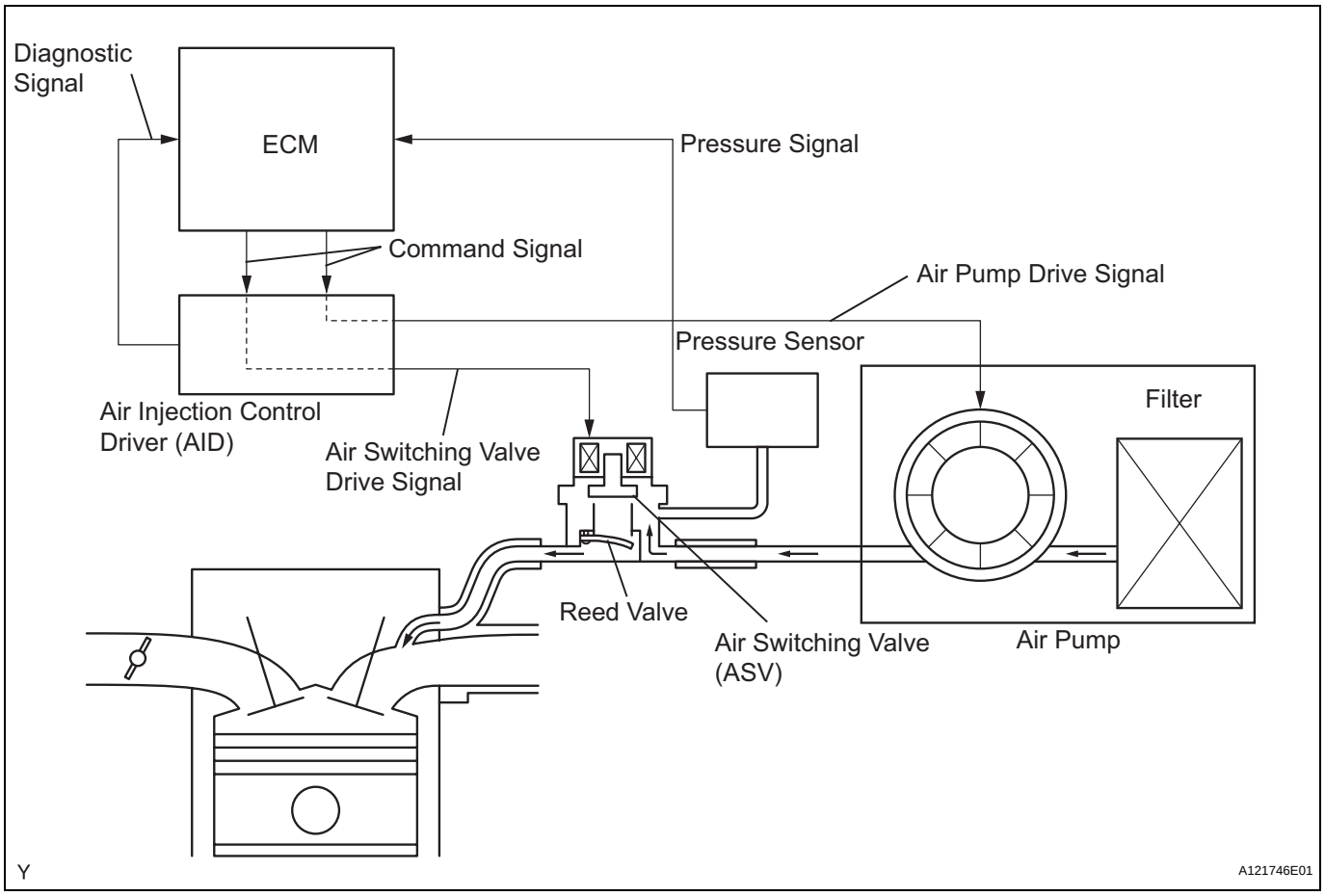
The Secondary Air injection (AIR) system consists of an air pump, the Air Switching Valve (ASV), a pressure sensor, the Air Injection Control Driver (AID) and the ECM. For a short time after cold engine starts, the AIR system pumps secondary air to the exhaust port of the cylinder head to purify the exhaust emissions. The secondary air is supplied by the air pump and is pumped to the exhaust port through the ASV.

The AID drives the ASV and the air pump according to command signals transmitted by the ECM. The pressure sensor detects the pressure in the secondary air passage when the AIR system is ON and OFF, and transmits pressure signal to the ECM.

The AID is not only equipped to drive the pump and valve, but also with a diagnosis function to detect malfunctions in the AIR system circuit.

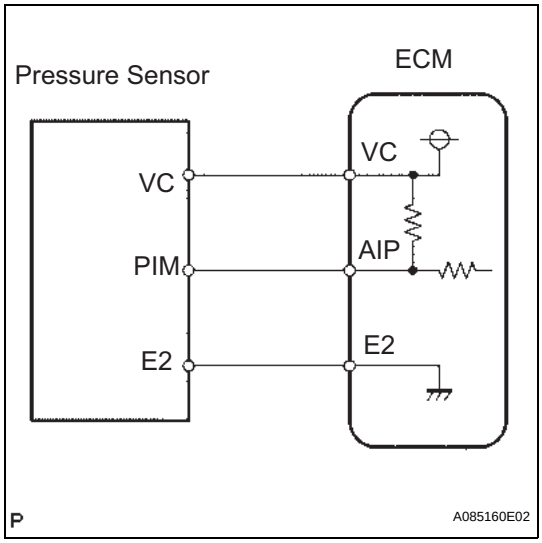
HINT:

As a large current is required to drive the air pump and ASV, an AID has been added to the previous system.



DTC No.	DTC Detection Conditions	Trouble Areas
P2430	While engine running, voltage output of pressure sensor indicates 0.1 V or less, or indicates 4.8V or more (1 trip detection logic	• Pressure sensor • Open or short in pressure sensor circuit • ECM
P2431	Pressure sensor indicates less than 45 kPa (338 mmHg), or more than 135 kPa (1,013 mmHg) (2 trip detection logic)	• Pressure sensor • Open or short in pressure sensor circuit • ECM
P2432	While engine running, voltage output of pressure sensor remains below 0.1 V (1 trip detection logic)	• Pressure sensor • Open or short in pressure sensor circuit • ECM
P2433	While engine running, voltage output of pressure sensor remains above 4.8 V (1 trip detection logic)	• Pressure sensor • Open or short in pressure sensor circuit • ECM

MONITOR DESCRIPTION



The ECM monitors the pressure in the secondary air passage using the pressure sensor located on the air switching valve in the secondary air injection system.
If there is a defect in the sensor or the sensor circuit, the voltage level deviates from the normal operating range, the ECM interprets this deviation as a malfunction in the pressure sensor or circuit and sets a DTC.

MONITOR STRATEGY

Related DTCs	P2430: Air flow/Pressure sensor circuit range check (Fluctuating) P2431: Air flow/Pressure sensor circuit rationality P2432: Air flow/Pressure sensor circuit range check (Low voltage) P2433: Air flow/Pressure sensor circuit range check (High voltage)
Required Sensors/Components (Main)	Pressure sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	P2430, P2432, P2433: 0.5 seconds P2431: 5 seconds
MIL Operation	P2430, P2432 and P2433: Immediate P2431: 2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P2430, P2432 and P2433

Monitor runs whenever following DTCs not present	None
All of following conditions met:	-
Starter	OFF
Battery voltage	8 V or more
Ignition switch	ON

P2431 Case 1:

Monitor runs whenever following DTCs not present	None
All following conditions met for:	3 seconds or more
Secondary air injection system	Operating
Starter	OFF
Battery voltage	8 V or more
Ignition switch	ON

P2431 Case 2:

Monitor runs whenever following DTCs not present	None
All following conditions met for:	3 seconds or more
Secondary air injection system	Not operating
Starter	OFF
Battery voltage	8 V or more
Ignition switch	ON

TYPICAL MALFUNCTION THRESHOLDS

P2430:

Air pressure sensor voltage	Less than 0.1 V, or more than 4.8 V

P2432:

Air pressure sensor voltage	Less than 0.1 V

P2433:

Air pressure sensor voltage	More than 4.8 V

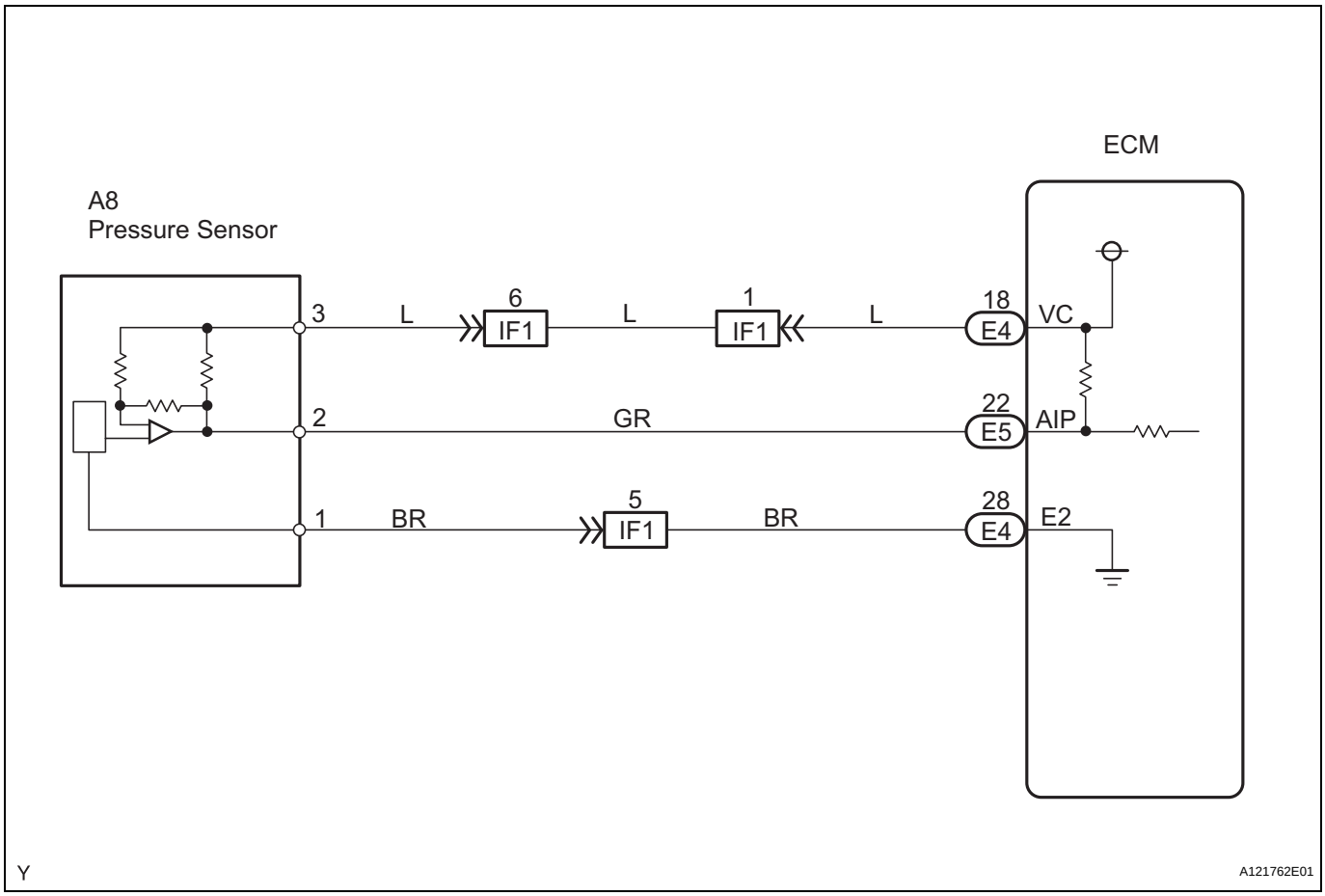
P2431:

Air Pressure	Less than 45 kPa (338 mmHg), or more than 135 kPa (1,013 mmHg)

COMPONENT OPERATING RANGE

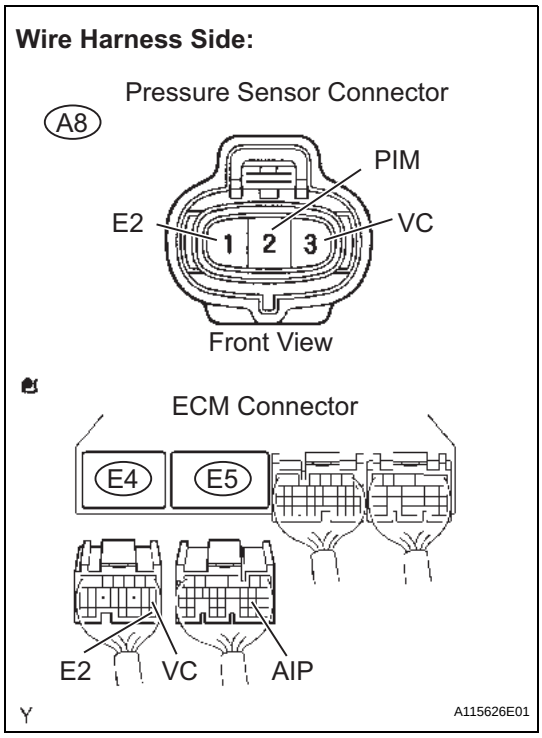
Air pressure sensor voltage	Between 0.1 V and 4.8 V

WIRING DIAGRAM



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

1 CHECK HARNESS AND CONNECTOR (PRESSURE SENSOR - ECM)



(a) Disconnect the A8 pressure sensor connector.
(b) Disconnect the E4 and E5 ECM connectors.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
Pressure sensor (A8-1) - E2 (E4-28)	Below 1 Ω
Pressure sensor (A8-2) - AIP (E5-22)	Below 1 Ω
Pressure sensor (A8-3) - VC (E4-18)	Below 1 Ω

Standard Resistance (Check for short)

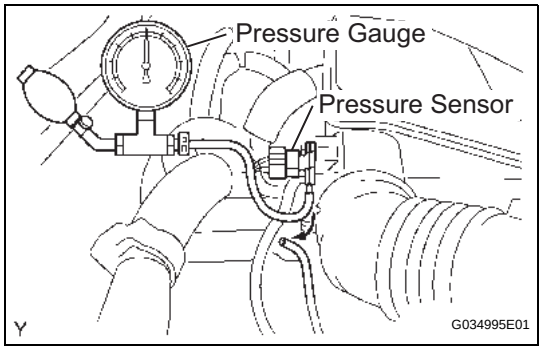
Tester Connections	Specified Conditions
Pressure sensor (A8-2) or AIP (E5-22) - Body ground	10 kΩ or higher
Pressure sensor (A8-3) or VC (E4-18) - Body ground	10 kΩ or higher

(d) Reconnect the pressure sensor connector.
(e) Reconnect the ECM connectors.

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

OK

2 INSPECT ECM (AIP VOLTAGE)



(a) Connect a pressure gauge to the air pressure sensor as shown in the illustration.
(b) Connect an intelligent tester to the DLC3.
(c) Turn the ignition switch to ON and turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / AIR PMP PRS(A).
(e) Check that the pressure displayed on the tester fluctuates when applying the pressure to the pressure sensor with the pressure gauge.
HINT:
The tester displays the air pump pressure (AIR PMP PRS(A)) as absolute pressure.

NG → **REPLACE PRESSURE SENSOR (TURBO PRESSURE SENSOR)**

OK

REPLACE ECM

DTC	P2440	Secondary Air Injection System Switching Valve Stuck Open Bank1

DTC	P2441	Secondary Air Injection System Switching Valve Stuck Close Bank1

DESCRIPTION

Refer to DTC P0412 (See page ES-189).

DTC No.	DTC Detection Conditions	Trouble Areas
P2440	Pressure sensor detects pulsation of exhaust gas despite ECM commanding Air Switching Valve (ASV) to close, while engine running (2 trip detection logic)	• ASV • Open or short in ASV circuit • Pressure sensor • Pressure sensor circuit • Air Injection Control Driver (AID) • ECM
P2441	Pressure sensor detects no pulsation of exhaust gas despite ECM commanding Air Switching Valve (ASV) to open, while engine running (2 trip detection logic)	• ASV • Open or short in ASV circuit • Vacuum hose (ASV - pressure sensor) • Air injection hose • Pressure sensor • Pressure sensor circuit • Air Injection Control Driver (AID) • ECM

HINT:
Air switching valve normal operation:
When the Air Switching Valve (ASV) is open, exhaust gas pulsation occurs in the secondary air passage.
When the ASV is closed, exhaust gas pulsation does not occur in the secondary air passage.

MONITOR DESCRIPTION

The ECM monitors the pressure in the secondary air passage using the pressure sensor connected to the ASV of the Secondary Air Injection (AIR) system.
If either of the following conditions occurs, the ECM interprets it as a malfunction of the secondary AIR system, and illuminates the MIL and sets a DTC:

- Exhaust gas pulsation is detected by the pressure sensor despite the ECM commanding the ASV to close.
- Exhaust gas pulsation is not detected by the pressure sensor despite the ECM commanding the ASV to open.

MONITOR STRATEGY

Related DTCs	P2440: Air control valve stuck open P2441: Air control valve stuck closed
Required Sensors/Components (Main)	Pressure sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Once per drive cycle
Duration	7 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs not present	• P0010 - P0022: VVT system • P0031 - P0052: Front A/F sensor heater • P0100 - P0103: MAF sensor • P0110 - P0113: IAT sensor • P0115 - P0118: ECT sensor • P0120 - P2125: TP sensor • P0125: Closed loop • P0171 - P0175: Fuel trim • P0300 - P0308: Misfire • P0325 - P0333: Knock sensor • P0335: CKP sensor • P0340 - P0346: VVT sensor • P0351 - P0358: Igniter • P0441 - P2420: EVAP system • P0500: VSS • P1340: CMP sensor • P2195 - P2A03: A/F sensor • P2430 - P2433: AIR pressure sensor
Battery voltage	11 V or more
Atmospheric pressure	45 kPa (337.5 mmHg) or more

While secondary air injection ON:

Time after secondary injection operation begins	6 seconds or more
Secondary air injection pump	ON
Secondary air injection switching valve	ON
Engine speed	Less than 3,750 rpm
Delay time after engine started	6 seconds or more
Pressure sensor malfunction	Not detected

While secondary air injection OFF:

Secondary air injection pump	OFF
Engine speed	Less than 3,750 rpm
Secondary air injection system monitor during secondary air injection ON	Completed
Pressure sensor malfunction	Not detected

TYPICAL MALFUNCTION THRESHOLDS

Condition 1:

AIR pressure during AIR ON	2.5 kPa or more and pulse is generated

Condition 2:

AIR pressure during AIR ON	Less than 2.5 kPa and pulse is generated

Condition 3:

AIR pressure during AIR ON	2.5 kPa or more and pulse is not generated

Condition 4:

AIR pressure during AIR ON	Less than 2.5 kPa and pulse is not generated

Condition 5:

AIR pressure during AIR OFF	2.5 kPa or more and pulse is generated

Condition 6:

AIR pressure during AIR OFF	Less than 2.5 kPa and pulse is generated

Condition 7:

AIR pressure during AIR OFF	2.5 kPa or more and pulse is not generated

Condition 8:

AIR pressure during AIR OFF	Less than 2.5 kPa and pulse is not generated

P2440: ASV stuck open

Any of following conditions met:	(a), (b) or (c)
(a) Conditions 1 and 6	Met
(b) Conditions 1 and 5	Met
(c) Conditions 2 and 6	Met

P2441: ASV stuck closed

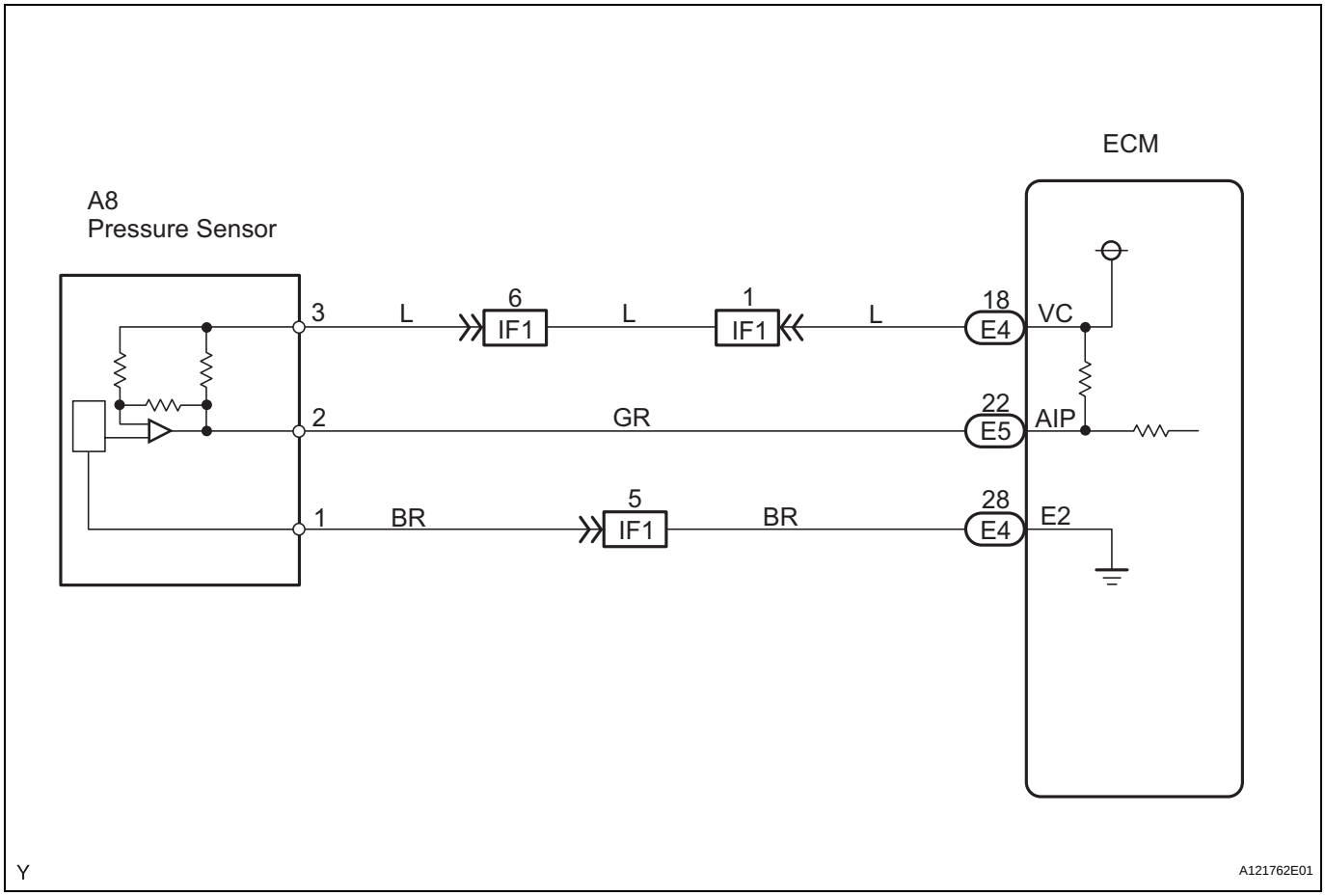
Any of following conditions met:	(a), (b) or (c)
(a) Conditions 3 and 7	Met
(b) Conditions 3 and 8	Met
(c) Conditions 4 and 8	Met

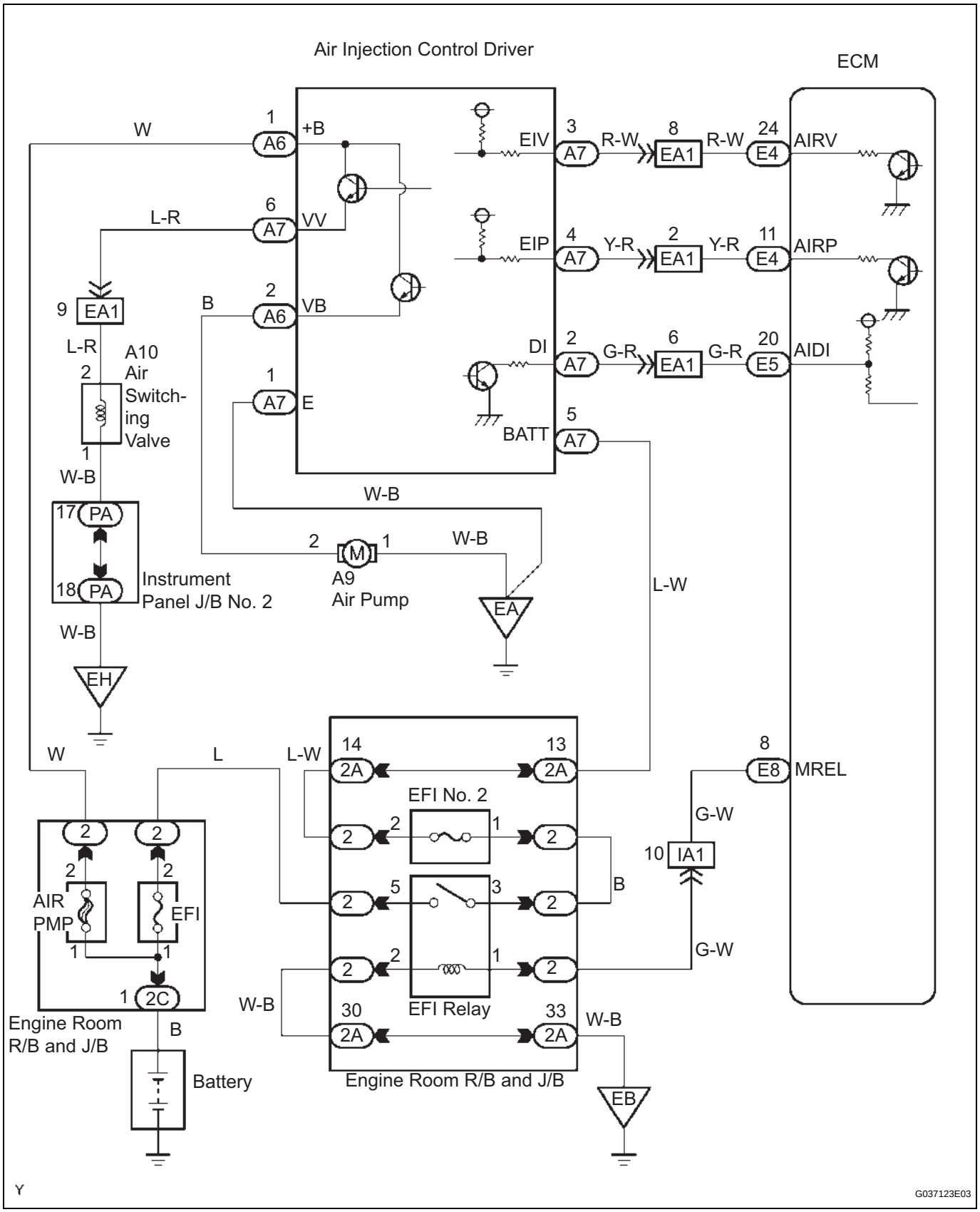
ES

MONITOR RESULT

Refer to Checking Monitor Status (See page ES-21).

WIRING DIAGRAM





HINT:
Determination by ECM monitoring:

The ECM locates malfunctions in the Secondary Air Injection (AIR) system by detecting the pressure in the AIR passage between the air pump and Air Switching Valve (ASV) and sets a DTC. Soon after cold engine starts, the monitor runs for a short time while the AIR system is both ON and OFF. The ECM detects both the pressure and the exhaust pulsation and compares them.
The following 4 patterns are AIR system pressure conditions in the AIR system passage.

Pressure condition in Secondary Air Injection System Case 1:

Air Pump	ON
Air Switching Valve	Open
Pressure	2.5 kPa or more
Pulsation Detection	Exhaust gas pulsation detected

Pressure condition in Secondary Air Injection System Case 2:

Air Pump	OFF
Air Switching Valve	Open
Pressure	Less than 2.5 kPa
Pulsation Detection	Exhaust gas pulsation detected

ES

Pressure condition in Secondary Air Injection System Case 3:

Air Pump	ON
Air Switching Valve	Closed
Pressure	2.5 kPa or more
Pulsation Detection	Slight pulsation detected

Pressure condition in Secondary Air Injection System Case 4:

Air Pump	OFF
Air Switching Valve	Open
Pressure	Less than 2.5 kPa
Pulsation Detection	Exhaust gas pulsation detected

If the detected pressure is high, the air pump is assumed to be ON and if it alternates sharply*, the ASV is assumed to be open. The ECM locates malfunctions from the combination of pressures detected when the AIR system is ON and OFF.
*: The exhaust pulsation value is calculated in the ECM. If the calculated value exceeds a certain level, the ECM determines that the exhaust pulsation is in the AIR system.
HINT:

- In case 3, as the pressure sensor detects a slight pump operation pulsation, the detected value is not constant. Since the pump outlet is blocked by closing the ASV, the average pressure is higher than in case 1 (approximately 20 to 30 kPa).
- In case 1, the average pressure is approximately 9 to 11 kPa. The value of 2.5 kPa indicated in the table above is a threshold for detecting pump malfunctions.

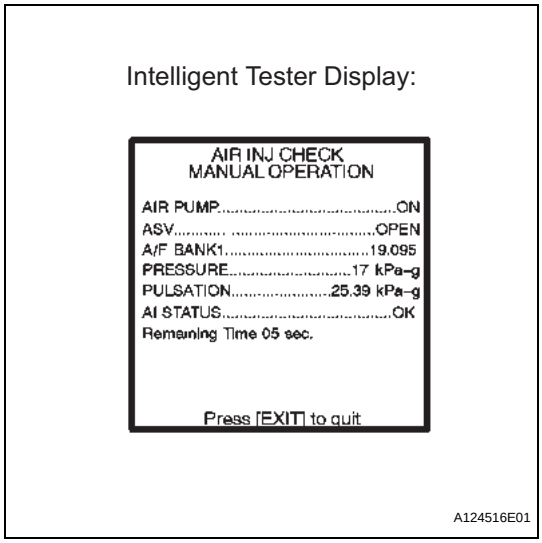
Detected Conditions while AIR operating: Air pump ON, ASV Open	Detected Conditions while AIR not operating: Air pump OFF, ASV Closed	ECM Determination	DTCs Output
Case 1	Case 4	Normal	-
Case 1	Case 2	ASV stuck open	P2440
Case 1	Case 3	Air pump stuck ON	P2444
Case 2	Case 4	Air pump stuck OFF	P2445
Case 3	Case 4	ASV stuck closed	P2441
Case 1	Case 1	ASV stuck open and Air pump stuck ON	P2440 and P2444
Case 2	Case 2	ASV stuck open and Air pump stuck OFF	P2440 and P2445
Case 3	Case 3	ASV stuck closed and Air pump stuck ON	P2441 and P2444

Detected Conditions while AIR operating: Air pump ON, ASV Open	Detected Conditions while AIR not operating: Air pump OFF, ASV Closed	ECM Determination	DTCs Output
Case 4	Case 4	ASV stuck closed and Air pump stuck OFF	P2441 and P2445

HINT:
- If the vacuum hose between the ASV and the pressure sensor is not connected correctly, case 4 may occur.
- By using an intelligent tester to perform the AIR INJ CHECK operation in the SYSTEM CHECK, the air-fuel ratio and the pressure in the secondary air injection system passage can be checked while the secondary air injection system is operating. This helps technicians to troubleshoot the system when it malfunctions. Furthermore, PENDING CODES also can be checked by performing SYSTEM CHECK / AUTOMATIC OPERATION after the repair.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

ES

SYSTEM CHECK:
The pressure in the secondary air passage can be checked using an intelligent tester.
(a) Start the engine and warm it up.



(b) Turn the ignition switch to OFF.
(c) Connect an intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Select the following menu items:
DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV: OPEN and AP: OFF, ASV CLOSE.
HINT:
When MANUAL OPERATION is selected, the tester initialization (atmospheric pressure measurement) is performed automatically. The initialization takes 10 seconds. After the initialization, AP and ASV operation can be selected.
(f) Start the engine.
(g) Perform the AIR system intrusive operation while the engine is idling.
(h) Check that the air pump (AIR PUMP), ASV and pressure in the AIR system passage (PRESSURE) displayed on the tester, indicate the conditions shown in the table below.

Standard

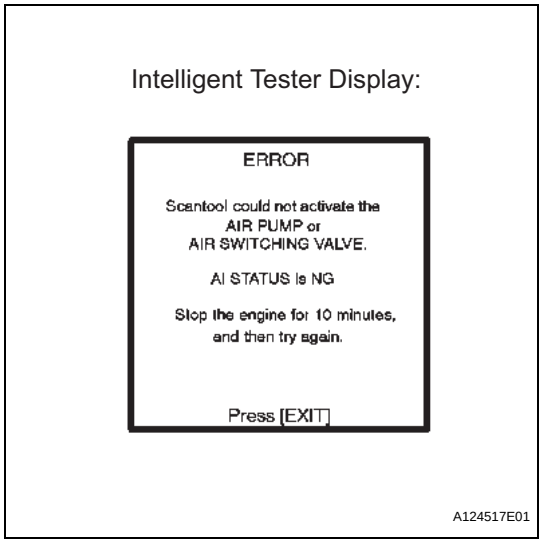
Intelligent Tester Operations	AIR PUMP	ASV	PRESSURE *1	PULSATION *2
AP: ON, ASV: OPEN	ON	OPEN	2.5 kPa or more	11.25 kPa or more

Intelligent Tester Operations	AIR PUMP	ASV	PRESSURE *1	PULSATION *2
AP: OFF, ASV: CLOSE	OFF	CLOSE	Less than 2.5 kPa	Less than 11.25 kPa

*1:
Average pumping pressure (gauge pressure). The pressure should be 2.5 kPa or more when the AIR system operates.

*2:
The cumulative exhaust pulsation calculated by the ECM. If the calculated value exceeds a certain level, the ECM determines that the exhaust pulsation is in the AIR system.

(i) Turn the ignition switch to OFF.



NOTICE:

- **This AIR INJECTION CHECK only allows technicians to operate the AIR system for a maximum of 5 seconds.**
  Furthermore, the check can only be performed up to 4 times per trip. If the test is repeated, intervals of at least 30 seconds are required between checks.
  While AIR system operation using the intelligent tester is prohibited, the tester display indicates the prohibition (WAIT or ERROR).
  If an ERROR as shown in the illustration is displayed on the tester during the test, stop the engine for 10 minutes, and then try again.
- **Performing the AIR INJ CHECK repetitively may cause damage to the AIR system. If necessary, leave an interval of several minutes between SYSTEM CHECK operations to prevent the system from overheating.**
- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

1	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO SECONDARY AIR INJECTION SYSTEM DTCS)**

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

Result

Display (DTC Output)	Proceed To
P2440 and/or P2441	A
P2440 and/or P2441, and P0412	B
P2440 and/or P2441, and other DTCs (except P0412)	C

If any DTCs other than P2440 and/or P2441 are output, troubleshoot those DTCs first.

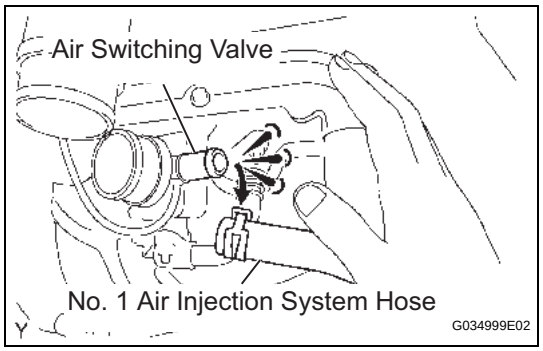
B → **GO TO AIR SWITCHING VALVE INSPECTION PROCEDURE**

C → **GO TO DTC CHART**

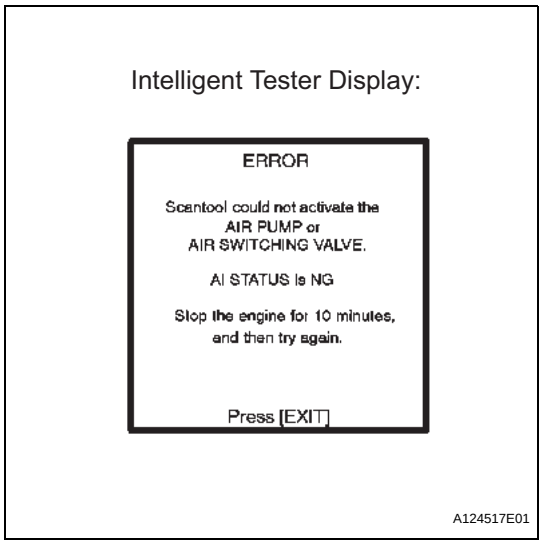
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ES

2 PERFORM ACTIVE TEST USING INTELLIGENT TESTER



(a) Visual check
  (1) Start the engine and warm it up.
  (2) Turn the ignition switch to OFF.
  (3) Disconnect the No. 1 air injection system hose.
  (4) Connect the intelligent tester to the DLC3.
  (5) Turn the ignition switch to ON and turn the tester ON.
  (6) Select the following menu items:
  DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV: OPEN.
  HINT:
  When MANUAL OPERATION is selected, the tester initialization (atmospheric pressure measurement) is performed automatically. The initialization takes 10 seconds. After the initialization, AP and ASV operation can be selected.
  (7) Start the engine.
  (8) Perform the AIR system intrusive operation while the engine is idling.
  (9) Place your hand near the air switching valve port and check that the exhaust gas pressure pulsates when the ASV is turned ON.
  CAUTION:
  To avoid the danger of being burned by the exhaust gas, bring your hand close to the valve port slowly.
  (10) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV: CLOSE.
  (11) Check that the exhaust gas does not pulsate when the ASV is turned OFF.



(12) Turn the ignition switch to OFF.

NOTICE:

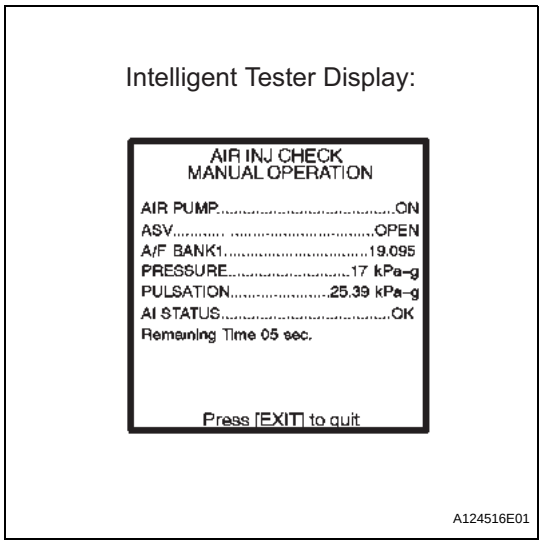
- **This AIR INJECTION CHECK only allows technicians to operate the AIR system for a maximum of 5 seconds. Furthermore, the check can only be performed up to 4 times per trip. If the test is repeated, intervals of at least 30 seconds are required between checks.**
  While AIR system operation using the intelligent tester is prohibited, the tester display indicates the prohibition (WAIT or ERROR).
  If an ERROR as shown in the illustration is displayed on the tester during the test, stop the engine for 10 minutes, and then try again.
- **Performing the AIR INJ CHECK repetitively may cause damage to the AIR system. If necessary, leave an interval of several minutes between SYSTEM CHECK operations to prevent the system from overheating.**
- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

Standard

Air Pump Operations	ASV Operations	Exhaust Gas Pulsation
ON	OFF	Not detected
ON	ON	Detected

(13) Reconnect the No. 1 air injection system hose.

(14) Reconnect the air cleaner hose.



(b) Other inspection method:

The ASV operation can be confirmed by checking the cumulative pressure pulsation* provided in the SYSTEM CHECK.

Perform SYSTEM CHECK operation under MANUAL OPERATION.

*: The exhaust pulsation value is calculated in the ECM. If the calculated value exceeds a certain level, the ECM determines that the exhaust pulsation is in the AIR system.

(1) Start the engine and warm it up.
(2) Turn the ignition switch to OFF.
(3) Connect the intelligent tester to the DLC3.
(4) Turn the ignition switch to ON and turn the tester ON.
(5) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV OPEN and AP: OFF, ASV: CLOSE.

(6) Start the engine after the tester initialization is finished.
(7) Perform the AIR system intrusive operation while the engine is idling.
(8) Check that the air-fuel ratio and pressure in the secondary air injection system passage (PULSATION) displayed on the tester, indicate the conditions shown in the table below.
(9) Turn the ignition switch to OFF.

Result

AIR System Operations	Pulsation Conditions (ECM Calculation)	Air-Fuel Ratio (Reference)
AP: ON, ASV: OPEN	11.25 kPa or more	18 or more
AP: OFF, ASV: CLOSE	Less than 11.25 kPa	Approximately 14.5 (around stoichiometric air-fuel ratio)

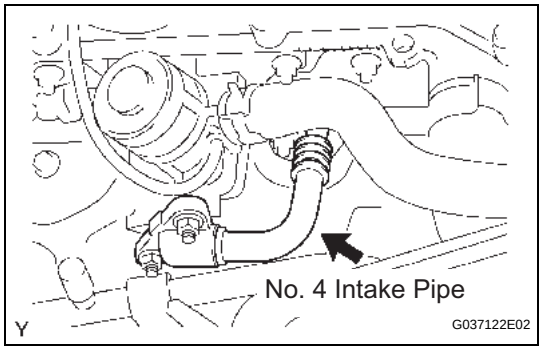
ES

REFERENCE:
If the air pump operation is confirmed as normal (See page ES-368), the air-fuel ratio detected in front of three-way catalytic converter changes in response to the secondary air pumped into the exhaust port when the air pump operates.

OK → **Go to step 9**

NG

3 INSPECT NO.4 INTAKE PIPE (BLOCKAGES AND LEAKAGES)



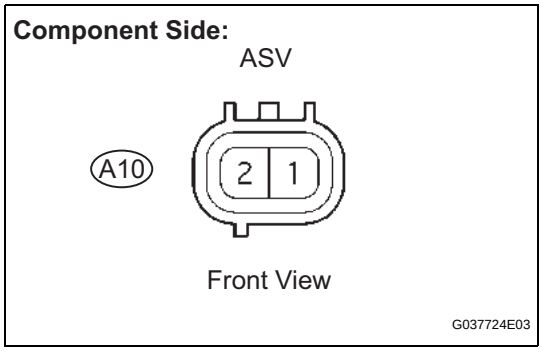
(a) Check that the No. 4 intake pipe is securely connected to both the exhaust manifold and the ASV.
(b) Inspect the No. 4 intake pipe for blockages and damage.
OK:
No blockages and damage on No. 4 intake pipe.

NG → **REPLACE NO.4 INTAKE PIPE**

OK

4 INSPECT AIR SWITCHING VALVE ASSEMBLY (AIR SWITCHING VALVE OPERATION)

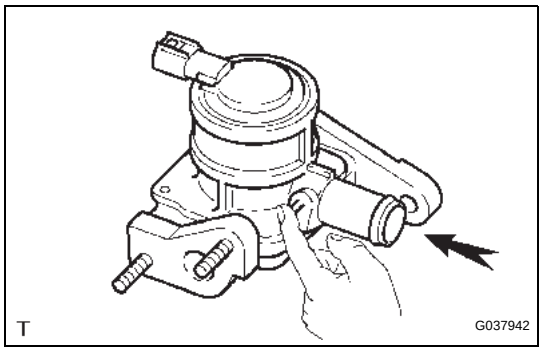
Component Side:



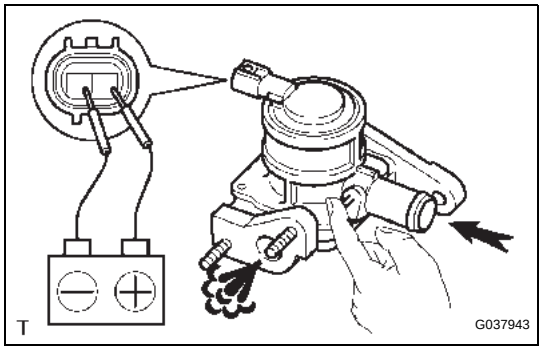
(a) Check the resistance.
(1) Using an ohmmeter, measure the resistance between the terminals.
Standard Resistance

Tester Connections	Specified Conditions
A10-1 - A10-2	3 to 10 Ω at 20°C (68°F)

If the result is not as specified, replace the ASV.



(b) Check the operation.
(1) Check that air does not flow from the ports.

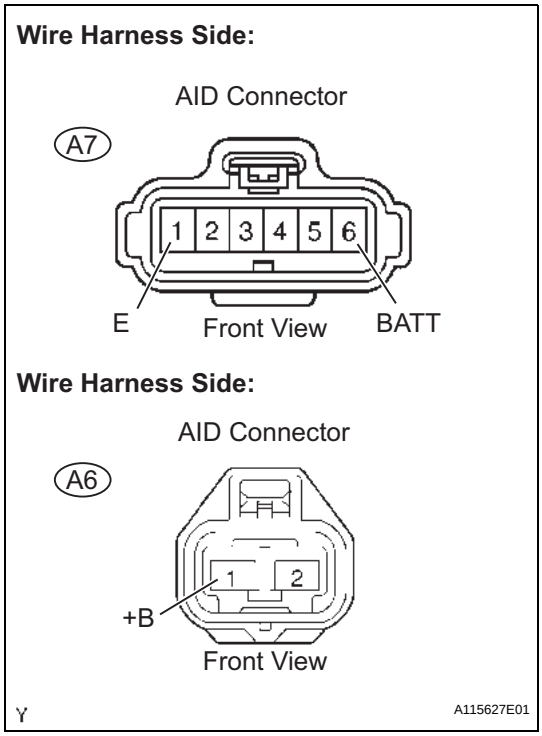


(2) Apply the battery positive voltage across the terminals.
(3) Check that air flows from the ports.
If the operation is not as specified, replace the ASV.
OK:
ASV operates correctly

NG → **REPLACE AIR SWITCHING VALVE ASSEMBLY**

OK

5	INSPECT AIR INJECTION CONTROL DRIVER (POWER SOURCE OF AIR INJECTION CONTROL DRIVER)



(a) Disconnect the A6 and A7 AID connectors.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between the terminals of the AID connector.
Standard Voltage

Tester Connections	Specified Conditions
BATT (A7-5) - Body ground	9 to 14 V (near battery voltage)
+B (A6-1) - Body ground	9 to 14 V (near battery voltage)

(d) Check the resistance.
Standard Resistance (Check for open)

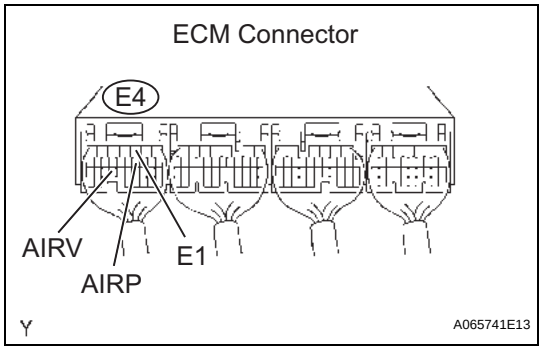
Tester Connections	Specified Conditions
E (A7-1) - Body ground	Below 1 Ω

(e) Reconnect the AID connectors.

NG → **REPAIR OR REPLACE AIR INJECTION CONTROL DRIVER POWER SOURCE CIRCUIT**

OK

6	PERFORM ACTIVE TEST USING INTELLIGENT TESTER



(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV: OPEN and AP: OFF, ASV: CLOSE.
(f) Start the engine after the tester initialization is finished.
(g) Operate the AIR system using the SYSTEM CHECK function and measure the voltage between the terminals of the ECM connector.
(h) Turn the ignition switch to OFF.

NOTICE:

- **Do not perform the SYSTEM CHECK operation repetitively. It may cause damage to the system. If necessary, leave an interval of several minutes between SYSTEM CHECK operations.**
- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

Standard Voltage

Intelligent Tester Operations	Voltmeter Connections	Specified Conditions
AP: ON, ASV: OPEN	AIRP (E4-11) - E1 (E4-3)	3.5 to 7.5 V
AP: OFF, ASV: CLOSE	AIRP (E4-11) - E1 (E4-3)	10 V or more
AP: ON, ASV: OPEN	AIRV (E4-24) - E1 (E4-3)	3.5 to 7.5 V
AP: OFF, ASV: CLOSE	AIRV (E4-24) - E1 (E4-3)	10 V or more

NG → Go to step 11

OK

7	REPLACE AIR INJECTION CONTROL DRIVER

NEXT

8	CHECK WHETHER DTC OUTPUT RECURS (DTC P2440 AND/OR P2441)

(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Clear DTCs (where set) (see page ES-40).
(f) Select the following menu items:

DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / AUTOMATIC OPERATION.

(g) Start the engine after the tester initialization is finished.
(h) Perform the SYSTEM CHECK operation by pressing ENTER.
(i) After operating the AIR system, press the ENTER button to confirm the AIR system pending codes.
(j) Check PENDING DTCs.
(k) Turn the ignition switch to OFF.

OK:

No pending DTC output.

NOTICE:

- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

ES

NEXT

END

9	INSPECT VACUUM HOSES (AIR SWITCHING VALVE - PRESSURE SENSOR)

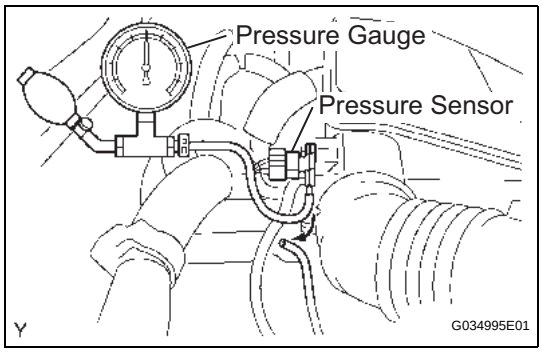
OK:

No blockage and no deformation in vacuum hose.

NG → **REPAIR OR REPLACE VACUUM HOSE**

OK

10	INSPECT ECM (AIP VOLTAGE)



(a) Connect a pressure gauge to the air pressure sensor as shown in the illustration.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch to ON and turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD ll / DATA LIST / AIR PMP PRS(A).
(e) Check that the pressure displayed on the tester fluctuates when applying pressure to the pressure sensor with the pressure gauge.

OK:

Pressure fluctuates in response to pressure applied with pressure gauge.

HINT:

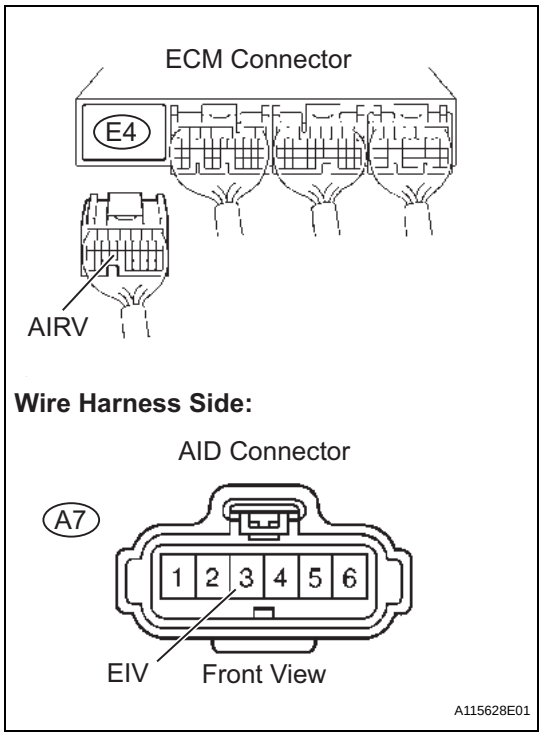
The tester displays the air pump pressure (AIR PMP PRS(A)) as absolute pressure.

NG → **REPLACE PRESSURE SENSOR (TURBO PRESSURE SENSOR)**

OK

CHECK FOR INTERMITTENT PROBLEMS

11 **CHECK HARNESS AND CONNECTOR (ECM - AIR INJECTION CONTROL DRIVER)**



(a) Disconnect the E4 ECM connector.
(b) Disconnect the A7 AID connector.
(c) Check the resistance.
Standard Resistance (Check for open)

Tester Connections	Specified Conditions
AIRV (E4-24) - EIV (A7-3)	Below 1 Ω

(d) Reconnect the ECM and AID connectors.

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

OK

REPLACE ECM

ES

DTC	P2444	Secondary Air Injection System Pump Stuck On Bank1

DTC	P2445	Secondary Air Injection System Pump Stuck Off Bank1

DESCRIPTION

Refer to P2440 (See page ES-354).

DTC No.	DTC Detection Conditions	Trouble Areas
P2444	Secondary air pressure more than 2.5 kPa (19 mmHg) despite ECM commanding air pump to turn off (2 trip detection logic)	• Short in air pump circuit • Open or short in pressure sensor circuit • Pressure sensor • Air Injection Control Driver (AID) • ECM
P2445	Secondary air pressure less than 2.5 kPa (19 mmHg) despite ECM commanding air pump to turn on (2 trip detection logic)	• Air pump • Open in air pump circuit • Air injection system piping • Vacuum hose (pressure sensor - air switching valve) • Pressure sensor • Open or short in pressure sensor circuit • Air Injection Control Driver (AID) • ECM

ES

MONITOR DESCRIPTION

The ECM monitors the pressure in the secondary air passage using the pressure sensor located on the Air Switching Valve (ASV) of the Secondary Air Injection (AIR) system. The sensor measures the pressure in the secondary air passage and transmits a signal to the ECM.
If either of the following conditions occurs, the ECM interprets it as a malfunction of the AIR system, and illuminates the MIL and sets a DTC:

- The pressure indicated by the pressure sensor does not reach threshold levels despite the ECM turning on the air pump.
- The pressure indicated by the pressure sensor exceeds threshold levels despite the ECM turning off the air pump.

MONITOR STRATEGY

Related DTCs	P2444: Air pump stuck ON P2445: Air pump stuck OFF
Required Sensors/Components (Main)	Pressure sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Once per drive cycle
Duration	7 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs not present	• P0010 - P0022: VVT system • P0031 - P0052: Front A/F sensor heater • P0100 - P0103: MAF sensor • P0110 - P0113: IAT sensor • P0115 - P0118: ECT sensor • P0120 - P2125: TP sensor • P0125: Closed loop • P0171 - P0175: Fuel trim • P0300 - P0308: Misfire • P0325 - P0333: Knock sensor • P0335: CKP sensor • P0340 - P0346: VVT sensor • P0351 - P0358: Igniter • P0441 - P2420: EVAP system • P0500: VSS • P1340: CMP sensor • P2195 - P2A03: A/F sensor • P2430 - P2433: AIR pressure sensor
Battery voltage	11 V or more
Atmospheric pressure	45 kPa (337.5 mmHg) or more

While secondary air injection ON:

Secondary air injection pump	ON
Secondary air injection switching valve	ON
Engine speed	Less than 3,750 rpm
Delay time after engine started	6 seconds or more
Pressure sensor malfunction	Not detected

While secondary air injection OFF:

Secondary air injection pump	OFF
Engine speed	Less than 3,750 rpm
Secondary air injection system monitor during secondary air injection ON	Completed
Pressure sensor malfunction	Not detected

TYPICAL MALFUNCTION THRESHOLDS

Condition 1:

AIR pressure during AIR ON	2.5 kPa or more and pulse is generated

Condition 2:

AIR pressure during AIR ON	Less than 2.5 kPa and pulse is generated

Condition 3:

AIR pressure during AIR ON	2.5 kPa or more and pulse is not generated

Condition 4:

AIR pressure during AIR ON	Less than 2.5 kPa and pulse is not generated

Condition 5:

AIR pressure during AIR OFF	2.5 kPa or more and pulse is generated

Condition 6:

AIR pressure during AIR OFF	Less than 2.5 kPa and pulse is generated

Condition 7:

AIR pressure during AIR OFF	2.5 kPa or more and pulse is not generated

Condition 8:

AIR pressure during AIR OFF	Less than 2.5 kPa and pulse is not generated

P2444: AIR pump stuck ON

Both of following conditions met:	(a) and (b)
(a) Not condition 6	Met
(b) Not condition 8	Met

P2445: AIR pump stuck OFF

Both of following conditions met:	(a) and (b)
(a) Not condition 1	Met
(b) Not condition 3	Met

P2445: AIR insufficient

AIR amount	0 L/min or less

ES

MONITOR RESULT

Refer to Checking Monitor Status (See page ES-21).

WIRING DIAGRAM

Refer to DTC P2440 (See page ES-356).

HINT:
Determination by ECM monitoring:
The ECM locates malfunctions in the secondary Air Injection (AIR) system by detecting the pressure in the AIR passage between the air pump and Air Switching Valve (ASV) and sets a DTC. Soon after cold engine starts, the monitor runs for a short time while the AIR system is both ON and OFF. The ECM detects both the pressure and the exhaust pulsation and compares them.
The following 4 patterns are AIR system pressure conditions in the AIR system passage.

Pressure condition in Secondary Air Injection System Case 1:

Air Pump	ON
Air Switching Valve	Open
Pressure	2.5 kPa or more
Pulsation Detection	Exhaust gas pulsation detected

Pressure condition in Secondary Air Injection System Case 2:

Air Pump	OFF
Air Switching Valve	Open
Pressure	Less than 2.5 kPa
Pulsation Detection	Exhaust gas pulsation detected

Pressure condition in Secondary Air Injection System Case 3:

Air Pump	ON
Air Switching Valve	Closed
Pressure	2.5 kPa or more
Pulsation Detection	Slight pulsation detected

Pressure condition in Secondary Air Injection System Case 4:

Air Pump	OFF
Air Switching Valve	Closed
Pressure	Less than 2.5 kPa
Pulsation Detection	Exhaust pulsation not detected

If the detected pressure is high, the air pump is assumed to be ON and if it alternates sharply*, the ASV is assumed to be open. The ECM locates malfunctions from the combination of pressures detected when the AIR system is ON and OFF.

*: The exhaust pulsation value is calculated in the ECM. If the calculated value exceeds a certain level, the ECM determines that the exhaust pulsation is in the AIR system.

HINT:

- In case 3, as the pressure sensor detects a slight pump operation pulsation, the detected value is not constant. Since the pump outlet is blocked by closing the ASV, the average pressure is higher than in case 1 (approximately 20 to 30 kPa).
- In case 1, the average pressure is approximately 9 to 11 kPa. The value of 2.5 kPa indicated in the table above is a threshold for detecting pump malfunctions.

Detected Conditions while AIR operating: Air pump ON, ASV Open	Detected Conditions while AIR not operating: Air pump OFF, ASV Closed	ECM Determination	DTCs Output
Case 1	Case 4	Normal	-
Case 1	Case 2	ASV stuck open	P2440
Case 1	Case 3	Air pump stuck ON	P2444
Case 2	Case 4	Air pump stuck OFF	P2445
Case 3	Case 4	ASV stuck closed	P2441
Case 1	Case 1	ASV stuck open and Air pump stuck ON	P2440 and P2444
Case 2	Case 2	ASV stuck open and Air pump stuck OFF	P2440 and P2445
Case 3	Case 3	ASV stuck closed and Air pump stuck ON	P2441 and P2444
Case 4	Case 4	ASV stuck closed and Air pump stuck OFF	P2441 and P2445

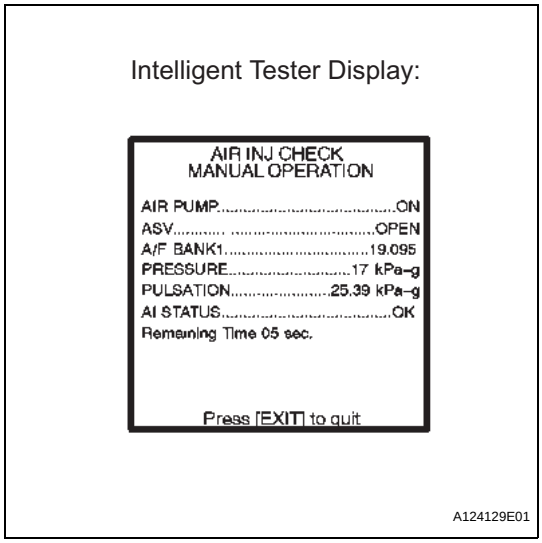
HINT:

- If the vacuum hose between the ASV and the pressure sensor is not connected correctly, case 4 may occur.
- By using an intelligent tester to perform the AIR INJ CHECK operation in the SYSTEM CHECK, the air-fuel ratio and the pressure in the secondary air injection system passage can be checked while the secondary air injection system is operating. This helps technicians to troubleshoot the system when it malfunctions. Furthermore, PENDING CODES also can be checked by performing SYSTEM CHECK / AUTOMATIC OPERATION after the repair.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

SYSTEM CHECK:

The pressure in the secondary air passage can be checked using an intelligent tester.

(a) Start the engine and warm it up.



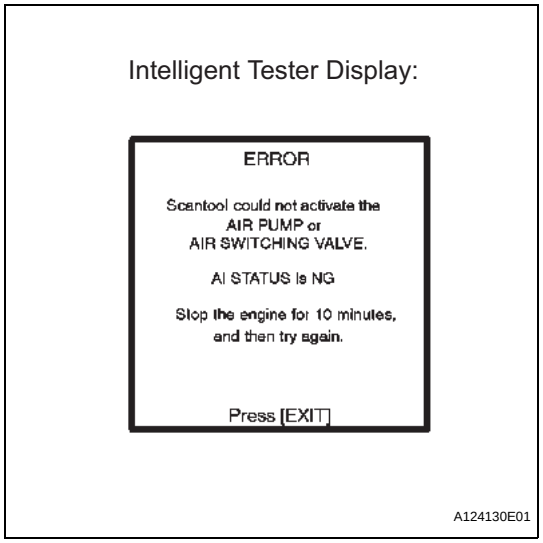
(b) Turn the ignition switch to OFF.
(c) Connect an intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Select the following menu items:
DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV: OPEN and AP: OFF, ASV CLOSE.
HINT:
When MANUAL OPERATION is selected, the tester initialization (atmospheric pressure measurement) is performed automatically. The initialization takes 10 seconds. After the initialization, AP and ASV operation canbe selected.
(f) Start the engine.
(g) Perform the AIR system intrusive operation while the engine is idling.
(h) Check that the air pump (AIR PUMP), ASV and pressure in the AIR system passage (PRESSURE) displayed on the tester, indicate the conditions shown in the table below.

Standard

Intelligent Tester Operations	AIR PUMP	ASV	PRESSURE *1	PULSATION *2
AP: ON, ASV: OPEN	ON	OPEN	2.5 kPa or more	11.25 kPa or more
AP: OFF, ASV: CLOSE	OFF	CLOSE	Less than 2.5 kPa	Less than 11.25 kPa

*1:
Average pumping pressure (gauge pressure). The pressure should be 2.5 kPa or more when the AIR system operates.
*2:
The cumulative exhaust pulsation calculated by the ECM. If the calculated value exceeds a certain level, the ECM determines that the exhaust pulsation is in the AIR system.

(i) Turn the ignition switch to OFF.



NOTICE:

- **This AIR INJECTION CHECK only allows technicians to operate the AIR system for a maximum of 5 seconds.**
  Furthermore, the check can only be performed up to 4 times per trip. If the test is repeated, intervals of at least 30 seconds are required between checks.
  While AIR system operation using the intelligent tester is prohibited, the tester display indicates the prohibition (WAIT or ERROR).
  If an ERROR as shown in the illustration is displayed on the tester during the test, stop the engine for 10 minutes, and then try again.
- **Performing the AIR INJ CHECK repetitively may cause damage to the AIR system. If necessary, leave an interval of several minutes between SYSTEM CHECK operations to prevent the system from overheating.**
- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2444 AND/OR P2445)

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

Result

Display (DTC Output)	Proceed To
P2444 and/or P2445	A
P2444 and/or P2445, and P0418	B
P2444 and/or P2445, and other DTCs (except P0418)	C

If any DTCs other than P2444, P2445 and/or P0418 are output, troubleshoot those DTCs first.

B	GO TO AIR PUMP INSPECTION PROCEDURE
C	GO TO DTC CHART

A

2	PERFORM ACTIVE TEST USING INTELLIGENT TESTER (SECONDARY AIR INJECTION SYSTEM OPERATION)

Intelligent Tester Display:



A124129E01

(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Select the following menu items:
DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV: OPEN and AP: OFF, ASV CLOSE.
HINT:
When MANUAL OPERATION is selected, the tester initialization (atmospheric pressure measurement) is performed automatically. The initialization takes 10 seconds. After the initialization, AP and ASV operation can be selected.
(f) Start the engine.
(g) Perform the AIR system intrusive operation while the engine is idling.
(h) Check that the air pump (AIR PUMP), ASV and pressure in the AIR system passage (PRESSURE) status displayed on the tester, indicate the conditions shown in the table below.

Standard

Intelligent Tester Operations	AIR PUMP	ASV	PRESSURE*
AP: ON, ASV: OPEN	ON	ON	2.5 kPa or more
AP: OFF, ASV: CLOSE	OFF	OFF	Less than 2.5 kPa

*: Average pumping pressure. The pressure should be 2.5 kPa or more when the AIR system operates.

Intelligent Tester Display:



A124130E01

(i) Turn the ignition switch to OFF.

NOTICE:

- **This AIR INJECTION CHECK only allows technicians to operate the AIR system for a maximum of 5 seconds.**
  Furthermore, the check can only be performed up to 4 times per trip. If the test is repeated, intervals of at least 30 seconds are required between checks.
  While AIR system operation using the intelligent tester is prohibited, the tester display indicates the prohibition (WAIT or ERROR).
  If an ERROR as shown in the illustration is displayed on the tester during the test, stop the engine for 10 minutes, and then try again.
- **Performing the AIR INJ CHECK repetitively may cause damage to the AIR system. If necessary, leave an interval of several minutes between SYSTEM CHECK operations to prevent the system from overheating.**

- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

NG → **Go to step 4**

OK

3 CHECK WHETHER DTC OUTPUT RECURS (DTC P2444 AND/OR P2445)

(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Clear DTCs (where set) (see page ES-40).
(f) Select the following menu items:
DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / AUTOMATIC OPERATION.
(g) Start the engine after the tester initialization is finished.
(h) Perform the SYSTEM CHECK operation by pressing ENTER.
(i) After operating the AIR system, press the ENTER button to confirm the AIR system pending codes.
(j) Check PENDING DTCs.
(k) Turn the ignition switch to OFF.

NOTICE:

- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

Result

Display (DTC output)	Proceed To
P2444 and/or P2445	A
No pending DTC	B

B → **CHECK FOR INTERMITTENT PROBLEMS**

A

4 CHECK VACUUM HOSES (PRESSURE SENSOR - AIR SWITCHING VALVE)

(a) Check the vacuum hose connections with the pressure sensor and ASV.
(b) Inspect the vacuum hose for blockages and damage.

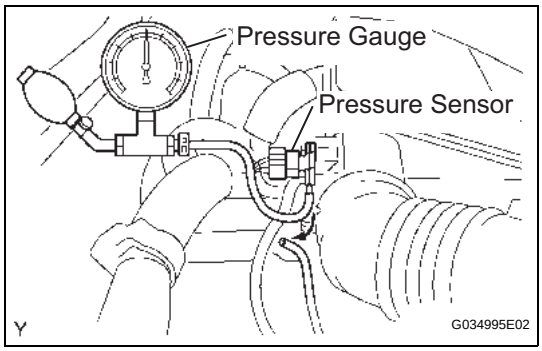
OK:

Vacuum hose has no blockages or damage.

NG → **REPAIR OR REPLACE VACUUM HOSE**

OK

5	INSPECT ECM (AIP VOLTAGE)



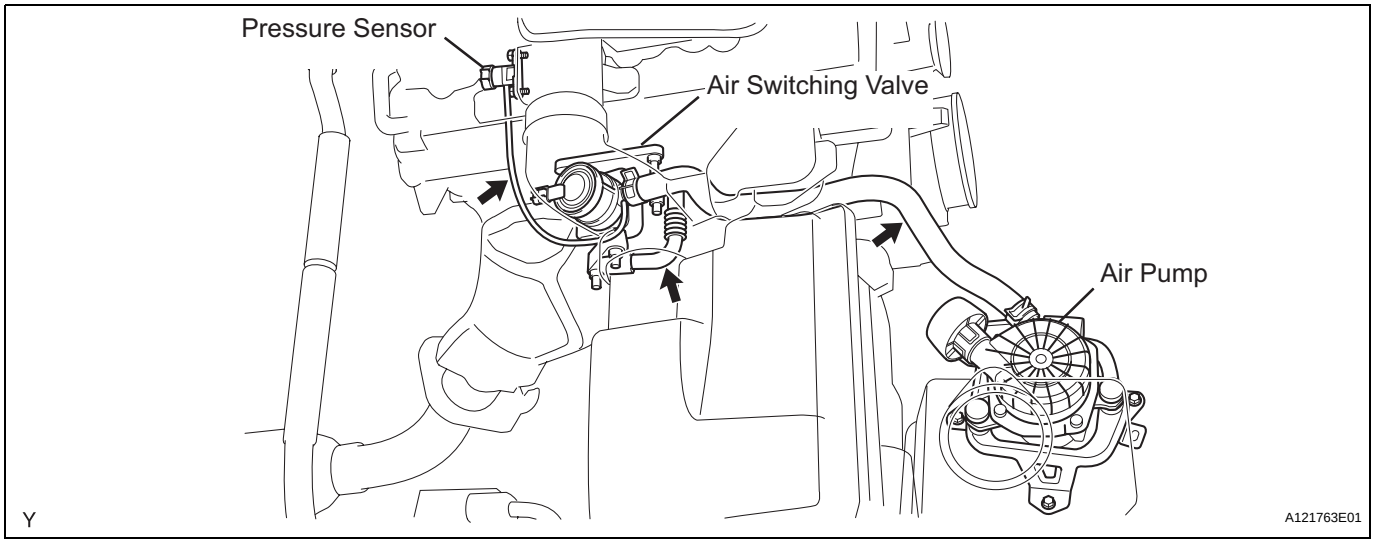
(a) Connect a pressure gauge to the air pressure sensor as shown in the illustration.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch to ON and the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD ll / DATA LIST / AIR PMP PRS(A).
(e) Check that the pressure displayed on the tester fluctuates when applying the pressure to the pressure sensor with the pressure gauge.
OK:
Pressure fluctuates in response to pressure applied with pressure gauge.
HINT:
The tester displays the air pump pressure (AIR PMP PRS(A)) as absolute pressure.

ES

NG → **REPLACE PRESSURE SENSOR (TURBO PRESSURE SENSOR)**

OK

6	CHECK AIR INJECTION SYSTEM PIPE CONNECTIONS

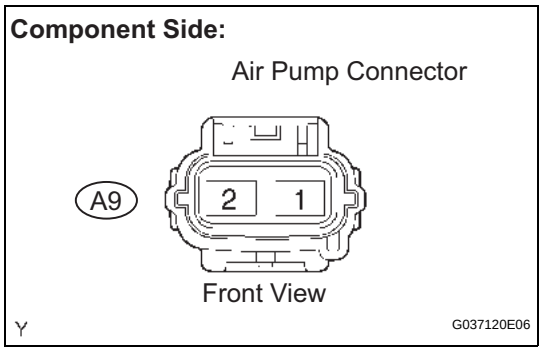


(a) Check that all the pipes and hoses between the air pump and ASV are securely connected.
(b) Inspect the pipes and hoses for blockages and damage.
OK:
AIR system piping has no blockages or damage.

NG → **REPAIR OR REPLACE AIR INJECTION SYSTEM PIPING**

OK

7 INSPECT AIR PUMP ASSEMBLY



(a) Check the resistance.
(1) Using an ohmmeter, measure the resistance between the terminals.
Standard Resistance

Tester Connections	Specified Conditions
Air pump (A9-1) - Air pump (A9-2)	0.4 to 10 Ω at 20°C (68°F)

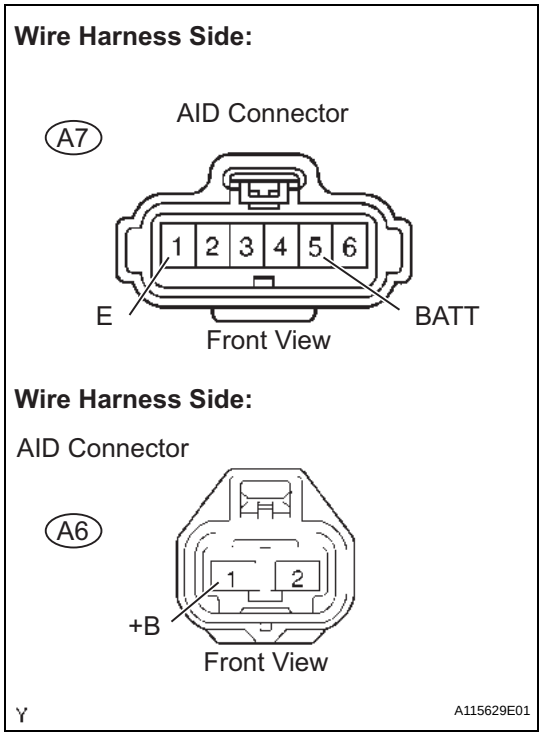
If the result is not as specified, replace the air pump.
HINT:
To check the air pump operation, use the AIR INJ CHECK function described in the SYSTEM CHECK.

ES

NG → **REPLACE AIR PUMP ASSEMBLY**

OK

8 INSPECT AIR INJECTION CONTROL DRIVER (AIR INJECTION CONTROL DRIVER POWER SOURCE CIRCUIT)



(a) Disconnect the A6 and A7 AID connectors.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between the terminals of the AID connector.
Standard Voltage

Tester Connections	Specified Conditions
BATT (A7-5) - Body ground	9 to 14 V (near battery voltage)
+B (A6-1) - Body ground	9 to 14 V (near battery voltage)

(d) Check the resistance.
Standard Resistance (Check for open)

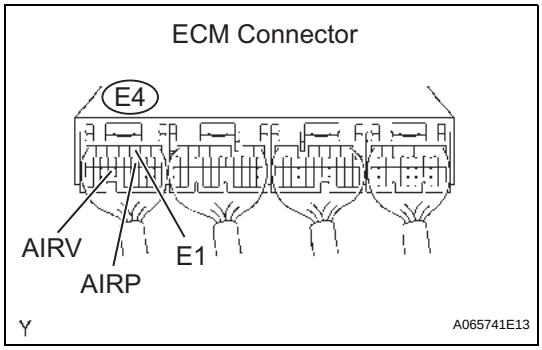
Tester Connections	Specified Conditions
E (A7-1) - Body ground	Below 1 Ω

(e) Reconnect the AID connector.

NG → **REPAIR OR REPLACE AIR INJECTION CONTROL DRIVER POWER SOURCE CIRCUIT**

OK

9	PERFORM ACTIVE TEST USING INTELLIGENT TESTER



(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV: OPEN and AP: OFF, ASV: CLOSE.
(f) Start the engine after the tester initialization is finished.
(g) Operate the AIR system using SYSTEM CHECK function and measure the voltage between the terminals of the ECM connector.
(h) Turn the ignition switch to OFF.

NOTICE:

- **Do not perform the SYSTEM CHECK operation repetitively. It may cause damage to the system. If necessary, leave an interval of several minutes between SYSTEM CHECK operations.**
- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

Standard Voltage

Intelligent Tester Operations	Voltmeter Connections	Specified Conditions
AP: ON, ASV: OPEN	AIRP (E4-11) - E1 (E4-3)	3.5 to 7.5 V
AP: OFF, ASV: CLOSE	AIRP (E4-11) - E1 (E4-3)	10 V or more
AP: ON, ASV: OPEN	AIRV (E4-24) - E1 (E4-3)	3.5 to 7.5 V
AP: OFF, ASV: CLOSE	AIRV (E4-24) - E1 (E4-3)	10 V or more

NG → Go to step 12

OK

10	REPLACE AIR INJECTION CONTROL DRIVER

NEXT

11	CHECK WHETHER DTC OUTPUT RECURS (DTC P2444 AND/OR P2445)

(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Clear DTCs (where set) (see page ES-40).
(f) Select the following menu items:

DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / AUTOMATIC OPERATION.

(g) Start the engine after the tester initialization is finished.
(h) Perform the SYSTEM CHECK operation by pressing ENTER.
(i) After operating the AIR system, press the ENTER button to confirm the AIR system pending codes.
(j) Check PENDING DTCs.
(k) Turn the ignition switch to OFF.

OK:

No pending DTC output.

NOTICE:

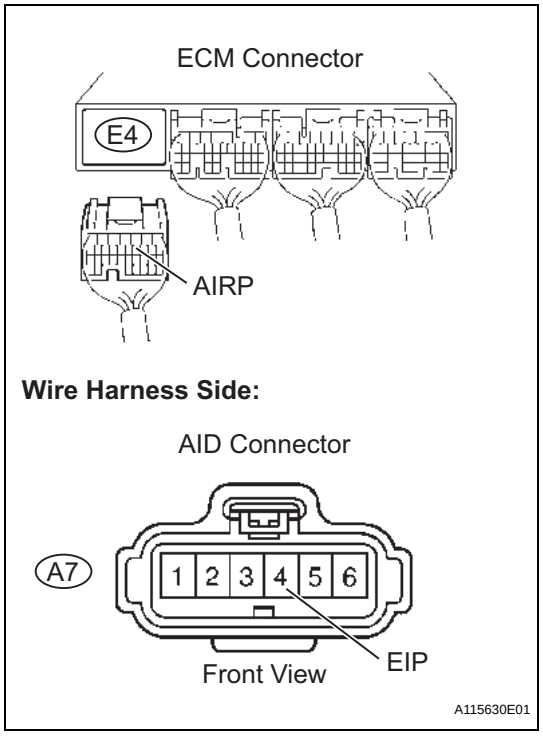
- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

ES

NEXT

END

12 CHECK HARNESS AND CONNECTOR (ECM - AIR INJECTION CONTROL DRIVER)



(a) Disconnect the E4 ECM connector.
(b) Disconnect the A7 AID connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
AIRP (E4-11) - EIP (A7-4)	Below 1 Ω

(d) Reconnect the ECM and AID connectors.

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

OK

REPLACE ECM

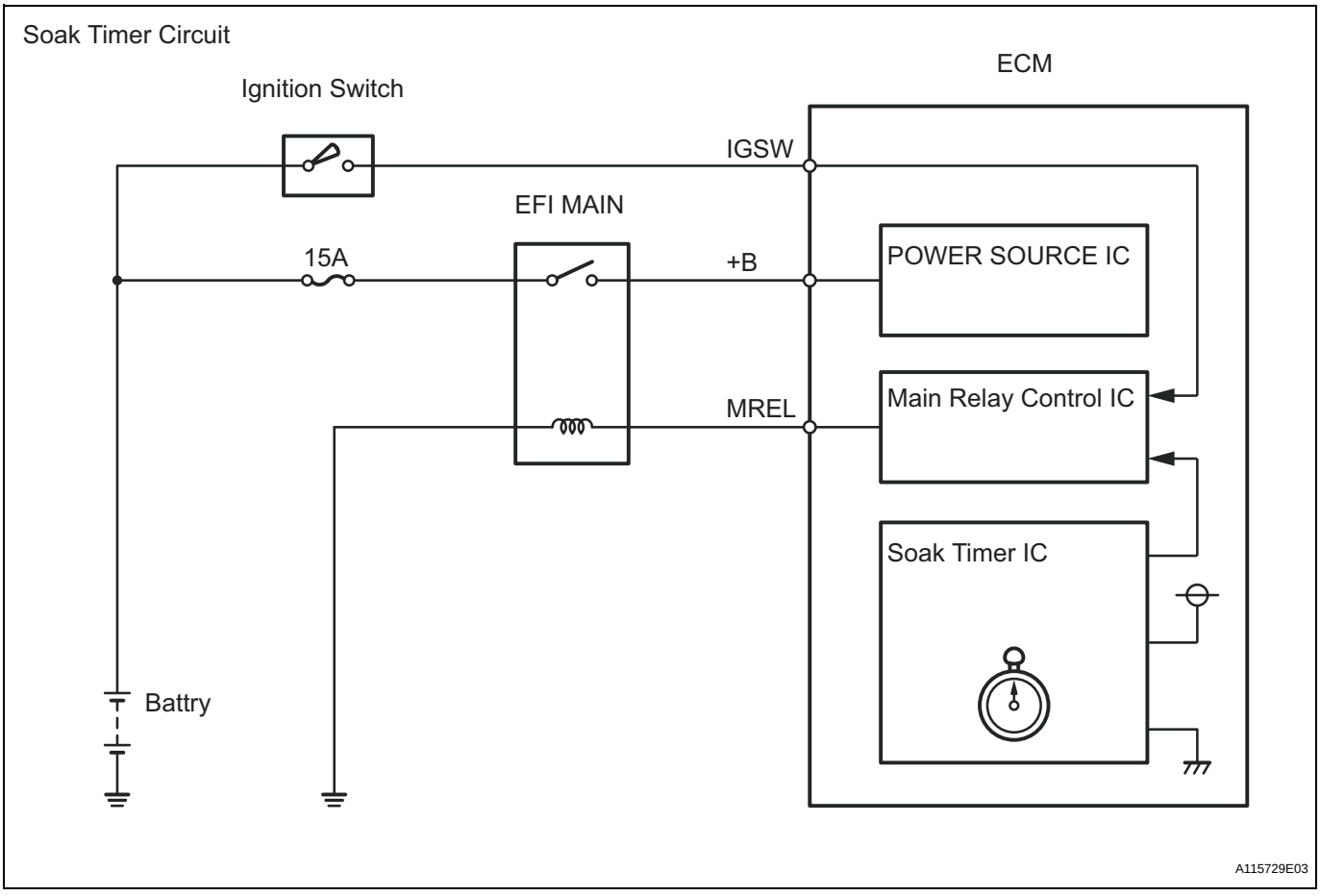
DTC	P2610	ECM / PCM Internal Engine Off Timer Performance

DTC SUMMARY

DTC	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timings	Detection Logic
P2610	Soak timer (built into ECM)	ECM internal malfunction	ECM	Engine running	2 trip

DESCRIPTION

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



MONITOR DESCRIPTION

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

MONITOR STRATEGY

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 following DTC not present	None
Ignition switch	ON
Engine	Running
Battery voltage	8 V or more
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

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

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 an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	**REPLACE ECM**

NEXT

2	**CHECK WHETHER DTC OUTPUT RECURS**

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Clear DTCs (See page ES-40).
(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)

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

DESCRIPTION

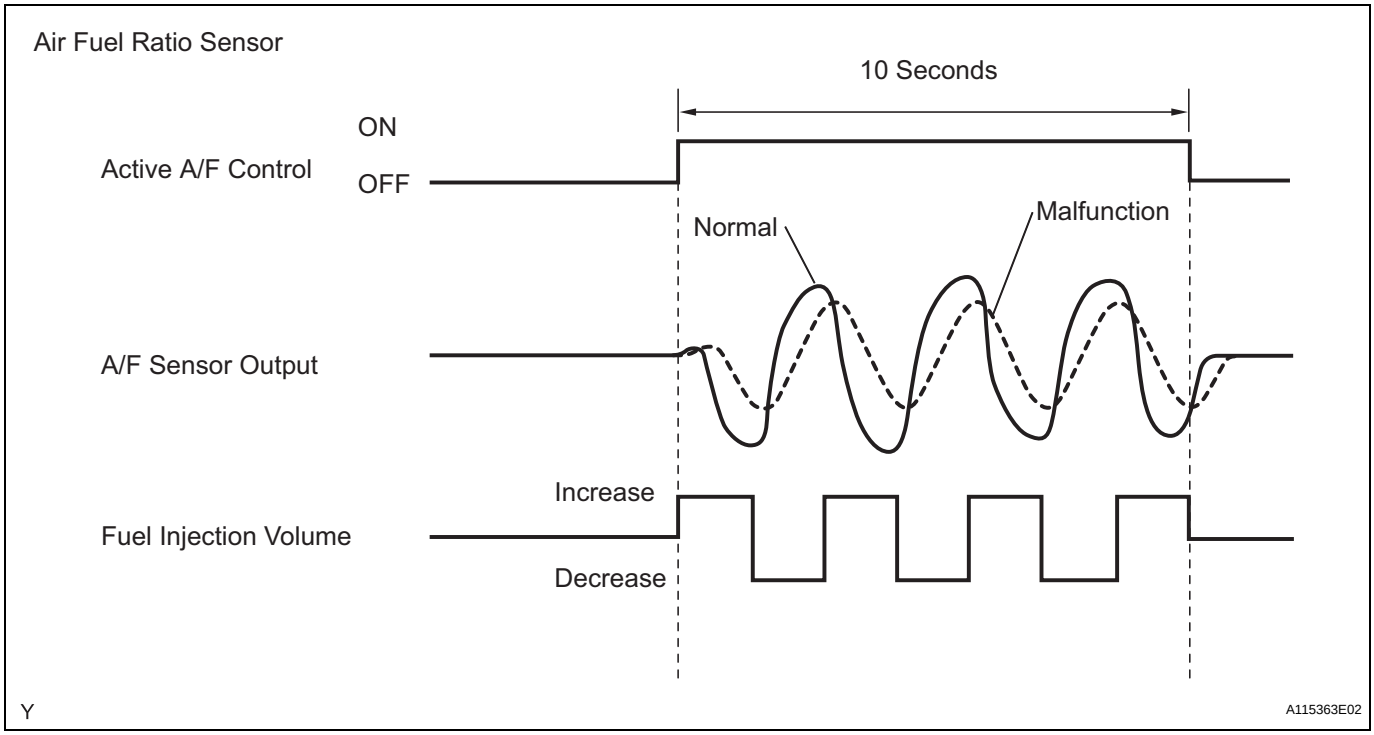
Refer to DTC P2195 (See page ES-312).

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

ES

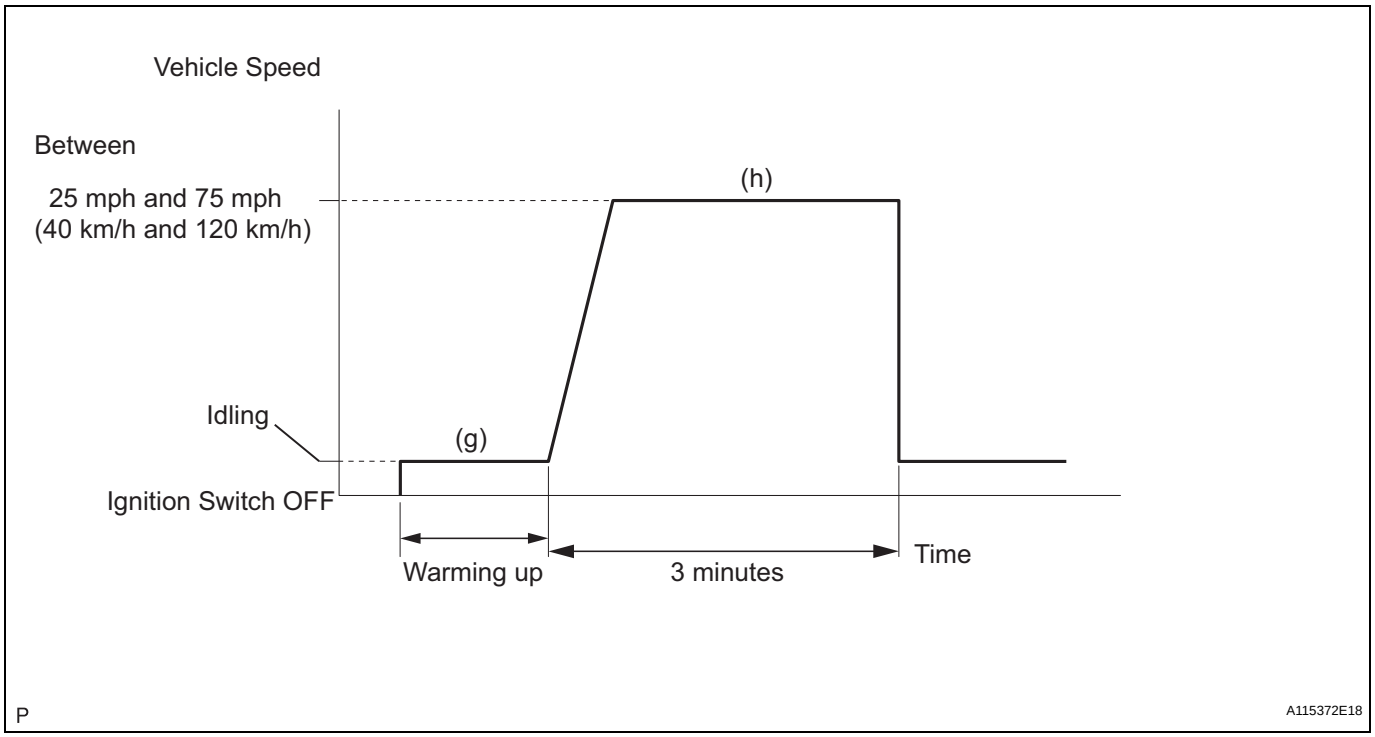
MONITOR DESCRIPTION

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

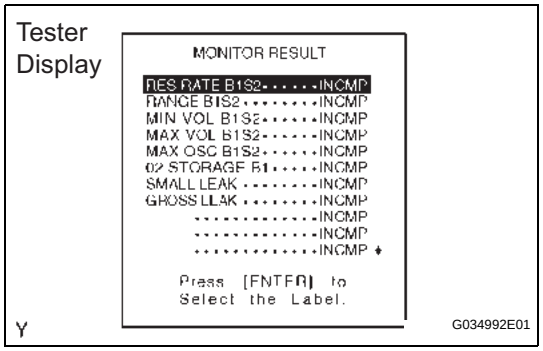


CONFIRMATION DRIVING PATTERN

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



(a) Connect an intelligent tester to the DLC3.



(b) Turn the ignition switch to ON.
(c) Turn the tester ON.
(d) Clear DTCs (where set).
(e) Select the following menu items: DIAGNOSIS /ENHANCED OBD II / MONITOR INFO / MONITOR RESULT.
(f) Check that RES RATE B1S1 is INCOMP.
(g) Start the engine and warm it up.
(h) Drive the vehicle at between 25 mph and 75 mph (40 km/h and 120 km/h) for 3 minutes. However, the vehicle should be driven at a constant speed.
(i) Check the monitor result values on the intelligent tester by selecting the following menu items: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / TEST RESULT.
(j) If the values indicated on the tester do not change, perform READINESS MONITOR DRIVE PATTERN for the A/F sensor and the heated oxygen sensor (see page ES-25).
HINT:
Completion of all A/F sensor monitors is required to change the value in TEST RESULT.
(k) Note the value of the Monitor Result.
(l) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.
(m) Check if any DTCs (any pending DTCs) are set.

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	10 to 15 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0442 - P0456 (EVAP system) P0500 (VSS) P2196, P2198 (A/F sensor - rationality) P2440 (A/R control valve stuck open) P2441 (A/R control valve stuck close) P2444 (AIP stuck ON) P2445 (AIP stuck OFF)
A/F sensor active control	Executing
Engine coolant temperature	70°C (158°F) or more
Battery voltage	11 V or more
Malfunction determination in this driving cycle	Not yet
Engine RPM	Less than 4,000 rpm
Fuel system status	Closed-loop
A/F sensor status	Activated
Fuel-cut	OFF (for 5 seconds or more)
Engine load	10 to 70 %
Shift position	2nd or more
Intake air amount	3 to 14 g/sec

TYPICAL MALFUNCTION THRESHOLDS

Response rate deterioration level	Less than 0.2 V

MONITOR RESULT

Refer to Checking Monitor Status (See page ES-21).

WIRING DIAGRAM

Refer to DTC P2195 (See page ES-316).

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.

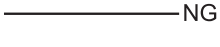
The following instructions describe how to conduct the A/F CONTROL operation using an intelligent tester.

1. Connect an 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 Voltage

Tester Display (Sensor)	Injection Volumes	Status	Voltages
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 0.5
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 Areas
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.5 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		

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Areas
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:

- DTC P2A00 may be set, when the air-fuel ratio is stuck rich or lean.
- A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.
- DTC P2A00 may also be set, when the sensor element is electrically clogged or contaminated.

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2A00)

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

Result

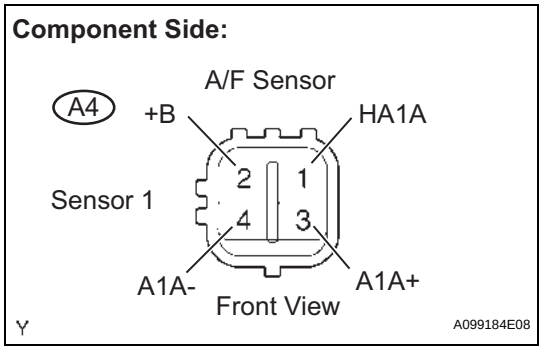
Display (DTC Output)	Proceed To
P2A00	A
P2A00 and other DTCs	B

If any DTCs relating to the A/F sensor (DTCs for the A/F sensor heater or A/F sensor admittance) are output, troubleshoot those DTCs first.

B → GO TO DTC CHART

A

2 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the A4 Air-Fuel Ratio (A/F) sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor connector.

Standard Resistance

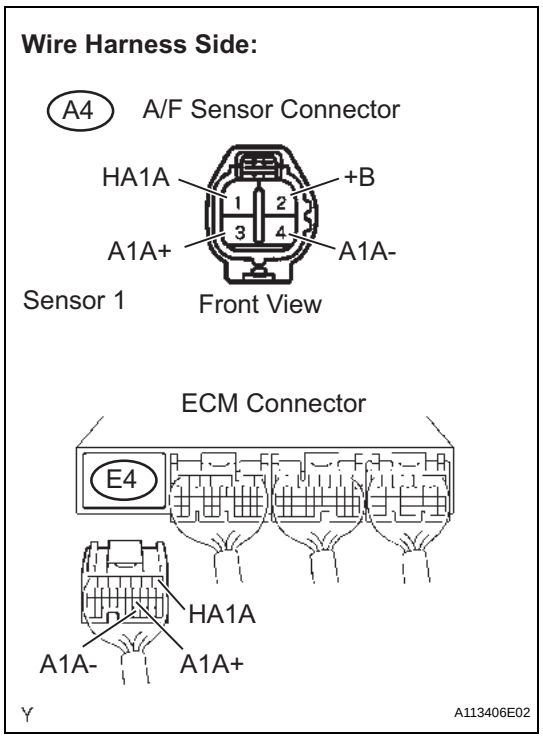
Tester Connections	Specified Conditions
HA1A (1) - +B (2)	1.8 to 3.4 Ω at 20°C (68°F)
HA1A (1) - A1A- (4)	10 kΩ or higher

(c) Reconnect the air-fuel ratio sensor connector.

NG → REPLACE AIR FUEL RATIO SENSOR

OK

3 CHECK HARNESS AND CONNECTOR (ECM - AIR FUEL RATIO SENSOR)



(a) Disconnect the A4 A/F sensor connector.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between the +B terminal of the A/F sensor connector and body ground.

Standard Voltage

Tester Connections	Specified Conditions
+B (A4-2) - Body ground	9 to 14 V

(d) Turn the ignition switch to OFF.
(e) Disconnect the E4 ECM connector.
(f) Check the resistance.

Standard Resistance (Check for open)

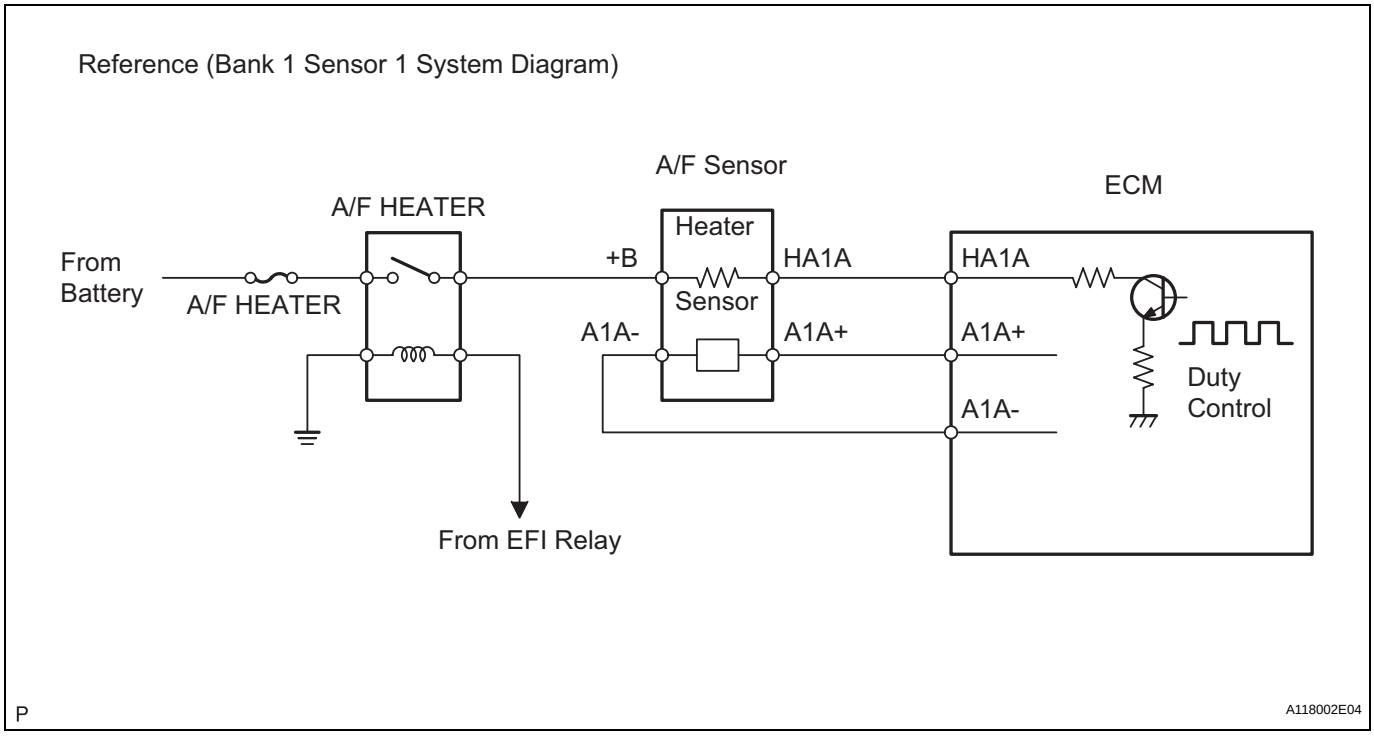
Tester Connections	Specified Conditions
HA1A (A4-1) - HA1A (E4-1)	Below 1 Ω
A1A+ (A4-3) - A1A+ (E4-21)	Below 1 Ω
A1A- (A4-4) - A1A- (E4-31)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
HA1A (A4-1) or HA1A (E4-1) - Body ground	10 kΩ or higher
A1A+ (A4-3) or A1A+ (E4-21) - Body ground	10 kΩ or higher
A1A- (A4-4) or A1A- (E4-31) - Body ground	10 kΩ or higher

(g) Reconnect the ECM connector.
(h) Reconnect the A/F sensor connector.

ES



ES

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

OK

4	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

5	CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00)

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

Result

Display (DTC Output)	Proceed To
P2A00	A
No output	B

B → **CHECK FOR INTERMITTENT PROBLEMS**

A

6	REPLACE AIR FUEL RATIO SENSOR

NEXT

7	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

8	CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00)

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

ES

Result

Display (DTC Output)	Proceed To
No output	A
P2A00	B

B → CHECK EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO (REFER TO DTC P0171 PROCEDURE)

A

END

EVAP System

RELATED DTCS

DTC No.	Monitoring Items	See procedure
P043E	Reference orifice clogged (built into canister pump module)	ES-213
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-220
P0450	Canister pressure sensor (built into canister pump module) voltage abnormal fluctuation	ES-228
P0451	• Canister pressure sensor (built into canister pump module) noise • Canister pressure sensor stuck (built into canister pump module)	
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-237
P0456	EVAP small leak	
P2401	Leak detection pump stuck OFF (built into canister pump module)	ES-334
P2402	Leak detection pump stuck ON (built into canister pump module)	
P2419	Vent valve stuck closed (built into canister pump module)	ES-341
P2420	Vent valve stuck open (vent) (built into canister pump module)	
P2610	Soak timer (built into ECM)	ES-380

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 stuck				●							
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

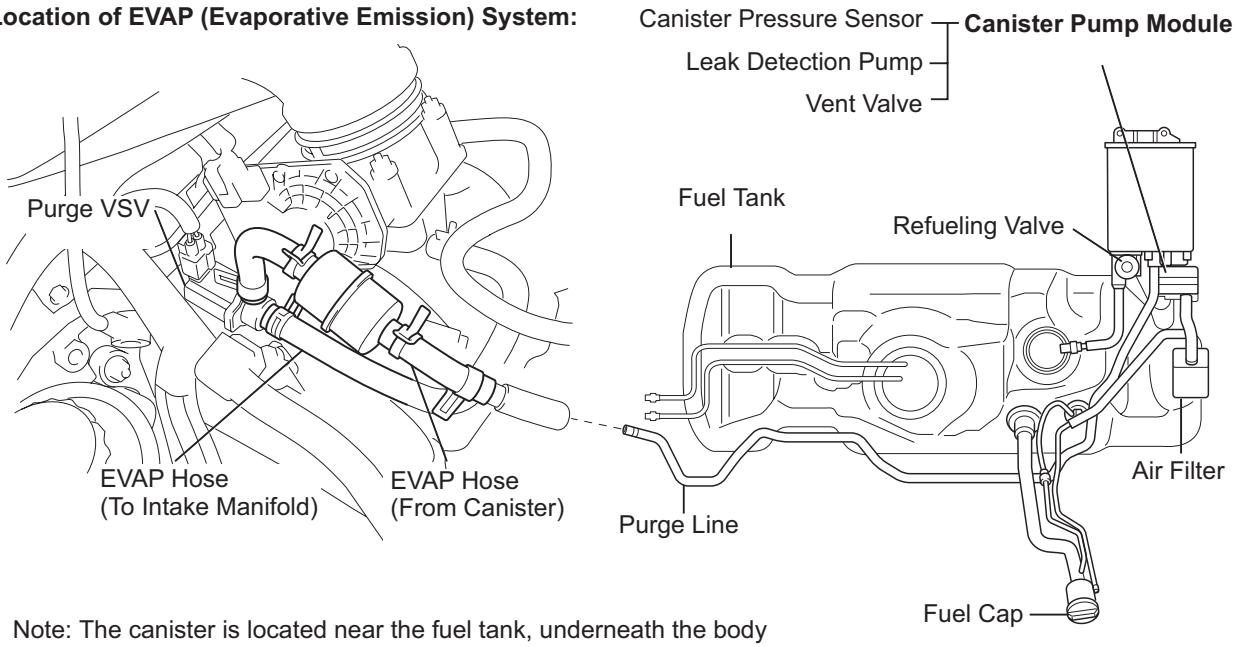
A106731E06

NOTICE:
If the 0.02 inch leak criterion difference between the first and second checks is greater than the specification, the DTCs corresponding to the leak criterion (P043E, P043F, P2401, P2402 and P2419) will be all stored.

ES

DESCRIPTION

Location of EVAP (Evaporative Emission) System:

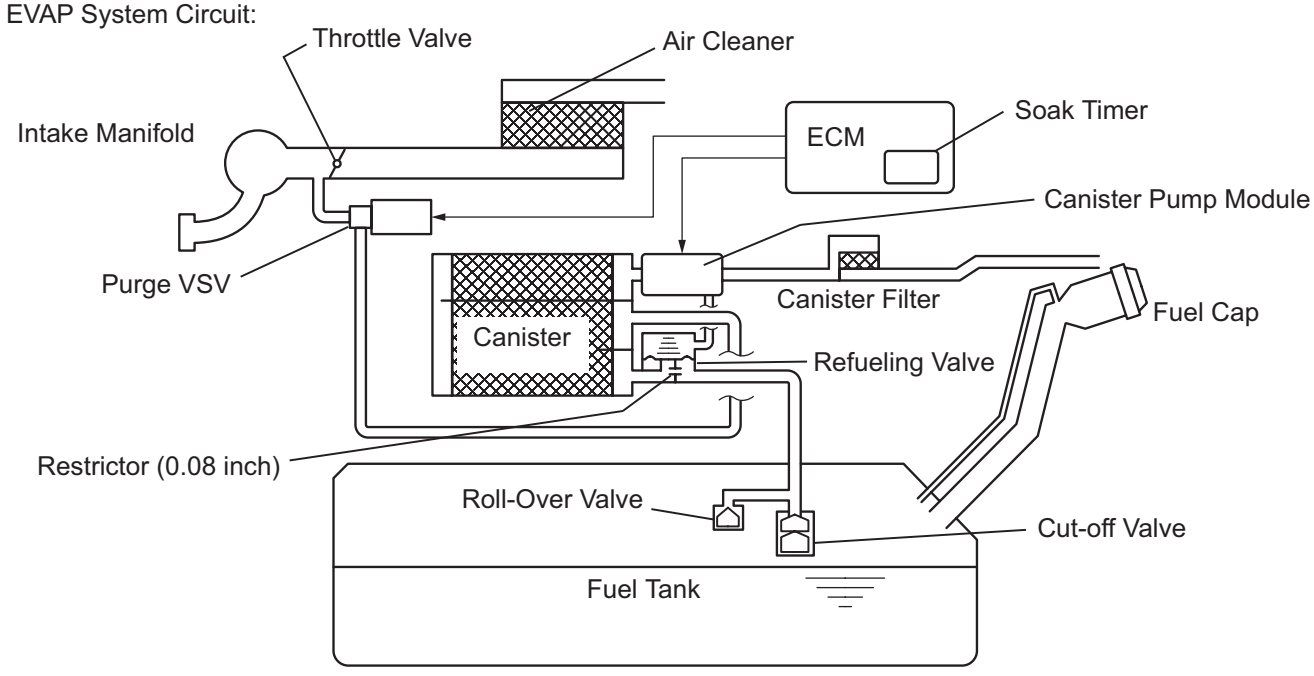


Note: The canister is located near the fuel tank, underneath the body

Y

A121764E01

EVAP System Circuit:



Y

A122570E01

NOTICE:

In this vehicle's EVAP system, turning ON the vent valve does not seal off the EVAP system. To check for leaks in the EVAP system, disconnect the air inlet vent hose and apply pressure from the atmosphere side of the canister.

While the engine is running, if a predetermined condition (closed-loop etc.) is met, the purge VSV is opened by the ECM and stored fuel vapors in the canister are purged to the intake manifold. The ECM changes the duty cycle ratio of the purge VSV to control purge flow volume.
The purge flow volume is also determined by the intake manifold pressure. Atmospheric pressure is allowed into the canister through the vent valve to ensure that the purge flow is maintained when the negative pressure (vacuum) is applied to the canister.
The following two monitors run to confirm appropriate EVAP system operation.

1. Key-off monitor

This monitor checks for EVAP (Evaporative Emission) system leaks and canister pump module malfunctions. The monitor starts 5 hours* after the ignition switch is turned to OFF. More than 5 hours are required to allow enough time for the fuel to cool down to stabilize the Fuel Tank Pressure (FTP), thus making the EVAP system monitor more accurate.
The leak detection pump creates negative pressure (vacuum) in the EVAP system and the pressure is measured. Finally, the ECM monitors for leaks from the EVAP system, and malfunctions in both the canister pump module and purge VSV, based on the EVAP pressure.
HINT:
*: If the engine coolant temperature is not below 35°C 5 hours after the ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.

2. Purge flow monitor

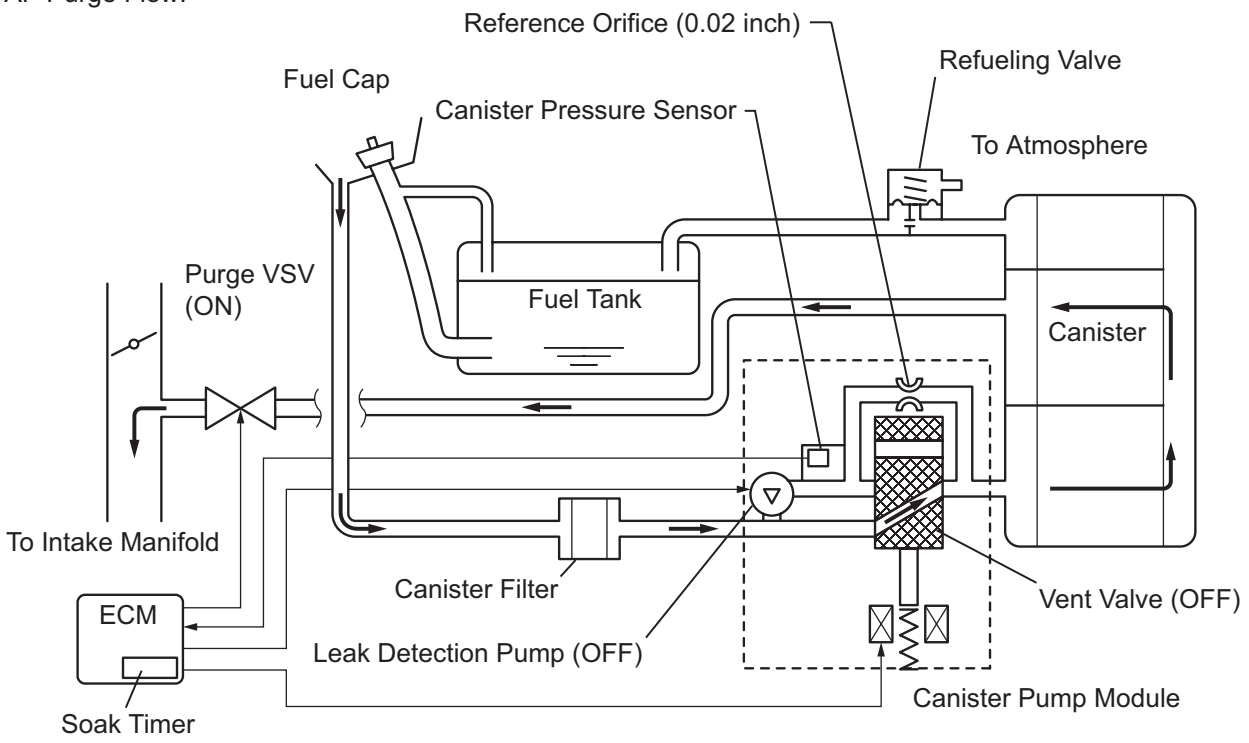
The purge flow monitor consists of the two monitors. The 1st monitor is always conducted every time and the 2nd monitor is activated if necessary.

- 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 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 pressures, before and after conduction of the purge flow monitor, is measured by the ECM.

ES

EVAP Purge Flow:



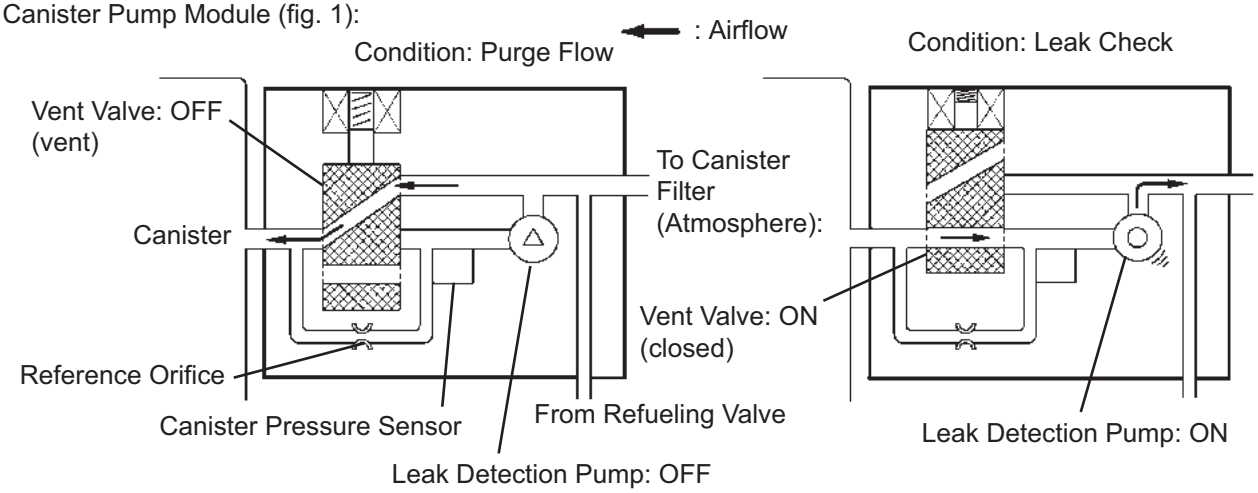
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A122571E01

Components	Operations
Canister	Contains activated charcoal to absorb EVAP (Evaporative Emissions) generated in fuel tank.
Cut-off valve	Located in fuel tank. Valve floats and closes when fuel tank 100 % full.
Purge VSV (Vacuum Switching Valve)	Opens or closes line between canister and intake manifold. ECM uses purge VSV to control EVAP purge flow. In order to discharge EVAP absorbed by canister to intake manifold, ECM opens purge VSV. EVAP discharge volume to intake manifold controlled by purge VSV duty cycle ratio (current-carrying time). (Open: ON, Close: OFF)
Refueling valve	Controls EVAP pressure from fuel tank to canister. Valve consists of diaphragm, spring and restrictor (diameter: 0.08 inch). When fuel vapor and pressure inside fuel tank increase, valve opens. While EVAP purged, valve closes and restrictor prevents large amount of vacuum from affecting pressure in fuel tank. Valve opened while refueling. When valve open, adding fuel into fuel tank possible.
Roll-over valve	Located in fuel tank. Valve closes by its own weight when vehicle overturns to prevent fuel from spilling out.
Soak timer	Built into ECM. To ensure accurate EVAP monitor, measures 5 hours (+- 15 min) after ignition switch turned to OFF. This allows fuel to cool down, stabilizing Fuel Tank Pressure (FTP). When approximately 5 hours elapsed, ECM activates.
Canister pump module	Consists of (a) to (d) below. Canister pump module cannot be disassembled.
(a) Vent valve	Vents and closes EVAP system. When ECM turns valve ON, EVAP system closed. When, ECM turns valve OFF, EVAP system vented. Negative pressure (vacuum) created in EVAP system to check for EVAP leaks by closing purge VSV, turning on vent valve (closed) and operating leak detection pump (refer to fig. 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).

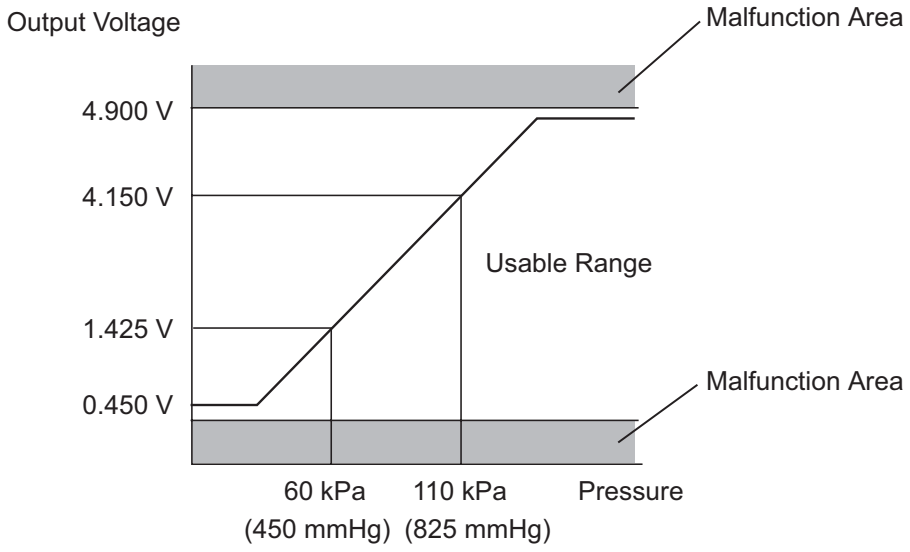
Components	Operations
(c) Leak detection pump	Creates negative pressure (vacuum) in EVAP system for leak check.
(d) Reference orifice	Has opening with 0.02 inch diameter. Vacuum produced through orifice by closing purge VSV, turning off vent valve and operating leak detection pump, to monitor 0.02 inch leak criterion. 0.02 inch leak criterion indicates small leak of EVAP.

Canister Pump Module (fig. 1):



A097611E07

Canister Pressure Sensor Specification (fig. 2):



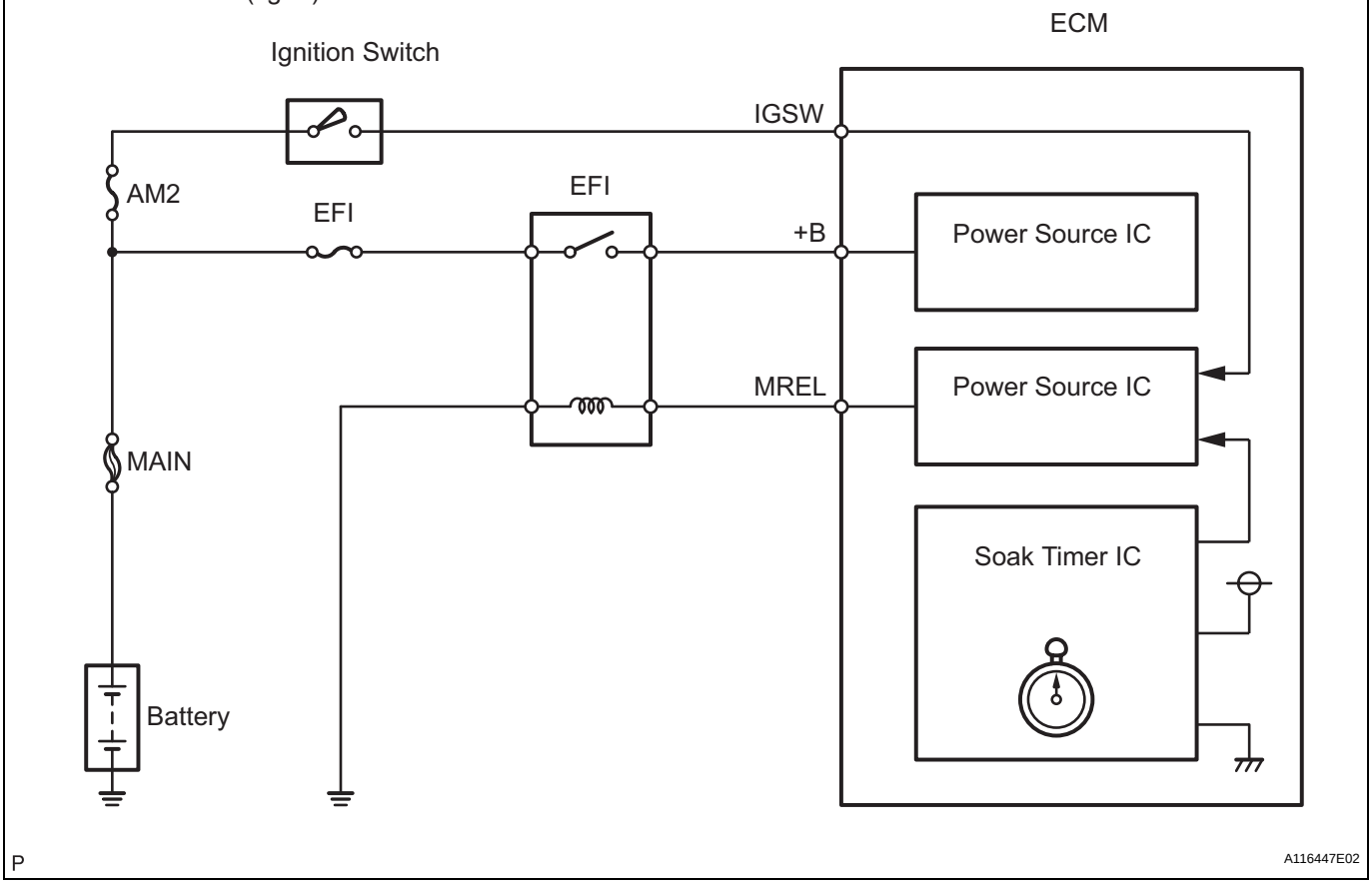
HINT:

Standard atmospheric pressure is 101.3 kPa (759.8mmHg)

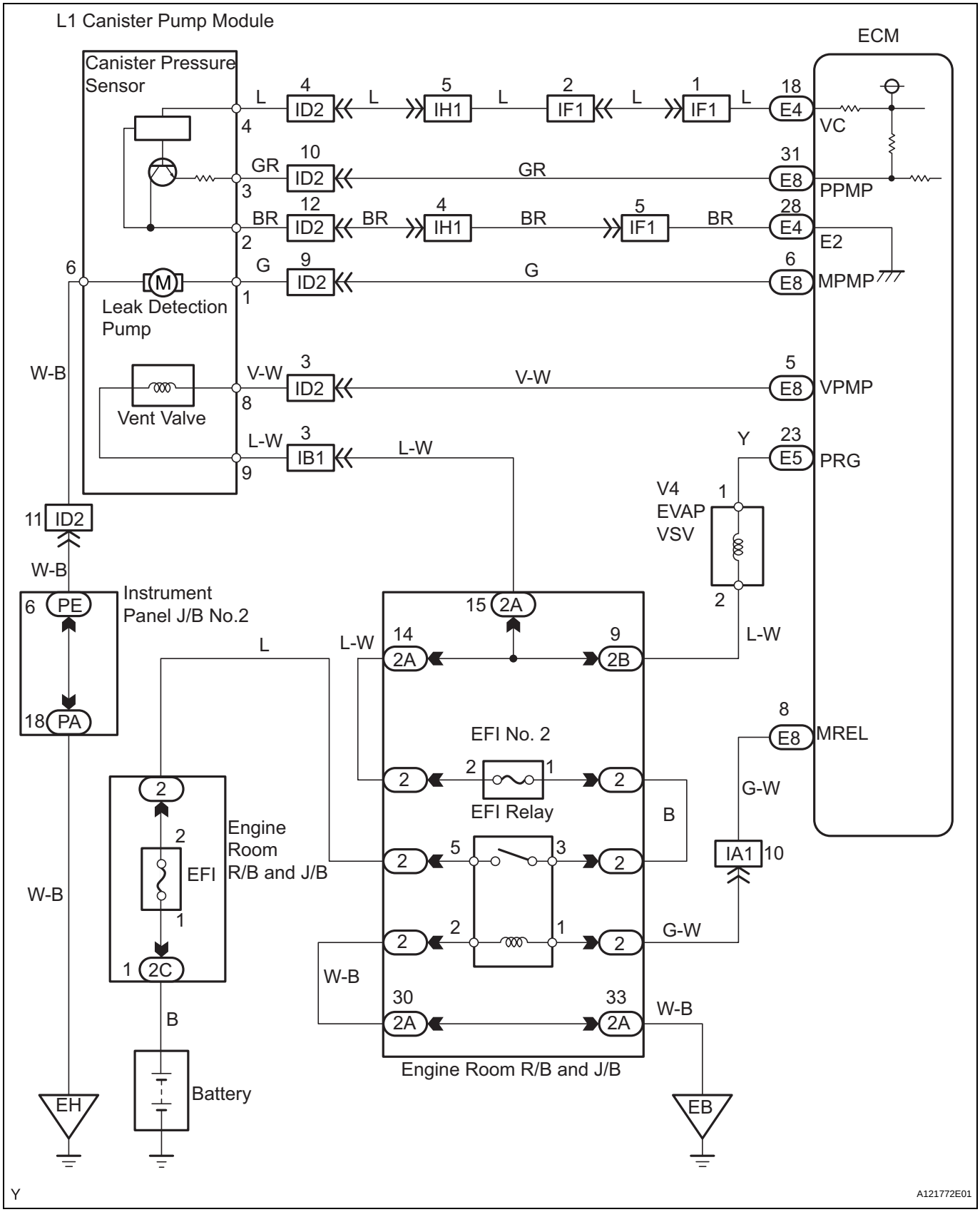
A115543E02

ES

Soak Timer Circuit (fig. 3):



WIRING DIAGRAM



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 an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	**CONFIRM DTC**

(a) Turn the ignition switch to OFF and wait for 10 seconds.
(b) Turn the ignition switch to ON.
(c) Turn the ignition switch to OFF and wait for 10 seconds.
(d) Connect an intelligent tester to the DLC3.
(e) Turn the ignition switch to ON 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 0.02 inch leak criterion difference between the first and second checks is greater than the specification, the DTCs corresponding to the leak criterion (P043E, P043F, P2401, P2402 and P2419) will all be stored.

ES

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 stuck				●							
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

A106731E06

ES

NEXT

2	PERFORM EVAP SYSTEM CHECK (AUTO OPERATION)

NOTICE:

- **The EVAP SYSTEM CHECK (AUTO OPERATION) consists of five 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 and making the leak check of the fuel tank 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 the EVAP SYSTEM CHECK, keep the temperature below 35°C (95°F).**

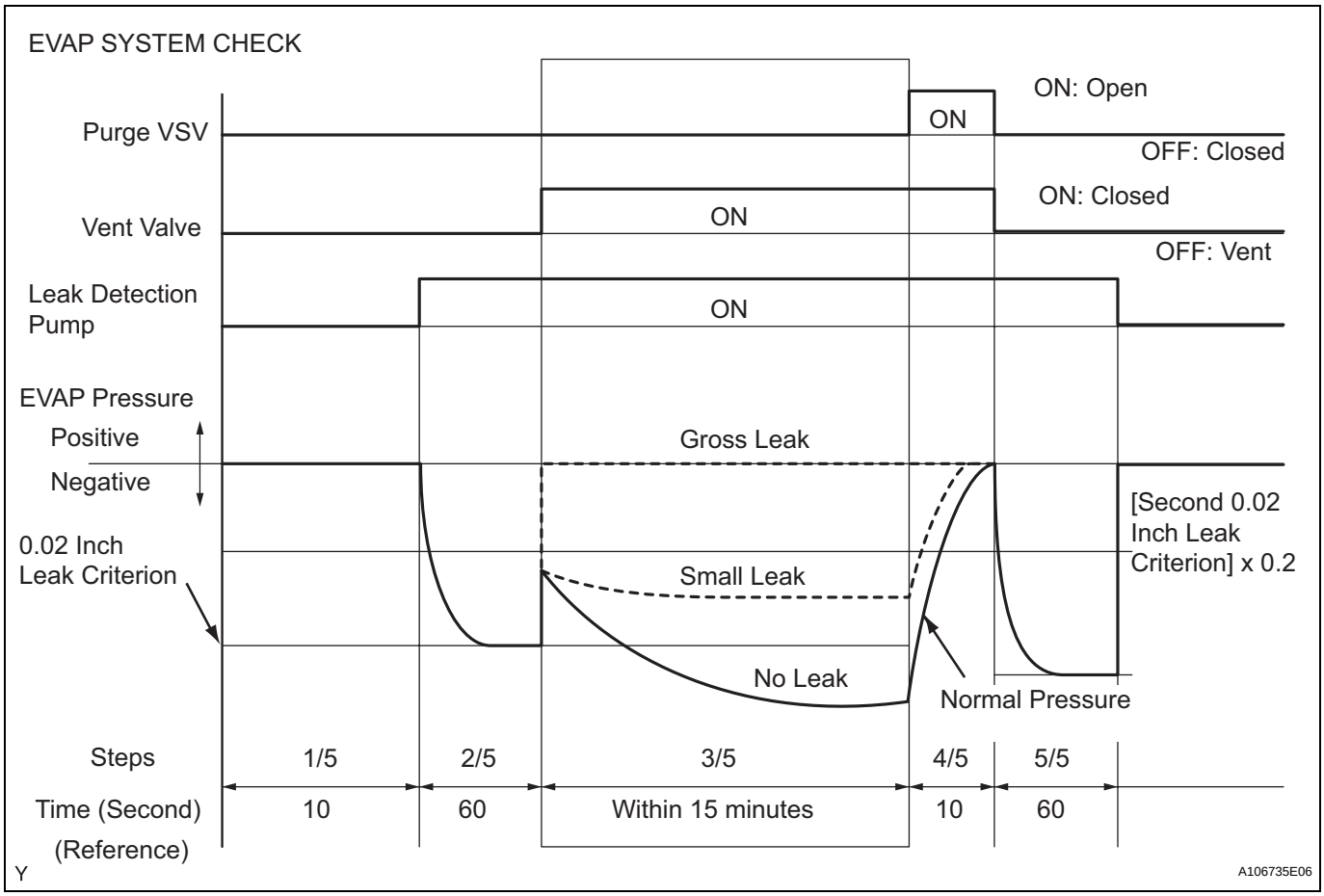
(a) Clear DTCs (see page ES-40).

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

NEXT

ES

3	PERFORM EVAP SYSTEM CHECK (MANUAL OPERATION)



NOTICE:

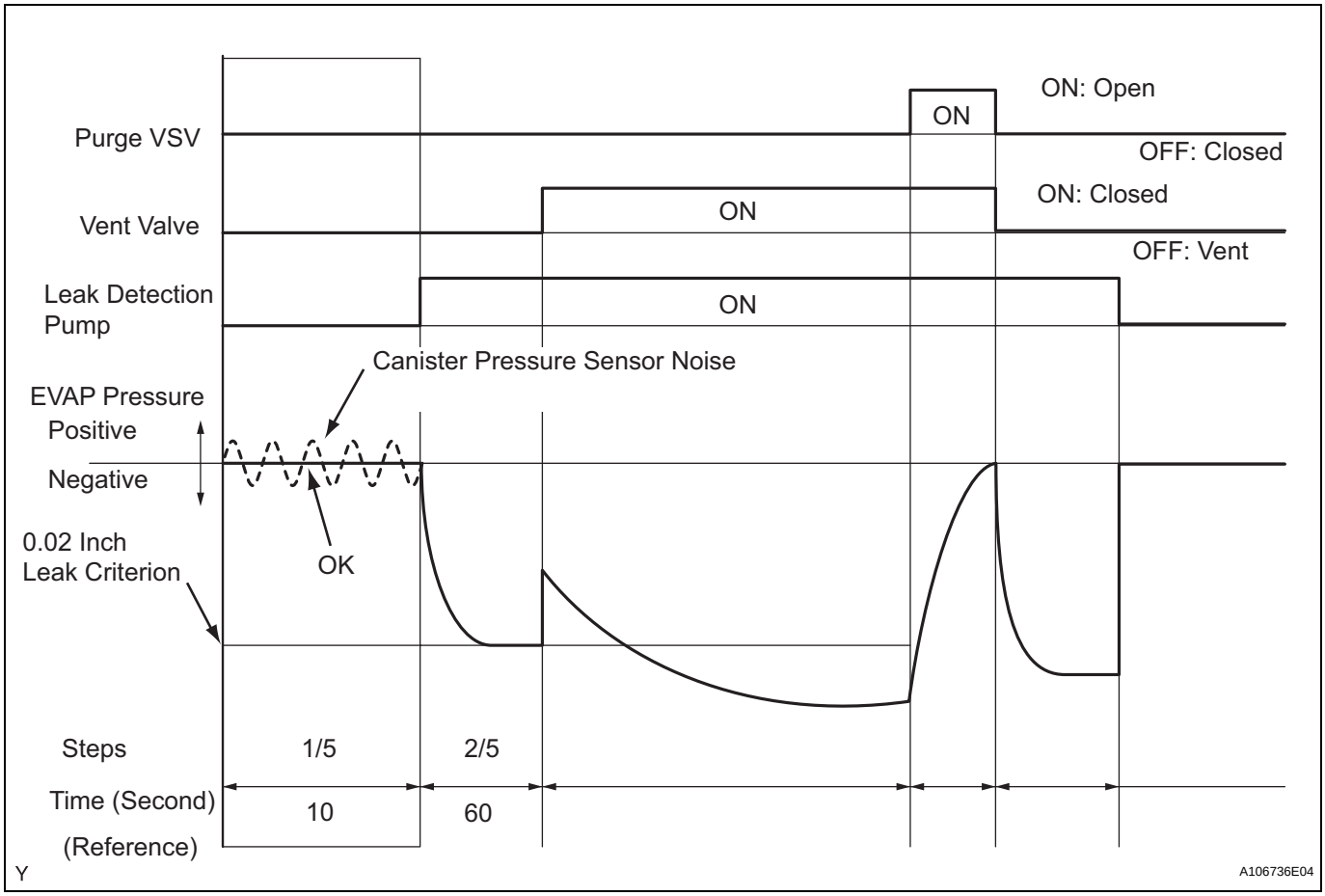
- **In the EVAP SYSTEM CHECK (MANUAL OPERATION), the series of 5 EVAP SYSTEM CHECK steps is performed manually by the intelligent tester.**
- **Do not perform the EVAP SYSTEM CHECK when the fuel tank is more than 90 % full because the cut-off valve may be closed and making the leak check of the fuel tank 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 the EVAP SYSTEM CHECK, keep the temperature below 35°C (95°F).**

(a) Clear DTCs (see page ES-40).
(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)



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

Result

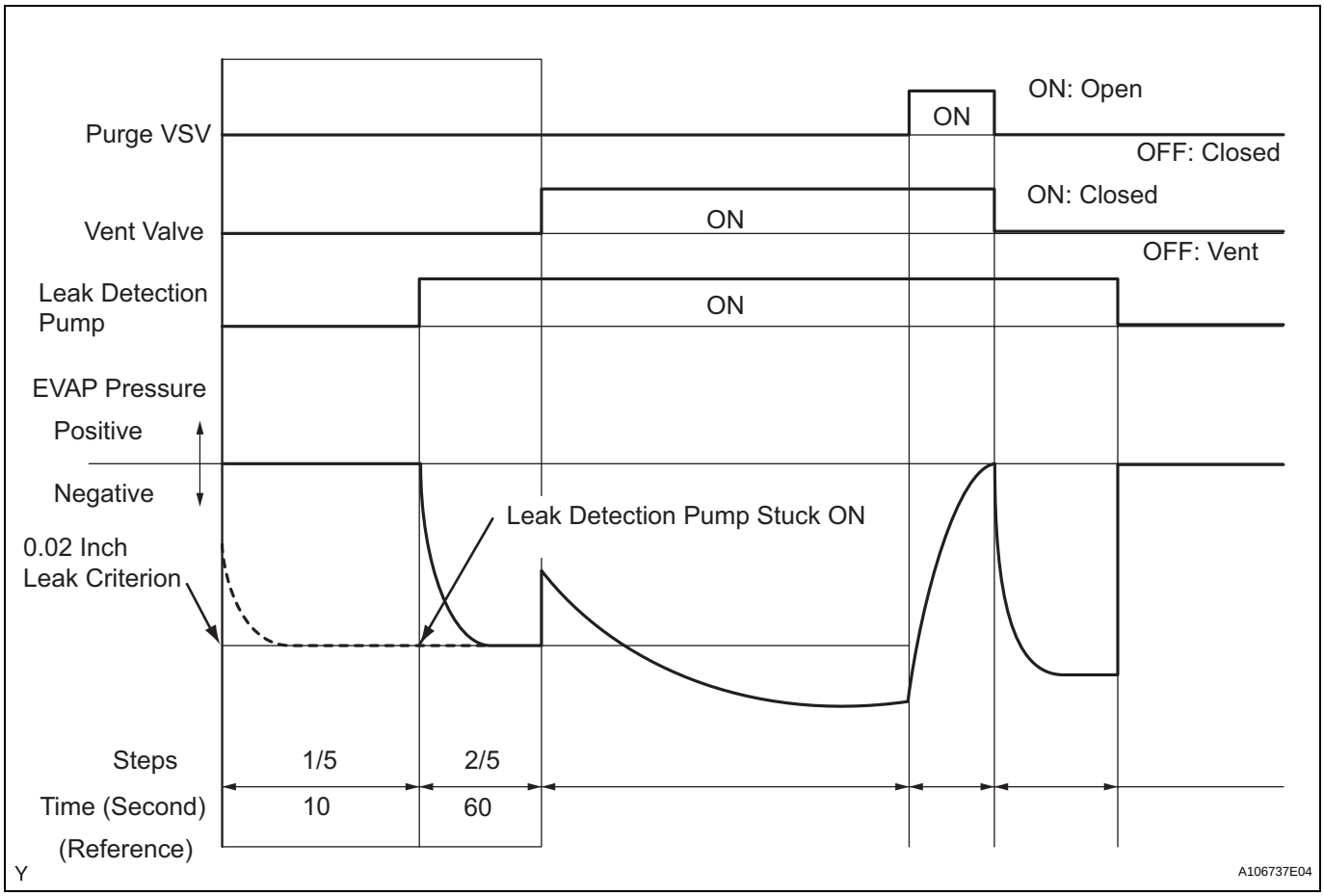
DTCs*	Test Results	Suspected Trouble Areas	Proceed To
-	Virtually no variation in EVAP pressure	Not yet determined	A
P0451	EVAP pressure fluctuates by +-0.3 kPa (2.25 mmHg) or more	Canister pressure sensor noise	B

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in step 1.

B	Go to step 30

A

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



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

Result

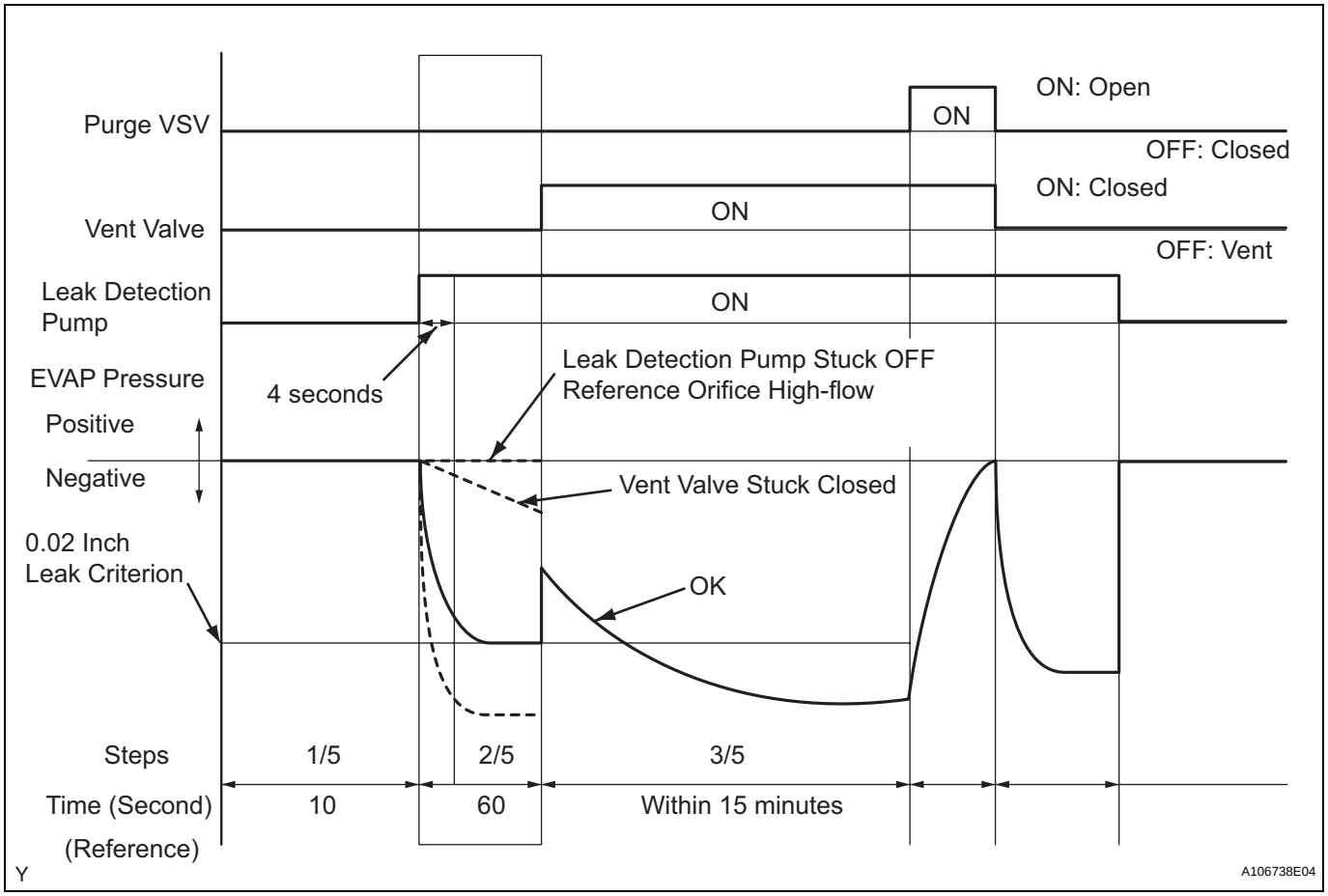
DTCs*	Test Results	Suspected Trouble Areas	Proceed To
-	Virtually no variation in EVAP pressure during step 1/5. Then decreases to 0.02 inch leak criterion	Not yet determined	A
P2402	Small difference between EVAP pressures during steps 1/5 and 2/5	Leak detection pump stuck ON	B

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in step 1.
HINT:
The first 0.02 inch leak criterion is the value determined in step 2/5.

B → Go to step 23

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*.

(b) Check the EVAP pressure again when it has stabilized. This pressure is the 0.02 inch leak criterion.

*: The leak detection pump begins to operate as step 1/5 is proceeded to step 2/5.

Result

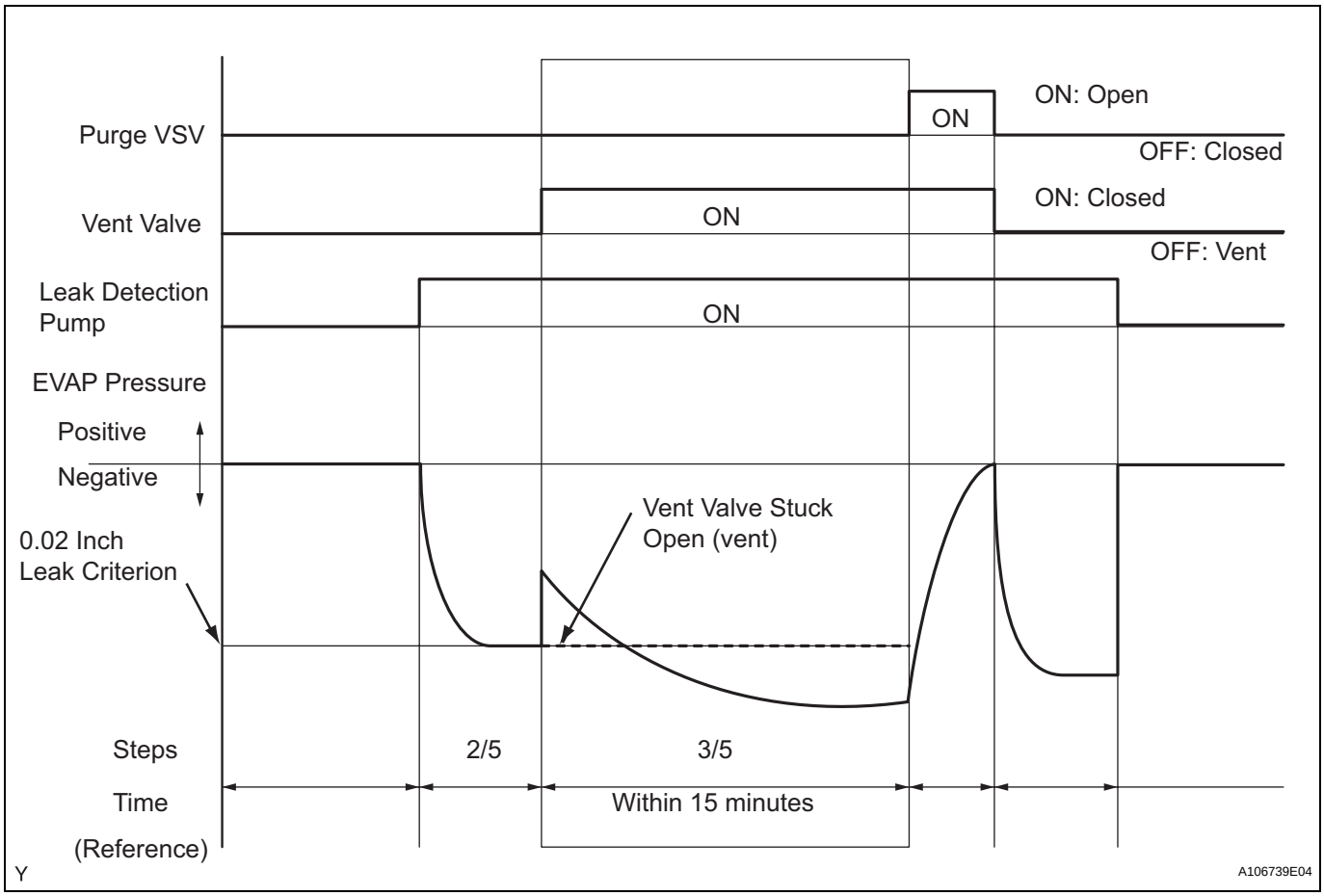
DTCs*	Test Results	Suspected Trouble Areas	Proceed To
-	EVAP pressure in step (b) between -4.85 kPa and -1.06 kPa (-36.38 mmHg and -7.95 mmHg)	Not yet determined	A
P043F and P2401	EVAP pressure in step (b) -1.06 kPa (-7.95 mmHg) or more	• Reference orifice high-flow • Leak detection pump stuck OFF	B
P043E	EVAP pressure in step (b) below -4.85 kPa (-36.38 mmHg)	Reference orifice clogged	C
P2419	EVAP pressure in step (a) more than -1.06 kPa (-7.95 mmHg)	Vent valve stuck closed	D

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in step 1.

B	Go to step 11
C	Go to step 30
D	Go to step 19

A

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



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

Result

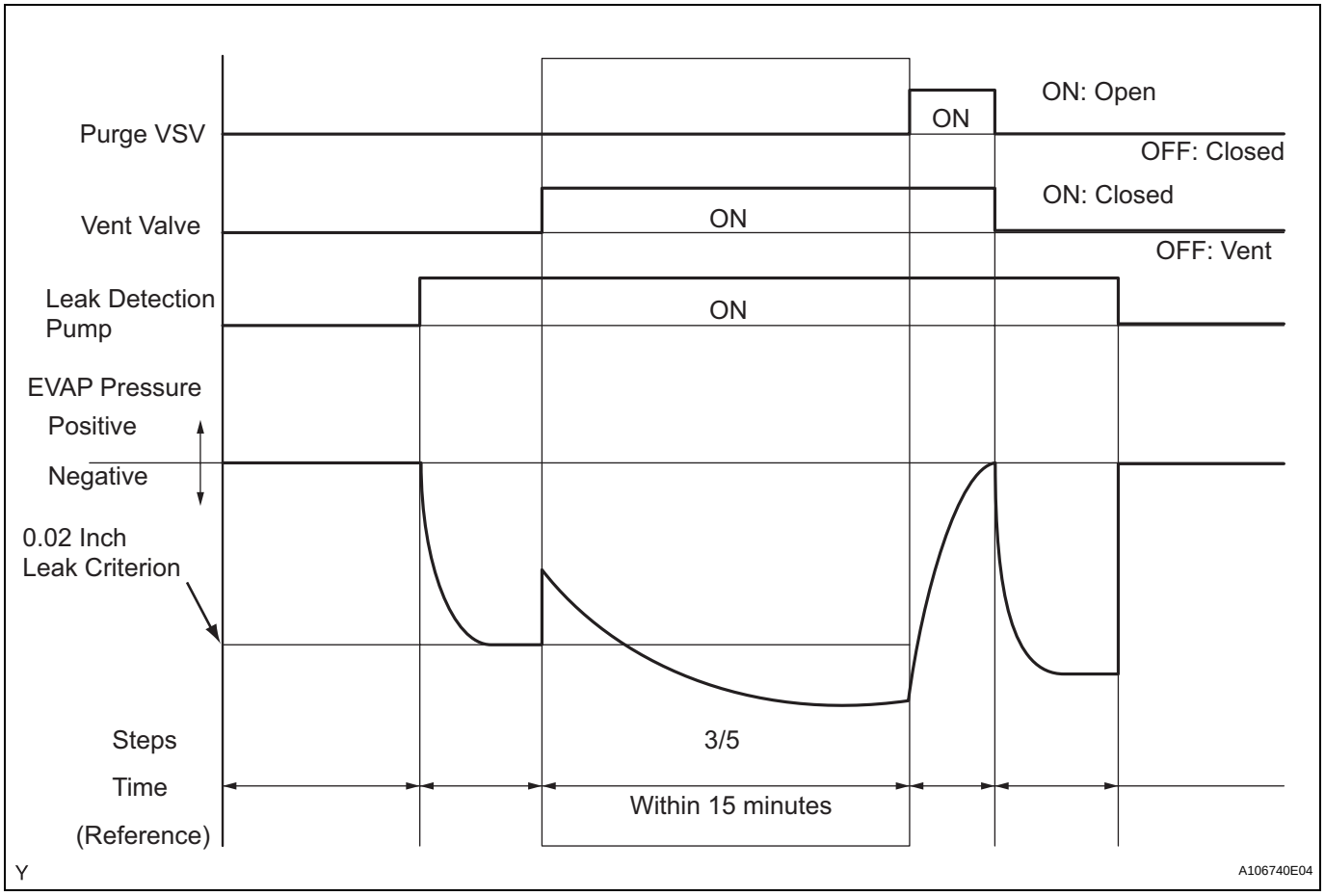
DTCs*	Test Results	Suspected Trouble Areas	Proceed To
-	EVAP pressure increases by 0.3 kPa (2.25 mmHg) or more within 10 seconds of proceeding from step 2/5 to step 3/5	Not yet determined	A
P2420	No variation in EVAP pressure despite proceeding from step 2/5 to step 3/5	Vent valve stuck open (vent)	B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

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in step 1.

B	Go to step 20
C	Go to step 30

A

8	PERFORM EVAP SYSTEM CHECK (STEP 3/5)

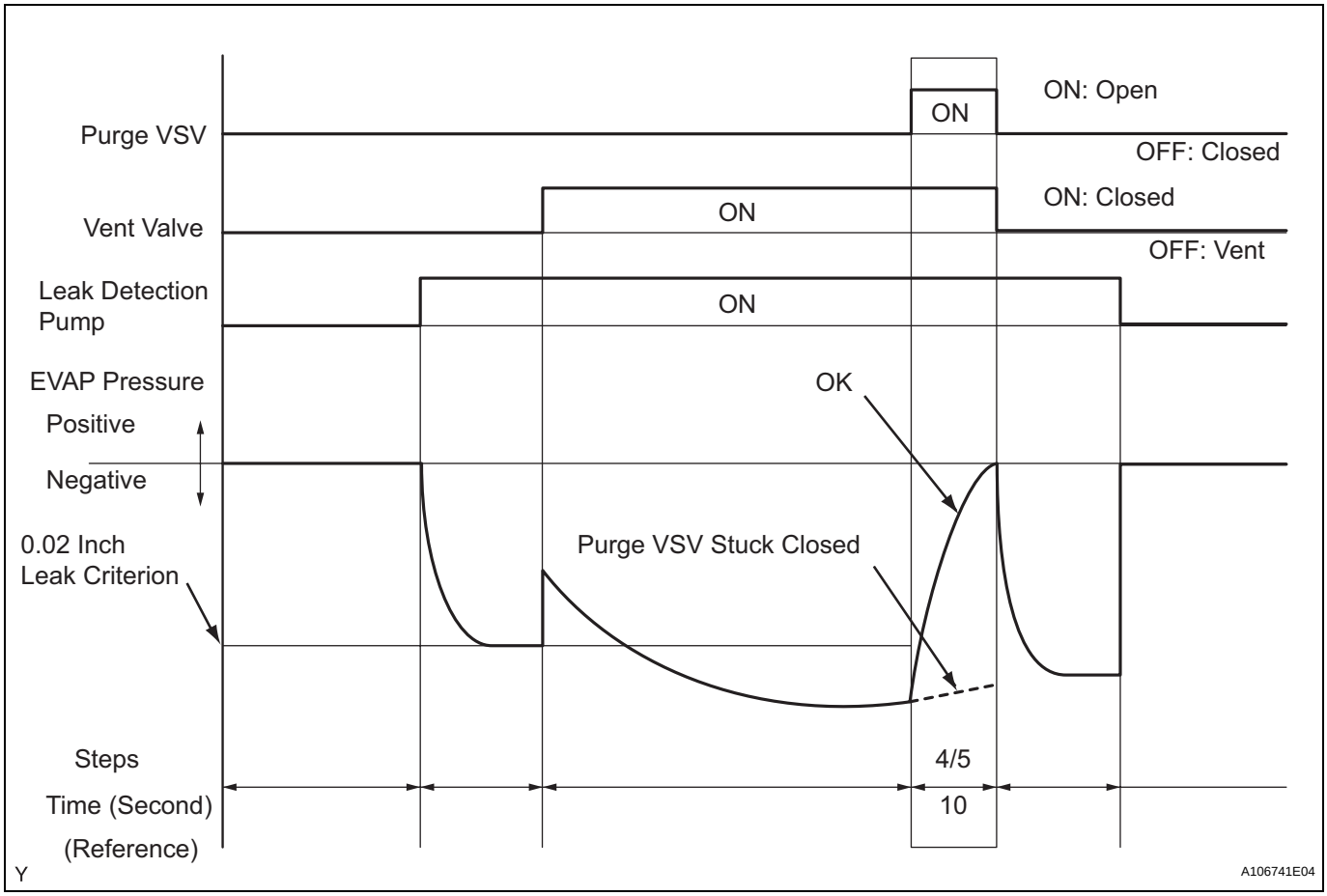


(a) Wait until the EVAP pressure change is less than 0.1 kPa (0.75 mmHg) for 30 seconds.

(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 (900 seconds).

NEXT

9	PERFORM EVAP SYSTEM CHECK (STEP 4/5)



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

Result

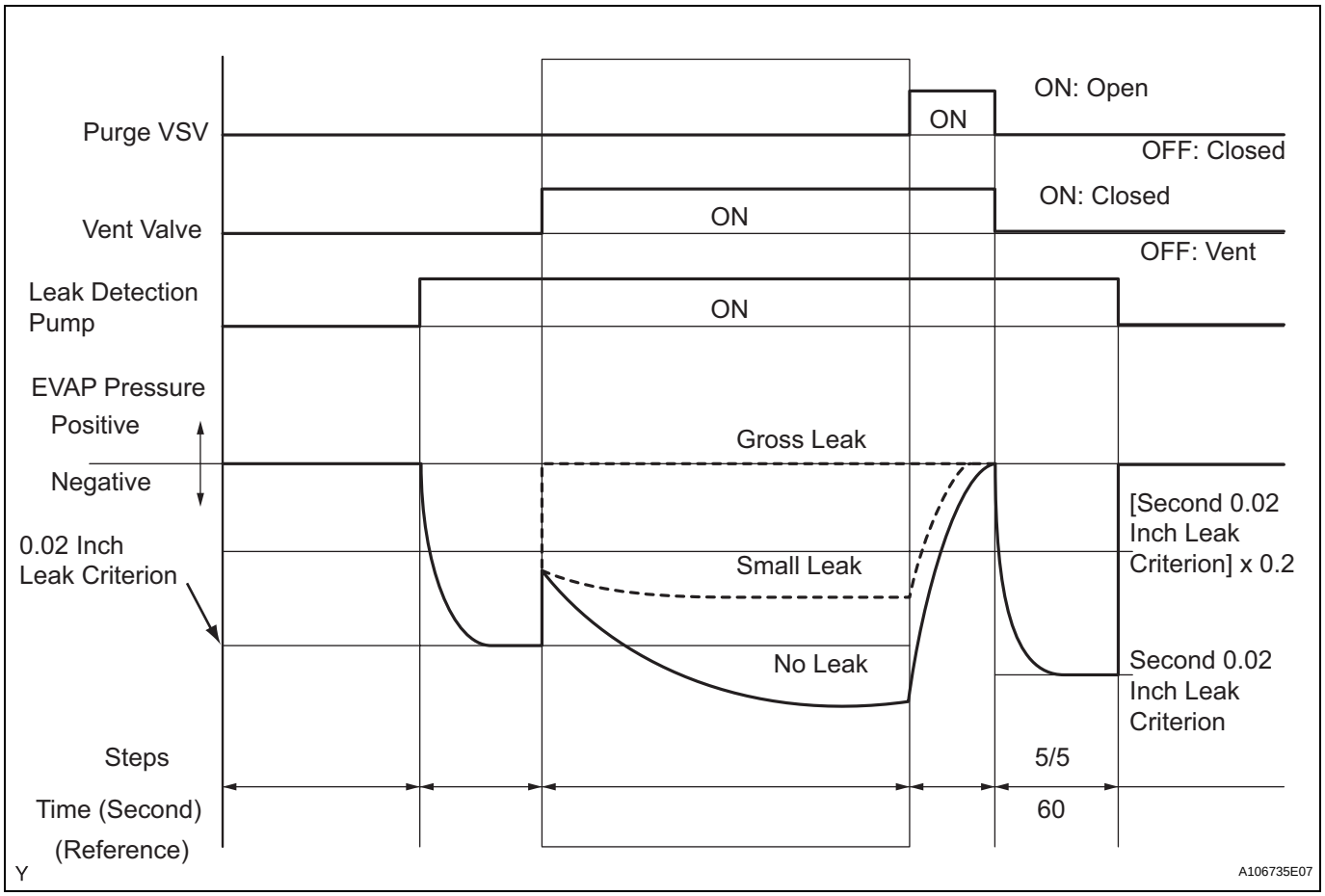
DTCs*	Test Results	Suspected Trouble Areas	Proceed To
-	EVAP pressure increases by 0.3 kPa (2.25 mmHg) or more within 10 seconds of proceeding from step 3/5 to step 4/5	Not yet determined	A
P0441	EVAP pressure increases by 0.3 kPa (2.25 mmHg) or more within 10 seconds of proceeding from step 3/5 to step 4/5	Problems in EVAP hose between pure VSV and intake manifold	B
P0441	Variation in EVAP pressure less than 0.3 kPa (2.25 mmHg) 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 step 1.

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 0.02 inch leak criterion (step 5/5).

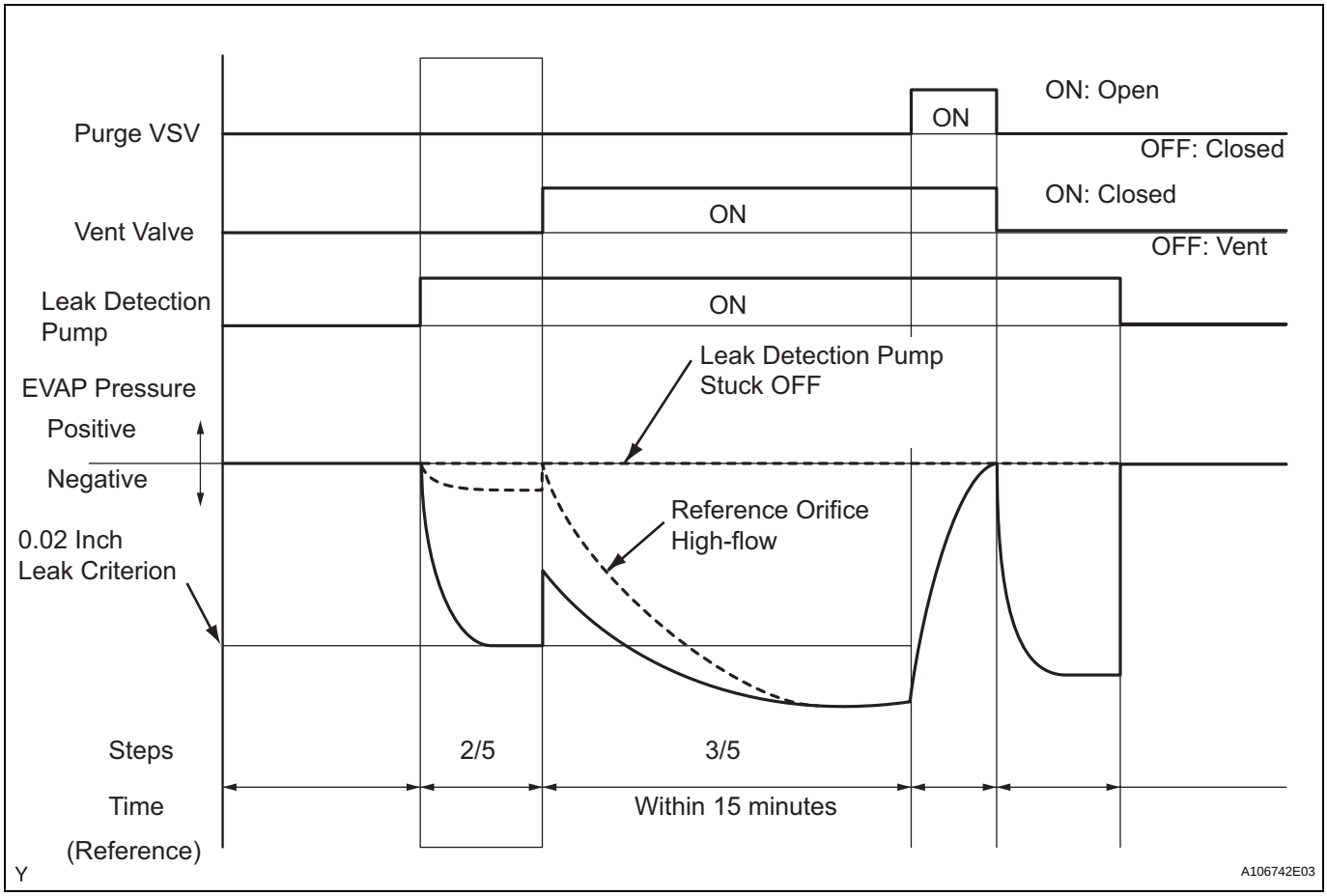
Result

DTCs*	Test Results	Suspected Trouble Areas	Proceed To
-	EVAP pressure (step 3/5) lower than second 0.02 inch leak criterion (step 5/5)	Not yet determined (no leakage from EVAP system)	A
P0441 and P0455	EVAP pressure (step 3/5) higher than [second 0.02 inch leak criterion (step 5/5) x 0.2]	• Purge VSV stuck open • EVAP gross leak	B
P0456	EVAP pressure (step 3/5) higher than second 0.02 inch leak criterion (step 5/5)	EVAP small leak	B

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in step 1.

A	Go to step 36
B	Go to step 12

11	PERFORM EVAP SYSTEM CHECK (STEP 3/5)



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

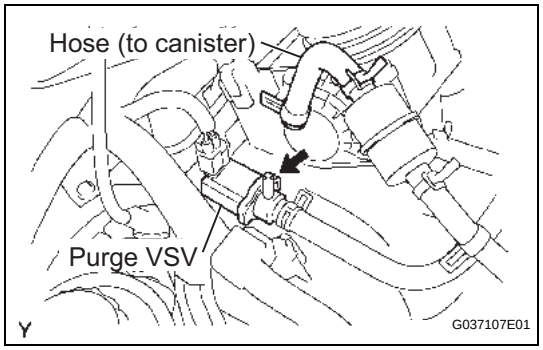
Result

DTCs*	Test Results	Suspected Trouble Areas	Proceed To
P043F	EVAP pressure less than [0.02 inch leak criterion] measured at 2/5	Reference orifice high-flow	A
P2401	EVAP pressure almost same as [0.02 inch leak criterion] 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 step 1.
HINT:
The first 0.02 inch leak criterion is the value determined in step 2/5.

A	Go to step 30
B	Go to step 23

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

(h) Reconnect the hose.

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.
(b) Confirm that the fuel cap is tightened until a few 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 adaptor.
(2) Connect an EVAP tester pump hose to the adaptor, and pressurize the cap to 3.2 to 3.7 kPa (24 to 28 mmHg) using an EVAP tester pump.
(3) Seal the adaptor and wait for 2 minutes.
(4) Check the pressure. If the pressure is 2 kPa (15 mmHg) or more, the fuel cap is normal.
(c) Reinstall the fuel cap.

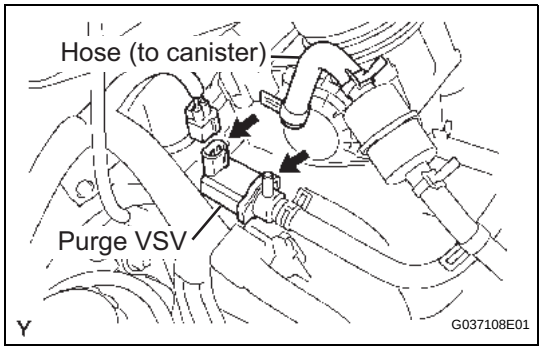
Result

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

A	Go to step 29
B	Go to step 27
C	Go to step 28

ES

14 INSPECT DUTY VACUUM SWITCHING VALVE (PURGE VSV)



(a) Turn the ignition switch to OFF.
(b) Disconnect the V4 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.

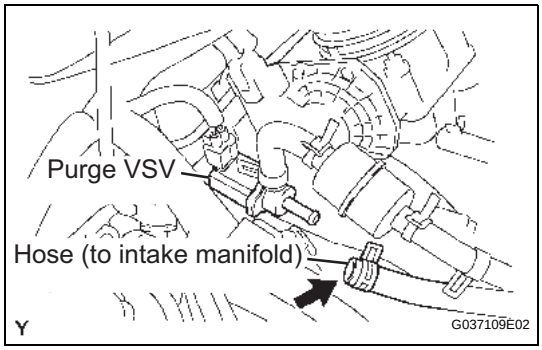
Result

Test Results	Suspected Trouble Areas	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 35
B	Go to step 31

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

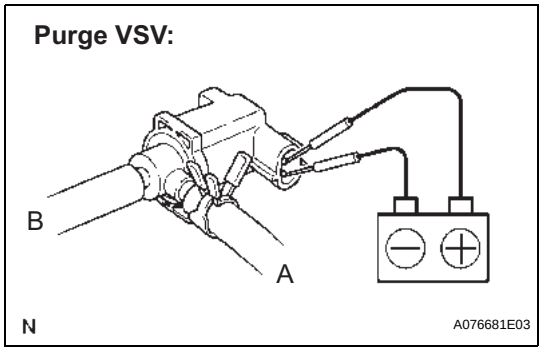
Test Results	Suspected Trouble Areas	Proceed To
Suction applied	EVAP hose between purge VSV and intake manifold normal	A
No suction	• Intake manifold port • EVAP hose between purge VSV and intake manifold	B

(d) Reconnect the hose.

B → Go to step 26

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

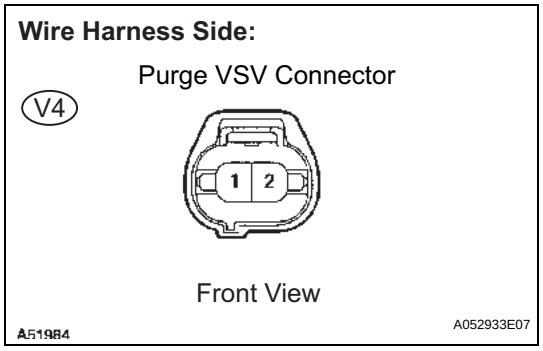
Test Results	Suspected Trouble Areas	Proceed To
Air flows	Purge VSV normal	A
No air flow	Purge VSV	B

(d) Install the purge VSV.

B → Go to step 31

A

17 CHECK HARNESS AND CONNECTOR (POWER SOURCE OF PURGE VSV)



(a) Disconnect the V4 purge VSV connector.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between terminal 1 of the purge VSV connector and the body ground.

Result

Test Results	Suspected Trouble Areas	Proceed To
Between 11 V and 14 V	Normal	A

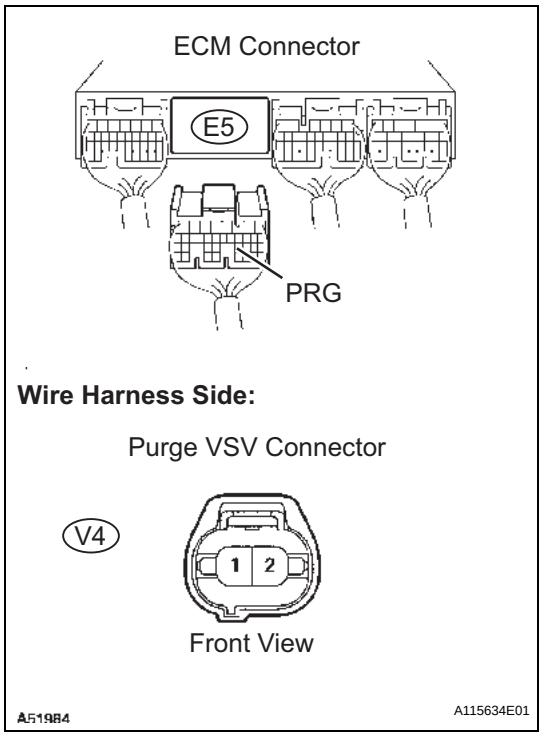
Test Results	Suspected Trouble Areas	Proceed To
Other than result above	Wire harness or connectors between purge VSV and ECM	B

(d) Reconnect the purge VSV connector.

B → **Go to step 32**

A

18 CHECK HARNESS AND CONNECTOR (PURGE VSV - ECM)



(a) Disconnect the E5 ECM connector and the V4 purge VSV connector.
(b) Check the resistance.
Standard Resistance

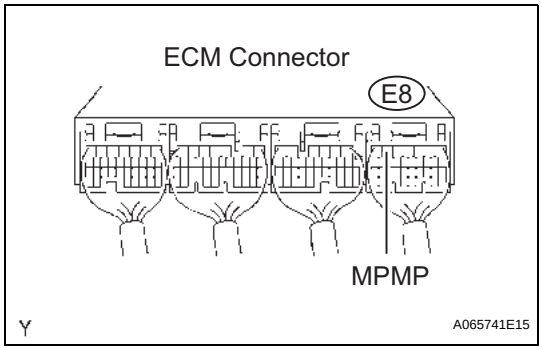
Tester Connections	Specified Conditions
PRG (E5-23) - Purge VSV (V4-1)	Below 1 Ω
PRG (E5-23) - Body ground	10 kΩ or higher
Purge VSV (V4-2) - Body ground	10 kΩ or higher

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

OK → **Go to step 35**

NG → **Go to step 32**

19 PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FOR VENT VALVE)



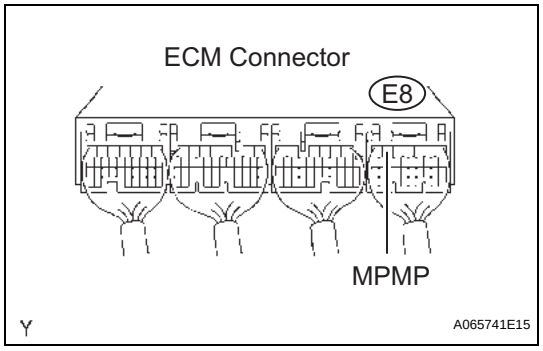
(a) Turn the ignition switch to ON.
(b) On the intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VENT VALVE (ALONE).
(c) Measure the voltage between terminal VPMP of the ECM connector and the body ground when the vent valve is turned ON (close) and OFF (vent) using the tester.

Result

Test Results	Suspected Trouble Areas	Proceed To
Between 9 V and 14 V when OFF Below 3 V when ON	Vent valve	A
Below 3 V when OFF and ON	ECM	B

A	Go to step 22
B	Go to step 35

20 PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FOR VENT VALVE)



(a) Turn the ignition switch to ON.
(b) On the intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VENT VALVE (ALONE).
(c) Measure the voltage between terminal VPMP of the ECM connector and the body ground when the vent valve is turned ON (close) and OFF (vent) using the tester.

ES

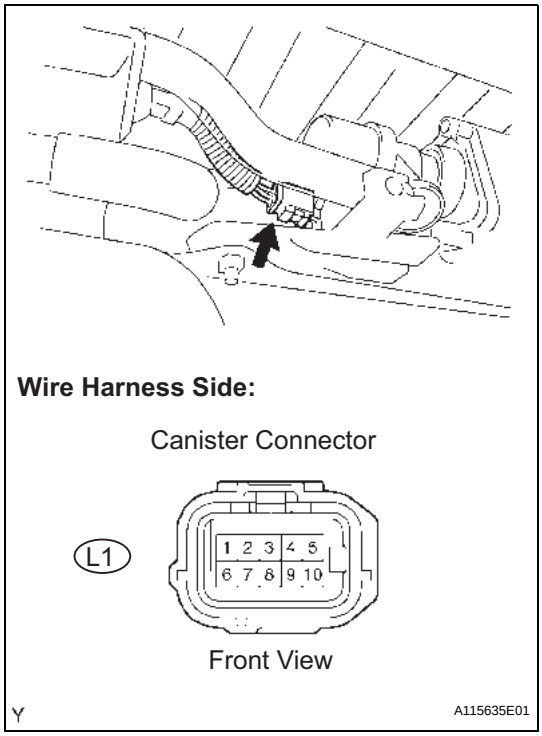
Result

Test Results	Suspected Trouble Areas	Proceed To
Below 3 V when OFF and ON	Power source of vent valve	A
Between 9 V and 14 V when OFF Below 3 V when ON	Vent valve	B
Between 9 V and 14 V when OFF and ON	ECM	C

B	Go to step 22
C	Go to step 35

A

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



(a) Turn the ignition switch OFF.
(b) Disconnect the L1 canister connector.
(c) Turn the ignition switch to ON.
(d) Measure the voltage between terminal 9 of the canister connector and the body ground.

Result

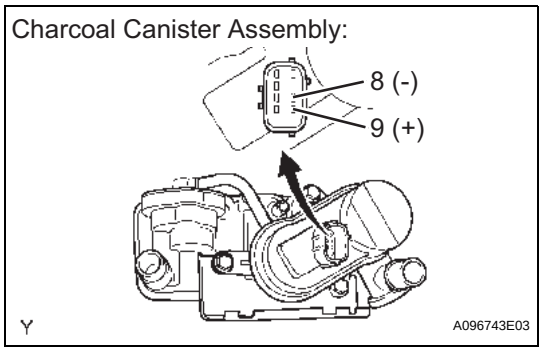
Test Results	Suspected Trouble Areas	Proceed To
Between 9 V and 14 V	Normal	A
Between 0 V and 3 V	Power source wire harness of vent valve	B

(e) Reconnect the canister connector.

B → **Go to step 32**

A

22	INSPECT CANISTER PUMP MODULE (VENT VALVE OPERATION)



(a) Turn the ignition switch to OFF.
(b) Disconnect the L1 canister connector.
(c) Apply the battery voltage to terminals 9 and 8 of the canister pump module.
(d) Touch the canister pump module to confirm the vent valve operation.

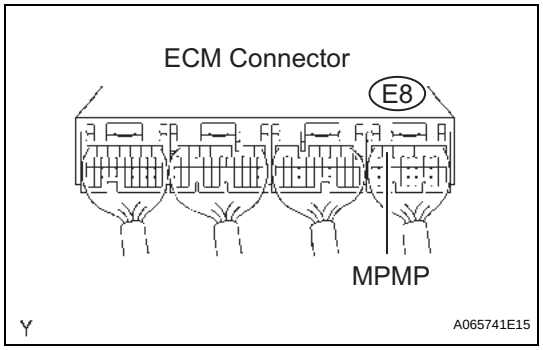
Result

Test Results	Suspected Trouble Areas	Proceed To
Operating	Wire harness between vent valve and ECM	A
Not operating	Vent valve	B

(e) Reconnect the canister connector.

A	Go to step 32
B	Go to step 30

23	PERFORM ACTIVE TEST USING INTELLIGENT TESTER (FOR CANISTER PUMP MODULE (LEAK DETECTION PUMP))



(a) On the intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VACUUM PUMP (ALONE).

(b) Measure the voltage between MPMP terminal of the ECM connector and the body ground when the leak detection pump is turned ON and OFF using the tester.

ES

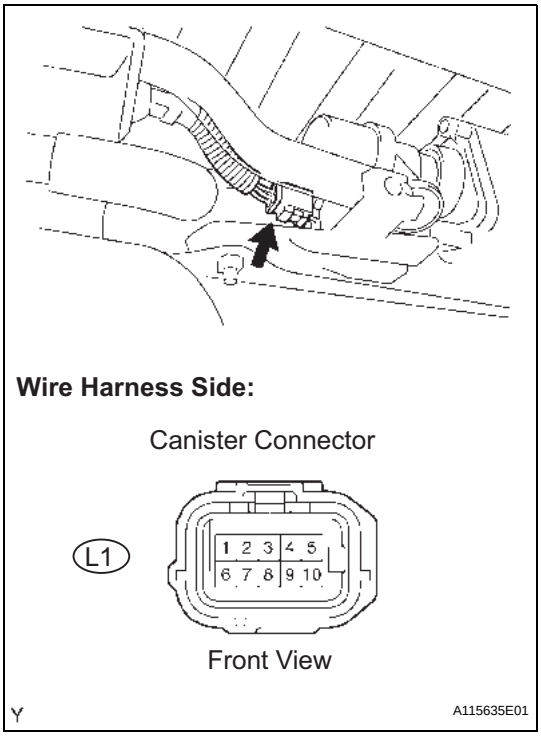
Result

Test Results	Suspected Trouble Areas	Proceed To
Between 0 V and 3 V when OFF Between 9 V and 14 V when ON	ECM normal	A
Between 9 V and 14 V when OFF Between 0 V and 3 V when ON	ECM	B

B	Go to step 35

A

24	CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - ECM)



(a) Turn the ignition switch to OFF.
(b) Disconnect the L1 canister connector.
(c) Turn the ignition switch to ON.
(d) On the intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VACUUM PUMP (ALONE).
(e) Turn the leak detection pump ON.
(f) Measure the voltage between terminal 1 of the canister connector and the body ground.

Result

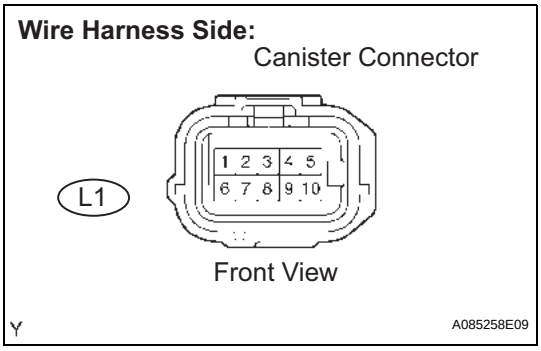
Test Results	Suspected Trouble Areas	Proceed To
Between 9 V and 14 V	Normal	A
Between 0 V and 3 V	Wire harness between ECM and leak detection pump	B

(g) Reconnect the canister connector.

B → **Go to step 32**

A

25	CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - GROUND)



(a) Disconnect the L1 canister connector.
(b) Turn the ignition switch to OFF.
(c) Check the resistance between terminal 6 of the canister connector and the body ground.

Result

Test Results	Suspected Trouble Areas	Proceed To
Below 1 Ω	Leak detection pump	A

Test Results	Suspected Trouble Areas	Proceed To
10 kΩ or higher	Wire harness between leak detection pump and body ground	B

(d) Reconnect the canister connector.

A	Go to step 30
B	Go to step 32

26 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.

ES

Result

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

(e) Reconnect the EVAP hose.

A	Go to step 33
B	Go to step 34

27 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 few click sounds are heard.

NEXT	Go to step 37

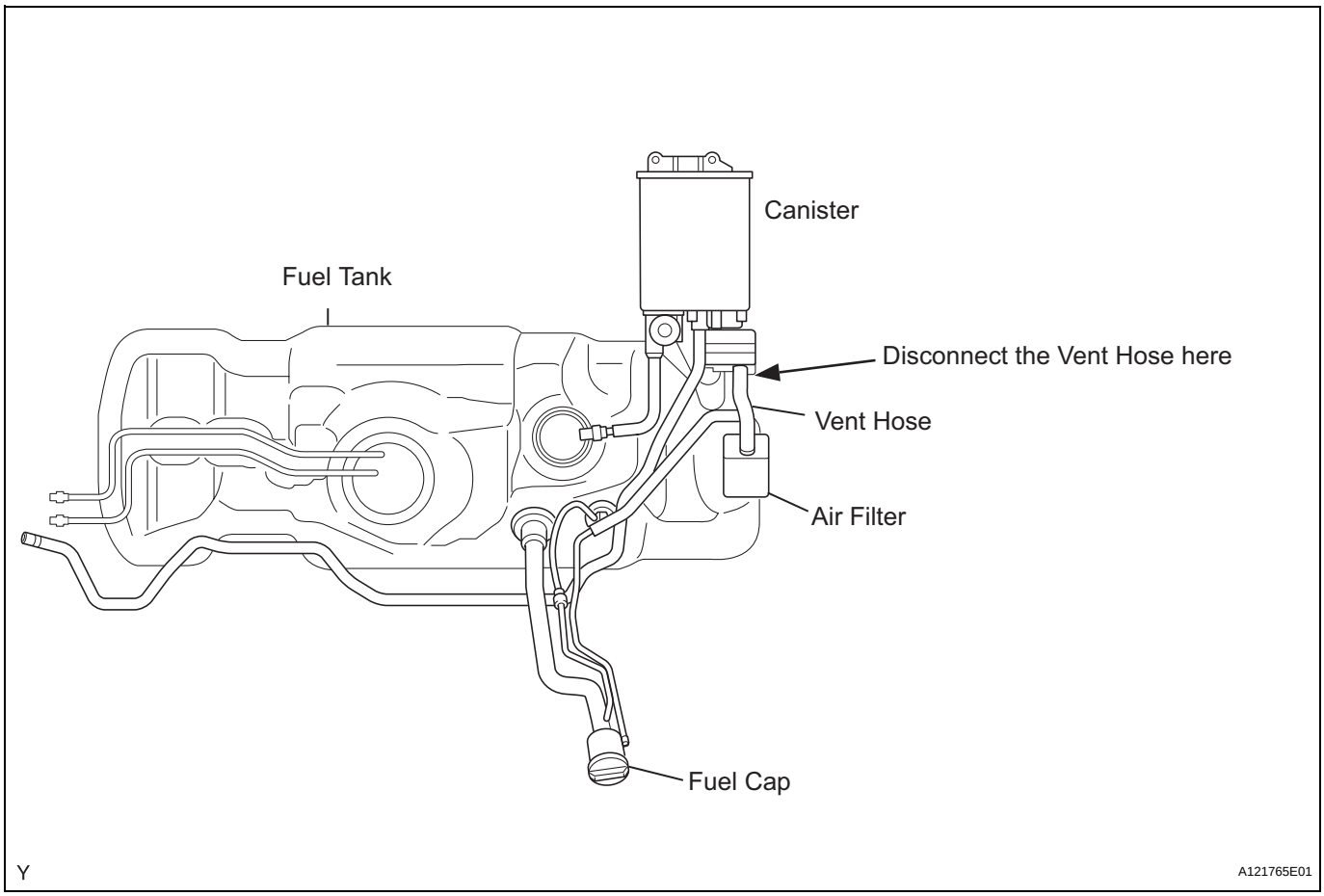
28 REPLACE FUEL CAP ASSEMBLY

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

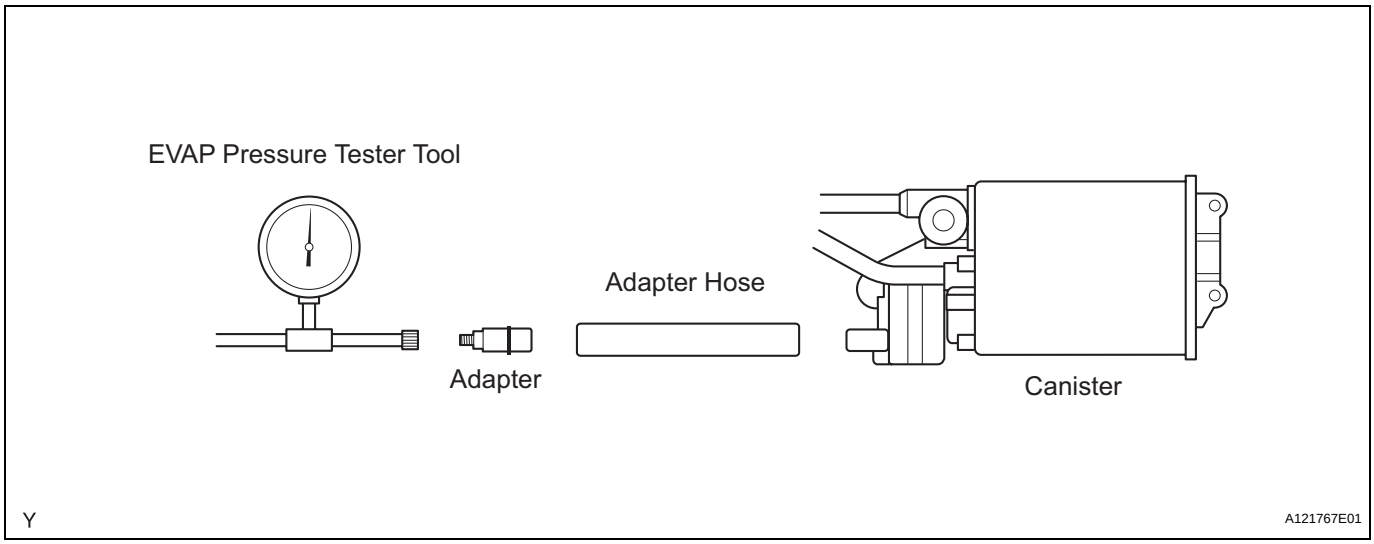
NEXT	Go to step 37

29 REPAIR EVAP LEAKING PART

(a) Reinstall the fuel cap.
(b) Disconnect the vent hose.



(c) Connect the EVAP pressure tester tool to the canister with the adapter.



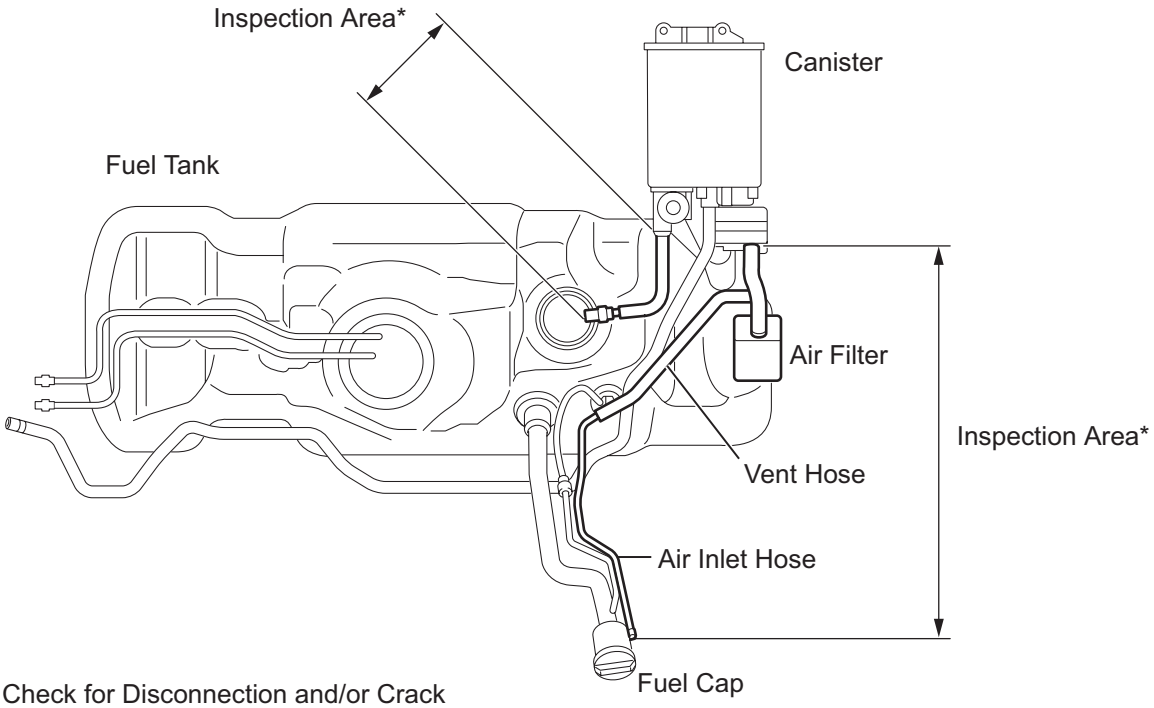
(d) Pressurize the EVAP system to 3.2 to 3.7 kPa (24 to 28 mmHg).
(e) Apply soapy water to the piping and connecting parts of the EVAP system.
(f) Look for areas where bubbles appear. This indicates leak point.
(g) Repair or replace the leak point.

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 37

30	REPLACE CHARCOAL CANISTER ASSEMBLY

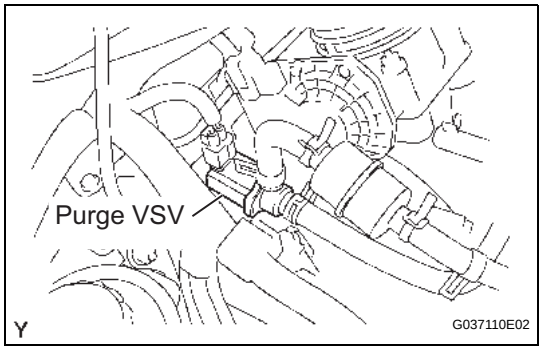
(a) Replace the canister assembly.



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

NEXT	Go to step 37

31	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 37

ES

32	REPAIR OR REPLACE HARNESS AND CONNECTOR

NEXT → Go to step 37

33	REPLACE EVAP HOSE (INTAKE MANIFOLD - PURGE VSV)

NEXT → Go to step 37

34	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 37

35	REPLACE ECM

(a) replace the ECM (See page ES-467).

NEXT → Go to step 37

36	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 37

37	PERFORM EVAP SYSTEM CHECK (AUTO OPERATION)

NOTICE:

- **The EVAP SYSTEM CHECK (AUTO OPERATION) consists of five 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 and making the leak check of the fuel tank 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 DTCs (see page ES-40).

(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 DTC is 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 free way)
- 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 to 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 an intelligent tester to the DLC3.
2. Turn the ignition switch to ON 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 completed. Make sure that the preconditions have been met, and perform the Monitor Conditions again.

2. PURGE FLOW MONITOR CONFIRMATION (P0441)

HINT:
Perform this monitor confirmation after the Key-Off Monitor Confirmation shows 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 free way)
- 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 to OFF (where ON or the engine is running).
2. Connect an intelligent tester to the DLC3.
3. Turn the ignition switch to ON 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 completed. Make sure that the preconditions have been met, and perform the Monitor Conditions again.

MONITOR RESULT

Refer to Checking Monitor Status (See page ES-21).

The test value and test limit information are described as shown in the following table. This information is included under MONITOR RESULT in the emissions-related DTC sections:
- MID (Monitor Identification Data) is assigned to each emissions-related component.
- TID (Test Identification Data) is assigned to each test value.
- Scaling is used to calculate the test value indicated on generic OBD II scan tools.

Thermostat

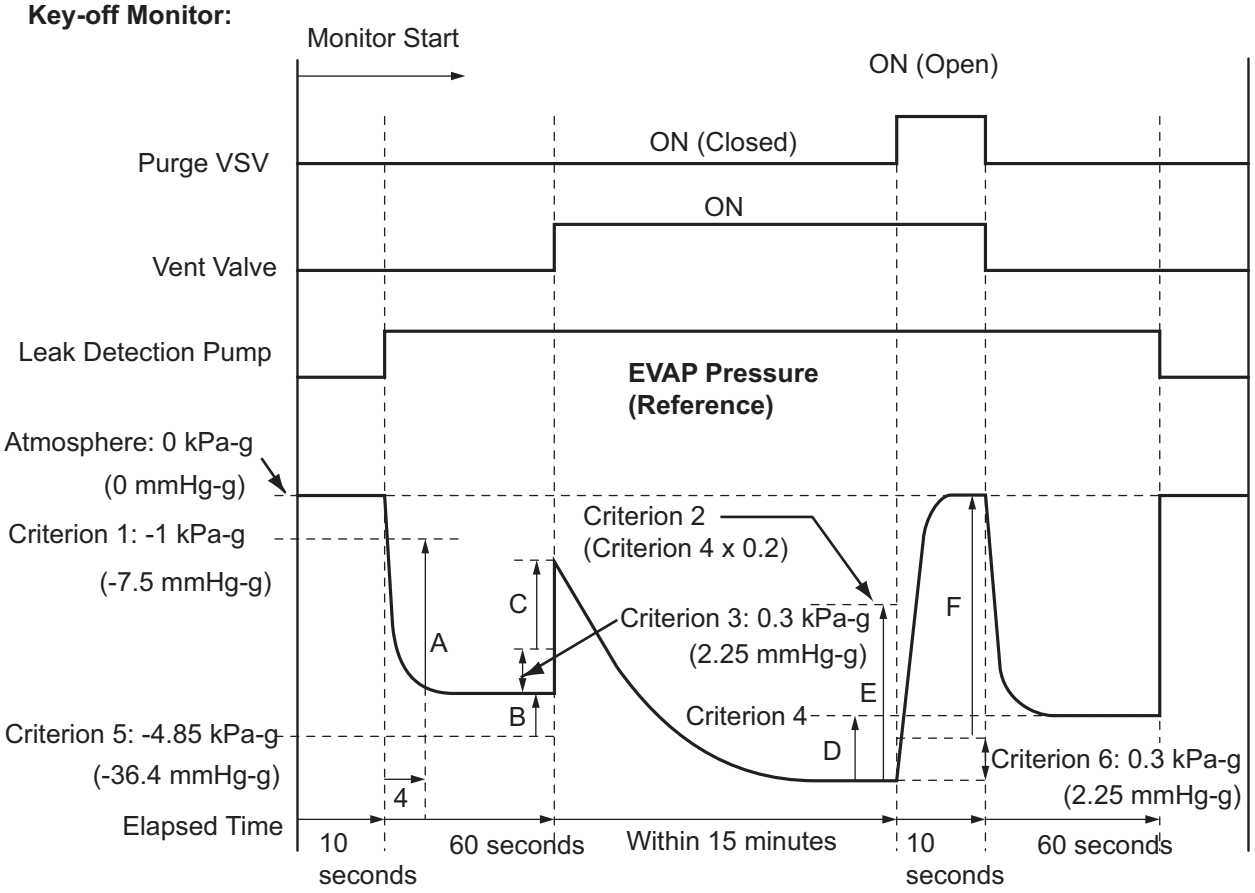
MID	TID	Scaling	Description of Test Value	Minimum Test Limit	Maximum Test Limit
$3D	$C9	Multiply by 0.001 [kPa]	Test value for small leak (P0456) Refer to pressure D*	Minimum test limit for small leak	Maximum test limit for small leak
$3D	$CA	Multiply by 0.001 [kPa]	Test value for gross leak (P0455) Refer to pressure E*	Minimum test limit for gross leak	Maximum test limit for gross leak
$3D	$CB	Multiply by 0.001 [kPa]	Test value for leak detection pump stuck OFF (P2401) Refer to pressure A*	Minimum test limit for leak detection pump stuck OFF	Maximum test limit for leak detection pump stuck OFF
$3D	$CD	Multiply by 0.001 [kPa]	Test value for leak detection pump stuck ON (P2402) Refer to pressure A*	Minimum test limit for leak detection pump stuck ON	Maximum test limit for leak detection pump stuck ON

MID	TID	Scaling	Description of Test Value	Minimum Test Limit	Maximum Test Limit
$3D	$CE	Multiply by 0.001 [kPa]	Test value for vent valve stuck OFF (vent) (P2420) Refer to pressure C*	Minimum test limit for vent valve stuck ON	Maximum test limit for vent valve stuck ON
$3D	$CF	Multiply by 0.001 [kPa]	Test value for vent valve stuck ON (P2419) Refer to pressure A*	Minimum test limit for vent valve stuck OFF	Maximum test limit for vent valve stuck OFF
$3D	$D0	Multiply by 0.001 [kPa]	Test value for reference orifice low flow (P043E) Refer to pressure B*	Minimum test limit for reference orifice low flow	Maximum test limit for reference orifice low flow
$3D	$D1	Multiply by 0.001 [kPa]	Test value for reference orifice high flow (P043F) Refer to pressure A*	Minimum test limit for reference orifice high flow	Maximum test limit for reference orifice high flow
$3D	$D4	Multiply by 0.001 [kPa]	Test value for Purge VSV stuck closed (P0441) Refer to pressure F*	Minimum test limit for Purge VSV stuck closed	Maximum test limit for Purge VSV stuck closed
$3D	$D5	Multiply by 0.001 [kPa]	Test value for Purge VSV stuck open (P0441) Refer to pressure E*	Minimum test limit for Purge VSV stuck open	Maximum test limit for Purge VSV stuck open
$3D	$D7	Multiply by 0.001 [kPa]	Test value for purge flow (P0441) Refer to pressure G*	Minimum test limit for purge flow	Maximum test limit for purge flow

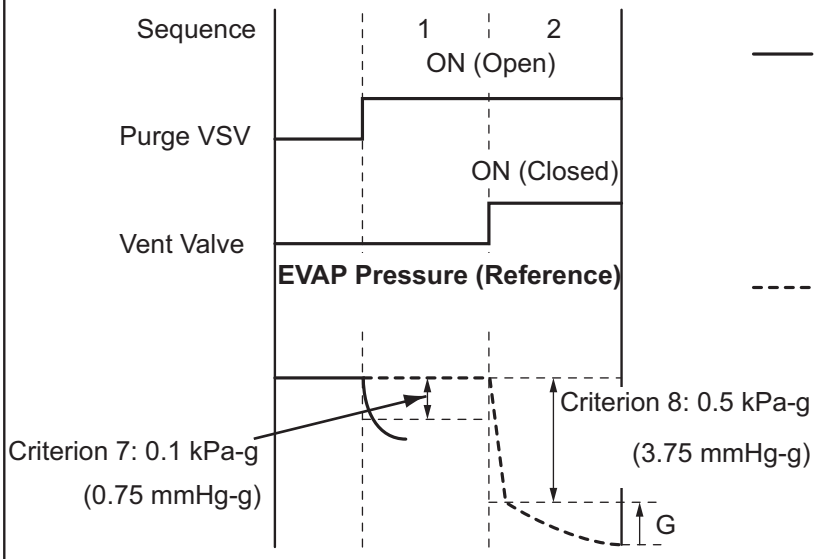
* Pressures A to G are indicated as shown in the diagram below.

ES

Key-off Monitor:



Purge Flow Monitor:



——— If pressure change in sequence 1 is greater than criterion 7, purge flow monitor is completed (functioning normally).

- - - - If pressure change in sequence 1 is smaller than criterion 7 and pressure change in sequence 2 is smaller than criterion 8, purge flow is insufficient.

Y

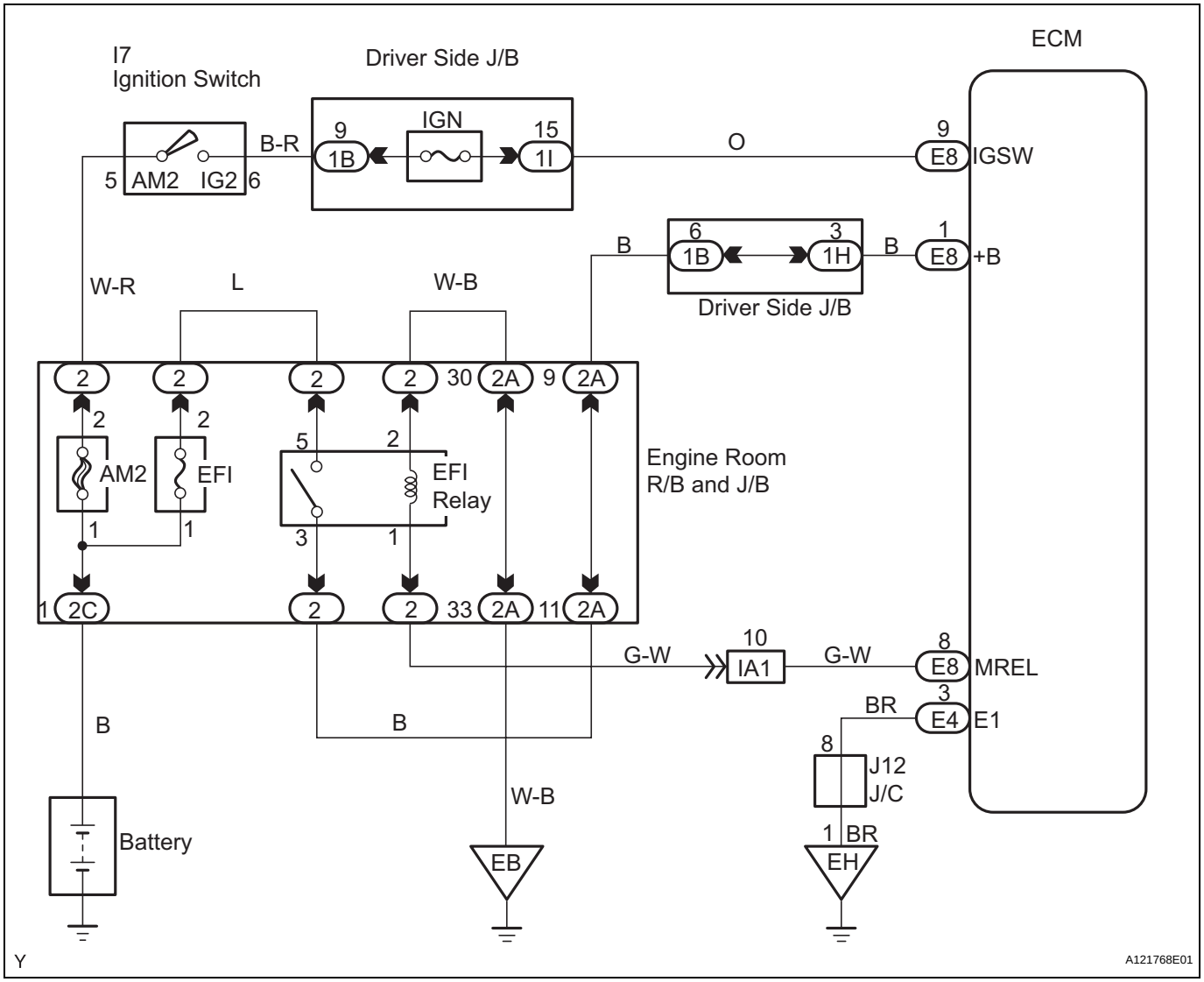
A106747E07

ECM Power Source Circuit

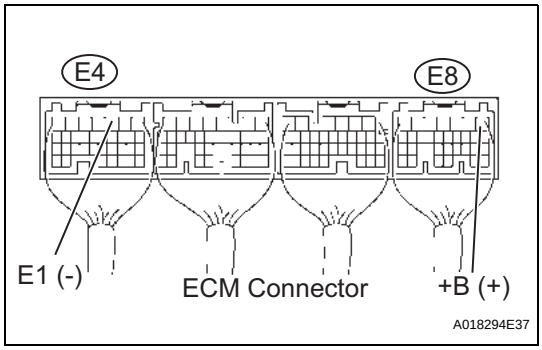
DESCRIPTION

When the ignition switch is turned to ON, the battery voltage is applied to terminal IGSW of the ECM. The ECM MREL output signal causes a current to flow to the coil, closing the contacts of the EFI relay and supplying power to terminal +B of the ECM.

WIRING DIAGRAM



1 **INSPECT ECM (+B VOLTAGE)**



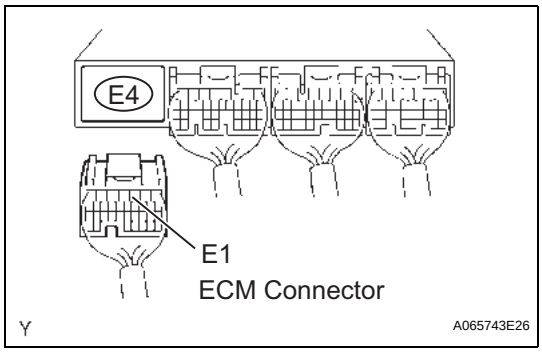
(a) Turn the ignition switch to ON.
(b) Measure the voltage between the terminals of the ECM connectors.
Standard Voltage

Tester Connections	Specified Conditions
+B (E8-1) - E1 (E4-3)	9 to 14 V

OK → **PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE**

ES **NG**

2 **CHECK HARNESS AND CONNECTOR (ECM - BODY GROUND)**



(a) Disconnect the negative battery cable.
(b) Disconnect the E4 ECM connector.
(c) Check the resistance.
Standard Resistance

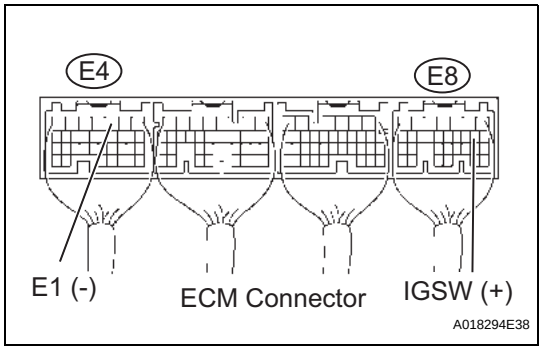
Tester Connections	Specified Conditions
E1 (E4-3) - Body ground	Below 1 Ω

(d) Reconnect the ECM connector.
(e) Reconnect the negative battery cable.

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

OK

3 **INSPECT ECM (IGSW VOLTAGE)**



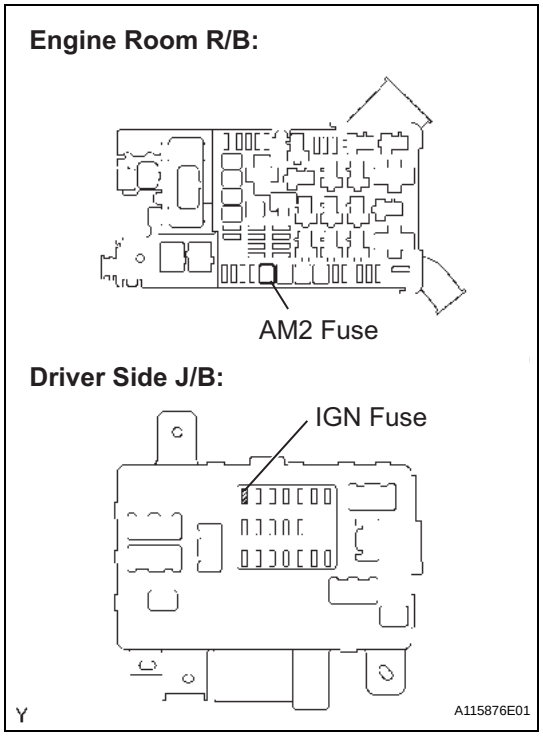
(a) Turn the ignition switch to ON.
(b) Measure the voltage between the terminals of the ECM connectors.
Standard Voltage

Tester Connections	Specified Conditions
IGSW (E8-9) - E1 (E4-3)	9 to 14 V

OK → **Go to step 6**

NG

4 CHECK FUSE (AM2 AND IGN)



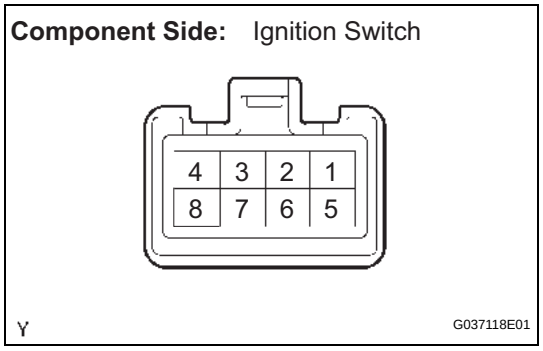
(a) Check the AM2 fuse.
  (1) Remove the AM2 fuse from the engine room R/B.
  (2) Check the AM2 fuse resistance.
    Standard Resistance:
    Below 1 Ω
  (3) Reinstall the AM2 fuse.

(b) Check the IGN fuse.
  (1) Remove the IGN fuse from the driver side J/B.
  (2) Check the IGN fuse resistance.
    Standard Resistance:
    Below 1 Ω
  (3) Reinstall the IGN fuse.

NG → **CHECK FOR SHORT IN ALL HARNESS AND COMPONENTS CONNECTED TO FUSE**

OK

5 INSPECT IGNITION OR STARTER SWITCH ASSEMBLY



(a) Disconnect the I7 ignition switch connector.

(b) Check the resistance.

Standard Resistance

Ignition Switch Positions	Tester Connections	Specified Conditions
LOCK	All Terminals	10 kΩ or higher
ACC	2-4	Below 1 Ω
ON	1-4, 1-6, 2-4, 3-4, 5-6	Below 1 Ω
START	1-4, 3-4, 5-6, 5-7	Below 1 Ω

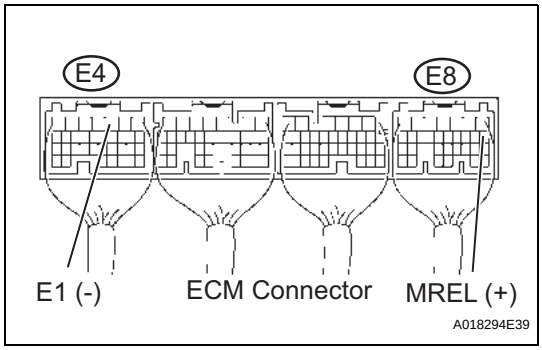
(c) Reconnect the ignition switch connector.

NG → **REPLACE IGNITION OR STARTER SWITCH ASSEMBLY**

OK

CHECK AND REPAIR HARNESS AND CONNECTOR (BATTERY - IGNITION SWITCH, IGNITION SWITCH - ECM)

6 INSPECT ECM (MREL VOLTAGE)



(a) Turn the ignition switch to ON.
(b) Measure the voltage between the terminals of the ECM connectors.
Standard Voltage

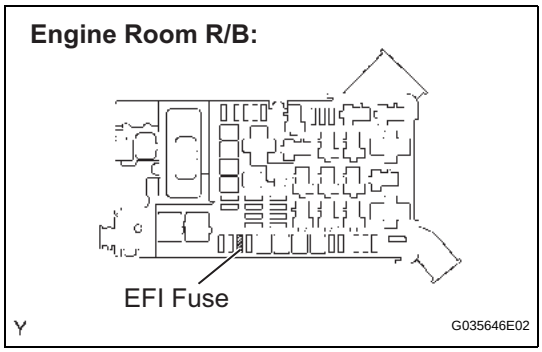
Tester Connections	Specified Conditions
MREL (E8-8) - E1 (E4-3)	9 to 14 V

NG → **REPLACE ECM**

ES

OK

7 CHECK FUSE (EFI)

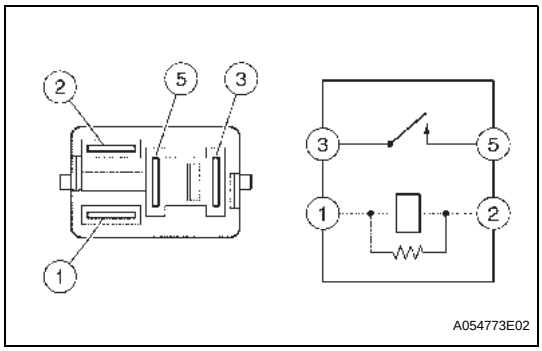


(a) Remove the EFI fuse from the engine room R/B.
(b) Check the EFI fuse resistance.
Standard Resistance:
Below 1 Ω
(c) Reinstall the EFI fuse.

NG → **CHECK FOR SHORT IN ALL HARNESS AND COMPONENTS CONNECTED TO FUSE**

OK

8 INSPECT EFI RELAY



(a) Remove the EFI relay from the engine room R/B.
(b) Check the EFI relay resistance.
Standard Resistance

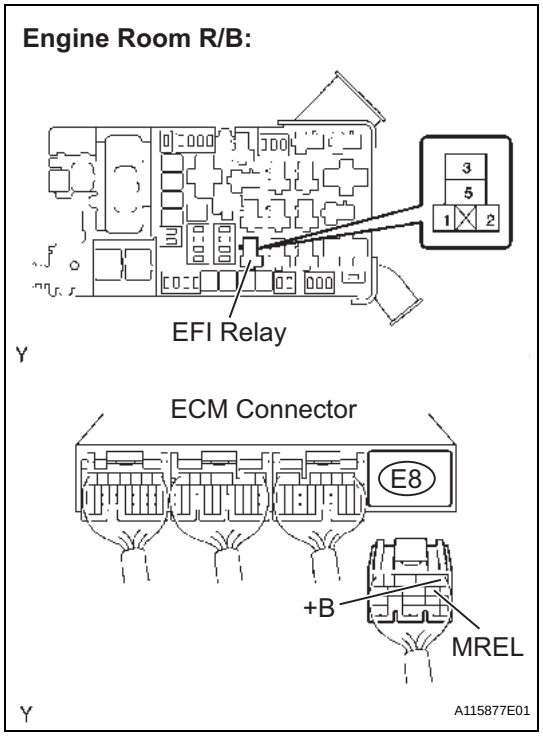
Tester Connections	Specified Conditions
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the EFI relay.

NG → **REPLACE EFI RELAY**

OK

9	CHECK HARNESS AND CONNECTOR (EFI RELAY - ECM, EFI RELAY - BODY GROUND)



(a) Check the harness and connector between the EFI relay and ECM.
  (1) Remove the EFI relay from the engine room R/B.
  (2) Disconnect the E8 ECM connector.
  (3) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
Engine room R/B (EFI relay terminal 1) - MREL (E8-8)	Below 1 Ω
Engine room R/B (EFI relay terminal 3) - +B (E8-1)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
Engine room R/B (EFI relay terminal 1) or MREL (E8-8) - Body ground	10 kΩ or higher
Engine room R/B (EFI relay terminal 3) or +B (E8-1) - Body ground	10 kΩ or higher

  (4) Reconnect the ECM connector.
  (5) Reinstall the EFI relay.

(b) Check the harness and connector between the EFI relay and body ground.
  (1) Remove the EFI relay from the engine room R/B.
  (2) Check the resistance.

Standard Resistance (Check for open):

Tester Connections	Specified Conditions
Engine room R/B (EFI relay terminal 2) - Body ground	Below 1 Ω

  (3) Reinstall the EFI relay.

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

OK

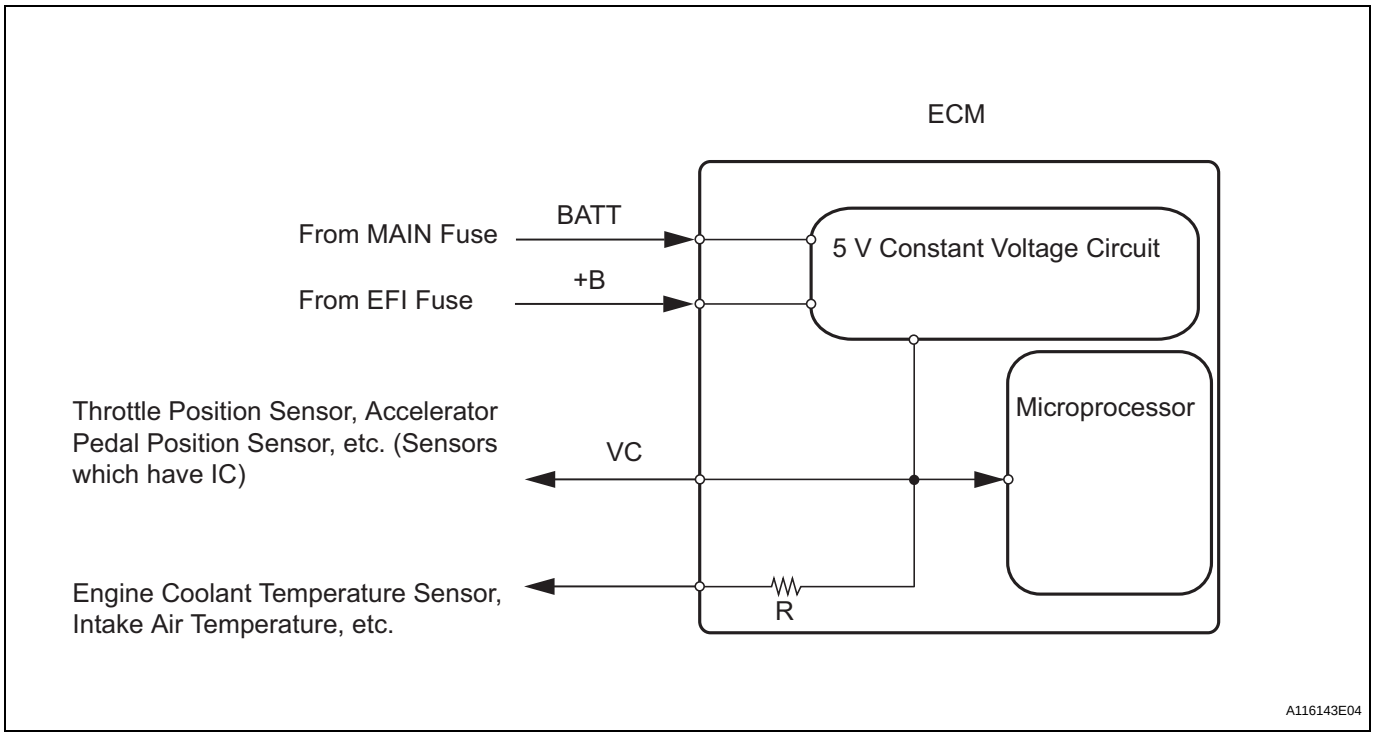
CHECK AND REPLACE HARNESS AND CONNECTOR (TERMINAL 5 OF EFI RELAY - BATTERY POSITIVE TERMINAL)

ES

VC Output Circuit

DESCRIPTION

The ECM constantly generates 5 V power from the battery voltage supplied to the +B (BATT) terminal to operate the microprocessor. The ECM also provides this power to the sensors through the VC output circuit.



When the VC circuit is short-circuited, the microprocessor in the ECM and sensors that are supplied power through the VC circuit are inactivated because the power is not supplied from the VC circuit. Under this condition, the system does not start up and the MIL does not illuminate even if the system malfunctions.

HINT:

Under normal conditions, the MIL is illuminated for several seconds when the ignition switch is first turned to ON. The MIL goes off when the engine is started.

WIRING DIAGRAM

Refer to the following pages.

- Throttle position sensor circuit (See page ES-114).
- Canister pump module circuit (See page ES-397).
- Secondary air injection pressure sensor circuit (See page ES-192).
- Accelerator pedal circuit (See page ES-305).

1	**CHECK MIL**

(a) Check that the Malfunction Indicator Lamp (MIL) lights up when turning the ignition switch ON.

OK:

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 ON and intelligent tester ON.
(c) Check the communication between the intelligent tester and ECM.

Result	Proceed to
Communication is possible	A
Communication is not possible	B

A → **GO TO MIL CIRCUIT**

B

3 CHECK MIL (THROTTLE BODY)

(a) Disconnect the throttle body connector.
(b) Turn the ignition switch ON.
(c) Check the MIL.

Result

Result	Proceed to
MIL illuminates	**A**
MIL does not illuminate	**B**

A → **REPLACE THROTTLE BODY**

B

4 CHECK MIL (ACCELERATOR PEDAL)

(a) Disconnect the accelerator pedal connector.
(b) Turn the ignition switch ON.
(c) Check the MIL.

Result

Result	Proceed to
MIL illuminates	**A**
MIL does not illuminate	**B**

A → **REPLACE ACCELERATOR PEDAL ASSEMBLY**

B

5 CHECK MIL (PRESSURE SENSOR FOR SECONDARY AIR INJECTION)

(a) Disconnect the pressure sensor connector.
(b) Turn the ignition switch ON.
(c) Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → **REPLACE PRESSURE SENSOR**

B

6 CHECK MIL (CANISTER PUMP MODULE)

(a) Disconnect the canister pump module connector.
(b) Turn the ignition switch ON.
(c) Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → **REPLACE CHARCOAL CANISTER ASSEMBLY**

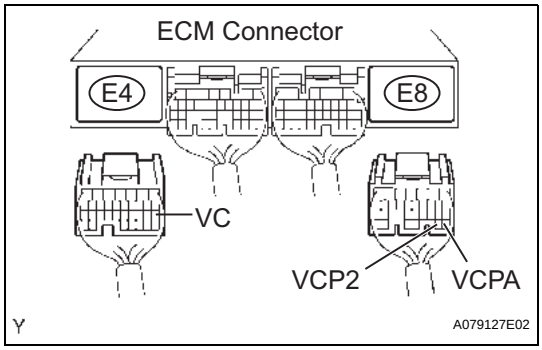
B

7 CHECK HARNESS AND CONNECTOR

(a) Disconnect the throttle body connector.
(b) Disconnect the accelerator pedal connector.
(c) Disconnect the pressure sensor connector.
(d) Disconnect the canister pump module connector.
(e) Disconnect the ECM connector.
(f) Measure the resistance of the wire harness side connector.

Standard Resistance (check for short)

Tester Connection	Specified Condition
VC (E4-18) - Body ground	10 kΩ or higher



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

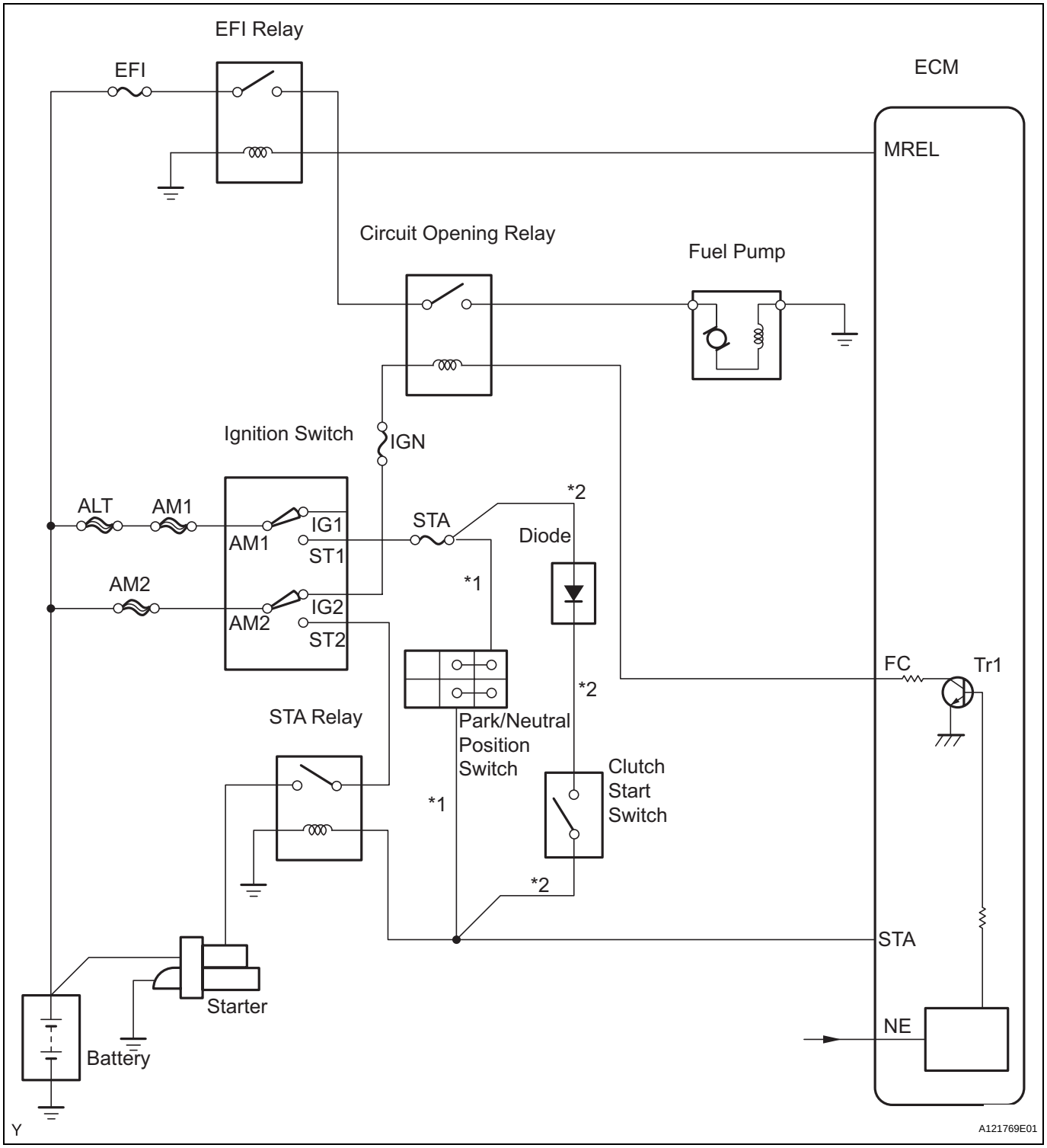
OK

REPLACE ECM

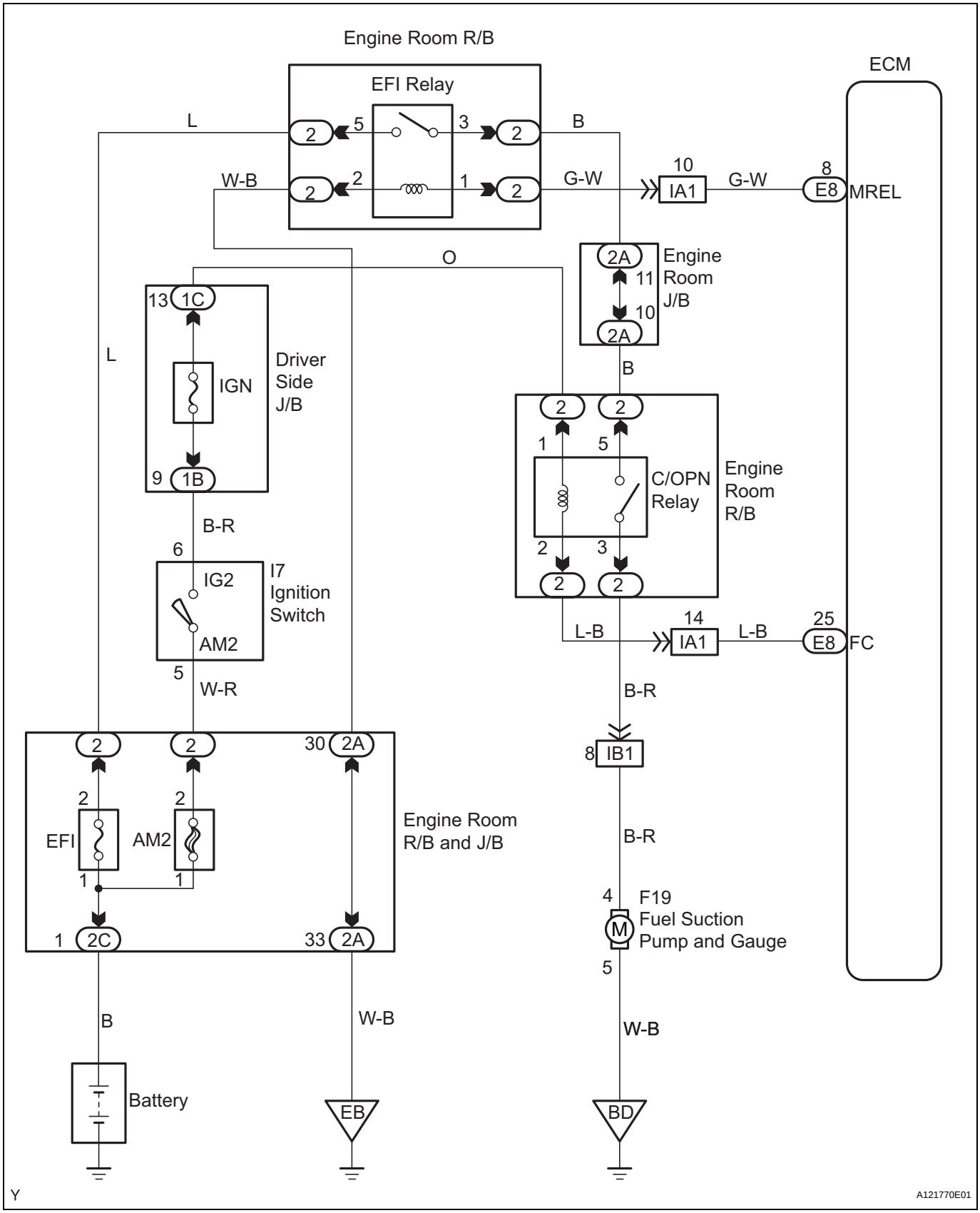
Fuel Pump Control Circuit

DESCRIPTION

When the engine is cranked, a current flows from terminal ST2 of the ignition switch into the STA (starter) relay 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 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



1	PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATION OF CIRCUIT OPENING RELAY)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / FUEL PUMP/ SPD.
(d) Check whether relay operating sounds can be heard while operating the relay using the tester.
OK:
Relay operating sounds can be heard from relay.

OK → **Go to step 7**

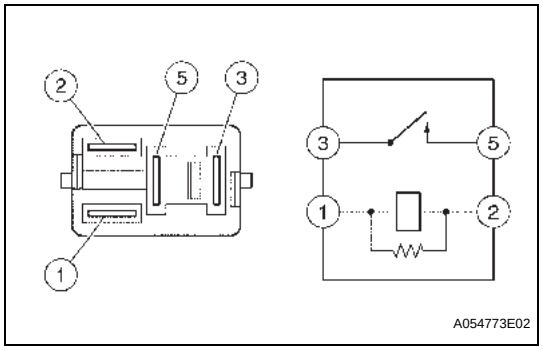
NG

2	INSPECT ECM POWER SOURCE CIRCUIT

NG → **REPAIR OR REPLACE POWER SOURCE CIRCUIT**

OK

3	INSPECT CIRCUIT OPENING RELAY (C/OPN RELAY)



(a) Remove the circuit opening (C/OPN) relay from the engine room R/B.
(b) Check the circuit opening relay resistance.
Standard Resistance

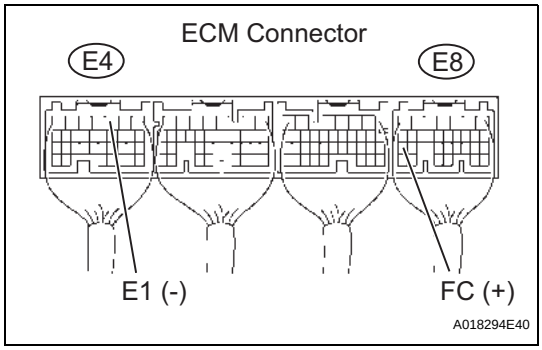
Tester Connections	Specified Conditions
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the circuit opening relay.

NG → **REPLACE CIRCUIT OPENING RELAY**

OK

4	INSPECT ECM (FC VOLTAGE)



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

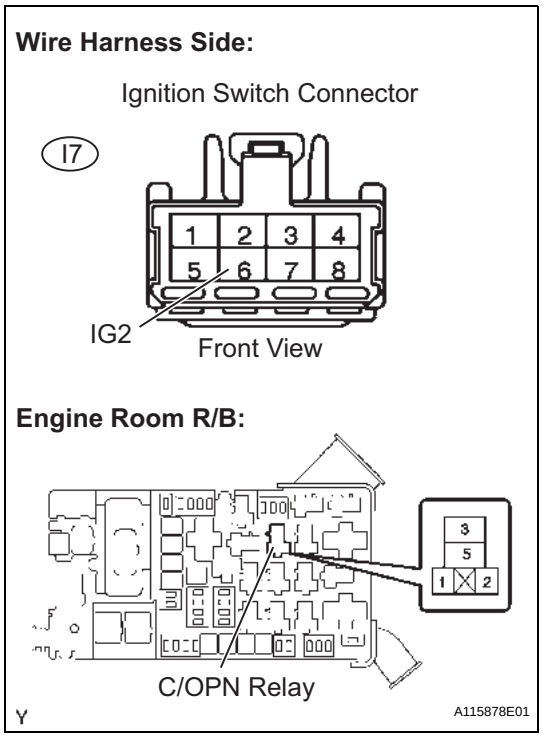
Standard Voltage

Tester Connections	Specified Conditions
FC (E8-25) - E1 (E4-3)	9 to 14 V

OK → **REPLACE ECM**

NG

5	CHECK HARNESS AND CONNECTOR (IGNITION SWITCH - CIRCUIT OPENING RELAY)



(a) Disconnect the I7 ignition switch connector.
(b) Remove the circuit opening (C/OPN) relay from the engine room R/B.
(c) Check the resistance.

Standard Resistance (Check for open)

Terminal Connections	Specified Conditions
IG2 (I7-6) - Engine room R/B (Circuit opening relay terminal 1)	Below 1 Ω

Standard Resistance (Check for short)

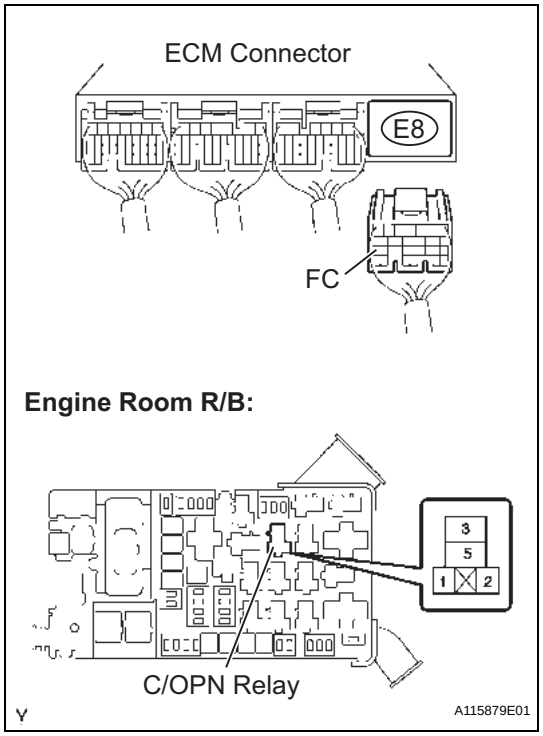
Terminal Connections	Specified Conditions
IG2 (I7-6) or Engine room R/B (Circuit opening relay terminal 1) - Body ground	10 kΩ or higher

(d) Reinstall the circuit opening relay.
(e) Reconnect the ignition switch connector.

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

OK

6	CHECK HARNESS AND CONNECTOR (ECM - CIRCUIT OPENING RELAY)



(a) Disconnect the E8 ECM connector.
(b) Remove the circuit opening (C/OPN) relay from the engine room R/B.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
FC (E8-25) - Engine room R/B (Circuit opening relay terminal 2)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
FC (E8-25) or Engine room R/B (Circuit opening relay terminal 2) - Body ground	10 kΩ or higher

(d) Reinstall the circuit opening relay.
(e) Reconnect the ECM connector.

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

OK

REPLACE ECM

7	INSPECT FUEL PUMP ASSEMBLY

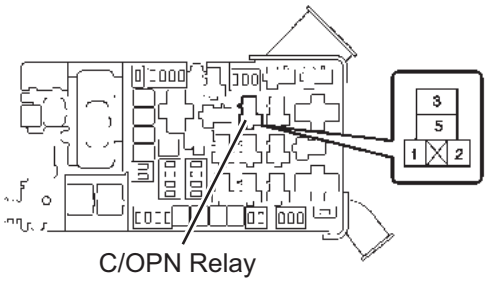
HINT:
Refer to Fuel Pump Inspection (See page FU-26).

NG → **REPLACE FUEL PUMP ASSEMBLY**

OK

8	CHECK HARNESS AND CONNECTOR (CIRCUIT OPENING RELAY - FUEL PUMP, FUEL PUMP - BODY GROUND)

Engine Room R/B:



C/OPN Relay

Wire Harness Side:

F19 Fuel Pump Connector



Front View

A115880E01

(a) Remove the circuit opening (C/OPN) relay from the engine room R/B.
(b) Disconnect the F19 fuel pump connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
Engine room R/B (Circuit opening relay terminal 3) - Fuel pump (F19-4)	Below 1 Ω
Fuel pump (F19-5) - Body ground	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
Engine room R/B (Circuit opening relay terminal 3) or Fuel pump (F19-4) - Body ground	10 kΩ or higher

(d) Reconnect the fuel pump connector.
(e) Reinstall the circuit opening relay.

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

OK

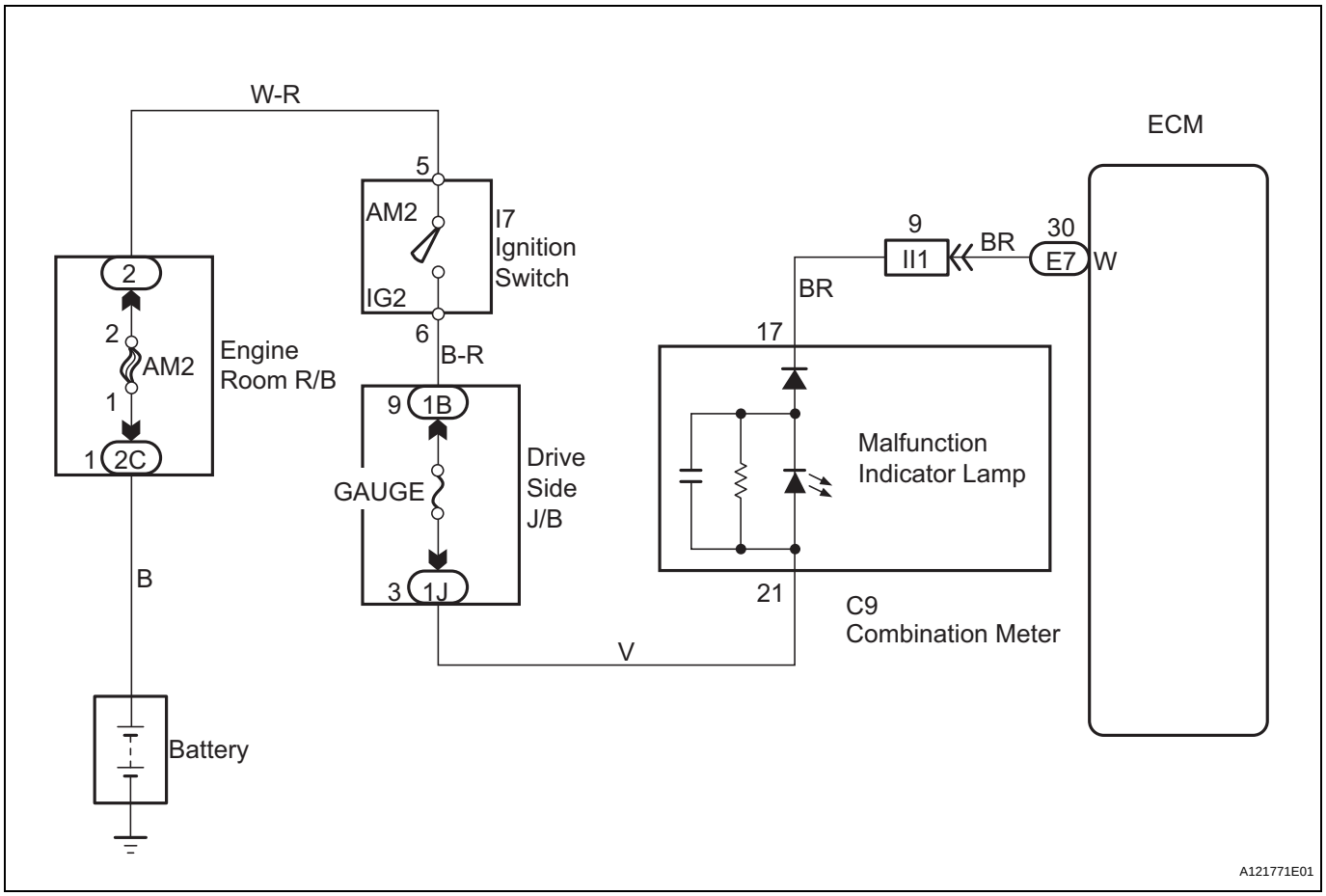
CHECK AND REPLACE HARNESS AND CONNECTOR (EFI RELAY - C/OPN RELAY)

MIL Circuit

DESCRIPTION

The MIL (Malfunction Indicator Lamp) is used to indicate vehicle malfunction detections by the ECM.
By turning the ignition switch to ON, power is supplied to the MIL circuit, and the ECM provides the circuit ground which illuminates the MIL.
The MIL operation can be checked visually: When the ignition switch is first turned to ON, the MIL should be illuminated and should then turn OFF. If the MIL remains illuminated or is not illuminated, conduct the following troubleshooting procedure using an intelligent tester.

WIRING DIAGRAM



ES

1	CHECK THAT MIL IS ILLUMINATED

(a) Perform troubleshooting in accordance with the chart below.

Result

MIL Condition	Proceed To
MIL remains ON	A
MIL does not illuminate	B

B	Go to step 4

A

2	CHECK WHETHER MIL TURNS OFF

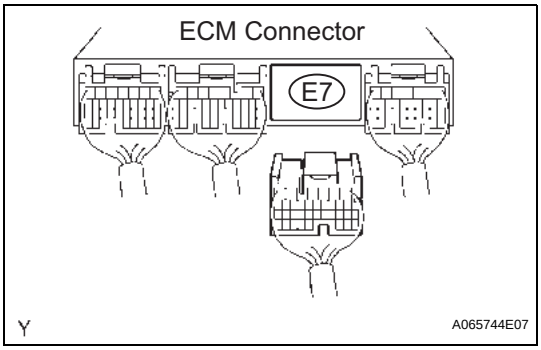
(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the tester ON.
(d) Check whether any DTCs have been stored (see page ES-40). Note them down if necessary.
(e) Clear DTCs (see page ES-40).
(f) Check if the MIL turns off.
OK:
MIL should turn off.

ES

OK → **REPAIR CIRCUITS INDICATED BY OUTPUT DTCS**

NG

3	CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT IN WIRE HARNESS)



(a) Disconnect the ECM connector.
(b) Turn the ignition switch to ON.
(c) Check that the MIL is not illuminated.
OK:
MIL is not illuminated.
(d) Reconnect the ECM connector.

OK → **REPLACE ECM**

NG

CHECK AND REPLACE HARNESS AND CONNECTOR

4	CHECK THAT MIL IS ILLUMINATED

(a) Check if the MIL is illuminated when the ignition switch is turned to ON.
OK:
MIL should be illuminated.

OK → **SYSTEM OK**

NG

5	CHECK THAT ENGINE STARTS

(a) Turn the ignition switch to ON
(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

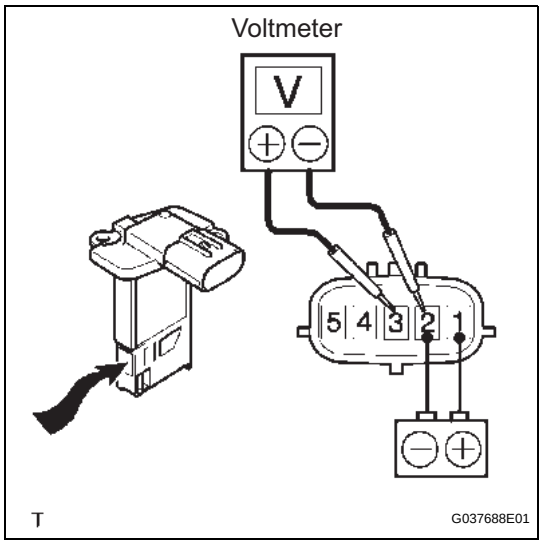
6	INSPECT COMBINATION METER ASSEMBLY (MIL CIRCUIT)

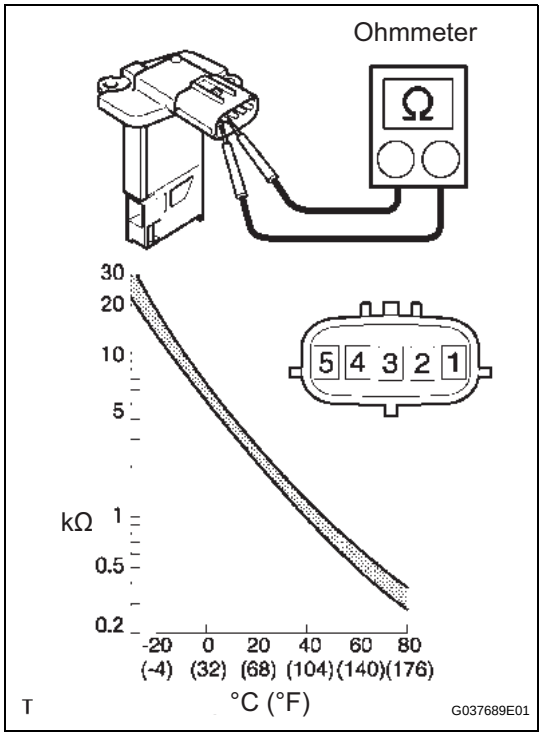
(a) See the combination meter troubleshooting procedure (See page ME-7).

NG → **REPAIR OR REPLACE BULB OR COMBINATION METER ASSEMBLY**

OK

CHECK AND REPLACE HARNESS AND CONNECTOR (COMBINATION METER - ECM)





MASS AIR FLOW METER

INSPECTION

1. INSPECT MASS AIR FLOW METER

(a) Check the operation.

(1) Apply battery voltage across terminals 1 (+B) and 2 (E2G).

(2) Using a voltmeter, connect the positive (+) tester prove to terminal 3 (VG) and the negative (-) tester prove to terminal 2 (E2G).

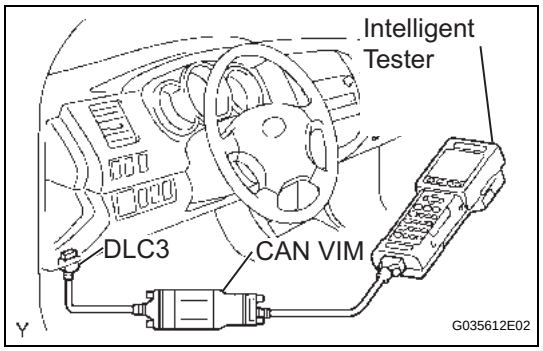
(3) Blow air into the mass air flow meter and check that the voltage fluctuates.
If the voltage does not fluctuate, replace the mass air flow meter.

(b) Check the resistance.

(1) Using an ohmmeter, measure the resistance between the terminals.
Standard

Tester Connection	Specified Condition
4 (THA) - 5 (E2)	12.5 to 16.9kΩ at -20°C (-4°F)
4 (THA) - 5 (E2)	2.19 to 2.67kΩ at 20°C (68°F)
4 (THA) - 5 (E2)	0.50 to 0.68kΩ at 60°C (140°F)

If the result is not as specified, replace the mass air flow meter.



CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

ON-VEHICLE INSPECTION

1. INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

(a) Check the operation.

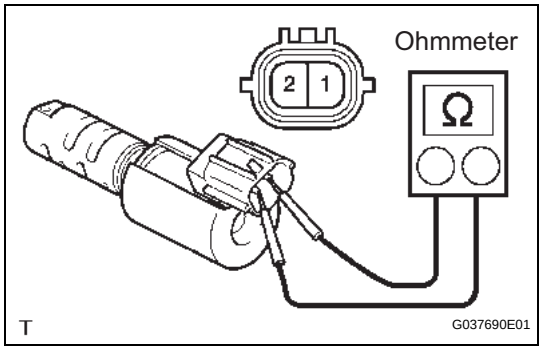
(1) Connect the intelligent tester to the DLC3.
(2) Turn the ignition switch to ON.
(3) Turn the intelligent tester ON.
(4) Start the engine and warm it up.
(5) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1.
(6) Operate the OCV using the hand-held tester, then check the engine speed.

Standard

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Rough idling engine stalls

If the operation is not specified, check the camshaft timing oil control valve, wire harness and ECM.

INSPECTION



1. INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

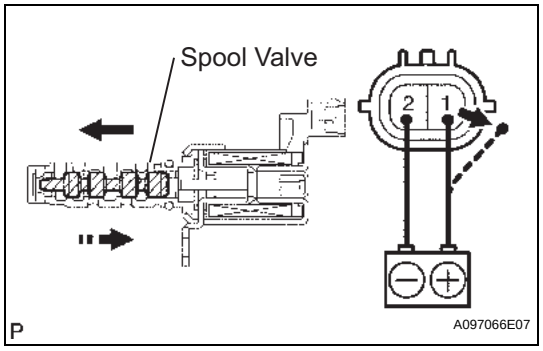
(a) Check the resistance.

(1) Using an ohmmeter, measure the resistance between the terminals.

Standard

Tester Connection	Specified Condition
1 (+B) - 2 (GND)	6.9 to 7.9 kΩ at 20°C (68°F)

If the result is not as specified, replace the camshaft timing oil control valve.



(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 leakage to the advance side, and a DTC may be set.

CAMSHAFT POSITION SENSOR

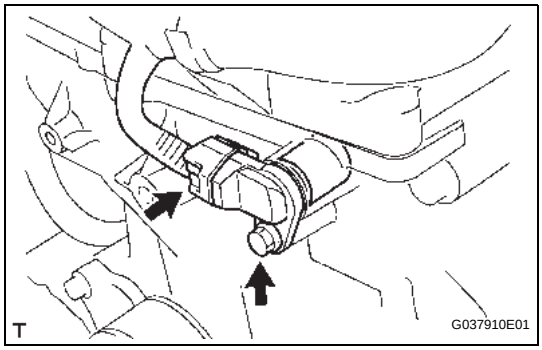
REMOVAL

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

2. REMOVE CAMSHAFT POSITION SENSOR

(a) Disconnect the camshaft position sensor connector.

(b) Remove the bolt, then remove the camshaft position sensor.



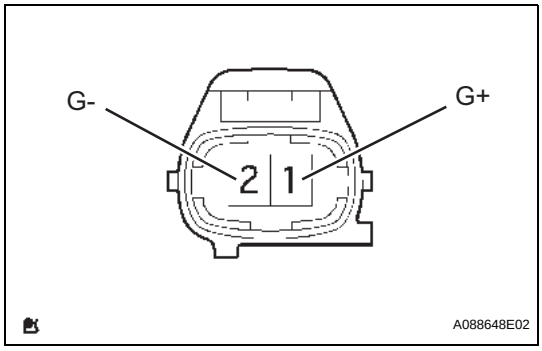
INSPECTION

1. INSPECT CAMSHAFT POSITION SENSOR

(a) Check the resistance.

(1) Using an ohmmeter, measure the resistance between the terminals.

Standard



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

HINT:

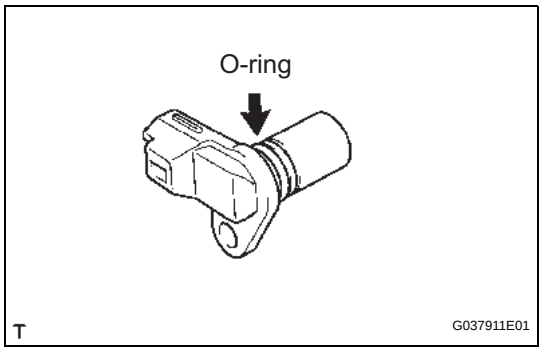
Cold and Hot mean the temperature of the coils themselves. Cold is from -10 to 50°C (14 to 122°F) and Hot is from 50 to 100°C (122 to 212°F).

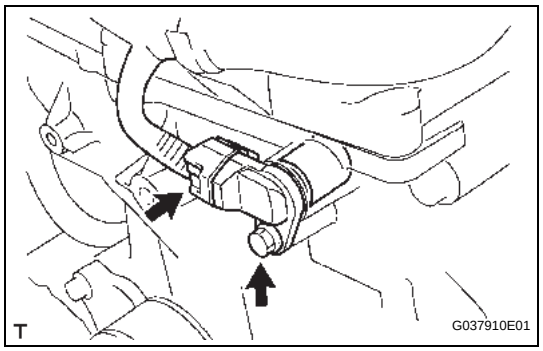
If the result is not as specified, replace the camshaft position sensor.

INSTALLATION

1. INSTALL CAMSHAFT POSITION SENSOR

(a) Apply a light coat of engine oil to the O-ring of the camshaft position sensor.





(b) Install the camshaft position sensor with the bolt.
Torque: 8.5 N*m (87 kgf*cm, 75 in.*lbf)
NOTICE:
Make sure that the O-ring is not cracked or jammed when installing.

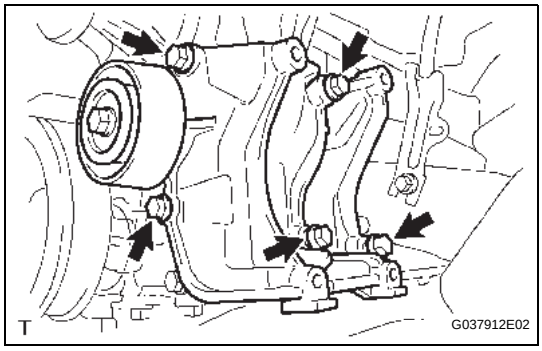
(c) Connect the camshaft position sensor connector.

2. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL
Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)

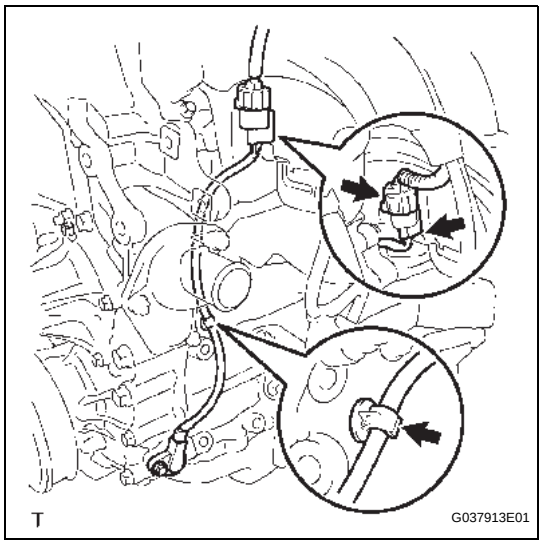
CRANKSHAFT POSITION SENSOR

REMOVAL

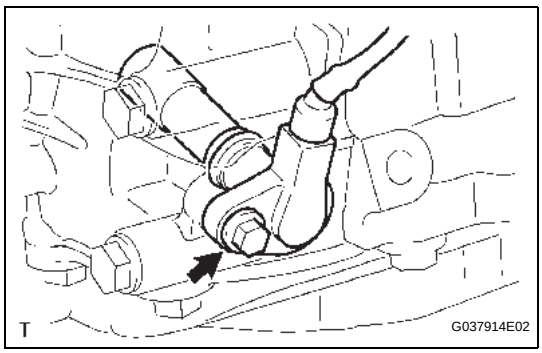
1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
2. **REMOVE ENGINE UNDER COVER SUB-ASSEMBLY NO.1 (for 4WD and Pre-Runner)**
3. **REMOVE FAN AND GENERATOR V BELT (W/ AIR CONDITIONING) (See page EM-5)**
4. **SEPARATE COMPRESSOR AND MAGNETIC CLUTCH (W/ AIR CONDITIONING) (See page EM-21)**
5. **REMOVE IDLE PULLEY ASSEMBLY WITH BRACKET (W/ AIR CONDITIONING)**
   (a) Remove the 5 bolts, then remove the idle pulley with bracket.

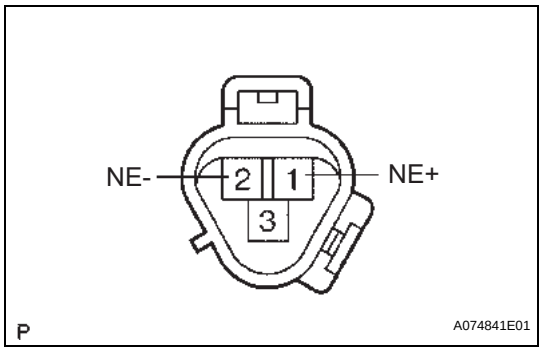


6. **REMOVE CRANKSHAFT POSITION SENSOR**
   (a) Disconnect the crankshaft position sensor connector and the 2 wire harness clamps.



   (b) Remove the bolt, then remove the crankshaft position sensor.





INSPECTION

1. INSPECT CRANKSHAFT POSITION SENSOR

(a) Check the resistance.

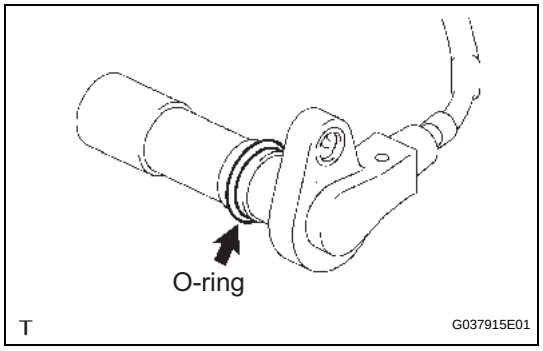
(1) Using an ohmmeter, measure the resistance between the terminals.

Standard

Tester Connection	Specified Condition
1 (NE+) - 2 (NE-)	1,630 to 2,740 Ω at COLD
1 (NE+) - 2 (NE-)	2,065 to 3,225 Ω at HOT

HINT:
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.

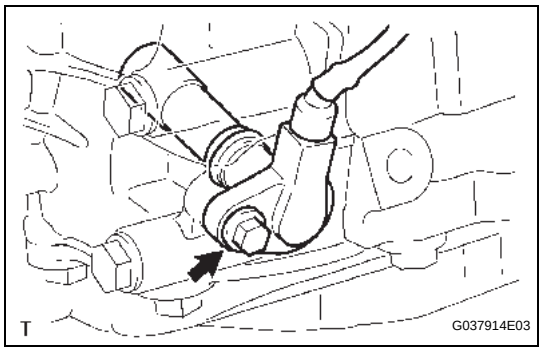
ES



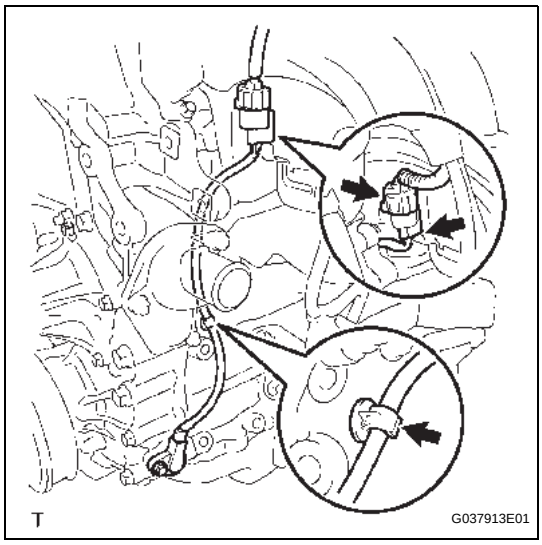
INSTALLATION

1. INSTALL CRANKSHAFT POSITION SENSOR

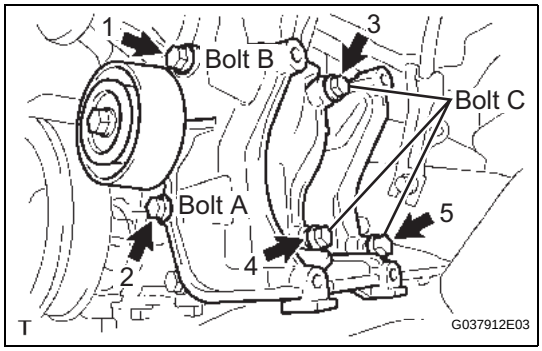
(a) Apply a light coat of engine oil to the O-ring of the crankshaft position sensor.



(b) Install the camshaft position sensor with the bolt.
Torque: 8.5 N*m (87 kgf*cm, 75 in.*lbf)
NOTICE:
Make sure that the O-ring is not cracked or jammed when installing.



(c) Connect the crankshaft position sensor connector and the 2 wire harness clamps.



2. INSTALL IDLE PULLEY ASSEMBLY WITH BRACKET (W/ AIR CONDITIONING)

(a) Using several steps, uniformly install and tighten the 5 bolts in the sequence shown in the illustration.

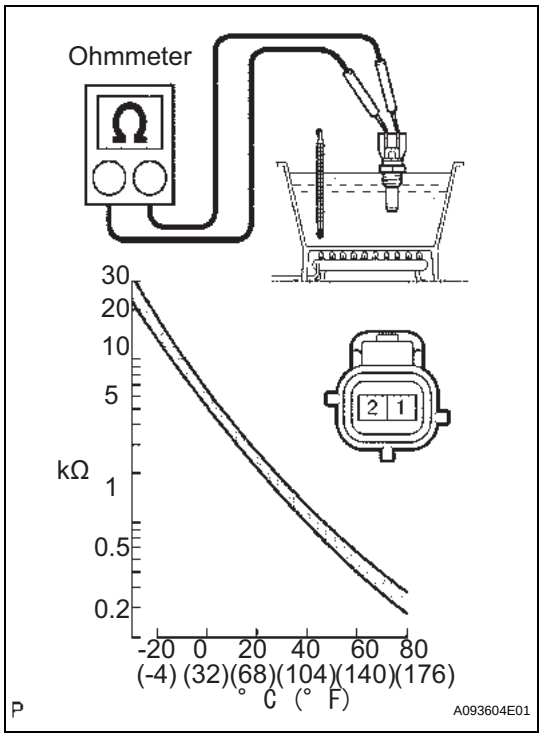
Torque: 21 N*m (214 kgf*cm, 16 ft.*lbf) for bolt A
43 N*m (438 kgf*cm, 32 ft.*lbf) for bolt B, C

3. INSTALL COMPRESSOR AND MAGNETIC CLUTCH (W/ AIR CONDITIONING) (See page EM-34)

4. INSTALL FAN AND GENERATOR V BELT (W/ AIR CONDITIONING) (See page EM-6)

5. INSTALL ENGINE UNDER COVER SUB-ASSEMBLY NO.1 (for 4WD and Pre-Runner)

6. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL
Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)



ENGINE COOLANT TEMPERATURE SENSOR

INSPECTION

1. INSPECT E.F.I. ENGINE COOLANT TEMPERATURE SENSOR

(a) Check the resistance.

(1) Using an ohmmeter, measure the resistance between the terminals.

Standard

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)

ES

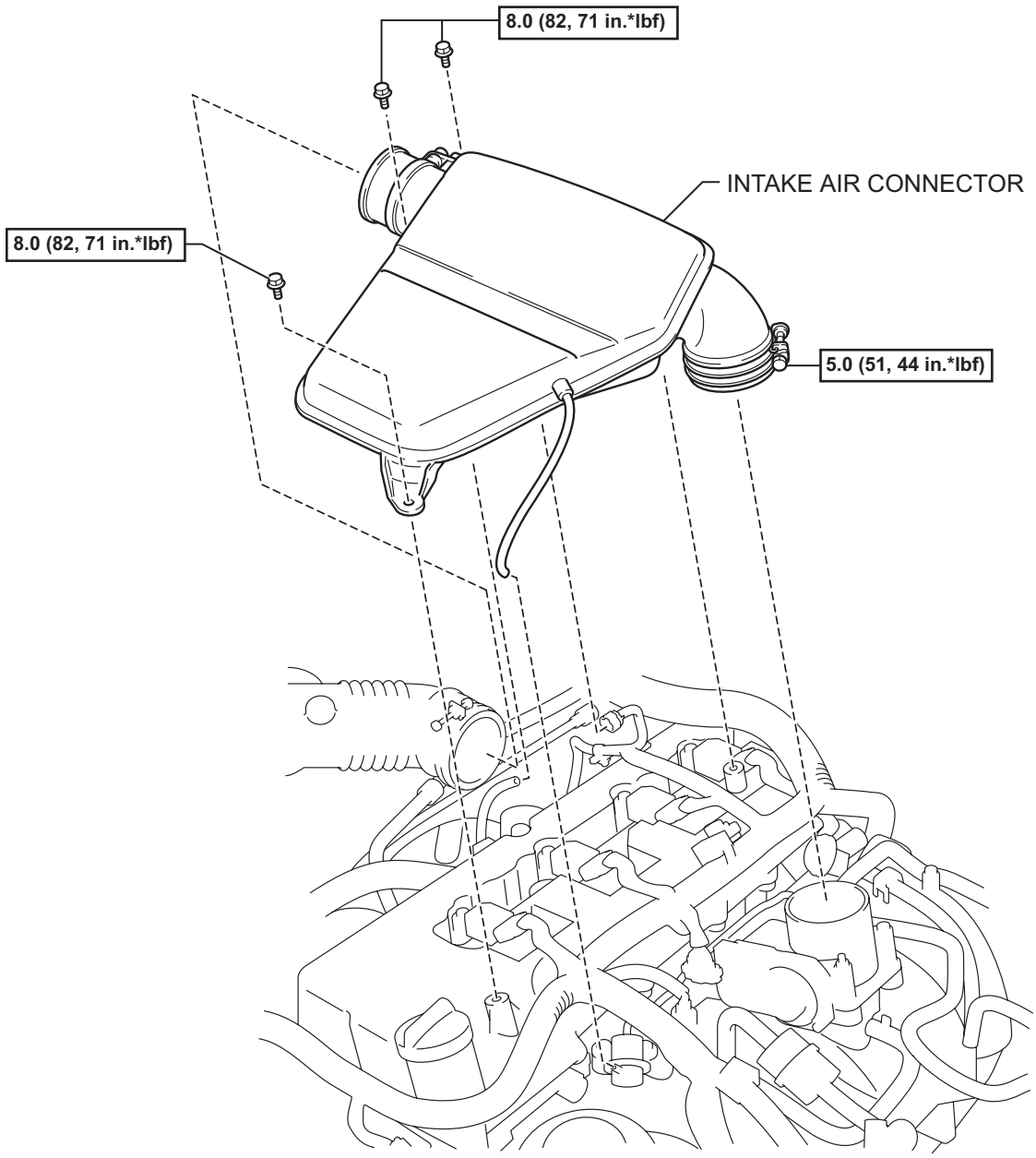
NOTICE:

If checking the engine coolant temperature sensor in water, be careful not to allow water to intrude into the terminals. After checking, wipe the water off the engine coolant temperature sensor.

If the result is not as specified, replace the engine coolant temperature sensor.

THROTTLE BODY

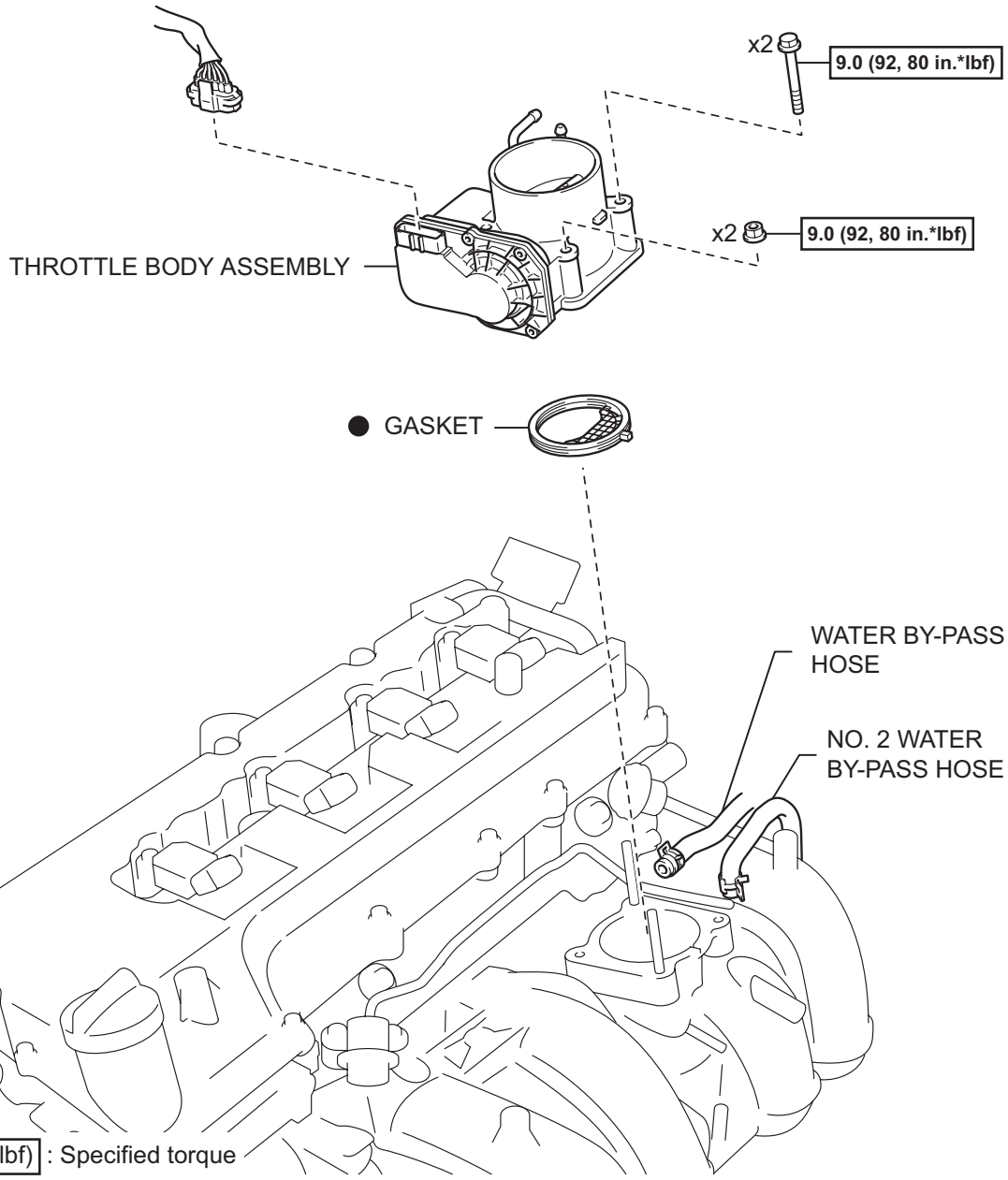
COMPONENTS



N*m (kgf*cm, ft*lbf) : Specified torque

T

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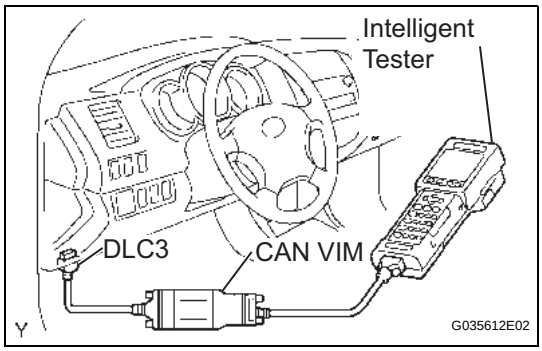

x2
9.0 (92, 80 in.*lbf)
x2
9.0 (92, 80 in.*lbf)
THROTTLE BODY ASSEMBLY
● GASKET
WATER BY-PASS HOSE
NO. 2 WATER BY-PASS HOSE
N*m (kgf*cm, ft*lbf) : Specified torque
● Non-reusable part
T
A113624E01

ES

ON-VEHICLE INSPECTION

1. INSPECT THROTTLE BODY ASSEMBLY

(a) Listen to the throttle control motor operating sounds.
  (1) Turn the ignition switch to ON.
  (2) When pressing the accelerator pedal, listen to the running sounds of the motor. Make sure no friction noises come from the motor.
  If friction noises exist, check the throttle body, wire harness and ECM.

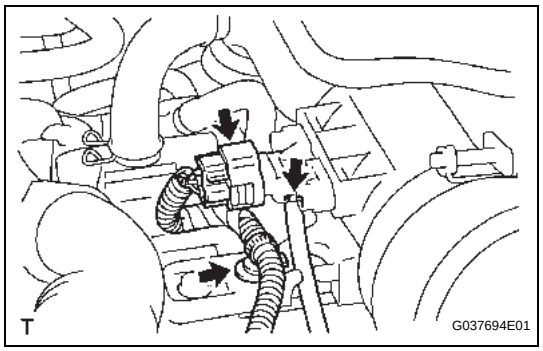


(b) Inspect the throttle position sensor.
  (1) Connect the intelligent tester to the DLC3.
  (2) Turn the ignition switch to ON.
  (3) Turn the intelligent tester ON.
  (4) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / THROTTLE POS.
  (5) Depress the accelerator pedal. When the throttle valve is fully opened, check that the THROTTLE POS value is within the specified range.
  Standard:
  60 % or more
  NOTICE:
  When checking the standard throttle valve opening percentage, the transmission should be in the neutral position.
  If the result is not as specified, check the throttle body, wire harness and ECM.

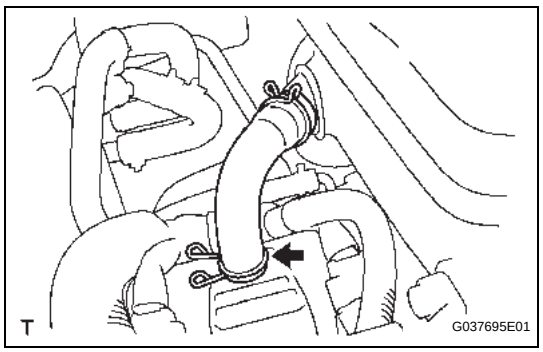
ES

REMOVAL

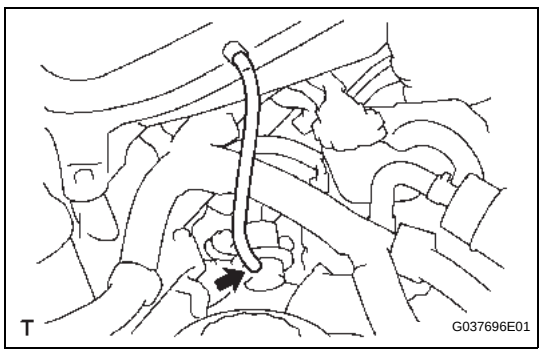
1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
2. **REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY (for 4WD and Pre-Runner)**
3. **DRAIN ENGINE COOLANT (See page CO-3)**
4. **REMOVE INTAKE AIR CONNECTOR**
   (a) Disconnect the pressure sensor connector.
   (b) Disengage the wire harness clamp.
   (c) Disconnect the vacuum hose.



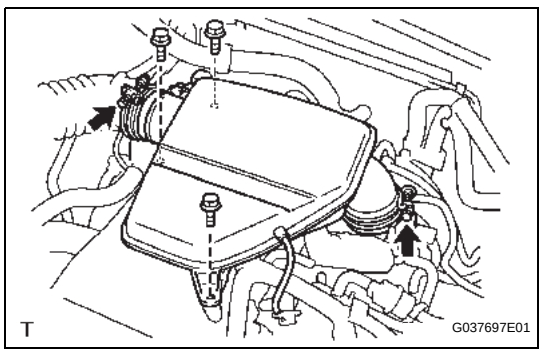
(d) Disconnect the No. 2 ventilation hose.

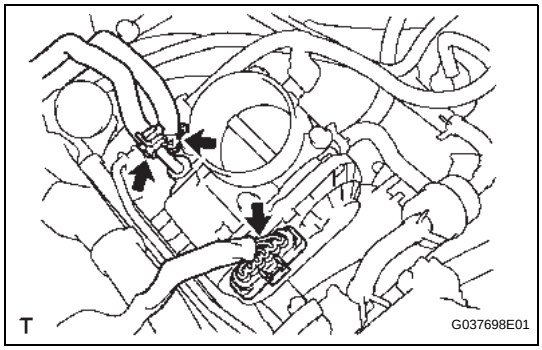


(e) Disconnect the vacuum hose.



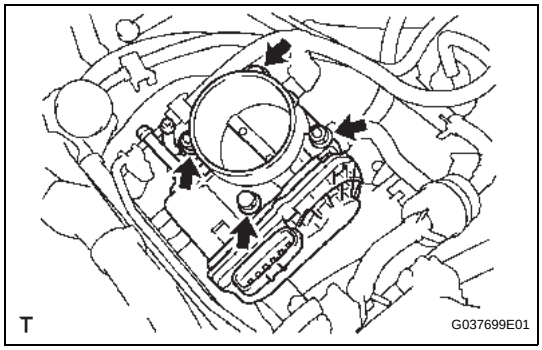
(f) Loosen the 2 hose clamp bolts.
(g) Remove the 3 bolts, then remove the intake air connector.



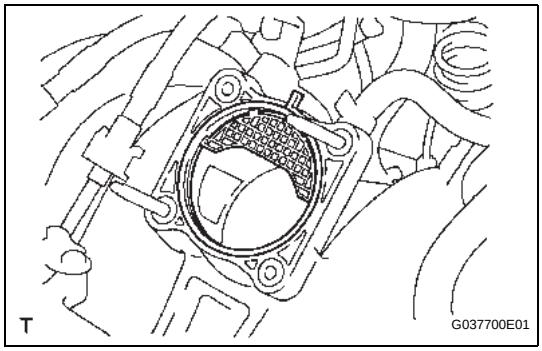


5. REMOVE THROTTLE WITH MOTOR BODY ASSEMBLY

(a) Disconnect the water by-pass hose.
(b) Disconnect the No. 2 water by-pass hose.
(c) Disconnect the throttle motor connector.



(d) Remove the 2 bolts and 2 nuts, then remove the throttle with motor body.

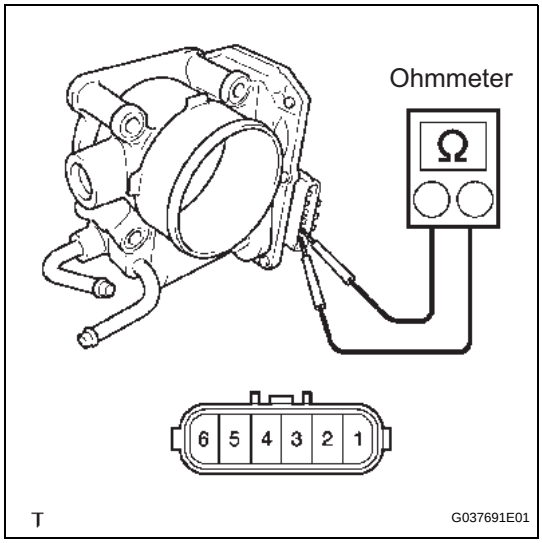


(e) Remove the gasket from the intake manifold.

INSPECTION

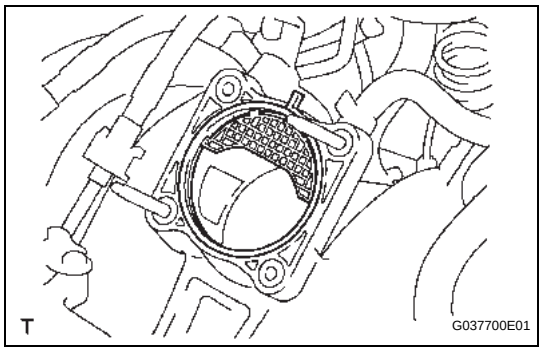
1. INSPECT THROTTLE WITH MOTOR BODY ASSEMBLY

(a) Check the resistance.
(1) Using an ohmmeter, measure the resistance between the terminals.
Standard



Tester Connection	Specified Condition
1(M-) - 2 (M+)	0.3 to 100 Ω at 20°C (68°F)
3 (E2) - 5 (VC)	2.0 to 4.0 kΩ at 20°C (68°F)

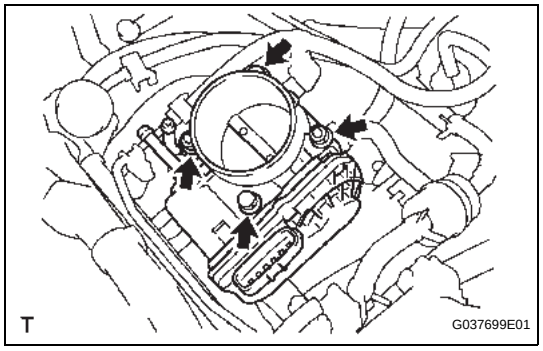
If the result is not as specified, replace the throttle body.



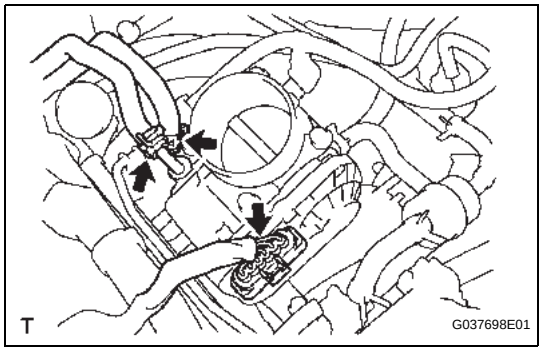
INSTALLATION

1. INSTALL THROTTLE WITH MOTOR BODY ASSEMBLY

(a) Install a new gasket onto the intake manifold.

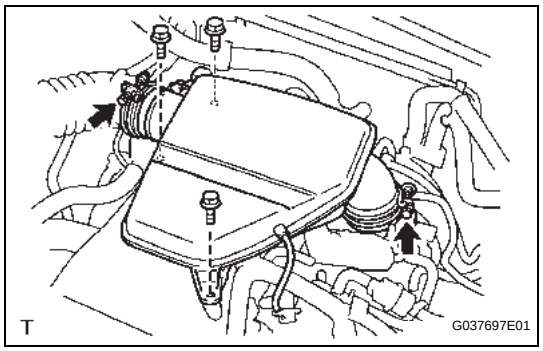


(b) Install the throttle with motor body with the 2 bolts and 2 nuts.
Torque: 9 N*m (92 kgf*cm, 80 in.*lbf)

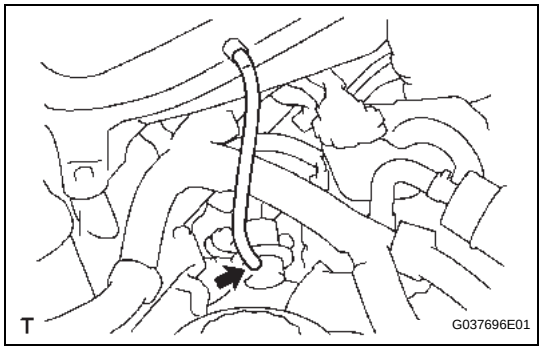


(c) Connect the water by-pass hose.
(d) Connect the water by-pass hose No. 2.
(e) Connect the throttle motor connector.

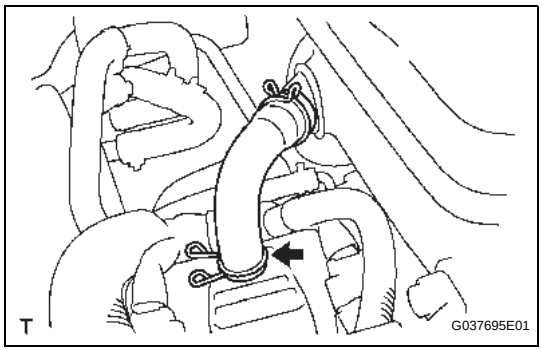
2. INSTALL INTAKE AIR CONNECTOR



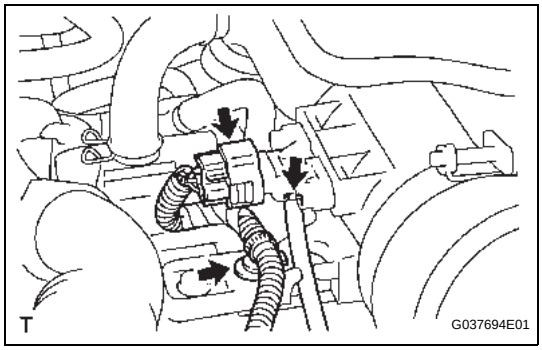
(a) Install the intake air connector with the 3 bolts.
Torque: 8 N*m (82 kgf*cm, 71 in.*lbf)
(b) Tighten the 2 hose clamp bolts.
Torque: 5 N*m (51 kgf*cm, 44 in.*lbf)



(c) Connect the vacuum hose.



(d) Connect the ventilation hose No. 2.



(e) Connect the vacuum hose.
(f) Engage the wire harness clamp.
(g) Connect the pressure sensor connector.

3. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL
Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)

4. ADD ENGINE COOLANT (See page CO-3)

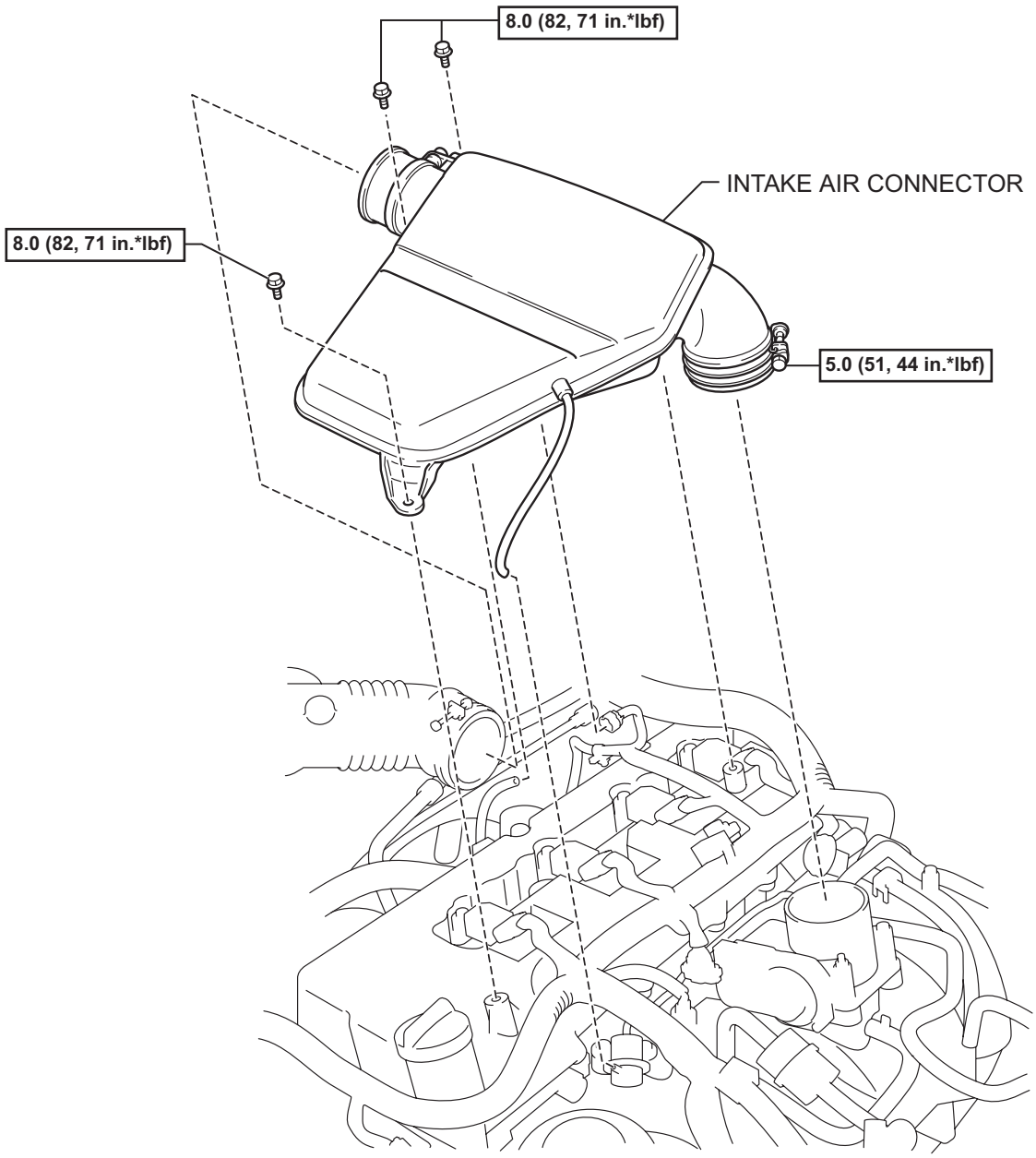
5. CHECK FOR ENGINE COOLANT LEAKAGE (See page CO-2)

6. INSTALL ENGINE UNDER COVER SUB-ASSEMBLY NO.1 (for 4WD and Pre-Runner)

ES

KNOCK SENSOR

COMPONENTS



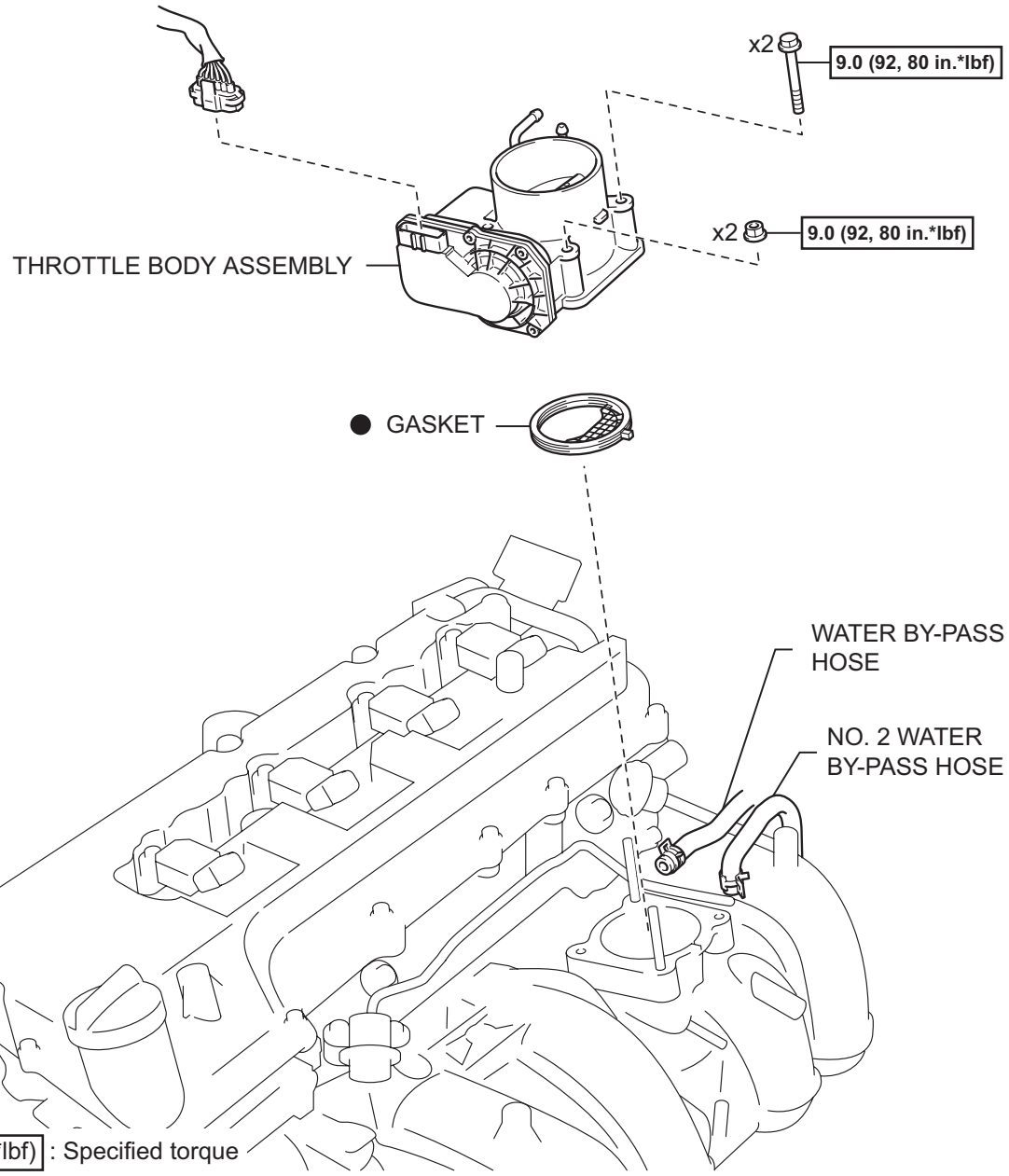
N*m (kgf*cm, ft*lbf) : Specified torque

T

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ES

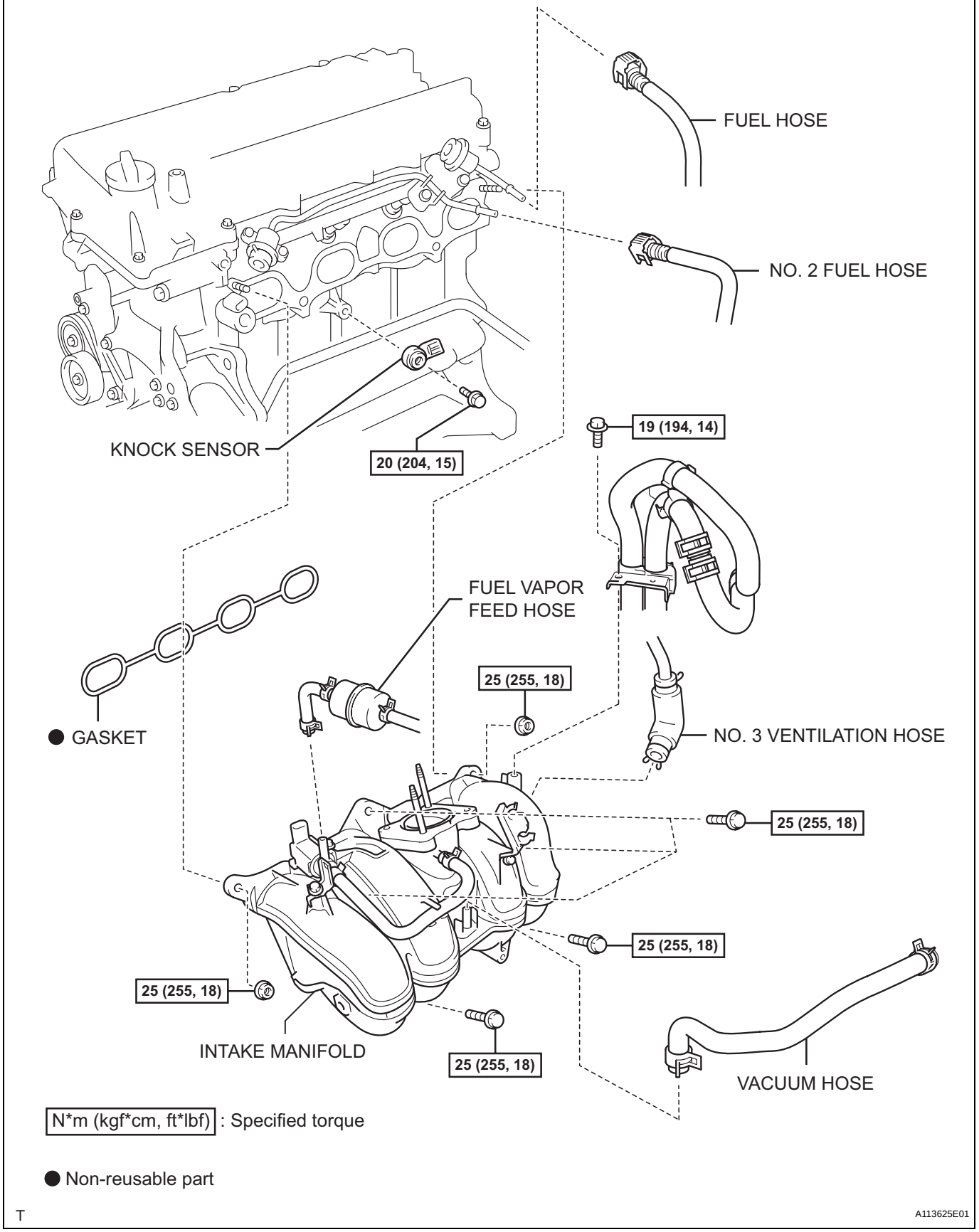
ES



● Non-reusable part

T

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FUEL HOSE
NO. 2 FUEL HOSE
KNOCK SENSOR
20 (204, 15)
19 (194, 14)
FUEL VAPOR FEED HOSE
25 (255, 18)
● GASKET
NO. 3 VENTILATION HOSE
25 (255, 18)
25 (255, 18)
25 (255, 18)
INTAKE MANIFOLD
25 (255, 18)
VACUUM HOSE
N*m (kgf*cm, ft*lbf) : Specified torque
● Non-reusable part
T
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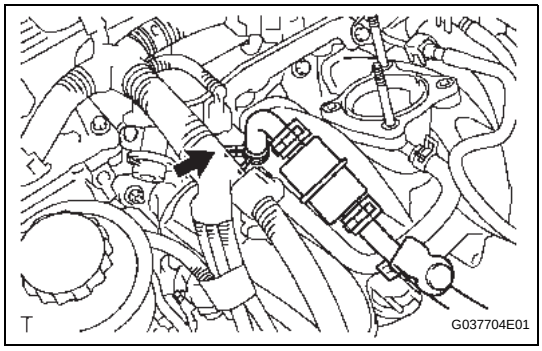
ES

ES

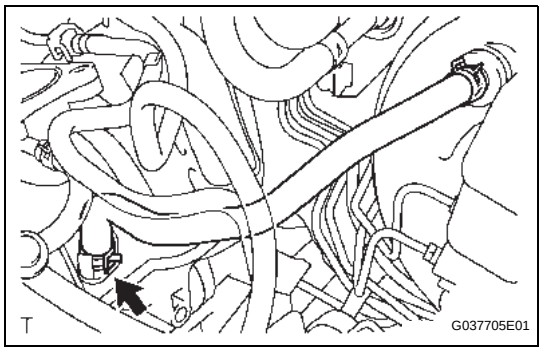
REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
2. **REMOVE ENGINE UNDER COVER SUB-ASSEMBLY (for 4WD and Pre-Runner)**
3. **DRAIN ENGINE COOLANT (See page CO-3)**
4. **REMOVE INTAKE AIR CONNECTOR (See page ES-452)**
5. **REMOVE THROTTLE WITH MOTOR BODY ASSEMBLY (See page ES-453)**
6. **DISCONNECT FUEL HOSE (See page FU-11)**
7. **DISCONNECT FUEL HOSE NO.2 (See page FU-11)**
8. **REMOVE INTAKE MANIFOLD**

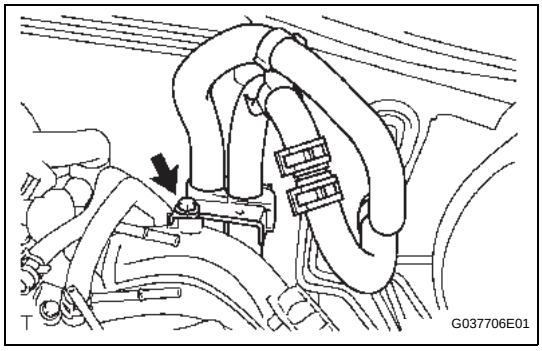
(a) Disconnect the fuel vapor feed hose from the VSV.

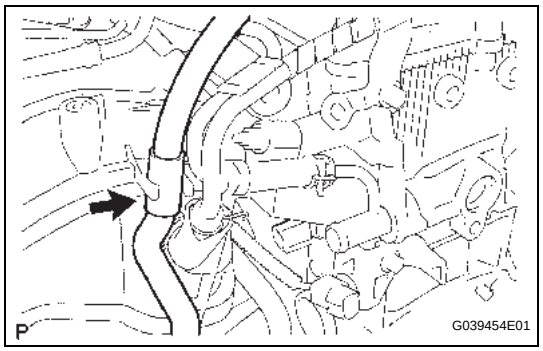


(b) Disconnect the vacuum hose.

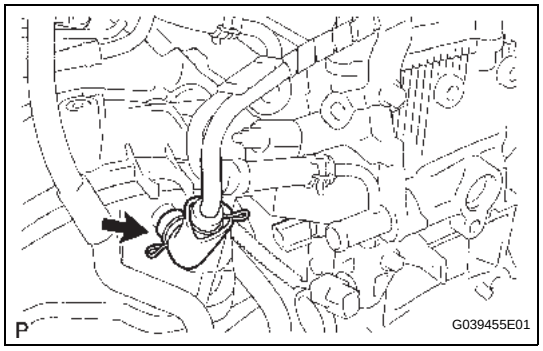


(c) Remove the bolt, then remove the clamp bracket.

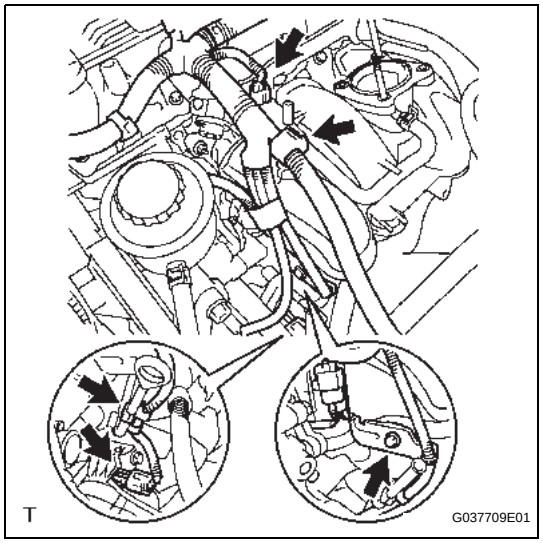




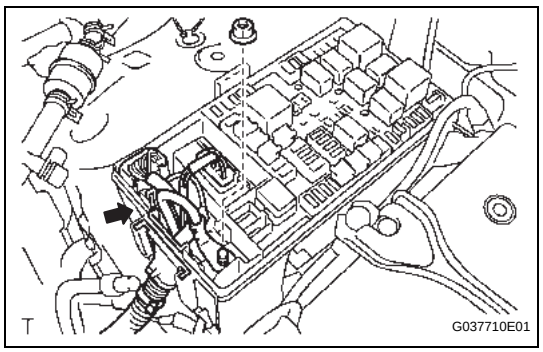
(d) Disconnect the water by-pass hose No. 2.



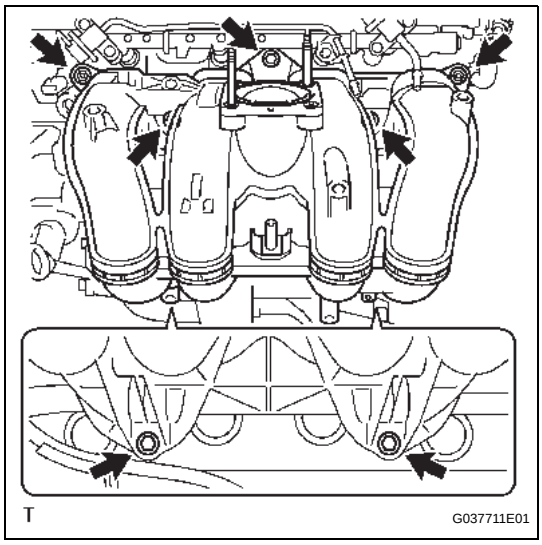
(e) Disconnect the ventilation hose No. 3.



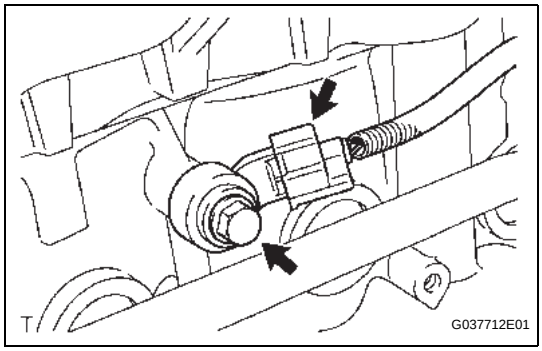
(f) Disconnect the VSV connector.
(g) Disengage the engine wire harness clamp.
(h) Disconnect the compressor magnetic clutch connector. (w/ AIR CONDITIONING)
(i) Disengage the wire harness clamp.
(j) Remove the bolt and harness clamp bracket.



(k) Disconnect the 3 connectors.
(l) Remove the nut shown in the illustration.
(m) Disconnect the engine wire harness from the relay block.

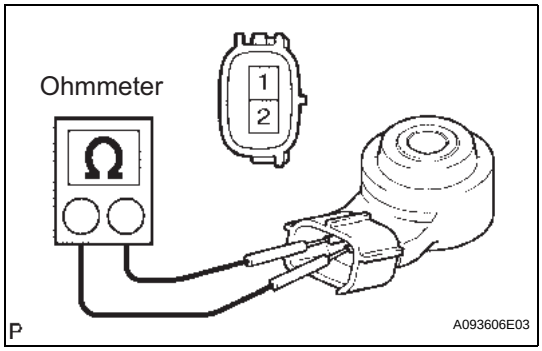


(n) Remove the 5 bolts and 2 nuts, then remove the intake manifold.



9. REMOVE KNOCK CONTROL SENSOR

(a) Disconnect the knock control sensor connector.
(b) Remove the bolt, then remove the knock control sensor.



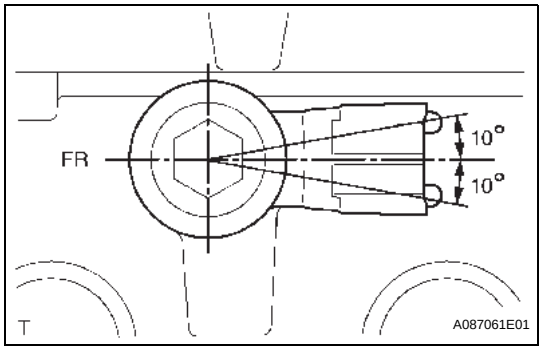
INSPECTION

1. INSPECT KNOCK SENSOR

(a) Check the resistance.
(1) Using an ohmmeter, measure the resistance between the terminals.
Standard

Tester Connection	Specified Condition
1 (Ground) - 2 (Output)	120 to 280 kΩ at 20°C (68°F)

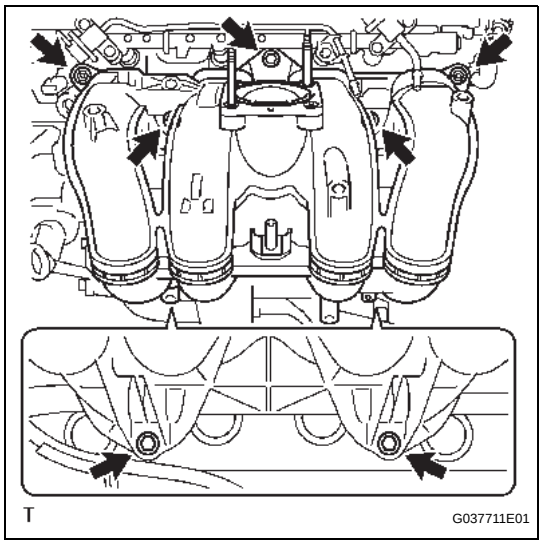
If the result is not as specified, replace the knock sensor.



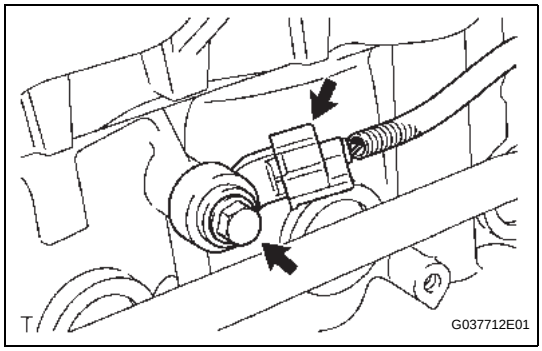
INSTALLATION

1. INSTALL KNOCK CONTROL SENSOR

(a) Install the knock control sensor with the bolt.
Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)
NOTICE:
Make sure that the knock sensor is at the correct angle when installing.
(b) Connect the knock control sensor connector.

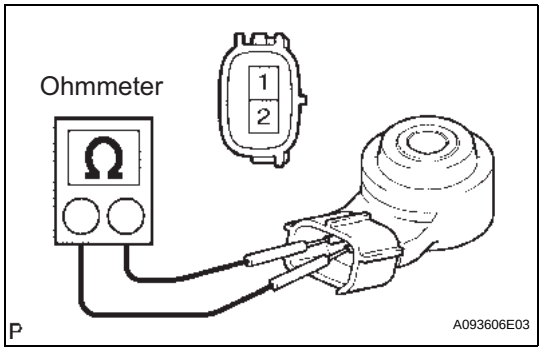


(n) Remove the 5 bolts and 2 nuts, then remove the intake manifold.



9. REMOVE KNOCK CONTROL SENSOR

(a) Disconnect the knock control sensor connector.
(b) Remove the bolt, then remove the knock control sensor.



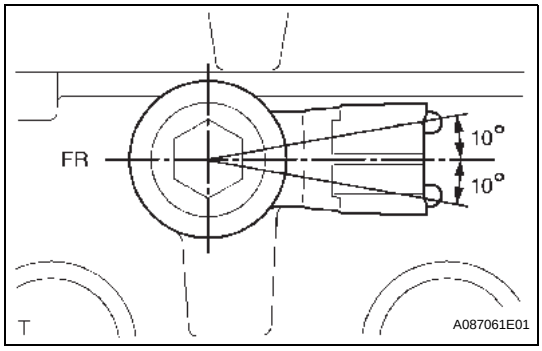
INSPECTION

1. INSPECT KNOCK SENSOR

(a) Check the resistance.
(1) Using an ohmmeter, measure the resistance between the terminals.
Standard

Tester Connection	Specified Condition
1 (Ground) - 2 (Output)	120 to 280 kΩ at 20°C (68°F)

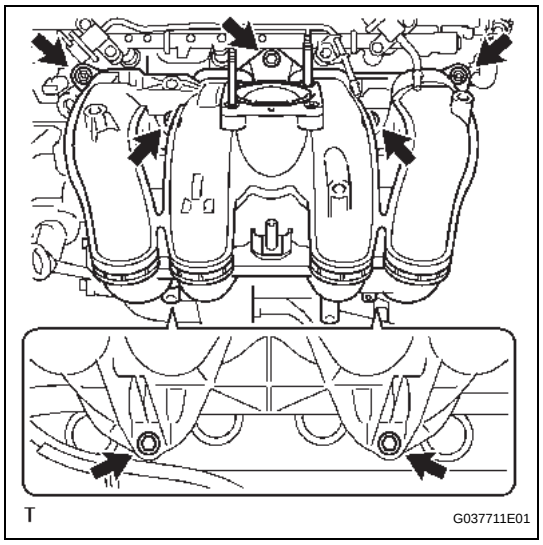
If the result is not as specified, replace the knock sensor.



INSTALLATION

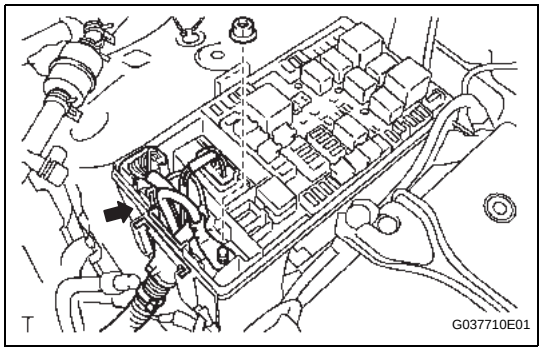
1. INSTALL KNOCK CONTROL SENSOR

(a) Install the knock control sensor with the bolt.
Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)
NOTICE:
Make sure that the knock sensor is at the correct angle when installing.
(b) Connect the knock control sensor connector.

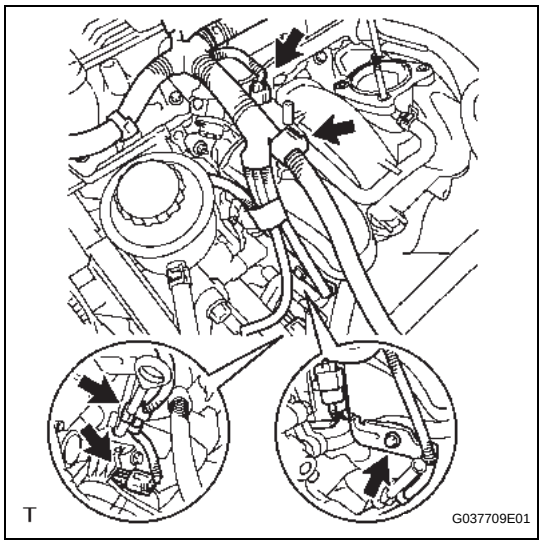


2. INSTALL INTAKE MANIFOLD

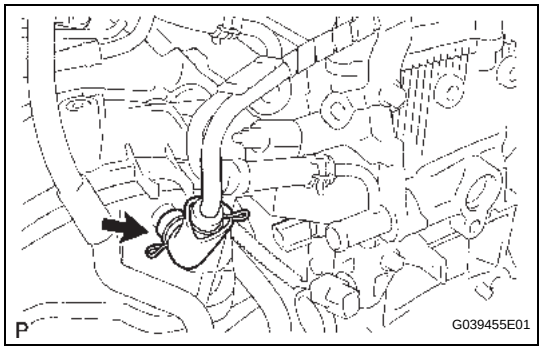
(a) Install a new gasket onto the intake manifold.
(b) Install the intake manifold with the 5 bolts and 2 nuts.
Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)



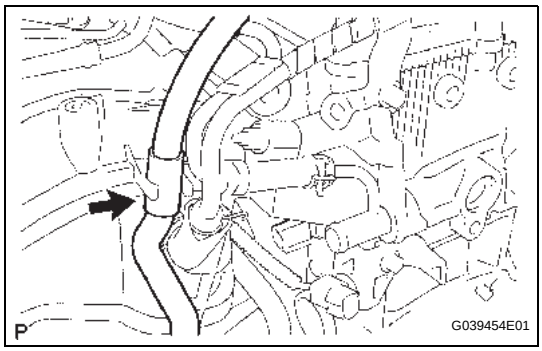
(c) Connect the engine wire harness to the relay block.
(d) Install the nut shown in the illustration.
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)
(e) Connect the 3 connectors.



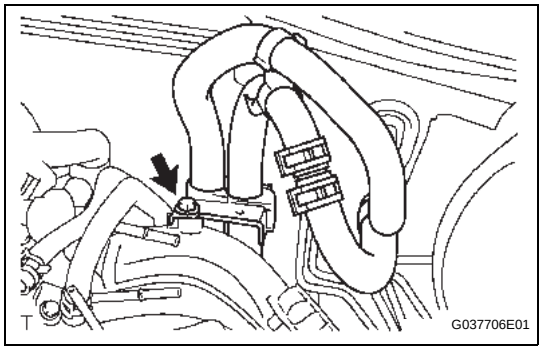
(f) Install the harness clamp bracket with the bolt.
Torque: 8.2 N*m (84 kgf*cm, 73 in.*lbf)
(g) Engage the wire harness clamp.
(h) Connect the compressor magnetic clutch connector. (w/ AIR CONDITIONING)
(i) Engage the engine wire harness clamp.
(j) Connect the VSV connector.



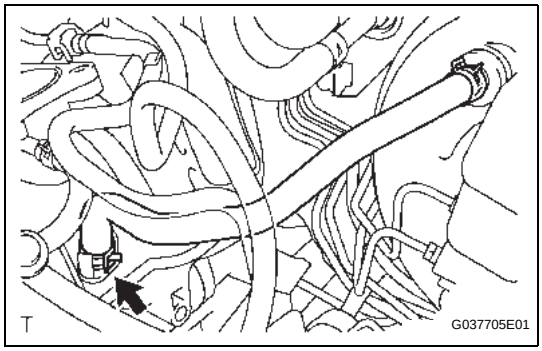
(k) Connect the ventilation hose No. 3.



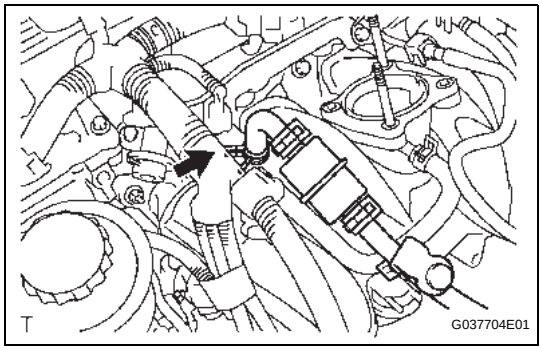
(l) Connect the water by-pass hose No. 2.



(m) Install the clamp bracket with the bolt.
Torque: 19 N*m (194 kgf*cm, 14 in.*lbf)

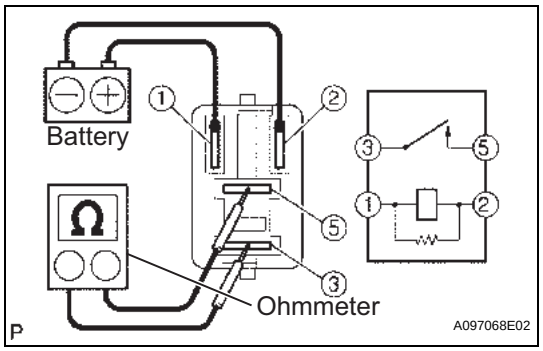


(n) Connect the vacuum hose.



(o) Connect the fuel vapor feed hose to the VSV.

3. **CONNECT FUEL HOSE (See page FU-17)**
4. **CONNECT FUEL HOSE NO.2 (See page FU-17)**
5. **INSTALL THROTTLE WITH MOTOR BODY ASSEMBLY (See page ES-454)**
6. **INSTALL INTAKE AIR CONNECTOR (See page ES-455)**
7. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
   Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)
8. **ADD ENGINE COOLANT (See page CO-3)**
9. **CHECK FOR ENGINE COOLANT LEAKAGE (See page CO-2)**
10. **CHECK FOR FUEL LEAKAGE**
11. **INSTALL ENGINE UNDER COVER SUB-ASSEMBLY NO.1 (for 4WD and Pre-Runner)**



EFI RELAY

INSPECTION

1. INSPECT EFI RELAY

(a) Check the resistance.

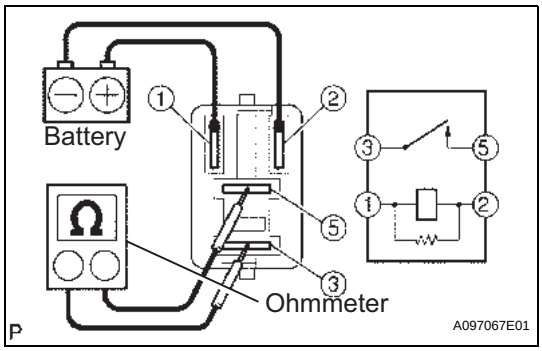
(1) Using an ohmmeter, measure the resistance between the terminals.

Standard

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

If the result is not as specified, replace the E.F.I. relay.

ES



CIRCUIT OPENING RELAY

INSPECTION

1. INSPECT CIRCUIT OPENING RELAY ASSEMBLY

(a) Check the resistance.

(1) Using an ohmmeter, measure the resistance between the terminals.

Standard

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

If the result is not as specified, replace the circuit opening relay assembly.

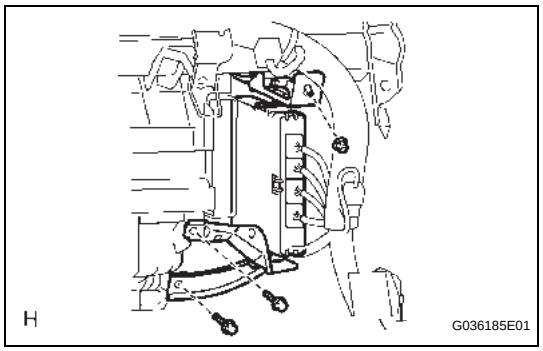
ES

ECM

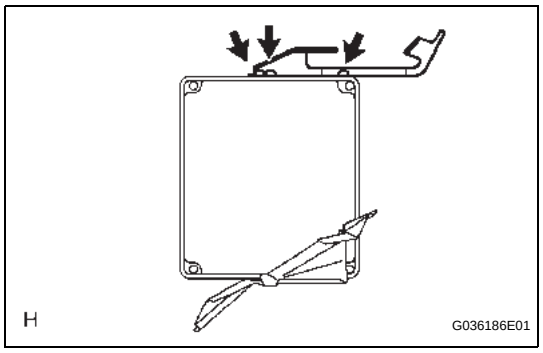
REMOVAL

NOTICE:
Perform REGISTRATION (VIN registration) when replacing the ECM (see page ES-16).

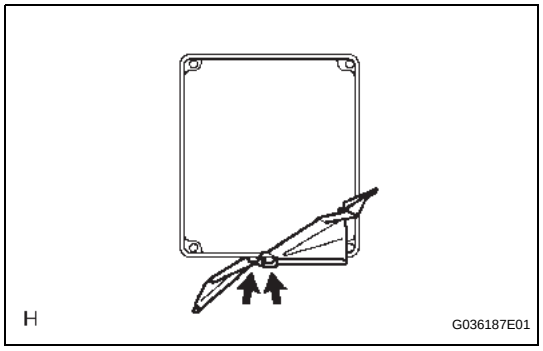
1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
2. **REMOVE GLOVE COMPARTMENT DOOR ASSEMBLY (See page IP-13)**
3. **REMOVE INSTRUMENT PANEL FINISH PANEL SUB-ASSEMBLY LOWER RH (See page IP-14)**
4. **REMOVE ECM**
   (a) Disconnect the 4 connectors.
   (b) Remove the 2 bolts and nut, then remove the ECM.



5. **REMOVE ECM BRACKET**
   (a) Remove the 3 screws, then remove the ECM bracket.

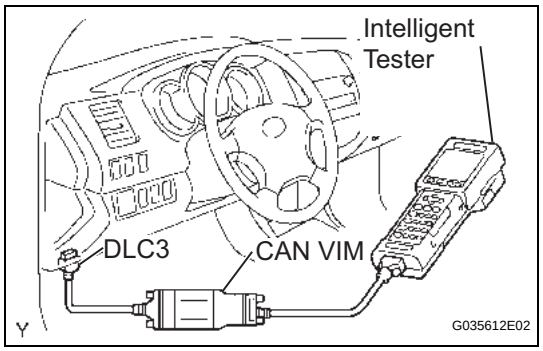


6. **REMOVE ECM BRACKET NO.2**
   (a) Remove the 2 screws, then remove the ECM bracket No. 2.



INSTALLATION

1. **INSTALL ECM BRACKET NO.2**
   Torque: 3 N*m (32 kgf*cm, 28 in.*lbf)
2. **INSTALL ECM BRACKET**
   Torque: 3 N*m (32 kgf*cm, 28 in.*lbf)
3. **INSTALL ECM**
   Torque: 5 N*m (51 kgf*cm, 44 in.*lbf)
4. **INSTALL INSTRUMENT PANEL FINISH PANEL SUB-ASSEMBLY LOWER RH (See page IP-20)**
5. **INSTALL GLOVE COMPARTMENT DOOR ASSEMBLY (See page IP-20)**
6. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
   Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)



ACCELERATOR PEDAL

ON-VEHICLE INSPECTION

1. INSPECT ACCELERATOR PEDAL ASSEMBLY

(a) Inspect the voltage.

(1) Connect the intelligent tester to the DLC3.

(2) Turn the ignition switch to ON.

(3) Turn the intelligent tester ON.

(4) Select the following menu items: DIAGNOSIS / ENHANCED OBD ll / DATA LIST /ALL /ACCEL POS #1, ACCEL POS #2.

(5) Operate the accelerator pedal, then check that the ACCEL POS #1 and ACCEL POS #2 values are within the specified ranges.

ACCEL POS #1

Accelerator Pedal Condition	Specified Condition
Released	0.5 to 1.1 V
Depressed	2.6 to 4.5 V

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 and ECM.

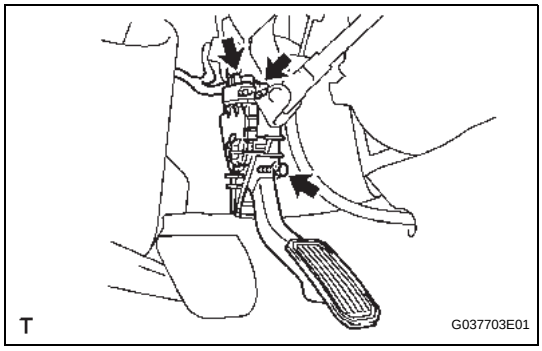
ES

ES

REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**

2. **REMOVE ACCELERATOR PEDAL ROD ASSEMBLY**
   (a) Disconnect the accelerator position sensor connector.
   (b) Remove the 2 bolts, then remove the accelerator pedal.

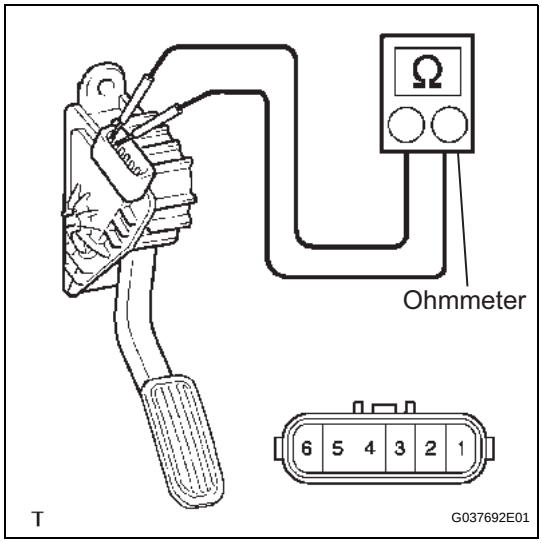


INSPECTION

1. **INSPECT ACCELERATOR PEDAL ROD ASSEMBLY**
   (a) Check the resistance.
      (1) Using an ohmmeter, measure the resistance between the terminals.
      Standard

Tester Connection	Specified Condition
5 (EP1) - 4 (VCP1)	1M Ω or higher
2 (EP2) - 1 (VCP2)	1M Ω or higher

If the result is not as specified, replace the accelerator pedal.



INSTALLATION

1. **INSTALL ACCELERATOR PEDAL ROD ASSEMBLY**
   NOTICE:
   - **Avoid any physical impact to the accelerator pedal assembly.**
   - **Do not disassemble the accelerator pedal assembly.**
   (a) Install the accelerator pedal with the 2 bolts.
   Torque: 5 N*m (51 kgf*cm, 44 in.*lbf)
   (b) Connect the accelerator position sensor connector.

2. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
   Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)

