SFI SYSTEM

PRECAUTION

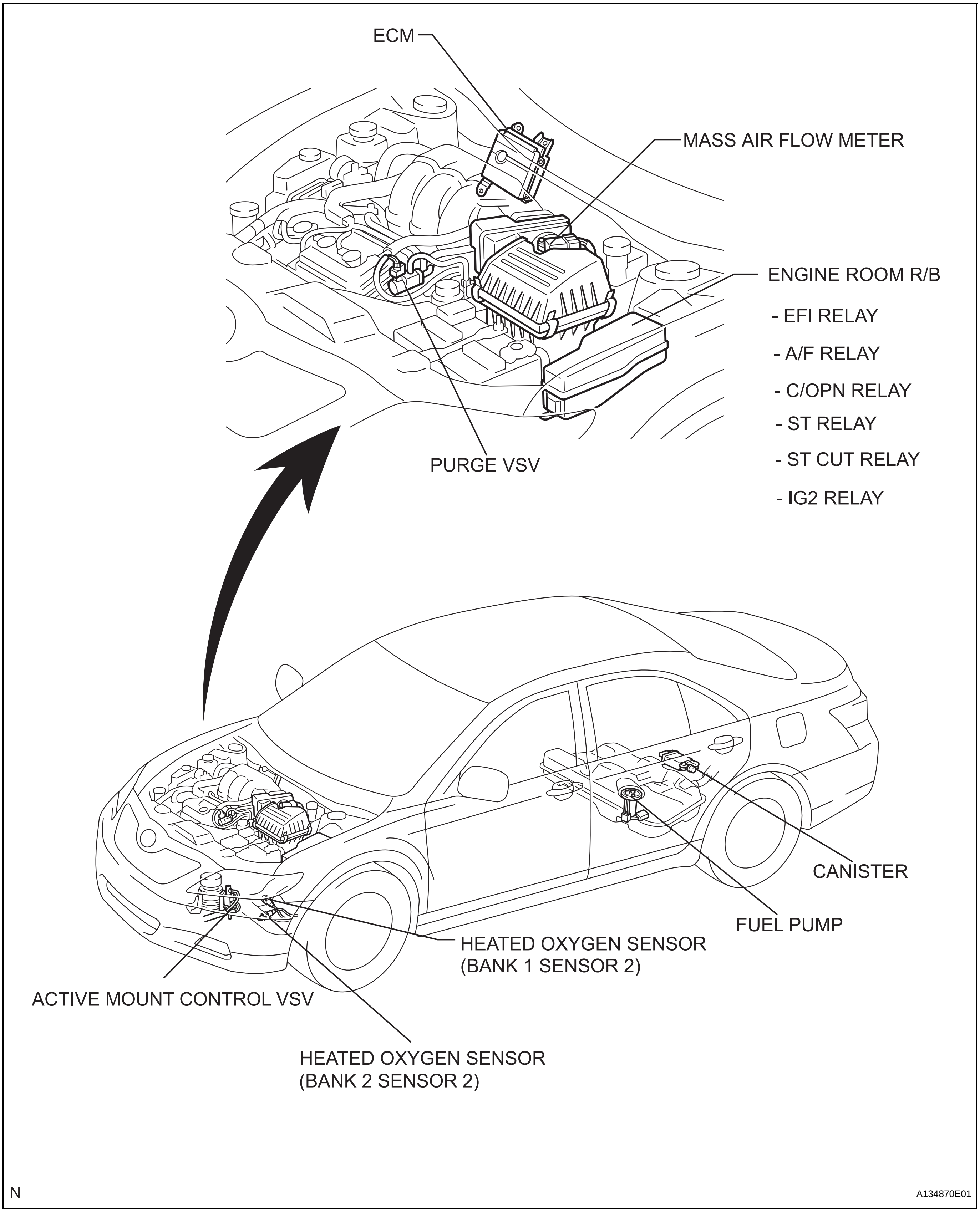
NOTICE:

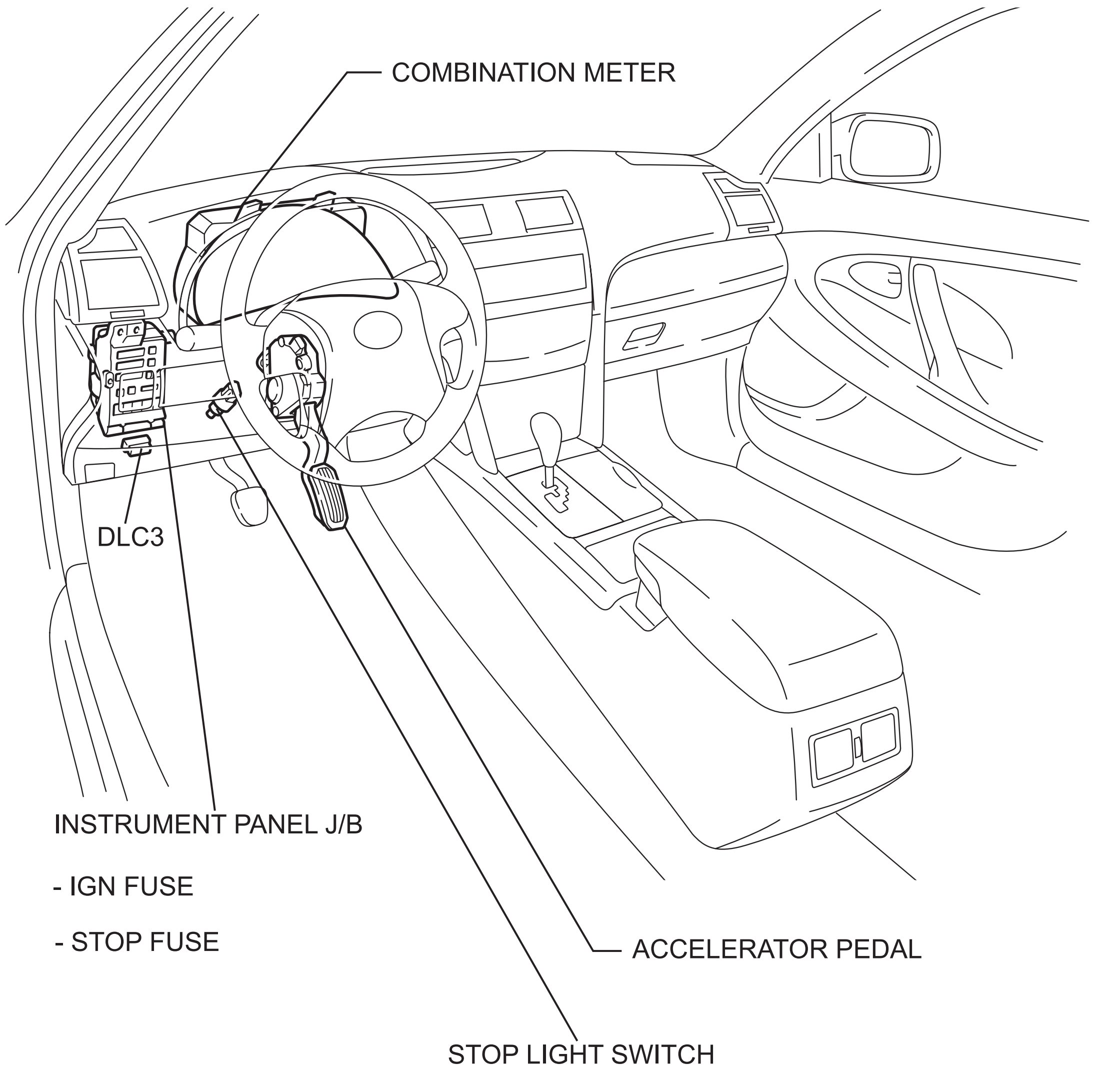
- **Perform the RESET MEMORY (AT) initialization operation after replacing the automatic transmission assembly, engine assembly or ECM (See page AX-25).**
- **Perform REGISTRATION (VIN registration) when replacing the ECM (See page ES-20).**

DEFINITION OF TERMS

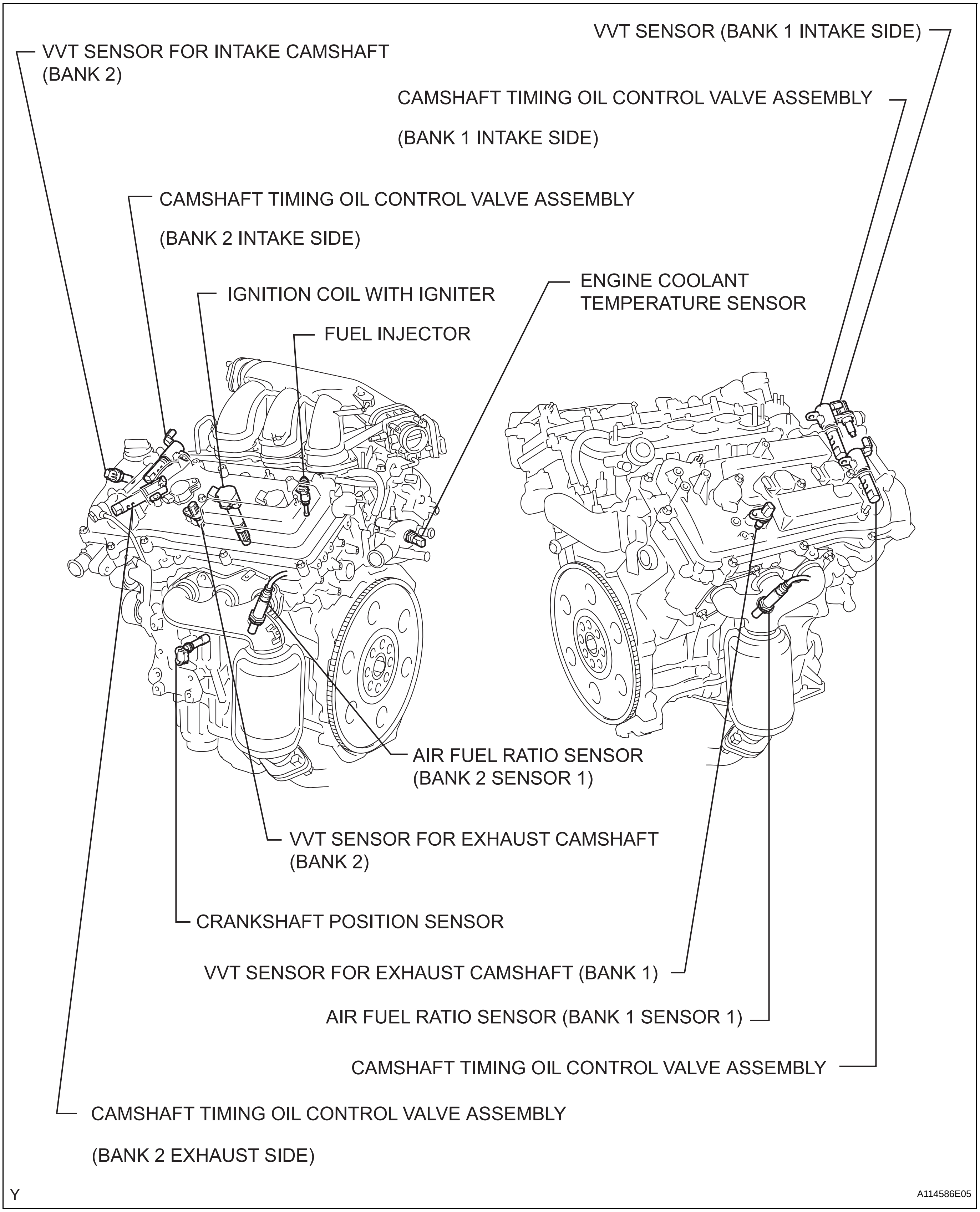
Terms	Definition
Monitor Description	Description of what ECM monitors and how to detect malfunctions (monitoring purpose and its details).
Related DTCs	A group of diagnostic trouble codes that are output by ECM based on the same malfunction detection logic.
Typical Enabling Condition	Preconditions that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

PARTS LOCATION

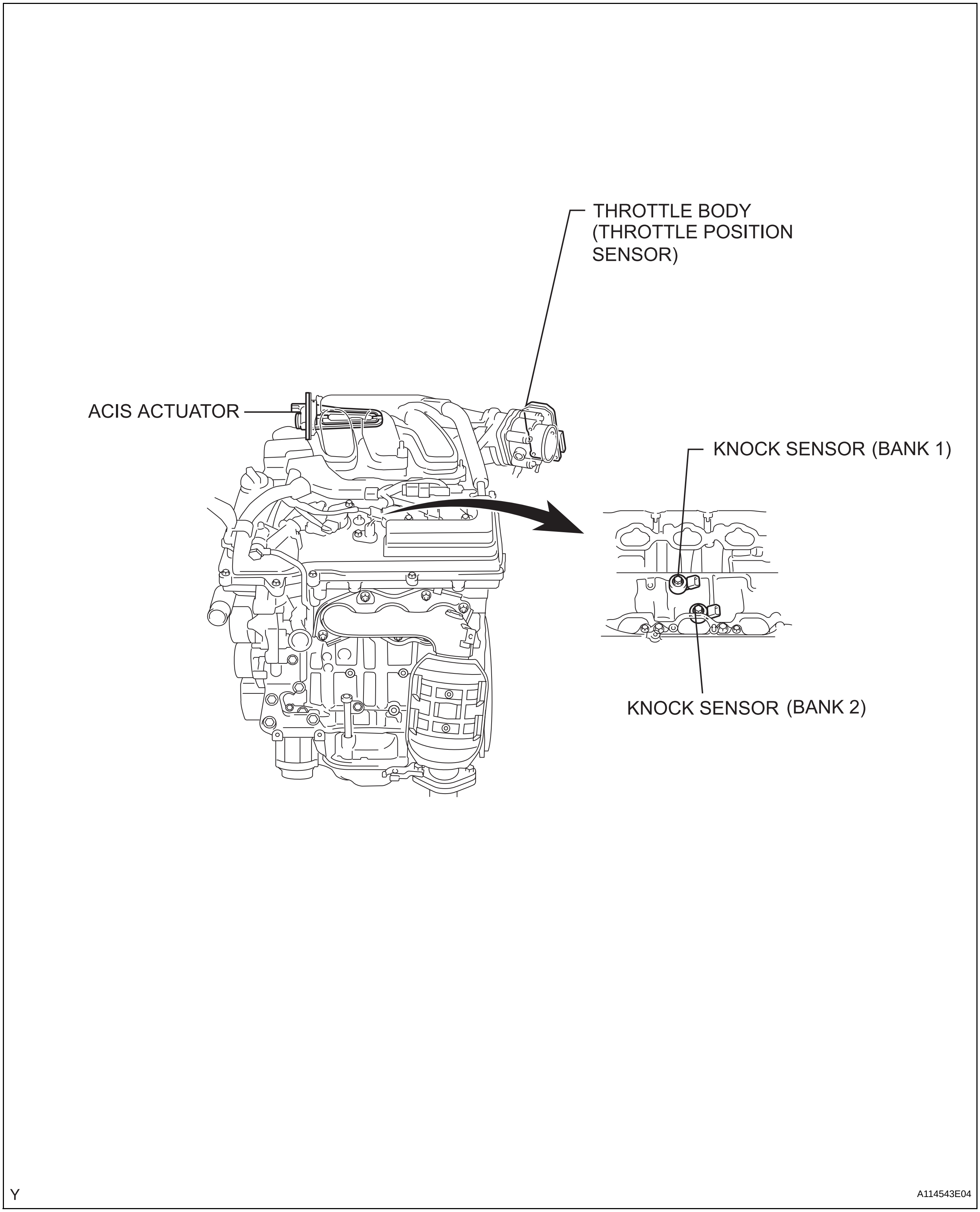




COMBINATION METER
DLC3
INSTRUMENT PANEL J/B
- IGN FUSE
- STOP FUSE
ACCELERATOR PEDAL
STOP LIGHT SWITCH
A139510E01

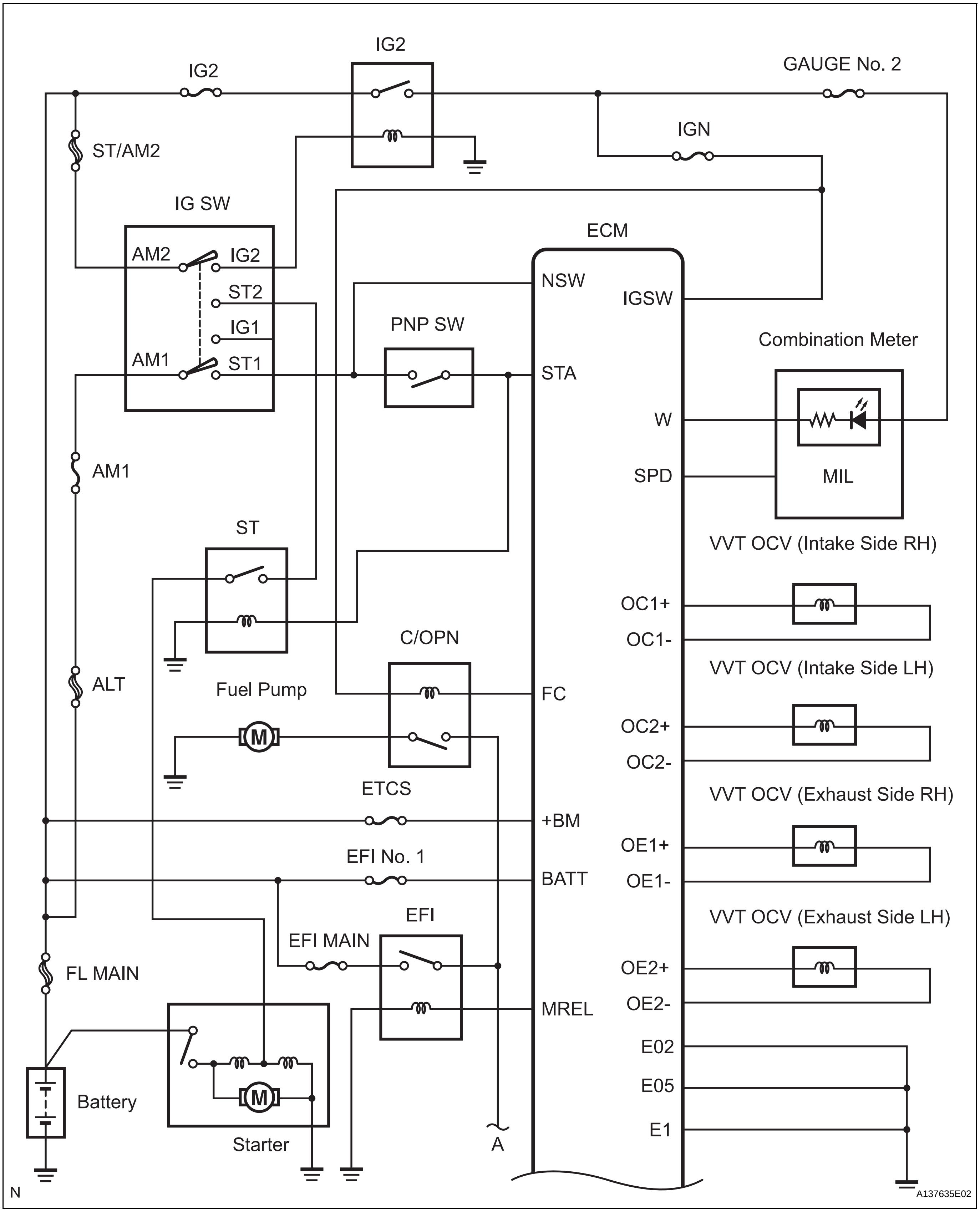

VVT SENSOR (BANK 1 INTAKE SIDE)
VVT SENSOR FOR INTAKE CAMSHAFT (BANK 2)
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (BANK 1 INTAKE SIDE)
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (BANK 2 INTAKE SIDE)
IGNITION COIL WITH IGNITER
ENGINE COOLANT TEMPERATURE SENSOR
FUEL INJECTOR
AIR FUEL RATIO SENSOR (BANK 2 SENSOR 1)
VVT SENSOR FOR EXHAUST CAMSHAFT (BANK 2)
CRANKSHAFT POSITION SENSOR
VVT SENSOR FOR EXHAUST CAMSHAFT (BANK 1)
AIR FUEL RATIO SENSOR (BANK 1 SENSOR 1)
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (BANK 2 EXHAUST SIDE)
Y
A114586E05

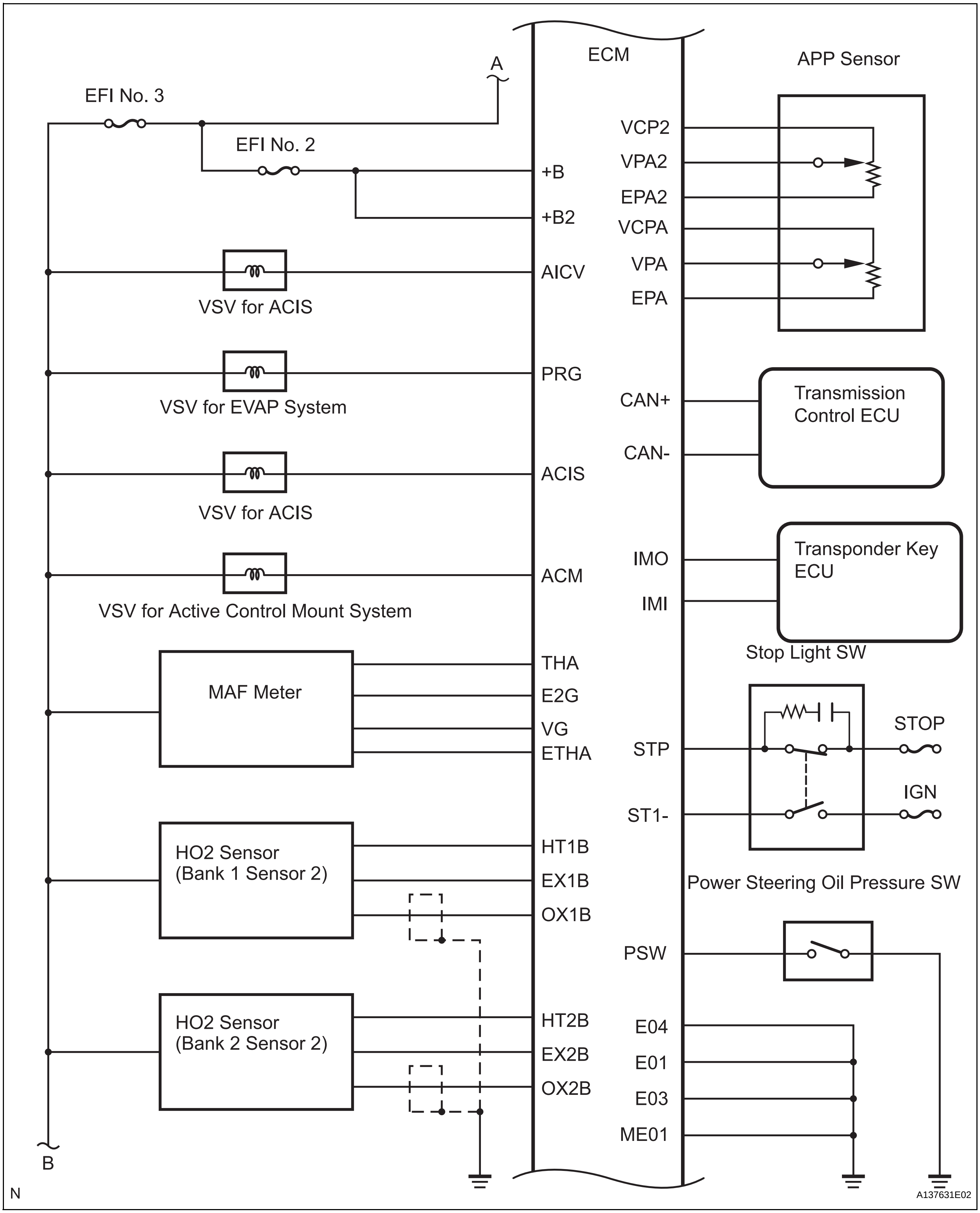
ES

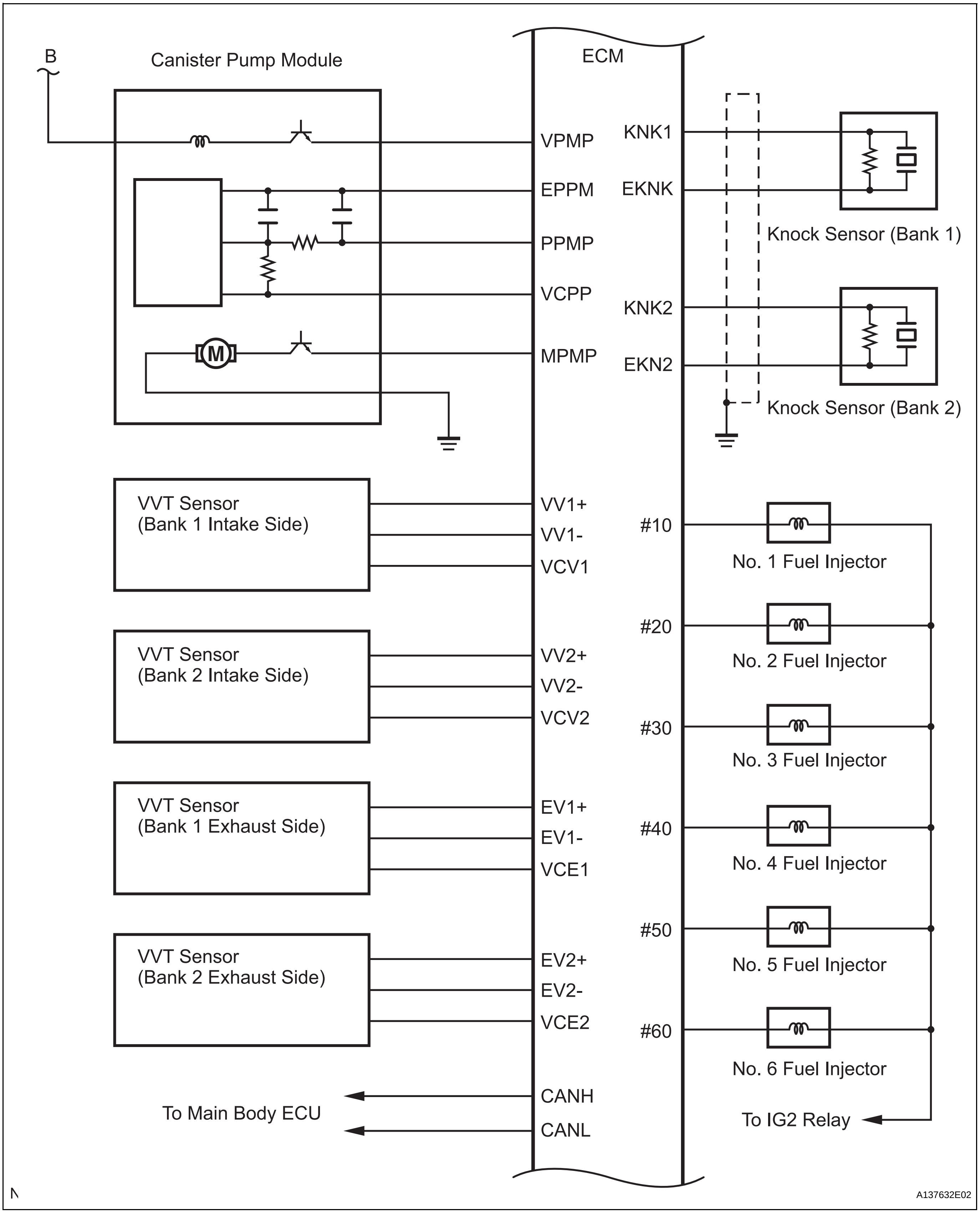

THROTTLE BODY
(THROTTLE POSITION
SENSOR)
ACIS ACTUATOR
KNOCK SENSOR (BANK 1)
KNOCK SENSOR (BANK 2)
Y
A114543E04

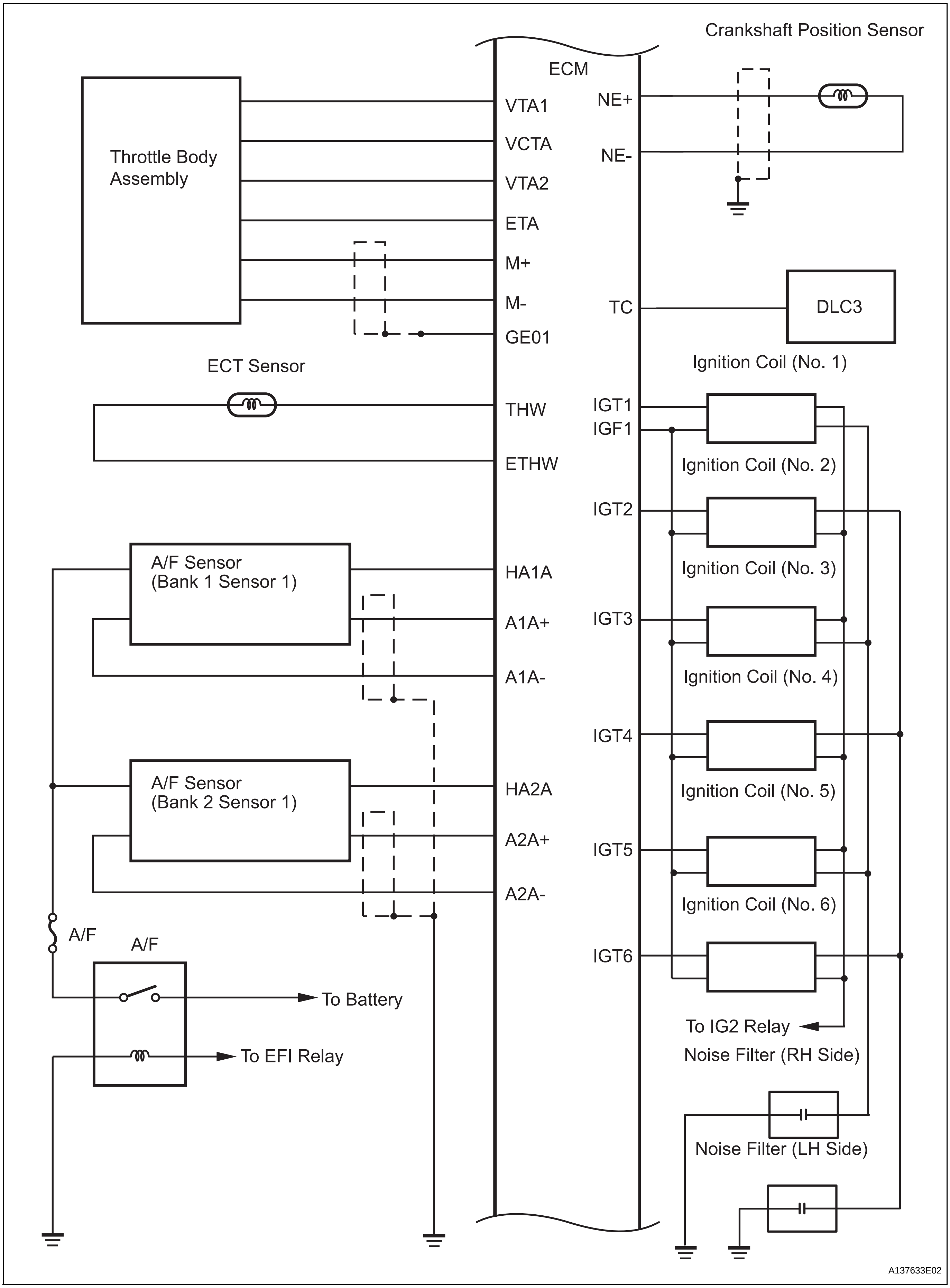
SYSTEM DIAGRAM

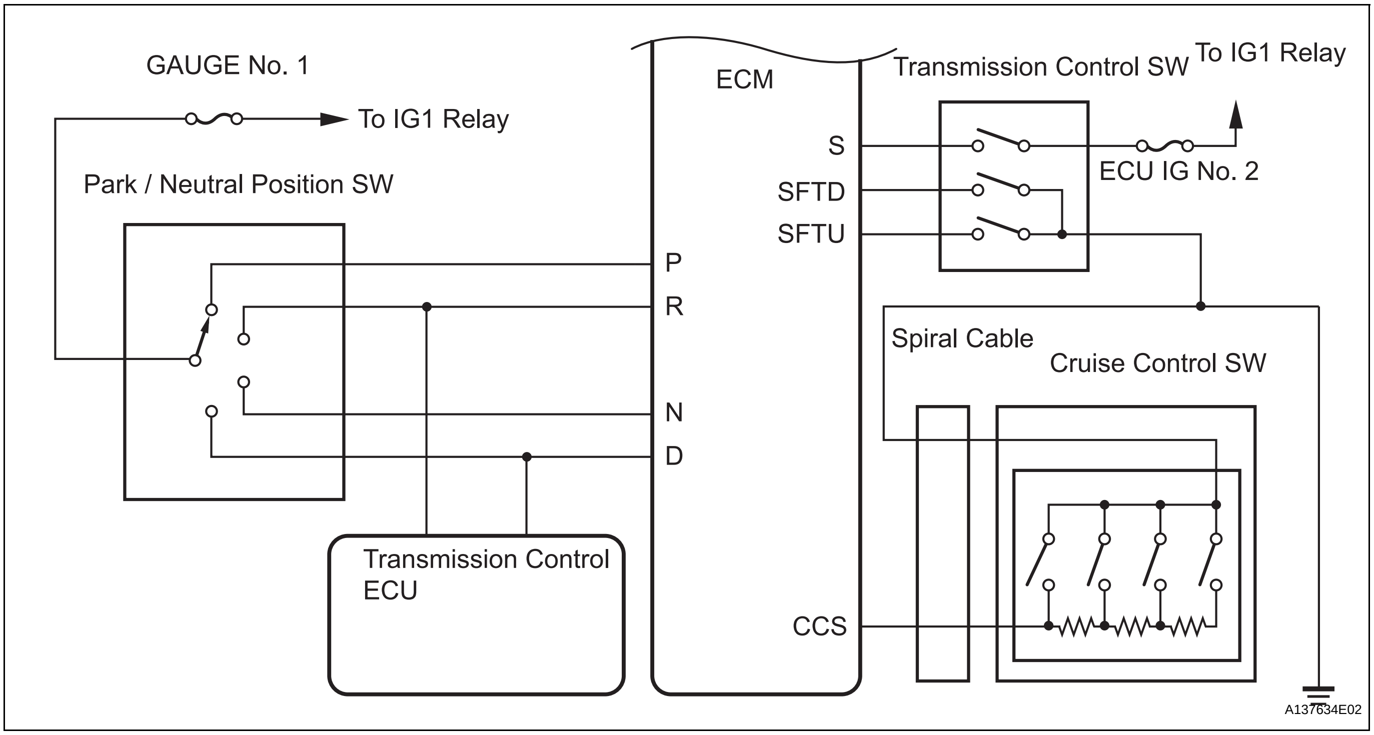
1. Without Smart Key System:




ECM
APP Sensor
A
EFI No. 3
EFI No. 2
VCP2
VPA2
+B
EPA2
+B2
VCPA
AICV
VPA
EPA
VSV for ACIS
PRG
CAN+
Transmission Control ECU
VSV for EVAP System
CAN-
ACIS
VSV for ACIS
IMO
Transponder Key ECU
ACM
IMI
VSV for Active Control Mount System
Stop Light SW
THA
MAF Meter
E2G
STOP
VG
ETHA
STP
IGN
ST1-
HT1B
HO2 Sensor (Bank 1 Sensor 2)
EX1B
Power Steering Oil Pressure SW
OX1B
PSW
HT2B
HO2 Sensor (Bank 2 Sensor 2)
E04
EX2B
E01
OX2B
E03
ME01
B
N
A137631E02

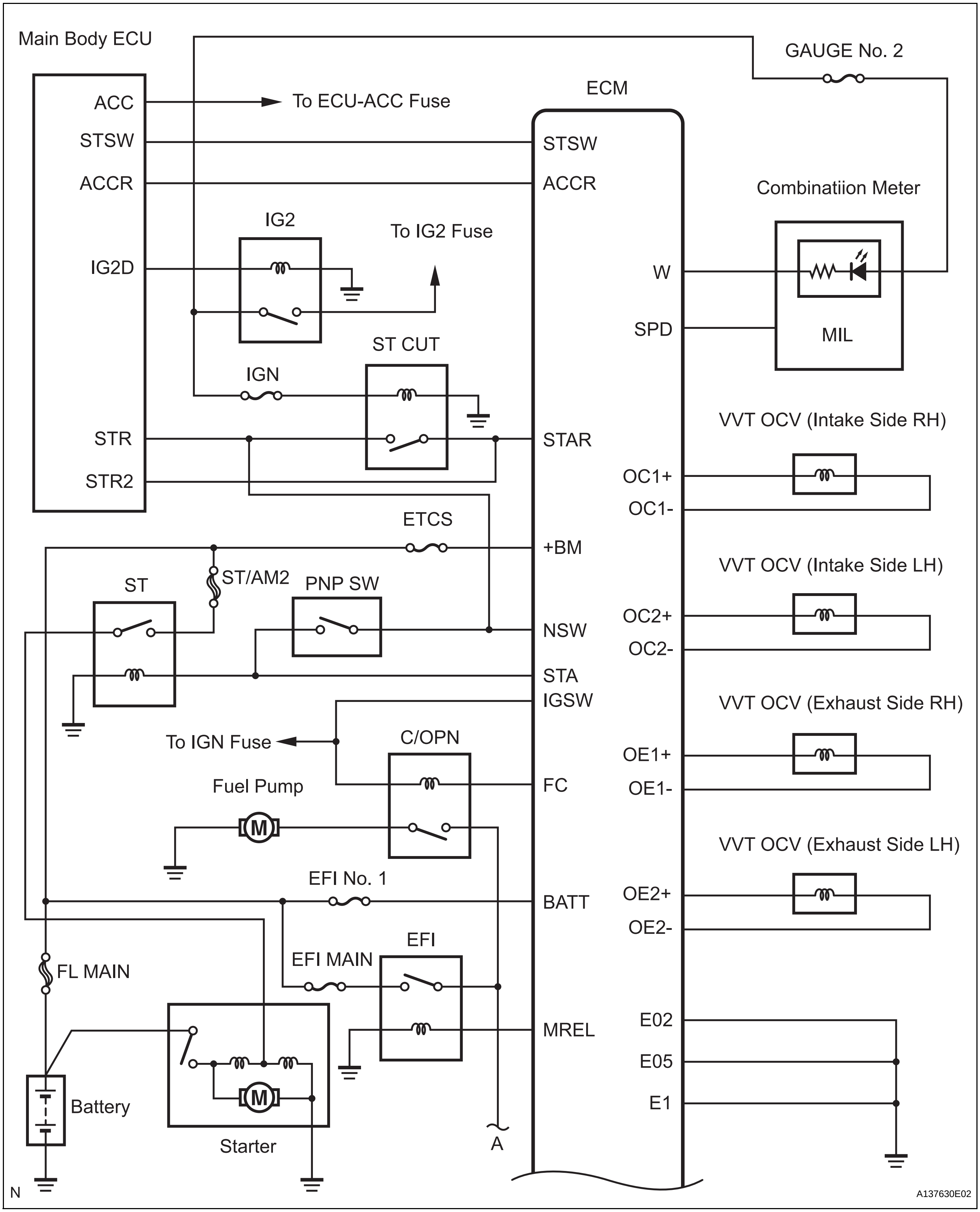

B
Canister Pump Module
ECM
VPMP
EPPM
PPMP
VCPP
MPMP
M
KNK1
EKNK
KNK2
EKN2
Knock Sensor (Bank 1)
Knock Sensor (Bank 2)
VVT Sensor
(Bank 1 Intake Side)
VV1+
VV1-
VCV1
VVT Sensor
(Bank 2 Intake Side)
VV2+
VV2-
VCV2
VVT Sensor
(Bank 1 Exhaust Side)
EV1+
EV1-
VCE1
VVT Sensor
(Bank 2 Exhaust Side)
EV2+
EV2-
VCE2
#10
No. 1 Fuel Injector
#20
No. 2 Fuel Injector
#30
No. 3 Fuel Injector
#40
No. 4 Fuel Injector
#50
No. 5 Fuel Injector
#60
No. 6 Fuel Injector
To Main Body ECU
CANH
CANL
To IG2 Relay
A137632E02

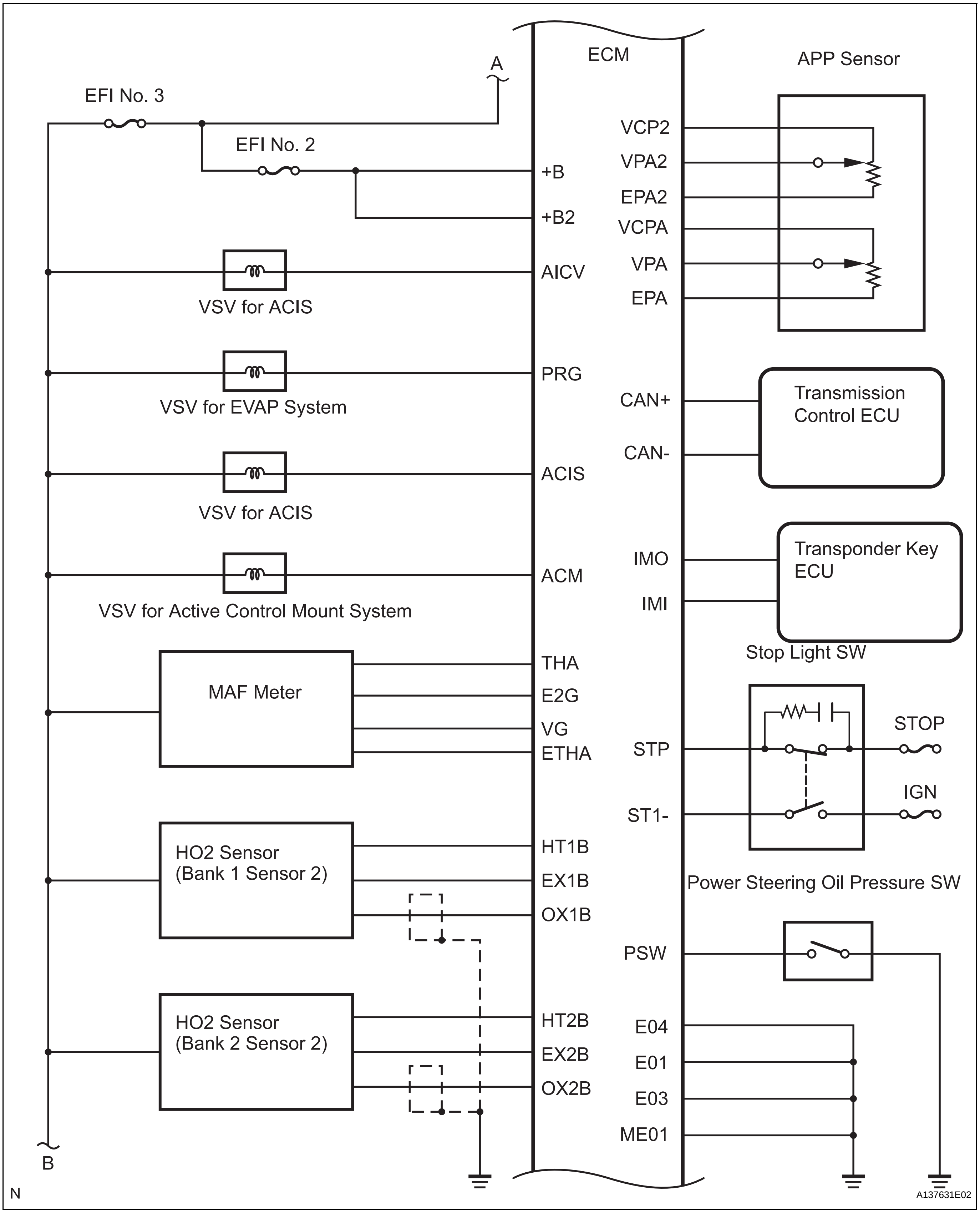

Crankshaft Position Sensor
ECM
VTA1
VCTA
VTA2
ETA
M+
M-
GE01
NE+
NE-
TC
DLC3
Throttle Body Assembly
ECT Sensor
THW
ETHW
Ignition Coil (No. 1)
IGT1
IGF1
Ignition Coil (No. 2)
IGT2
Ignition Coil (No. 3)
IGT3
Ignition Coil (No. 4)
IGT4
Ignition Coil (No. 5)
IGT5
Ignition Coil (No. 6)
IGT6
A/F Sensor (Bank 1 Sensor 1)
HA1A
A1A+
A1A-
A/F Sensor (Bank 2 Sensor 1)
HA2A
A2A+
A2A-
A/F
A/F
To Battery
To EFI Relay
To IG2 Relay
Noise Filter (RH Side)
Noise Filter (LH Side)
A137633E02

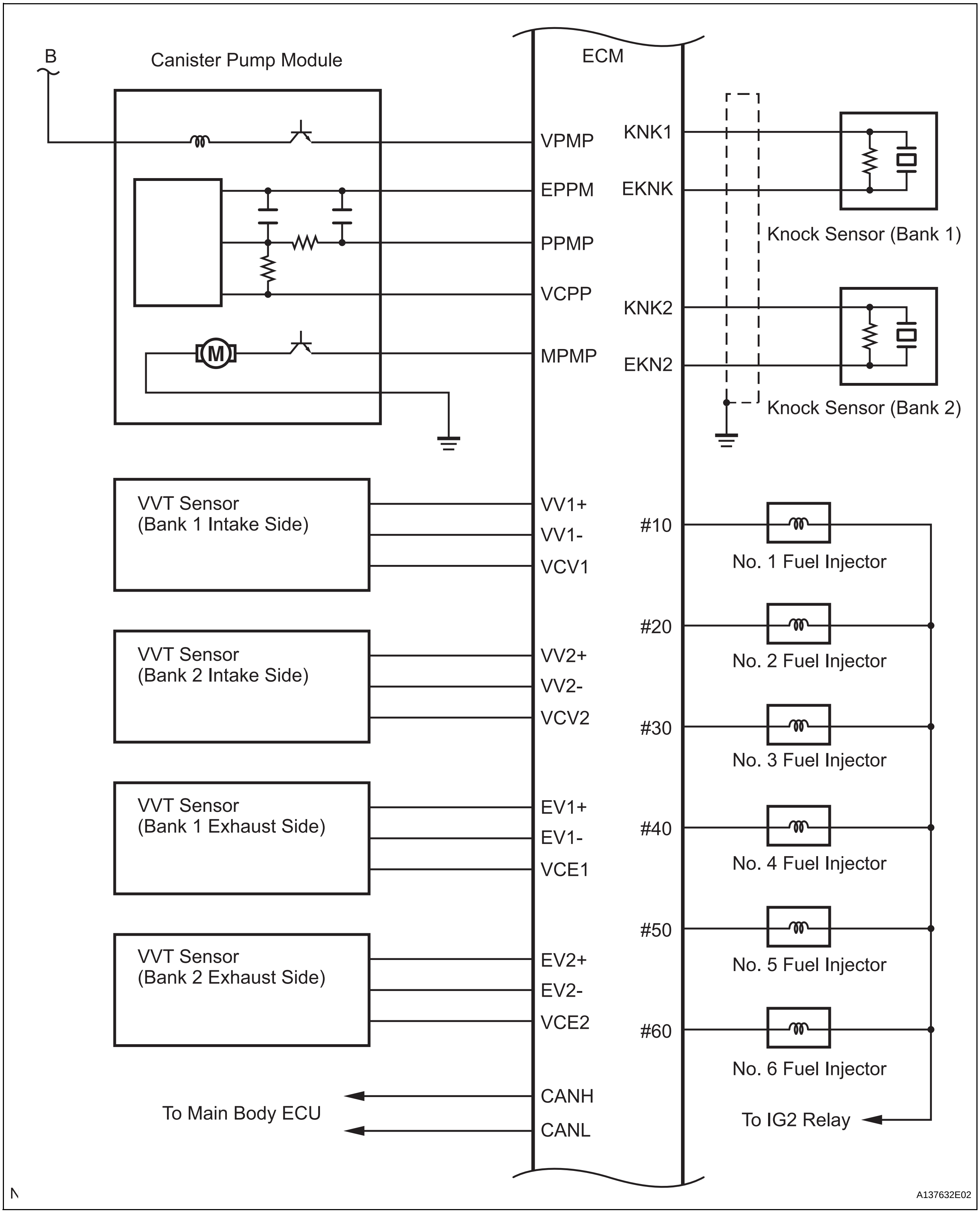

GAUGE No. 1
To IG1 Relay
Park / Neutral Position SW
ECM
S
SFTD
SFTU
P
R
N
D
CCS
Transmission Control SW
To IG1 Relay
ECU IG No. 2
Spiral Cable
Cruise Control SW
Transmission Control ECU
A137634E02

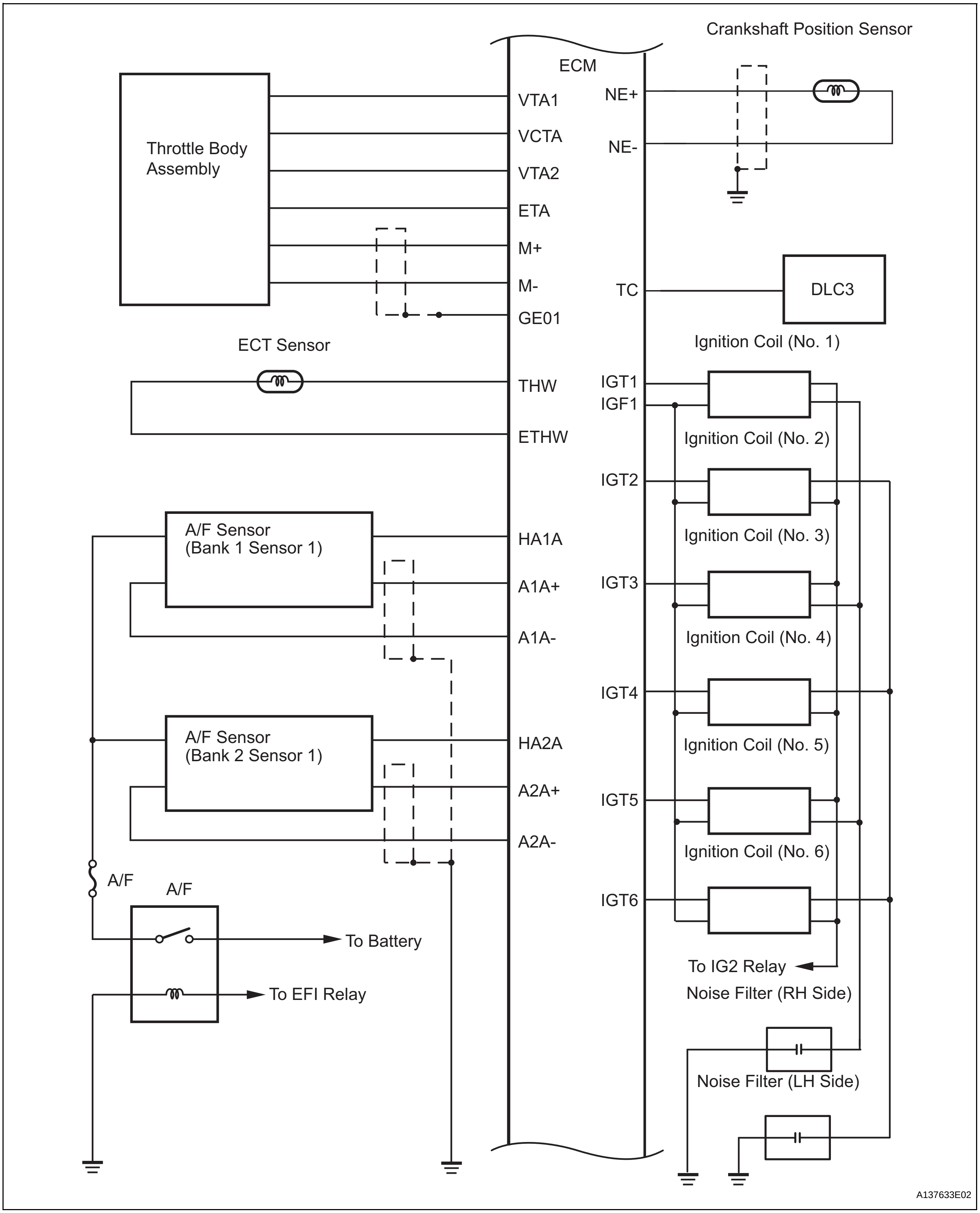
ES

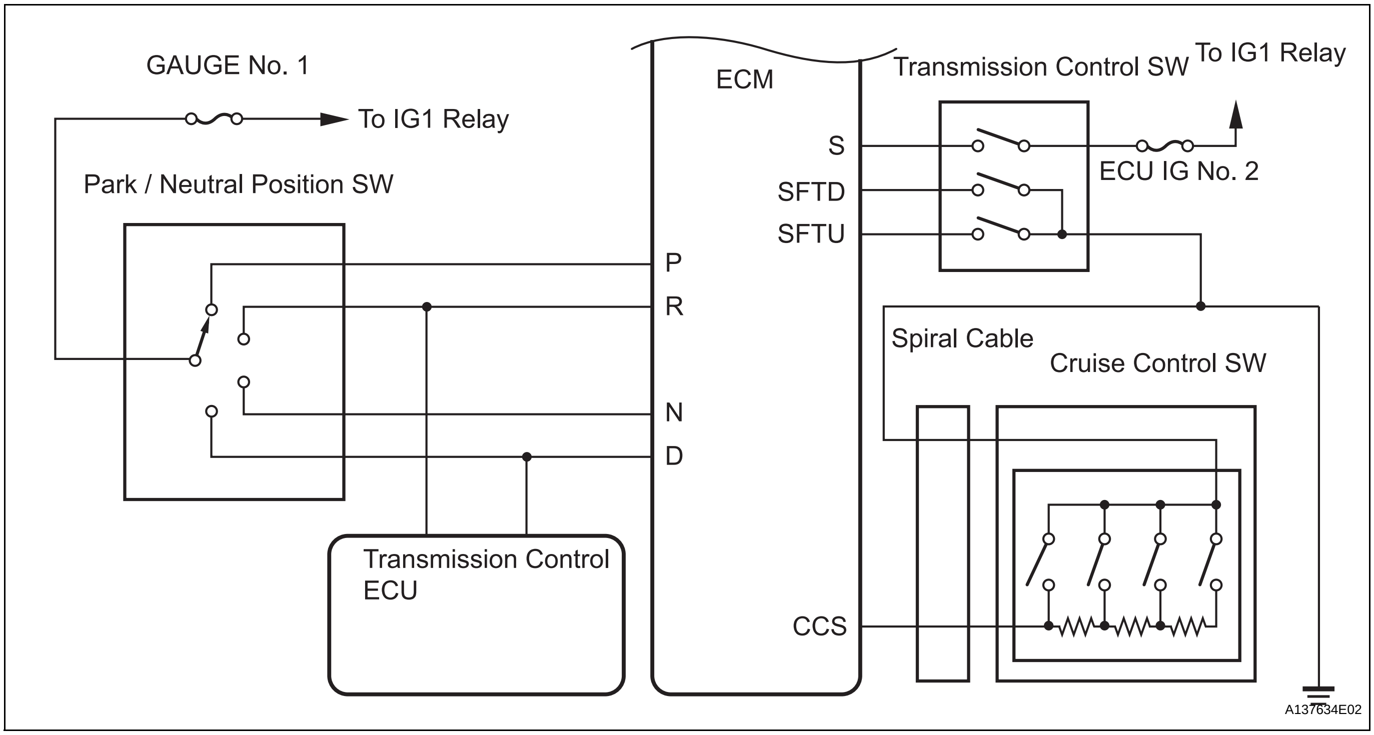
2. With Smart Key System:




ECM
A
EFI No. 3
EFI No. 2
+B
+B2
AICV
VSV for ACIS
PRG
VSV for EVAP System
ACIS
VSV for ACIS
ACM
VSV for Active Control Mount System
MAF Meter
THA
E2G
VG
ETHA
HO2 Sensor
(Bank 1 Sensor 2)
HT1B
EX1B
OX1B
HO2 Sensor
(Bank 2 Sensor 2)
HT2B
EX2B
OX2B
B
N
APP Sensor
VCP2
VPA2
EPA2
VCPA
VPA
EPA
Transmission
Control ECU
CAN+
CAN-
Transponder Key
ECU
IMO
IMI
Stop Light SW
STOP
STP
IGN
ST1-
Power Steering Oil Pressure SW
PSW
E04
E01
E03
ME01
A137631E02


B
Canister Pump Module
ECM
VPMP
EPPM
PPMP
VCPP
MPMP
M
KNK1
EKNK
Knock Sensor (Bank 1)
KNK2
EKN2
Knock Sensor (Bank 2)
VVT Sensor
(Bank 1 Intake Side)
VV1+
VV1-
VCV1
VVT Sensor
(Bank 2 Intake Side)
VV2+
VV2-
VCV2
VVT Sensor
(Bank 1 Exhaust Side)
EV1+
EV1-
VCE1
VVT Sensor
(Bank 2 Exhaust Side)
EV2+
EV2-
VCE2
#10
No. 1 Fuel Injector
#20
No. 2 Fuel Injector
#30
No. 3 Fuel Injector
#40
No. 4 Fuel Injector
#50
No. 5 Fuel Injector
#60
No. 6 Fuel Injector
CANH
CANL
To Main Body ECU
To IG2 Relay
A137632E02


Crankshaft Position Sensor
ECM
VTA1
VCTA
VTA2
ETA
M+
M-
GE01
NE+
NE-
TC
DLC3
Throttle Body Assembly
ECT Sensor
THW
ETHW
Ignition Coil (No. 1)
IGT1
IGF1
Ignition Coil (No. 2)
IGT2
Ignition Coil (No. 3)
IGT3
Ignition Coil (No. 4)
IGT4
Ignition Coil (No. 5)
IGT5
Ignition Coil (No. 6)
IGT6
A/F Sensor (Bank 1 Sensor 1)
HA1A
A1A+
A1A-
A/F Sensor (Bank 2 Sensor 1)
HA2A
A2A+
A2A-
A/F
A/F
To Battery
To EFI Relay
To IG2 Relay
Noise Filter (RH Side)
Noise Filter (LH Side)
A137633E02


GAUGE No. 1
To IG1 Relay
Park / Neutral Position SW
ECM
S
SFTD
SFTU
P
R
N
D
CCS
Transmission Control SW
To IG1 Relay
ECU IG No. 2
Spiral Cable
Cruise Control SW
Transmission Control
ECU
A137634E02

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

Result	Proceed to
Malfunction does not occur	A
Malfunction occurs	B

B → **GO TO STEP 10**

A

9 SIMULATE SYMPTOMS

NEXT

ES

10 CHECK FOR DTCS*

Result

Result	Proceed to
Trouble code	A
No code	B

B → **GO TO STEP 12**

A

11 REFER TO DTC CHART

NEXT

GO TO STEP 14

12 CONDUCT BASIC INSPECTION

Result

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

Result	Proceed to
Malfunctioning circuit confirmed	A

Result	Proceed to
Malfunctioning parts confirmed	B

B → GO TO STEP 17

A

14 CHECK ECM POWER SOURCE CIRCUIT

NEXT

15 CONDUCT CIRCUIT INSPECTION

Result

Result	Proceed to
Malfunction not confirmed	A
Malfunction confirmed	B

B → GO TO STEP 18

A

16 CHECK FOR INTERMITTENT PROBLEMS

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

1. Clear the DTCs.
2. Switch the ECM from normal mode to check mode using an intelligent tester (See page ES-49).
3. Perform a simulation test (See page IN-40).
4. Check and wiggle the harness(es), connector(s) and terminal(s) (See page IN-45).

BASIC INSPECTION

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

1	CHECK BATTERY VOLTAGE

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

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

NG → CHARGE OR REPLACE BATTERY

OK

2	CHECK WHETHER ENGINE CRANKS

NG → PROCEED TO PROBLEM SYMPTOMS TABLE

OK

3	CHECK WHETHER ENGINE STARTS

NG → GO TO STEP 6

OK

4	CHECK AIR FILTER

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

NG → REPLACE AIR FILTER

OK

5	CHECK IDLING SPEED

NG → 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 SPARKS

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 register the VIN.

ES

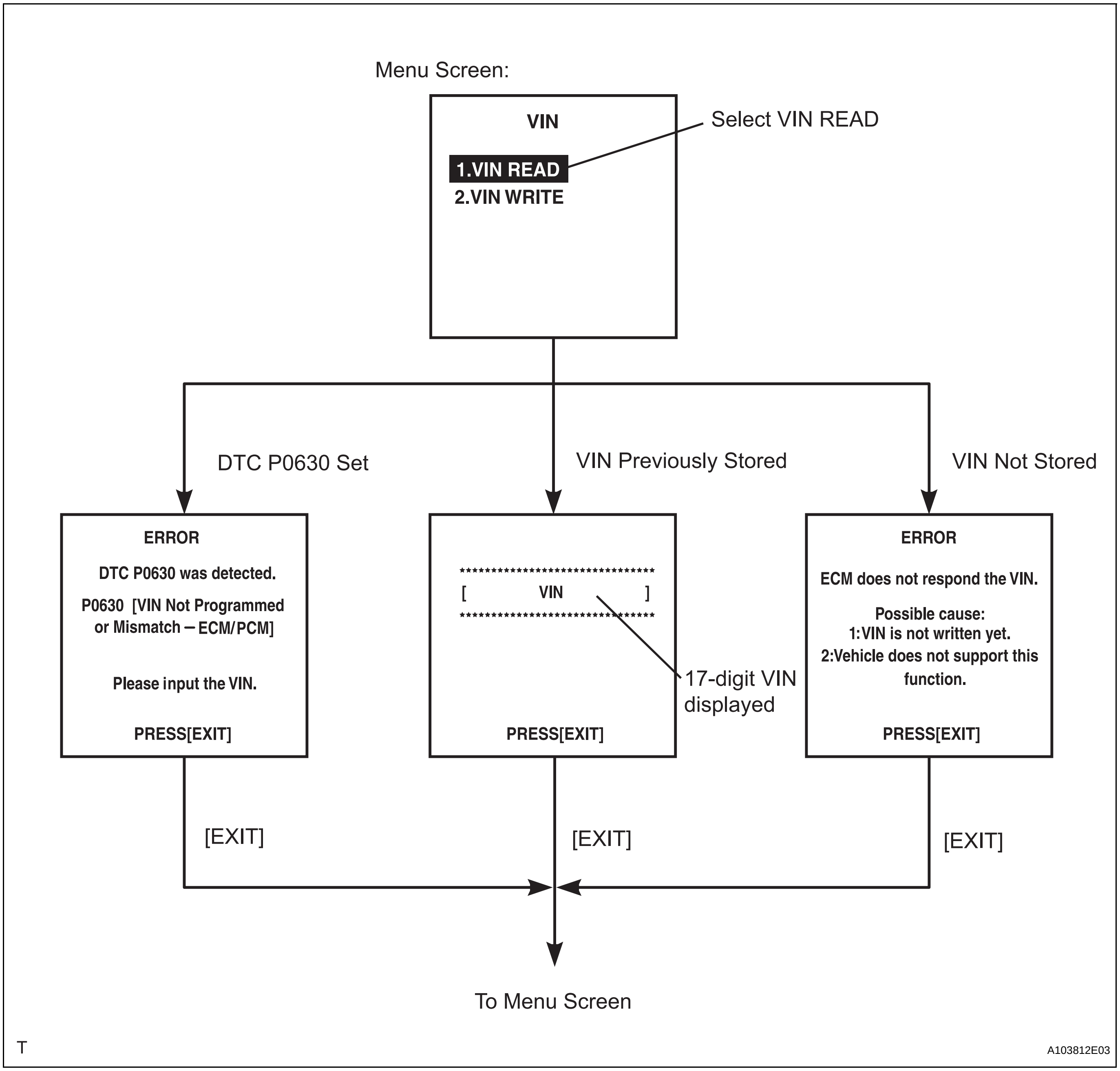
1. INPUT INSTRUCTIONS

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

2. READ VIN (Vehicle Identification Number)

(a) The flowchart of the VIN reading process is shown. 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.
(b) Read VIN using an intelligent tester.
(c) Check the vehicle's VIN.
(d) Connect the intelligent tester to the DLC3.
(e) Turn the ignition switch on (IG).
(f) Turn the tester on.

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



3. WRITE VIN

(a) The flowchart of the VIN writing process is shown. This process allows the VIN to be input into the ECM. If the ECM is changed, or the VINs do not match, the VIN can be registered, or overwritten in the ECM by following this procedure.

(b) Write VIN using the intelligent tester.

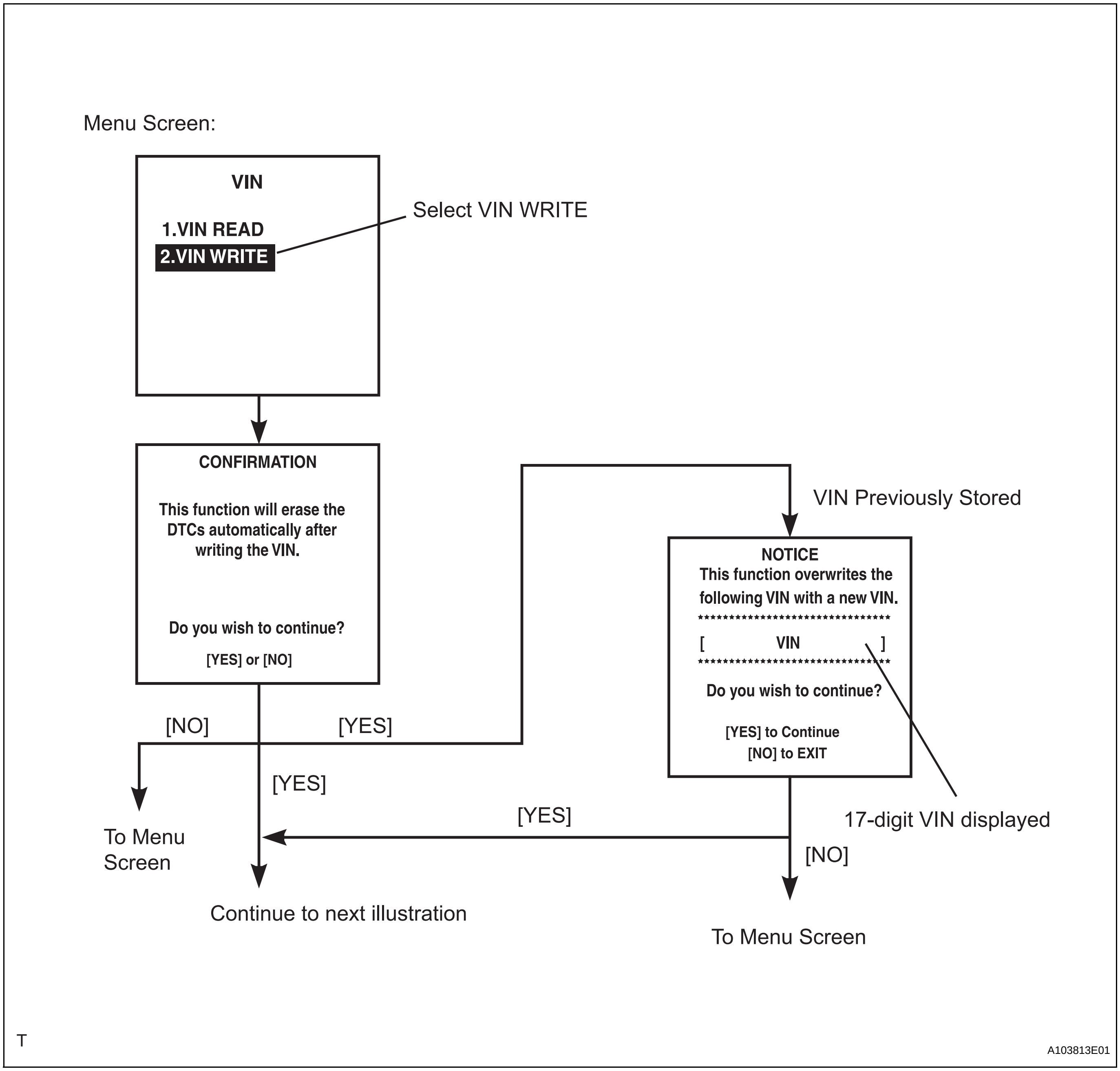
(c) Check the vehicle's VIN.

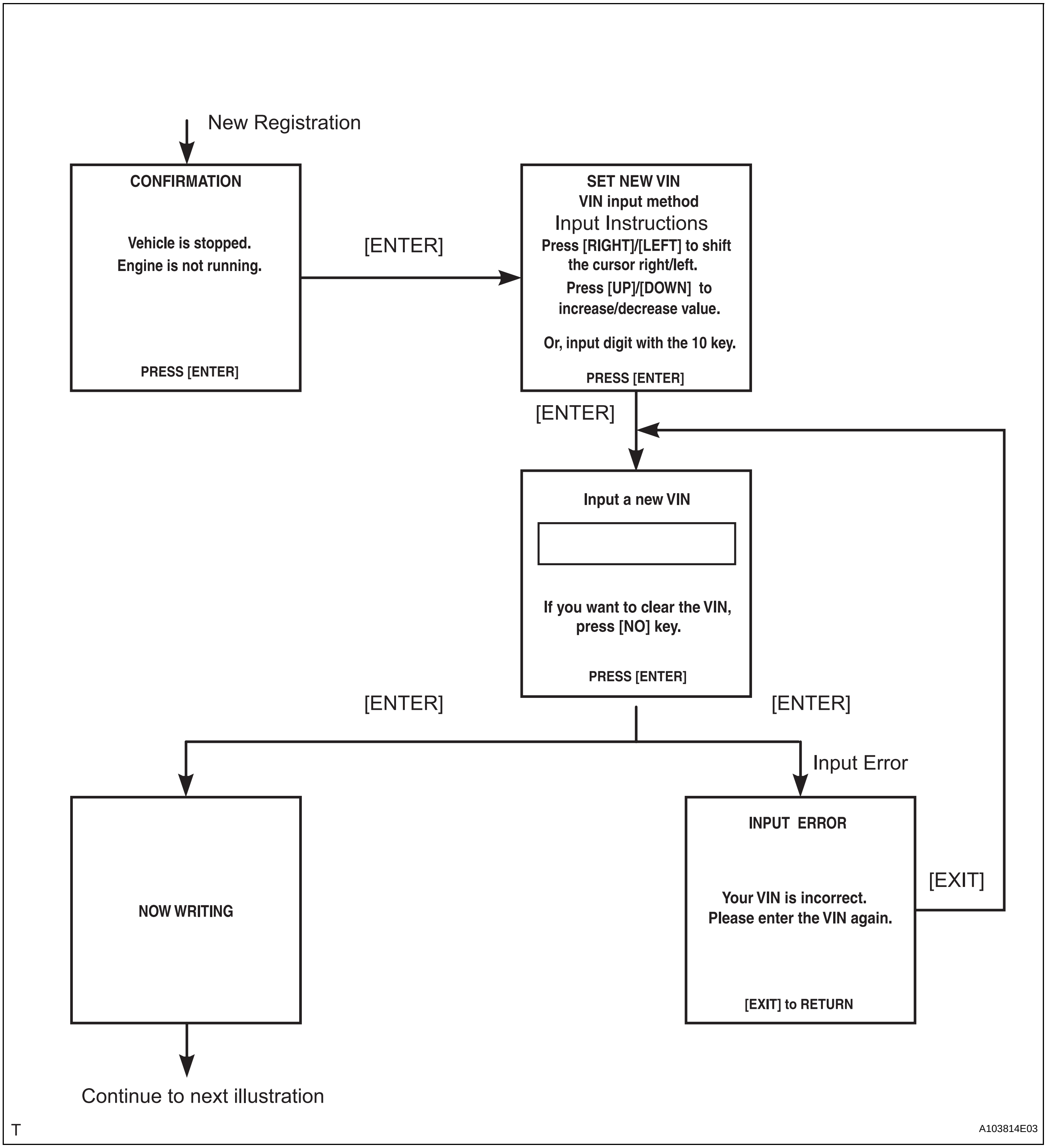
(d) Connect the intelligent tester to the DLC3.

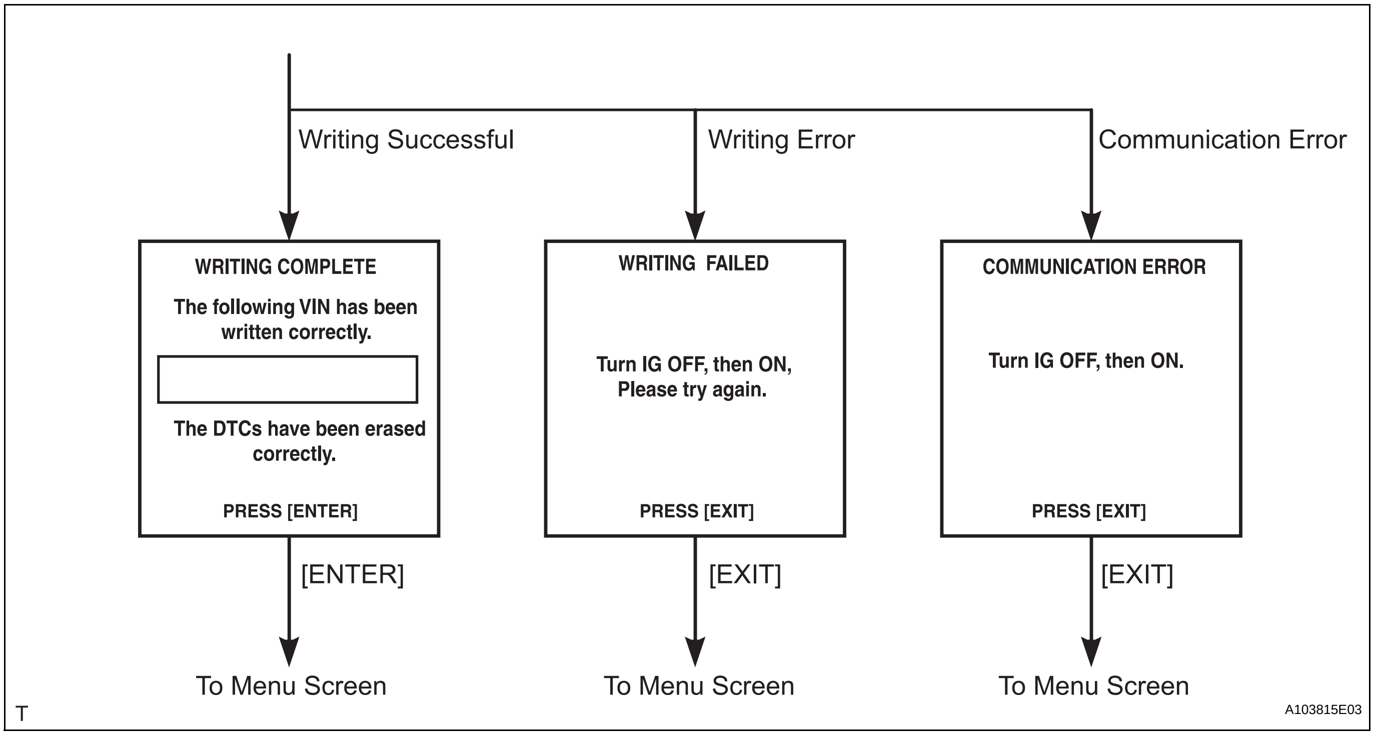
(e) Turn the ignition switch on (IG).

(f) Turn the tester on.

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




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


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

CHECKING MONITOR STATUS

The purpose of the monitor result (mode 06) is to allow access to the results 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 instructions to view the monitor status. Although the Toyota diagnostic tester is used in the following instructions, 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

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

(a) Connect the intelligent tester to the DLC3.

(b) Start the engine and turn the tester on.

(c) Clear the DTCs.

(d) Run the vehicle in accordance with the applicable drive pattern described in READINESS MONITOR DRIVE PATTERN (See page ES-28). DO NOT turn the engine switch off.

NOTICE:

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

ES

2. **ACCESS MONITOR RESULT**
   (a) Select the following menus on the intelligent tester: 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.
   HINT:
   The monitor result might be PASS on rare occasions even if the Malfunction Indicator Lamp (MIL) is illuminated. This indicates that the system was malfunctioning in the previous driving cycle. This might be caused by an intermittent problem.
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 be PASS on rare occasions even if the Malfunction Indicator Lamp (MIL) is illuminated. This indicates that the system was malfunctioning in the 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 0.0003	No dimension	A/F sensor deterioration level
$01	$91	Multiply by 0.004	mA	A/F sensor current

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 0.003	g	Maximum oxygen storage capacity

A/F Sensor Bank 2:

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

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 0.003	g	Maximum oxygen storage capacity

Catalyst-Bank 1:

Monitor ID	Test ID	Scaling	Unit	Description
$21	$A9	Multiply by 0.003	No dimension	Oxygen storage capacity of catalyst-bank 1

Catalyst-Bank 2:

Monitor ID	Test ID	Scaling	Unit	Description
$22	$A9	Multiply by 0.003	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)

ES

Misfire:

Monitor ID	Test ID	Scaling	Unit	Description
$A1	$0B	Multiply by 1	Time	Exponential Weighted Moving Average (EWMA) misfire for all cylinders: Misfire counts for last ten driving cycles-Total
$A1	$0C	Multiply by 1	Time	Misfire rate for all cylinders: Misfire counts for last/current driving cycles-Total
$A2	$0B	Multiply by 1	Time	EWMA misfire for cylinder 1: Misfire counts for last ten driving cycles-Total
$A2	$0C	Multiply by 1	Time	Misfire rate for cylinder 1: Misfire counts for last/current driving cycle-Total
$A3	$0B	Multiply by 1	Time	EWMA misfire for cylinder 2: Misfire counts for last ten driving cycles-Total
$A3	$0C	Multiply by 1	Time	Misfire rate for cylinder 2: Misfire counts for last/current driving cycle-Total
$A4	$0B	Multiply by 1	Time	EWMA misfire for cylinder 3: Misfire counts for last ten driving cycles-Total
$A4	$0C	Multiply by 1	Time	Misfire rate for cylinder 3: Misfire counts for last/current driving cycle-Total
$A5	$0B	Multiply by 1	Time	EWMA misfire for cylinder 4: Misfire counts for last ten driving cycles-Total
$A5	$0C	Multiply by 1	Time	Misfire rate for cylinder 4: Misfire counts for last/current driving cycle-Total
$A6	$0B	Multiply by 1	Time	EWMA misfire for cylinder 5: Misfire counts for last ten driving cycles-Total
$A6	$0C	Multiply by 1	Time	Misfire rate for cylinder 5: Misfire counts for last/current driving cycle-Total
$A7	$0B	Multiply by 1	Time	EWMA misfire for cylinder 6: Misfire counts for last ten driving cycles-Total

Monitor ID	Test ID	Scaling	Unit	Description
$A7	$0C	Multiply by 1	Time	Misfire rate for cylinder 6: Misfire counts for last/current driving cycle-Total

Rear Oxygen Sensor Heater:

Monitor ID	Test ID	Scaling	Unit	Description
$42	$91	Multiply by 0.001	Ohm	Oxygen sensor heater resistance bank 1 sensor 2
$46	$91	Multiply by 0.004	Ohm	Oxygen sensor heater resistance bank 2 sensor 2

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 in 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 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:

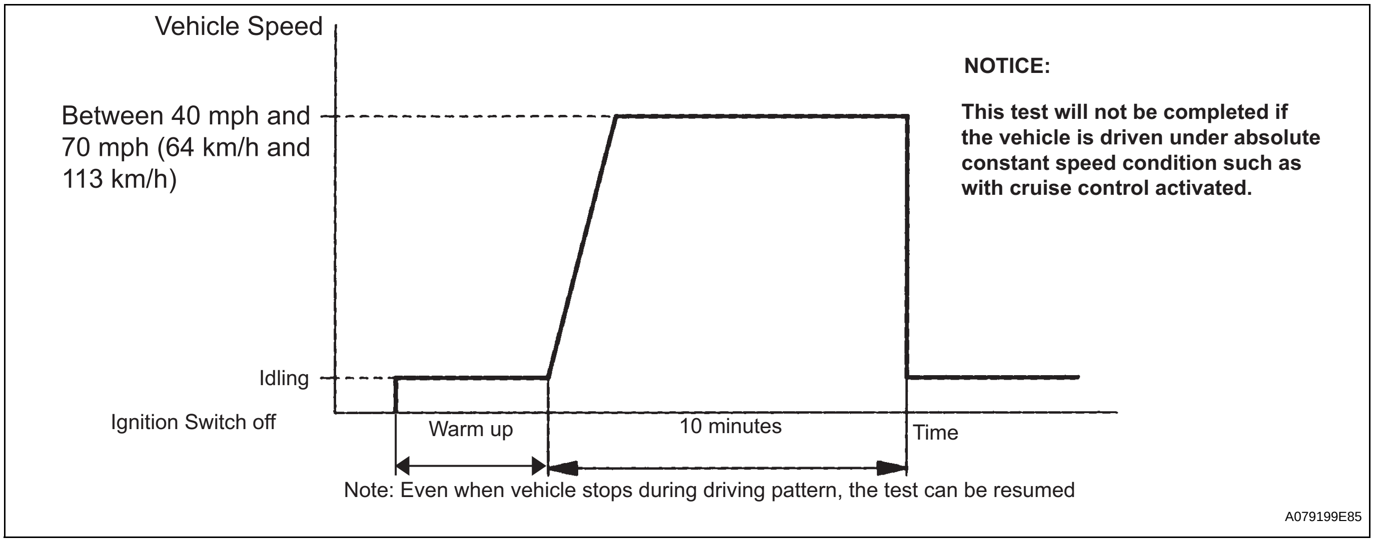
- The ECM has lost battery power or broken a fuse.
- DTCs have been cleared.
- The conditions for running the Readiness Monitor have not been met.

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).

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 an intelligent tester.
(2) Turn the ignition switch on (IG).
(3) Turn the tester or scan tool ON.
(4) Clear the DTCs.
(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.
(2) If the status does not switch to COMPL (complete), extend the driving time.

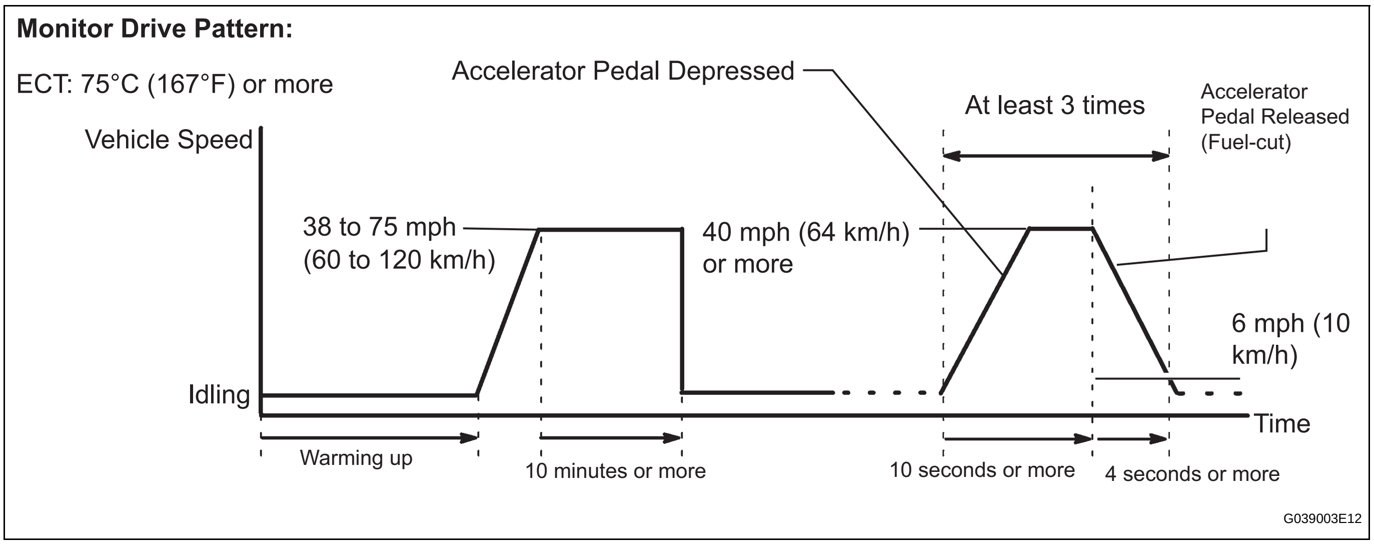
3. EVAP MONITOR (KEY-OFF TYPE)

(a) Preconditions
The monitor will not run unless:
- The fuel tank is less than 90% full.
- The altitude is less than 8,000 ft (2,450 m).
- The vehicle is stationary.
- The engine coolant temperature is 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 freeway) 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 (IG).
(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. A/F SENSOR AND HO2S MONITORS



(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 (IG).
(3) Turn the tester on.
(4) Clear the DTCs.
(5) Start the engine, and warm it up until the ECT reaches 75°C (167°F) or higher.
(6) Drive the vehicle at 38 mph (60 km/h) or more for at least 10 minutes.
(7) Change the transmission to the 2nd gear.
(8) Accelerate the vehicle to 40 mph (64 km/h) or more by depressing the accelerator pedal for at least 10 seconds (Procedure "A").

(9) Soon after performing procedure "A" above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal, in order to execute fuel-cut control (Procedure "B").

(10) Allow the vehicle to decelerate until the vehicle speed declines to less than 6 mph (10 km/h) (Procedure "C").

(11) Repeat procedures from "A" through "C" 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 the Drive Pattern again.

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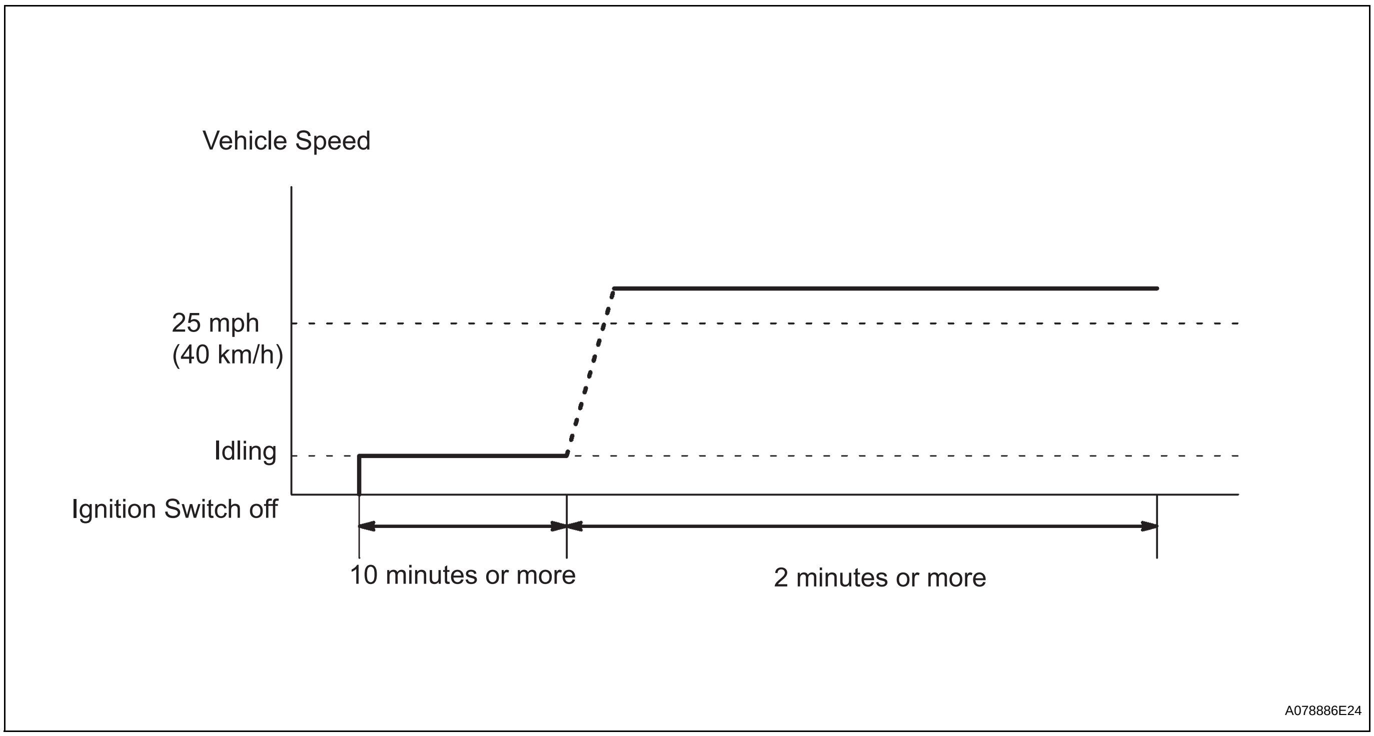
5. AIR-FUEL RATIO (A/F) AND HEATED OXYGEN (HO2) SENSOR HEATER MONITORS (FRONT A/F AND REAR HO2 SENSOR TYPE)



(a) Preconditions

The monitor will not run unless:

- The MIL is OFF.

(b) Drive Pattern

(1) Connect an intelligent tester to the DLC3.

(2) Turn the ignition switch on (IG).

(3) Clear the DTCs.

(4) Start the engine.

(5) Allow the engine to idle for 10 minutes or more.

(6) 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 the Drive Pattern.

PROBLEM SYMPTOMS TABLE

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

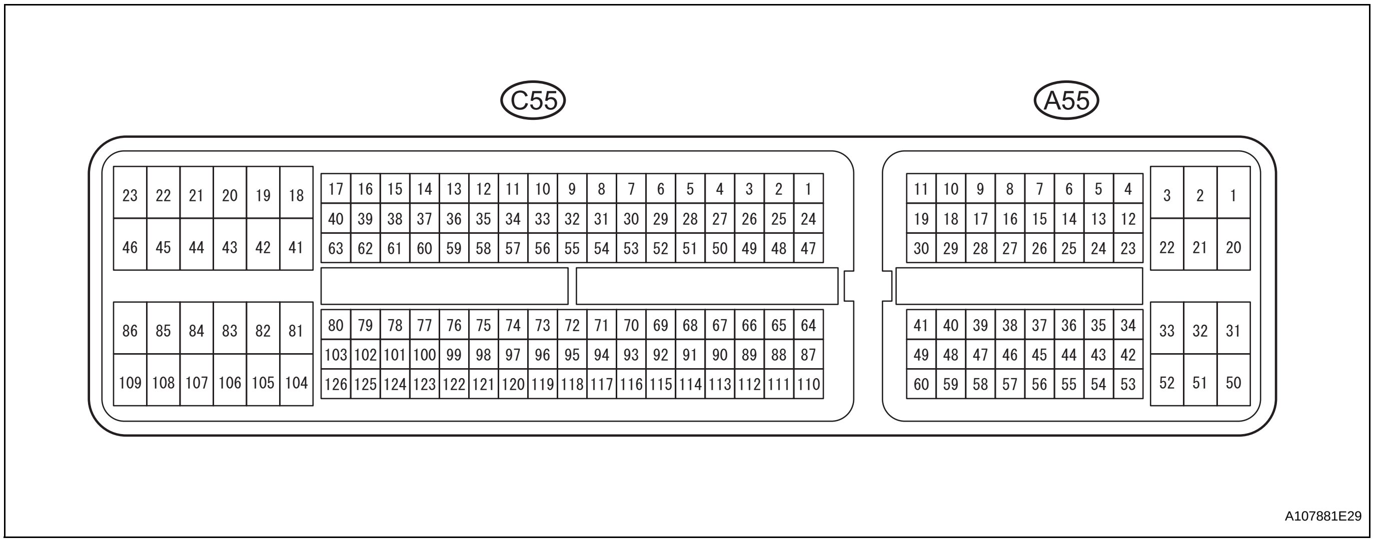
SFI SYSTEM

Symptom	Suspected area	See page
Without Smart Key System: Engine does not crank (Does not start)	1. Immobilizer system (with smart key system)	EI-7
	2. Immobilizer system (without smart key system)	EI-55
	3. Starter signal circuit	ES-304
	4. Starter	ST-143
	5. STARTER relay	ST-149
With Smart Key System: Engine does not crank (Does not start)	1. Immobilizer system (with smart key system)	EI-7
	2. Immobilizer system (without smart key system)	EI-55
	3. Cranking holding function circuit	ES-455
	4. Starter signal circuit	ES-304
	5. Starter	ST-143
	6. STARTER relay	ST-149
	7. ECM power source circuit	ES-432
	8. ECM	ES-518
No initial combustion (Does not start)	1. ECM power source circuit	ES-432
	2. Ignition system	IG-3
	3. Fuel pump control circuit	ES-449
	4. Injector	FU-15
	5. Crank angle sensor	ES-497
	6. ECM	ES-518
Engine cranks normally but difficult to start	1. Electronic Throttle Control System (ETCS)	ES-320
	2. Fuel pump control circuit	ES-449
	3. Ignition system	IG-3
	4. Spark plug	IG-5
	5. Compression	EM-3
	6. Injector	FU-15
	7. Crank angle sensor	ES-497
Difficult to start with cold engine	1. Starter signal circuit	ES-304
	2. Electronic Throttle Control System (ETCS)	ES-320
	3. Fuel pump control circuit	ES-449
	4. Spark plug	IG-5
	5. Ignition system	IG-3
	6. Injector	FU-15
	7. Engine coolant temperature sensor	ES-500
Difficult to start with warm engine	1. Starter signal circuit	ES-304
	2. Electronic Throttle Control System (ETCS)	ES-320
	3. Fuel pump control circuit	ES-449
	4. Spark plug	IG-5
	5. Ignition system	IG-3
	6. Injector	FU-15
	7. Engine coolant temperature sensor	ES-500

Symptom	Suspected area	See page
High engine idling speed (Poor idling)	1. Electronic Throttle Control System (ETCS)	ES-320
	2. ECM power source circuit	ES-432
	3. A/C signal circuit (Compressor circuit)	-
	4. Acoustic Control Induction System (ACIS)	ES-462
	5. PCV hose	EC-5
	6. ECM	ES-518
Low engine idling speed (Poor idling)	1. Electronic Throttle Control System (ETCS)	ES-320
	2. ECM power source circuit	ES-432
	3. A/C signal circuit (Compressor circuit)	-
	4. Acoustic Control Induction System (ACIS)	ES-462
	5. PCV hose	EC-5
	6. Injector	FU-15
	7. ECM	ES-518
Rough idling (Poor idling)	1. Electronic Throttle Control System (ETCS)	ES-320
	2. Injector	FU-15
	3. Ignition system	IG-3
	4. Compression	EM-3
	5. Fuel pump control circuit	ES-449
	6. Spark plug	IG-5
	7. Acoustic Control Induction System (ACIS)	ES-462
	8. PCV hose	EC-5
Hunting (Poor idling)	1. Electronic Throttle Control System (ETCS)	ES-320
	2. ECM power source circuit	ES-432
	3. Fuel pump control circuit	ES-449
	4. Spark plug	IG-5
	5. Ignition system	IG-3
	6. Injector	FU-15
	7. Acoustic Control Induction System (ACIS)	ES-462
	8. PCV hose	EC-5
Hesitation/Poor acceleration (Poor driveability)	1. Injector	FU-15
	2. Fuel pump control circuit	ES-449
	3. Ignition system	IG-3
	4. Spark plug	IG-5
	5. Air Intake Control System (AICS)	ES-462
	6. A/T faulty	AX-9
Surging (Poor driveability)	1. Fuel pump control circuit	ES-449
	2. Spark plug	IG-5
	3. Ignition system	IG-3
	4. Injector	FU-15
Engine stalls soon after starting	1. Fuel pump control circuit	ES-449
	2. Electronic Throttle Control System (ETCS)	ES-320
	3. Crank angle sensor	ES-497
	4. Spark plug	IG-5
	5. Ignition system	IG-3
	6. Injector	FU-15
Engine stalls during A/C operation	1. A/C signal circuit	-
	2. ECM	ES-518
Unable/difficult to refuel	Refueling valve (canister)	-
Engine vibrates frequently when idling (Active Control engine Mount (ACM) system does not operate)	Active control engine mount circuit	ES-393

TERMINALS OF ECM

1. SFI SYSTEM



HINT:
The standard normal voltage between each pair of the ECM terminals is shown in the table below. The appropriate conditions for checking each pair of the terminals are also indicated.
The check results should be compared with the standard normal voltage for that pair of terminals, listed 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
+B (A55-2) - E1 (C55-81)	R - W-B	Power source of ECM	Ignition switch on (IG)	9 to 14 V
+B2 (A55-1) - E1 (C55-81)	R - W-B	Power source of ECM	Ignition switch on (IG)	9 to 14 V
BATT (A55-20) - E1 (C55-81)	Y - W-B	Battery (for measuring the battery voltage and for the ECM memory)	Always	9 to 14 V
VPMP (A55-42) - E1 (C55-81)	W - W-B	Vent valve operation signal (built into pump module)	Ignition switch on (IG)	9 to 14 V
MPMP (A55-34) - E1 (C55-81)	G - W-B	Vacuum pump operation signal (built into pump module)	Vacuum pump OFF	0 to 3 V
MPMP (A55-34) - E1 (C55-81)	G - W-B	Vacuum pump operation signal (built into pump module)	Vacuum pump ON	9 to 14 V
+BM (A55-3) - E1 (C55-81)	LG - W-B	Power source of ETCS throttle motor	Always	9 to 14 V
MREL (A55-44) - E1 (C55-81)	O - W-B	EFI relay operation signal	Ignition switch on (IG)	9 to 14 V
IGSW (A55-28) - E1 (C55-81)	Y - W-B	Ignition switch signal	Ignition switch on (IG)	9 to 14 V
FC (A55-7) - E1 (C55-81)	FC (A55-7) - E1 (C55-81)	C/OPEN relay operation signal (fuel pump control)	Ignition switch on (IG), Engine stopped	9 to 14 V
FC (A55-7) - E1 (C55-81)	FC (A55-7) - E1 (C55-81)	C/OPEN relay operation signal (fuel pump control)	Ignition switch on (IG), Engine idling	0 to 1.5 V
STP (A55-36) - E1 (C55-81)	- W-B	Stop light switch signal	W-Brake pedal depressed	7.5 to 14 V
STP (A55-36) - E1 (C55-81)	- W-B	Stop light switch signal	W-Brake pedal released	Below 1.5 V
ST1- (A55-35) - E1 (C55-81)	GR - W-B	Stop light switch signal (opposite to STP terminal)	Ignition switch on (IG), W-Brake pedal depressed	Below 1.5 V

Symbols (Terminal No.)	Wiring Colors	Terminal Descriptions	Conditions	STD Voltages
ST1- (A55-35) - E1 (C55-81)	GR - W-B	Stop light switch signal (opposite to STP terminal)	Ignition switch on (IG), W-Brake pedal released	7.5 to 14 V
ACCR*2 (A24-17) - E1 (C55-81)	B - W-B	ACC relay control signal	Cranking	Below 1.5 V
VPA (A55-55) - E1 (C55-81)	G - W-B	Accelerator pedal position sensor signal (for engine control)	Ignition switch on (IG), Accelerator pedal fully released	0.5 to 1.1 V
VPA (A55-55) - E1 (C55-81)	G - W-B	Accelerator pedal position sensor signal (for engine control)	Ignition switch on (IG), Accelerator pedal fully depressed	2.6 to 4.5 V
VPA2 (A55-58) - EPA2 (A55-60)	R - O	Accelerator pedal position sensor signal (for sensor malfunction detection)	Ignition switch on (IG), Accelerator pedal fully released	1.2 to 2.0 V
VPA2 (A55-58) - EPA2 (A55-60)	R - O	Accelerator pedal position sensor signal (for sensor malfunction detection)	Ignition switch on (IG), Accelerator pedal fully depressed	3.4 to 5.0 V
EPA (A5-59) - VPA (A55-55)	Y - G	Accelerator pedal position sensor signal (for engine control)	Ignition switch on (IG), Accelerator pedal fully released	0.5 to 1.1 V
EPA (A5-59) - VPA (A55-55)	Y - G	Accelerator pedal position sensor signal (for engine control)	Ignition switch on (IG), Accelerator pedal fully depressed	2.6 to 4.5 V
EPA2 (A55-60) - VPA2 (A55-58)	O - R	Accelerator pedal position sensor signal (for sensor malfunction detection)	Ignition switch on (IG), Accelerator pedal fully released	1.2 to 2.0 V
EPA2 (A55-60) - VPA2 (A55-58)	O - R	Accelerator pedal position sensor signal (for sensor malfunction detection)	Ignition switch on (IG), Accelerator pedal fully depressed	3.4 to 5.0 V
PPMP (C55-77) - E1 (C55-81)	L - W-B	Pressure sensor signal (built into pump module)	Ignition switch on (IG)	3 to 3.6 V
TC (A55-27) - E1 (C55-81)	P - W-B	Terminal TC of DLC3	Ignition switch on (IG)	9 to 14 V
VCPA (A55-57) - EPA (A55-59)	R - Y	Power source of accelerator pedal position sensor (for VPA)	Ignition switch on (IG)	4.5 to 5.0 V
VCP2 (A55-56) - EPA2 (A55-60)	L - O	Power source of accelerator pedal position sensor (for VPA2)	Ignition switch on (IG)	4.5 to 5.0 V
TACH (A55-15) - E1 (C55-81)	B - W-B	Engine speed signal (for combination meter)	Idling	Pulse generation (see waveform 11)
CCS (A55-40) - E1 (C55-81)	W - W-B	Cruise control main switch signal	Ignition switch on (IG) CANCEL switch ON SET/COAST switch ON RES/ACC switch ON Main switch ON	10 to 16 V 6.6 to 10.1 V 4.5 to 7.1 V 2.3 to 4.0 V Below 1 V
SPD (A55-24) - E1 (C55-81)	BR - W-B	Vehicle speed signal from combination meter	Ignition switch on (IG), driving wheel rotated slowly	Pulse generation (see waveform 8)
W (A55-24) - E1 (C55-81)	BR - W-B	Malfunction Indicator Lamp (MIL) operation signal	Ignition switch on (IG)	Below 3.0 V
W (A55-24) - E1 (C55-81)	BR - W-B	Malfunction Indicator Lamp (MIL) operation signal	Idling	9 to 14 V
CANH (A55-41) - CANL (A55-49)	B - W	CAN communication circuit	Ignition switch off	54 to 69 Ω
E1 (C55-81) - Body ground	W-B - -	Earth (ground) circuit of ECM	Always	Below 1 V

ES

Symbols (Terminal No.)	Wiring Colors	Terminal Descriptions	Conditions	STD Voltages
#10 (C55-45) - E01 (C55-22) #20 (C55-85) - E01 (C55-22) #30 (C55-44) - E01 (C55-22) #40 (C55-84) - E01 (C55-22) #50 (C55-43) - E01 (C55-22) #60 (C55-83) - E01 (C55-20)	B - W-B R - W-B Y - W-B L - W-B W-L - W-B BR - W-B	Fuel injector operation signal	Ignition switch on (IG)	9 to 14 V
#10 (C55-45) - E01 (C55-22) #20 (C55-85) - E01 (C55-22) #30 (C55-44) - E01 (C55-22) #40 (C55-84) - E01 (C55-22) #50 (C55-43) - E01 (C55-22) #60 (C55-83) - E01 (C55-20)	B - W-B R - W-B Y - W-B L - W-B W-L - W-B BR - W-B	Fuel injector operation signal	Idling	Pulse generation (see waveform 3)
PSW (C55-810) - E1 (C55-81)	B - W-B	P/S pressure switch signal	Ignition switch on (IG)	9 to 14 V
STA (A55-48) - E1 (C55-81)	V - W-B	Starter relay operation signal	Cranking	9 to 14 V
STSW*2 (A55-14) - E1 (C55-81)	R - W-B	Starter relay operation signal	Cranking	9 to 14 V
OC2- (C55-51) - OC2+ (C55-52)	R - BR	Camshaft timing Oil Control Valve (OCV) operation signal (Intake side)	Ignition switch on (IG)	Pulse generation (see waveform 1)
OC2+ (C55-52) - OC2- (C55-51)	BR - R	Camshaft timing Oil Control Valve (OCV) operation signal (Intake side)	Ignition switch on (IG)	Pulse generation (see waveform 1)
OC1- (C55-57) - OC1+ (C55-58)	B - W	Camshaft timing Oil Control Valve (OCV) operation signal (Intake side)	Ignition switch on (IG)	Pulse generation (see waveform 1)
OC1+ (C55-58) - OC1- (C55-57)	W - B	Camshaft timing Oil Control Valve (OCV) operation signal (Intake side)	Ignition switch on (IG)	Pulse generation (see waveform 1)
VV2+ (C55-67) - VV2- (C55-90)	W - B	Variable Valve Timing (VVT) sensor signal (Intake side)	Idling	Pulse generation (see waveform 5)
VV1+ (C55-69) - VV1- (C55-92)	L - LG	Variable Valve Timing (VVT) sensor signal (Intake side)	Idling	Pulse generation (see waveform 5)
NE- (C55-111) - NE+ (C55-110)	R - G	Crankshaft position sensor signal	Idling	Pulse generation (see waveform 5)
NE+ (C55-110) - NE- (C55-111)	G - R	Crankshaft position sensor signal	Idling	Pulse generation (see waveform 5)
EV2- (C55-89) - EV2+ (C55-66)	L - G-R	Variable Valve Timing (VVT) sensor signal (Exhaust side)	Idling	Pulse generation (see waveform 5)
EV2+ (C55-66) - EV2- (C55-89)	G-R - L	Variable Valve Timing (VVT) sensor signal (Exhaust side)	Idling	Pulse generation (see waveform 5)
EV1- (C55-91) - EV1+ (C55-68)	B - Y	Variable Valve Timing (VVT) sensor signal (Exhaust side)	Idling	Pulse generation (see waveform 5)
EV1+ (C55-68) - EV1- (C55-91)	Y - B	Variable Valve Timing (VVT) sensor signal (Exhaust side)	Idling	Pulse generation (see waveform 5)
OE1+ (C55-16) - OE1- (C55-17)	L - LG	Camshaft timing Oil Control Valve (OCV) operation signal (Exhaust side)	Ignition switch on (IG)	Pulse generation (see waveform 1)

Symbols (Terminal No.)	Wiring Colors	Terminal Descriptions	Conditions	STD Voltages
OE2+ (C55-14) - OE2- (C55-15)	W-L - Y	Camshaft timing Oil Control Valve (OCV) operation signal (Exhaust side)	Ignition switch on (IG)	Pulse generation (see waveform 1)
VV2- (C55-90) - VV2+ (C55-67)	B - W	Variable Valve Timing (VVT) sensor signal (Intake side)	Idling	Pulse generation (see waveform 5)
VV1- (C55-92) - VV1+ (C55-69)	LG - L	Variable Valve Timing (VVT) sensor signal (Intake side)	Idling	Pulse generation (see waveform 5)
OE1- (B47-31) - OE1+ (B47-26)	LG - L	Camshaft timing Oil Control Valve (OCV) operation signal (Exhaust side)	Ignition switch on (IG)	Pulse generation (see waveform 1)
OE2- (C55-15) - OE2+ (C55-14)	Y - W-L	Camshaft timing Oil Control Valve (OCV) operation signal (Exhaust side)	Ignition switch on (IG)	Pulse generation (see waveform 1)
HT1B (C55-48) - E1 (C55-81) HT2B (C55-47) - E1 (C55-81)	LG - W-B Y - W-B	Heated oxygen sensor heater operation signal	Idling	Below 3.0 V
HT1B (C55-48) - E1 (C55-81) HT2B (C55-47) - E1 (C55-81)	LG - W-B Y - W-B	Heated oxygen sensor heater operation signal	Ignition switch on (IG)	9 to 14 V
ACM (C55-42) - E1 (C55-81)	L-B - W-B	VSV for active control mount system operation signal	Ignition switch on (IG)	9 to 14 V
M- (C55-18) - ME01 (C55-20)	R - B	Throttle drive motor operation signal (negative terminal)	Idling with warm engine	Pulse generation (see waveform 10)
M+ (C55-19) - ME01 (C55-20)	G - B	Throttle drive motor operation signal (positive terminal)	Idling with warm engine	Pluse generation (see waveform 9)
E02 (C55-21) - Body ground	B-W - -	Earth (ground) circuit of ECM	Always	Below 1 V
E01 (C55-22) - Body ground	W-B - -	Earth (ground) circuit of ECM	Always	Below 1 V
IGT1 (C55-40) - E1 (C55-81) IGT2 (C55-39) - E1 (C55-81) IGT3 (C55-38) - E1 (C55-81) IGT4 (C55-37) - E1 (C55-81) IGT5 (C55-36) - E1 (C55-81) IGT6 (C55-35) - E1 (C55-81)	W - W-B GR - W-B G - W-B LG - W-B P - W-B G-R - W-B	Ignition coil with igniter (ignition signal)	Idling	Pulse generation (see waveform 6)
GE01(C55-41) - E1 (C55-81)	G-R - W-B	Shielded earth (ground) circuit of throttle drive motor	Always	Below 1 V
OX1B (C55-88) - EX1B (C55-65) OX2B (C55-87) - EX2B (C55-64)	W - BR B - W-B	Heated oxygen sensor signal	With engine speed at 2,500 rpm for 2 minutes after warming up	Pulse generation (see waveform 2)
VTA2 (C55-99) - ETA (C55-97)	W-L - P	Throttle position sensor signal (for sensor malfunction detection)	Ignition switch on (IG), Accelerator pedal fully released	2.1 to 3.1 V
VTA2 (C55-99) - ETA (C55-97)	W-L - P	Throttle position sensor signal (for sensor malfunction detection)	Ignition switch on (IG), Accelerator pedal fully depressed	4.5 to 5.0 V
VTA1 (C55-98) - ETA (C55-97)	Y - P	Throttle position sensor signal (for engine control)	Ignition switch on (IG), Throttle valve fully closed	0.5 to 1.2 V
VTA1 (C55-98) - ETA (C55-97)	Y - P	Throttle position sensor signal (for engine control)	Ignition switch on (IG), Throttle valve fully open	3.2 to 4.8 V
THW (C55-79) - ETHW (C55-78)	B - P	Engine coolant temperature sensor signal	Idling, Engine coolant temperature 80°C (176°F)	0.2 to 1.0 V
THA (C55-71) - ETHA (C55-74)	P - G-R	Intake air temperature sensor signal	Idling, Intake air temperature 20°C (68°F)	0.5 to 3.4 V

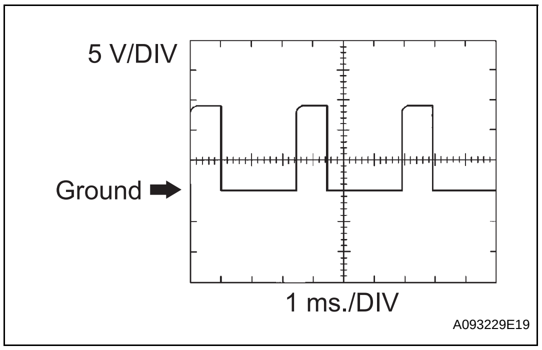
ES

Symbols (Terminal No.)	Wiring Colors	Terminal Descriptions	Conditions	STD Voltages
IGF1 (C55-106) - E1 (C55-81)	BR - W-B	Ignition coil with igniter (ignition confirmation signal)	Ignition switch on (IG)	4.5 to 5.0 V
IGF1 (C55-106) - E1 (C55-81)	BR - W-B	Ignition coil with igniter (ignition confirmation signal)	Idling	Pulse generation (see waveform 6)
AICV (A55-4) - E1 (C55-81)	V - W-B	VSV for Air intake control system operation signal	Ignition switch on (IG)	9 to 14 V
E2G (C55-73) - E1 (C55-81)	LG - W-B	Earth (ground) circuit of sensor for mass air flow meter	Always	Below 1 V
VG (C55-72) - E2G (C55-73)	L-B - LG	Mass Air Flow (MAF) meter signal	Idling, Shift lever position P or N, A/C switch OFF	0.5 to 3.0 V
ACIS (C55-107) - E1 (C55-81)	R - W-B	VSV for ACIS (Acoustic Control Induction System) operation signal	Ignition switch on (IG)	9 to 14 V
PRG (C55-108) - E1 (C55-81)	G-R - W-B	Purge VSV for EVAP system operation signal	Ignition switch on (IG)	9 to 14 V
PRG (C55-108) - E1 (C55-81)	G-R - W-B	Purge VSV for EVAP system operation signal	Idling	Pulse generation (see waveform 7)
HA2A (C55-109) - E05 (C55-46)	B-W - W	A/F sensor heater operation signal	Idling	Below 3.0 V
HA2A (C55-109) - E05 (C55-46)	B-W - W	A/F sensor heater operation signal	Ignition switch on (IG)	9 to 14 V
HA1A (C55-86) - E04 (C55-23)	G - W	A/F sensor heater operation signal	Idling	Below 3.0 V
HA1A (C55-86) - E04 (C55-23)	G - W	A/F sensor heater operation signal	Ignition switch on (IG)	9 to 14 V
ME01 (C55-20) - E1 (C55-81)	B - W-R	Earth (ground) circuit of ECM	Always	Below 1 V
E03 (C55-104) - E1 (C55-81)	B - W-B	Earth (ground) circuit of ECM	Always	Below 1 V
HT2B (C55-47) - E1 (C55-81) HT1B (C55-48) - E1 (C55-81)	Y - W-B LG - W-B	Heated oxygen sensor heater operation signal	Idling	Below 3.0 V
HT2B (C55-47) - E1 (C55-81) HT1B (C55-48) - E1 (C55-81)	Y - W-B LG - W-B	Heated oxygen sensor heater operation signal	Ignition switch on (IG)	9 to 14 V
E05 (C55-46) - E1 (C55-81)	W - W-B	Earth (ground) circuit of ECM	Always	Below 1 V
E04 (C55-23) - E1 (C55-81)	W - W-B	Earth (ground) circuit of ECM	Always	Below 1 V
NSW (C55-62) - E1 (C55-81)	R - W-B	Park/Neutral position switch signal	Ignition switch on (IG), Shift lever position P or N	Below 3.0 V
NSW (C55-62) - E1 (C55-81)	R - W-B	Park/Neutral position switch signal	Ignition switch on (IG), Shift lever position other than P or N	9 to 14 V
EKN2 (C55-117) - KNK2 (C55-118)	W - B	Earth (ground) circuit of knock sensor	With engine speed at 4,000 rpm after warming up	Pulse generation (see waveform 4)
KNK2 (C55-118) - EKN2 (C55-117)	B - W	Knock sensor signal	With engine speed at 4,000 rpm after warming up	Pulse generation (see waveform 4)
A1A+ (C55-93) - E1 (C55-81)	P - W-B	A/F sensor signal	Ignition switch on (IG)	3.3 V*1
A1A+ (C55-93) - E1 (C55-81)	P - W-B	A/F sensor signal	Ignition switch on (IG)	3.0 V*1
A2A+ (C55-120) - E1 (C55-81)	L - W-B	A/F sensor signal	Ignition switch on (IG)	3.3 V*1
A2A+ (C55-120) - E1 (C55-81)	L - W-B	A/F sensor signal	Ignition switch on (IG)	3.0 V*1
EKNK (C55-94) - KNK1 (C55-95)	G - R	Earth (ground) circuit of knock sensor	With engine speed at 4,000 rpm after warming up	Pulse generation (see waveform 4)
KNK1 (C55-95) - EKNK (C55-94)	R - G	Knock sensor signal	With engine speed at 4,000 rpm after warming up	Pulse generation (see waveform 4)
A1A- (C55-116) - E1 (C55-81)	P - W-B	A/F sensor	Ignition switch on (IG)	3.3 V*1

Symbols (Terminal No.)	Wiring Colors	Terminal Descriptions	Conditions	STD Voltages
A1A- (B46-30) - E1 (C55-81)	P - W-B	A/F sensor	Ignition switch on (IG)	3.0 V*1
A2A- (C55-119) - E1 (C55-81)	Y - W-B	A/F sensor	Ignition switch on (IG)	3.3 V*1
A2A- (C55-119) - E1 (C55-81)	Y - W-B	A/F sensor	Ignition switch on (IG)	3.0 V*1
OX2B (C55-87) - EX2B (C55-64) OX1B (C55-88) - EX1B (C55-65)	B - W-R W - BR	Heated oxygen sensor signal	With engine speed at 2,500 rpm for 2 minutes after warming up	Pulse generation (see waveform 2)

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

*2: With Smart Key system

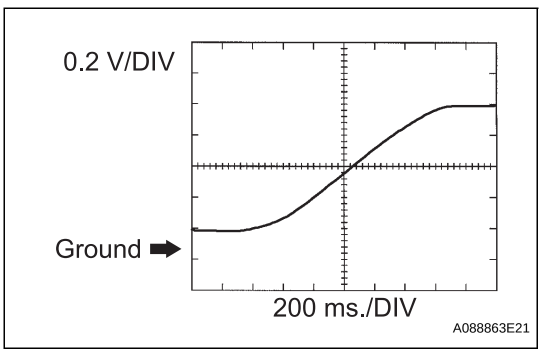


(a) WAVEFORM 1

(1) Camshaft timing Oil Control Valve (OCV) operation signal

ECM Terminal Names	Between OC1+ and OC1- , OC2+ and OC2- , OE1+ and OE1- , or OE2+ and OE2-
Tester Ranges	5 V/DIV, 1 ms./DIV
Conditions	Idling

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

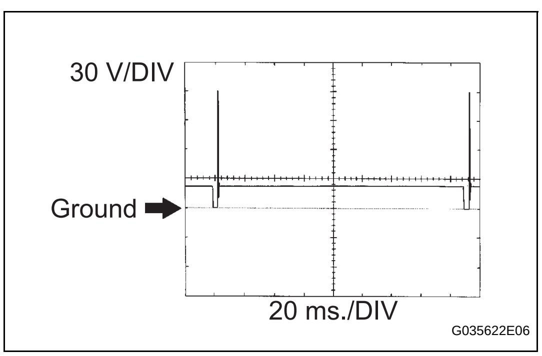


(b) WAVEFORM 2

(1) Heated oxygen sensor signal

ECM Terminal Names	Between OX1B and EX1B, or OX2B and EX2B
Tester Ranges	0.2 V/DIV, 200 ms./DIV
Conditions	Engine speed is maintained at 2,500 rpm for 2 minutes after sensor is warmed up

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

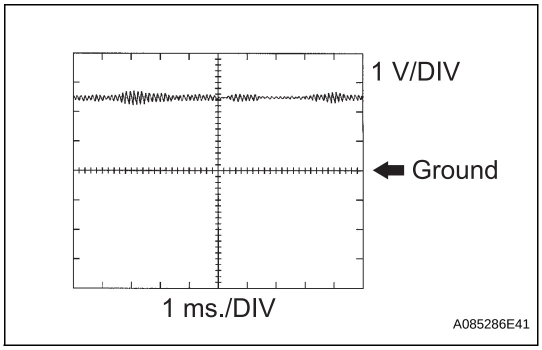


(c) WAVEFORM 3

(1) Fuel injector operation signal

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

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



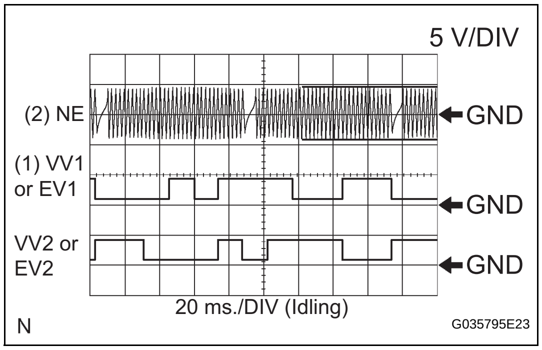
(d) WAVEFORM 4

(1) Knock sensor signal

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

HINT:

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



(e) WAVEFORM 5

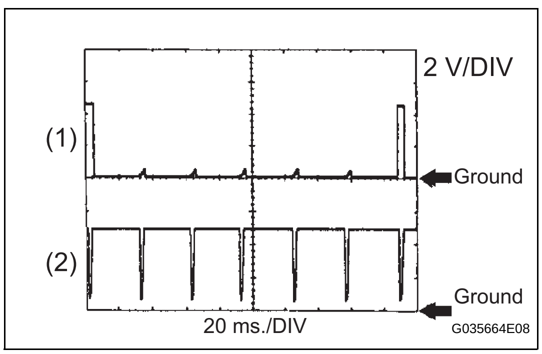
(1) Variable Valve Timing (VVT) sensor signal (1)

(2) Crankshaft position sensor signal (2)

ECM Terminal Names	(1) Between VV1+ and VV1- , VV2+ and VV2-, EV1+ and EV1-, or EV2+ and EV2- (2) Between NE+ and NE-
Tester Ranges	5 V/DIV, 20 ms./DIV
Conditions	Idling

HINT:

The wavelength becomes shorter as the engine rpm increases.



(f) WAVEFORM 6

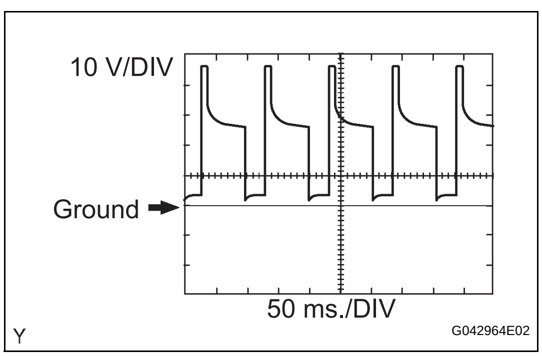
(1) Igniter IGT signal (from ECM to igniter) (1)

(2) Igniter IGF signal (from igniter to ECM) (2)

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

HINT:

The wavelength becomes shorter as the engine rpm increases.



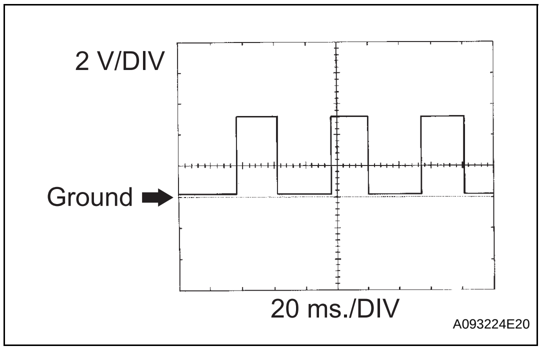
(g) WAVEFORM 7

(1) Purge VSV for EVAP system operation signal

ECM Terminal Names	Between PRG and E1
Tester Ranges	10 V/DIV, 50 ms./DIV
Conditions	Idling

HINT:

If the waveform is not similar to that shown in the illustration, check the waveform again after idling for 10 minutes or more.

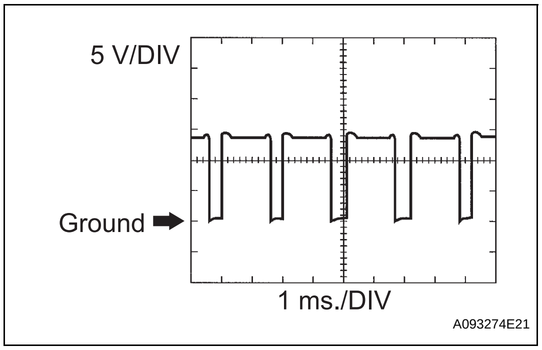


(h) WAVEFORM 8

(1) Vehicle speed signal

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

HINT:
- The wavelength becomes shorter as the vehicle speed increases.
- Depending on the vehicle, the output waveform voltage may rise to 12 V if influenced by optionally installed systems.

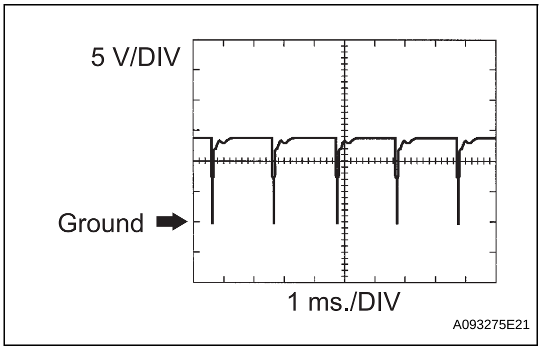


(i) WAVEFORM 9

(1) Throttle drive motor operation signal (positive terminal)

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

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

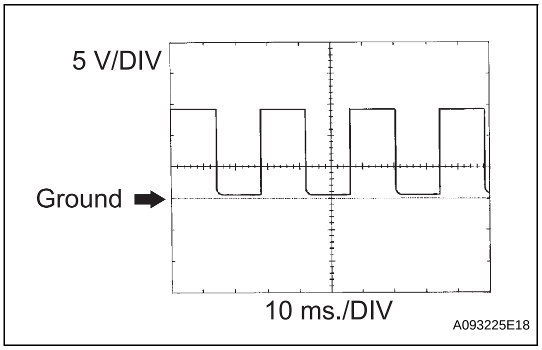


(j) WAVEFORM 10

(1) Throttle drive motor operation signal (negative terminal)

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

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



(k) WAVEFORM 11

(1) Engine speed signal

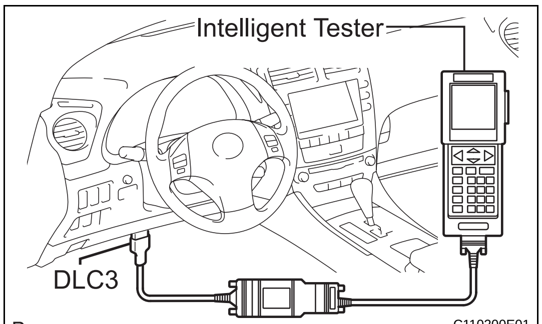
ECM Terminal Names	Between TACH and E1
Tester Ranges	5 V/DIV, 10 ms./DIV
Conditions	Idling

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

ES

DIAGNOSIS SYSTEM

FI00534



C110200E01

1. DESCRIPTION

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

OBD II regulations require that the vehicle's on-board computer 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 for DTCs, connect the intelligent tester to the DLC3. The tester displays DTCs, freeze frame data, and a variety of the engine data. The DTCs and freeze frame data can be erased with the tester. 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 simplification of the wire harness connection. Since this system is equipped with the CAN communication, connecting the CAN VIM (VIM: Vehicle Interface Module) with the intelligent tester is necessary to display any information from the ECM. (Also the communication between the intelligent tester and the ECM uses CAN communication 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

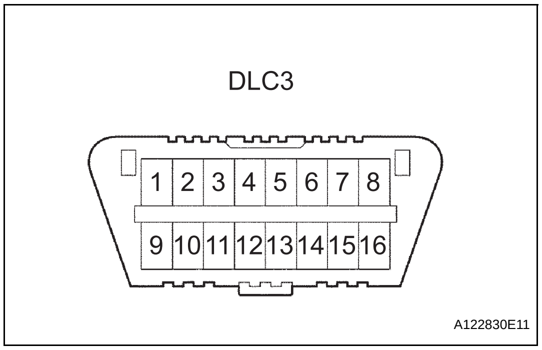
The diagnosis system operates in normal mode during normal vehicle use. In normal mode, 2 trip detection logic is used to ensure accurate detection of malfunctions. Check mode is also available as an option for technicians. In check mode, 1 trip detection logic is used for simulating malfunction symptoms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

3. 2 TRIP DETECTION LOGIC

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

4. FREEZE FRAME DATA

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



5. DLC3 (Data link Connector 3)

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

Symbols	Terminal No.	Names	Reference terminal	Results	Condition
SIL	7	Bus "+" line	5 - Signal ground	Pulse generation	During transmission
CG	4	Chassis ground	Body ground	1 Ω or less	Always
SG	5	Signal ground	Body ground	1 Ω or less	Always
BAT	16	Battery ground	Body ground	9 to 14 V	Always
CANH	6	CAN "High" line	CANL	54 to 69 Ω	Engine switch off
CANH	6	CAN "High" line	Battery positive	1 MΩ or higher	Engine switch off
CANH	6	CAN "High" line	CG	1 kΩ or higher	Engine switch off
CANL	14	CAN "Low" line	Battery positive	1 MΩ or higher	Engine switch off
CANL	14	CAN "Low" line	CG	1 kΩ or higher	Engine 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 (IG) and turn the tester on. If a communication failure message is displayed on the tester screen (on the tester: UNABLE TO CONNECT TO VEHICLE), a problem exists in either the vehicle or tester. In order to identify the location of the problem, connect the tester to another vehicle.

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

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

6. BATTERY VOLTAGE

Standard Voltage:

11 to 14 V

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

7. MIL (Malfunction Indicator Lamp)

(a) The MIL is illuminated when the engine 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 engine switch is first turned on, check the MIL circuit (See page ES-471).

DTC CHECK / CLEAR

NOTICE:

When the diagnosis system is changed from the 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 the 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 (IG).
(c) Turn the tester on.
(d) Enter 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-63).

2. CLEAR DTC (Using an intelligent tester)

(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the tester on.
(d) Enter 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 MAIN and ETCS fuses from the Engine Room relay block located inside the engine compartment for more than 1 minute.

FREEZE FRAME DATA

1. DESCRIPTION

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

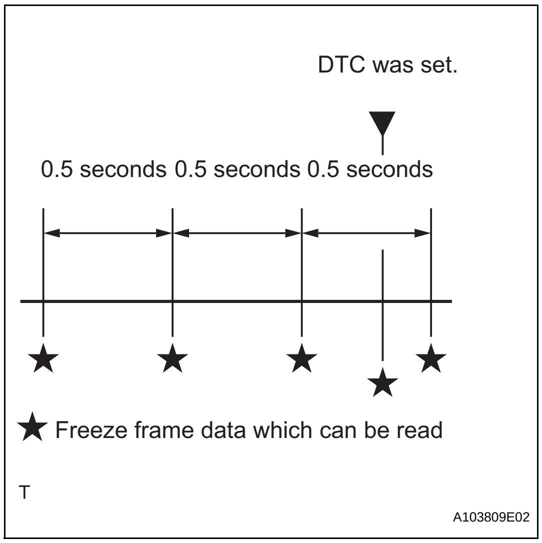
HINT:

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

The ECM records engine conditions as 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 set 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
IGN ADVANCE	Ignition advance	-
CALC LOAD	Calculate load	Calculated load by ECM
VEHICLE LOAD	Vehicle load	-
MAF	Mass air flow volume	If value is approximately 0.0 g/s: • Mass air flow meter power source circuit open or shorted • VG circuit open or shorted If value is 160.0 g/s or more: • E2G circuit open
ENGINE SPD	Engine speed	-
VEHICLE SPD	Vehicle speed	Speed indicated on speedometer
COOLANT TEMP	Engine coolant temperature	If value is -40°C (-40°F), sensor circuit open If value is 140°C (284°F), sensor circuit shorted
INTAKE AIR	Intake air temperature	If value is -40°C (-40°F), sensor circuit open If value is 140°C (284°F), sensor circuit shorted
FUEL PRESS	Fuel pressure	-
AIR-FUEL PATIO	Air-fuel ratio	-
AMBIENT TEMP	Ambient temperature	-
PURGE DENSITY	Learning value of purge density	-
PURGE FLOW	Purge flow	-
EVAP PURGE VSV	EVAP purge VSV duty ratio	-
KNOCK CRRT VAL	Correction learning value of knocking	-

LABEL (Intelligent Tester Display)	Measurement Item/Range	Diagnostic Note
KNOCK FB VAL	Feedback value of knocking	-
ACCEL POS #1	Absolute Accelerator Pedal Position (APP) No. 1	-
ACCEL POS #2	Absolute APP No. 2	-
THROTTLE POS	Throttle position	Read value with ignition switch on (IG) (Do not start engine)
THROTTLE POS	Throttle sensor positioning	Read value with ignition switch on (IG) (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 output voltage of sensor
O2S B2 S2	Heated oxygen sensor output	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check output voltage of sensor
AFS B1 S1	A/F sensor output	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check output voltage of sensor
AFS B2 S1	A/F sensor output	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check output voltage of sensor
TOTAL FT #1	Total fuel trim	-
TOTAL FT #2	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 for a continual deviation of short-term fuel trim from central valve
SHORT FT #2	Short-term fuel trim	Short-term fuel compensation used to maintain air-fuel ratio at stoichiometric air-fuel ratio
LONG FT #2	Long-term fuel trim	Overall fuel compensation carried out in long-term to compensate for a continual deviation of short-term fuel trim from central valve
FUEL SYS #1	Fuel system status (Bank 1)	• 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
FUEL SYS #2	Fuel system status (Bank 2)	• 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

LABEL (Intelligent Tester Display)	Measurement Item/Range	Diagnostic Note
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	-
ING TIMMING D4	Injection timing (D4)	-
FUEL PUMP D4	Fuel pump duty (D4)	-
COMBUSTION D4	Combustion status (D4)	-
ACC RELAY	ACC relay	-
STARTER RELAY	Starter relay	-
STARTER SIG	Starter signal	-
STARTER CONTROL	Starter control	-
CTP SW	Closed throttle position switch	-
A/C SIGNAL	A/C signal	-
PNP SW (NSW)	Neutral position switch signal	-
ELECT LOAD SIG	Electrical load signal	-
STOP LIGHT SW	Stop light switch	-
ENG OIL PRES SW	Engine oil pressure switch signal	Always ON while engine is running
BATTERY VOLTAGE	Battery voltage	-
ATM PRESSURE	Atmospheric pressure	-
FUEL PMP SP CTL	Fuel pump speed control status	-
VVT CTRL B2	VVT control status (bank 2)	-
EVAP (Purge) VSV	EVAP Purge VSV	-
A/C MAG CLUTCH	A/C magnetic clutch relay	-
FUEL PUMP/SPD	Fuel pump/speed status	-
VVT CTRL B1	VVT control status (bank 1)	-
TC/TE1	TC and TE1 terminals of DLC3	-
SCV DUTY RATIO	SCV duty ratio	-
VVTL AIM ANGL#1	VVT aim angle (bank 1)	-
VVT CHNG ANGL#1	VVT change angle (bank 1)	-
VVT OCV D B1	VVT OCV operation duty (bank 1)	-
VVT EX HOLD B1	VVT exhaust hold duty ratio learning value (bank 1)	-
VVT EX CHG ANG1	VVT exhaust change angle (bank 1)	-
VVT EX OCV D B1	VVT exhaust OCV duty (bank 1)	-
VVTL AIM ANGL#2	VVT aim angle (bank 2)	-
VVT CHNG ANGL#2	VVT change angle (bank 2)	-
VVT OCV DUTY B2	VVT OCV operation duty (bank 2)	-
VVT EX HOLD B2	VVT exhaust hold duty ratio learning value (bank 2)	-
VVT EX CHG ANG2	VVT exhaust change angle (bank 2)	-
VVT EX OCV D B2	VVT exhaust OCV duty (bank 2)	-
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 incomplete engine combustion

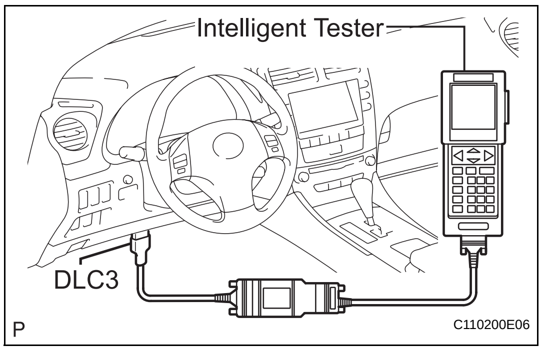
LABEL (Intelligent Tester Display)	Measurement Item/Range	Diagnostic Note
IGNITION	Ignition	-
CYL ALL	All cylinder misfire rate	Displayed only during idling
MISFIRE RPM	Misfire RPM	-
CYL ALL	All cylinder misfire rate	Displayed only during idling
MISFIRE RPM	Misfire RPM	-
MISFIRE LOAD	Misfired load	-
MISFIRE MARGIN	Misfire monitoring	-
ENG RUN TIME	Accumulated engine running time	-
TIME DTC CLEAR	Cumulative time after DTC cleared	-
DIST DTC CLEAR	Accumulated distance after DTC cleared	-
WU CYC DTC CLEAR	Warm-up cycle after DTC cleared	-

CHECK MODE PROCEDURE

HINT:
Intelligent tester only:
Compared to the normal mode, check mode is more sensitive to malfunctions. Therefore, check mode can detect the malfunctions that cannot be detected in 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 engine switch is turned from on (IG) to ACC or off while in check mode. Before changing modes, always check and note any DTCs and freeze frame data.

ES



1. CHECK MODE PROCEDURE (Using an intelligent tester)

(a) Check and ensure the following conditions:
  (1) Battery positive voltage 11 V or more.
  (2) Throttle valve fully closed.
  (3) Transmission in the P or N position.
  (4) A/C switch OFF.

(b) Turn the engine switch off.

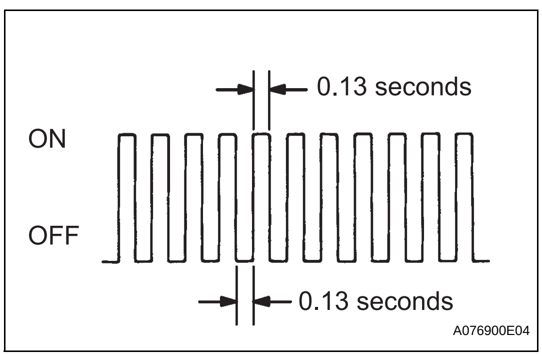
(c) Connect the intelligent tester to the DLC3.

(d) Turn the ignition switch on (IG).

(e) Turn the tester on.

(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / CHECK MODE.

(g) Switch the ECM from normal mode to check mode.



(h) Make sure that the MIL flashes as shown in the illustration.

(i) Start the engine.

(j) Make sure that the MIL turns OFF.

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

(l) Check for DTCs and freeze frame data using the tester.

FAIL-SAFE CHART

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

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 6.5° 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, 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 the 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 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 in troubleshooting is one method of shortening diagnostic time.

NOTICE:

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

(a) Warm up the engine.
(b) Turn the ignition switch off.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch on (IG).
(e) Turn the tester on.
(f) Enter the following menus: 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*1	Diagnostic Note
INJECTOR	Injection period of No. 1 cylinder: Min.: 0 ms, Max.: 32.64 ms	1.2 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 deg: Idling	-
CALC LOAD	Load calculated by ECM: Min.: 0%, Max.: 100%	• 10 to 20%: Idling • 10 to 20%: Running without load at 2,500 rpm	Load value
VEHICLE LOAD	Vehicle load: Min.: 0%, Max.: 25,700%	Actual vehicle load	Load percentage in terms of maximum intake air flow amount
MAF	Air flow rate from MAF meter: Min.: 0 g/sec., Max.: 655.35 g/sec.	2 to 5 g/sec.: Idling 8 to 19 g/sec.: Running without load at 2,500 rpm	If value is approximately 0.0 g/sec.: • Mass air flow meter power source circuit open • VG circuit open or shorted If value is 160.0 g/sec. or more: • E2G circuit open
ENGINE SPD	Engine speed: Min.: 0 rpm, Max.: 16,383.75 rpm	600 to 700 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 is -40°C (-40°F): sensor circuit open • If value is 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 is -40°C (-40°F): sensor circuit open • If value is 140°C (284°F) or more: sensor circuit shorted
AIR-FUEL RATIO	Ratio compared to stoichiometric level: Min.: 0, Max.: 1.999	0.8 to 1.2: Idling	-
PURGE DENSITY	Learning value of purge density: Min.: -50, Max.: 350	-40 to 0: Idling	Service data

Intelligent Tester Display	Measurement Item: Range (Display)	Normal Condition*1	Diagnostic Note
EVAP PURGE FLOW	Ratio of evaporative purge flow to intake air volume: Min.: 0%, Max.: 102.4%	0 to 8%: Idling	-
EVAP PURGE VSV	EVAP (PURGE) VSV control duty: Min.: 0%, Max.: 100%	0 to 100%: Idling	Command signal from ECM
VAPOR PRES PUMP	Vapor pressure: Min.: 33.853 kPa, Max.: 125.596 kPa	0 kPa: Fuel tank cap removed	EVAP system pressure monitored by canister pressure sensor
VAPOR PRES CALC	Vapor pressure (calculated): Min.: -5.632 kPa, Max.: 715.264 kPa	0 kPa: Fuel tank cap removed	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 at 70 km/h (44 mph)	Service data
KNOCK FB VAL	Feedback value of knocking: Min: -64°CA, Max.: 1,984°CA	-22 to 0°CA: Driving at 70 km/h (44 mph)	Service data
CLUTCH	Clutch current: Min.: 0 A, Max.: 2.49 A	-	-
EVAP VAPOR PRES	EVAP vapor pressure: Min.: 0 kPa, Max.: 327.675 kPa	0 kPa: Fuel tank cap removed	EVAP system pressure monitored by canister pressure sensor
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	Read value with ignition switch ON (Do not start engine)
ACCEL POS #2	Absolute APP No. 2: Min.: 0%, Max.: 100%	12 to 42%: Accelerator pedal released 66 to 98%: Accelerator pedal fully depressed	Read value with ignition switch ON (Do not start engine)
ACCEL POS #1	APP sensor No. 1 voltage: Min.: 0 V, Max.: 4.98 V	-	ETCS freeze frame data
ACCEL POS #2	APP sensor No. 2 voltage: Min.: 0 V, Max.: 4.98 V	-	ETCS freeze frame 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 4.5 V: Accelerator pedal fully depressed	Read value with ignition switch ON (Do not start engine)
ACCEL POS #2	APP sensor No. 2 voltage: Min.: 0 V, Max.: 5 V	1.2 to 2.0 V: Accelerator pedal released 3.4 to 5.0 V: Accelerator pedal fully depressed	Read value with ignition switch ON (Do not start engine)
ACCEL IDL POS	Whether or not accelerator pedal position sensor detecting idle: ON or OFF	ON: Idling	-
THRTL LEARN VAL	Throttle valve fully closed (learned value): Min.: 0 V, Max.: 5 V	0.4 to 0.8 V	-
ACCEL SSR #1 AD	Accelerator fully closed value No. 1 (AD): Min.: 0 V, Max.: 4.98 V	-	ETCS service data
ACCEL LRN VAL#1	Accelerator fully closed learning value No. 1: Min.: 0 deg, Max.: 124.512 deg	-	ETCS service data
ACCEL LRN VAL#2	Accelerator fully closed learning value No. 2: Min.: 0 deg, Max.: 124.512 deg	-	ETCS service data
FAIL #1	Whether or not fail safe function executed: ON or OFF	ON: ETCS has failed	-

Intelligent Tester Display	Measurement Item: Range (Display)	Normal Condition*1	Diagnostic Note
FAIL #2	Whether or not fail safe function executed: ON or OFF	ON: ETCS has failed	-
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	• Calculated value based on VTA1 • Read value with ignition switch ON (Do not start engine)
THROTTL IDL POS	Whether or not throttle position sensor detecting idle: ON or OFF	ON: Idling	-
THRTL REQ POS	Throttle requirement position: Min.: 0 V, Max.: 5 V	0.5 to 1.0 V: Idling	-
THROTTLE POS	Throttle position: Min.: 0%, Max.: 100%	0 to 18%: Idling	Calculated value based on VTA1
THROTTLE POS #2	Absolute throttle position sensor No. 2: Min.: 0%, Max.: 100%	-	Calculated value based on VTA2
THROTTLE POS #1	Throttle position sensor No. 1 output voltage: Min.: 0 V, Max.: 4.98 V	-	ETCS freeze frame data
THROTTLE POS #2	Throttle position sensor No. 2 output voltage: Min.: 0 V, Max.: 4.98 V	-	ETCS freeze frame data
THROTTLE POS #1	Throttle position sensor No. 1 output voltage: Min.: 0 V, Max.: 5 V	• 0.5 to 1.2 V: Throttle fully closed • 3.2 to 4.8 V: Throttle fully open	-
THROTTLE POS #2	Throttle position sensor No. 2 output voltage: 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 ignition switch ON (Do not start engine)
THRTL COMND VAL	Throttle position command value: Min.: 0 V, Max.: 4.9804 V	0.5 to 4.8 V	Read value with ignition switch ON (Do not start engine)
THROTTLE SSR #1	Throttle sensor opener position No. 1: Min.: 0 V, Max.: 4.9804 V	0.6 to 0.9 V	ETCS service data
THROTTLE SSR #2	Throttle sensor opener position No. 2: Min.: 0 V, Max.: 4.9804 V	2.2 to 2.6 V	ETCS service data
THRTL SSR #1 AD	Throttle position sensor No. 1 output voltage (AD): Min.: 0 V, Max.: 4.9804 V	0.6 to 0.9 V	ETCS service data
THROTTLE MOT	Whether or not throttle actuator control permitted: ON or OFF	ON: Idling	Read value with ignition switch ON (Do not start engine)
THROTTLE MOT	Throttle actuator current: Min.: 0 A, Max.: 80 A	0 to 3.0 A: Idling	-
THROTTLE MOT	Throttle actuator: Min.: 0%, Max.: 100%	0.5 to 40%: Idling	-
THROTTLE MOT	Throttle actuator current: Min.: 0 A, Max.: 19.92 A	0 to 3.0 A: Idling	-

Intelligent Tester Display	Measurement Item: Range (Display)	Normal Condition*1	Diagnostic Note
THROTL OPN DUTY	Throttle actuator opening duty ratio: Min.: 0%, Max.: 100%	0 to 40%: Idling	• When accelerator pedal is depressed, duty ratio increaseds • Read value with ignition switch ON (Do not start engine)
THROTL CLS DUTY	Throttle actuator closed duty ratio: Min.: 0%, Max.: 100%	0 to 40%: Idling	• When accelerator pedal is increaseds quickly, duty ratio increaseds • Read value with ignition switch ON (Do not start engine)
THRTL MOT (OPN)	Throttle actuator duty ratio (open): Min.: 0%, Max.: 100%	-	ETCS service data
THRTL MOT (CLS)	Throttle actuator duty ratio (closed): 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 at 70 km/h (44 mph)	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check output voltage 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 at 70 km/h (44 mph)	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check output voltage of sensor
AF FT B1 S1	Short-term fuel trim associated with sensor 1: Min.: 0, Max.: 1.999	• Value less than 1 (0.000 to 0.999) =Lean • Stoichiometric air-fuel ratio=1 • Value greater than 1 (1.001 to 1.999) = Rich	-
AF FT B2 S1	Short-term fuel trim associated with sensor 1: Min.: 0, Max.: 1.999	• Value less than 1 (0.000 to 0.999) =Lean • Stoichiometric air-fuel ratio=1 • Value greater than 1 (1.001 to 1.999) = Rich	-
AFS B1 S1	A/F sensor 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 output voltage 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 output voltage of sensor
TOTAL FT #1	Total fuel trim of bank 1 Average value for fuel 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 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%	-20 to 20%	Short-term fuel compensation used to maintain air-fuel ratio at stoichiometric air-fuel ratio
SHORT FT #2	Short-term fuel trim of bank 2: Min.: -100%, Max.: 99.2%	-20 to 20%	Short-term fuel compensation used to maintain air-fuel ratio at stoichiometric air-fuel ratio
LONG FT #1	Long-term fuel trim of bank 1: Min.: -100%, Max.: 99.2%	-20 to 20%	Overall fuel compensation carried out in long-term to compensate for continual deviation of short-term fuel trim from central value

Intelligent Tester Display	Measurement Item: Range (Display)	Normal Condition*1	Diagnostic Note
LONG FT #2	Long-term fuel trim of bank 2: Min.: -100%, Max.: 99.2%	-20 to 20%	Overall fuel compensation carried out in long-term to compensate for continual deviation of short-term fuel trim from central value
FUEL SYS #1	Fuel system status (Bank 1): OL or CL or OL DRIVE or OL FAULT or CL FAULT	CL: Idling after warming up	• OL (Open Loop): Has not yet satisfied conditions to go closed loop • CL (Closed Loop): Using A/F sensor as feedback for fuel control • OL DRIVE: Open loop due to driving conditions (fuel enrichment) • OL FAULT: Open loop due to detected system fault • CL FAULT: Closed loop but A/F sensor, which used for fuel control malfunctioning
FUEL SYS #2	Fuel system status (Bank 2): OL or CL or OL DRIVE or OL FAULT or CL FAULT	CL: Idling after warming up	• OL (Open Loop): Has not yet satisfied conditions to go closed loop • CL (Closed Loop): Using A/F sensor as feedback for fuel control • OL DRIVE: Open loop due to driving conditions (fuel enrichment) • OL FAULT: Open loop due to detected system fault • CL FAULT: Closed loop but A/F sensor, which used for fuel control, malfunctioning
O2FT B1 S2	Short-term fuel trim associated with bank 1 sensor 2: Min.: -100%, Max.: 99.2%	-20 to 20%	Same as SHORT FT #1
O2FT B2 S2	Short-term fuel trim associated with bank 2 sensor 2: Min.: -100%, Max.: 99.2%	-20 to 20%	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	-
AFS B1 S1	A/F sensor current: Min.: -128 mA, Max.: 127.99 mA	-	-
AFS B2 S1	A/F sensor current: Min.: -128 mA, Max.: 127.99 mA	-	-
CAT TEMP B1S1	Estimated catalyst temperature (bank 1 sensor 1): Min.: -40°C, Max.: 6,513.5°C	-	-
CAT TEMP B1S2	Estimated catalyst temperature (bank 1 sensor 2): Min.: -40°C, Max.: 6,513.5°C	-	-
CAT TEMP B2S1	Estimated catalyst temperature (bank 2 sensor 1): Min.: -40°C, Max.: 6,513.5°C	-	-

Intelligent Tester Display	Measurement Item: Range (Display)	Normal Condition*1	Diagnostic Note
CAT TEMP B2S2	Estimated catalyst temperature (bank 2 sensor 2): Min.: -40°C, Max.: 6,513.5°C	-	-
S O2S B1S2	Sub heated oxygen sensor impedance (bank 1 sensor 2): Min.: 0 Ω, Max.: 21,247.68 Ω	-	-
S O2S B2S2	Sub heated oxygen sensor impedance (bank 2 sensor 2): Min.: 0 Ω, Max.: 21,247.68 Ω	-	-
INI COOL TEMP	Engine coolant temperature at engine start: Min.: -40°C, Max.: 120°C	Close to ambient air temperature	-
INI INTAKE TEMP	Intake air temperature at engine start: Min.: -40°C, Max.: 120°C	Close to ambient air temperature	-
INJ VOL	Injection volume (cylinder 1): Min.: 0 ml, Max.: 2.048 ml	Max.: 0.5 ml	Fuel volume injected over 10 injections
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 is first turned after battery terminals connected	Signal status usually ON until battery terminals disconnected
CTP SW	Closed throttle position switch: ON or OFF	• ON: Throttle fully closed • OFF: Throttle open	-
A/C SIGNAL	A/C signal: ON or OFF	ON: A/C ON	-
PNP SW [NSW]	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 input: ON or OFF	ON: Idling	-
+BM VOLTAGE	+BM voltage: Min.: 0, Max.: 19.922	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.: 255 kPa	Equivalent to atmospheric pressure (absolute pressure)	-
BATTERY CURRENT	Battery current: Min.: -100 A, Max.: 100 A	-	-
BATTERY TEMP	Battery temperature: Min.: -45 °C, Max.: 156.4 °C	-	-
ALT OUTPUT DUTY	Generator output duty ratio: Min.: 0%, Max.: 100%	-	During charge control
ALT V NORMAL	Request output voltage: Min.: 0 V, Max.: 20 V	9 to 14 V	Not during alternator forced activation
ALT V ACT TST	Request output voltage: Min.: 0 V, Max.: 20 V	-	During alternator forced activation
FUEL PMP SP CTL	Fuel pump speed control status: ON or OFF	Idling: ON	Active Test support data

ES

Intelligent Tester Display	Measurement Item: Range (Display)	Normal Condition*1	Diagnostic Note
ACIS VSV	VSV for Acoustic Control Induction System Status: ON or OFF	-	ON: Open OFF: Closed
EVAP (Purge) VSV	Purge VSV status: 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
VVT CTRL B2	VVT control (bank 2) status: ON or OFF	-	Active Test support data
VACUUM PUMP	Key-off EVAP system leak detection pump status: ON or OFF	-	Active Test support data
EVAP VENT VAL	Key-off EVAP system vent valve status: ON or OFF	-	Active Test support data
FAN MOTOR	Electric fan motor: ON or OFF	ON: Electric fan motor operating	Active Test support data
AICV VSV	VSV for Air Intake Control System Status: ON or OFF	-	-
TC/TE1	TC and CG (TE1) terminal of DLC3: ON or OFF	-	Active Test support data
VVTL AIM ANGL#1*2	VVT aim angle (bank 1 Intake side): Min.: 0%, Max.: 100%	-	-
VVT CHNG ANGL#1*2	VVT change angle (bank 1 Intake side): Min.: 0°FR, Max.: 60°FR	0 to 5°FR: Idling	Displacement angle during intrusive operation
VVT OCV DUTY B1*2	VVT OCV operation duty (bank 1 Intake side): Min.: 0%, Max.: 100%	0 to 100%	Requested duty value for intrusive operation
VVT EX HOLD B1*2	VVT exhaust hold duty ratio learning value (bank 1 Exhaust side): Min.: 0%, Max.: 100%	10 to 50%: Idling	Requested duty value for intrusive operation
VVT EX CHG ANG1*2	VVT change angle (bank 1 Exhaust side): Min.: 0° FR, Max.: 60° FR	0 to 5° FR: Idling	Displacement angle during intrusive operation
VVT EX OCV D B1*2	VVT OCV operation duty (bank 1 Exhaust side): Min.: 0%, Max.: 100%	0 to 100%	Requested duty value for intrusive operation
VVTL AIM ANGL #2*2	VVT aim angle (bank 2 Intake side): Min.: 0%, Max.: 100%	-	-
VVT CHNG ANGL #2*2	VVT change angle (bank 2 Intake side): Min.: 0° FR, Max.: 60° FR	0 to 5° FR: Idling	Displacement angle during intrusive operation
VVT OCV DUTY B2*2	VVT OCV operation duty (bank 2 Intake side): Min.: 0%, Max.: 100%	0 to 100%	Requested duty value for intrusive operation
VVT EX HOLD B2*2	VVT exhaust hold duty ratio learning value (bank 2 Exhaust side): Min.: 0%, Max.: 100%	10 to 50%: Idling	Requested duty value for intrusive operation
VVT EX CHG ANG2*2	VVT change angle (bank 2 Exhaust side): Min.: 0° FR, Max.: 60° FR	0 to 5° FR: Idling	Displacement angle during intrusive operation

Intelligent Tester Display	Measurement Item: Range (Display)	Normal Condition*1	Diagnostic Note
VVT EX OCV D B2*2	VVT exhaust operation duty (bank 2 Exhaust side): Min.: 0%, Max.: 100%	0 to 100%	Requested duty value for intrusive operation
FC IDL	Fuel cut idle: ON or OFF	ON: Fuel cut operation	FC IDL = "ON" when throttle valve fully closed and engine speed over 2,800 rpm
FC TAU	Fuel cut TAU (Fuel cut with very light load): ON or OFF	ON: Fuel cut operating	Fuel cut being performed with very light load to prevent incomplete engine combustion
IGNITION	Ignition counter: Min.: 0, Max.: 800	0 to 800	-
CYL #1	Misfire ratio of cylinder 1: Min.: 0, Max.: 255	0	This item displayed only during idling
CYL #2	Misfire ratio of cylinder 2: Min.: 0, Max.: 255	0	This item displayed only during idling
CYL #3	Misfire ratio of cylinder 3: Min.: 0, Max.: 255	0	This item displayed only during idling
CYL #4	Misfire ratio of cylinder 4: Min.: 0, Max.: 255	0	This item displayed only during idling
CYL #5	Misfire ratio of cylinder 5: Min.: 0, Max.: 255	0	This item displayed only during idling
CYL #6	Misfire ratio of cylinder 6: Min.: 0, Max.: 255	0	This item displayed only during 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 99.22%	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-49)
SPD TEST	Check mode result for vehicle speed sensor: COMPL or INCMPL	-	-
MISFIRE TEST	Check mode result for misfire monitor: COMPL or INCMPL	-	-
OXS1 TEST	Check mode result for HO2 sensor (bank 1): COMPL or INCMPL	-	-
OXS2 TEST	Check mode result for HO2 sensor (bank 2): COMPL or INCMPL	-	-
A/F SSR TEST B1	Check mode result for air-fuel ratio sensor (bank 1): COMPL or INCMPL	-	-
A/F SSR TEST B2	Check mode result for air-fuel ratio sensor (bank 2): COMPL or INCMPL	-	-
MIL	MIL status: ON or OFF	ON: MIL ON	-
MIL ON RUN DIST	MIL ON run distance: Min.: 0 km, Max.: 65,535 km	Distance driven after DTC detected	-

Intelligent Tester Display	Measurement Item: Range (Display)	Normal Condition*1	Diagnostic Note
MIL ON RUN TIME	Running time from MIL ON: Min.: 0 minutes, Max.: 65,535 minutes	Running time after MIL ON	-
ENG RUN TIME	Engine run time: Min.: 0 seconds, Max.: 65,535 seconds	Time after engine start	-
TIME DTC CLEAR	Time after DTC cleared: Min.: 0 minutes, Max.: 65,535 minutes	Time after DTCs erased	-
DIST DTC CLEAR	Distance after DTC cleared: Min.: 0 km, Max.: 65,535 km	Distance driven after DTCs erased	-
WU CYC DTC CLEAR	Warm-up cycle after DTC cleared: Min.: 0, Max.: 255	-	Number of warm-up cycles after DTC cleared
OBD CERT	OBD requirement	OBD2	-
#CARB CODES	Number of emission related DTCs	-	-
COMP MON	Comprehensive component monitor: NOT AVL or AVAIL	-	-
FUEL MON	Fuel system monitor: NOT AVL or AVAIL	-	-
MISFIRE MON	Misfire monitor: NOT AVL or AVAIL	-	-
O2S (A/FS) HTR	O2S (A/FS) heater monitor: NOT AVL or AVAIL	-	-
O2S (A/FS) HTR	O2S (A/FS) heater monitor: COMPL or INCMPL	-	-
O2S (A/FS) MON	O2S (A/FS) monitor: NOT AVL or AVAIL	-	-
O2S (A/FS) MON	O2S (A/FS) monitor: COMPL or INCMPL	-	-
EVAP MON	EVAP monitor: NOT AVL or AVAIL	-	-
EVAP MON	EVAP monitor: COMPL or INCMPL	-	-
CAT MON	Catalyst monitor: NOT AVL or AVAIL	-	-
CAT MON	Catalyst monitor: COMPL or INCMPL	-	-
CCM ENA	Comprehensive component monitor: UNABLE or ENABLE	-	-
CCM CMPL	Comprehensive component monitor: COMPL or INCMPL	-	-
FUEL ENA	Fuel system monitor: UNABLE or ENABLE	-	-
FUEL CMPL	Fuel system monitor: COMPL or INCMPL	-	-
MISFIRE ENA	Misfire monitor: UNABLE or ENABLE	-	-
MISFIRE CMPL	Misfire monitor: COMPL or INCMPL	-	-
EGR ENA	EGR monitor: UNABLE or ENABLE	-	-
EGR CMPL	EGR monitor: COMPL or INCMPL	-	-
HTR ENA	O2S (A/FS) heater monitor: UNABLE or ENABLE	-	-

Intelligent Tester Display	Measurement Item: Range (Display)	Normal Condition*1	Diagnostic Note
HTR CMPL	O2S (A/FS) heater monitor: COMPL or INCMPL	-	-
O2S (A/FS) ENA	O2S (A/FS) monitor: UNABLE or ENABLE	-	-
O2S (A/FS) CMPL	O2S (A/FS) monitor: COMPL or INCMPL	-	-
ACRF ENA	A/C monitor: UNABLE or ENABLE	-	-
ACRF CMPL	A/C monitor: COMPL or INCMPL	-	-
AIR ENA	2nd Air monitor: UNABLE or ENABLE	-	-
AIR CMPL	2nd Air monitor: COMPL or INCMPL	-	-
EVAP ENA	EVAP monitor: UNABLE or ENABLE	-	-
EVAP CMPL	EVAP monitor: COMPL or INCMPL	-	-
HCAT ENA	Heated catalyst monitor: UNABLE or ENABLE	-	-
HCAT CMPL	Heated catalyst monitor: COMPL or INCMPL	-	-
CAT ENA	Catalyst monitor: UNABLE or ENABLE	-	-
CAT CMPL	Catalyst monitor: COMPL or INCMPL	-	-
MODEL CODE	Model code information	-	Identifying model code: GSA3#
ENGINE TYPE	Engine type information	-	Identifying engine type: 2GRFE
CYLINDER NUMBER	Cylinder number: Min.: 0, Max.: 255	-	Identifying cylinder number: 6
TRANSMISSION	Transmission type information	-	Identifying transmission type: 5AT
DESTINATION	Destination information	-	Identifying destination: A (America)
MODEL YEAR	Model year: Min.: 1900, Max.: 2155	-	Identifying model year: 200#
SYSTEM	Engine system information	-	Identifying engine system: GASLIN (gasoline engine)

HINT:
- *1: If no idling conditions are specified, the transmission gear selector lever should be in the N or P position, and the A/C switch and all accessory switches should be OFF.
- *2: DATA LIST values are displayed only when performing the following ACTIVE TESTs: VVT B1, VVT B2, VVT EX B1 and VVT EX B2. For other ACTIVE TESTs, the DATA LIST value will be 0.

ES

ES

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 in troubleshooting is one method of shortening diagnostic time.

DATA LIST can be displayed during ACTIVE TEST.

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

Intelligent Tester Displays	Test Details	Control Ranges	Diagnostic Note
INJ VOL	Change injection volume	Between -12.5 and 24.8 %	• All injectors tested at the 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 24.8 %	• Perform test at less than 3,000 rpm • A/F CONTROL enables to check and to graph 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)	Test is possible when following conditions are met: • Ignition switch is on (IG) • Engine is stopped
EVAP (PURGE) VSV	Activate VSV for EVAP (Purge)	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 MAG CLUTCH	Control the A/C magnet clutch	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	-

Intelligent Tester Displays	Test Details	Control Ranges	Diagnostic Note
COOLING FAN	Control Electric Cooling Fan	ON/OFF	Test is possible when following conditions are met: • Ignition switch is on (IG) • Ignition is stopped
ACC CUT	Active ACC cut relay	ON/OFF	Test is possible when following conditions are met: • Ignition switch is on (IG) • Ignition is stopped
STARTER	Starter	ON/OFF	-
ETCS OPEN SLOW	Throttle actuator	ON: Throttle valve opens slowly	Test is possible when following conditions are met: • Ignition switch is on (IG) • Ignition is stopped • Accelerator pedal is fully depressed (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 is 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
COMPRESS CHECK	Check the cylinder compression pressure	ON/OFF	Fuel injection and ignition stop in all cylinders.
VVT B1	Control VVT (bank 1)	-128 to 127 % This valve added to present OCV control duty 100 %: Maximum advance -100 %: Maximum retard	Engine stalls or roughly idles when VVT actuator is operated by 100 %. Test is possible during idling.
VVT B2	Control VVT (bank 2)	Between -128 and 127%	Same as above
VVT EX B1	Control VVT (bank 1)	-128 to 127 % This valve added to present OCV control duty 100 %: Maximum advance -100 %: Maximum retard	-
VVT EX B2	Control VVT (bank 2)	Between -128 and 127 %	Same as above
TARGET FUEL PRS	Control the target fuel pressure	Between -12.5 and 24.8 %	Test is possible during vehicle stopping and engine idling.
INJ TIMING #1	Control injection timing #1	Between -16 CA and 16 CA	Test is possible during vehicle stopping and engine idling.
INJ TIMING #2	Control injection timing #2	Between -16 CA and 16 CA	Same as above
INJ TIMING #3	Control injection timing #3	Between -16 CA and 16 CA	Same as above
INJ TIMING #4	Control injection timing #4	Between -16 CA and 16 CA	Same as above
INJ TIMING #5	Control injection timing #5	Between -16 CA and 16 CA	Same as above
INJ TIMING #6	Control injection timing #6	Between -16 CA and 16 CA	Same as above
VACUUM PUMP	Vacuum 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 the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the tester on.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK.
(e) Perform the SYSTEM CHECK by referring to the table below.

Intelligent Tester Display	Test Detail	Recommended Fuel Temperature	Diagnostic Note
EVAP SYS CHECK (AUTO OPERATION)	Perform 4 steps in order to operate EVAP key-off monitor automatically	35°C (95°F) or less	• If no DTCs are in PENDING CODE after performing this test, system is functioning normally • Refer to EVAP system
EVAP SYS CHECK (MANUAL OPERATION)	Perform 4 steps in order to operate EVAP key-off monitor automatically	35°C (95°F) or less	• Used to detect malfunctioning parts • Refer to EVAP system

DIAGNOSTIC TROUBLE CODE CHART

HINT:
The parameters listed in the chart may not conform exactly to those read during the DTC check due to the type of instrument or other factors.
If a trouble code is displayed during the DTC check in the check mode, check the circuit for the code listed in the table below. For details of each code, refer to the "See page" column in the DTC chart.

SFI SYSTEM:

DTC No.	Detection Item	Suspected Trouble Area	MIL	Memory	See page
P0010	Camshaft Position "A" Actuator Circuit (Bank 1)	1. Open or short in Oil Control Valve (OCV) for intake camshaft circuit 2. OCV for intake camshaft (bank 1) 3. ECM	Comes on	DTC stored	ES-79
P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)	1. Valve timing 2. OCV for intake camshaft 3. OCV filter 4. Intake camshaft timing gear assembly 5. ECM	Comes on	DTC stored	ES-84
P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)	Same as DTC P0011	Comes on	DTC stored	ES-84
P0013	Camshaft Position "B" Actuator Circuit / Open (Bank 1)	1. Open or short in Oil Control Valve (OCV) for exhaust camshaft circuit 2. OCV for exhaust camshaft (bank 1) 3. ECM	Comes on	DTC stored	ES-91
P0014	Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 1)	1. Valve timing 2. OCV for exhaust camshaft 3. OCV filter 4. Exhaust camshaft 5. ECM	Comes on	DTC stored	ES-96
P0015	Camshaft Position "B" - Timing Over-Retarded (Bank 1)	Same as DTC P0014	Comes on	DTC stored	ES-96
P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)	1. Mechanical system (Timing chain has jumped teeth or chain is stretched) 2. ECM	Comes on	DTC stored	ES-104
P0017	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor B)	Same as DTC P0016	Comes on	DTC stored	ES-104
P0018	Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)	Same as DTC P0016	Comes on	DTC stored	ES-104
P0019	Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor B)	Same as DTC P0016	Comes on	DTC stored	ES-104

ES

DTC No.	Detection Item	Suspected Trouble Area	MIL	Memory	See page
P0020	Camshaft Position "A" Actuator Circuit (Bank 2)	1. Open or short in Oil Control Valve (OCV) for intake camshaft circuit 2. OCV for intake camshaft (bank 2) 3. ECM	Comes on	DTC stored	ES-79
P0021	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)	Same as DTC P0011	Comes on	DTC stored	ES-84
P0022	Camshaft Position "A" - Timing Over-Retarded (Bank 2)	Same as DTC P0011	Comes on	DTC stored	ES-84
P0023	Camshaft Position "B" Actuator Circuit / Open (Bank 2)	1. Open or short in Oil Control Valve (OCV) for exhaust camshaft circuit 2. OCV for exhaust camshaft (bank 2) 3. ECM	Comes on	DTC stored	ES-91
P0024	Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 2)	Same as DTC P0014	Comes on	DTC stored	ES-96
P0025	Camshaft Position "B" - Timing Over-Retarded (Bank 2)	Same as DTC P0014	Comes on	DTC stored	ES-96
P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)	1. Open in Air-Fuel Ratio (A/F) sensor heater circuit 2. A/F sensor heater (bank 1 sensor 1) 3. A/F sensor heater relay 4. ECM	Comes on	DTC stored	ES-107
P0032	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)	1. Short in A/F sensor heater circuit 2. A/F sensor heater (bank 1 sensor 1) 3. A/F sensor heater relay 4. ECM	Comes on	DTC stored	ES-107
P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)	1. Open in Heated Oxygen (HO2) sensor heater circuit 2. HO2 sensor heater (bank 1 sensor 2) 3. Engine room junction block (EFI relay) 4. ECM	Comes on	DTC stored	ES-115
P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	1. Short in HO2 sensor heater circuit 2. HO2 sensor heater (bank 1 sensor 2) 3. Engine room junction block (EFI relay) 4. ECM	Comes on	DTC stored	ES-115

DTC No.	Detection Item	Suspected Trouble Area	MIL	Memory	See page
P0051	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)	1. Open in A/F sensor heater circuit 2. A/F sensor heater (bank 2 sensor 1) 3. A/F sensor heater relay 4. ECM	Comes on	DTC stored	ES-107
P0052	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)	1. Short in A/F sensor heater circuit 2. A/F sensor heater (bank 2 sensor 1) 3. A/F sensor heater relay 4. ECM	Comes on	DTC stored	ES-107
P0057	Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)	1. Open in HO2 sensor heater circuit 2. HO2 sensor heater (bank 2 sensor 2) 3. Engine room junction block (EFI relay) 4. ECM	Comes on	DTC stored	ES-115
P0058	Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)	1. Short in HO2 sensor heater circuit 2. HO2 sensor heater (bank 2 sensor 2) 3. Engine room junction block (EFI relay) 4. ECM	Comes on	DTC stored	ES-115
P0100	Mass or Volume Air Flow Circuit	1. Open or short in Mass Air Flow (MAF) meter circuit 2. MAF meter 3. ECM	Comes on	DTC stored	ES-125
P0101	Mass Air Flow Circuit Range / Performance Problem	MAF meter	Comes on	DTC stored	ES-133
P0102	Mass or Volume Air Flow Circuit Low Input	1. Open in MAF meter circuit 2. Short in MAF meter circuit 3. MAF meter 4. ECM	Comes on	DTC stored	ES-125
P0103	Mass or Volume Air Flow Circuit High Input	1. Short in MAF meter circuit (+B circuit) 2. MAF meter 3. ECM	Comes on	DTC stored	ES-125
P0110	Intake Air Temperature Circuit Malfunction	1. Open or short in Intake Air Temperature (IAT) sensor circuit 2. IAT sensor (built into Mass Air Flow [MAF] meter) 3. ECM	Comes on	DTC stored	ES-136
P0111	Intake Air Temperature Sensor Gradient Too High	MAF meter	Comes on	DTC stored	ES-142

DTC No.	Detection Item	Suspected Trouble Area	MIL	Memory	See page
P0112	Intake Air Temperature Circuit Low Input	1. Short in IAT sensor circuit 2. IAT sensor (built into MAF meter) 3. ECM	Comes on	DTC stored	ES-136
P0113	Intake Air Temperature Circuit High Input	1. Open in IAT sensor circuit 2. IAT sensor (built into MAF meter) 3. ECM	Comes on	DTC stored	ES-136
P0115	Engine Coolant Temperature Circuit Malfunction	1. Open or short in Engine Coolant Temperature (ECT) sensor circuit 2. ECT sensor 3. ECM	Comes on	DTC stored	ES-145
P0116	Engine Coolant Temperature Circuit Range / Performance Problem	1. Thermostat 2. ECT sensor	Comes on	DTC stored	ES-151
P0117	Engine Coolant Temperature Circuit Low Input	1. Short in ECT sensor circuit 2. ECT sensor 3. ECM	Comes on	DTC stored	ES-145
P0118	Engine Coolant Temperature Circuit High Input	1. Open in ECT sensor circuit 2. ECT sensor 3. ECM	Comes on	DTC stored	ES-145
P0120	Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction	1. Throttle Position (TP) sensor (built into throttle body) 2. ECM	Comes on	DTC stored	ES-154
P0121	Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem	TP sensor (built into throttle body)	Comes on	DTC stored	ES-161
P0122	Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input	1. TP sensor (built into throttle body) 2. Short in VTA1 circuit 3. Open in VC circuit 4. ECM	Comes on	DTC stored	ES-154
P0123	Throttle / Pedal Position Sensor / Switch "A" Circuit High Input	1. TP sensor (built into throttle body) 2. Open in VTA1 circuit 3. Open in E2 circuit 4. Short between VC and VTA1 circuits 5. ECM	Comes on	DTC stored	ES-154
P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control	1. Cooling system 2. ECT sensor 3. Thermostat	Comes on	DTC stored	ES-165
P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	1. Thermostat 2. Cooling system 3. ECT sensor 4. ECM	Comes on	DTC stored	ES-168

DTC No.	Detection Item	Suspected Trouble Area	MIL	Memory	See page
P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	1. Open or short in HO2 sensor (bank 1 sensor 2) circuit 2. HO2 sensor (bank 1 sensor 2) 3. HO2 sensor heater (bank 1 sensor 2) 4. A/F sensor (bank 1 sensor 1) 5. Engine room junction block (EFI relay) 6. Gas leakage from exhaust system	Comes on	DTC stored	ES-171
P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	1. Open in HO2 sensor (bank 1 sensor 2) circuit 2. HO2 sensor (bank 1 sensor 2) 3. HO2 sensor heater (bank 1 sensor 2) 4. Engine room junction block (EFI relay) 5. Gas leakage from exhaust system	Comes on	DTC stored	ES-171
P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)	1. Short in HO2 sensor (bank 1 sensor 2) circuit 2. HO2 sensor (bank 1 sensor 2) 3. ECM internal circuit malfunction	Comes on	DTC stored	ES-171
P0141	Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)	1. HO2 sensor 2. ECM	Comes on	DTC stored	ES-115
P0156	Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)	1. Open or short in HO2 sensor (bank 2 sensor 2) circuit 2. HO2 sensor (bank 2 sensor 2) 3. HO2 sensor heater (bank 2 sensor 2) 4. A/F sensor (bank 2 sensor 1) 5. Engine room junction block (EFI relay) 6. Gas leakage from exhaust system	Comes on	DTC stored	ES-171
P0157	Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)	1. Open in HO2 sensor (bank 2 sensor 2) circuit 2. HO2 sensor (bank 2 sensor 2) 3. HO2 sensor heater (bank 2 sensor 2) 4. Engine room junction block (EFI relay) 5. Gas leakage from exhaust system	Comes on	DTC stored	ES-171

DTC No.	Detection Item	Suspected Trouble Area	MIL	Memory	See page
P0158	Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)	1. Short in HO2 sensor (bank 2 sensor 2) circuit 2. HO2 sensor (bank 2 sensor 2) 3. ECM internal circuit malfunction	Comes on	DTC stored	ES-171
P0161	Oxygen Sensor Heater Circuit Malfunction (Bank 2 Sensor 2)	1. HO2 sensor 2. ECM	Comes on	DTC stored	ES-115
P0171	System Too Lean (Bank 1)	1. Air induction system 2. Injector blockage 3. MAF meter 4. ECT sensor 5. Fuel pressure 6. Gas leakage from exhaust system 7. Open or short in A/F sensor (bank 1 sensor 1) circuit 8. A/F sensor (bank 1 sensor 1) 9. A/F sensor heater (bank 1 sensor 1) 10. A/F sensor heater relay 11. A/F sensor heater and A/F sensor heater relay circuits 12. PCV hose connections 13. PCV valve and hose 14. ECM	Comes on	DTC stored	ES-191
P0172	System Too Rich (Bank 1)	1. Injector leakage or blockage 2. MAF meter 3. ECT sensor 4. Ignition system 5. Fuel pressure 6. Gas leakage from exhaust system 7. Open or short in A/F sensor (bank 1 sensor 1) circuit 8. A/F sensor (bank 1 sensor 1) 9. A/F sensor heater (bank 1 sensor 1) 10. A/F sensor heater relay 11. A/F sensor heater and A/F sensor heater relay circuits 12. ECM	Comes on	DTC stored	ES-191

ES

DTC No.	Detection Item	Suspected Trouble Area	MIL	Memory	See page
P0174	System Too Lean (Bank 2)	1. Air induction system 2. Injector blockage 3. MAF meter 4. ECT sensor 5. Fuel pressure 6. Gas leakage from exhaust system 7. Open or short in A/F sensor (bank 2 sensor 1) circuit 8. A/F sensor (bank 2 sensor 1) 9. A/F sensor heater (bank 2 sensor 1) 10. A/F sensor heater relay 11. A/F sensor heater and A/F sensor heater relay circuits 12. PCV hose connections 13. PCV valve and hose 14. ECM	Comes on	DTC stored	ES-191
P0175	System Too Rich (Bank 2)	1. Injector leakage or blockage 2. MAF meter 3. ECT sensor 4. Ignition system 5. Fuel pressure 6. Gas leakage from exhaust system 7. Open or short in A/F sensor (bank 2 sensor 1) circuit 8. A/F sensor (bank 2 sensor 1) 9. A/F sensor heater (bank 2 sensor 1) 10. A/F sensor heater relay 11. A/F sensor heater and A/F sensor heater relay circuits 12. ECM	Comes on	DTC stored	ES-191
P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit	1. TP sensor (built into throttle body) 2. ECM	Comes on	DTC stored	ES-154
P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input	1. TP sensor (built into throttle body) 2. Short in VTA2 circuit 3. Open in VC circuit 4. ECM	Comes on	DTC stored	ES-154
P0223	Throttle / Pedal Position Sensor / Switch "B" Circuit High Input	1. TP sensor (built into throttle body) 2. Open in VTA2 circuit 3. Open in E2 circuit 4. Short between VC and VTA2 circuits 5. ECM	Comes on	DTC stored	ES-154

DTC No.	Detection Item	Suspected Trouble Area	MIL	Memory	See page
P0300	Random / Multiple Cylinder Misfire Detected	1. Open or short in engine wire harness 2. Connector connections 3. Vacuum hose connection 4. Ignition system 5. Injector 6. Fuel pressure 7. Mass Air Flow (MAF) meter 8. Engine Coolant Temperature (ECT) sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV valve and hose 13. PCV hose connections 14. Air induction system 15. ECM	Comes on or flashes	DTC stored	ES-204
P0301	Cylinder 1 Misfire Detected	Same as DTC P0300	Comes on or flashes	DTC stored	ES-204
P0302	Cylinder 2 Misfire Detected	Same as DTC P0300	Comes on or flashes	DTC stored	ES-204
P0303	Cylinder 3 Misfire Detected	Same as DTC P0300	Comes on or flashes	DTC stored	ES-204
P0304	Cylinder 4 Misfire Detected	Same as DTC P0300	Comes on or flashes	DTC stored	ES-204
P0305	Cylinder 5 Misfire Detected	Same as DTC P0300	Comes on or flashes	DTC stored	ES-204
P0306	Cylinder 6 Misfire Detected	Same as DTC P0300	Comes on or flashes	DTC stored	ES-204
P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	1. Short in knock sensor 1 circuit 2. Knock sensor 1 3. ECM	Comes on	DTC stored	ES-216
P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	1. Open in knock sensor 1 circuit 2. Knock sensor 1 3. ECM	Comes on	DTC stored	ES-216
P0332	Knock Sensor 2 Circuit Low Input (Bank 2)	1. Short in knock sensor 2 circuit 2. Knock sensor 2 3. ECM	Comes on	DTC stored	ES-216
P0333	Knock Sensor 2 Circuit High Input (Bank 2)	1. Open in knock sensor 2 circuit 2. Knock sensor 2 3. ECM	Comes on	DTC stored	ES-216
P0335	Crankshaft Position Sensor "A" Circuit	1. Open or short in Crankshaft Position Sensor (CKP) circuit 2. CKP sensor 3. Sensor plate (CKP sensor plate) 4. ECM	Comes on	DTC stored	ES-222
P0339	Crankshaft Position Sensor "A" Circuit Intermittent	Same as DTC P0335	Does not come on	DTC stored	ES-222

DTC No.	Detection Item	Suspected Trouble Area	MIL	Memory	See page
P0340	Camshaft Position Sensor Circuit Malfunction	1. Open or short in VVT sensor for intake camshaft circuit 2. VVT sensor for intake camshaft 3. Camshaft timing gear for intake camshaft 4. Jumped tooth of timing chain for intake camshaft 5. ECM	Comes on	DTC stored	ES-228
P0342	Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)	Same as DTC P0340	Comes on	DTC stored	ES-228
P0343	Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)	Same as DTC P0340	Comes on	DTC stored	ES-228
P0345	Camshaft Position Sensor "A" Circuit (Bank 2)	Same as DTC P0340	Comes on	DTC stored	ES-228
P0347	Camshaft Position Sensor "A" Circuit Low Input (Bank 2)	Same as DTC P0340	Comes on	DTC stored	ES-228
P0348	Camshaft Position Sensor "A" Circuit High Input (Bank 2)	Same as DTC P0340	Comes on	DTC stored	ES-228
P0351	Ignition Coil "A" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IGF1 or IGT circuit (1 to 6) between ignition coil and ECM 3. No. 1 to No. 6 ignition coils 4. ECM	Comes on	DTC stored	ES-234
P0352	Ignition Coil "B" Primary / Secondary Circuit	Same as DTC P0351	Comes on	DTC stored	ES-234
P0353	Ignition Coil "C" Primary / Secondary Circuit	Same as DTC P0351	Comes on	DTC stored	ES-234
P0354	Ignition Coil "D" Primary / Secondary Circuit	Same as DTC P0351	Comes on	DTC stored	ES-234
P0355	Ignition Coil "E" Primary / Secondary Circuit	Same as DTC P0351	Comes on	DTC stored	ES-234
P0356	Ignition Coil "F" Primary / Secondary Circuit	Same as DTC P0351	Comes on	DTC stored	ES-234
P0365	Camshaft Position Sensor "B" Circuit (Bank 1)	1. Open or short in VVT sensor for exhaust camshaft circuit 2. VVT sensor for exhaust camshaft 3. Exhaust camshaft 4. Jumped tooth of timing chain 5. ECM	Comes on	DTC stored	ES-243

DTC No.	Detection Item	Suspected Trouble Area	MIL	Memory	See page
P0367	Camshaft Position Sensor "B" Circuit Low Input (Bank 1)	1. Open or short in VVT sensor for exhaust camshaft circuit 2. VVT sensor for exhaust camshaft 3. Exhaust camshaft 4. Jumped tooth of timing chain 5. ECM	Comes on	DTC stored	ES-243
P0368	Camshaft Position Sensor "B" Circuit High Input (Bank 1)	1. Open or short in VVT sensor for exhaust camshaft circuit 2. VVT sensor for exhaust camshaft 3. Exhaust camshaft 4. Jumped tooth of timing chain 5. ECM	Comes on	DTC stored	ES-243
P0390	Camshaft Position Sensor "B" Circuit (Bank 2)	1. Open or short in VVT sensor for exhaust camshaft circuit 2. VVT sensor for exhaust camshaft 3. Exhaust camshaft 4. Jumped tooth of timing chain 5. ECM	Comes on	DTC stored	ES-243
P0392	Camshaft Position Sensor "B" Circuit Low Input (Bank 2)	1. Open or short in VVT sensor for exhaust camshaft circuit 2. VVT sensor for exhaust camshaft 3. Exhaust camshaft 4. Jumped tooth of timing chain 5. ECM	Comes on	DTC stored	ES-243
P0393	Camshaft Position Sensor "B" Circuit High Input (Bank 2)	1. Open or short in VVT sensor for exhaust camshaft circuit 2. VVT sensor for exhaust camshaft 3. Exhaust camshaft 4. Jumped tooth of timing chain 5. ECM	Comes on	DTC stored	ES-243
P0420	Catalyst System Efficiency Below Threshold (Bank 1)	1. Gas leakage from exhaust system 2. A/F sensor (bank 1 sensor 1) 3. HO2 sensor (bank 1 sensor 2) 4. Exhaust manifold (Three-Way Catalytic Converter [TWC])	Comes on	DTC stored	ES-249

DTC No.	Detection Item	Suspected Trouble Area	MIL	Memory	See page
P0430	Catalyst System Efficiency Below Threshold (Bank 2)	1. Gas leakage from exhaust system 2. A/F sensor (bank 2 sensor 1) 3. HO2 sensor (bank 2 sensor 2) 4. Exhaust manifold (Three-Way Catalytic Converter [TWC])	Comes on	DTC stored	ES-249
P043E	Evaporative Emission System Reference Orifice Clog Up	1. Pump module 2. Connector / wire harness (Pump module - ECM) 3. ECM	Comes on	DTC stored	ES-255
P043F	Evaporative Emission System Reference Orifice High Flow	1. Pump module 2. Connector / wire harness (Pump module - ECM) 3. ECM	Comes on	DTC stored	ES-255
P0441	Evaporative Emission Control System Incorrect Purge Flow	1. EVAP VSV 2. Connector / wire harness (EVAP VSV - ECM) 3. ECM 4. Pump module 5. Leakage from EVAP system 6. Leakage from EVAP line (EVAP VSV - Intake manifold)	Comes on	DTC stored	ES-260
P0450	Evaporative Emission Control System Pressure Sensor / Switch	1. Pump module (including pressure sensor) 2. ECM	Comes on	DTC stored	ES-267
P0451	Evaporative Emission Control System Pressure Sensor Range / Performance	1. Pump module (including pressure sensor) 2. Connector / wire harness (between pump module and ECM) 3. ECM	Comes on	DTC stored	ES-267
P0452	Evaporative Emission Control System Pressure Sensor / Switch Low Input	1. Pump module (including pressure sensor) 2. Connector / wire harness (between pump module and ECM) 3. ECM	Comes on	DTC stored	ES-267
P0453	Evaporative Emission Control System Pressure Sensor / Switch High Input	1. Pump module (include pressure sensor) 2. Connector / wire harness (between pump module and ECM) 3. ECM	Comes on	DTC stored	ES-267

DTC No.	Detection Item	Suspected Trouble Area	MIL	Memory	See page
P0455	Evaporative Emission Control System Leak Detected (Gross Leak)	1. Fuel tank cap (loose) 2. Leakage from EVAP line (Canister - Fuel tank) 3. Leakage from EVAP line (EVAP VSV - Canister) 4. Pump module 5. Leakage from fuel tank 6. Leakage from canister	Comes on	DTC stored	ES-274
P0456	Evaporative Emission Control System Leak Detected (Very Small Leak)	Same as DTC P0455	Comes on	DTC stored	ES-274
P0500	Vehicle Speed Sensor "A"	1. Vehicle speed sensor 2. Vehicle speed sensor signal circuit 3. Combination meter 4. ECM 5. Skid control ECU	Comes on	DTC stored	ES-279
P0504	Brake Switch "A" / "B" Correlation	1. Short in stop light switch signal circuit 2. Stop light switch 3. ECM	Does not come on	DTC stored	ES-284
P0505	Idle Control System Malfunction	1. ETCS (Electronic Throttle Control System) 2. Air induction system 3. PCV hose connection 4. ECM	Comes on	DTC stored	ES-288
P050A	Cold Start Idle Air Control System Performance	1. Throttle body assembly 2. MAF meter 3. Air induction system 4. PCV hose connections 5. VVT system 6. Air cleaner filter element 7. ECM	Comes on	DTC stored	ES-291
P050B	Cold Start Ignition Timing Performance	Same as DTC P050A	Comes on	DTC stored	ES-291
P0560	System Voltage	1. Open in back-up power source circuit 2. ECM	Comes on	DTC stored	ES-297
P0604	Internal Control Module Random Access Memory (RAM) Error	ECM	Comes on	DTC stored	ES-302
P0606	ECM / PCM Processor	ECM	Comes on (except when there is a malfunction in the ECM internal circuit)	DTC stored	ES-302

DTC No.	Detection Item	Suspected Trouble Area	MIL	Memory	See page
P0607	Control Module Performance	ECM	Comes on (except when there is a malfunction in the cruise control switch circuit)	DTC stored	ES-302
P0617	Starter Relay Circuit High	1. Park / Neutral Position (PNP) switch 2. Starter relay circuit 3. Cranking holding function circuit 4. Ignition switch 5. ECM	Comes on	DTC stored	ES-304
P0630	VIN not Programmed or Mismatch - ECM / PCM	ECM	Comes on	DTC stored	ES-309
P0657	Actuator Supply Voltage Circuit / Open	ECM	Comes on	DTC stored	ES-302
P0705	Transmission Range Sensor Circuit Malfunction (PRNDL Input)	1. Short in park / neutral position switch circuit 2. Park / neutral position switch 3. ECM	Comes on	DTC stored	ES-311
P0724	Brake Switch "B" Circuit High	1. Short in stop light switch signal circuit 2. Stop light switch 3. ECM	Comes on	DTC stored	ES-284
P2102	Throttle Actuator Control Motor Circuit Low	1. Open in throttle actuator circuit 2. Throttle actuator 3. ECM	Comes on	DTC stored	ES-320
P2103	Throttle Actuator Control Motor Circuit High	1. Short in throttle actuator circuit 2. Throttle actuator 3. Throttle valve 4. Throttle body assembly 5. ECM	Comes on	DTC stored	ES-320
P2111	Throttle Actuator Control System - Stuck Open	1. Throttle actuator 2. Throttle body 3. Throttle valve	Comes on	DTC stored	ES-324
P2112	Throttle Actuator Control System - Stuck Closed	Same as DTC P2111	Comes on	DTC stored	ES-324
P2118	Throttle Actuator Control Motor Current Range / Performance	1. Open in ETCS power source circuit 2. ETCS fuse 3. ECM	Comes on	DTC stored	ES-327
P2119	Throttle Actuator Control Throttle Body Range / Performance	1. ETCS 2. ECM	Comes on	DTC stored	ES-331
P2120	Throttle / Pedal Position Sensor / Switch "D" Circuit	1. Accelerator Pedal Position (APP) sensor 2. ECM	Comes on	DTC stored	ES-334
P2121	Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance	1. Accelerator Pedal Position (APP) sensor 2. ECM	Comes on	DTC stored	ES-341

DTC No.	Detection Item	Suspected Trouble Area	MIL	Memory	See page
P2122	Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input	1. Accelerator Pedal Position (APP) sensor 2. Open in VCP1 circuit 3. Open or ground short in VPA circuit 4. ECM	Comes on	DTC stored	ES-334
P2123	Throttle / Pedal Position Sensor / Switch "D" Circuit High Input	1. Accelerator Pedal Position (APP) sensor 2. Open in EPA circuit 3. ECM	Comes on	DTC stored	ES-334
P2125	Throttle / Pedal Position Sensor / Switch "E" Circuit	1. Accelerator Pedal Position (APP) sensor 2. ECM	Comes on	DTC stored	ES-334
P2127	Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input	1. Accelerator Pedal Position (APP) sensor 2. Open in VCP2 circuit 3. Open or ground short in VPA2 circuit 4. ECM	Comes on	DTC stored	ES-334
P2128	Throttle / Pedal Position Sensor / Switch "E" Circuit High Input	1. Accelerator Pedal Position (APP) sensor 2. Open in EPA2 circuit 3. ECM	Comes on	DTC stored	ES-334
P2135	Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation	1. Short between VTA1 and VTA2 circuits 2. TP sensor (built into throttle body) 3. ECM	Comes on	DTC stored	ES-154
P2138	Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation	1. Short between VPA and VPA2 circuits 2. APP sensor 3. ECM	Comes on	DTC stored	ES-334
P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank 1 sensor 1) 3. A/F sensor heater (bank 1 sensor 1) 4. A/F sensor heater relay 5. A/F sensor heater and relay circuits 6. Air induction system 7. Fuel pressure 8. Injector 9. ECM	Comes on	DTC stored	ES-345
P2196	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)	Same as DTC P2195	Comes on	DTC stored	ES-345

DTC No.	Detection Item	Suspected Trouble Area	MIL	Memory	See page
P2197	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)	1. Open or short in A/F sensor (bank 2 sensor 1) circuit 2. A/F sensor (bank 2 sensor 1) 3. A/F sensor heater (bank 2 sensor 1) 4. A/F sensor heater relay 5. A/F sensor heater and relay circuits 6. Air induction system 7. Fuel pressure 8. Injector 9. ECM	Comes on	DTC stored	ES-345
P2198	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)	Same as DTC P2197	Comes on	DTC stored	ES-345
P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank 1 sensor 1) 3. A/F sensor heater (bank 1 sensor 1) 4. A/F sensor heater relay 5. A/F sensor heater and relay circuits 6. ECM	Comes on	DTC stored	ES-364
P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)	Same as DTC P2238	Comes on	DTC stored	ES-364
P2241	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)	1. Open or short in A/F sensor (bank 2 sensor 1) circuit 2. A/F sensor (bank 2 sensor 1) 3. A/F sensor heater (bank 2 sensor 1) 4. A/F sensor heater relay 5. A/F sensor heater and relay circuits 6. ECM	Comes on	DTC stored	ES-364
P2242	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)	Same as DTC P2241	Comes on	DTC stored	ES-364
P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)	Same as DTC P2238	Comes on	DTC stored	ES-364
P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)	Same as DTC P2238	Comes on	DTC stored	ES-364
P2255	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)	Same as DTC P2241	Comes on	DTC stored	ES-364

DTC No.	Detection Item	Suspected Trouble Area	MIL	Memory	See page
P2256	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)	Same as DTC P2241	Comes on	DTC stored	ES-364
P2401	Evaporative Emission System Leak Detection Pump Control Circuit Low	1. Pump module 2. Connector / wire harness (Pump module - ECM) 3. ECM	Comes on	DTC stored	ES-255
P2402	Evaporative Emission System Leak Detection Pump Control Circuit High	1. Pump module 2. Connector / wire harness (Pump module - ECM) 3. ECM	Comes on	DTC stored	ES-255
P2419	Evaporative Emission System Switching Valve Control Circuit Low	1. Pump module 2. Connector / wire harness (Pump module - ECM) 3. ECM	Comes on	DTC stored	ES-255
P2420	Evaporative Emission System Switching Valve Control Circuit High	1. Pump module (0.02 inch orifice, vacuum pump, vent valve) EVAP system monitor 2. Connector / wire harness (Pump module - ECM) 3. ECM	Comes on	DTC stored	ES-373
P2610	ECM / PCM Internal Engine Off Timer Performance	ECM	Comes on	DTC stored	ES-377
P2A00	A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank1 sensor 1) 3. ECM	Comes on	DTC stored	ES-380
P2A03	A/F Sensor Circuit Slow Response (Bank 2 Sensor 1)	1. Open or short in A/F sensor (bank 2 sensor 1) circuit 2. A/F sensor (bank 2 sensor 1) 3. ECM	Comes on	DTC stored	ES-380
U0101	Lost Communication with TCM	1. Open or short in TCM and ECM circuit 2. TCM 3. ECM	Comes on	DTC stored	ES-389

*1: This DTC is related to the A/F sensor, although the caption in the "Detection Item" column refers to the heated oxygen sensor.
*2: This DTC indicates a malfunction related to the primary circuit.

ES

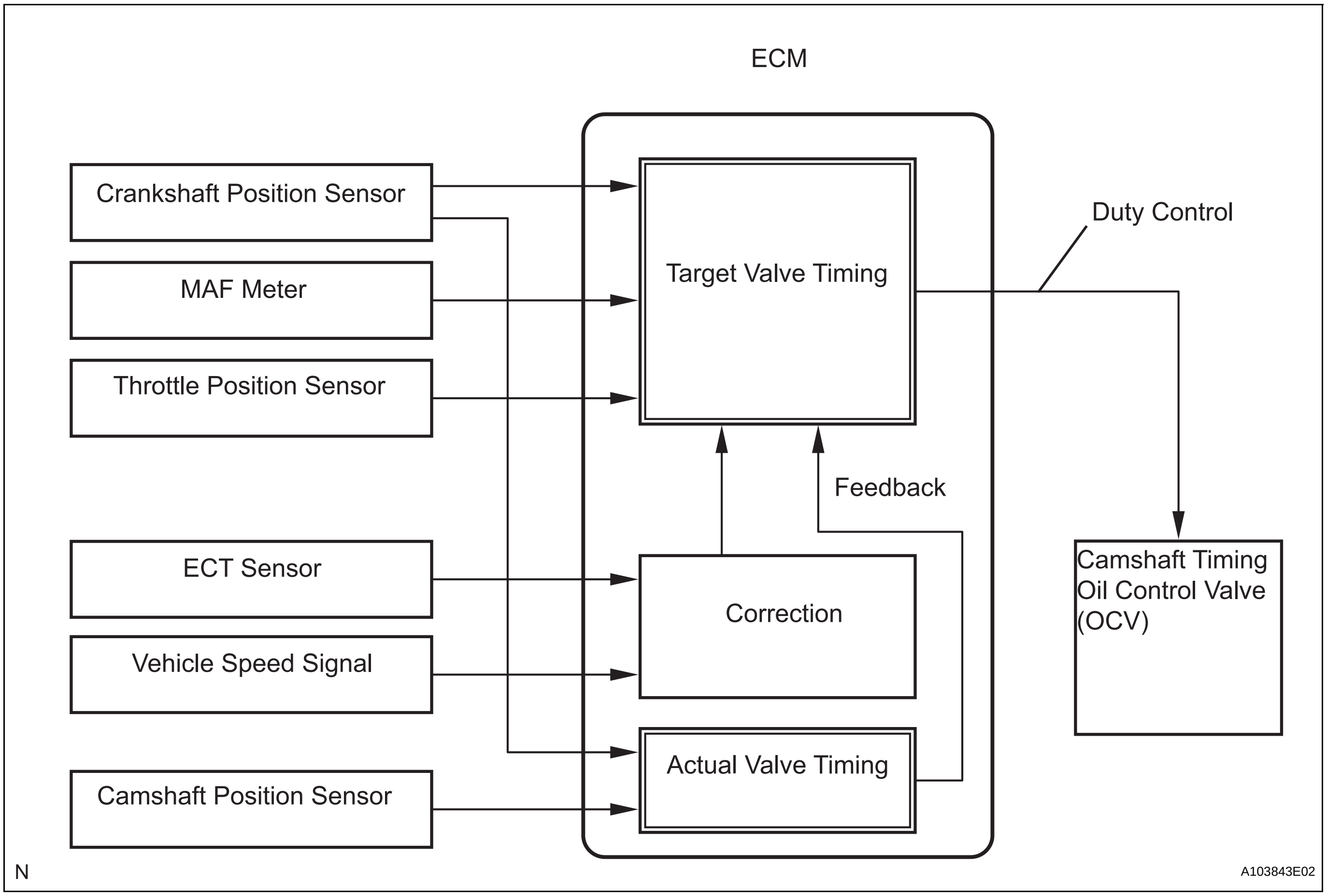
DTC	P0010	Camshaft Position "A" Actuator Circuit (Bank 1)

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

DESCRIPTION

The Variable Valve Timing (VVT) system includes the ECM, Oil Control Valve (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 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 improves, and the exhaust emissions decrease under overall driving conditions. The ECM detects the actual intake valve timing using signals from the camshaft and crankshaft position sensors, and performs feedback control. This is how the target intake valve timing is verified by the ECM.

ES



DTC No.	DTC Detection Condition	Trouble Area
P0010	Open or short in OCV for intake camshaft (bank 1) circuit (1 trip detection logic)	• Open or short in OCV for intake camshaft (bank 1) circuit • OCV for intake camshaft (bank 1) • ECM
P0020	Open or short in OCV for intake camshaft (bank 2) circuit (1 trip detection logic)	• Open or short in OCV for intake camshaft (bank 2) circuit • OCV for intake camshaft (bank 2) • ECM

MONITOR DESCRIPTION

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

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Monitor will run whenever these DTCs are not present	None
All of the following conditions are met:	-
Starter	OFF
Engine switch	ON
Time after turning ignition switch off to on (IG)	0.5 seconds or more

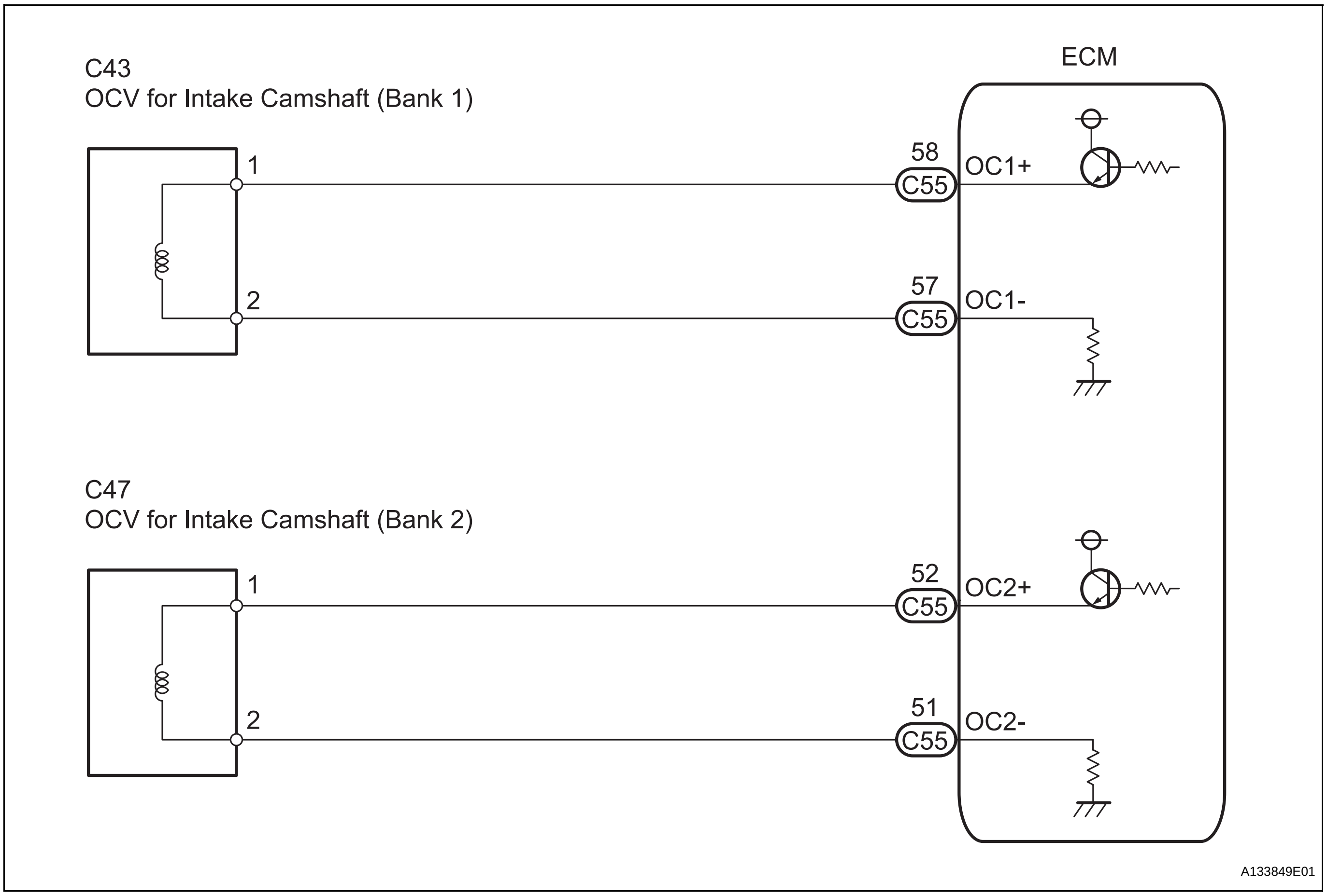
TYPICAL MALFUNCTION THRESHOLDS

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

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- If DTC P0010 is displayed, check the intake camshaft circuit for the right bank VVT system.
- Bank 1 refers to the bank that includes cylinder No. 1.
- If DTC P0020 is displayed, check the intake camshaft circuit for the left bank VVT system.
- Bank 2 refers to the bank that does not include cylinder No. 1.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	PERFORM ACTIVE TEST BY CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine.
(d) On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1 or VVT CTRL B2.
(e) Check the engine speed while operating the Oil Control Valve (OCV) using the tester.

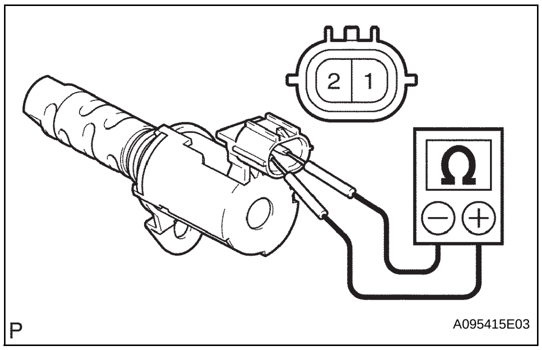
OK

Tester Operation	Specified Condition
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 (See page ES-33)**

NG

2 INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY



(a) Disconnect the C43 or C47 OCV connector.
(b) Measure the resistance between the terminals of the OCV.
Standard resistance

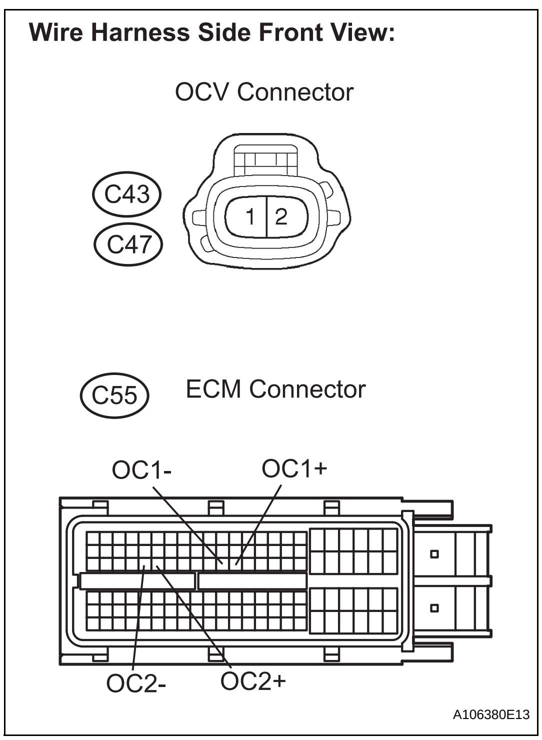
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

(c) Reconnect the OCV connector.

OK → **REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (See page ES-481)**

NG

3 CHECK HARNESS AND CONNECTOR (OCV - ECM)



(a) Disconnect the C43 or C47 OCV connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance between the terminals.
Standard resistance (Check for open)

Tester Connection	Specified Condition
OC1+ (C55-58) - C43-1	Below 1 Ω
OC1- (C55-57) - C43-2	Below 1 Ω
OC2+ (C55-52) - C47-1	Below 1 Ω
OC2- (C55-51) - C47-2	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
OC1+ (C55-58) or C43-1 - Body ground	10 kΩ or higher
OC1- (C55-57) or C43-2 - Body ground	10 kΩ or higher
OC2+ (C55-52) or C47-1 - Body ground	10 kΩ or higher
OC2- (C55-51) or C47-2 - Body ground	10 kΩ or higher

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

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

OK

REPLACE ECM (See page ES-518)

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

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

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

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

DESCRIPTION

The Variable Valve Timing (VVT) system includes the ECM, Oil Control Valve (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 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 Condition	Trouble Area
P0011 P0021	Advanced cam timing: With warm engine and engine speed of between 500 rpm and 4,000 rpm, all conditions (1), (2) and (3) are met (1 trip detection logic): 1. Difference between target and actual intake valve timing is more than 5°CA (Crankshaft Angle) for 4.5 seconds 2. Current intake valve timing is fixed (timing changes less than 5°CA in 5 seconds) 3. Variations in VVT controller timing is more than 19°CA of maximum delayed timing (advance)	• Valve timing • Oil Control valve (OCV) for intake camshaft (bank 1) • OCV filter (bank 1) • Intake camshaft (bank 1) 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 (1), (2) and (3) are met (2 trip detection logic): 1. Difference between target and actual intake valve timing is more than 5°CA (Crankshaft Angle) for 4.5 seconds 2. Current intake valve timing is fixed (timing changes less than 5°CA in 5 seconds) 3. Variations in VVT controller timing is 19°CA or less of maximum delayed timing (retarded)	• Valve timing • OCV for intake camshaft (bank 2) • OCV filter (bank 2) • Intake camshaft (bank 2) timing gear assembly • ECM

MONITOR DESCRIPTION

1. 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.

2. 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 timing is large, and changes in the actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and sets a DTC.
   Example:
   A DTC will be set 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.
3. DTCs P0011 and P0021 (Advanced Cam Timing) are detected with 1 trip detection logic.
4. DTCs P0012 and P0022 (Retarded Cam Timing) are detected with 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.
5. The monitor will not run unless the following conditions are met:
   (a) The engine is warm (the engine coolant temperature is 75°C (167°F) or more).
   (b) The vehicle has been driven at more than 40 mph (64 km/h) for 3 minutes.
   (c) 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 (Sub)	Crankshaft position sensor, camshaft position sensor and Engine coolant temperature sensor
Frequency of operation	Once per drive cycle
Duration	Within 10 seconds
MIL operation	Advanced camshaft timing (bank 1): Immediately Advanced camshaft timing (bank 2): Immediately Retard camshaft timing (bank 1): 2 driving cycles Retard camshaft timing (bank 2): 2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	P0100 - P0103 (MAF sensor) P0115 - P0118 (ECT sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351 - P0358 (ignitor)
Battery voltage	11 V or more
Engine	500 to 4,000 rpm
ECT	75 to 100°C (167 to 212°F)

TYPICAL MALFUNCTION THRESHOLDS

Advanced camshaft timing:

Difference between actual valve timing and target valve timing	More than 5°CA
Valve timing	No change in advanced valve timing

Retard camshaft timing:

Difference between actual valve timing and target valve timing	More than 5°CA

Valve timing	No change in retarded valve timing

WIRING DIAGRAM

Refer to DTC P0010 (See page ES-81).

INSPECTION PROCEDURE

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 right bank VVT system for intake camshaft circuit (bank 1).
- Bank 1 refers to the bank that includes cylinder No. 1.
- If DTC P0021 or P0022 is displayed, check the intake camshaft circuit for the left bank VVT system (bank 2).
- Bank 2 refers to the bank that does not include cylinder No. 1.
- Read freeze frame data using an intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

ES

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

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

Result

Display (DTC Output)	Proceed to
P0011, 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 (See page ES-63)**

A

2 PERFORM ACTIVE TEST BY 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) Enter the following menus: 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 Operation	Specified Condition
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 the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) and turn the tester on.
(c) Clear the DTCs.
(d) Start the engine and warm it up.
(e) Switch the ECM from normal mode to check mode using the tester.
(f) Drive the vehicle for more than 10 minutes.
(g) Read the DTCs using the tester.

OK:
No DTC output.

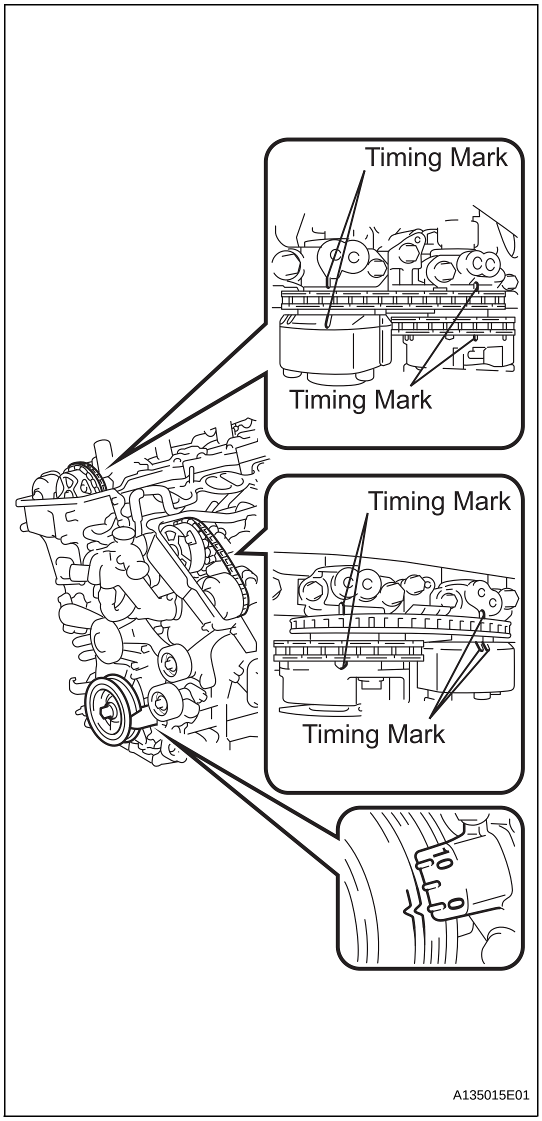
NG → **Go to step 4**

OK

END

ES

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

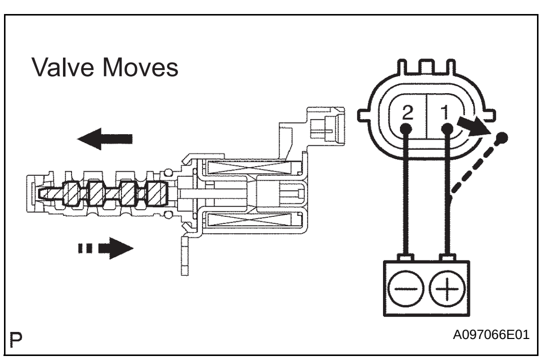


(a) Remove the cylinder head covers RH and LH.
(b) Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.
(c) Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not, 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.

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

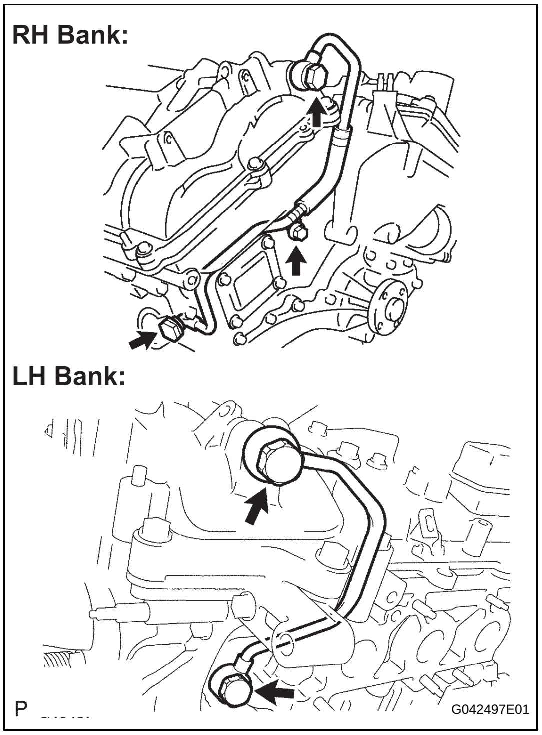
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

(c) Apply 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 (See page ES-481)**

OK

6 INSPECT OIL CONTROL VALVE FILTER AND PIPE



(a) Remove the oil pipe No. 1 or No. 2.
(b) Remove the oil control valve filter.
(c) Check that the filter and pipe are not clogged.
OK:
The filter and pipe are not clogged.

NG → **CLEAN OIL CONTROL VALVE FILTER AND PIPE**

ES

OK

7 REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

NEXT

8 CHECK WHETHER DTC OUTPUT RECURS

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) and turn the tester on.
(c) Clear the DTCs.
(d) Start the engine and warm it up.
(e) Switch the ECM from normal mode to check mode using the tester.
(f) Driver the vehicle for more than 10 minutes.
(g) Read the output DTCs using the intelligent tester.
OK:
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 output 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 IS OK**

NG

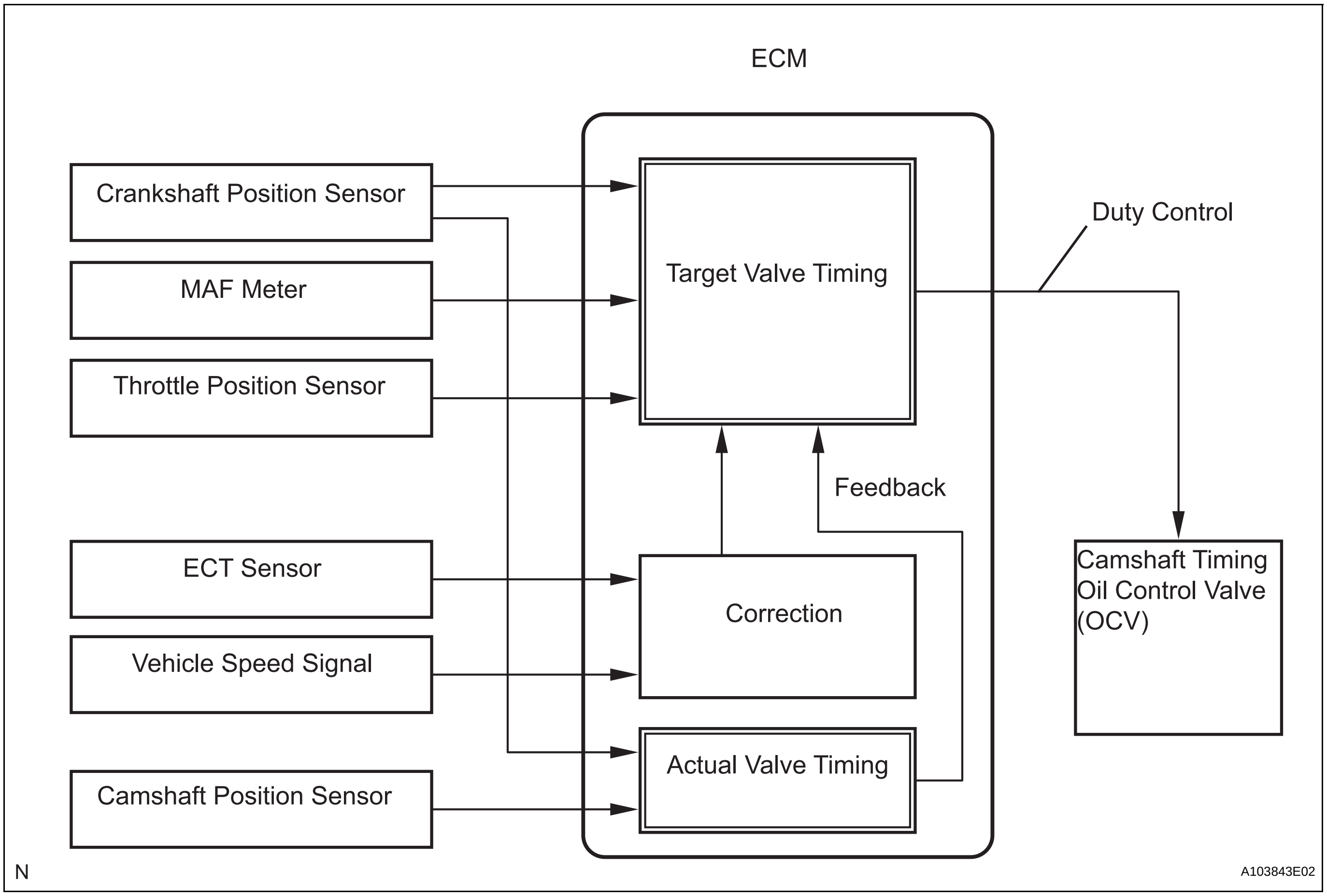
REPLACE ECM (See page ES-518)

DTC	P0013	Camshaft Position "B" Actuator Circuit / Open (Bank 1)

DTC	P0023	Camshaft Position "B" Actuator Circuit / Open (Bank 2)

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 exhaust 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 exhaust 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 Condition	Trouble Area
P0013	Open or short in OCV for exhaust camshaft (bank 1) circuit (1 trip detection logic)	• Open or short in OCV for exhaust camshaft (bank 1) circuit • OCV for exhaust camshaft (bank 1) • ECM
P0023	Open or short in OCV for exhaust camshaft (bank 2) circuit (1 trip detection logic)	• Open or short in OCV for exhaust camshaft (bank 2) circuit • OCV for exhaust camshaft (bank 2) • ECM

MONITOR DESCRIPTION

The ECM optimizes the valve timing using the VVT system to control the exhaust 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 exhaust 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	P0013: VVT OCV (bank 1) open/short P0023: VVT OCV (bank 2) open/short
Required sensors / components (Main)	VVT OCV (Variable Valve Timing oil control valve)
Required sensors / components (Sub)	-
Frequency of operation	Continuous
Duration	1 second
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None
All of the following conditions are met:	-
Starter	OFF
Engine switch	ON
Time after engine switch off to on	0.5 seconds or more

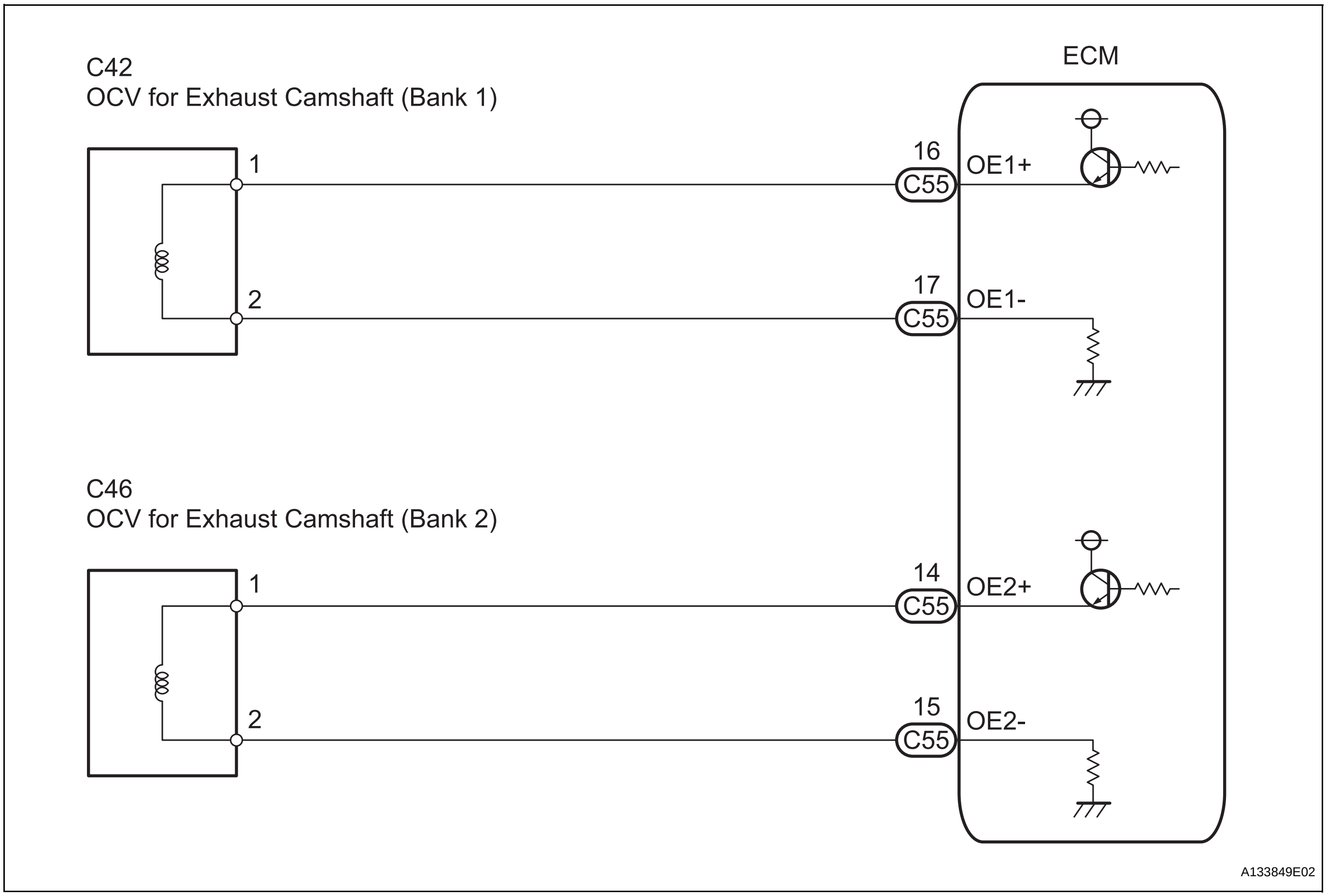
TYPICAL MALFUNCTION THRESHOLDS

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

COMPONENT OPERATING RANGE

VVT duty ratio	More than 3, and less than 100 %

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:
- If DTC P0013 is displayed, check the exhaust camshaft circuit for the bank 1 VVT system.
- Bank 1 refers to the bank that includes cylinder No. 1.
- If DTC P0023 is displayed, check the exhaust camshaft circuit for the bank 2 VVT system.
- Bank 2 refers to the bank that does not include cylinder No. 1.
- Read freeze frame data using an intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	PERFORM ACTIVE TEST BY 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) Enter the following menus: 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

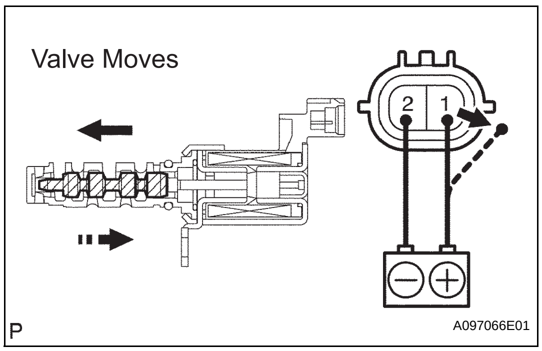
Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

NG → **Go to step 2**

OK

CHECK FOR INTERMITTENT PROBLEMS

2 INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY



(a) Disconnect the C42 or C46 OCV connector.
(b) Measure the resistance between the terminals of the OCV.
Standard resistance

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

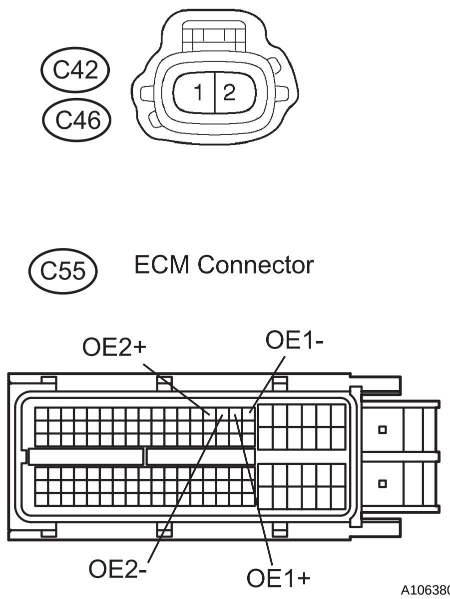
(c) Reconnect the OCV connector.

NG → **Go to step 3**

OK

REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (See page ES-481)

3	CHECK HARNESS AND CONNECTOR (OCV - ECM)



(a) Disconnect the C42 or C46 OCV connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance between the terminals.

Standard resistance (Check for open)

Tester Connection	Specified Condition
OE1+ (C55-16) - C42-1	Below 1 Ω
OE1- (C55-17) - C42-2	Below 1 Ω
OE2+ (C55-14) - C46-1	Below 1 Ω
OE2- (C55-15) - C46-2	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
OE1+ (C55-16) or C42-1 - Body ground	10 kΩ or higher
OE1- (C55-17) or C42-2 - Body ground	10 kΩ or higher
OE2+ (C55-14) or C46-1 - Body ground	10 kΩ or higher
OE2- (C55-15) or C46-2 - Body ground	10 kΩ or higher

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

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

ES

OK

REPLACE ECM (See page ES-481)

DTC	**P0014**	**Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 1)**

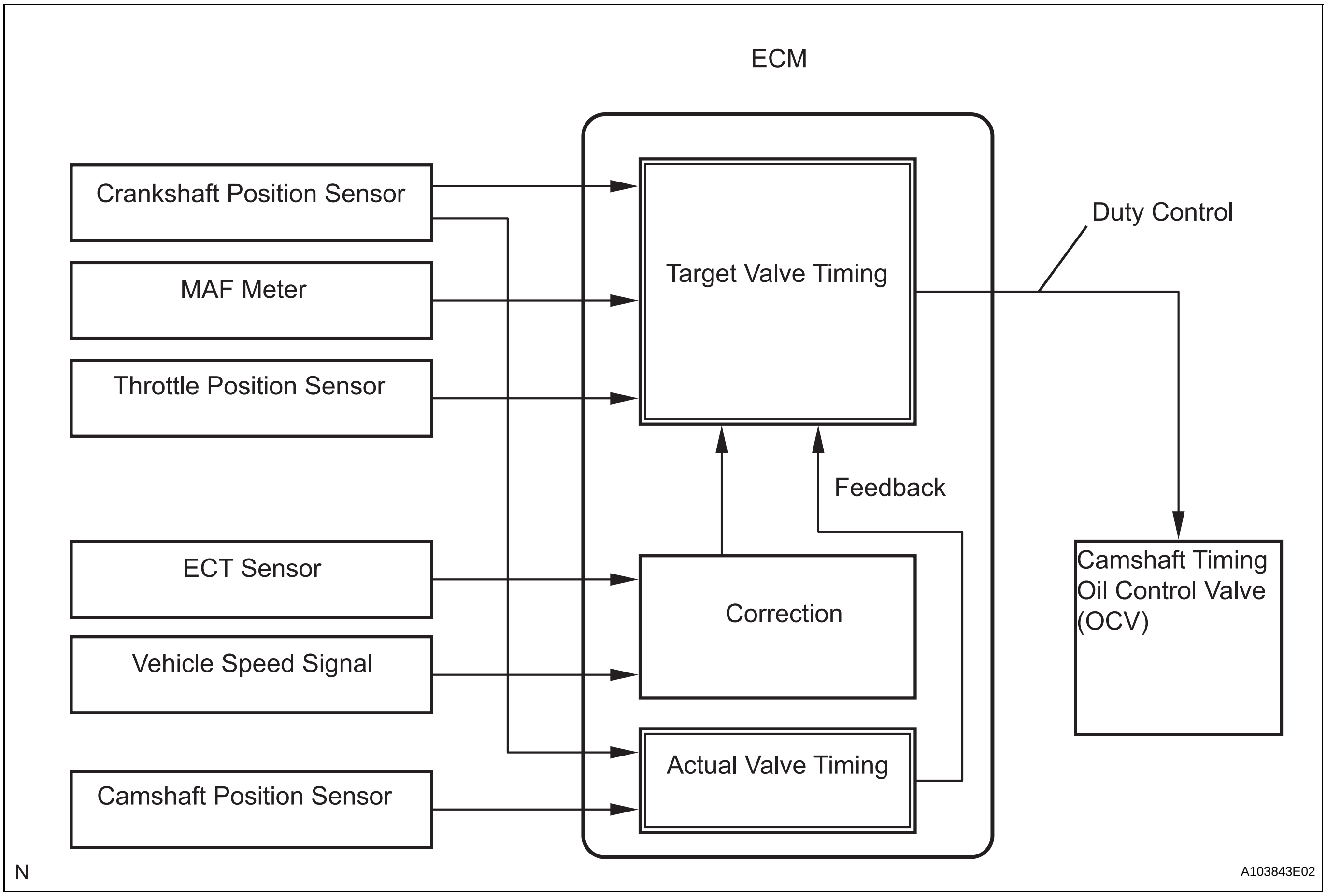
DTC	**P0015**	**Camshaft Position "B" - Timing Over-Retarded (Bank 1)**

DTC	**P0024**	**Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 2)**

DTC	**P0025**	**Camshaft Position "B" - Timing Over-Retarded (Bank 2)**

DESCRIPTION

HINT:
If DTC P0014, P0015, P0024 or P0025 is present, check the VVT (Variable Valve Timing) system.
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 exhaust 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 exhaust 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 Condition	Trouble Area
P0014 P0024	Advanced cam timing: With warm engine and engine speed of between 500 rpm and 4,000 rpm, all conditions (a), (b) and (c) are met (2 trip detection logic): (a) Difference between target and actual exhaust valve timing is more than 5°CA (Crankshaft Angle) for 4.5 seconds (b) Current exhaust valve timing is fixed (timing changes less than 5°CA in 5 seconds) (c) Variations in VVT controller timing are more than 19°CA of maximum delayed timing (advanced)	• Valve timing • Oil control valve (OCV) for exhaust camshaft (bank 1) • OCV filter (bank 1) • Exhaust camshaft • ECM
P0015 P0025	Retarded cam timing: With warm engine and engine speed of between 500 rpm and 4,000 rpm, all conditions (a), (b) and (c) are met (1 trip detection logic): (a) Difference between target and actual exhaust valve timing is more than 5°CA (Crankshaft Angle) for 4.5 seconds (b) Current exhaust valve timing is fixed (timing changes less than 5°CA in 5 seconds) (c) Variations in VVT controller timing are more than 19°CA or less of maximum delayed timing (retarded)	• Valve timing • OCV for exhaust camshaft (bank 2) • OCV filter (bank 2) • Exhaust camshaft • ECM

MONITOR DESCRIPTION

1. The ECM optimizes the exhaust valve timing using the VVT (Variable Valve Timing) system to control the exhaust camshaft. The VVT system includes the ECM, the Oil Control Valve (OCV) and the VVT controller.

ES

2. 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 exhaust camshaft.
   If the difference between the target and actual exhaust valve timings is large, and changes in actual exhaust 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 A, B and C are met:
   (1) The difference between the target and actual exhaust valve timings is more than 5°CA (Crankshaft Angle) and the condition continues for more than 4.5 seconds (Procedure "A").
   (2) It takes 5 seconds or more to change the valve timing by 5°CA (Procedure "B").
   (3) After above procedures "A" and "B" are met, the OCV is forcibly activated 63 times or more (Procedure "C").
3. DTCs P0014 and P0024 (Advanced Cam Timing) are detected with 1 trip detection logic.
4. DTCs P0015 and P0025 (Retarded Cam Timing) are detected with 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.
5. The monitor will not run unless the following conditions are met:
   (a) The engine is warm (the engine coolant temperature is 75°C [167°F] or more).
   (b) The vehicle has been driven at more than 40 mph (64 km/h) for 3 minutes.
   (c) The engine has idled for 3 minutes.

ES

MONITOR STRATEGY

Related DTCs	P0014: Advanced camshaft timing (bank 1) P0015: Retarded camshaft timing (bank 1) P0024: Advanced camshaft timing (bank 2) P0025: Retarded 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	Advanced camshaft timing (bank 1): Immediate Advanced camshaft timing (bank 2): Immediate Retarded camshaft timing (bank 1): 2 driving cycles Retarded camshaft timing (bank 2): 2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	P0100 - P0103 (MAF sensor) P0115 - P0118 (ECT sensor) P0125 (insufficient ECT for closed loop) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351 - P0358 (ignitor)
Battery voltage	11 V or more
Engine RPM	500 to 4,000 rpm
Engine coolant temperature	75 to 100°C (167 to 212°F)

TYPICAL MALFUNCTION THRESHOLDS

Advanced camshaft timing:

Valve timing	No change
Valve timing	Advanced position

Retarded camshaft timing:

Valve timing	No change
Valve timing	Retard position

WIRING DIAGRAM

Refer to DTC P0013 (See page ES-93).

INSPECTION PROCEDURE

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	P0014	P0015
Bank 2	P0024	P0025

- If DTC P0014 or P0015 is displayed, check the exhaust camshaft circuit for the bank 1 VVT system.
- Bank 1 refers to the bank that includes cylinder No. 1.
- If DTC P0024 or P0025 is displayed, check for exhaust camshaft circuit for the bank 2 VVT system.
- Bank 2 refers to the bank that does not include cylinder No. 1.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

ES

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0014, P0015, P0024 OR P0025)

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

Result

Display (DTC output)	Proceed to
P0014, P0015, P0024 or P0025	**A**
P0014, P0015, P0024 or P0025 and other DTCs	**B**

HINT:
If any DTCs other than P0014, P0015, P0024 or P0025 are output, troubleshoot those DTCs first.

B → **GO TO DTC CHART (See page ES-63)**

A

2	PERFORM ACTIVE TEST BY 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) Enter the following menus: 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 Operation	Specified Condition
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 P0014, P0015, P0024 OR P0025)

ES

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) and turn the tester on.
(c) Clear the DTCs (See page ES-45).
(d) Start the engine and warm it up.
(e) Switch the ECM from normal mode to check mode using the tester (See page ES-49).
(f) Drive the vehicle for more than 10 minutes.
(g) Read the DTCs using the tester.

OK:

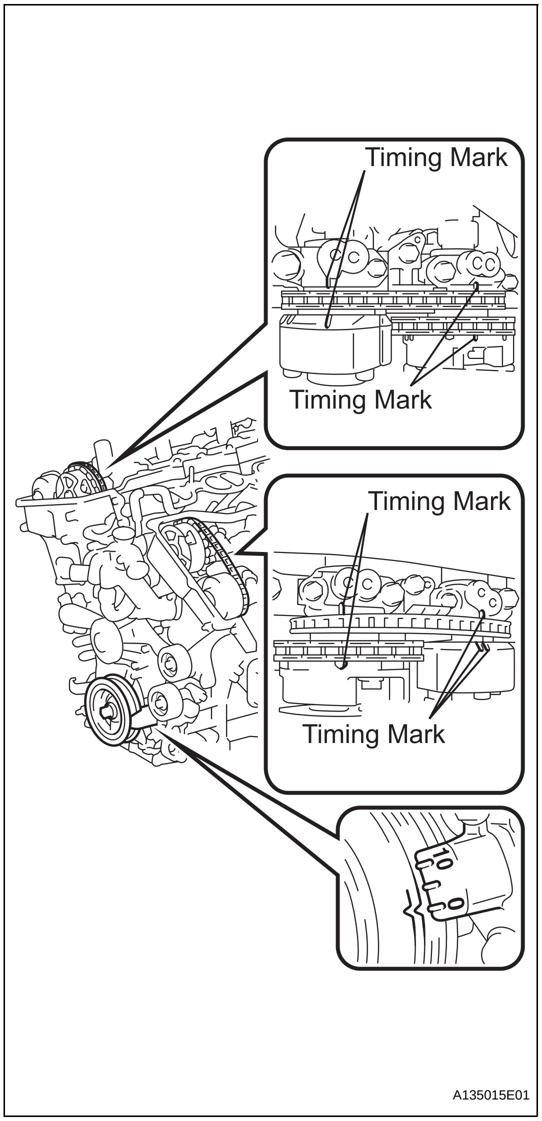
No DTC output.

NG → Go to step 4

OK

END

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



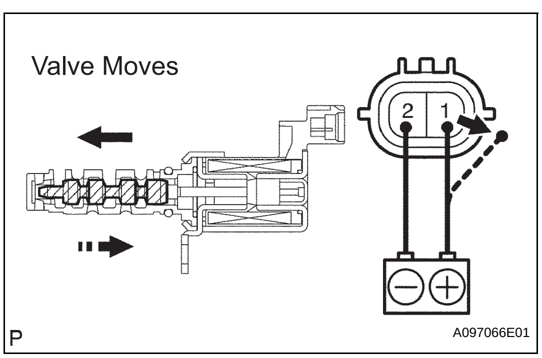
(a) Remove the cylinder head covers RH and LH.
(b) Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.
(c) Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.
If not,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

ES

NG → **ADJUST VALVE TIMING**

OK

5	INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV FOR EXHAUST CAMSHAFT)



(a) Remove the OCV.
(b) Measure the resistance between the terminals of the OCV.
Standard resistance

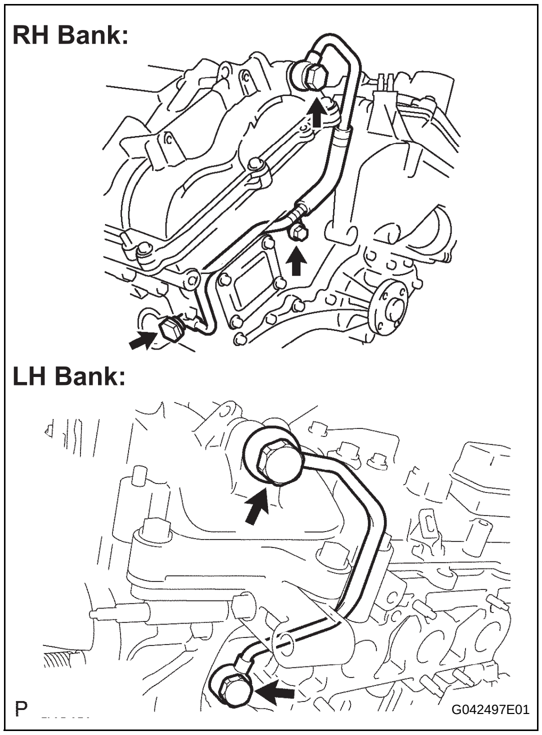
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 Ω

(c) Apply 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 (See page ES-481)**

OK

6	INSPECT OIL CONTROL VALVE FILTER AND PIPE



(a) Remove the oil pipe No. 1 or No. 2.
(b) Remove the oil control valve filter.
(c) Check that the filter and pipe are not clogged.
OK:
Filter is not clogged.

NG → **CLEAN OIL CONTROL VALVE FILTER AND PIPE**

OK

7	REPLACE EXHAUST CAMSHAFT

NEXT

8	CHECK WHETHER DTC OUTPUT RECURS

(a) Clear the DTCs.
(1) Operate the intelligent tester, or disconnect the EFI and ETCS fuses more than 60 seconds to erase the codes.
(b) Start the engine and warm up the engine.
(c) Switch the ECM from normal mode to check mode using the intelligent tester (See page ES-49).
(d) Drive the vehicle for more than 10 minutes or more.
(e) Read the output DTCs using the intelligent tester.
OK:
No DTC output.

HINT:
DTC P0014, P0015, P0024 or P0025 is output when foreign objects in engine oil are caught in some parts of the system. These codes will stay output even if the system returns to normal after a short time. These foreign objects are then captured by the oil, thus eliminating the source of the problem.

OK → **SYSTEM IS OK**

NG

REPLACE ECM (See page ES-518)

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

DTC	P0017	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor B)

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

DTC	P0019	Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor B)

DESCRIPTION

In the VVT system, the appropriate intake and exhaust valve open and close timings are controlled by the ECM. The ECM performs intake and exhaust valve control by performing the following: 1) controlling the camshaft and camshaft oil control valve, and operating the camshaft timing gear; and 2) changing the relative positions of the gaps between the camshaft and crankshaft.

DTC No.	DTC Detection Condition	Trouble Area
P0016	Deviation in crankshaft position sensor signal and VVT sensor 1 (for intake camshaft (bank 1)) signal (2 trip detection logic)	• Mechanical system (Timing chain has jumped teeth or chain stretched) • ECM
P0017	Deviation in crankshaft position sensor signal and VVT sensor 1 (for exhaust camshaft (bank 1)) signal (2 trip detection logic)	• Mechanical system (Timing chain has jumped teeth or chain stretched) • ECM
P0018	Deviation in crankshaft position sensor signal and VVT sensor 2 (for intake camshaft (bank 2)) signal (2 trip detection logic)	• Mechanical system (Timing chain has jumped teeth or chain stretched) • ECM
P0019	Deviation in crankshaft position sensor signal and VVT sensor 2 (for exhaust camshaft (bank 2)) signal (2 trip detection logic)	• Mechanical system (Timing chain has jumped teeth or chain stretched) • ECM

MONITOR DESCRIPTION

To monitor the correlation of the intake camshaft position and crankshaft position, the ECM checks the VVT learning value while the engine is idling. The VVT learning value is calibrated based on the camshaft position and crankshaft position. The intake valve timing is set to the most retarded angle while the engine is idling. If the VVT learning value is out of the specified range in consecutive driving cycles, the ECM illuminates the MIL and sets the DTC P0016 (Bank 1) or P0018 (Bank 2).
To monitor the correlation of the exhaust camshaft position and crankshaft position, the ECM checks the VVT learning value while the engine is idling. The VVT learning value is calibrated based on the camshaft position and crankshaft position. The exhaust valve timing is set to the most advanced angle while the engine is idling. If the VVT learning value is out of the specified range in consecutive driving cycles, the ECM illuminates the MIL and sets the DTC P0017 (Bank 1) or P0019 (Bank 2).

MONITOR STRATEGY

Related DTCs	P0016: Camshaft timing misalignment at idle (intake camshaft bank 1) P0017: Camshaft timing misalignment at idle (exhaust camshaft bank 1) P0018: Camshaft timing misalignment at idle (intake camshaft bank 2) P0019: Camshaft timing misalignment at idle (exhaust camshaft bank 2)
Required sensors/components (Main)	VVT actuator

Required sensors/components (Sub)	Camshaft position sensor, Crankshaft position sensor
Frequency of operation	Once per drive cycle
Duration	Within 1 minute
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs are not present	P0011 (VVT system 1 - advance) P0012 (VVT system 1 - retard) P0021 (VVT system 2 - advance) P0115 - P0118 (ECT sensor)

Intake side:

Engine speed	500 to 1,000 rpm

Exhaust side:

VVT feedback mode	Executing
VVT	Maximum advanced position
Engine speed	500 to 1,000 rpm

TYPICAL MALFUNCTION THRESHOLDS

Intake side:

One of the following conditions is met:	Condition 1 or 2
1. VVT leaning value at maximum retarded valve timing	Less than 18.5°CA
2. VVT leaning valve at maximum retarded valve timing	More than 43.5°CA

Exhaust side:

One of the following conditions is met:	Condition 1 or 2
1. VVT leaning value	Less than 77°CA
2. VVT leaning value	More than 102°CA

WIRING DIAGRAM

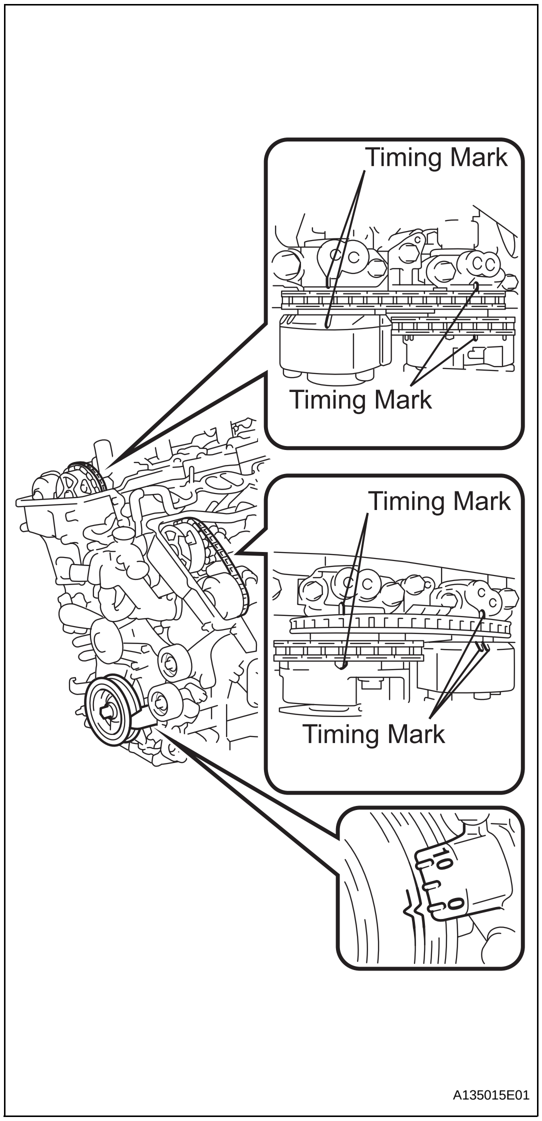
Refer to DTC P0335 (See page ES-224).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

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



(a) Remove the cylinder head covers RH and LH.

(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 covers.

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

OK

REPLACE ECM (See page ES-518)

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

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

DTC	**P0051**	**Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)**

DTC	**P0052**	**Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)**

DESCRIPTION

HINT:

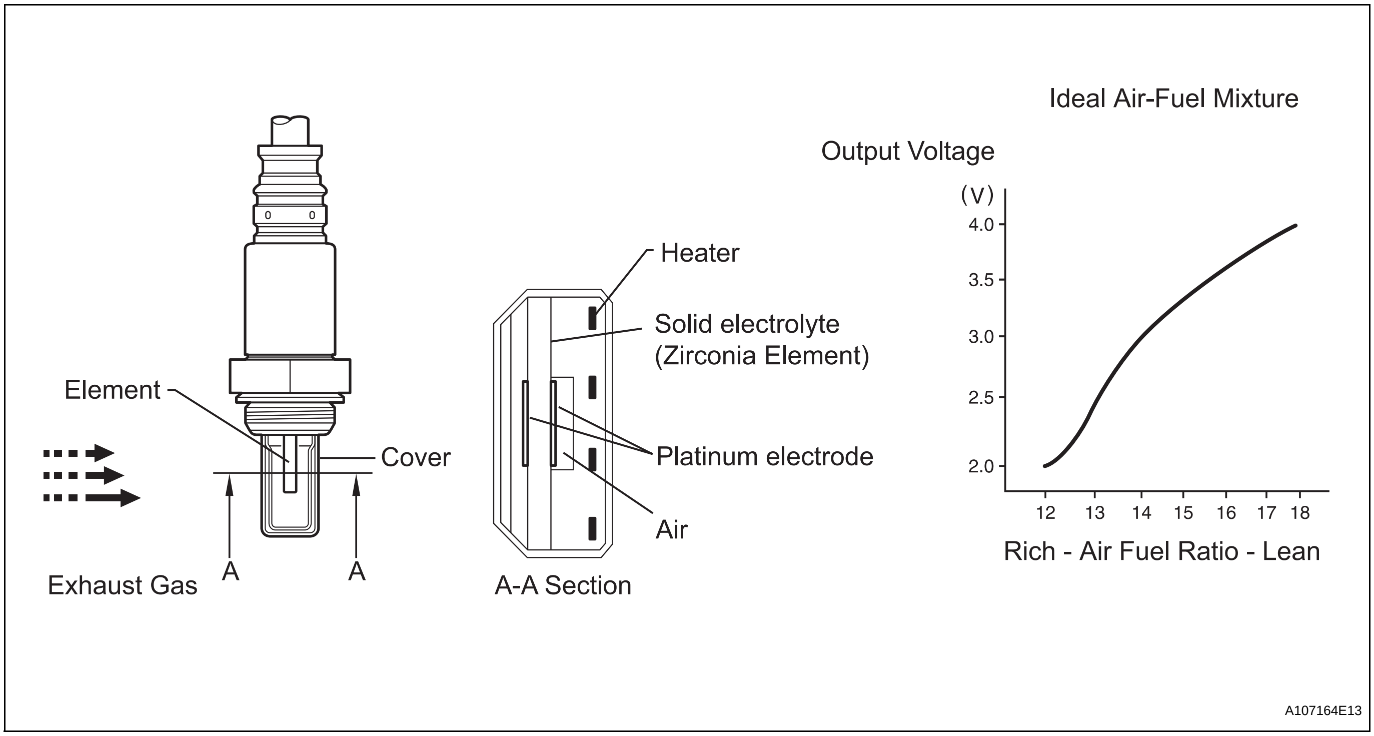
- Although the DTC titles include oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.

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

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

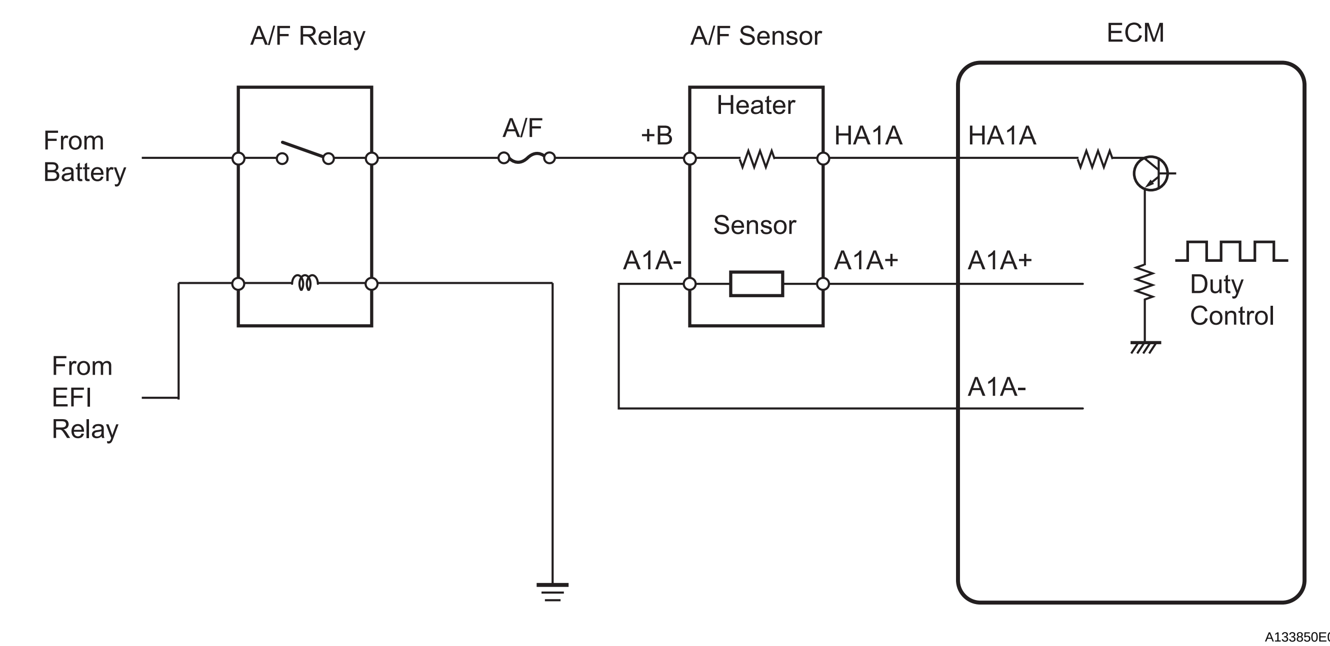
A three-way catalytic converter (TWC) is used in order to convert the carbon monoxide (CO), hydrocarbon (HC), and nitrogen oxide (NOx) into less harmful substances. To allow the TWC to function effectively, it is necessary to keep the air-fuel ratio of the engine near the stoichiometric air-fuel ratio.

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



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 engine switch is turned off.
- The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the B+ side of the circuit.

Reference (System Diagram of Bank 1 Sensor 1):



DTC No.	DTC Detection Condition	Trouble Area
P0031 P0051	Air-Fuel Ratio (A/F) sensor heater (bank 1, 2, sensor 1) current is less than 0.8 A (1 trip detection logic)	• Open in A/F sensor heater (bank 1, 2, sensor 1) circuit • A/F sensor heater (bank 1, 2, sensor 1) • A/F HTR relay • ECM

DTC No.	DTC Detection Condition	Trouble Area
P0032 P0052	Air-Fuel Ratio (A/F) sensor heater (bank 1, 2, sensor 1) current is more than 10 A (1 trip detection logic)	• Short in A/F sensor heater (bank 1, 2, sensor 1) circuit • A/F sensor heater (sensor 1) • A/F HTR 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

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.

ES

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 (Sub)	-
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs are not present	P0300 - P0306 (misfire)

P0031 and P0051:

Battery voltage	10.5 V or more
Heater output duty	50 % or more

Time after engine start	10 seconds or more

P0032 and P0052:

Battery voltage	Less than 20 V
Engine	Running
Heater output duty	More than 0 %

TYPICAL MALFUNCTION THRESHOLDS

P0031 and P0051:

A/F sensor heater current	Less than 0.8 A

P0032 and P0052:

Hybrid IC high current limiter port	Fail

COMPONENT OPERATING RANGE

P0031 and P0051:

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

WIRING DIAGRAM

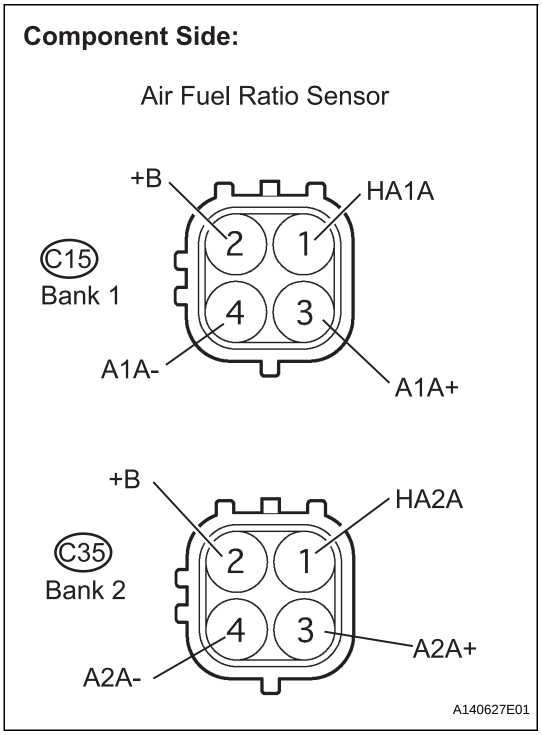
Refer to DTC P2195 (See page ES-350)

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the C15 or C35 A/F sensor connector.
(b) Measure the resistance according to the value(s) in the table below.
Standard resistance (Bank 1 sensor 1)

Tester Connection	Condition	Specified Condition
HA1A (1) - +B (2)	20°C (68°F)	1.8 to 3.4 Ω
HA1A (1) - A1A- (4)	-	10 kΩ or higher

Standard resistance (Bank 2 sensor 1)

Tester Connection	Condition	Specified Condition
HA2A (1) - +B (2)	20°C (68°F)	1.8 to 3.4 Ω
HA2A (1) - A2A- (4)	-	10 kΩ or higher

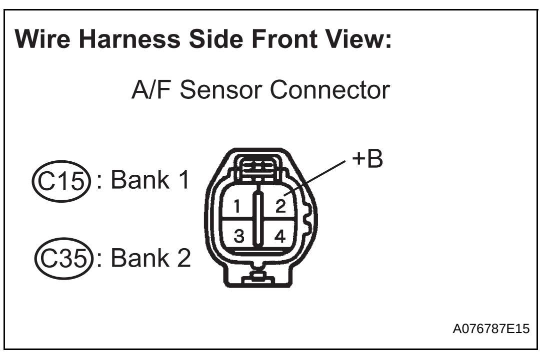
(c) Reconnect the A/F sensor connector.

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

ES

OK

2	CHECK TERMINAL VOLTAGE (+B OF A/F SENSOR)



(a) Disconnect the C15 or C35 A/F sensor Connector.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage between the terminals of the A/F sensor connector and body ground.
Standard voltage

Tester Connection	Specified Condition
+B (C15-2) - Body ground	9 to 14 V
+B (C35-2) - Body ground	9 to 14 V

OK → **Go to step 7**

NG

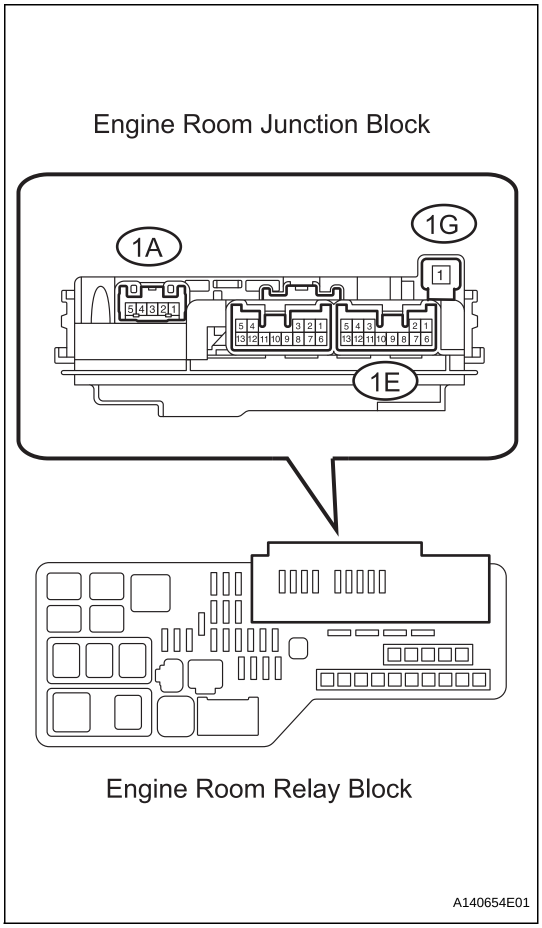
3	INSPECT FUSE (A/F)

(a) Remove the A/F sensor fuse from the No. 1 integration relay.
(b) Measure the A/F sensor fuse resistance.
Standard resistance:
Below 1 Ω
(c) Reinstall the A/F fuse.

NG → **REPLACE A/F FUSE**

OK

4 INSPECT ENGINE ROOM JUNCTION BLOCK (EFI RELAY, A/F RELAY)



(a) Remove the engine room junction block from the engine room R/B.

(b) Inspect the EFI relay.

(1) Measure the EFI relay resistance.

Standard resistance

Tester Connection	Specified Condition
1E-12 - 1E-6	10 kΩ or higher
1E-12 - 1E-6	Below 1 Ω (Apply battery voltage between terminals 1E-9 and 1E-10)

(c) Inspect the A/F relay.

(1) Measure the A/F relay resistance.

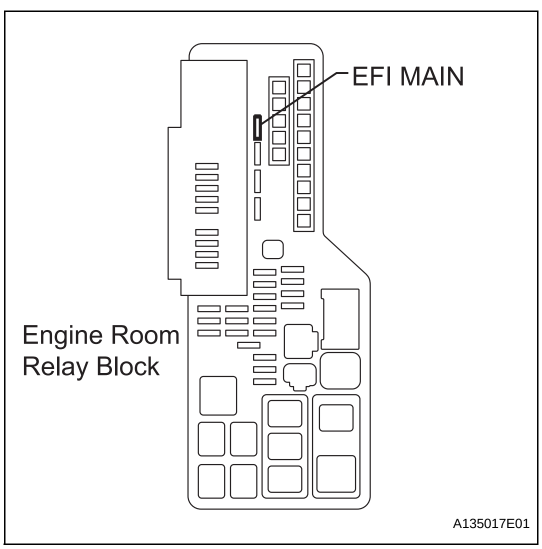
Standard resistance

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

NG → **REPLACE ENGINE ROOM JUNCTION BLOCK**

OK

5 INSPECT FUSE (EFI MAIN)



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

(b) Measure the EFI MAIN fuse resistance.

Standard resistance:

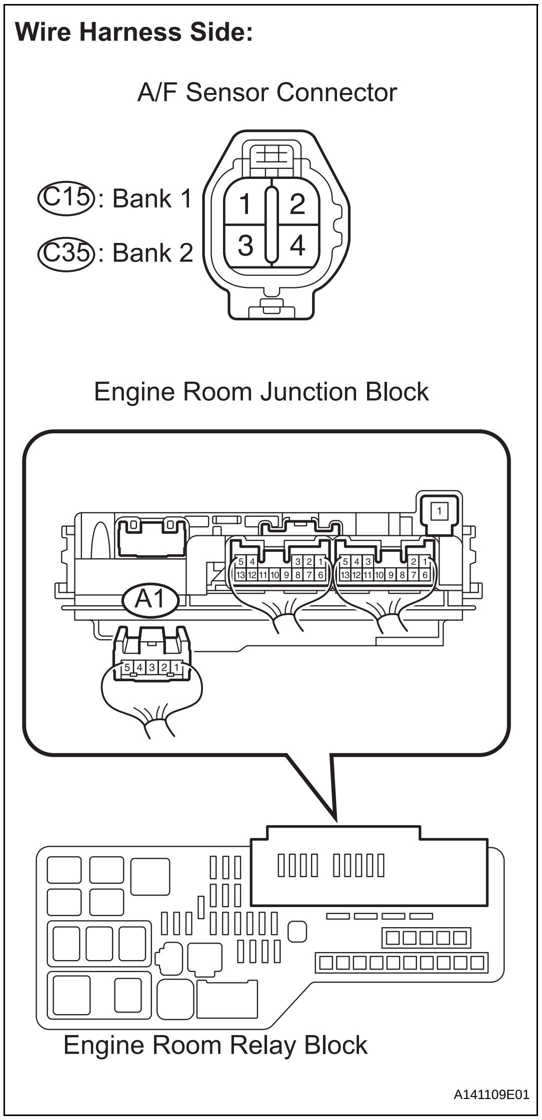
Below 1 Ω

(c) Reinstall the EFI MAIN fuse.

NG → **REPLACE EFI MAIN FUSE**

OK

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



(a) Disconnect the C15 or C35 A/F sensor connector.
(b) Remove the engine room junction block from the engine room R/B.
(c) Measure the resistance between the terminals.

Standard resistance (Check for open)

Tester Connection	Specified Condition
+B (C15-2) - 1A-4 (Engine room R/B)	Below 1 Ω
+B (C35-2) - 1A-4 (Engine room R/B)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
+B (C15-2) or 1A-4 (Engine room R/B) - Body ground	10 kΩ or higher
+B (C35-2) or 1A-4 (Engine room R/B) - Body ground	10 kΩ or higher

(d) Reinstall the engine room junction block.
(e) Reconnect the A/F sensor connector.

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

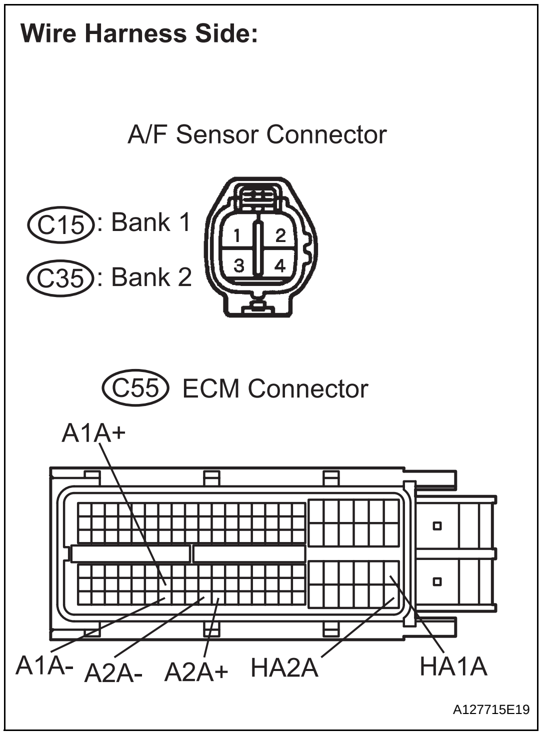
ES

OK

CHECK ECM POWER SOURCE CIRCUIT (See page ES-432)

ES

7 CHECK HARNESS AND CONNECTOR



(a) Disconnect the C15 or C35 A/F sensor connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance between the terminals.
Standard resistance (Check for open)

Tester Connection	Specified Condition
HA1A (C55-86) - HA1A (C15-1)	Below 1 Ω
HA2A (C55-109) - HA2A (C35-1)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
HA1A (C55-86) or HA1A (C15-1) - Body ground	10 kΩ or higher
HA2A (C55-109) or HA2A (C35-1) - Body ground	10 kΩ or higher

(d) Reconnect the ECM connector.
(e) Reconnect the A/F sensor connectors.

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

OK

8 CHECK WHETHER DTC OUTPUT RECURS

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the intelligent tester on.
(d) Clear the DTCs (See page ES-45).
(e) Start the engine.
(f) Allow the engine to idle for 1 minute or more.
(g) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(h) Read the DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P0031, P0032, P0051 and/or P0052	B

B → **REPLACE ECM (See page ES-518)**

A

CHECK FOR INTERMITTENT PROBLEMS

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)**

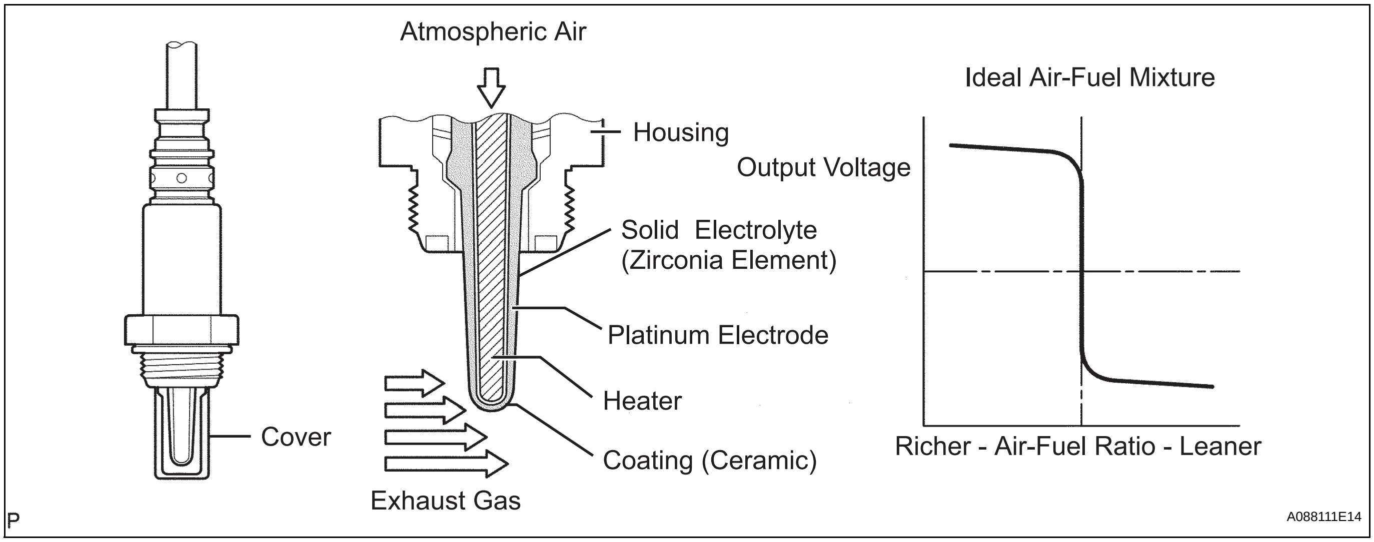
DTC	**P0058**	**Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)**

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

DTC	**P0161**	**Oxygen Sensor Heater Circuit Malfunction (Bank 2 Sensor 2)**

DESCRIPTION

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

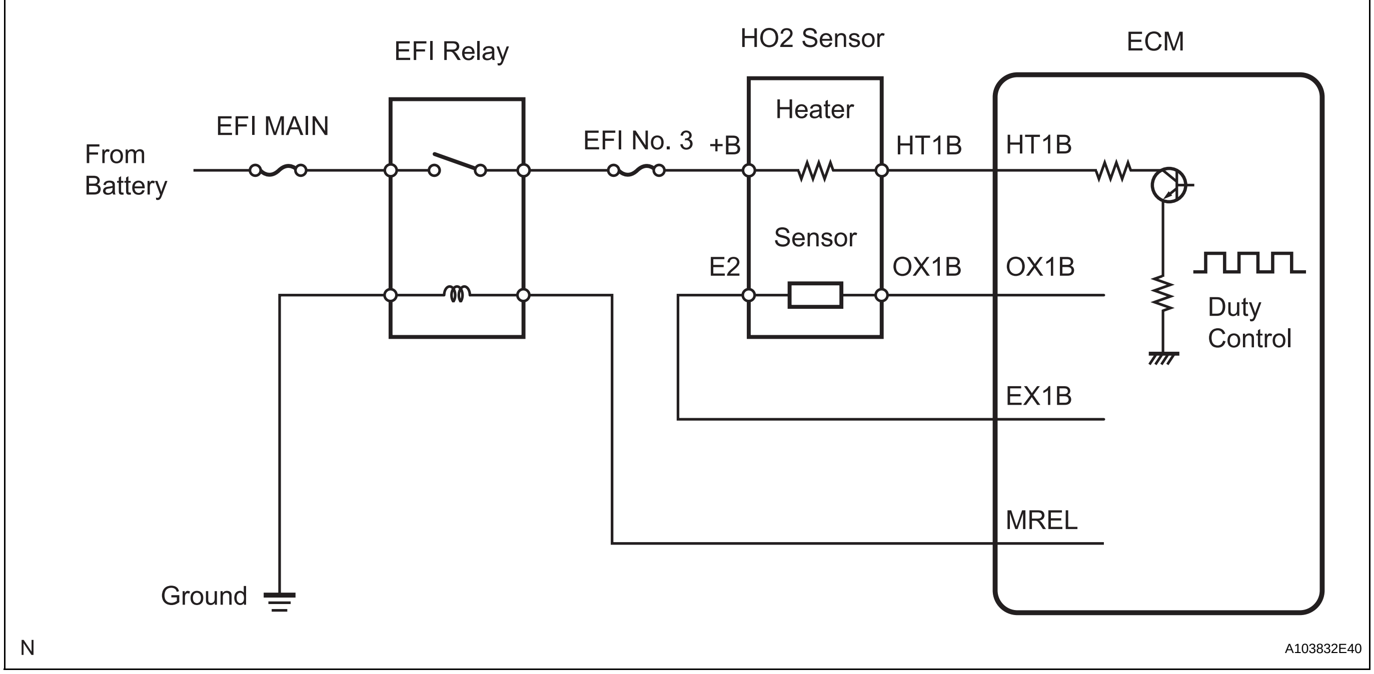


ES

HINT:

- Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.
- When any of these DTCs are set, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) Sensor heater in fail-safe mode. Fail-safe mode continues until the engine 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.

Reference (System Diagram of Bank 1 Sensor 2):



DTC No.	DTC Detection Condition	Trouble Area
P0037 P0057	Heated Oxygen (HO2) sensor heater current is less than 0.3 A (1 trip detection logic)	• Open in HO2 sensor heater circuit • HO2 sensor heater • Engine room junction block (EFI relay) • ECM
P0038 P0058	Heated Oxygen (HO2) sensor heater current is more than 2 A (1 trip detection logic)	• Short in HO2 sensor heater circuit • HO2 sensor heater • Engine room junction block (EFI relay) • ECM

DTC No.	DTC Detection Condition	Trouble Area
P0141 P0161	Cumulative heater resistance correction value exceeds the acceptable threshold. (2 trip detection logic)	• HO2 sensor heater • 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 sensing position 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.

Heated oxygen sensor heater range check (P0037,P0038, P0057 and P0058):

The ECM monitors the current applied to the O2 sensor heater to check the heater for malfunctions. If the current is below the threshold value, the ECM will determine that there is an open circuit in the heater. If the current is above the threshold value, the ECM will determine that there is a short circuit in the heater.

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.

Heated oxygen sensor heater performance (P0141 and P0161):

After the accumulated heater ON time exceeds 100 seconds, the ECM calculates the heater resistance using the battery voltage and the current applied to the heater. If the resistance is above the threshold value, the ECM will determine that there is a malfunction in the HO2S heater and set DTC P0141 and P0161.

MONITOR STRATEGY

Related DTCs	P0037: Heated oxygen sensor heater (bank 1 sensor 2) open/short (Low electrical current) P0038: Heated oxygen sensor heater (bank 1 sensor 2) open/short (High electrical current) P0057: Heated oxygen sensor heater (bank 2 sensor 2) open/short (Low electrical current) P0058: Heated oxygen sensor heater (bank 2 sensor 2) open/short (High electrical current) P0141: Heated oxygen sensor heater performance (bank 1 sensor 2) P0161: Heated oxygen sensor heater performance (bank 2 sensor 2)
Required sensors / components (Main)	Heated oxygen sensor heater (bank 1 sensor 2) Heated oxygen sensor heater (bank 2 sensor 2)
Required sensors / components (Sub)	Vehicle speed sensor
Frequency of operation	Continuous
Duration	1 second: P0037, P0038, P0057 and P0058 10 seconds: P0141 and P0161
MIL operation	Immediate: P0037, P0038, P0057 and P0058 2 driving cycles: P0141 and P0161
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs are not present	None

P0037 and P0057:

Battery voltage	10.5 to 20 V

P0038 and P0058 (Case 1):

Battery voltage	10.5 V or more
Engine	Running
Starter	OFF

P0038 and P0058 (Case 2):

Battery voltage	10.5 to 20 V

P0141 and P0161:

One of the following conditions is met:	Condition A or B
A. All of the following conditions are met:	Conditions 1, 2, 3, 4 and 5
1. Battery voltage	10.5 V or more
2. Fuel cut	OFF
3. Time after fuel cut ON to OFF	30 seconds or more
4. Accumulated heater ON time	100 seconds or more
5. Learned heater OFF current operation	Completed
B. Duration that rear heated oxygen sensor impedance is less than 15 kΩ	2 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

P0037 and P0057:

Heater current	Less than 0.3 A

P0038 and P0058:

One of the following conditions is met:	Condition A or B
A. Learned heater OFF current	More than 2 A
B. Heater current	2 A or more

P0141 and P0161 (Heater performance monitor check):

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

COMPONENT OPERATING RANGE

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

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-25).

WIRING DIAGRAM

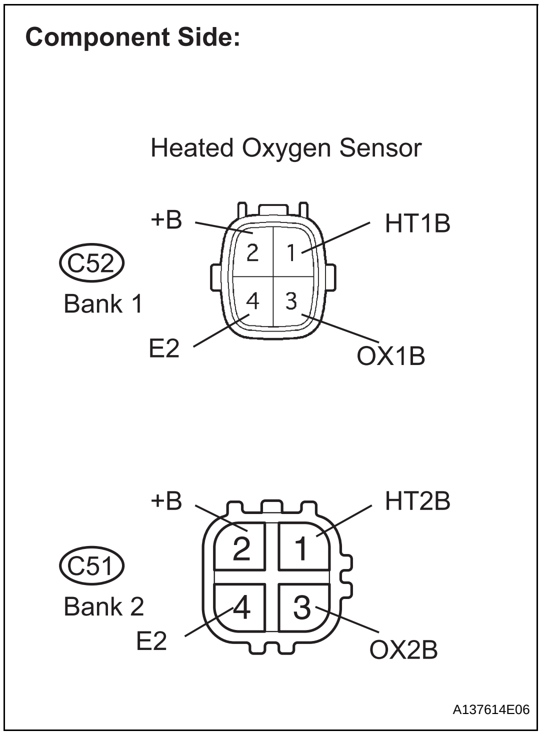
Refer to DTC P0136 (See page ES-178).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)



(a) Disconnect the C52 heated oxygen sensor connector (Bank 1 Sensor 2) or C51 heated oxygen sensor connector (Bank 2 Sensor 2).

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

Standard resistance (Bank 1 sensor 2)

Tester Connection	Condition	Specified Condition
HT1B (1) - +B (2)	20°C (68°F)	11 to 16 Ω
HT1B (1) - E2 (4)	Always	10 kΩ or higher

Standard resistance (Bank 2 sensor 2)

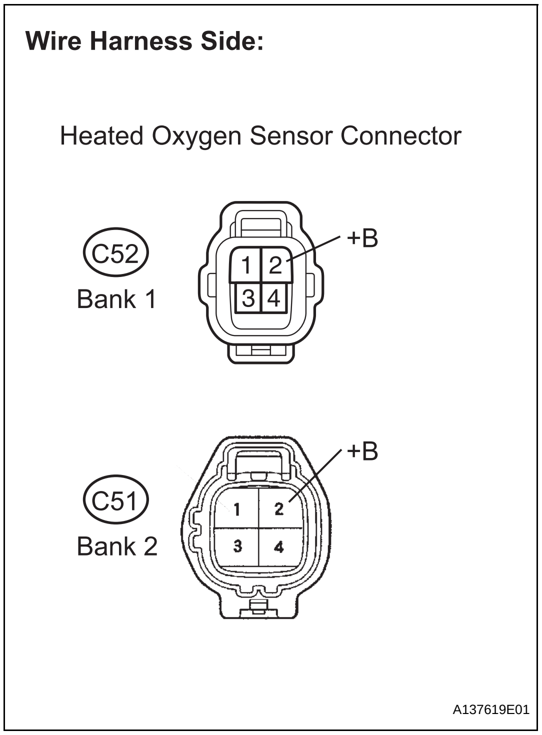
Tester Connection	Condition	Specified Condition
HT2B (1) - +B (2)	20°C (68°F)	11 to 16 Ω
HT2B (1) - E2 (4)	Always	10 kΩ or higher

(c) Reconnect the HO2 sensor connector.

NG → **REPLACE HEATED OXYGEN SENSOR (See page EC-20)**

OK

2	CHECK TERMINAL VOLTAGE (+B OF HO2 SENSOR)



(a) Disconnect the C52 heated oxygen sensor connector (Bank 1 Sensor 2) or C51 heated oxygen sensor connector (Bank 2 Sensor 2).

(b) Turn the ignition switch on (IG).

(c) Measure the voltage between the terminals.

Standard voltage

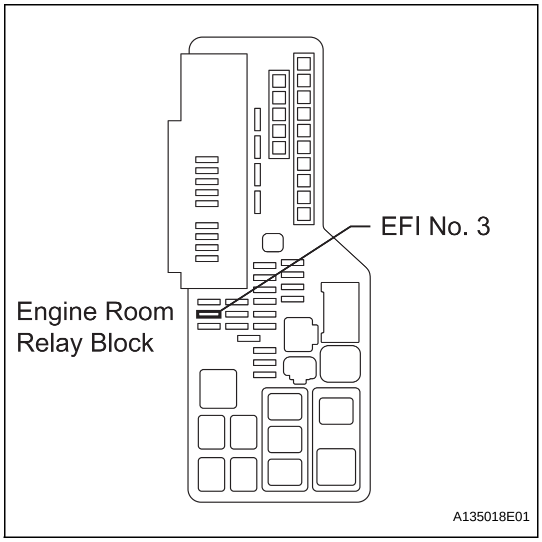
Tester Connection	Specified Condition
+B (C52-2) - Body ground	9 to 11 V
+B (C51-2) - Body ground	9 to 11 V

(d) Reconnect the HO2 sensor connector.

OK → **Go to step 7**

NG

3 INSPECT FUSE (EFI NO. 3)

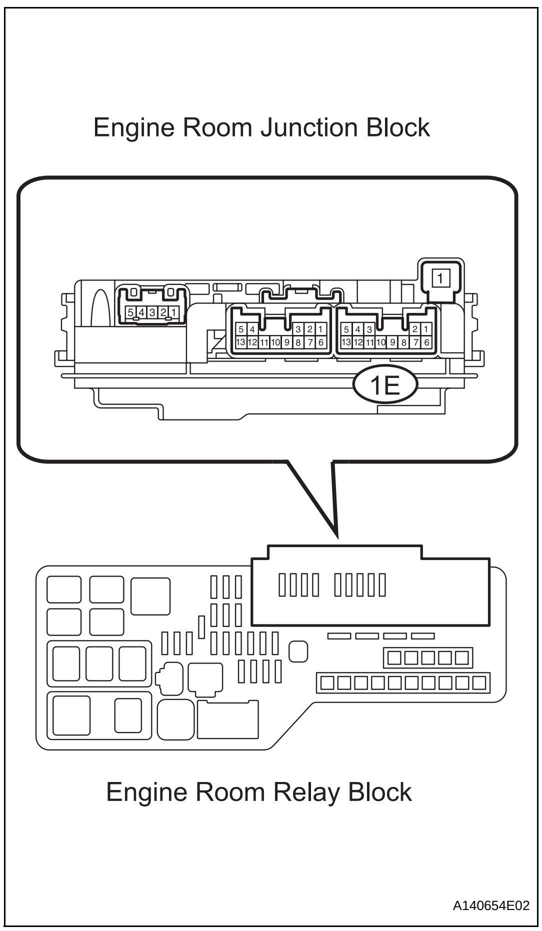


(a) Remove the EFI No. 3 fuse from the engine room R/B.
(b) Measure the EFI No. 3 fuse resistance.
Standard resistance:
Below 1 Ω
(c) Reinstall the EFI No. 3 fuse.

NG → **REPLACE EFI NO. 3 FUSE**

OK

4 INSPECT ENGINE ROOM JUNCTION BLOCK



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

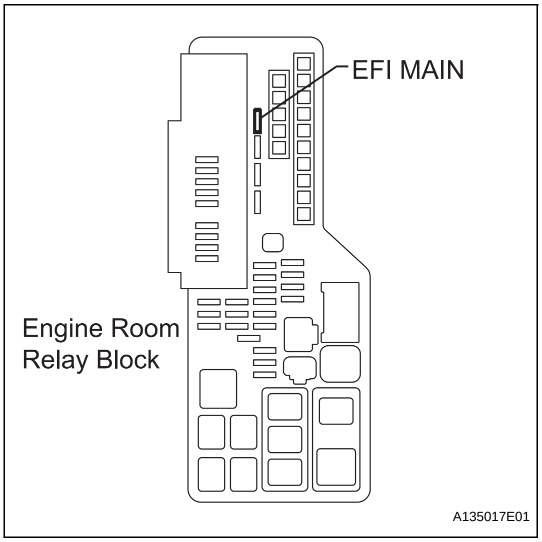
Tester Connection	Specified Condition
1E-12 - 1E-6	10 kΩ or higher
1E-12 - 1E-6	Below 1 Ω (Apply battery voltage between terminals 1E-9 and 1E-10)

(c) Reinstall the engine room junction block.

NG → **REPLACE ENGINE ROOM JUNCTION BLOCK**

OK

5	**INSPECT FUSE (EFI MAIN)**

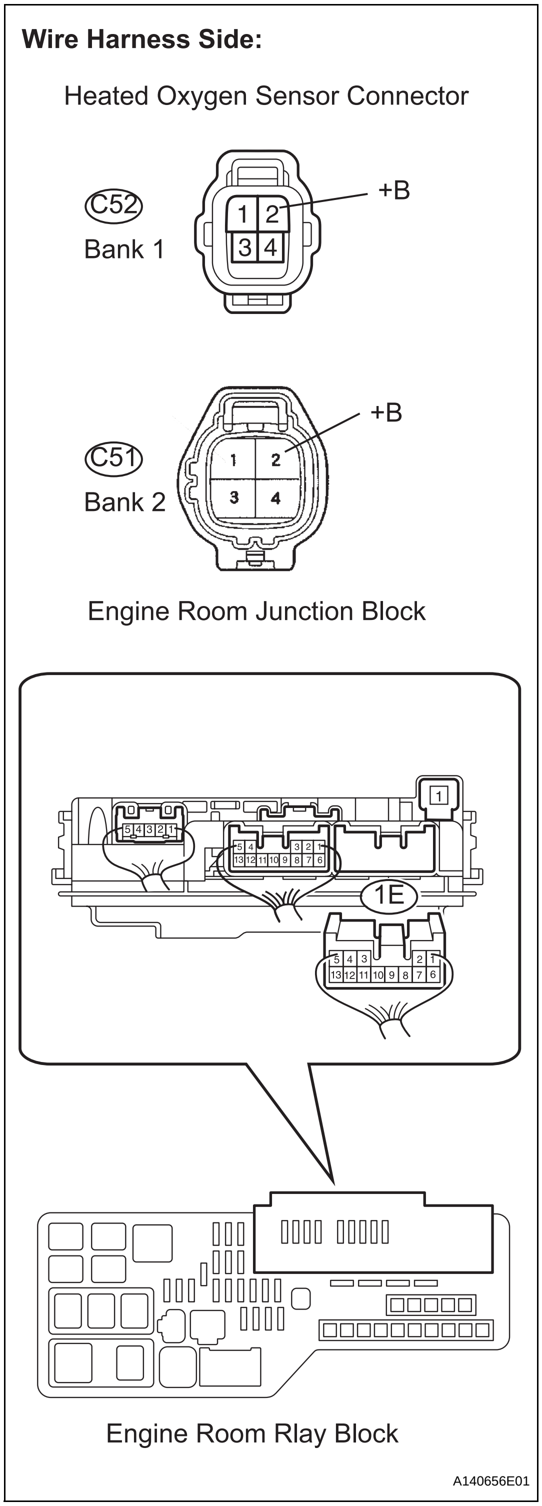


(a) Remove the EFI MAIN fuse from the engine room R/B.
(b) Measure the EFI MAIN fuse.
Standard resistance:
Below 1 Ω
(c) Reinstall the EFI MAIN fuse.

NG → **REPLACE EFI MAIN FUSE**

OK

6	CHECK HARNESS AND CONNECTOR (HO2 SENSOR - EFI RELAY)



(a) Disconnect the C52 or C51 HO2 sensor connector.
(b) Remove the engine room junction block from the engine room R/B.
(c) Measure the resistance between the terminals.

Standard resistance (Check for open)

Tester Connection	Specified Condition
+B (C52-2) - 1E-6 (Engine room R/B)	Below 1 Ω
+B (C51-2) - 1E-6 (Engine room R/B)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
+B (C52-2) or 1E-6 (Engine room R/B) - Body ground	10 kΩ or higher
+B (C51-2) or 1E-6 (Engine room R/B) - Body ground	10 kΩ or higher

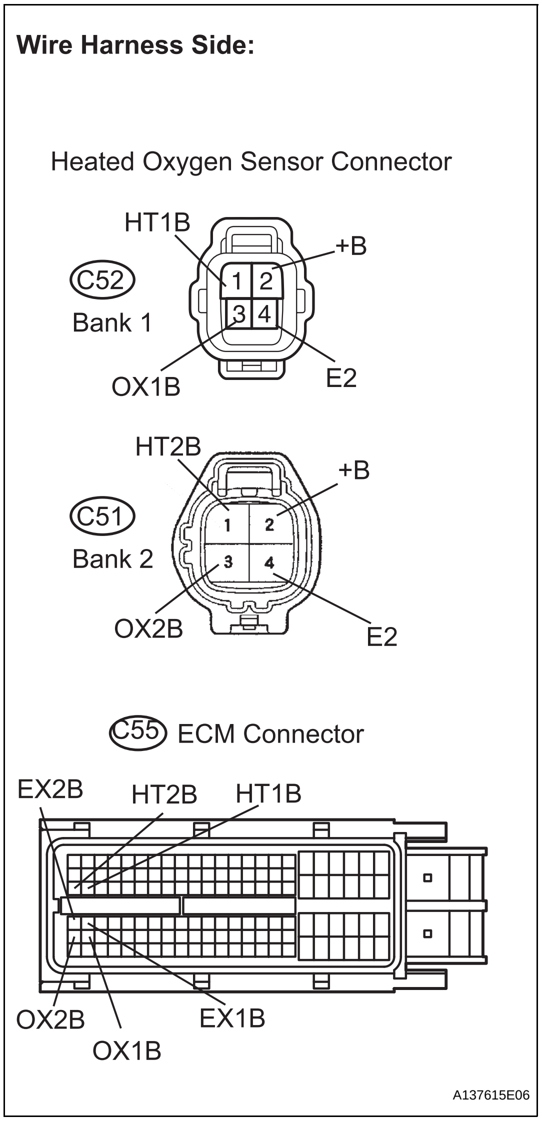
(d) Reinstall the engine room junction block.
(e) Reconnect the HO2 sensor connector.

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

OK

CHECK ECM POWER SOURCE CIRCUIT

7	CHECK HARNESS AND CONNECTOR (HO2 SENSOR - ECM)



(a) Disconnect the C52 heated oxygen sensor connector (Bank 1 Sensor 2) or C51 heated oxygen sensor connector (Bank 2 Sensor 2).
(b) Turn the ignition switch on (IG).
(c) Measure the voltage according to the value(s) in the table below.

Standard voltage

Terminal Connection	Specified Condition
+B (C52-2) - Body ground	9 to 14 V
+B (C51-2) - Body ground	9 to 14 V

(d) Turn the engine switch off.
(e) Disconnect the C55 ECM connector.
(f) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Terminal Connection	Specified Condition
HT1B (C52-1) - HT1B (C55-48)	Below 1 Ω
OX1B (C52-3) - OX1B (C55-88)	Below 1 Ω
E2 (C52-4) - EX1B (C55-65)	Below 1 Ω
HT2B (C51-1) - HT2B (C55-47)	Below 1 Ω
OX2B (C51-3) - OX2B (C55-87)	Below 1 Ω
E2 (C51-4) - EX2B (C55-64)	Below 1 Ω

Standard resistance (Check for short)

Terminal Connection	Specified Condition
HT1B (C52-1) or HT1B (C55-48) - Body ground	10 kΩ or higher
OX1B (C52-3) - OX1B (C55-88) - Body ground	10 kΩ or higher
E2 (C52-4) or EX1B (C55-65) - Body ground	10 kΩ or higher
HT2B (C51-1) or HT2B (C55-47) - Body ground	10 kΩ or higher
OX2B (C51-3) or OX2B (C55-87) - Body ground	10 kΩ or higher
E2 (C51-4) or EX2B (C55-64) - Body ground	10 kΩ or higher

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

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

OK

8	CHECK WHETHER DTC OUTPUT RECURS

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the intelligent tester on.
(d) Clear the DTCs (See page ES-45).
(e) Start the engine.
(f) Allow the engine to idle for 2 minutes.

ES

(g) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(h) Read the DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P0037, P0038, P0057 and/or P0058	B

B → **REPLACE ECM (See page ES-518)**

A

CHECK FOR INTERMITTENT PROBLEMS (See page ES-33)

DTC	P0100	Mass or Volume Air Flow Circuit

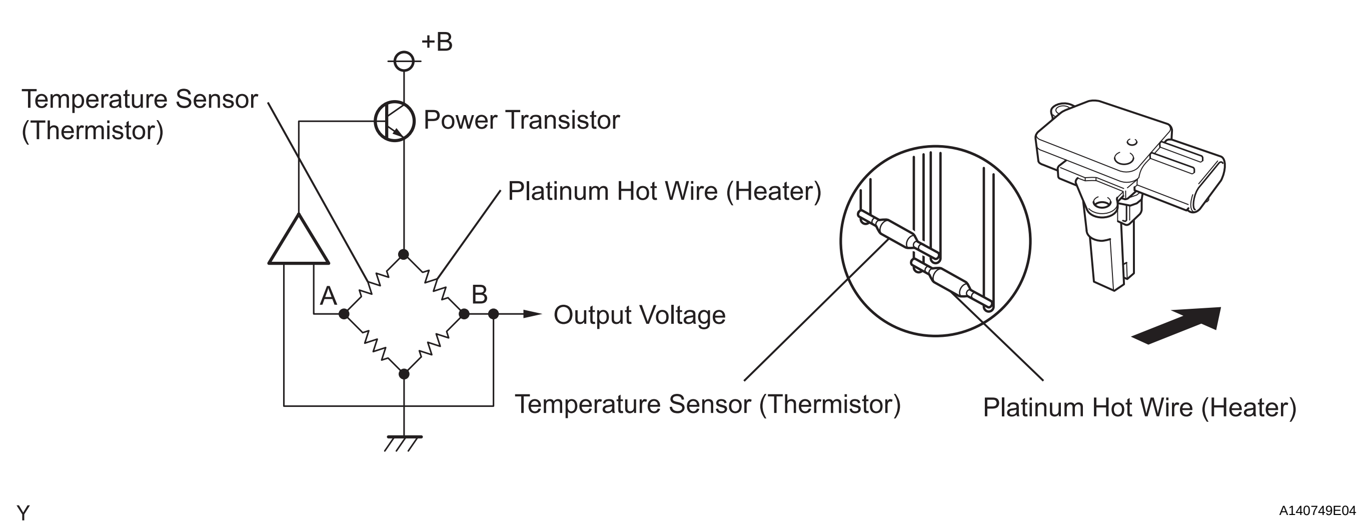
DTC	P0102	Mass or Volume Air Flow Circuit Low Input

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 valve. The ECM uses this information to determine the fuel injection time and to prove 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.

ES



DTC No.	DTC Detection Condition	Trouble Area
P0100	Open or short in Mass Air Flow (MAF) meter circuit for 3 seconds	• Open or short in MAF meter circuit • MAF meter • ECM
P0102	Open in Mass Air Flow (MAF) meter circuit for 3 seconds	• Open in MAF meter circuit • Short in MAF meter circuit • MAF meter • ECM
P0103	Short in Mass Air Flow (MAF) meter circuit for 3 seconds	• Short in MAF meter circuit (+B circuit) • MAF meter • ECM

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

Mass Air Flow Rate (gm/s)	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 output voltage 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 (Sub)	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 are not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0100:

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

P0102:

Mass air flow meter voltage	Less than 0.2 V

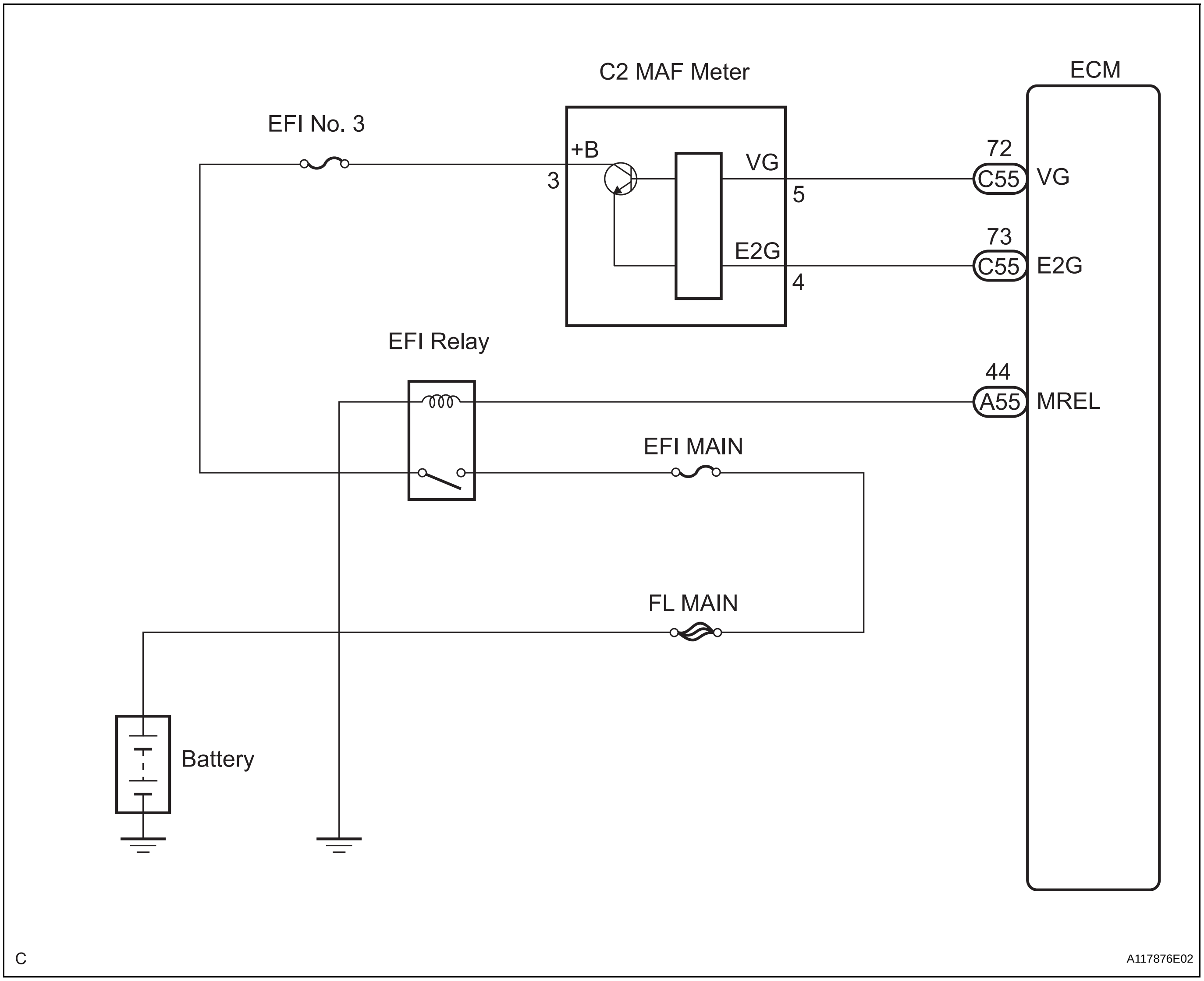
P0103:

Mass air flow meter voltage	More than 4.9 V

COMPONENT OPERATING RANGE

Mass air flow meter voltage	Between 0.4 V and 2.2 V

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	READ VALUE OF MASS AIR FLOW METER (MAF)

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

Result

Mass Air Flow Rate (gm/s)	Proceed to
0.0	A
271.0 or more	B
Between 1.0 and 270.0 (*1)	C

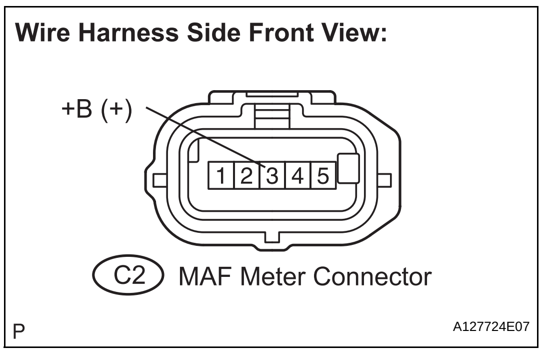
*1: The value must be changed when the throttle valve is open or closed.

B → **Go to step 8**

C → **CHECK FOR INTERMITTENT PROBLEMS (See page ES-33)**

A

2 INSPECT MASS AIR FLOW METER (POWER SOURCE VOLTAGE)



(a) Disconnect the C2 mass air flow (MAF) meter connector.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage according to the value(s) in the table below.

Standard voltage

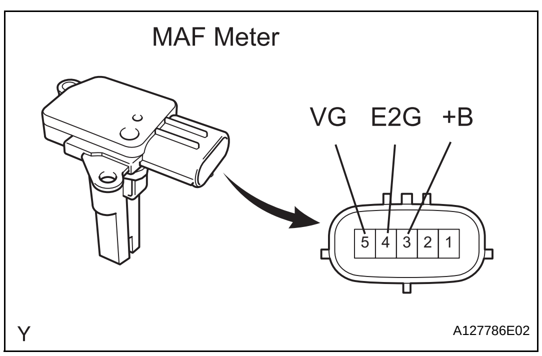
Tester Connection	Specified Condition
+B (C2-3) - Body ground	9 to 14 V

(d) Reconnect the MAF meter connector.

NG → **Go to step 5**

OK

3 INSPECT MASS AIR FLOW METER (VG VOLTAGE)



(a) Inspect the output voltage.
(1) Apply battery voltage across terminals +B and E2G.
(2) Connect the positive (+) tester probe to terminal VG, and negative (-) tester probe to terminal E2G.
(3) Measure the voltage between the terminals.

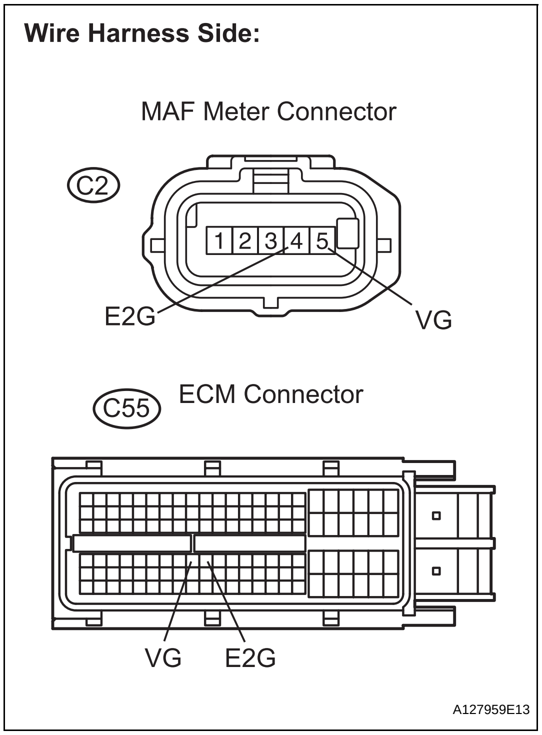
Standard voltage

Tester Connection	Specified Condition
5 (VG) - 4 (E2G)	0.2 to 4.9 V

NG → **REPLACE MASS AIR FLOW METER**

OK

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



(a) Disconnect the C2 MAF meter connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance between the terminals.
Standard resistance (Check for open)

Tester Connection	Specified Condition
VG (C55-72) - VG (C2-5)	Below 1 Ω
E2G (C55-73) - E2G (C2-4)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
VG (C55-72) or VG (C2-5) - Body ground	10 kΩ or higher
E2G (C55-73) or E2G (C2-4) - Body ground	10 kΩ or higher

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

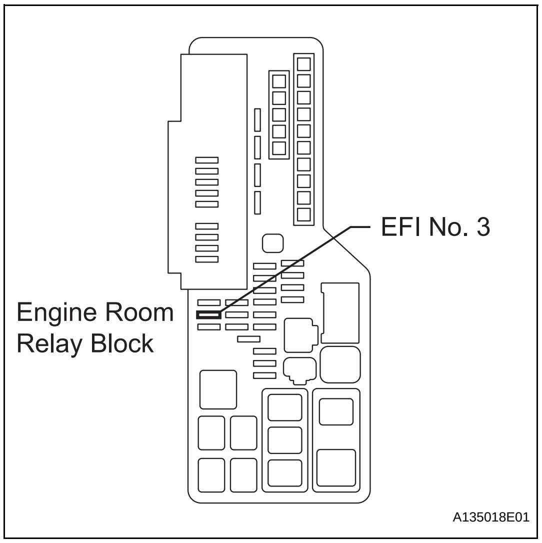
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

ES

OK

REPLACE ECM

5 INSPECT FUSE (EFI NO. 3)

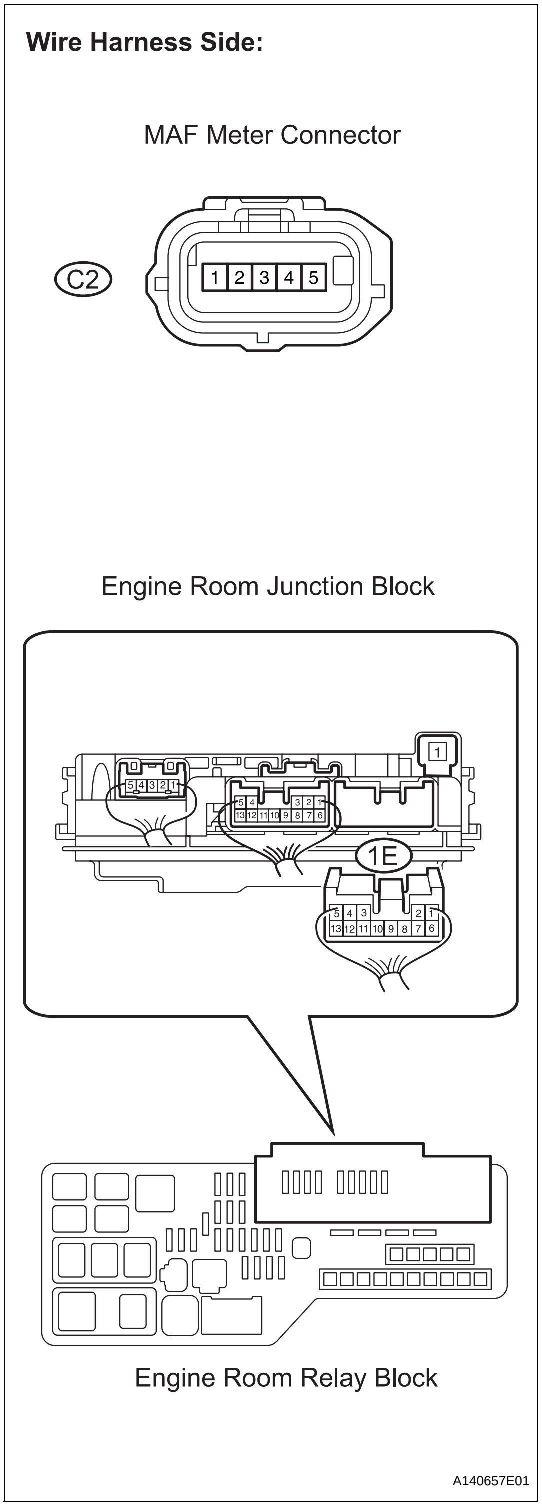


(a) Remove the EFI No. 3 fuse from the engine room R/B.
(b) Measure the EFI No. 3 fuse resistance.
Standard resistance:
Below 1 Ω
(c) Reinstall the EFI No. 3 fuse.

NG → **REPLACE EFI NO. 3 FUSE**

OK

6	CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ENGINE ROOM JUNCTION BLOCK)



(a) Disconnect the C2 MAF meter connector.
(b) Remove the engine room junction block from the engine room R/B.
(c) Measure the resistance between the terminals.

Standard resistance (Check for open)

Tester Connection	Specified Condition
+B (C2-3) - 1E-6 (Engine room R/B)	Below 1 Ω

Standard resistance (Check for short)

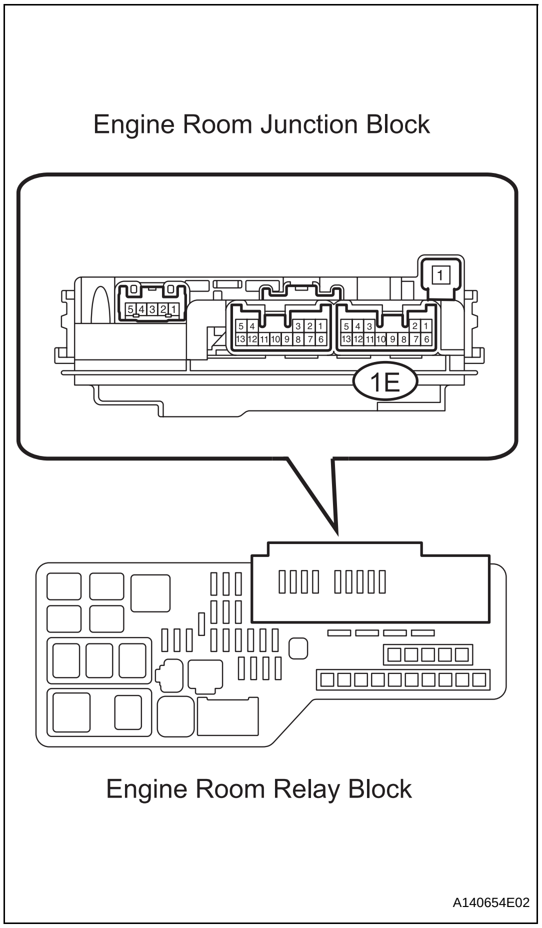
Tester Connection	Specified Condition
+B (C2-3) or 1E-6 (Engine room R/B) - Body ground	10 kΩ or higher

(d) Reinstall the engine room junction block.
(e) Reconnect the C2 MAF meter connector.

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

OK

7	INSPECT ENGINE ROOM JUNCTION BLOCK (EFI RELAY)



(a) Remove the engine room junction block from the engine room R/B.

(b) Inspect the EFI relay.

(1) Measure the EFI relay resistance.

Standard resistance

Tester Connection	Specified Condition
1E-12 - 1E-6	10 kΩ or higher
1E-12 - 1E-6	Bellow 1 Ω (Apply battery voltage between terminals 1E-9 and 1E-10)

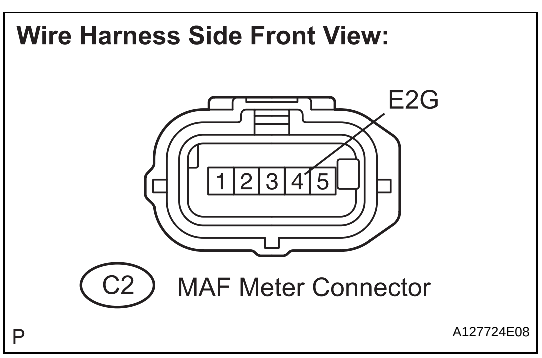
(c) Reinstall the engine room junction block.

NG → **REPLACE ENGINE ROOM JUNCTION BLOCK**

OK

CHECK ECM POWER SOURCE CIRCUIT (See page ES-432)

8	CHECK HARNESS AND CONNECTOR (SENSOR GROUND)



(a) Disconnect the C2 MAF meter connector.

(b) Measure the resistance between the terminals.

Standard resistance

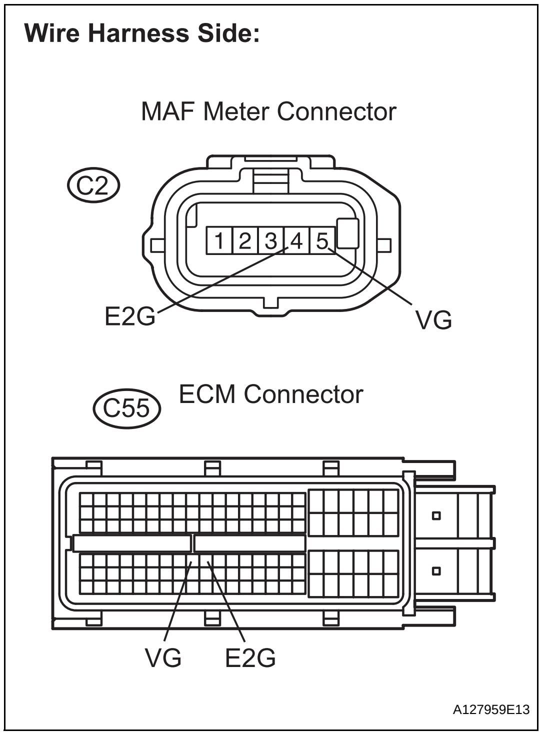
Tester Connection	Specified Condition
E2G (C2-4) - Body ground	Below 1 Ω

(c) Reconnect the MAF meter connector.

OK → **REPLACE MASS AIR FLOW METER (See page ES-477)**

NG

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



(a) Disconnect the C2 MAF meter connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance between the terminals.

Standard resistance (Check for open)

Tester Connection	Specified Condition
VG (C55-72) - VG (C2-5)	Below 1 Ω
E2G (C55-73) - E2G (C2-4)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
VG (C55-72) or VG (C2-5) - Body ground	10 kΩ or higher
E2G (C55-73) or E2G (C2-4) - 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 ECM (See page ES-518)

ES

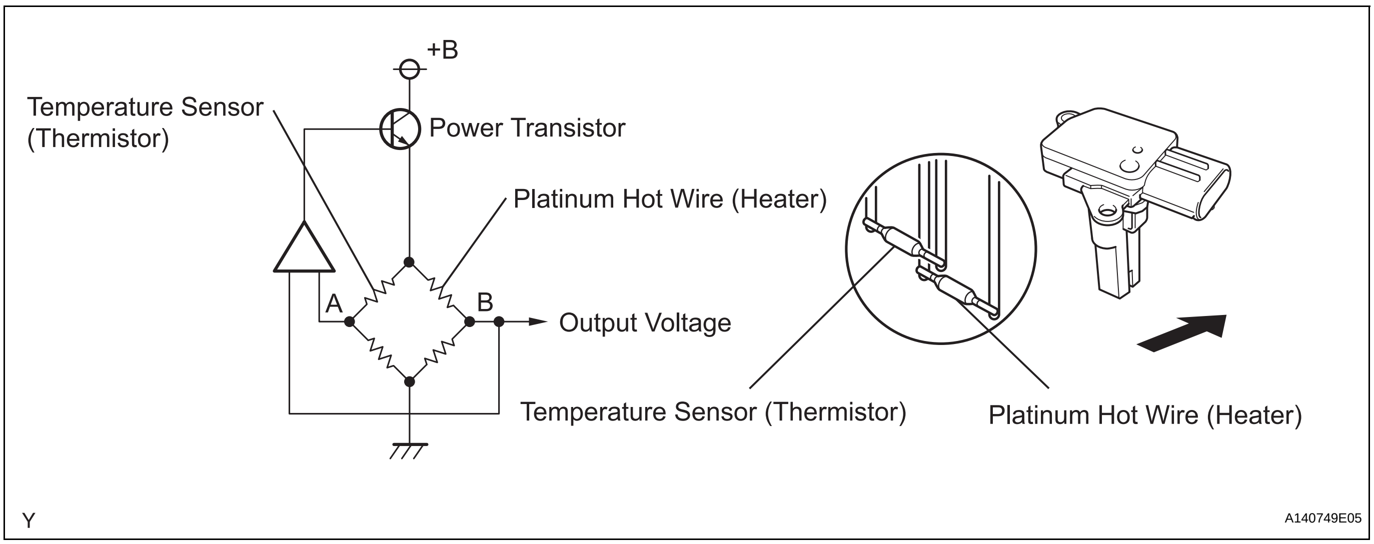
DTC	P0101	Mass Air Flow Circuit Range / Performance Problem

DESCRIPTION

The Mass Air Flow (MAF) meter is a sensor that measures the amount of air flowing through the valve. The ECM uses this information to determine the fuel injection time and to prove 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.

ES

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



DTC No.	DTC Detection Condition	Trouble Area
P0101	Test value calculated with engine load and fuel trim are out of specified threshold under the following conditions (2 trip detection logic): – Engine load is 30 % or more and constant – Engine coolant temperature is 70°C (158°F) or higher	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 1.48 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 (Sub)	Crankshaft position sensor, engine coolant temperature sensor and throttle position sensor
Frequency of Operation	Continuos
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor) P0340, P0341 (CMP sensor)
TP (Throttle position) sensor voltage	0.24 V or more
Engine	Running
Battery voltage	10.5 V or more
ECT	70°C (158°F) or more
IAT sensor circuit	OK
ECT sensor circuit	OK
CKP sensor circuit	OK
TP sensor circuit	OK
FTP sensor circuit	OK
EVAP leak detection pump	OK
EVAP vent valve	OK

TYPICAL MALFUNCTION THRESHOLDS

Average engine load	Less than 0.838 %, or more than 1.287 %

WIRING DIAGRAM

Refer to DTC P0100 (See page ES-127).

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

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

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

Result

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

(e) Read the DTCs.
HINT:
If any DTCs other than P0101 are output, troubleshoot those DTCs first.

B → **REPLACE MASS AIR FLOW METER (See page ES-477)**

A

GO TO DTC CHART (See page ES-63)

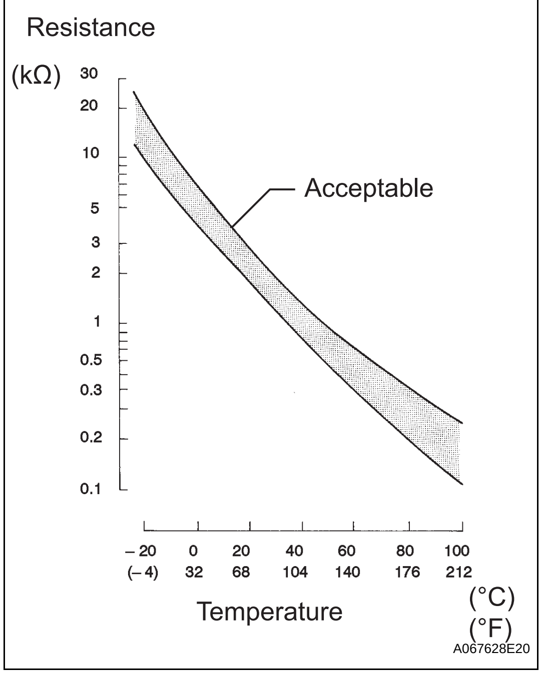
DTC	P0110	Intake Air Temperature Circuit Malfunction

DTC	P0112	Intake Air Temperature Circuit Low Input

DTC	P0113	Intake Air Temperature Circuit High Input

DESCRIPTION

Fig. 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 drops, the resistance of the thermistor increases. When the temperature rises, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (See Fig. 1).

The IAT sensor is powered by a 5 V supply from the THA terminal of the ECM, via resistor R. Resistor R and the IAT sensor are connected in series. When the resistance value of the IAT sensor changes, according to changes in the IAT, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

HINT:

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

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

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

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

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the Intake Air Temperature (IAT). When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a malfunction in the IAT sensor and sets a DTC.
Example:

If the sensor output voltage is -40°C (-40°F) for 0.5 seconds or more, the ECM determines that there is an open in the IAT sensor circuit, and sets DTC P0113. Conversely, if the output voltage is more than 140°C (284°F) for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and sets DTC P0112.

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

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 (Sub)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

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

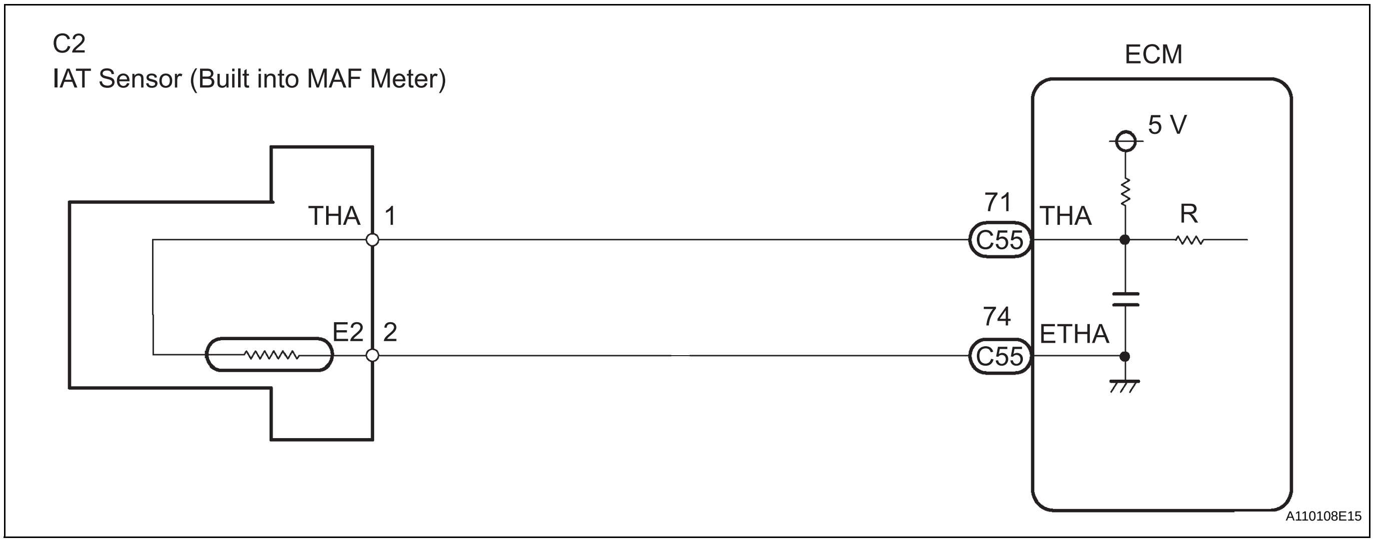
P0113:

Intake air temperature sensor voltage	More than 4.91 V

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM



ES

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	CHECK DTC OUTPUT

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the intelligent 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
P0110	A
P0112	B
P0113	C

B → **Go to step 6**

C → **Go to step 4**

A

2	READ VALUE OF INTAKE AIR TEMPERATURE SENSOR (INTAKE AIR)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the tester on.

(d) Enter the following menus: 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.

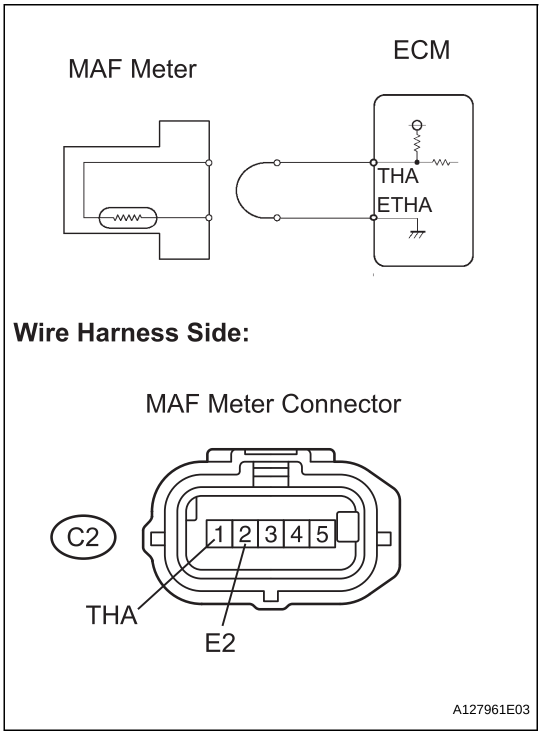
ES

B → **Go to step 5**

C → **CHECK FOR INTERMITTENT PROBLEMS (See page ES-33)**

A

3 CHECK MASS AIR FLOW METER (CHECK FOR OPEN IN SENSOR)



(a) Confirm good connection of the Mass Air Flow (MAF) meter.
(b) Disconnect the C2 MAF meter connector.
(c) Connect terminals THA and E2 of the MAF meter wire harness side connector.
(d) Connect the intelligent tester to the DLC3.
(e) Turn the ignition switch on (IG).
(f) Turn the tester on.
(g) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(h) Read the value displayed on the tester.

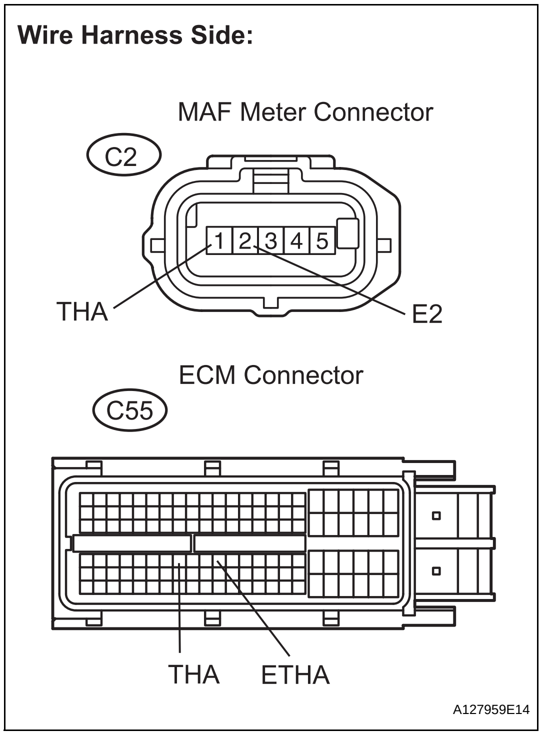
Standard:
140°C (284°F) or higher

(i) Reconnect the MAF meter connector.

OK → **REPLACE MASS AIR FLOW METER (See page ES-477)**

NG

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



(a) Disconnect the C2 MAF meter connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance between the terminals.
Standard resistance (Check for open)

Tester Connection	Specified Condition
THA (C55-71) - THA (C2-1)	Below 1 Ω
ETHA (C55-74) - E2 (C2-2)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
THA (C55-71) or THA (C2-1) - Body ground	10 kΩ or higher
ETHA (C55-74) or E2 (C2-2) - Body ground	10 kΩ or higher

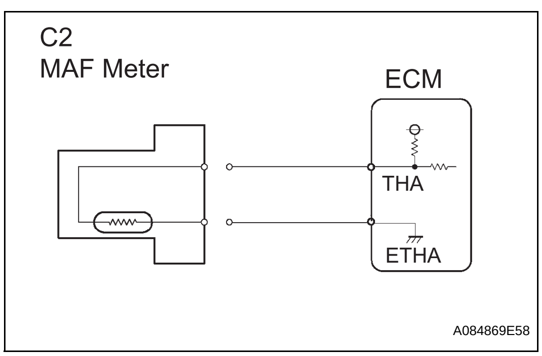
(d) Reconnect the MAF meter connector.
(e) Reconnect the ECM connector.

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

OK

REPLACE ECM (See page ES-518)

5 CHECK MASS AIR FLOW METER (CHECK FOR SHORT IN SENSOR)

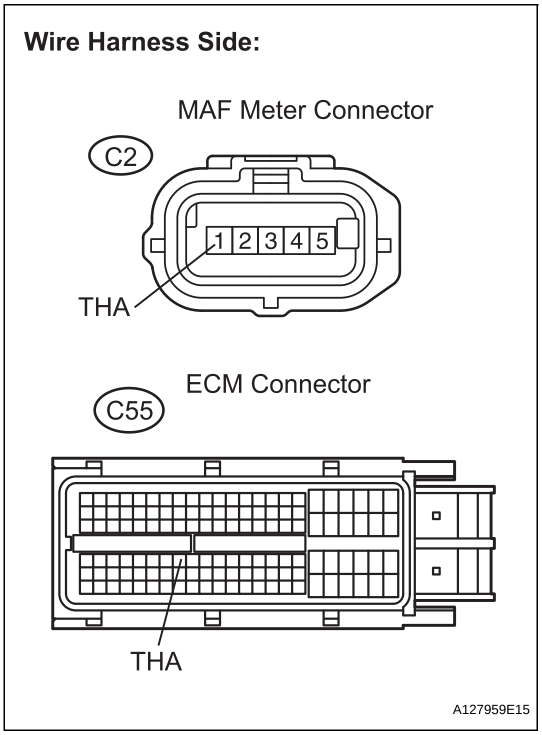


(a) Disconnect the C2 MAF meter connector.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch on (IG).
(d) Turn the tester on.
(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(f) Read the value displayed on the tester.
Standard:
-40°C (-40°F) or higher
(g) Reconnect the MAF meter connector.

OK → **REPLACE MASS AIR FLOW METER (See page ES-477)**

NG

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



(a) Disconnect the C2 MAF meter connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance between the terminals.
Standard resistance

Tester Connection	Specified Condition
THA (C55-71) or THA (C2-1) - Body ground	10 kΩ or higher

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

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

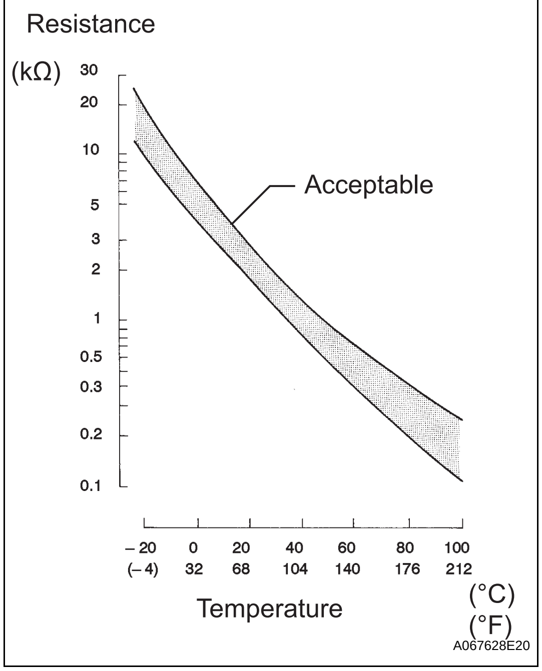
OK

REPLACE ECM (See page ES-518)

DTC	P0111	Intake Air Temperature Sensor Gradient Too High

DESCRIPTION

Fig. 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 drops, the resistance of the thermistor increases. When the temperature rises, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (See Fig. 1).
The IAT sensor is powered by a 5 V supply from the THA terminal of the ECM, via resistor R.
Resistor R and the IAT sensor are connected in series. When the resistance value of the IAT sensor changes, according to changes in the IAT, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

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

MONITOR DESCRIPTION

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

MONITOR STRATEGY

Related DTCs	P0111: Intake air temperature sensor rationality (After engine stop) P0111: Intake air temperature sensor rationality (After cold engine start)

Required Sensors/Components (Main)	Intake Air Temperature (IAT) sensor
Required Sensors/Components (Sub)	-
Frequency of Operation	Once per driving cycle
Duration	5 hours
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs are not present	None

After engine stop:

Time after engine start	10 seconds or more
Battery voltage	10.5 V or more
ECT sensor circuit	OK
ECT change since engine stopped	Less than 180°C (356°F)
ECT before engine stop	70°C (158°F) or more
Time that MAF is low before engine stop	70 minutes
Accumulated MAF amount before engine stop	3,800 g or more
Key-off duration	30 minutes

After cold engine start:

Key-off duration	5 hours
Time after engine start	10 seconds or more
ECT sensor circuit	OK
ECT	70°C (158°F) or more
Accumulated MAF amount	6,300 g or more
One of the following conditions 1 or 2 is met:	-
1. Duration while engine load is low	129 seconds or more
2. Duration while engine load is high	10 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

After engine stop:

IAT change	Less than 1°C (2°F)

After cold engine start:

IAT change	Less than 1°C (2°F)

WIRING DIAGRAM

Refer to DTC P0110 (See page ES-138).

INSPECTION PROCEDURE

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

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

(e) Read the DTCs.

Result

Display (DTC Output)	Proceed to
P0111 and other DTCs	A
P0111	B

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

B

REPLACE MASS AIR FLOW METER (See page ES-477)

A

GO TO DTC CHART (See page ES-63)

DTC	P0115	Engine Coolant Temperature Circuit Malfunction

DTC	P0117	Engine Coolant Temperature Circuit Low Input

DTC	P0118	Engine Coolant Temperature Circuit High Input

DESCRIPTION

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

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

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

MONITOR DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to monitor the ECT. The ECT sensor has a thermistor with a resistance that varies according to the temperature of the engine coolant. When the coolant temperature drops, the resistance in the thermistor increases. When the temperature rises, the resistance drops. These variations in resistance are reflected in the output voltage from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the ECT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the ECT sensor and sets a DTC.

Example:

If the sensor output voltage is -40°C (-40°F) for 0.5 seconds or more, the ECM determines that there is an open in the ECT sensor circuit, and sets DTC P0118. Conversely, if the voltage output is more than 140°C (284°F) for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and sets DTC P0117.

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

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

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

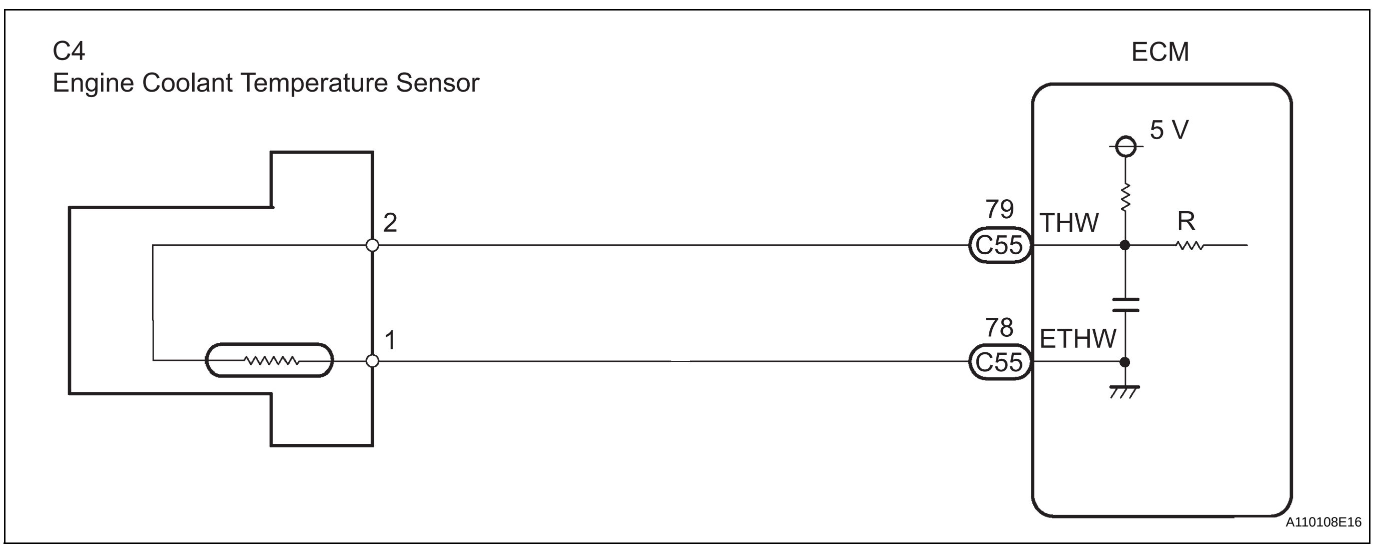
P0118:

Engine coolant temperature sensor voltage	More than 4.91 V

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	CHECK DTC OUTPUT

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

Result

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

B → **Go to step 6**

C → **Go to step 4**

A ↓

2	READ VALUE OF ENGINE COOLANT TEMPERATURE SENSOR (COOLANT TEMP)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the tester on.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(e) Read the value displayed on the tester.

Standard:

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

Result

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

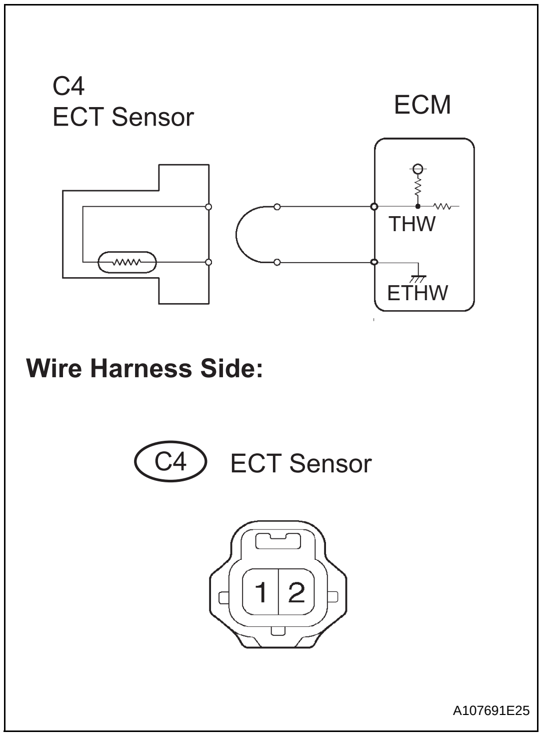
HINT:
- If there is an open circuit, the intelligent tester indicates -40°C (-40°F).
- If there is a short circuit, the intelligent tester indicates 140°C (284°F) or higher.

B → **Go to step 5**

C → **CHECK FOR INTERMITTENT PROBLEMS**

A

3 CHECK ENGINE COOLANT TEMPERATURE SENSOR (CHECK FOR OPEN IN SENSOR)

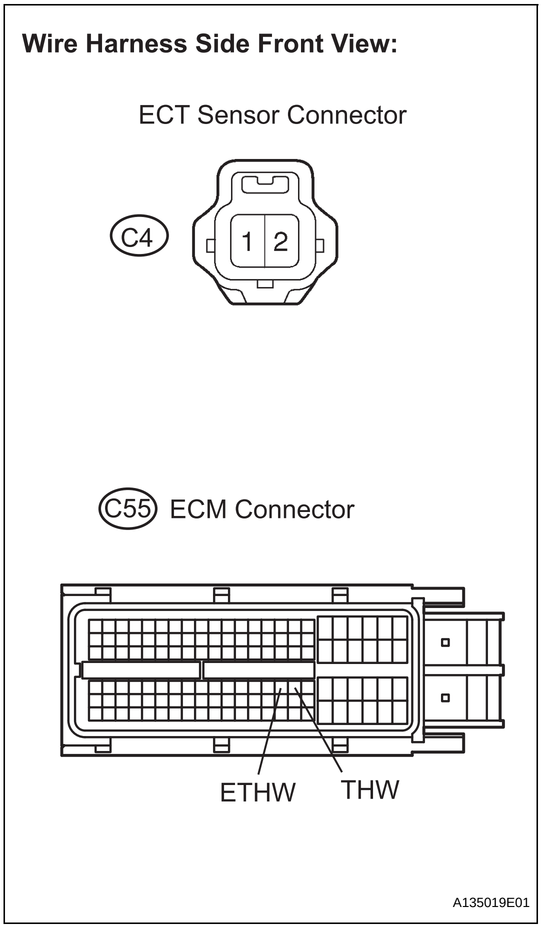


(a) Confirm good connection of the sensor.
(b) Disconnect the C4 engine coolant temperature (ECT) sensor connector.
(c) Connect terminals 1 and 2 of the ECT sensor connector on the wire harness side.
(d) Connect the intelligent tester to the DLC3.
(e) Turn the ignition switch on (IG).
(f) Turn the tester on.
(g) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(h) Read the value displayed on the tester.
Standard:
140°C (284°F) or higher.
(i) Reconnect the ECT sensor connector.

OK → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See page ES-499)**

NG

4	CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)



(a) Disconnect the C4 ECT sensor connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance between the terminals.
Standard resistance

Tester Connection	Specified Condition
THW (C55-79) - C4-2	Below 1 Ω
ETHW (C55-78) - C4-1	Below 1 Ω

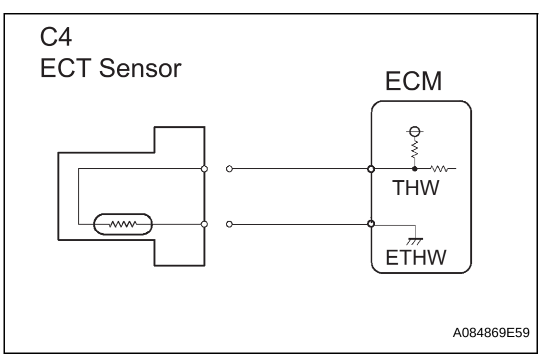
(d) Reconnect the ECM connector.
(e) Reconnect the ECT connector.

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

OK

REPLACE ECM (See page ES-518)

5	CHECK ENGINE COOLANT TEMPERATURE SENSOR (CHECK FOR SHORT IN SENSOR)

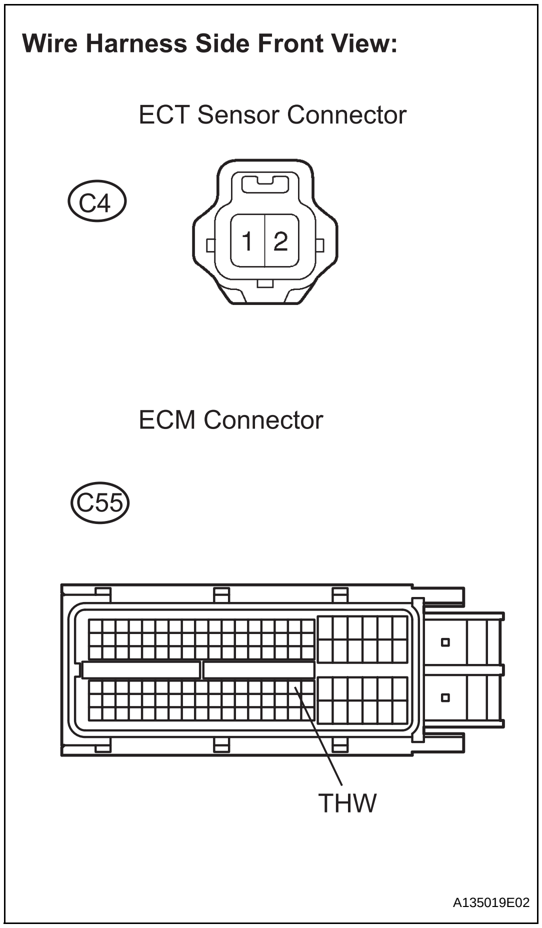


(a) Disconnect the C4 ECT sensor connector.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch on (IG).
(d) Turn the tester on.
(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(f) Read the value displayed on the tester.
Standard:
-40°C (-40°F)
(g) Reconnect the ECT sensor connector.

OK → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See page ES-499)**

NG

6	CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)



(a) Disconnect the C4 ECT sensor connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance between the terminals.
Standard resistance

Tester Connection	Specified Condition
THW (C55-79) or C4-2 - Body ground	10 kΩ or higher

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

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

OK

REPLACE ECM (See page ES-518)

DTC	P0116	Engine Coolant Temperature Circuit Range / Performance Problem

DESCRIPTION

A thermistor is built into the Engine Coolant Temperature (ECT) sensor, of which the resistance value varies according to the ECT.
The structure of the sensor and its connection to the ECM are the same as those of the Intake Air Temperature (IAT) sensor.

DTC No.	DTC Detection Condition	Trouble Area
P0116	ECTs as listed below are nearly same (2 trip detection logic): – ECT when engine is started at lower than 60°C (140°F) of ECT – ECT when engine is warmed up	• Thermostat • ECT sensor
	ECTs as listed below are nearly same when engine is started at higher than 60°C (140°F) of ECT (2 trip detection logic) – ECT when engine is stopped after driving – ECT when engine is started at lower than 60°C (140°F) of ECT	

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 drops, the resistance of the thermistor increases. When the temperature rises, the resistance drops. These variations in the resistance are reflected in the output voltage from the ECT sensor.
The ECM monitors the sensor voltage and uses this value to calculate the ECT. If the sensor output voltage deviates from the normal operating range, the ECM interprets this deviation as a malfunction in the ECT sensor and sets the DTC.

Examples:

(1) 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).

(2) 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 rationality (ECT sensor cold start monitor) P0116: Engine coolant temperature sensor rationality (ECT sensor soak monitor)
Required Sensors/Components (Main)	Engine coolant temperature (ECT) sensor
Required Sensors/Components (Sub)	-
Frequency of Operation	Once per driving cycle
Duration	10
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs are not present	P0100 - P0103 (MAF sensor)

ECT sensor cold start monitor:

Battery voltage	10.5 V or more
Time after engine start	1 second or more
ECT at engine start	Less than 60°C (140°F)
IAT sensor circuit	OK
Soak time	5 hours
Accumulated MAF	1,056.06 g or more
Engine	Running
Fuel cut	OFF
Difference between ECT at engine start and IAT	Less than 40°C (104°F)

ECT sensor soak monitor:

Battery voltage	10.5 V or more
Engine	Running
Soak time	5 hours or more
ECT at engine start	60°C (140°F) or more
Accumulated MAF	2,101.98 times or more

TYPICAL MALFUNCTION THRESHOLDS

ECT sensor cold start monitor:

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

ECT sensor soak monitor:

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

COMPONENT OPERATING RANGE

Engine coolant temperature	Varies with actual engine coolant temperature

INSPECTION PROCEDURE

HINT:

- If any of DTCs P0115, P0117, P0118 or P0125 are set simultaneously with DTC P0116, the ECT sensor may have an open or a short circuit. Troubleshoot those DTCs first.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

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

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(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

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

B **GO TO DTC CHART (See page ES-63)**

A

2 INSPECT THERMOSTAT

(a) Remove the thermostat (See page CO-13).
(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-14).

NG **REPLACE THERMOSTAT (See page CO-13)**

OK

REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See page ES-499)

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

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

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

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

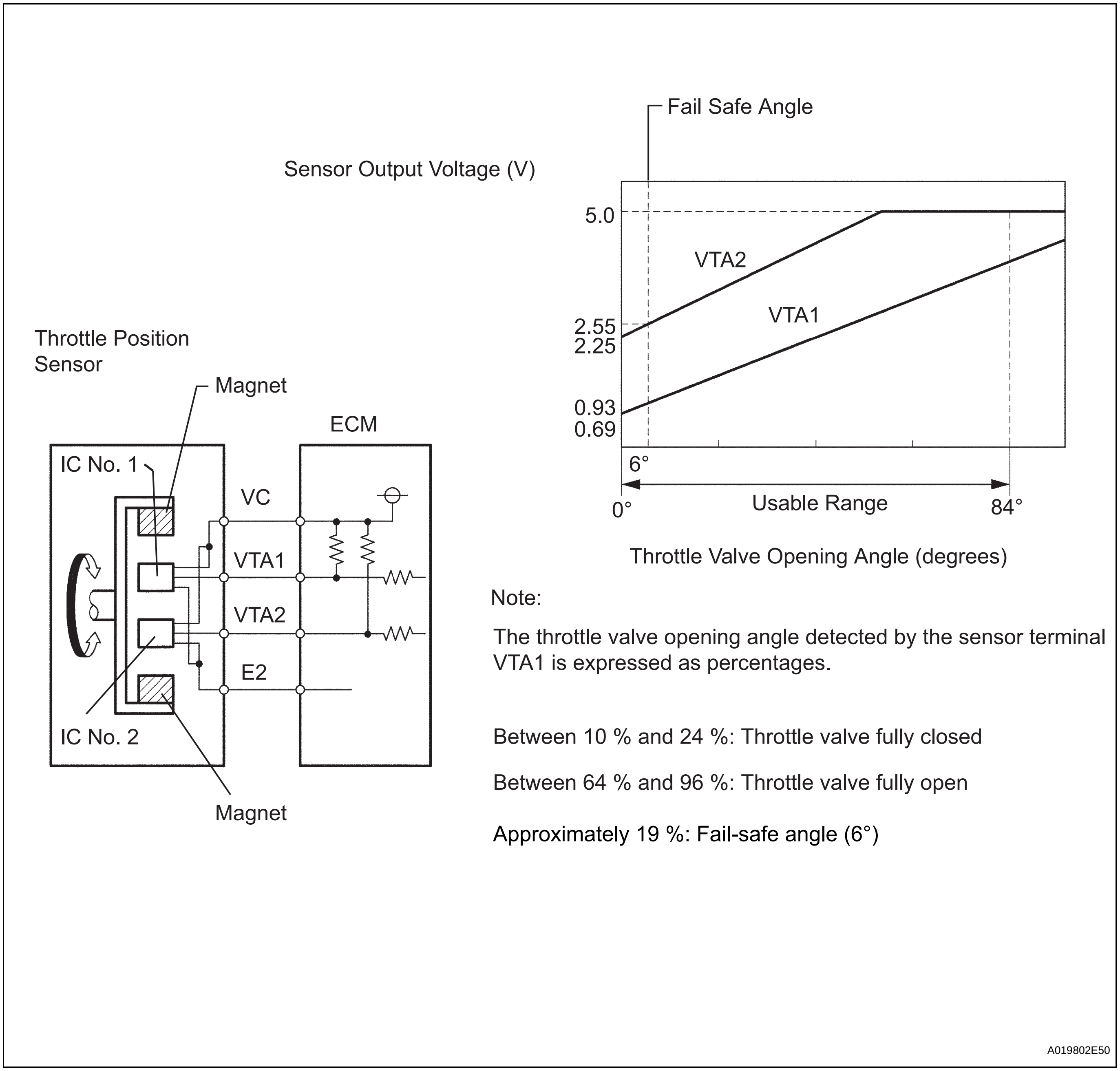
DTC	P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input

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

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

DESCRIPTION

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



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 is 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 is 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 Condition	Trouble Area
P0222	Output voltage of VTA2 is 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 is 4.8 V or more, and VTA1 is 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) is met (1 trip detection logic): (a) Difference between output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more (b) Output voltage of VTA1 is 0.2 V or less, and VTA2 is 1.75 V or less, for 0.4 seconds or more	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

HINT:

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

Reference (Normal Condition):

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
THROTTLE POS	10 to 24 %	64 to 96 %
THROTTLE POS #2	2.1 to 3.1 V	4.5 to 5.0 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.

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 (Sub)	-
Frequency of Operation	Continuous

Duration	Throttle position sensor 1 range check (Fluctuating): 2 seconds (Accelerator pedal ON) Throttle position sensor 1 range check (Low voltage): 2 seconds (Accelerator pedal ON) Throttle position sensor 1 range check (High voltage): 2 seconds (Accelerator pedal ON) Throttle position sensor 2 range check (Fluctuating): 2 seconds (Accelerator pedal ON) Throttle position sensor 2 range check (Low voltage): 2 seconds (Accelerator pedal ON) Throttle position sensor 2 range check (High voltage): 2 seconds (Accelerator pedal ON) Throttle position sensor 1 range check (Fluctuating): 10 seconds (Accelerator pedal OFF) Throttle position sensor 1 range check (Low voltage): 10 seconds (Accelerator pedal OFF) Throttle position sensor 1 range check (High voltage): 10 seconds (Accelerator pedal OFF) Throttle position sensor 2 range check (Fluctuating): 10 seconds (Accelerator pedal OFF) Throttle position sensor 2 range check (Low voltage): 10 seconds (Accelerator pedal OFF) Throttle position sensor 2 range check (High voltage): 10 seconds (Accelerator pedal OFF) Throttle position sensor range check (Correlation): Within 0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0120:

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

P0122:

VTA1 voltage	0.2 V or less

P0123:

VTA1 voltage	4.535 V or more

P0220:

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

P0222:

VTA2 voltage	1.75 V or less

P0223:

VTA2 voltage when VTA1 is 0.2 to 2.02 V	4.8 V or more

P2135:

Either of following conditions A or B is 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

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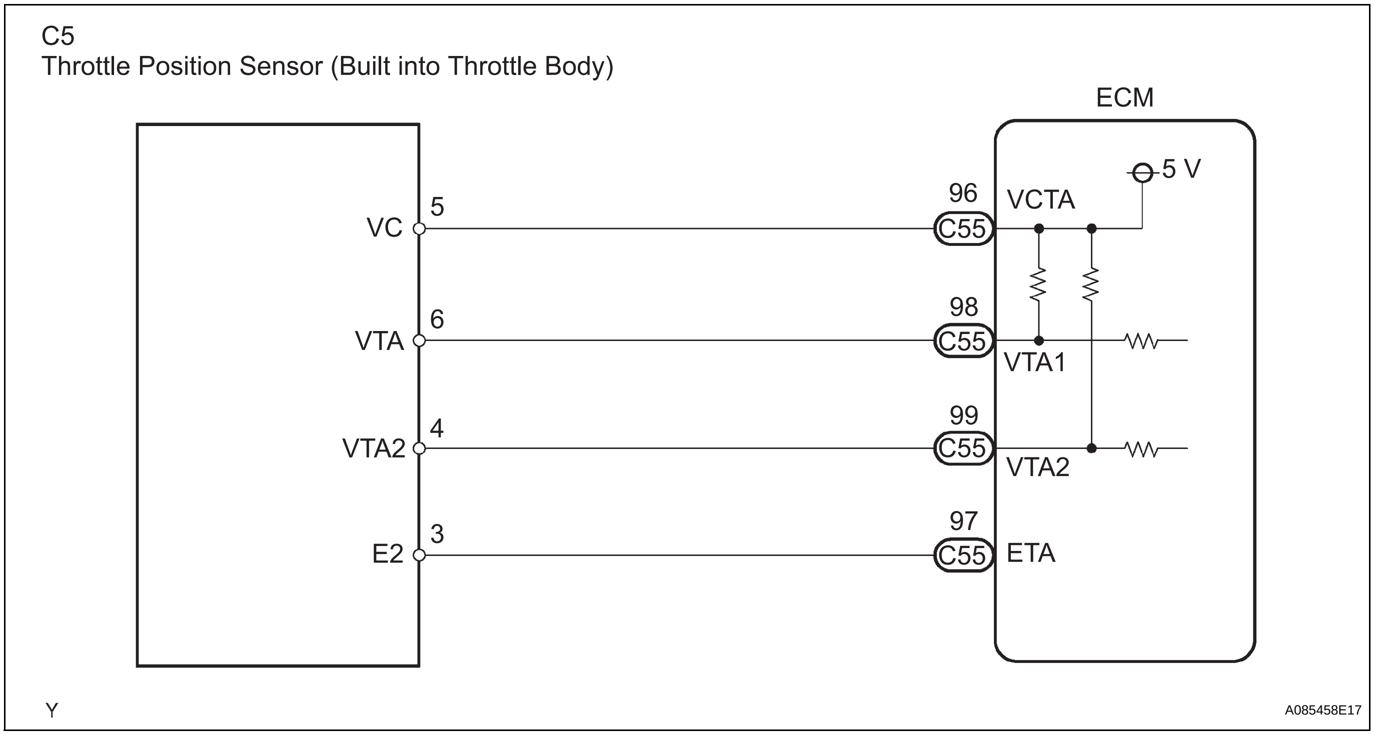
COMPONENT OPERATING RANGE

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 gently, the vehicle can be driven slowly.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	**READ VALUE OF THROTTLE POSITION SENSOR (THROTTLE POS AND THROTTLE POS #2)**

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) and turn the intelligent tester on.

(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ETCS / THROTTLE POS and THROTTLE POS #2.
(d) Check the values displayed on the tester.

Result

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

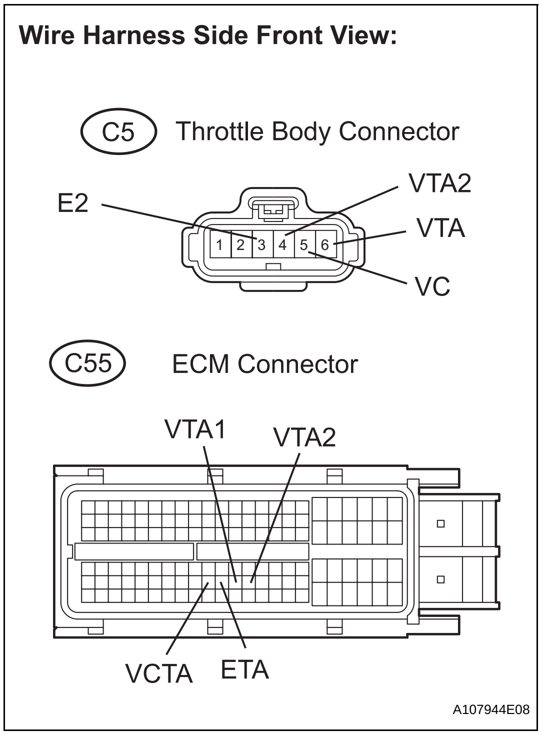
HINT:
- TP#1 denotes THROTTLE POS, and TP#2 denotes THROTTLE POS#2.
- AP denotes Accelerator Pedal.
- VTA1 is expressed as percentages, and VTA2 is expressed as voltages.

B **Go to step 5**

A

ES

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



(a) Disconnect the C5 throttle body connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
VC (C5-5) - VCTA (C55-96)	Below 1 Ω
VTA (C5-6) - VTA1 (C55-98)	Below 1 Ω
VTA2 (C5-4) - VTA2 (C55-99)	Below 1 Ω
E2 (C5-3) - ETA (C55-97)	Below 1 Ω

Standard resistance (Check for short)

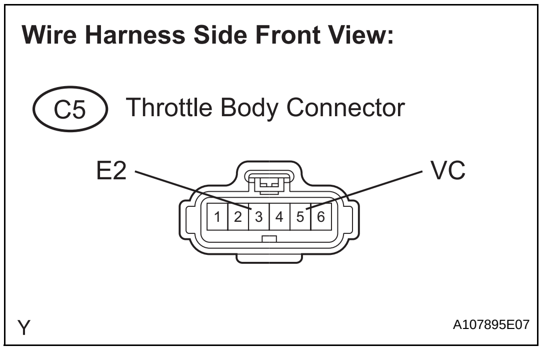
Tester Connection	Specified Condition
VC (C5-5) or VCTA (C55-96) - Body ground	10 kΩ or higher
VTA (C5-6) or VTA1 (C55-98) - Body ground	10 kΩ or higher
VTA2 (C5-4) or VTA2 (C55-99) - Body ground	10 kΩ or higher

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

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

OK

3 INSPECT ECM (VC VOLTAGE)



(a) Disconnect the C5 throttle body connector.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
VC (C5-5) - E2 (C5-3)	4.5 to 5.0 V

(d) Reconnect the throttle body connector.

NG → **REPLACE ECM (See page ES-518)**

OK

4 REPLACE THROTTLE BODY

(a) Replace the throttle body assembly (See page ES-503).

NEXT

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

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) and turn the tester on.
(c) Clear the DTCs (See page ES-45).
(d) Start the engine.
(e) Allow the engine to idle for 15 seconds or more.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Read the DTCs.

Result

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

B → **SYSTEM IS OK**

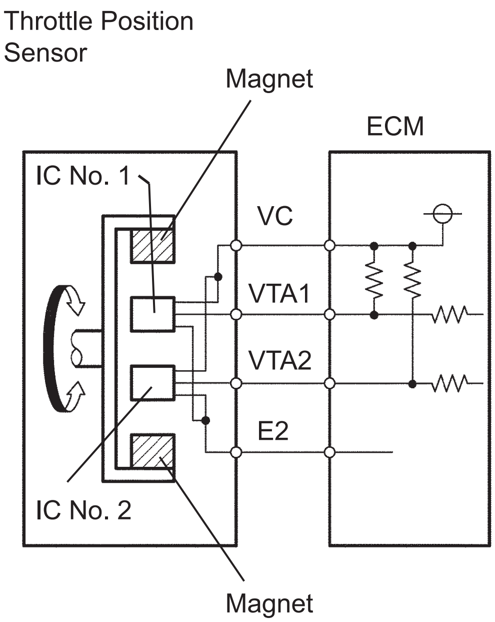
A

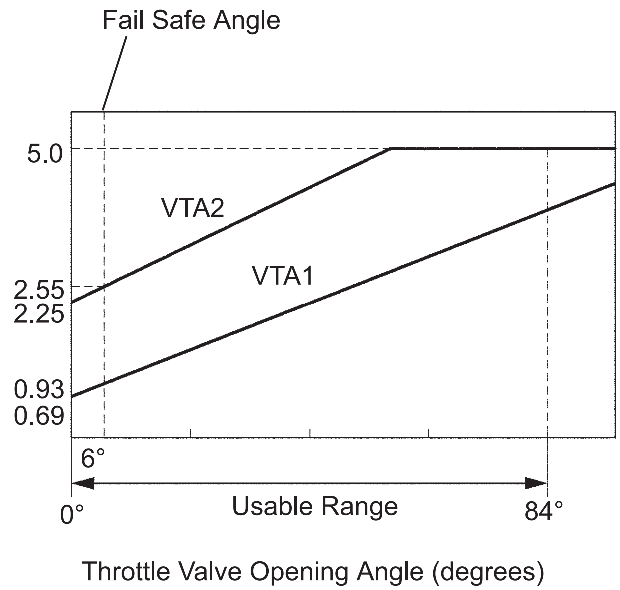
REPLACE ECM (See page ES-518)

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

DESCRIPTION

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





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 64 % and 96 %: Throttle valve fully open

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

A019802E31

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

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

MONITOR DESCRIPTION

The ECM uses the TP sensor to monitor the throttle valve opening angle.
This sensor transmits two signals: VTA1 and VTA2. VTA1 is used to detect the throttle opening angle and VTA2 is used to detect malfunctions in VTA1. The ECM performs several checks to confirm the proper operation of the TP sensor and VTA1.

For each throttle opening angle, a specific voltage difference is expected between the outputs of VTA1 and VTA2. If the output voltage difference between the two signals deviates from the normal operating range, the ECM interprets this as a malfunction of the TP sensor. The ECM illuminates the MIL and sets the DTC.
If the malfunction is not repaired successfully, the DTC is set 2 seconds after the engine is next started.

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	P0120, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor)
Either of following conditions A or B is met:	-
A. Engine switch	ON
B. Electric throttle motor power	ON
TP sensor malfunction (P0120, P0122, P0123, P0220, P0222, P0223, P2135)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

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

FAIL-SAFE

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

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air/fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	**CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0121)**

(a) Connect the intelligent tester to the DLC3.
(b) Turn the engine switch on (IG).
(c) Turn the tester on.

(d) Enter the following menus: DIAGNOSIS / ENHANCED 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 (See page ES-63)**

A

REPLACE THROTTLE BODY (See page ES-503)

DTC	P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control

DESCRIPTION

A thermistor is built into the Engine Coolant Temperature (ECT) sensor, and its resistance value varies according to the ECT.
The structure of the sensor and its connection to the ECM are the same as those of the Intake Air Temperature (IAT) sensor.

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

MONITOR DESCRIPTION

The resistance of the ECT varies in proportion to the actual ECT. The ECT supplies a constant voltage to the sensor and monitors the signal output voltage of the sensor. The signal voltage output varies according to the changing resistance of the sensor. After the engine is started, the ECT is monitored through this signal. If the ECT sensor indicates that the engine is not yet warm enough for closed-loop fuel control, despite a specified period of time having elapsed since the engine was started, the ECM interprets this as a malfunction in the sensor or cooling system and sets the DTC.
Example:

The ECT is 0°C (32°F) at engine start. After 5 minutes running time, the ECT sensor still indicates that the engine is not warm enough to begin closed-loop fuel (air-fuel ratio feedback) control. The ECM interprets this as a malfunction in the sensor or cooling system and sets the DTC.

MONITOR STRATEGY

Related DTCs	P0125: Insufficient engine coolant temperature for closed-loop fuel control
Required Sensors/Components (Main)	Thermostat, cooling system
Required Sensors/Components (Related)	Engine coolant temperature sensor and mass air flow meter
Frequency of Operation	Once per driving cycle
Duration	64 seconds: Closed-loop enabling temperature - 8.34°C (15°F) or more 111.2 seconds: Closed-loop enabling temperature - 19.45 to 8.34°C (35 to 15°F) 1,200 seconds: Less than closed-loop enabling temperature - 19.45°C (35°F)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

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

TYPICAL MALFUNCTION THRESHOLDS

Time until actual engine coolant temperature reaches closed-loop fuel control enabling temperature	64 seconds or more: Engine coolant temperature at engine start is - 8.34°C (15°F) or more 111.2 seconds or more: Engine coolant temperature at engine start is - 19.45 to 8.35°C (15 to 35°F) 1,200 seconds or more: Engine coolant temperature at engine start is less than - 19.4°C (35°F)

WIRING DIAGRAM

Refer to DTC P0115 (See page ES-146).

INSPECTION PROCEDURE

HINT:

- If any of DTCs P0115, P0116, P0117 or P0118 are set simultaneously with DTC P0125, the Engine Coolant Temperature (ECT) sensor may have an open or a short circuit. Troubleshoot those DTCs first.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

ES

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 (IG).
(c) Turn the tester on.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read the DTCs.

Result

Display (DTC Output)	Proceed to
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 (See page ES-63)**

A

2 INSPECT THERMOSTAT

(a) Remove the thermostat (See page CO-13).
(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-14).

NG → **REPLACE THERMOSTAT (See page CO-13)**

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 (See page ES-499)

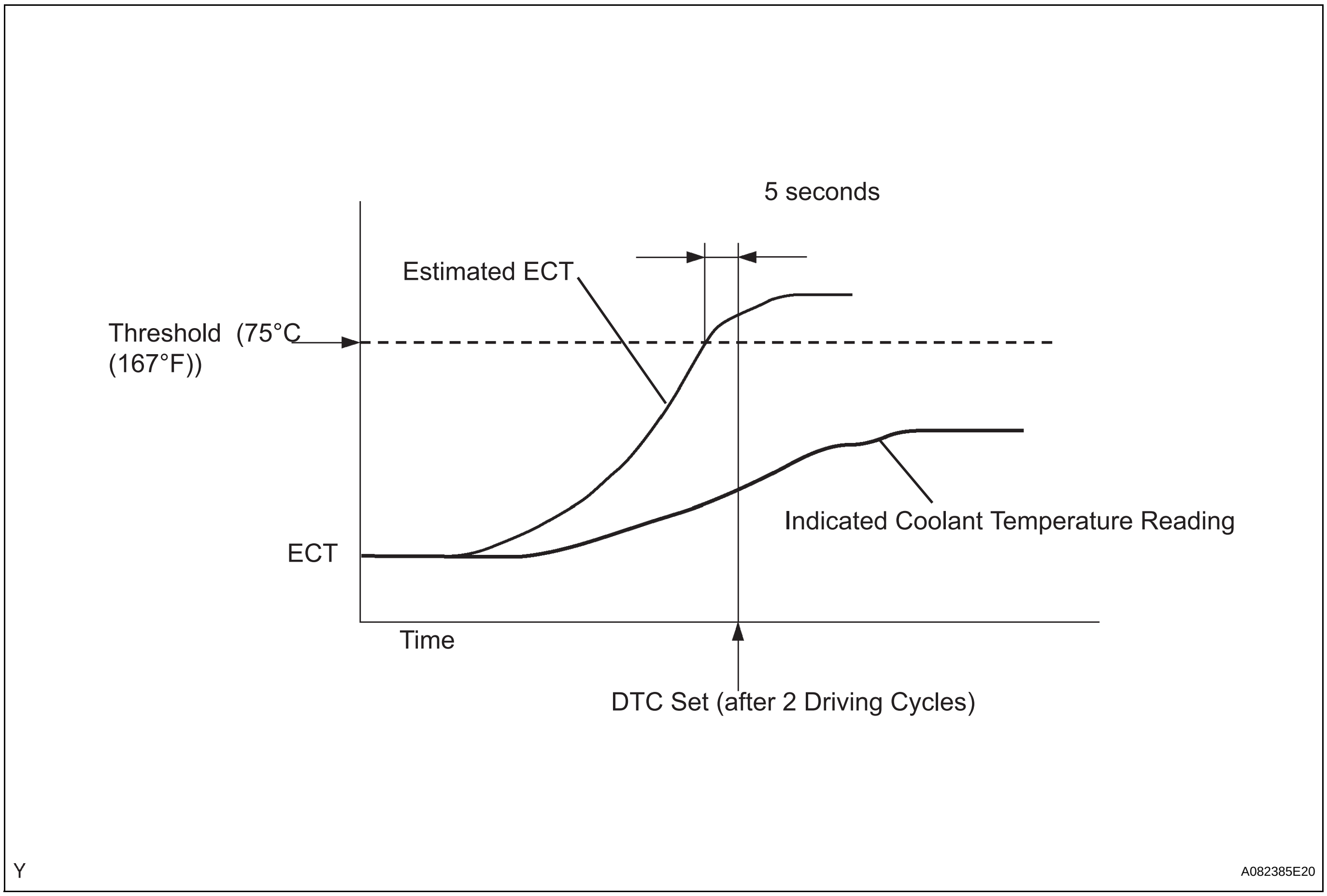
DTC	P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)

DESCRIPTION

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

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

MONITOR DESCRIPTION



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

MONITOR STRATEGY

Related DTCs	P0128: Coolant Thermostat
Required Sensors/Components (Main)	Thermostat
Required Sensors/Components (Sub)	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 will run whenever this DTC is not present	P0010, P0020 (VVT 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 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (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
Either of following conditions 1 or 2 is met:	-
1. All of following conditions are met:	-
• ECT at engine start - IAT at engine start	-15 to 7°C (-27 to 12.6°F)
• ECT at engine start	-10 to 56°C (14 to 133°F)
• IAT at engine start	-10 to 56°C (14 to 133°F)
2. All of following conditions are met:	-
• ECT at engine start - IAT at engine start	More than 7°C (12.6°F)
• ECT at engine start	56°C (132.8°F) or less
• IAT at engine start	-10°C (14°F) or more
Accumulated time with 80 mph (128 km/h) or more of vehicle speed	Less than 20 seconds

TYPICAL MALFUNCTION THRESHOLDS

Duration that both of the following conditions 1 and 2 are met:	5 seconds or more
1. Estimated ECT	75°C (167°F) or more
2. ECT sensor output	Less than 75°C (167°F)

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

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

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the tester on.

ES

(d) Enter the following menus: DIAGNOSIS / ENHANCED 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 DTC other than P0128 are output, troubleshoot those DTCs first.

B → **GO TO DTC CHART (See page ES-63)**

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-13).
(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-14).

NG → **REPLACE THERMOSTAT (See page CO-13)**

OK

REPLACE ECM (See page ES-518)

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)**

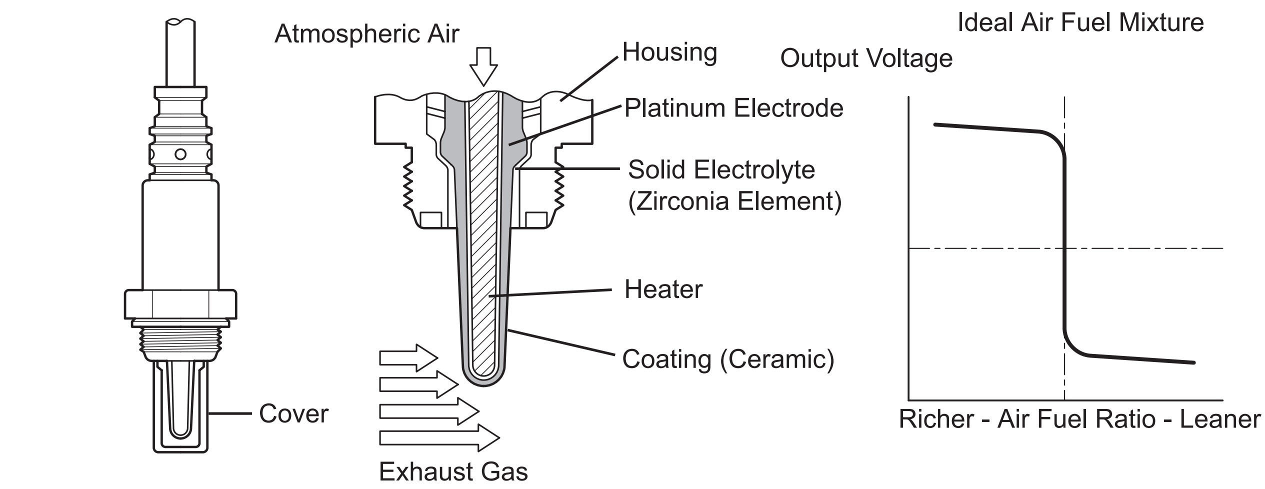
DTC	**P0156**	**Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)**

DTC	**P0157**	**Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)**

DTC	**P0158**	**Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)**

DESCRIPTION

A three-way catalytic converter (TWC) is used in order to convert the carbon monoxide (CO), hydrocarbon (HC), and nitrogen oxide (NOx) into less harmful substances. To allow the TWC to function effectively, it is necessary to keep the air-fuel ratio of the engine near the stoichiometric air-fuel ratio. For the purpose of helping the ECM to deliver accurate air-fuel ratio control, the Heated Oxygen (HO2) sensor is used.
The HO2 sensor is located behind the TWC, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with the heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).
When the air-fuel ratio becomes lean, the oxygen concentration in the exhaust gas becomes 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 Condition	Trouble Area
P0136 P0156	• Abnormal voltage output: During active air-fuel ratio control, following conditions (a) and (b) are met for a certain period of time (2 trip detection logic) (a) Heated Oxygen (HO2) sensor voltage does not decrease to less than 0.2 V (b) HO2 sensor voltage does not increase to more than 0.6 V • Low impedance: Sensor impedance is 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) • Engine room junction block (EFI relay) • Gas leakage from exhaust system
P0137 P0157	• Low voltage (open): During active air-fuel ratio control, following conditions (a) and (b) are met for a 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 is 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) • Engine room junction block (EFI relay) • Gas leakage from exhaust system
P0138 P0158	• High voltage (short): During active air-fuel ratio control, following conditions (a) and (b) are met for a 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 30 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

ES

MONITOR DESCRIPTION

1. Active Air-Fuel Ratio Control

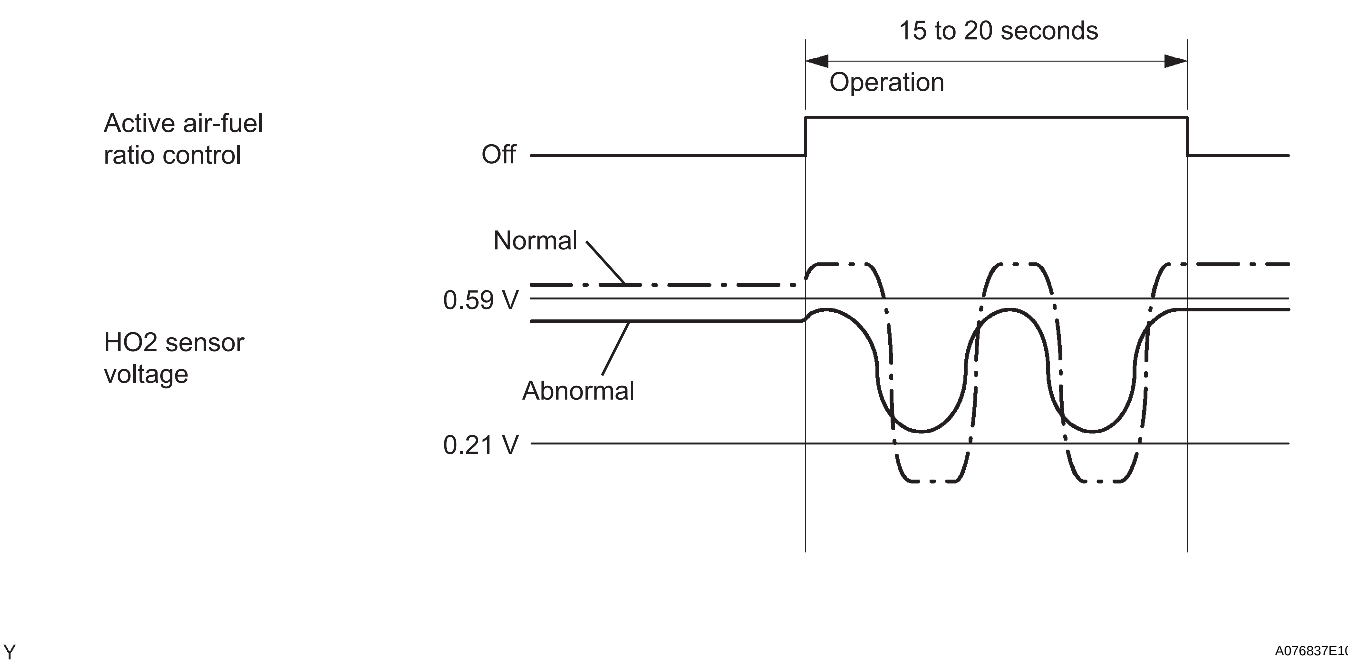
The ECM usually performs air-fuel ratio feedback control so that the Air-Fuel Ratio (A/F) sensor output indicates a near stoichiometric air-fuel level. This vehicle includes active air-fuel ratio control in addition to regular air-fuel ratio control. The ECM performs active air-fuel ratio control to 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)

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):



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

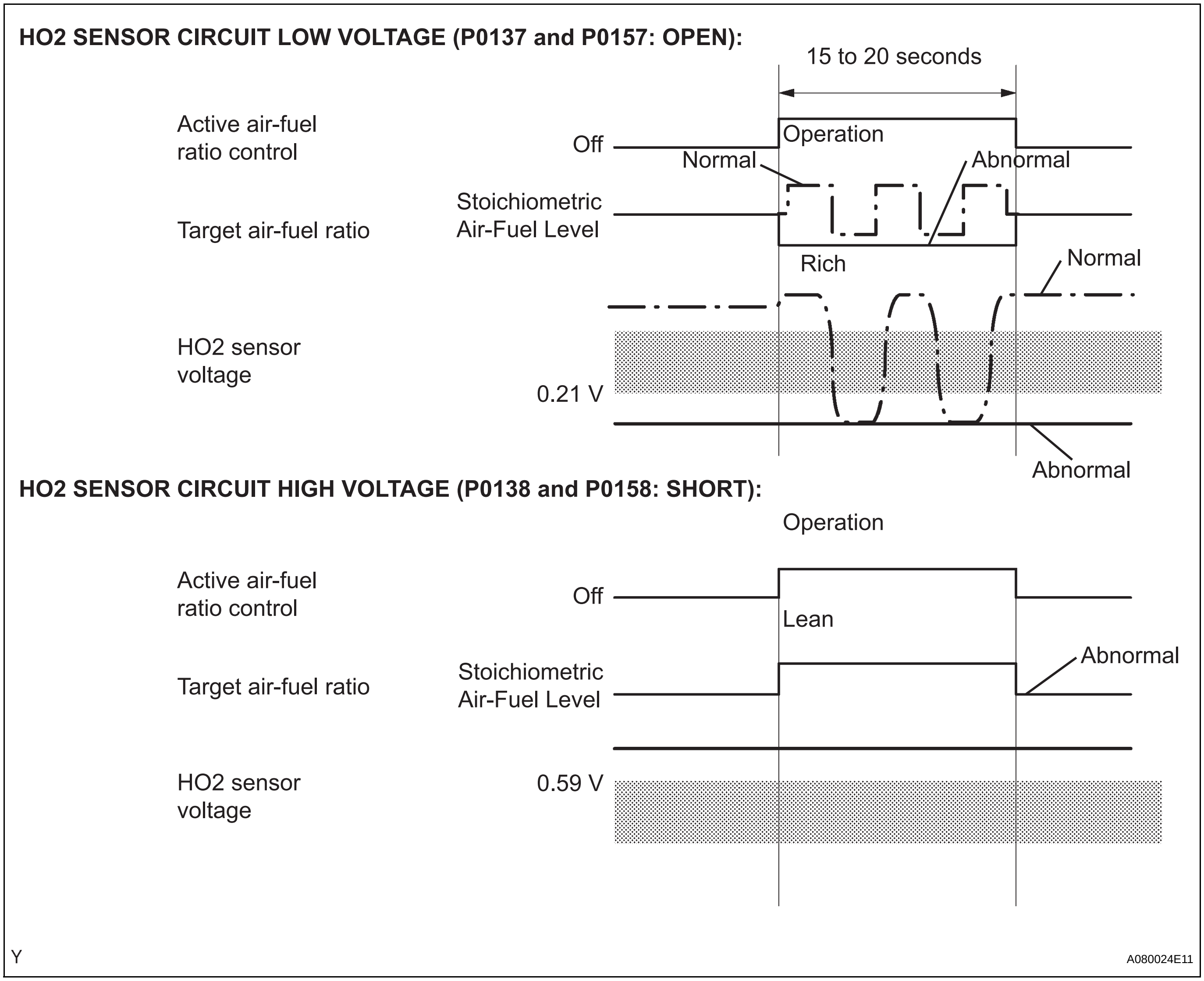
During active air-fuel ratio control, the ECM calculates the Oxygen Storage Capacity (OSC)* of the Three- Way Catalytic Converter (TWC) by forcibly regulating the air-fuel ratio to become rich or lean. If the HO2 sensor has an open or short circuit, or the voltage output of the sensor noticeably decreases, 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.

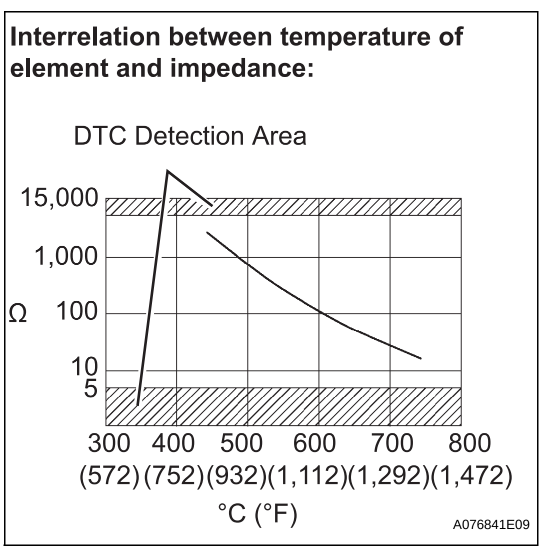
While performing active air-fuel ratio control, when the target air-fuel ratio is rich and the HO2 sensor voltage output is 0.21 V or less (lean), the ECM interprets this as an abnormally low sensor output voltage and sets DTC P0137 or P0157. When the target air-fuel ratio is lean and the voltage output 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 30 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-249).





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 (1 driving cycle).
- DTCs P0137 and P0157 indicate an open or short circuit in the HO2 sensor (1 driving cycle). The ECM sets the DTCs when the impedance of the sensor exceeds the threshold of 15 kΩ.

MONITOR STRATEGY

Related DTCs	P0136: HO2S voltage (Bank 1) P0136: HO2S low impedance (Bank 1) P0137: HO2S high impedance (Bank 1) P0137: HO2S low voltage (Bank 1) P0138: HO2S high voltage (Bank 1) P0138: HO2S high voltage (Extremely high) (Bank 1) P0156: HO2S voltage (Bank 2) P0156: HO2S low impedance (Bank 2) P0157: HO2S high impedance (Bank 2) P0157: HO2S low voltage (Bank 2) P0158: HO2S high voltage (Bank 2) P0158: HO2S high voltage (Extremely high) (Bank 2)
Required Sensors/Components (Main)	HO2S
Required Sensors/Components (Sub)	Crankshaft position sensor, Engine coolant temperature sensor, Mass air flow meter, Throttle position sensor
Frequency of Operation	Once per driving cycle
Duration	20 seconds: HO2S voltage (P0136, P0156), HO2S low voltage (P0137, P0157), HO2S high voltage (P0138, P0158) 30 seconds: HO2S low impedance (P0136, P0156) 90 seconds: HO2S high impedance (P0137, P0157) 10 seconds: HO2S high voltage (P0138, P0158)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following 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) 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) P2A00, P2A03 (A/F sensor - slow response)

HO2S voltage (P0136, P0156), HO2S low voltage (P0137, P0157), HO2S high voltage (P0138, P0158):

Active A/F control	Performing
Battery voltage	11 V or more
ECT	75 °C (167°F) or more
Idle	OFF

Engine rpm	Less than 3,200 rpm
A/F sensor status	Activated
Fuel system status	Closed loop
Fuel-cut	OFF
Engine load	10 to 70%
Shift position	4th or more

HO2S low impedance (P0136, P0156):

Battery voltage	11 V or more
Estimated rear HO2S temperature	Less than 700°C (1,292°F)
ECM monitor	Completed
P0606	Not set

HO2S high impedance (P0137, P0157):

Battery voltage	11 V or more
Estimated rear HO2S temperature	450°C (842°F) or more
P0606	Not preset

HO2S high voltage (Extremely high) (P0138, P0158):

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

TYPICAL MALFUNCTION THRESHOLDS

HO2S voltage (P0136, P0156):

Either of the following conditions 1 or 2 is met:	-
1. All of the following conditions (a), (b) and (c) are met:	-
(a) Commanded air-fuel ratio	14.3 or less
(b) Rear HO2S voltage	0.21 to 0.59 V
(c) OSC (Oxygen capacity of catalyst)	2 g or more
2. All of the following conditions (d), (e) and (f) are met:	-
(d) Commanded air-fuel ratio	14.9 or more
(e) Rear HO2S voltage	0.21 to 0.59 V
(f) OSC (Oxygen capacity of catalyst)	2 g or more

HO2S low impedance (P0136, P0156):

Duration that following condition is met:	30 seconds or more
Rear HO2S impedance	Less than 5 Ω

HO2S high impedance (P0137, P0157):

Duration that following condition is met:	90 seconds or more
Rear HO2S impedance	15 kΩ or more

HO2S low voltage (P0137, P0157):

All of the following conditions 1, 2 and 3 are met:	-
1. Commanded air-fuel ratio	14.3 or less
2. Rear HO2S voltage	Less than 0.21 V
3. OSC (Oxygen capacity of catalyst)	2 g or more

HO2S high voltage (P0138, P0158):

All of the following conditions 1, 2 and 3 are met:	-
1. Commanded air-fuel ratio	14.9 or more
2. Rear HO2S voltage	More than 0.59 V
3. OSC (Oxygen capacity of catalyst)	2 g or more

HO2S high voltage (Extremely high) (P0138, P0158):

Duration that following condition is met:	10 seconds or more
Rear HO2S voltage	1.2 V or more

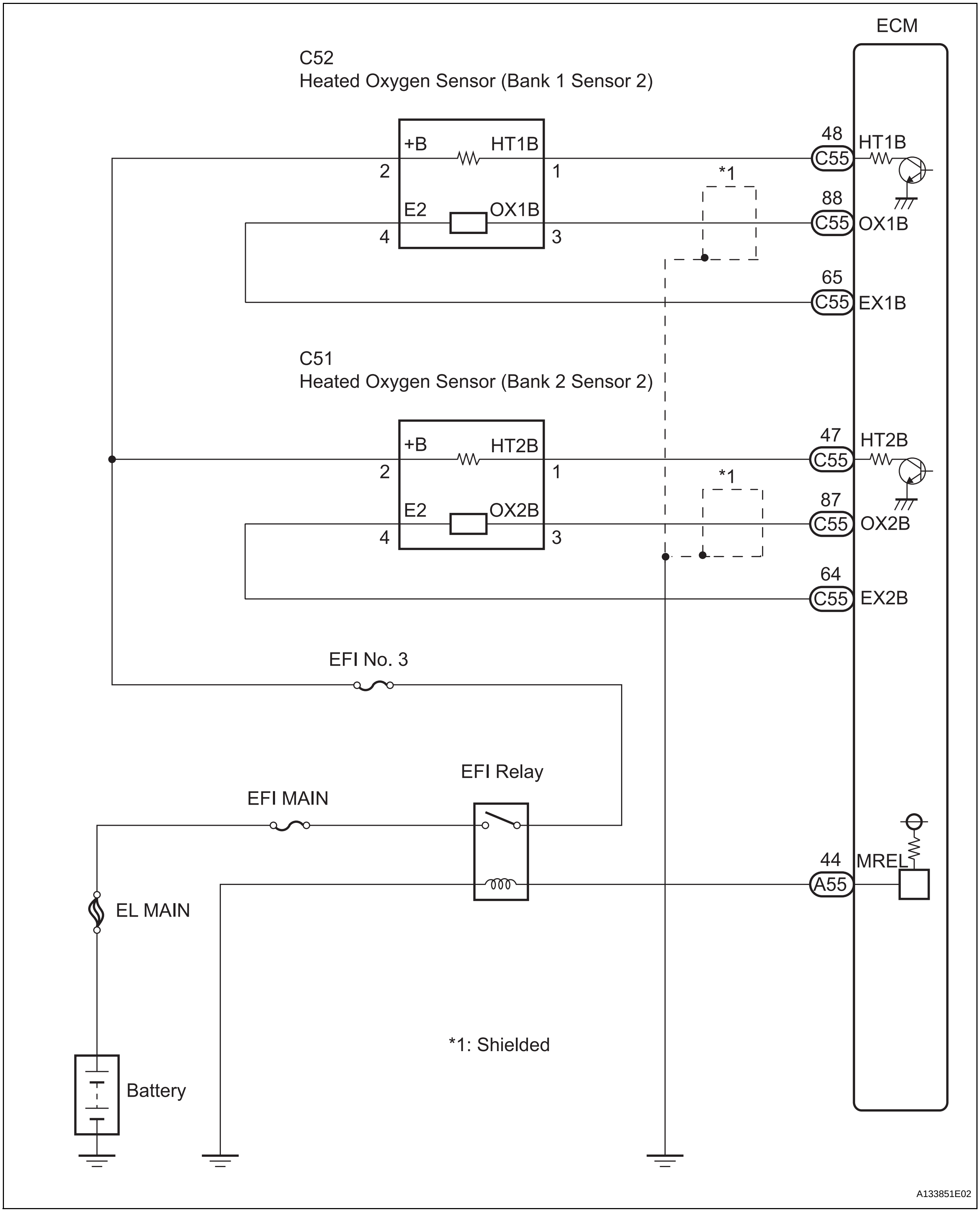
COMPONENT OPERATING RANGE

Duration that following condition is 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-25).

WIRING DIAGRAM



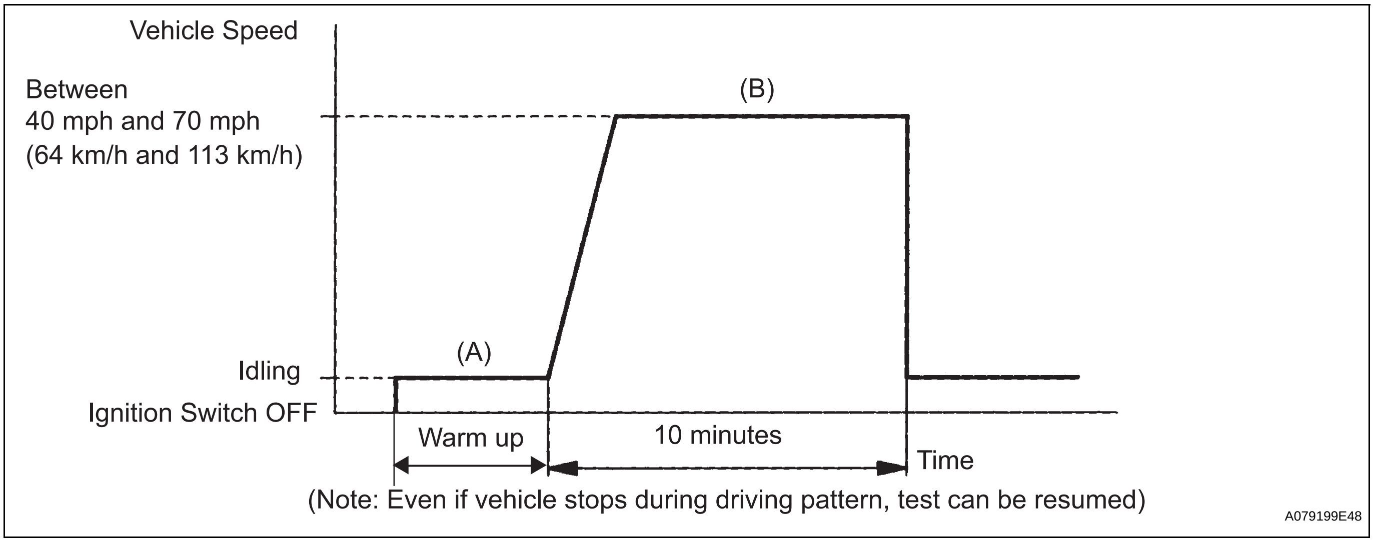
CONFIRMATION DRIVING PATTERN

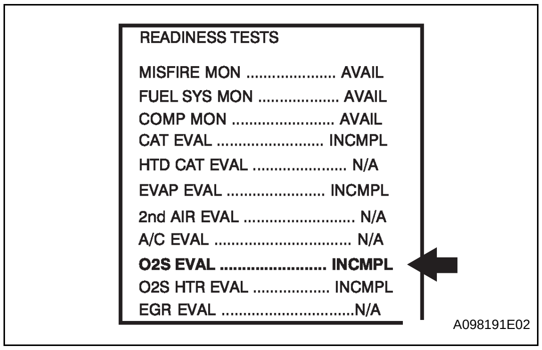
HINT:

- This confirmation driving pattern is used in steps 5, 8 and 11 of the following diagnostic troubleshooting procedure when using an intelligent tester.
- 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.





1. Connect an intelligent tester to the DLC3.
2. Turn the ignition switch on (IG).
3. Turn the tester on.
4. Clear the DTCs (where set) (See page ES-45).
5. Select the following menu items: DIAGNOSIS / CARB OBD II / READINESS TESTS.
6. Check that O2S EVAL is INCMPL (incomplete).
7. Start the engine and warm it up (Procedure "A").
8. Drive the vehicle at between 40 mph and 70 mph (64 km/h and 113 km/h) for at least 10 minutes (Procedure "B").
9. Note the state of the Readiness Tests items. Those items will change to COMPL (complete) as O2S EVAL monitor operates.
10. 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.

INSPECTION PROCEDURE

HINT:

Intelligent tester only:

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

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

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

HINT:

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

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

NOTICE:

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

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V	 OK	Output Voltage More than 0.55 V Less than 0.4 V	 OK	
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• A/F sensor • A/F sensor heater • A/F sensor circuit
	Output Voltage Almost no reaction	NG	Output Voltage More than 0.55 V Less than 0.4 V	 OK	

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

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

HINT:
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).
- 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 READ DTC OUTPUT

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

Result

Display (DTC Output)	Proceed to
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 OXYGEN SENSOR (OUTPUT VOLTAGE)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) and turn the tester on.

(c) Enter the following menus: 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.

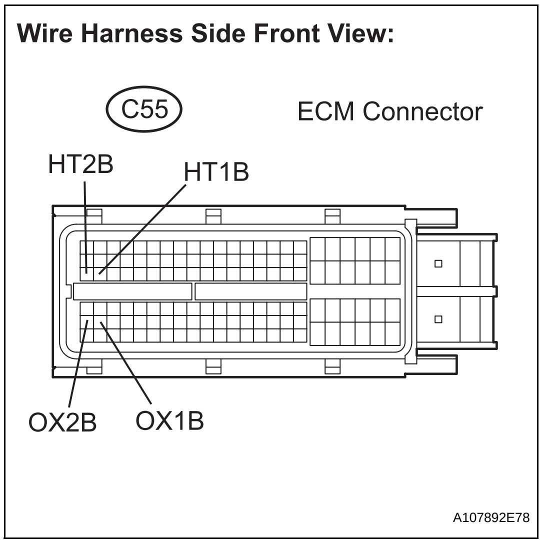
Result

HO2 Sensor Output Voltage	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 engine switch off and wait for 5 minutes.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
HT1B (C55-48) - OX1B (C55-88)	10 kΩ or higher
HT2B (C55-47) - OX2B (C55-87)	10 kΩ or higher

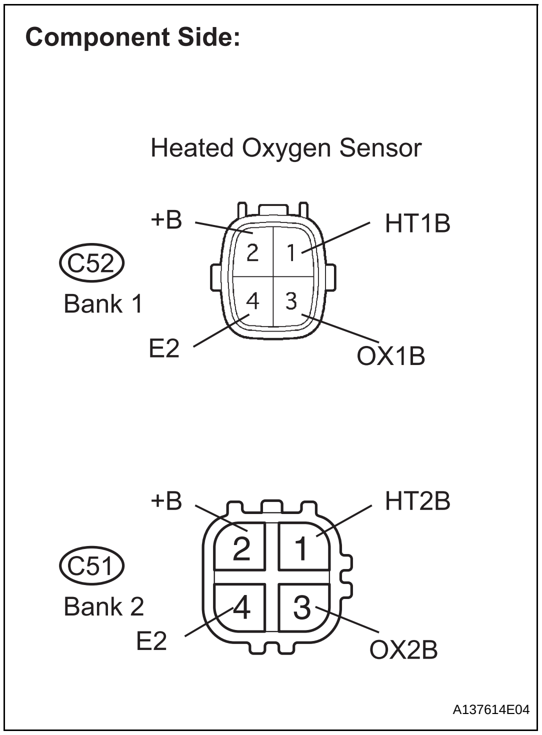
(d) Reconnect the ECM connector.

NG → **Go to step 4**

OK

REPLACE ECM (See page ES-518)

4	INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)



(a) Disconnect the C52 oxygen sensor connector (Bank 1 Sensor 2) or C51 oxygen sensor connector (Bank 2 sensor 2).

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

Standard resistance (Bank 1 sensor 2)

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

Standard resistance (Bank 2 sensor 2)

Tester Connection	Specified Condition
+B (2) - E2 (4)	10 kΩ or higher
+B (2) - OX2B (3)	10 kΩ or higher

NG → **REPLACE HEATED OXYGEN SENSOR (See page EC-20)**

ES

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

5	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

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

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

(b) Read the DTCs.

Result

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

B → **CHECK FOR INTERMITTENT PROBLEMS**

A

REPLACE HEATED OXYGEN SENSOR (See page EC-20)

7	READ VALUE OF OXYGEN SENSOR (OUTPUT VOLTAGE)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) and turn the tester on.
(c) Start the engine.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / O2S B1S2 or 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

ES

OK

8	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

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

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

Result

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

B → CHECK FOR INTERMITTENT PROBLEMS

A

10	REPLACE HEATED OXYGEN SENSOR

(a) Replace the hated oxygen sensor (See page EC-20).

NEXT

11	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

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

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

Result

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

B → END

A

13	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (INJECTION VOLUME)

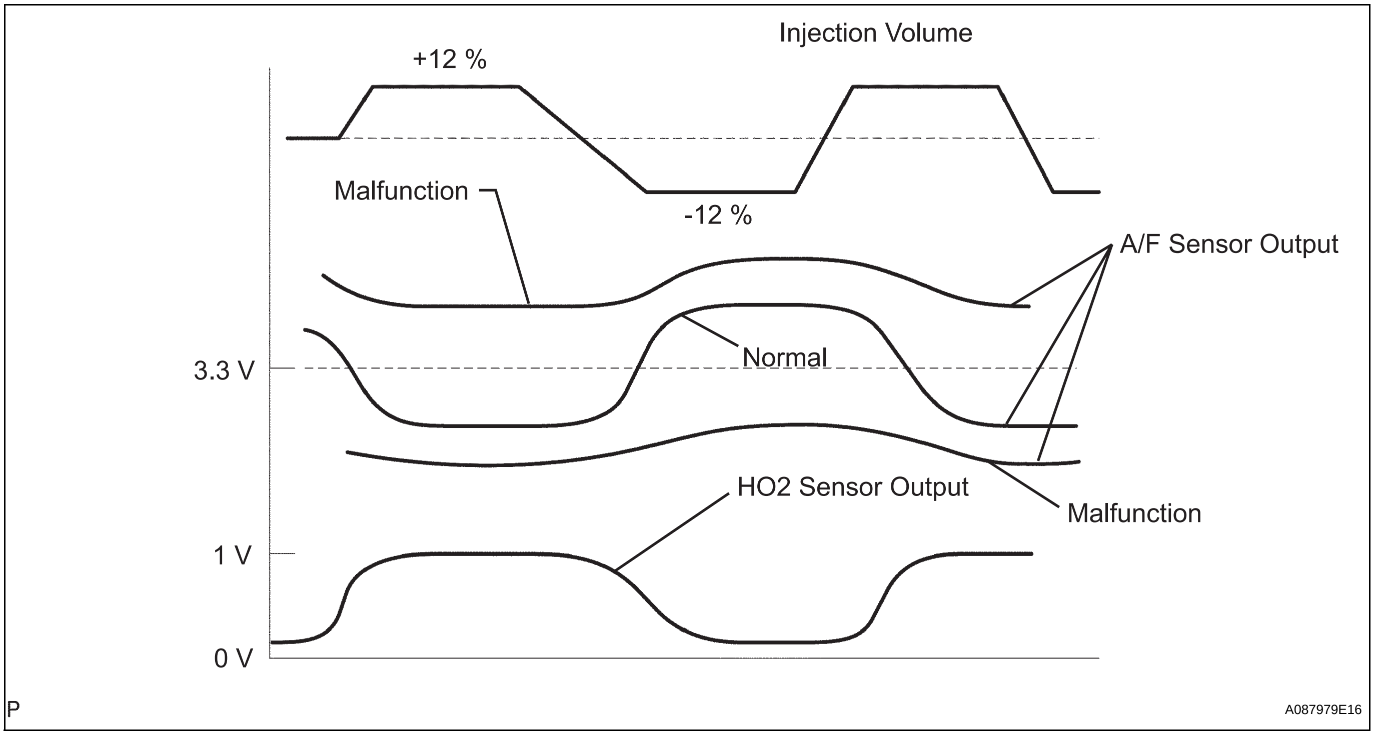
(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II /ACTIVE TEST / INJ VOL.
(e) Change the fuel injection volume using the tester, while monitoring the output voltage of Air-Fuel Ratio (A/F) and HO2 sensor 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 the intelligent tester.

Result

Tester Display (Sensor)	Voltage Variation	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 more than 3.3 V	NG
AFS B1S1 (A/F) AFS B2S1 (A/F)	Remains 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 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 (See page EC-19)**

OK ↓

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

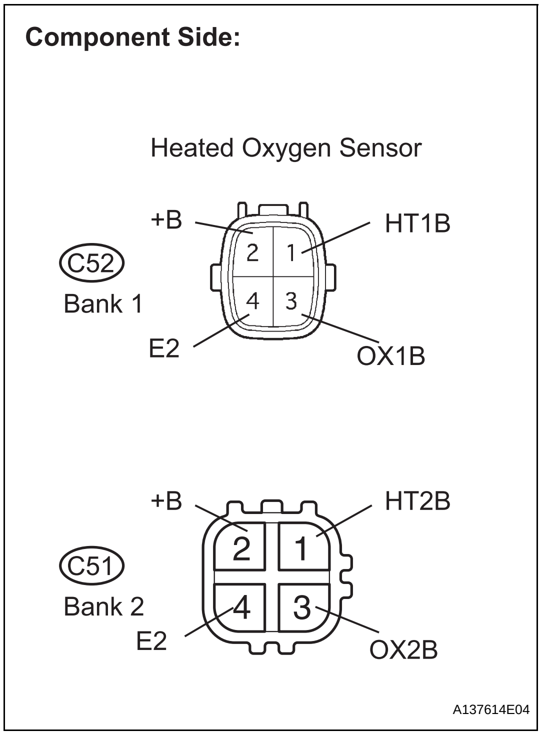
14 CHECK FOR EXHAUST GAS LEAKS

OK:
No gas leakage.

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

OK ↓

15	INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)



(a) Disconnect the C52 oxygen sensor connector (Bank 1 Sensor 2) or C51 oxygen sensor connector (Bank 2 sensor 2).

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

Standard resistance (Bank 1 sensor 2)

Tester Connection	Condition	Specified Condition
HT1B (1) - +B (2)	20°C (68°F)	11 to 16 Ω
HT1B (1) - E2 (4)	Always	10 kΩ or higher

Standard resistance (Bank 2 sensor 2)

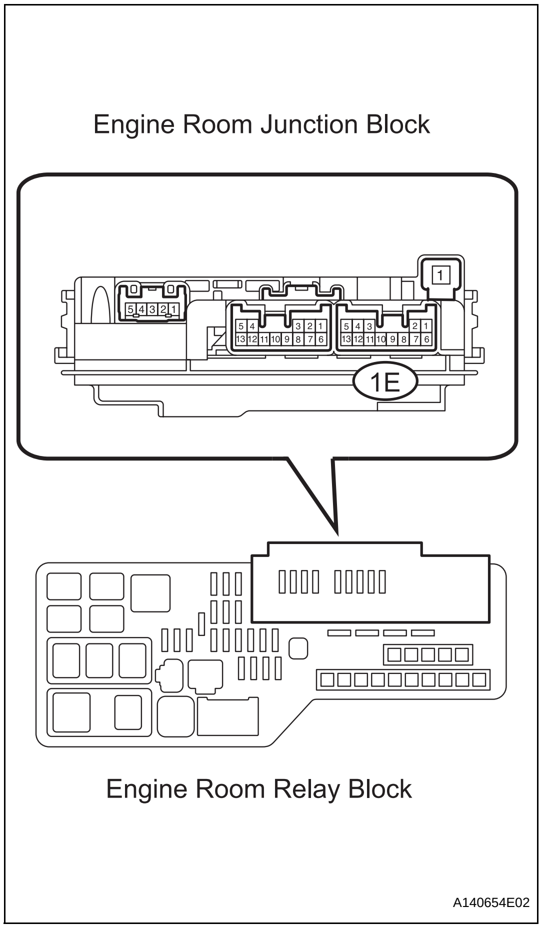
Tester Connection	Condition	Specified Condition
HT2B (1) - +B (2)	20°C (68°F)	11 to 16 Ω
HT2B (1) - E2 (4)	Always	10 kΩ or higher

NG → **REPLACE HEATED OXYGEN SENSOR (See page EC-20)**

ES

OK

16	INSPECT ENGINE ROOM JUNCTION BLOCK (EFI MAIN RELAY)



(a) Remove the engine room junction block from the engine room R/B.

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

Standard resistance

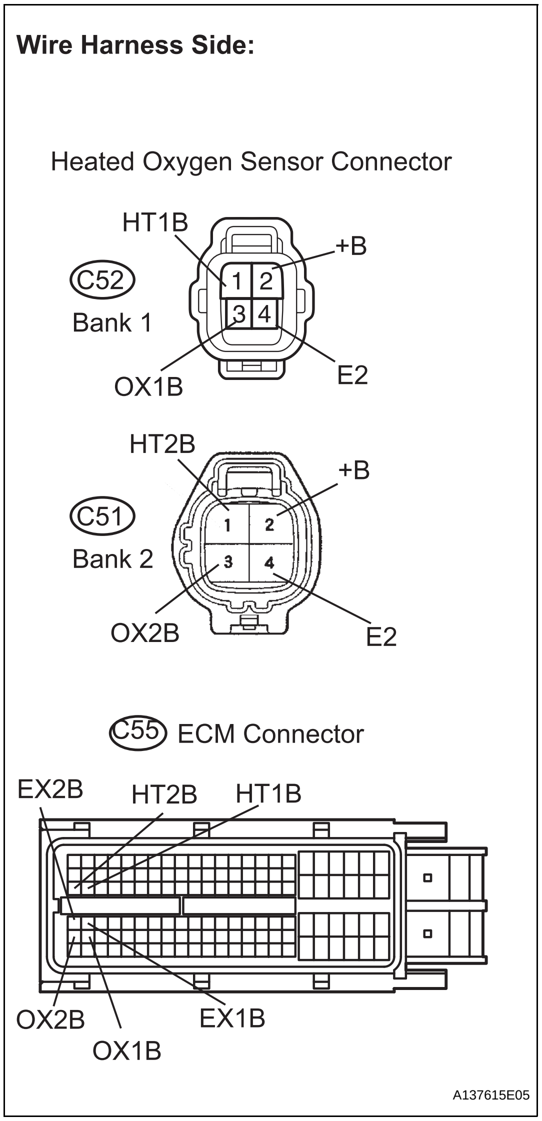
Terminal Connection	Specified Condition
1E-12 - 1E-6	10 kΩ or higher
1E-12 - 1E-6	Below 1 Ω (when battery voltage applied to terminals 1E-9 and 1E-10)

(c) Reinstall the engine room junction block.

NG → **REPLACE ENGINE ROOM JUNCTION BLOCK**

OK

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



(a) Disconnect the C52 oxygen sensor connector (Bank 1 Sensor 2) or C51 oxygen sensor connector (Bank 2 sensor 2).
(b) Turn the ignition switch on (IG).
(c) Measure the voltage according to the value(s) in the table below.

Standard voltage

Terminal Connection	Specified Condition
+B (C52-2) - Body ground	9 to 14 V
+B (C51-2) - Body ground	9 to 14 V

(d) Turn the engine switch off.
(e) Disconnect the C55 ECM connector.
(f) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Terminal Connection	Specified Condition
HT1B (C52-1) - HT1B (C55-48)	Below 1 Ω
OX1B (C52-3) - OX1B (C55-88)	Below 1 Ω
E2 (C52-4) - EX1B (C55-65)	Below 1 Ω
HT2B (C51-1) - HT2B (C55-47)	Below 1 Ω
OX2B (C51-3) - OX2B (C55-87)	Below 1 Ω
E2 (C51-4) - EX2B (C55-64)	Below 1 Ω

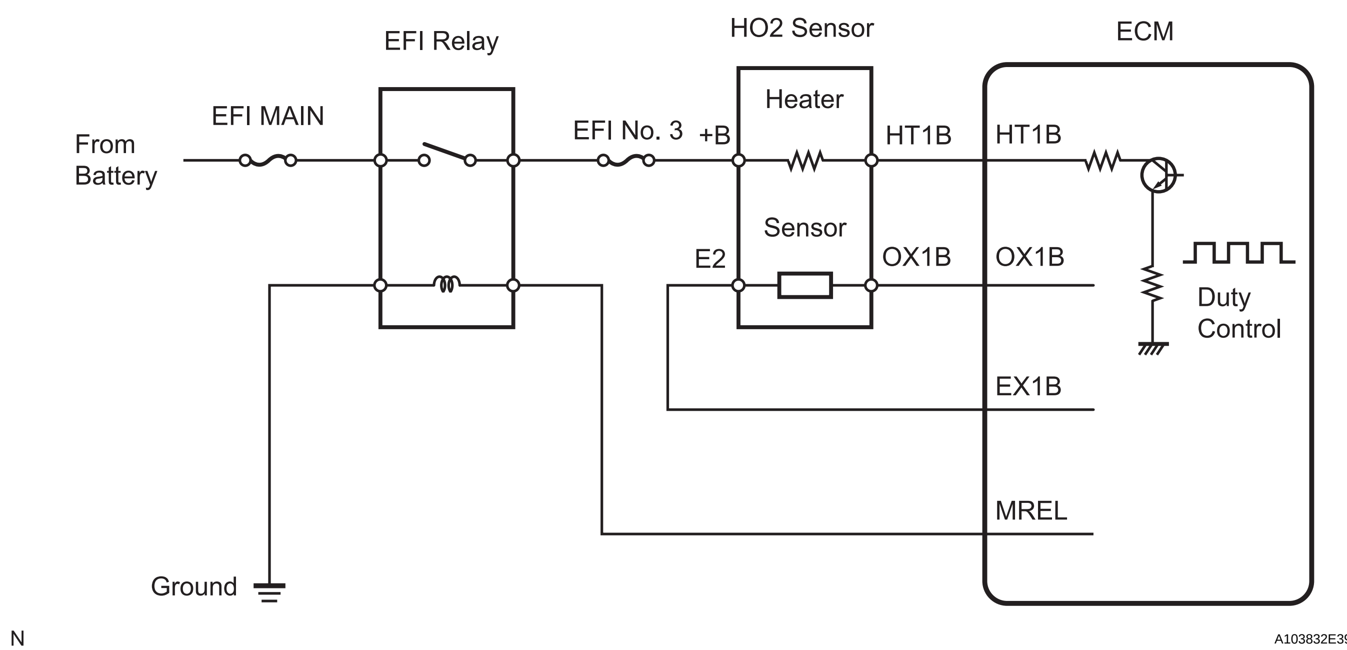
Standard resistance (Check for short)

Terminal Connection	Specified Condition
HT1B (C52-1) or HT1B (C55-48) - Body ground	10 kΩ or higher
OX1B (C52-3) or OX1B (C55-88) - Body ground	10 kΩ or higher
E2 (C52-4) or EX1B (C55-65) - Body ground	10 kΩ or higher
HT2B (C51-1) or HT2B (C55-47) - Body ground	10 kΩ or higher
OX2B (C51-3) or OX2B (C55-87) - Body ground	10 kΩ or higher
E2 (C51-4) or EX2B (C55-64) - Body ground	10 kΩ or higher

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

ES

Reference (System Diagram of Bank 1 Sensor 2):



NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE HEATED OXYGEN SENSOR (See page EC-20)

DTC	P0171	System Too Lean (Bank 1)

DTC	P0172	System Too Rich (Bank 1)

DTC	P0174	System Too Lean (Bank 2)

DTC	P0175	System Too Rich (Bank 2)

DESCRIPTION

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

ES

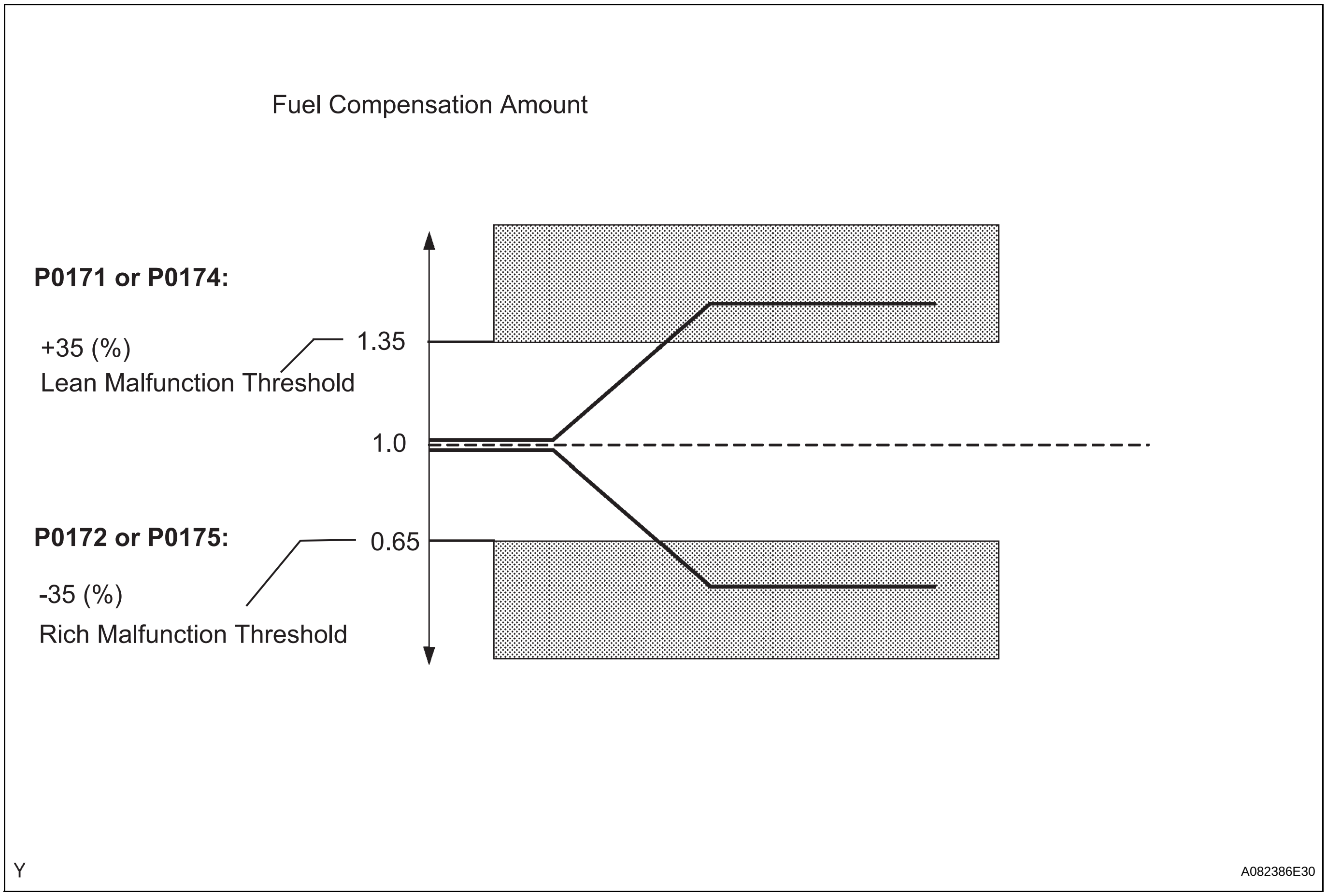
- When the total of the short-term and long-term fuel trim values is within the malfunction threshold (and the engine coolant temperature is more than 75°C [167°F]), the system is functioning normally.

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.



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	Less than 10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Fuel-trim:

The monitor will run whenever these DTCs are not present	P0010, P0020 (VVT VSV1, 2), P0011, P0012 (VVT System-Advance, Retard), P0021, P0022(VVT System2-Adavance, Retard), P0031, P0031, P0032, P0051, P0052 (A/F Sensor heater Sensor 1), P0100, P0101, P0102, P0103 (MAF Sensor), P0115, P0116, P0117, P0118 (ECT Sensor), P0120, P0121, P0122, P0123, P0220, P0222, P0223 , P2135 (TP Sensor), P0125 (Insufficient ECT for Closed Loop), P0335 (CKP Sensor), P0340, P0342, P0343, P0345 (VVT Sensor 1, 2), P0351, P0352, P0353, P0354, P0356 (Ignitor), P0500 (VSS),
Fuel system status	Closed-loop
Battery voltage	11 V or more
Either of following conditions is met	Condition 1 or 2
1. Engine RPM	Less than 1,100 rpm
2. Intake air amount per revolution	0.22 g/rev or more

ES

TYPICAL MALFUNCTION THRESHOLDS

Fuel trim:

EVAP purge-cut	Executing
Either of following conditions met	Condition 1 or 2
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-350).

INSPECTION PROCEDURE

HINT:

For use of the intelligent tester only:

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

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

1. Connect the intelligent tester to the DLC3.
2. Start the engine and turn the tester on.
3. Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
4. Select the following menu items on the tester: DIAGNOSIS / ENHANCEDOBD 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 voltage

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

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

– Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
– To display the graph, select the following menu items on the tester: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2. Press the YES button and then the ENTER button. Then press the F4 button.
HINT:
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.
- A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.

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

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

Result

Display (DTC Output)	Proceed to
P0171, 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 (See page ES-63)**

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 the air induction system.

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

OK

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

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
(d) Select the following menu items on the tester: 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 voltage

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 leakage or blockage • Gas leakage from exhaust system • Ignition system • Fuel pressure • MAF meter • ECT sensor	A
Lean	Lean/Rich	A/F sensor malfunction	-	A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	-	A/F sensor	B

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

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

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 the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) 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 (See page ES-499)**

OK

6	READ VALUE OF INTELLIGENT TESTER (MAF)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) 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 is idling:
Between 3.2 g/s and 4.7 g/s (shift position: N, A/C: OFF).
MAF at engine speed of 2,500 rpm:
Between 13.1 g/s and 18.9 g/s (shift position: N, A/C: OFF).

NG → **REPLACE MASS AIR FLOW METER (See page ES-477)**

OK

7	CHECK FUEL PRESSURE

(a) Check the fuel pressure (See page FU-8).

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

8	CHECK FOR EXHAUST GAS LEAKS

OK:
No gas leakage.

NG → **REPAIR OR REPLACE EXHAUST SYSTEM**

OK

9	CHECK FOR SPARKS AND IGNITION

(a) Check for sparks and ignition (See page IG-3).
HINT:
If the spark plugs or ignition system malfunctions, engine misfire may occur. The misfire count can be read using the intelligent tester. Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / CYL #1 (to CYL #6).

NG → **REPAIR OR REPLACE IGNITION SYSTEM**

OK

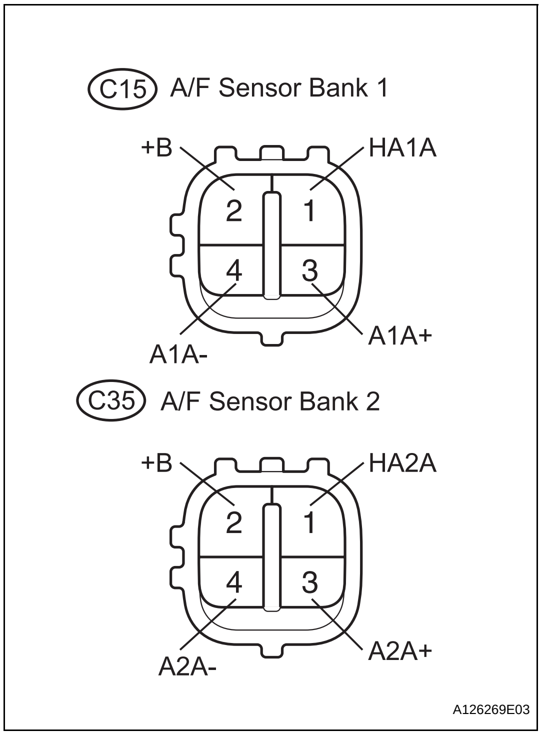
10	INSPECT FUEL INJECTOR ASSEMBLY (INJECTION AND VOLUME)

(a) Inspect the fuel injector assembly (See page FU-15).
HINT:
If the injectors malfunction, engine misfire may occur. The misfire count can be read using the intelligent tester. Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / CYL #1 (to CYL #6).

NG → **REPLACE FUEL INJECTOR ASSEMBLY (See page FU-13)**

OK

11 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the C15 or C35 A/F sensor connector.

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

Standard resistance:

Bank 1

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

Bank 2

Tester Connections	Specified Conditions
HA2A (1) - +B (2)	1.8 to 3.4 Ω at 20°C (68°F)
HT2A (1) - A2A- (4)	10 kΩ or higher

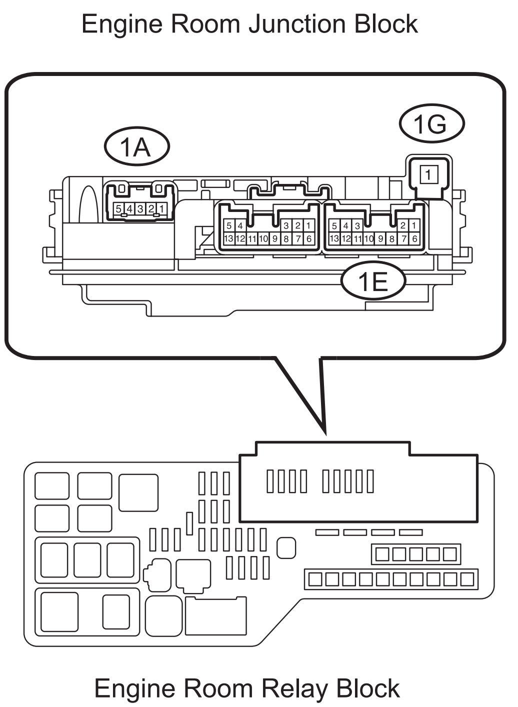
(c) Reconnect the A/F sensor connector.

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

OK

ES

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



(a) Remove the engine room junction block from the engine room R/B.

(b) Measure the A/F relay resistance.

Standard resistance

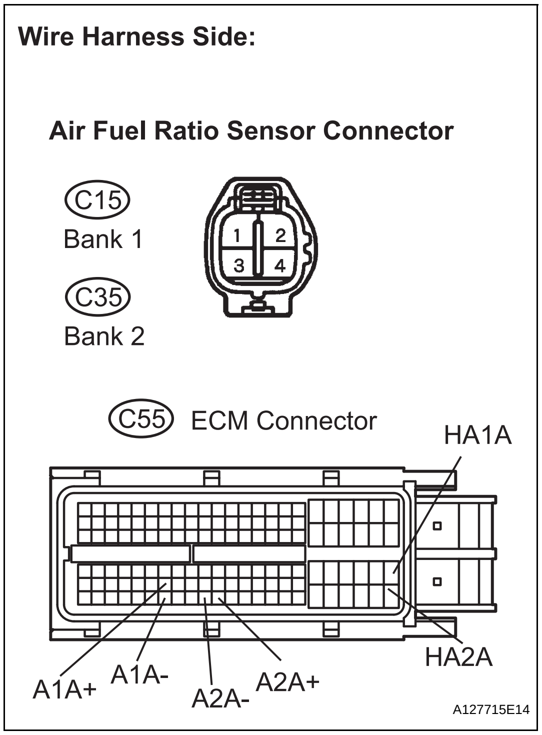
Tester Connections	Specified Conditions
1G-1 - 1A-4	10 kΩ or higher
1G-1 - 1A-4	Below 1 Ω (when battery voltage applied to terminals 1E-6 and 1E-10)

(c) Reinstall the engine room junction block.

NG → **REPLACE ENGINE ROOM JUNCTION BLOCK**

OK

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



(a) Disconnect the C15 or C35 A/F sensor connector.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage between the +B terminal of the A/F sensor connector and body ground.

Standard voltage

Tester Connections	Specified Conditions
+B (C15-2) - Body ground	9 to 14 V
+B (C35-2) - Body ground	9 to 14 V

(d) Turn the ignition switch off.
(e) Disconnect the C55 ECM connector.
(f) Measure the resistance.

Standard resistance (Check for open)

Tester Connections	Specified Conditions
HA1A (C15-1) - HA1A (C55-86)	Below 1 Ω
A1A+ (C15-3) - A1A+ (C55-93)	Below 1 Ω
A1A- (C15-4) - A1A- (C55-116)	Below 1 Ω
HA2A (C35-1) - HA2A (C55-109)	Below 1 Ω
A2A+ (C35-3) - A2A+ (C55-120)	Below 1 Ω
A2A- (C35-4) - A2A- (C55-119)	Below 1 Ω

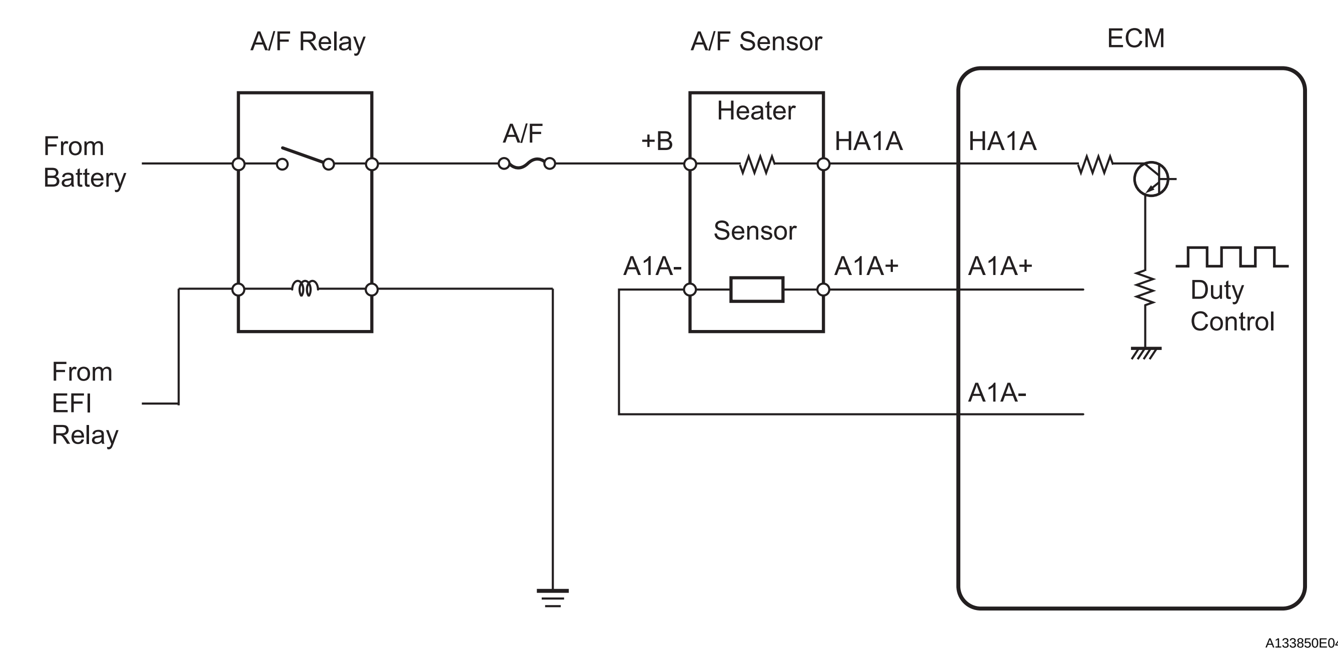
Standard resistance (Check for short)

Tester Connections	Specified Conditions
HA1A (C15-1) or HA1A (C55-86) - Body ground	10 kΩ or higher
A1A+ (C15-3) or A1A+ (C55-93) - Body ground	10 kΩ or higher
A1A- (C15-4) or A1A- (C55-116) - Body ground	10 kΩ or higher
HA2A (C35-1) or HA2A (C55-109) - Body ground	10 kΩ or higher
A2A+ (C35-3) or A2A+ (C55-120) - Body ground	10 kΩ or higher
A2A- (C35-4) or A2A- (C55-119) - Body ground	10 kΩ or higher

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

ES

Reference (System Diagram of Bank 1 Sensor 1):



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

OK

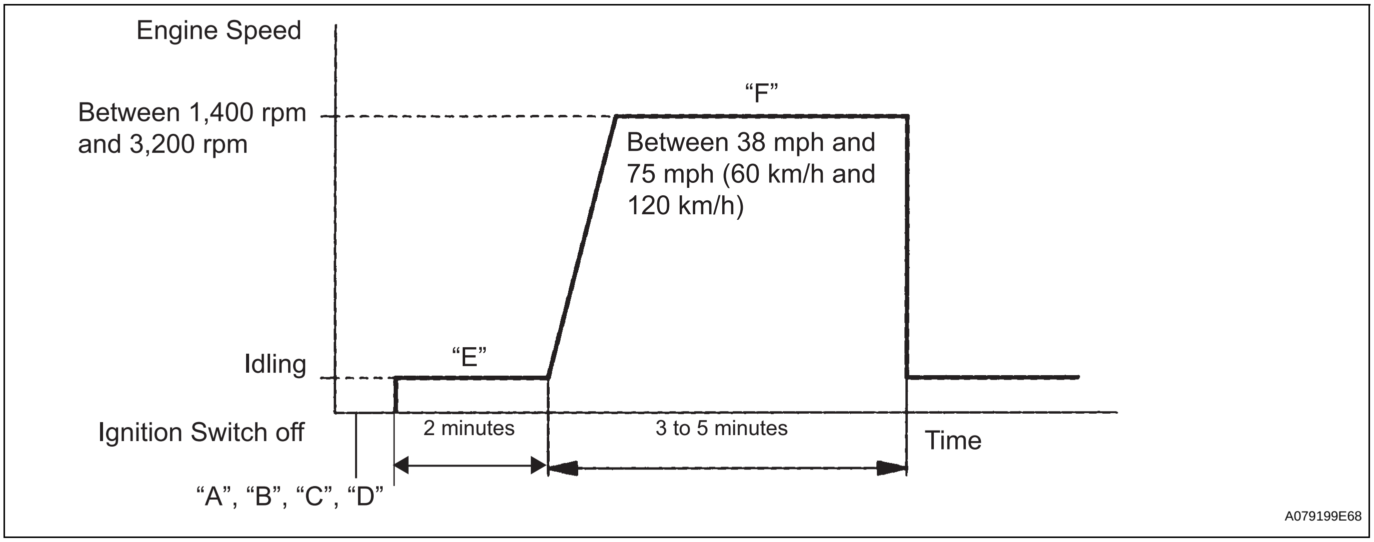
14 REPLACE AIR FUEL RATIO SENSOR

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

NEXT

15 PERFORM CONFIRMATION DRIVING PATTERN

(a) Connect the intelligent tester to the DLC3 (Procedure A).
(b) Turn the ignition switch on (IG) and turn the tester on (Procedure B).
(c) Clear the DTCs (See page ES-45) (Procedure C).
(d) Select the check mode using the tester (See page ES-49) (Procedure D).
(e) Start the engine and warm it up with all the accessories switched off (Procedure E).
(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 (Procedure F).



ES

HINT:
If the system is still malfunctioning, the MIL will be illuminated during procedure "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) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.
(b) Read the DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P0171, P0172, P0174 or P0175	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

DTC	P0305	Cylinder 5 Misfire Detected

DTC	P0306	Cylinder 6 Misfire Detected

DESCRIPTION

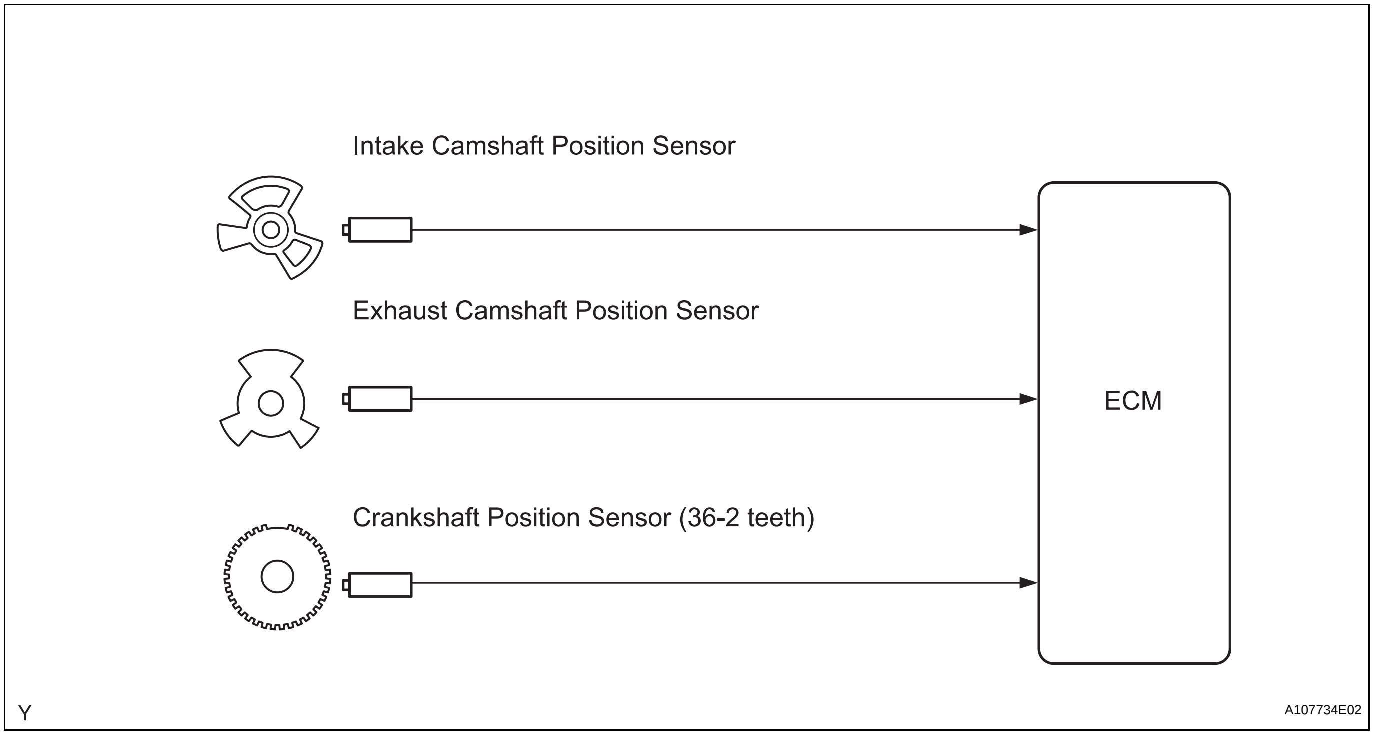
When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause an increase in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause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

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

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

If DTCs that indicate misfires are set for different cylinders, but DTC P0300 is not set, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only set when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION



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

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

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

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

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Misfire:

Monitor runs whenever following DTCs are not present	P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0327 - P0333 (Knock sensor) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0500 (VSS)
Battery voltage	8 V or more
VVT system	Not operated by scan tool
Engine RPM	450 to 6,500 rpm
Either of following conditions (a) or (b) is 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 are met:	Crankshaft 200 revolutions
1. Driving cycles	1st
2. Check mode	OFF
3. Engine RPM	Less than 2,500 rpm
Except above	Crankshaft 200 revolutions x 3

TYPICAL MALFUNCTION THRESHOLDS

Monitor period of emission-related-misfire:

Misfire rate	1 % or more

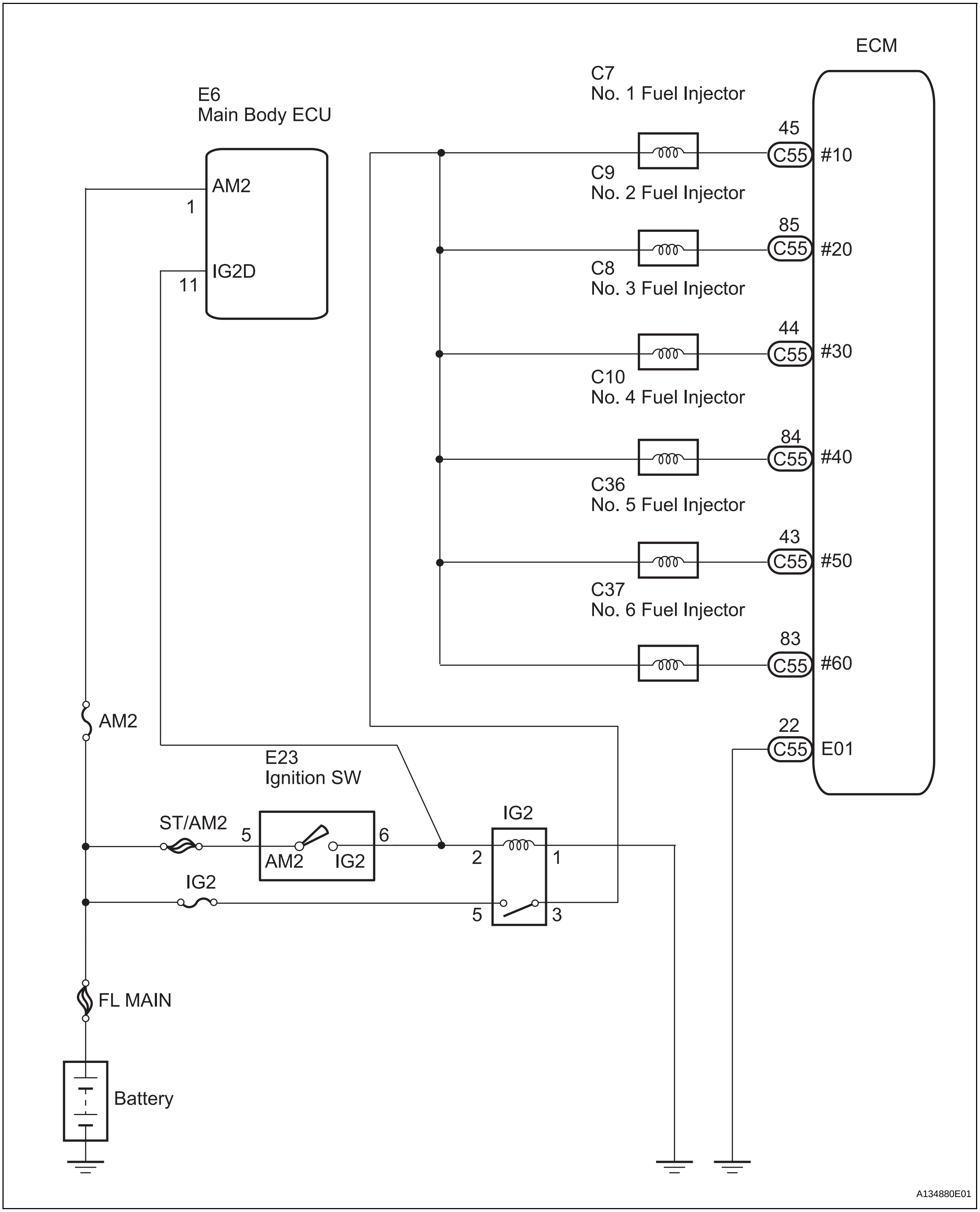
Monitor period of catalyst-damage-misfire (MIL blinks):

Number of misfire per 200 revolutions	94 or more (varies with intake air amount and RPM)
Paired cylinders misfire (MIL blinks immeditately)	Detected

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-25).

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the ignition switch on (IG).
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 (See page ES-49).
6. Read the misfire counts of each cylinder (CYL #10 to #60) 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 operate the vehicle for the period of time shown in the table below, using 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 engine 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.
9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the engine switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).
- If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the ECM as freeze frame data.
- If the misfire still cannot be reproduced even though the conditions stored in the ECM as freeze frame data have been reproduced, one of the following factors is considered to be a possible cause of the problem:
  (a) There was insufficient fuel in the tank.
  (b) Improper fuel is used.
  (c) The spark plugs have been contaminated.
  (d) The problem requires further diagnosis.
- 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 finishing 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-45).
  (b) Start the engine and conduct the confirmation driving pattern.
  (c) Read the misfiring rates of each cylinder or DTC(s) using the tester.

(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 misfire have occurred only while warming up the engine.

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

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

Result

Display (DTC output)	Proceed to
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 (See page ES-63)**

A

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

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

NEXT

3	CHECK PCV HOSE (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 the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the tester on.
(d) Clear DTCs.
(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / MISFIRE / CYL #1, #2, #3, #4, #5 and #6 (Step "A").
(f) Allow the engine to idle (Step "B").
(g) Read the value of CYL #1 to #6 displayed on the tester. If no misfire counts occur in any cylinders, perform the following operations (Step "C"):
  (1) Shift the gear selector lever to the D position.
  (2) Repeat steps "A" to "C" above.
  (3) Check the CYL #1 to #6.
  (4) If misfire counts are still no displayed, perform steps "D" and "E" and then check the misfire counts again.
(h) Drive the vehicle with the MISFIRE RPM and MISFIRE LOAD noted in step 2 (Step "D").
(i) Read the CYL #1 to #6 or DTCs displayed on the tester (Step "E").

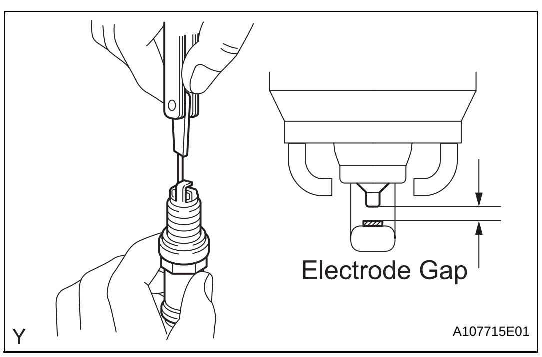
Result

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

B → **Go to step 13**

A

5 CHECK SPARK PLUG



(a) Remove the ignition coil and the spark plug of the misfiring cylinder.
(b) Measure the spark plug electrode gap.
Standard:
Between 1.0 mm and 1.4 mm (0.039 in. and 0.055 in.)
(c) Check the electrode for carbon deposits.
Recommended spark plug:

Manufacture	Product
DENSO	FK20HBR11

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 FOR 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 sparks.
OK:
Sparks jump across the electrode gap.
(e) Reconnect the injector connectors.

NG → **Go to step 8**

OK

7	CHECK CYLINDER COMPRESSION PRESSURE (MALFUNCTION 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

8	CHANGE SPARK PLUG WITH NORMAL ONE AND CHECK FOR SPARKS OF MISFIRING CYLINDER

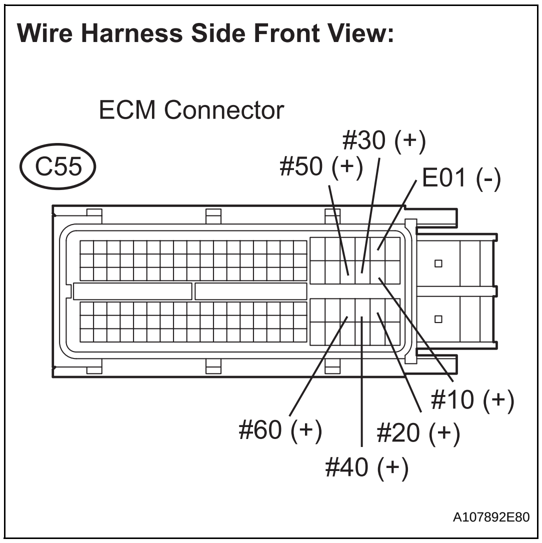
(a) Change the installed spark plug with a spark plug that functions normally.
(b) Perform a spark test.
CAUTION:
Always disconnect each injector connector.
NOTICE:
Do not crank the engine for more than 2 seconds.
(1) Install the spark plug to the ignition coil and connect the ignition coil connector.
(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 the electrode gap.

NG → **REPLACE IGNITION COIL ASSEMBLY (See page IG-9)**

OK

REPLACE SPARK PLUG

9 INSPECT ECM (#10, #20, #30, #40, #50 AND/OR #60 VOLTAGE))



(a) Disconnect the C55 ECM connector.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage between the terminals.
Standard voltage

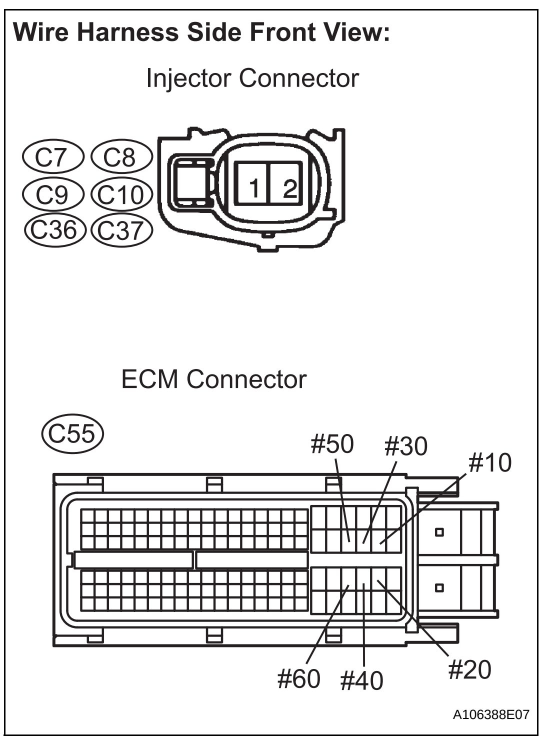
Tester Connection	Specified Condition
#10 (C55-45) - E01 (C55-22)	9 to 14 V
#20 (C55-85) - E01 (C55-22)	9 to 14 V
#30 (C55-44) - E01 (C55-22)	9 to 14 V
#40 (C55-84) - E01 (C55-22)	9 to 14 V
#50 (C55-43) - E01 (C55-22)	9 to 14 V
#60 (C55-83) - E01 (C55-22)	9 to 14 V

(d) Reconnect the ECM connector.

OK → **Go to step 12**

NG

10 CHECK HARNESS AND CONNECTOR (INJECTOR - ECM)



(a) Disconnect the injector connector (misfire cylinder).
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance between the terminals.
Standard resistance

Tester Connection	Specified Condition
#10 (C55-45) - C7-1	Below 1 Ω
#20 (C55-85) - C9-1	Below 1 Ω
#30 (C55-44) - C8-1	Below 1 Ω
#40 (C55-84) - C10-1	Below 1 Ω
#50 (C55-43) - C36-1	Below 1 Ω
#60 (C55-83) - C37-1	Below 1 Ω
#10 (C55-45) or C7-1 - Body ground	10 kΩ or higher
#20 (C55-85) or C9-1 - Body ground	10 kΩ or higher
#30 (C55-44) or C8-1 - Body ground	10 kΩ or higher
#40 (C55-84) or C10-1 - Body ground	10 kΩ or higher
#50 (C55-43) or C36-1 - Body ground	10 kΩ or higher
#60 (C55-83) or C37-1 - Body ground	10 kΩ or higher

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

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

ES

OK

11	CHECK FUEL INJECTOR ASSEMBLY (MISFIRING CYLINDER)

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

NG → **REPLACE FUEL INJECTOR ASSEMBLY (See page FU-13)**

OK

12	CHECK VALVE CLEARANCE (MISFIRING CYLINDER)

NG → **ADJUST VALVE CLEARANCE**

OK

13	CHECK AIR INDUCTION SYSTEM

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

OK:

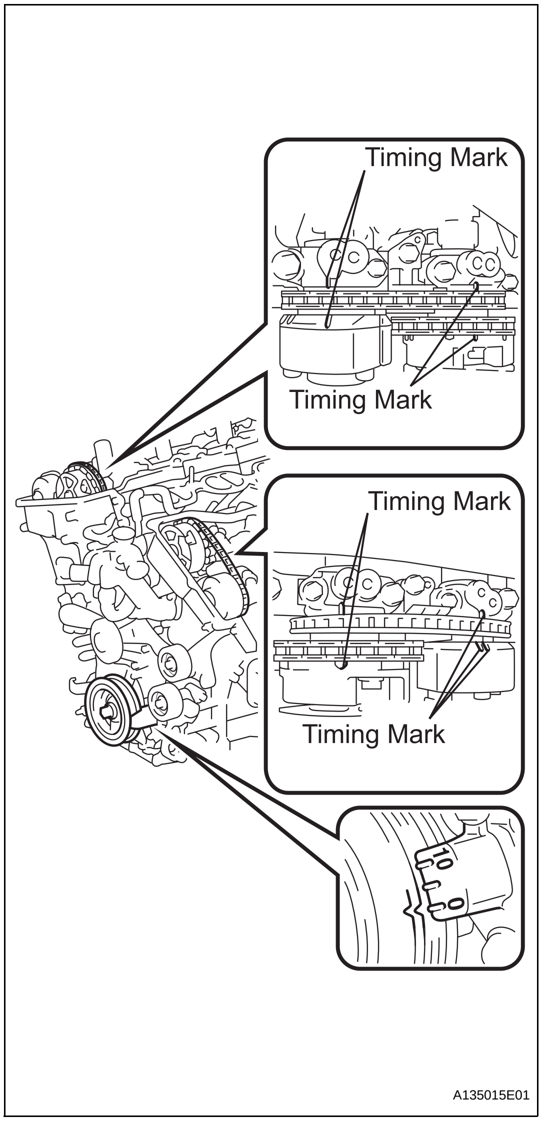
No leakage from air induction system.

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

OK

ES

14	CHECK VALVE TIMING



(a) Remove the cylinder head covers.
(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 covers.

NG → **ADJUST VALVE TIMING**

OK

15	CHECK FUEL PRESSURE

(a) Check the fuel pressure (high or low pressure).
Standard

Item	Standard Condition
Fuel pressure	147 kPa (1.5 kgf/cm^2, 21 psi)

NG → **CHECK AND REPLACE FUEL SYSTEM**

OK

16	READ VALUE OF INTELLIGENT TESTER (COOLANT TEMP)

(a) Connect the intelligent tester to the DLC3.

(b) Turn the ignition switch on (IG).
(c) Turn the tester on.
(d) Enter the following menus: 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 (See page ES-499)**

OK

ES

17 READ VALUE OF INTELLIGENT TESTER (MAF)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the tester on.
(d) Enter the following menus: 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 is idling:
Between 2.1 g/sec and 3.1 g/sec (shift position: N, A/C: OFF).
MAF at an engine speed of 2,500 rpm:
Between 7.8 g/sec and 11.4 g/sec (shift position: N, A/C: OFF).

NG → **REPLACE MASS AIR FLOW METER (See page ES-477)**

OK

18 CHECK MISFIRE COUNT (CYL #1, #2, #3, #4, #5 AND #6)

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

B → **Go to step 5**

A

CHECK FOR INTERMITTENT PROBLEMS

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

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

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

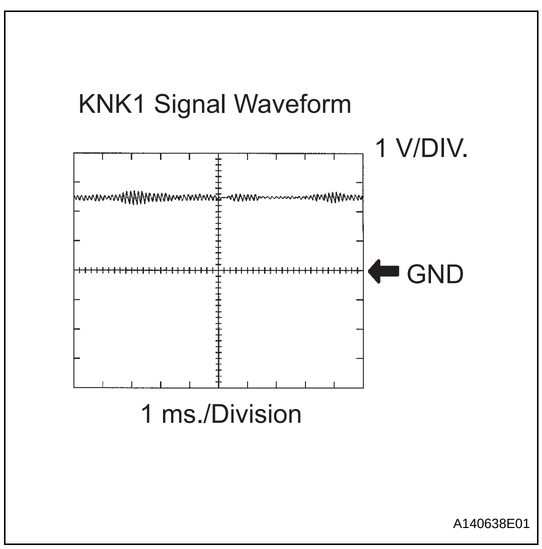
DTC	P0333	Knock Sensor 2 Circuit High Input (Bank 2)

DESCRIPTION

A flat type knock sensor (non-resonant type) 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 Condition	Trouble Area
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 engine switch is turned off.
Reference: Inspection using an oscilloscope



The correct waveform is as shown.

Item	Content
Terminals	KNK1 - EKNK or KNK2 -EKN2

Item	Content
Equipment Settings	0.01 to 10 V/DIV. 0.01 to 10 ms./DIV.
Conditions	Keep engine speed at 4,000 rpm with warm engine

MONITOR DESCRIPTION

The knock sensor, located on the cylinder block, detects spark knock. When spark knock occurs, the piezoelectric element of the sensor vibrates. When the ECM detects a voltage in this frequency range, it retards the ignition timing to suppress spark knock.
The ECM also senses background engine noise with the knock sensor and uses this noise to check for faults in the sensor. If the knock sensor signal level is too low for more than 10 seconds, or if the knock sensor output voltage is outside the normal range, the ECM interprets this as a fault in the knock sensor and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0327: Knock sensor (Bank 1) 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 are not present	None
Battery voltage	10.5 V or more
Time after engine start	5 seconds or more
Engine switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

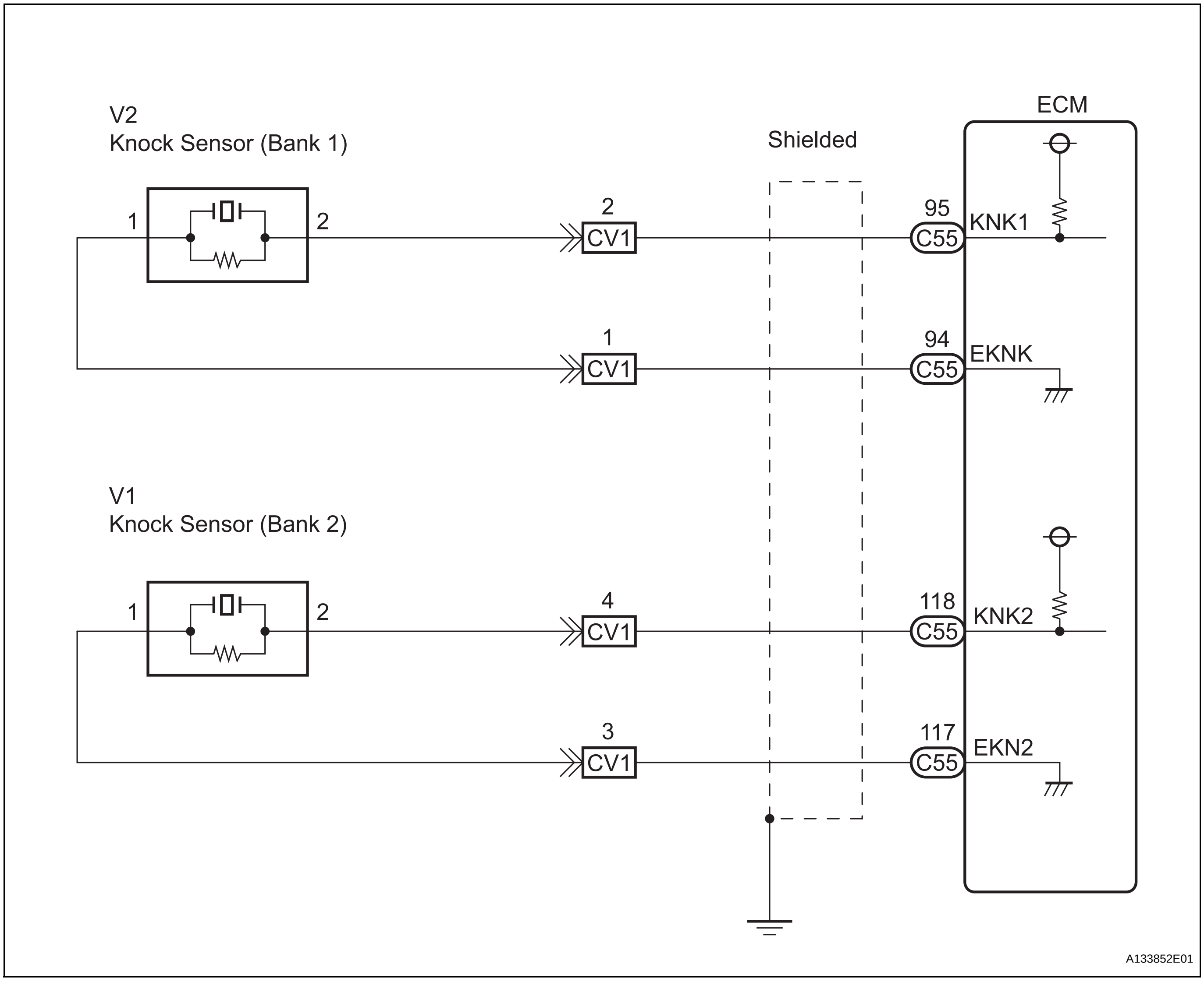
Knock Sensor Range Check (Low voltage) P0327 and P0332:

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

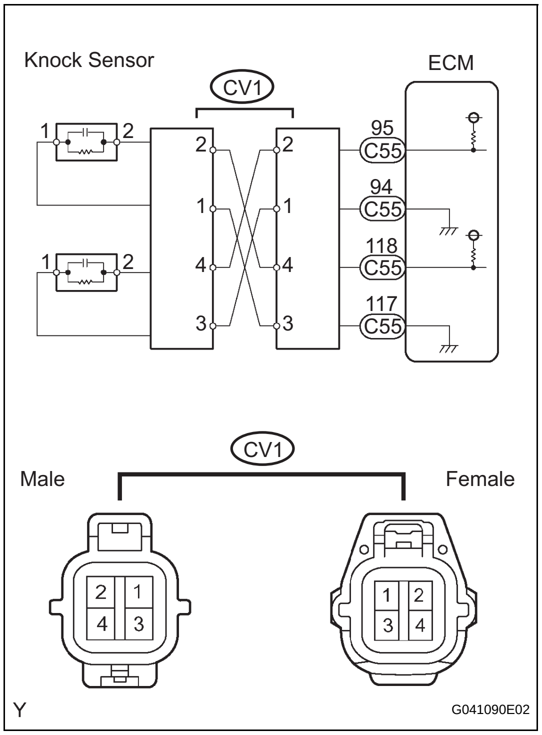


INSPECTION PROCEDURE

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 the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	READ OUTPUT DTC (CHECK KNOCK SENSOR CIRCUIT)



(a) Disconnect the CV1 connector.
(b) Using lead wires, connect the connectors as follows:

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

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

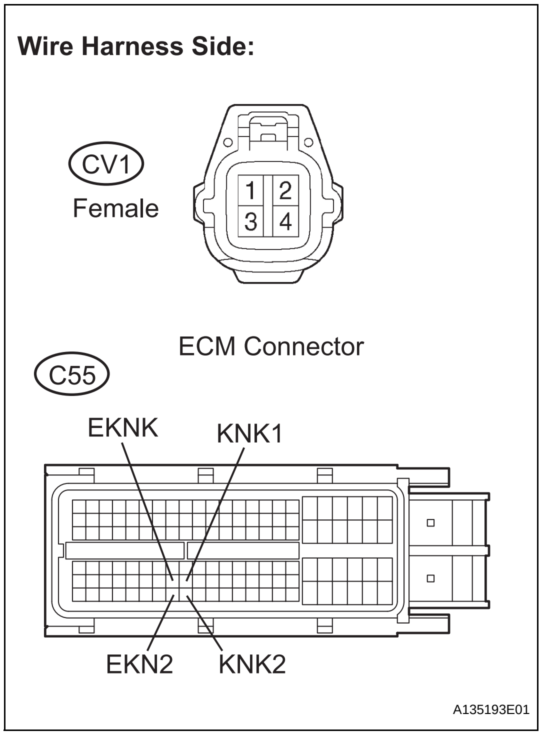
(i) Reconnect the CV1 connector.

B → **Go to step 4**

A

ES

2	CHECK WIRE HARNESS AND CONNECTOR (CONNECTOR - ECM)



(a) Disconnect the CV1 connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
CV1 female connector 2 - KNK1 (C55-95)	Below 1 Ω
CV1 female connector 1 - EKNK (C55-94)	Below 1 Ω
CV1 female connector 4 - KNK2 (C55-118)	Below 1 Ω
CV1 female connector 3 - EKN2 (C55-117)	Below 1 Ω

Standard resistance (Check for short)

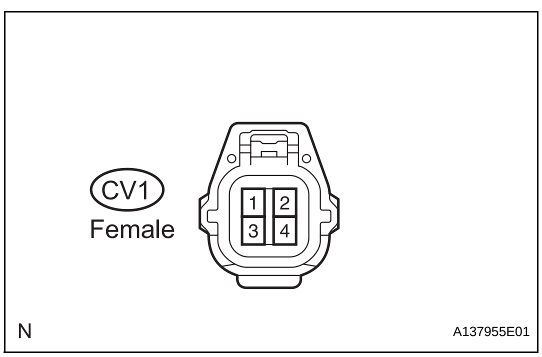
Tester Connection	Specified Condition
CV1 female connector 2 or KNK1 (C55-95) - Body ground	10 kΩ or higher
CV1 female connector 1 or EKNK (C55-94) - Body ground	10 kΩ or higher
CV1 female connector 4 or KNK2 (C55-118) - Body ground	10 kΩ or higher
CV1 female connector 3 or EKN2 (C55-117) - Body ground	10 kΩ or higher

(d) Reconnect the CV1 connector.
(e) Reconnect the ECM connector.

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

OK

3	INSPECT ECM



(a) Disconnect the CV1 connector.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
CV1 female connector 2 - 1	4.5 to 5.5 V
CV1 female connector 4 - 3	4.5 to 5.5 V

(d) Reconnect the ECM connector.

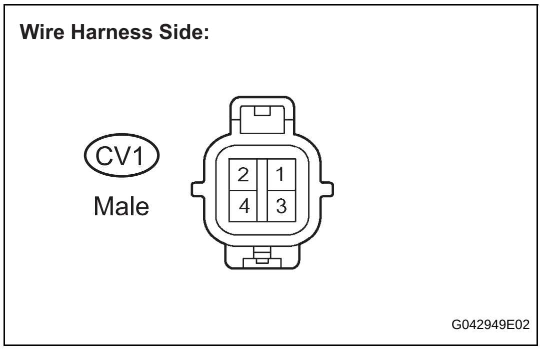
NG → **REPLACE ECM (See page ES-518)**

OK

CHECK FOR INTERMITTENT PROBLEMS

ES

4 INSPECT KNOCK SENSOR



(a) Disconnect the CV1 connector.
(b) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
CV1 male connector 1 - 2	120 to 280 kΩ
CV1 male connector 3- 4	120 to 280 kΩ

(c) Reconnect the CV1 connector.

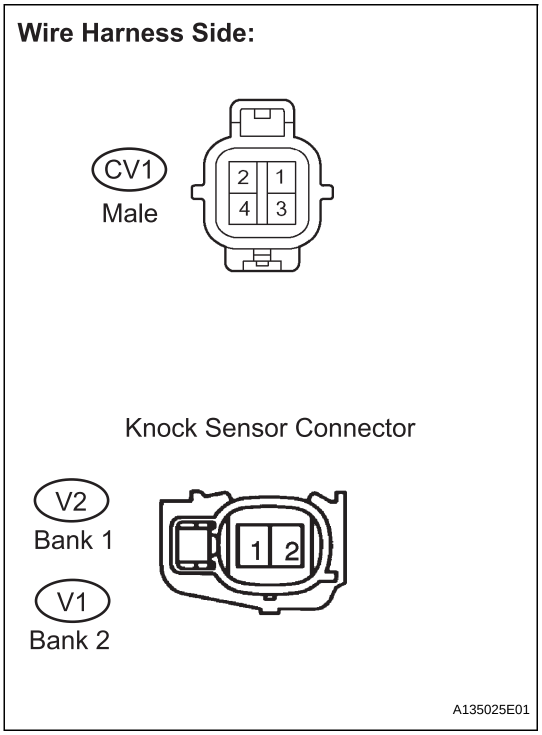
OK → **CHECK FOR INTERMITTENT PROBLEMS**

ES

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 CV1 connector.
(b) Disconnect the V2 and V1 knock sensor connectors.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
CV1 male connector 2 - V2-2	Below 1 Ω
CV1 male connector 1 - V2-1	Below 1 Ω
CV1 male connector 4 - V1-2	Below 1 Ω
CV1 male connector 3 - V1-1	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
CV1 male connector 2 or V2-2 - Body ground	10 kΩ or higher
CV1 male connector 1 or V2-1 - Body ground	10 kΩ or higher
CV1 male connector 4 or V1-2 - Body ground	10 kΩ or higher
CV1 male connector 3 or V1-1 - Body ground	10 kΩ or higher

(d) Reconnect the CV1 connector.
(e) Reconnect the knock sensor connectors.

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

OK ↓

REPLACE KNOCK SENSOR (See page ES-510)

DTC	P0335	Crankshaft Position Sensor "A" Circuit

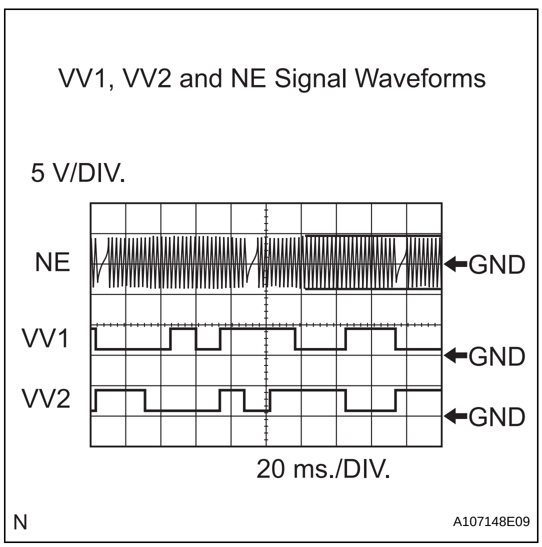
DTC	P0339	Crankshaft Position Sensor "A" Circuit Intermittent

DESCRIPTION

The crankshaft position (CKP) sensor system consists of a crankshaft position sensor plate and a magnetic coil.
The sensor plate has 34 teeth and is installed on the crankshaft. The pickup coil is made of windings, an iron core and 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 for each engine revolution. Based on these signals, the ECM calculates the crankshaft position and engine RPM. Using these calculations, the fuel injection time and ignition time are controlled.

DTC No.	DTC Detection Condition	Trouble Area
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 • 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 elapsed since starter signal switched from ON to OFF	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM

Reference: Inspection using an oscilloscope.



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

Item	Content
Terminals	VV1+ - VV1- VV2+ - VV2- NE+ - NE-
Equipment Settings	5 V/DIV, 20 ms./DIV.
Conditions	Cranking or idling

MONITOR DESCRIPTION

If there is no signal from the crankshaft position sensor despite the engine revolving, the ECM interprets this as a malfunction of the sensor.
If the malfunction is not repaired successfully, these DTCs are set 10 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0335: CKP sensor signal check when starter ON P0335: CKP sensor signal check when starter OFF P0335: sensor pulse check
Required Sensors/Components (Main)	Crankshaft Position (CKP) sensor
Required Sensors/Components (Sub)	-
Frequency of Operation	Continuous
Duration	Within 5 seconds and 3 times
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor will run whenever these DTCs are not present	-

CKP sensor signal check when starter OFF:

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

CKP sensor pulse check:

Battery voltage	7 V or higher
Starter	ON
Number of VVT sensor signal pulse	6 times
CMP sensor circuit fail	Not detected
Ignition switch	ON

TYPICAL MALFUNCTION THRESHOLDS

CKP sensor signal check when starter OFF:

Sensor signal	No signal

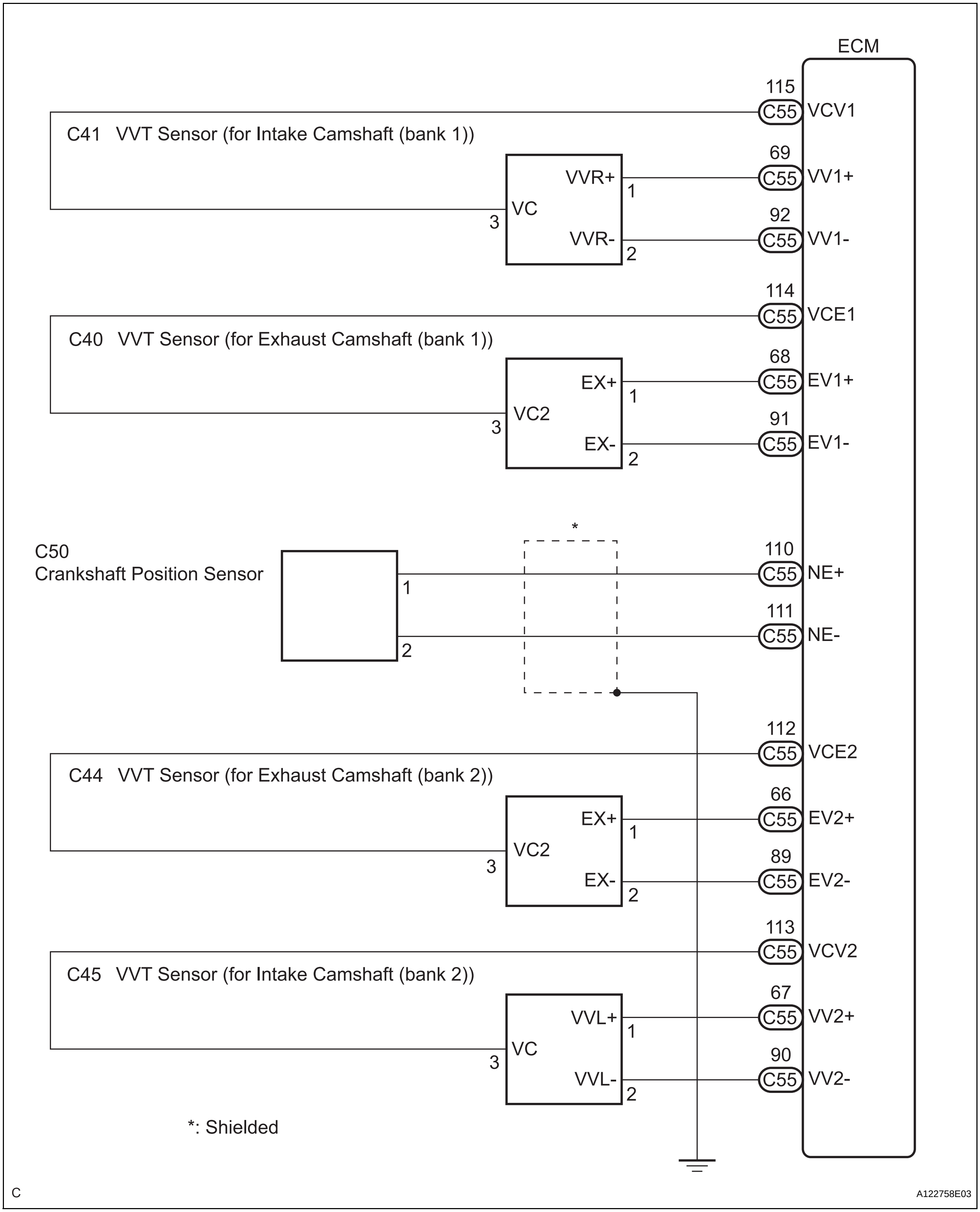
CKP sensor pulse check:

Number of sensor pulse	132 or less, or 174 or more

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM

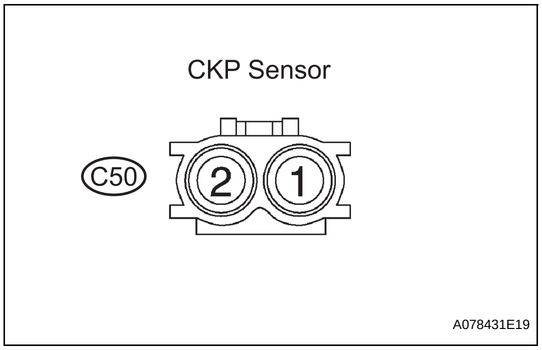


INSPECTION PROCEDURE

HINT:
- If no problem is found by this diagnostic troubleshooting procedure, troubleshoot the engine mechanical system.
- Check the engine speed. The engine speed can be checked by using the intelligent tester. To check, follow the procedure below:
  (a) Connect the intelligent tester to the DLC3.
  (b) Start the engine.
  (c) Turn the tester on.
  (d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / ENGINE SPD.
  The engine speed may be indicated as zero despite the engine revolving normally. This is caused by a lack of NE signals from the crankshaft position (CKP) sensor. Alternatively, the engine speed may be indicated as lower than the actual engine speed, if the CKP sensor output voltage is insufficient.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

ES

1	INSPECT CRANKSHAFT POSITION SENSOR



(a) Disconnect the C50 crankshaft position (CKP) sensor connector.
(b) Measure the resistance according to the value(s) in the table below.
Standard resistance

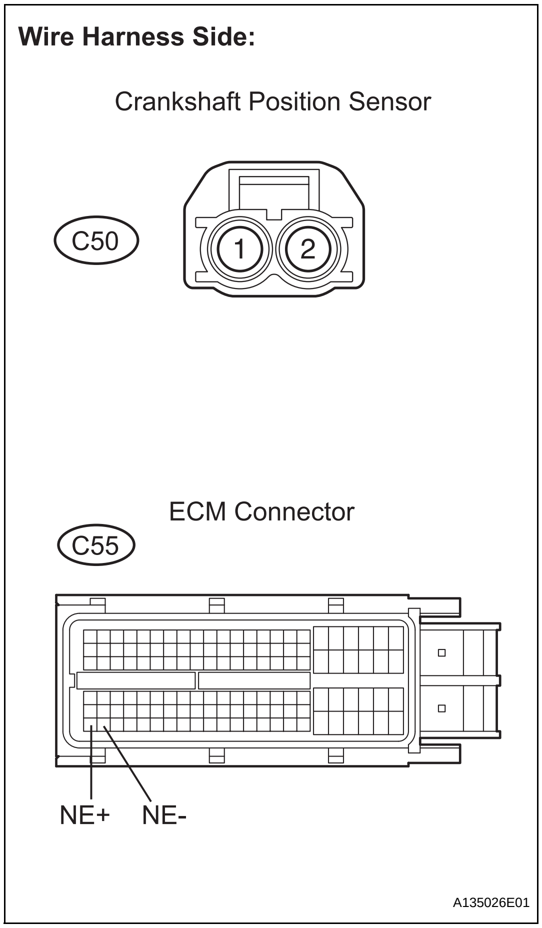
Tester Connection	Condition	Specified Condition
1 - 2	Cold	1,630 to 2,740 Ω
1 - 2	Hot	2,065 to 3,225 Ω

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

NG → **REPLACE CRANKSHAFT POSITION SENSOR (See page ES-496)**

OK

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



(a) Disconnect the C50 CKP sensor connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
C50-1 - NE+ (C55-110)	Below 1 Ω
C50-2 - NE- (C55-111)	Below 1 Ω

Standard resistance (Check for short)

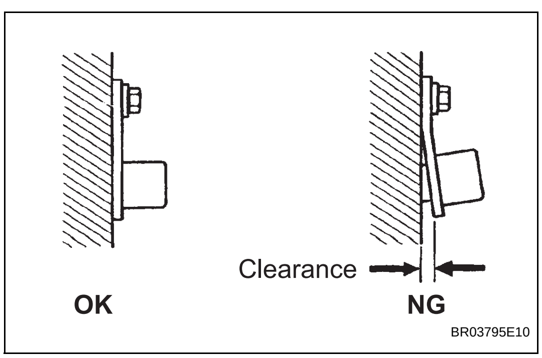
Tester Connection	Specified Condition
C50-1 or NE+ (C55-110) - Body ground	10 kΩ or higher
C50-2 or NE- (C55-111) - Body ground	10 kΩ or higher

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

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

OK

3 CHECK CRANK POSITION SENSOR (SENSOR INSTALLATION)



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

NG → **REPAIR OR REPLACE CRANK POSITION SENSOR**

OK

4 CHECK CRANKSHAFT POSITION SENSOR PLATE (TEETH OF SENSOR 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 (See page ES-518)

DTC	P0340	Camshaft Position Sensor Circuit Malfunction

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)

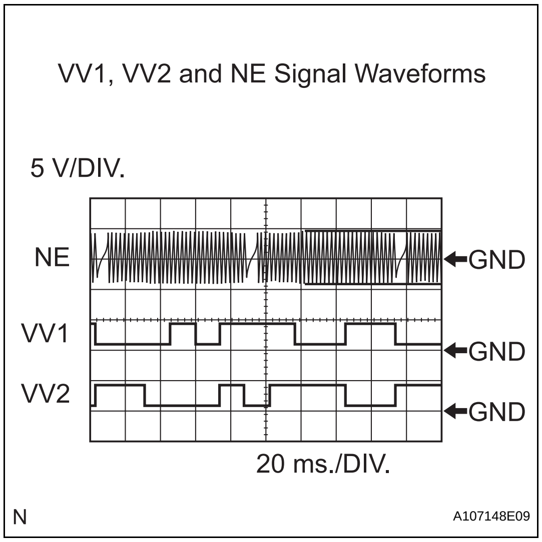
DTC	P0348	Camshaft Position Sensor "A" Circuit High Input (Bank 2)

DESCRIPTION

The intake camshaft's Variable Valve Timing (VVT) sensor (G signal) consists of a magnet and MRE (Magneto Resistance Element).
The VVT camshaft drive gear has a sensor plate with 3 teeth on its outer circumference. When the gear rotates, changes occur in the air gaps between the sensor plate and MRE, which affects the magnetic field. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the gear rotation data to pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.
The crankshaft angle sensor plate has 34 teeth. The pickup coil generates 34 signals for each engine revolution. Based on combination of the G signal and NE signal, the ECM detects the crankshaft angle. Then the ECM uses this data to control fuel injection time and injection timing. Also, based on the NE signal, the ECM detects the engine speed.

DTC No.	DTC Detection Condition	Trouble Area
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 engine switch on (IG) (1 trip detection logic) • No VVT sensor signal to ECM during cranking (1 trip detection logic)	• Open or short in VVT sensor for intake camshaft circuit • VVT sensor for intake camshaft • Camshaft timing gear for intake camshaft • Jumped tooth of timing chain for intake camshaft • ECM
P0342 P0347	Output voltage of VVT sensor 0.3 V or less is for 5 seconds (1 trip detection logic)	• Open or short in VVT sensor for intake camshaft circuit • VVT sensor for intake camshaft • Camshaft timing gear for intake camshaft • Jumped tooth of timing chain for intake camshaft • ECM
P0343 P0348	Output voltage of VVT sensor 4.7 V or more is for 5 seconds (1 trip detection logic)	• Open or short in VVT sensor for intake camshaft circuit • VVT sensor for intake camshaft • Camshaft timing gear for intake camshaft • Jumped tooth of timing chain for intake camshaft • ECM

Reference: Inspection using an oscilloscope



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

Item	Content
Terminals	NE+ - NE- VV1+ - VV1- VV2+ - VV2-
Equipment Settings	5 V/DIV. 20 ms./DIV.
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 (high 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 (high voltage)
Required Sensors/Components (Main)	VVT position sensor (Bank 1 and 2)
Required Sensors/Components (Sub)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	5 seconds
MIL Operation	2 driving cycles: P0340 (cranking), P0345 (cranking) Immediate: Others
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs are not present	None

ES

P0340 (Engine running):

Engine speed	600 rpm or more
Starter	OFF

P0345 (Engine running):

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

P0340 (Cranking):

Starter	ON
Minimum battery voltage	Less than 11 V
CPU initial	Not initial

P0345 (Cranking):

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

P0340, P0342, P0343 (Chattering, Low voltage, High voltage):

Starter	OFF
Engine switch	ON
Time after engine switch off to on	2 seconds or more

P0345, P0347, P0348 (Chattering, Low voltage, High voltage):

Starter	OFF
Engine switch	ON
Time after engine switch off to on	2 seconds or more
Battery Voltage	8 V or more

TYPICAL MALFUNCTION THRESHOLDS

P0340 (Engine running):

Camshaft position and crankshaft position phase	Misaligned
Camshaft position signal	No signal

P0340 (Cranking):

Camshaft position signal	No signal

P0340 (Chattering):

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

P0342 (Low voltage):

Camshaft position sensor voltage	Less than 0.3 V

P0343 (High voltage):

Camshaft position sensor voltage	More than 4.7 V

P0345 (Engine running, cranking):

VVT sensor signal	No signal

P0345 (Chattering):

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

P0347 (Low voltage):

VVT sensor voltage	Less than 0.3 V

P0348 (High voltage):

VVT sensor voltage	More than 4.7 V

COMPONENT OPERATING RANGE

VVT sensor voltage	0.3 to 4.7 V

WIRING DIAGRAM

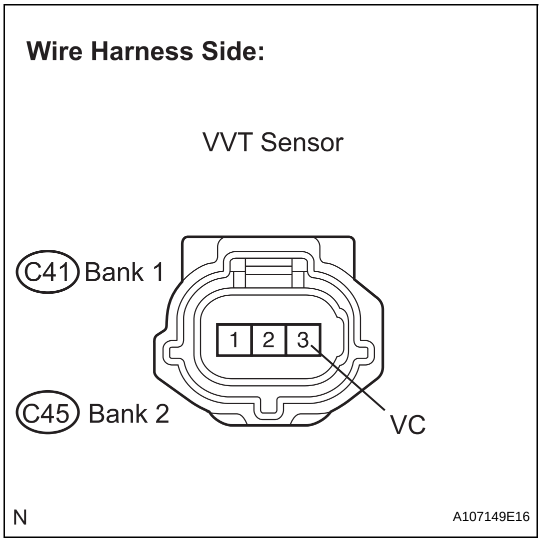
Refer to DTC P0335 (See page ES-224).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air/fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	CHECK HARNESS AND CONNECTOR (SENSOR POWER SOURCE)



(a) Disconnect the C41 or C45 VVT sensor connector.

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

Standard voltage

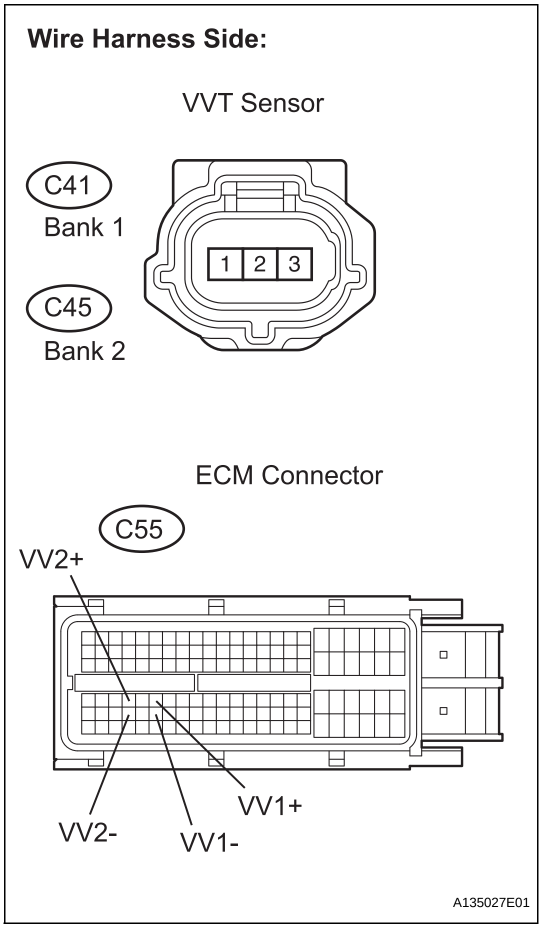
Tester Connection	Specified Condition
VC (C41-3) - Body ground	4.5 to 5.0 V
VC (C45-3) - Body ground	4.5 to 5.0 V

(c) Reconnect the VVT sensor connector.

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

OK

2 CHECK HARNESS AND CONNECTOR (VVT SENSOR FOR INTAKE CAMSHAFT - ECM)



(a) Disconnect the C41 or C45 VVT sensor connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
VVR+ (C41-1) - VV1+ (C55-69)	Below 1 Ω
VVR- (C41-2) - VV1- (C55-92)	Below 1 Ω
VVL+ (C45-1) - VV2+ (C55-67)	Below 1 Ω
VVL- (C45-2) - VV2- (C55-90)	Below 1 Ω

Standard resistance (Check for short)

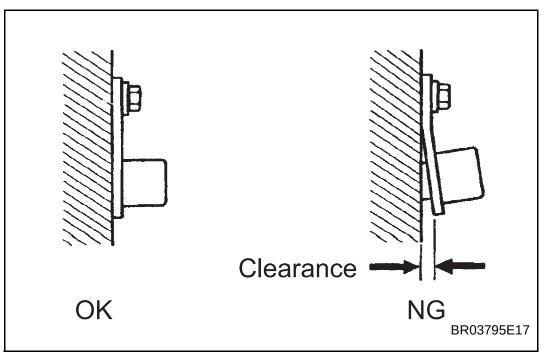
Tester Connection	Specified Condition
VVR+ (C41-1) or VV1+ (C55-69) - Body ground	10 kΩ or higher
VVR- (C41-2) or VV1- (C55-92) - Body ground	10 kΩ or higher
VVL+ (C45-1) or VV2+ (C55-67) - Body ground	10 kΩ or higher
VVL- (C45-2) or VV2- (C55-90) - Body ground	10 kΩ or higher

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

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

OK

3 CHECK VVT SENSOR FOR INTAKE CAMSHAFT (SENSOR INSTALLATION)



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

NG → **REPAIR OR REPLACE VVT SENSOR**

OK

4 CHECK CAMSHAFT TIMING GEAR ASSEMBLY (TEETH OF 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

5 REPLACE VVT SENSOR

NEXT

6 CHECK WHETHER DTC OUTPUT RECURS

ES

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to on (IG).
(c) Turn the intelligent tester on.
(d) Clear the DTCs (See page ES-45).
(e) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.
(f) Read the DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P0340, P0342, P0343, P0345, P0347 or P0348	B

HINT:
If the engine does not start, replace the ECM.

B → **REPLACE ECM (See page ES-518)**

A

END

DTC	**P0351**	**Ignition Coil "A" Primary / Secondary Circuit**

DTC	**P0352**	**Ignition Coil "B" Primary / Secondary Circuit**

DTC	**P0353**	**Ignition Coil "C" Primary / Secondary Circuit**

DTC	**P0354**	**Ignition Coil "D" Primary / Secondary Circuit**

DTC	**P0355**	**Ignition Coil "E" Primary / Secondary Circuit**

DTC	**P0356**	**Ignition Coil "F" Primary / Secondary Circuit**

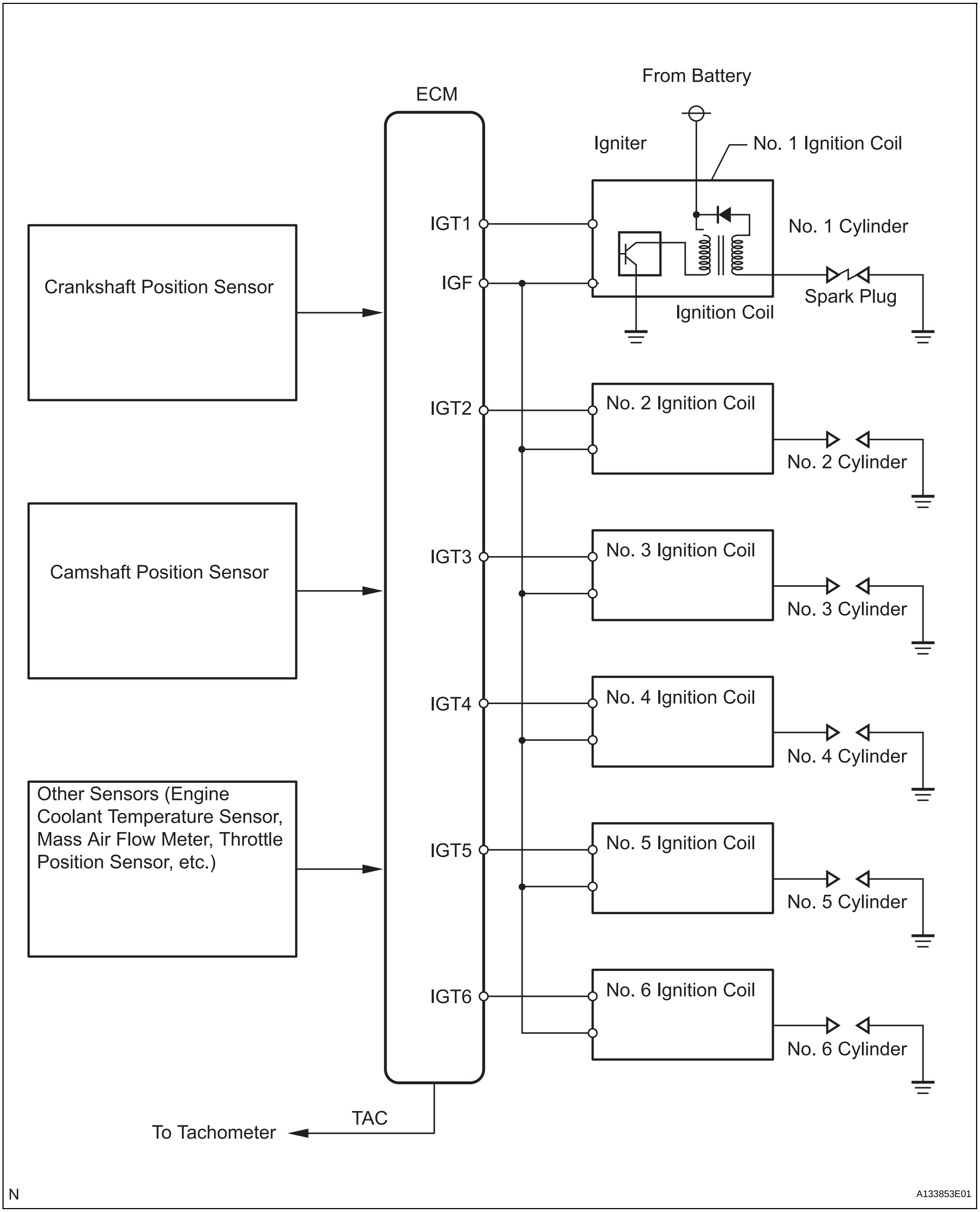
DESCRIPTION

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

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

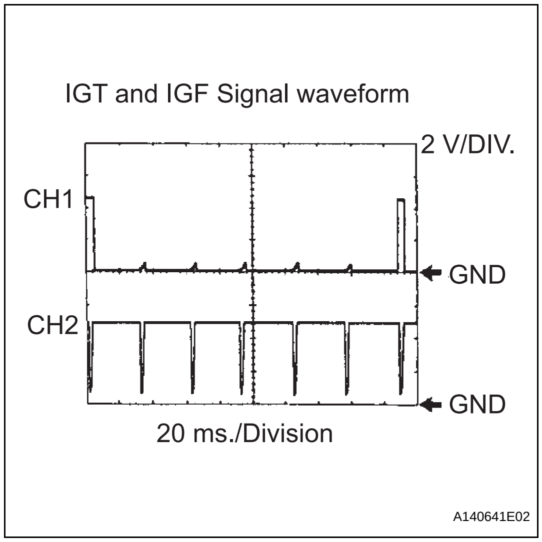
The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center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

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


ECM
From Battery
Igniter
No. 1 Ignition Coil
IGT1
IGF
No. 1 Cylinder
Spark Plug
Ignition Coil
Crankshaft Position Sensor
IGT2
No. 2 Ignition Coil
No. 2 Cylinder
Camshaft Position Sensor
IGT3
No. 3 Ignition Coil
No. 3 Cylinder
IGT4
No. 4 Ignition Coil
No. 4 Cylinder
Other Sensors (Engine Coolant Temperature Sensor, Mass Air Flow Meter, Throttle Position Sensor, etc.)
IGT5
No. 5 Ignition Coil
No. 5 Cylinder
IGT6
No. 6 Ignition Coil
No. 6 Cylinder
TAC
To Tachometer
N
A133853E01

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

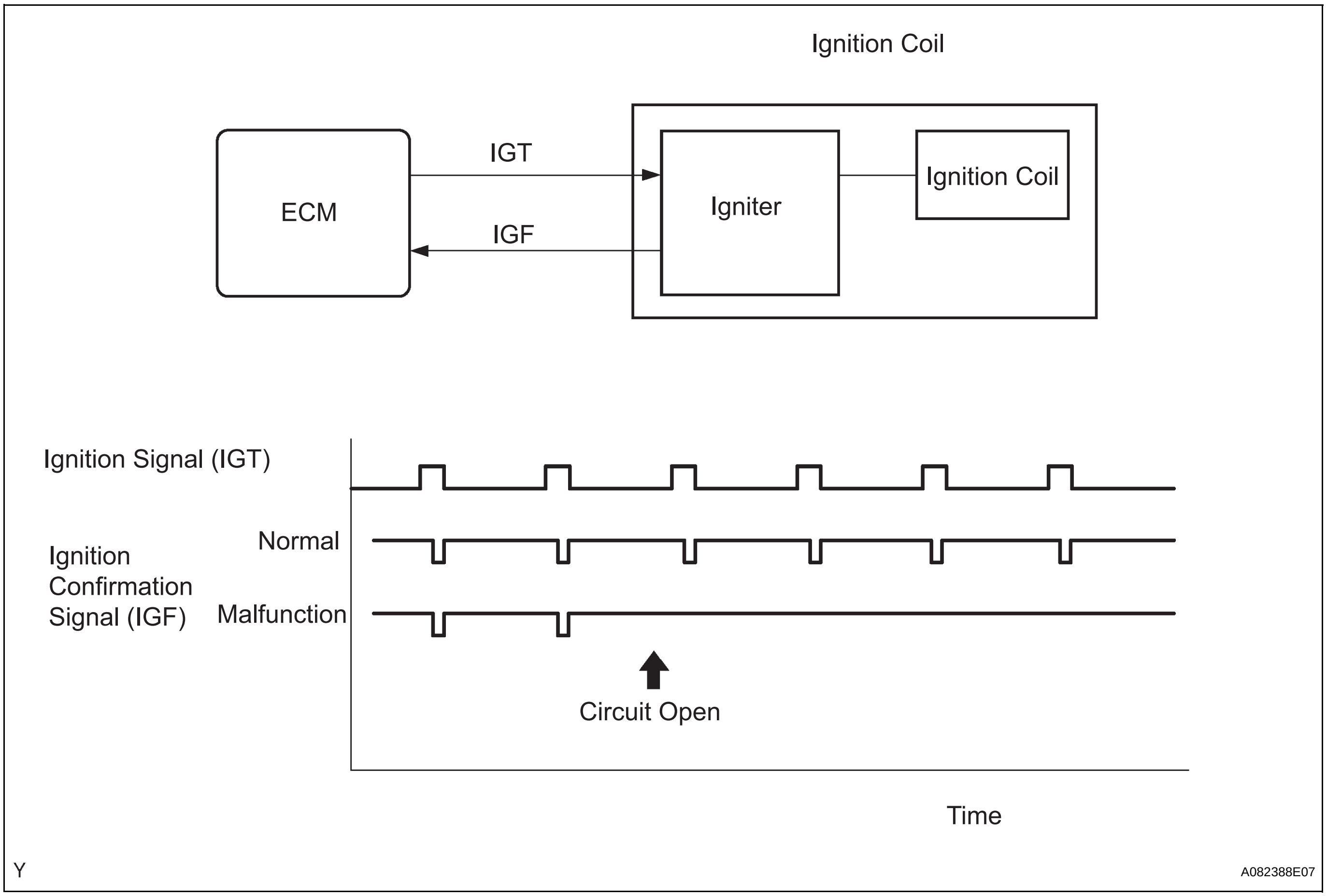
Reference: Inspection using an oscilloscope.



While cranking or idling the engine, check the waveform between terminals IGT (1 to 6) and E1, and IGF1, IGF1 and E1 of the ECM connector.

Item	Content
Terminals	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6 - E1 CH2: IGF1 - E1
Equipment Settings	2 V/DIV. 20 ms./DIV.
Conditions	Cranking or idling

MONITOR DESCRIPTION



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

MONITOR STRATEGY

Related DTCs	P0351: Igniter (cylinder 1) malfunction P0352: Igniter (cylinder 2) malfunction P0353: Igniter (cylinder 3) malfunction P0354: Igniter (cylinder 4) malfunction P0355: Igniter (cylinder 5) malfunction P0356: Igniter (cylinder 6) malfunction
Required Sensors/Components (Main)	Igniter (Cylinder 1 to 6)
Required Sensors/Components (Sub)	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 the following DTCs are not present	None
Either of the following condition A or B is met:	-
A. Engine RPM	1,500 rpm or less
B. Starter	OFF
Either of the following condition C or D is met:	-

ES

C. Both of the following conditions are met:	-
(a) Engine speed	500 rpm or less
(b) Battery voltage	6 V or more
D. All of the following conditions are met:	-
(a) Engine speed	More than 500 rpm
(b) Battery voltage	10 V or more
(c) Number of sparks after CPU reset	5 sparks or more

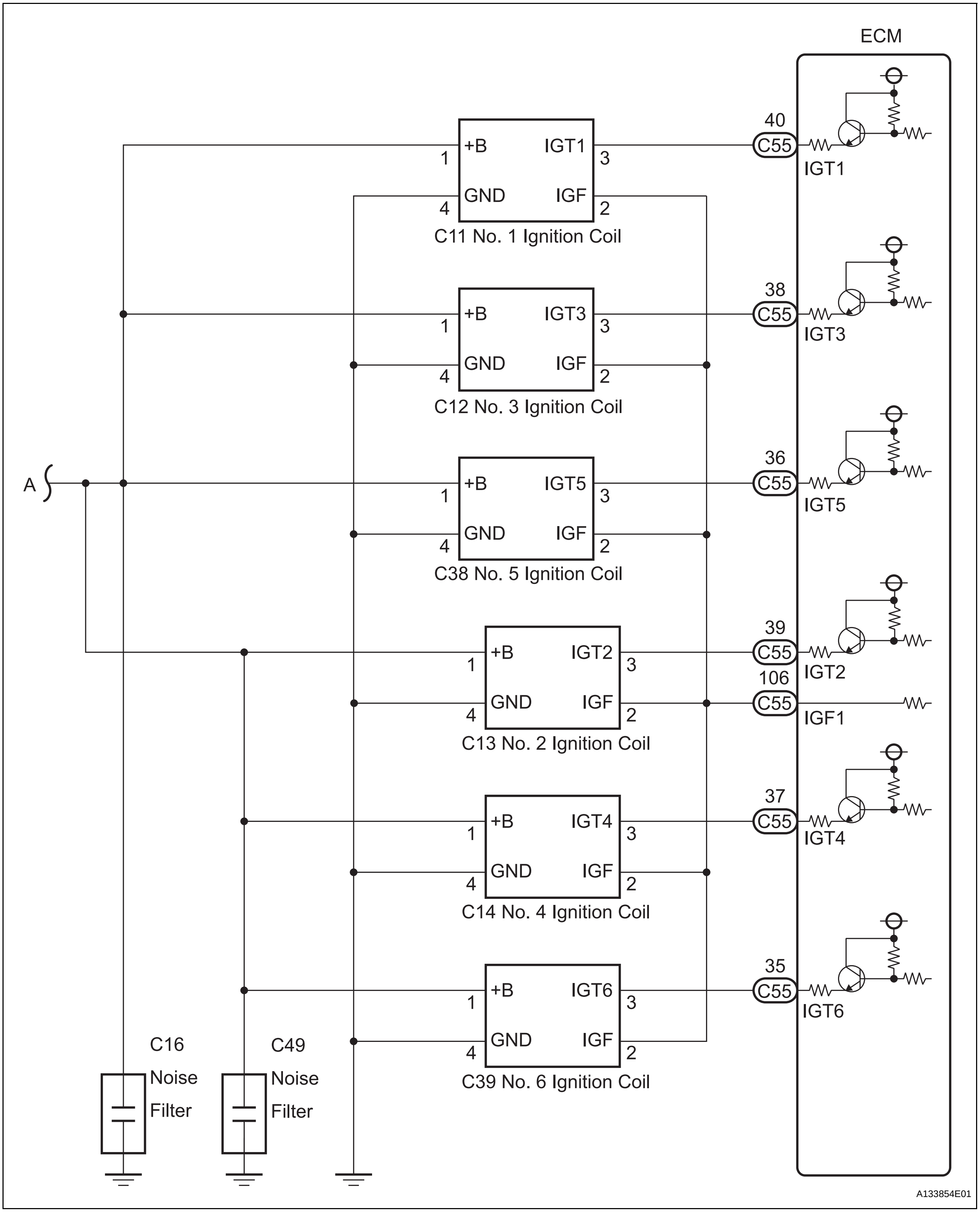
TYPICAL MALFUNCTION THRESHOLDS

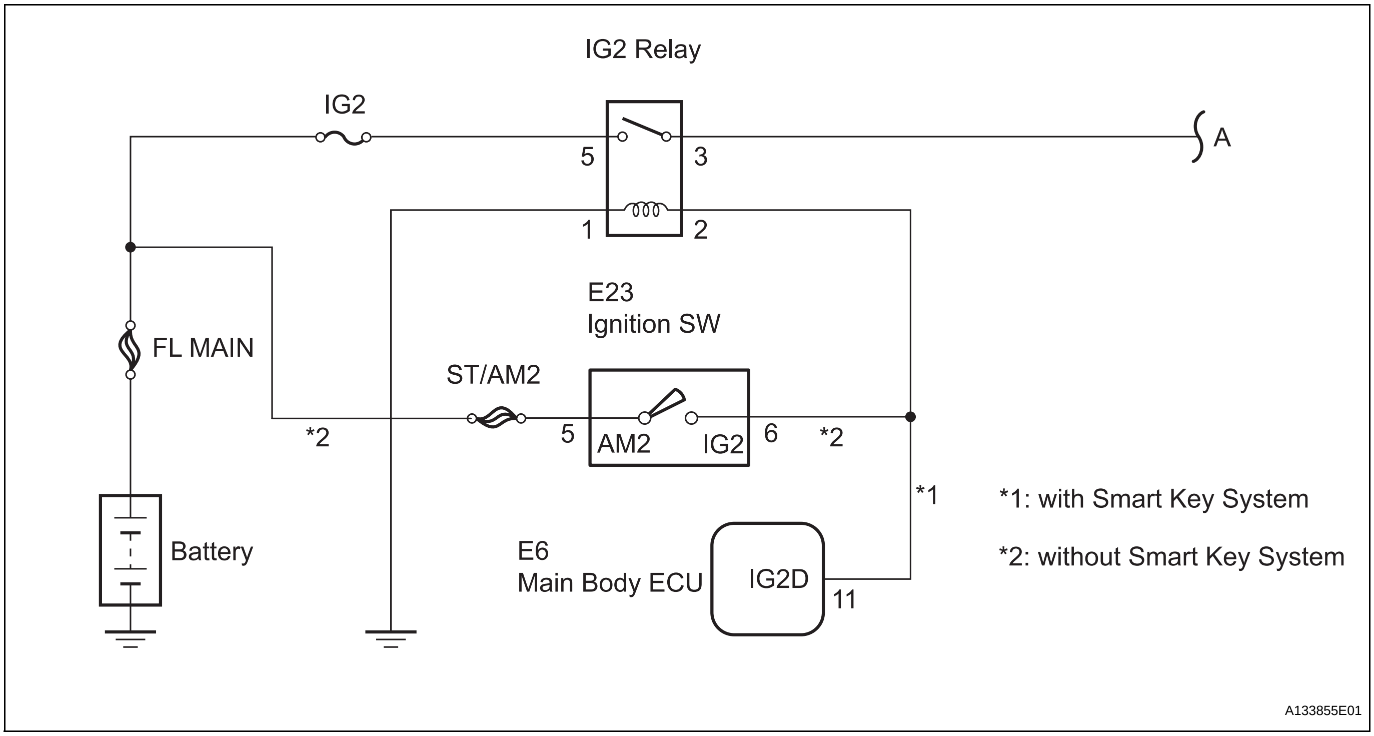
Ignition signal fail count	More than 2 times
Ignition signal fail count	No ignition confirmation signal from ignitor

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM



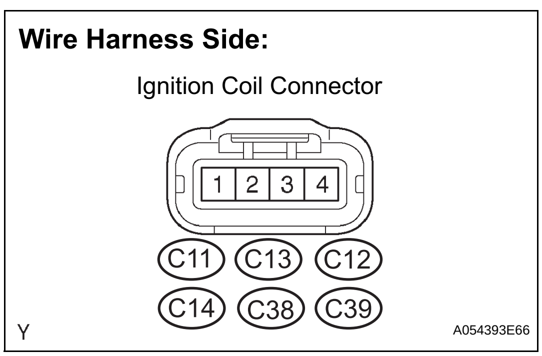


INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)



(a) Disconnect the C11, C13, C12, C14, C38 or C39 ignition coil connector.

(b) Turn the ignition switch on (IG).

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

Standard voltage

Tester Connection	Specified Condition
C11-1 - Body ground	9 to 14 V
C13-1 - Body ground	9 to 14 V
C12-1 - Body ground	9 to 14 V
C14-1 - Body ground	9 to 14 V
C38-1 - Body ground	9 to 14 V
C39-1 - Body ground	9 to 14 V

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

Standard resistance

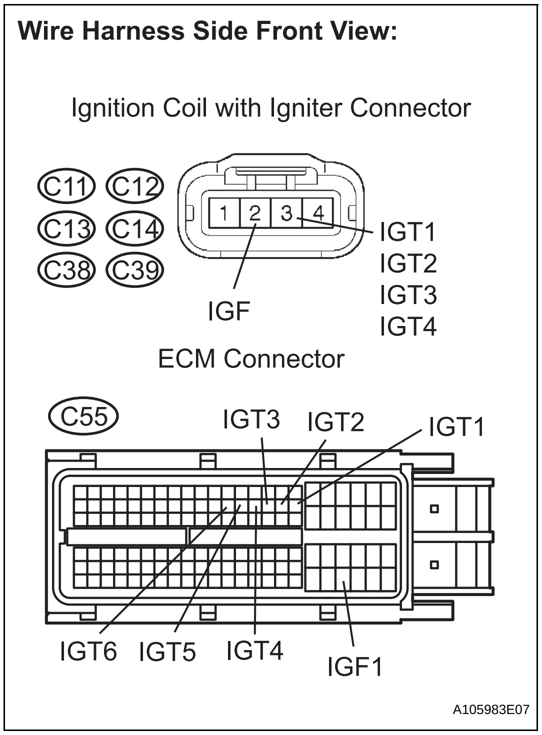
Tester Connection	Specified Condition
C11-4 - Body ground	Below 1 Ω
C13-4 - Body ground	Below 1 Ω

Tester Connection	Specified Condition
C12-4 - Body ground	Below 1 Ω
C14-4 - Body ground	Below 1 Ω
C38-4 - Body ground	Below 1 Ω
C39-4 - Body ground	Below 1 Ω

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

OK

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



(a) Disconnect the C11, C13, C12, C14, C38 or C39 ignition coil connector.

(b) Disconnect the ECM C55 connectors.

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

Standard resistance (Check for open)

Tester Connection	Specified Condition
IGT1 (C11-3) - IGT1 (C55-40)	Below 1 Ω
IGT2 (C13-3) - IGT2 (C55-39)	Below 1 Ω
IGT3 (C12-3) - IGT3 (C55-38)	Below 1 Ω
IGT4 (C14-3) - IGT4 (C55-37)	Below 1 Ω
IGT5 (C38-3) - IGT5 (C55-36)	Below 1 Ω
IGT6 (C39-3) - IGT6 (C55-35)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
IGT1 (C11-3) or IGT1 (C55-40) - Body ground	10 kΩ or higher
IGT2 (C13-3) or IGT2 (C55-39) - Body ground	10 kΩ or higher
IGT3 (C12-3) or IGT3 (C55-38) - Body ground	10 kΩ or higher
IGT4 (C14-3) or IGT4 (C55-37) - Body ground	10 kΩ or higher
IGT5 (C38-3) or IGT5 (C55-36) - Body ground	10 kΩ or higher
IGT6 (C39-3) or IGT6 (C55-35) - Body ground	10 kΩ or higher

Standard resistance (Check for open)

Tester Connection	Specified Condition
IGF (C11-2) - IGF1 (C55-106)	Below 1 Ω
IGF (C13-2) - IGF1 (C55-106)	Below 1 Ω
IGF (C12-2) - IGF1 (C55-106)	Below 1 Ω
IGF (C14-2) - IGF1 (C55-106)	Below 1 Ω
IGF (C38-2) - IGF1 (C55-106)	Below 1 Ω
IGF (C39-2) - IGF1 (C55-106)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
IGF (C11-2) or IGF1 (C55-106) - Body ground	10 kΩ or higher
IGF (C13-2) or IGF1 (C55-106) - Body ground	10 kΩ or higher
IGF (C12-2) or IGF1 (C55-106)- Body ground	10 kΩ or higher
IGF (C14-2) or IGF1 (C55-106) - Body ground	10 kΩ or higher

Tester Connection	Specified Condition
IGF (C38-2) or IGF1 (C55-106) - Body ground	10 kΩ or higher
IGF (C39-2) or IGF1 (C55-106) - Body ground	10 kΩ or higher

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

OK

3 PERFORM SIMULATION TEST

(a) Clear the DTC(s) (See page ES-45).
(b) Change the arrangement of the ignition coils (with igniters).
NOTICE:
Do not change the location of the connectors.
(c) Reform a simulation test.

Result

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

B → **REPLACE IGNITION COIL ASSEMBLY**

A

REPLACE ECM (See page ES-518)

DTC	P0365	Camshaft Position Sensor "B" Circuit (Bank 1)

DTC	P0367	Camshaft Position Sensor "B" Circuit Low Input (Bank 1)

DTC	P0368	Camshaft Position Sensor "B" Circuit High Input (Bank 1)

DTC	P0390	Camshaft Position Sensor "B" Circuit (Bank 2)

DTC	P0392	Camshaft Position Sensor "B" Circuit Low Input (Bank 2)

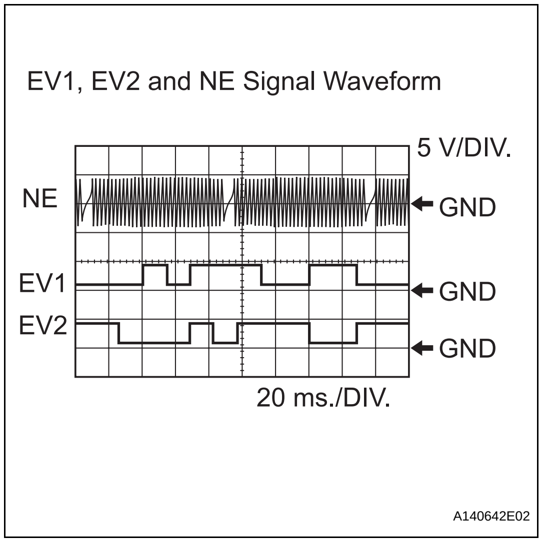
DTC	P0393	Camshaft Position Sensor "B" Circuit High Input (Bank 2)

DESCRIPTION

The exhaust camshaft's Variable Valve Timing (VVT) sensor consists of a magnet and MRE (Magneto Resistance Element).
The exhaust camshaft has a sensor plate with 3 teeth on its outer circumference.
When the exhaust camshaft rotates, changes occur in the air gaps between the 3 teeth and MRE, which affects the magnet. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the exhaust camshaft rotation data to pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.

DTC No.	DTC Detection Condition	Trouble Area
P0365 P0390	• 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 engine switch on (IG) (1 trip detection logic) • No VVT sensor signal to ECM during cranking (1 trip detection logic)	• Open or short in VVT sensor for exhaust camshaft circuit • VVT sensor for exhaust camshaft • Exhaust camshaft • Jumped tooth of timing chain • ECM
P0367 P0392	Output voltage of VVT sensor is 0.3 V or less for 5 seconds (1 trip detection logic)	• Open or short in VVT sensor for exhaust camshaft circuit • VVT sensor for exhaust camshaft • Exhaust camshaft • Jumped tooth of timing chain • ECM
P0368 P0393	Output voltage of VVT sensor is 4.7 V or more for 5 seconds (1 trip detection logic)	• Open or short in VVT sensor for exhaust camshaft circuit • VVT sensor for exhaust camshaft • Exhaust camshaft • Jumped tooth of timing chain • ECM

Reference: Inspection using an oscilloscope



HINT:
- The correct waveform is as shown.
- EV1+ and EV2+ stand for the VVT sensor signal, and NE+ stands for the CKP sensor signal.

Item	Content
Terminal	NE+ - NE- EV1+ - EV1- EV2+ - EV2-
Equipment Setting	5 V/DIV. 20 ms./DIV.
Condition	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	P0365: VVT sensor (Bank 1) open/short P0365: VVT position/Crankshaft position misalignment (Bank 1) P0367: VVT position sensor (Bank 1) range check (low voltage) P0368: VVT position sensor (Bank 1) range check (high voltage) P0390: VVT sensor (Bank 2) open/short P0390: VVT position/Crankshaft position misalignment (Bank 2) P0392: VVT position sensor (Bank 2) range check (low voltage) P0393: VVT position sensor (Bank 2) range check (high voltage)
Required Sensors/Components (Main)	VVT position sensor (Bank 1 and 2)
Required Sensors/Components (Sub)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	5 seconds
MIL Operation	2 driving cycles: P0365, P0390 (cranking) Immediate: Others
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs are not present	None

Chattering, Low voltage, High voltage:

Starter	OFF
Engine switch	ON
Time after engine switch off to on	2 seconds or more
Battery voltage	8 V or more

P0365, P0390 (Engine running):

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

P0365, P0390 (Cranking):

Starter	ON
Minimum battery voltage	Less than 11 V

TYPICAL MALFUNCTION THRESHOLDS

P0365, P0390 (Chattering):

Exhaust camshaft position sensor voltage	Less than 0.3 V, or more than 4.7 V

P0367, P0392 (Low voltage):

Exhaust camshaft position sensor voltage	Less than 0.3 V

P0368, P0393 (High voltage):

Exhaust camshaft position sensor voltage	More than 4.7 V

P0365, P0390 (Engine running, Cranking):

Exhaust camshaft position signal	No signal

COMPONENT OPERATING RANGE

VVT sensor voltage	0.3 to 4.7 V

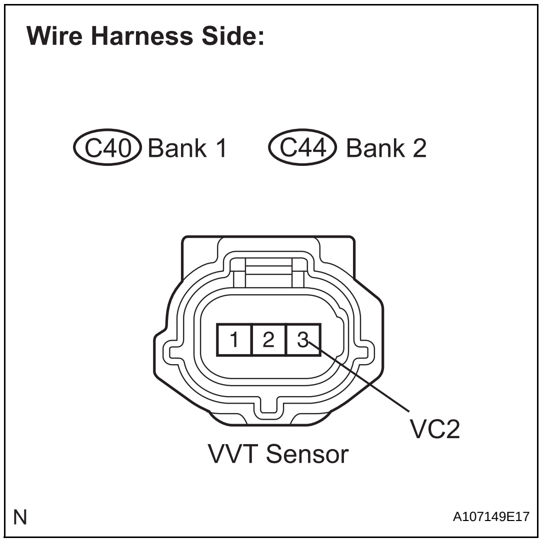
WIRING DIAGRAM

Refer to DTC P0335 (See page ES-224).

INSPECTION PROCEDURE

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	CHECK HARNESS AND CONNECTOR (SENSOR POWER SOURCE)



(a) Disconnect the C40 or C44 VVT sensor connector.
(b) Measure the voltage according to the value(s) in the table below.
Standard voltage

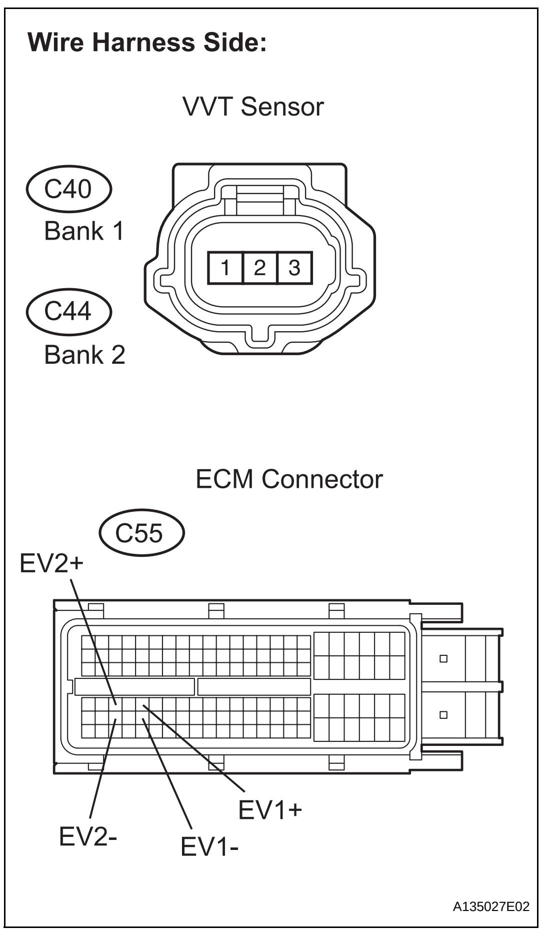
Tester Connection	Specified Condition
VC2 (C40-3) - Body ground	4.5 to 5.0 V
VC2 (C44-3) - Body ground	4.5 to 5.0 V

(c) Reconnect the VVT sensor connector.

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

OK

2	CHECK HARNESS AND CONNECTOR (VVT SENSOR - ECM)



(a) Disconnect the C40 or C44 VVT sensor connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.
Standard resistance (Check for open)

Tester Connection	Specified Condition
EX+ (C40-1) - EV1+ (C55-68)	Below 1 Ω
EX- (C40-2) - EV1- (C55-91)	Below 1 Ω
EX+ (C44-1) - EV2+ (C55-66)	Below 1 Ω
EX- (C44-2) - EV2- (C55-89)	Below 1 Ω

Standard resistance (Check for short)

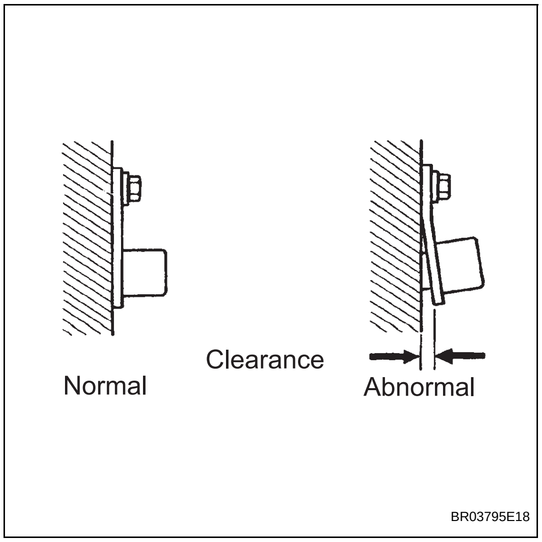
Tester Connection	Specified Condition
EX+ (C40-1) or EV1+ (C55-68) - Body ground	10 kΩ or higher
EX- (C40-2) or EV1- (C55-91) - Body ground	10 kΩ or higher
EX+ (C44-1) or EV2+ (C55-66) - Body ground	10 kΩ or higher
EX- (C44-2) or EV2- (C55-89) - Body ground	10 kΩ or higher

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

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

OK

3	CHECK VVT SENSOR FOR EXHAUST CAMSHAFT (SENSOR INSTALLATION)



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

NG → **REPAIR OR REPLACE VVT SENSOR**

OK ↓

4	CHECK EXHAUST CAMSHAFT

(a) Check the teeth of the camshaft.

NG → **REPLACE EXHAUST CAMSHAFT**

OK ↓

5	REPLACE VVT SENSOR

NEXT ↓

6	CHECK WHETHER DTC OUTPUT RECURS

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the intelligent tester on.
(d) Clear the DTCs (See page ES-45).
(e) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.
(f) Read the DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P0365, P0352, P0353, P0354, P0355 or P0356	B

HINT:
If the engine does not start, replace the ECM.

B → **REPLACE ECM (See page ES-518)**

ES

A

END

DTC	P0420	Catalyst System Efficiency Below Threshold (Bank 1)

DTC	P0430	Catalyst System Efficiency Below Threshold (Bank 2)

MONITOR DESCRIPTION

The ECM uses the 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.

ES

DTC No.	DTC Detection Condition	Trouble Area
P0420	OSC value is 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 is 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 P0420: Catalyst Deterioration
Required Sensors/Components (Main)	TWC
Required Sensors/Components (Sub)	A/F sensor, heated oxygen sensor, intake air temperature sensor, mass air flow meter, crankshaft position sensor and engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	Approximately 30 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	P0011, 14 (VVT System 1 - Advance) P0012, 15 (VVT System 1 - Retard) P0031, 32, 51, 52 (A/F Sensor heater - Sensor 1) P0037, 38, 58, 59 (O2 Sensor heater - Sensor 2) P0100 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0136, P0156(O2 Sensor - Sensor 2) P0171, P0172, P0174, P0175 (Fuel system) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340 (CMP sensor) P0351 - P0354 (Igniter) 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
ECT	70 kPa (525 mmHg) or more
Atmospheric pressure	-
Idle	OFF
Engine RPM	Less than 3,200 rpm
A/F sensor	Activated
Fuel system status	Closed loop
Engine load	10 to 70 %
All of the following conditions 1, 2 and 3 are met:	-
1. MAF	5 to 25 g/sec.
2. Front catalyst temperature (estimated)	600 to 750°C (1,112 to 1,382°F)
3. Rear catalyst temperature (estimated)	100 to 900°C (212 to 1,652°F)
EVAP system monitor	The monitor has not run yet or the vacuum introduction has been completed.
A/F sensor monitor	Completed
Rear HO2S monitor	Completed
Shift position	4th or higher

ES

TYPICAL MALFUNCTION THRESHOLDS

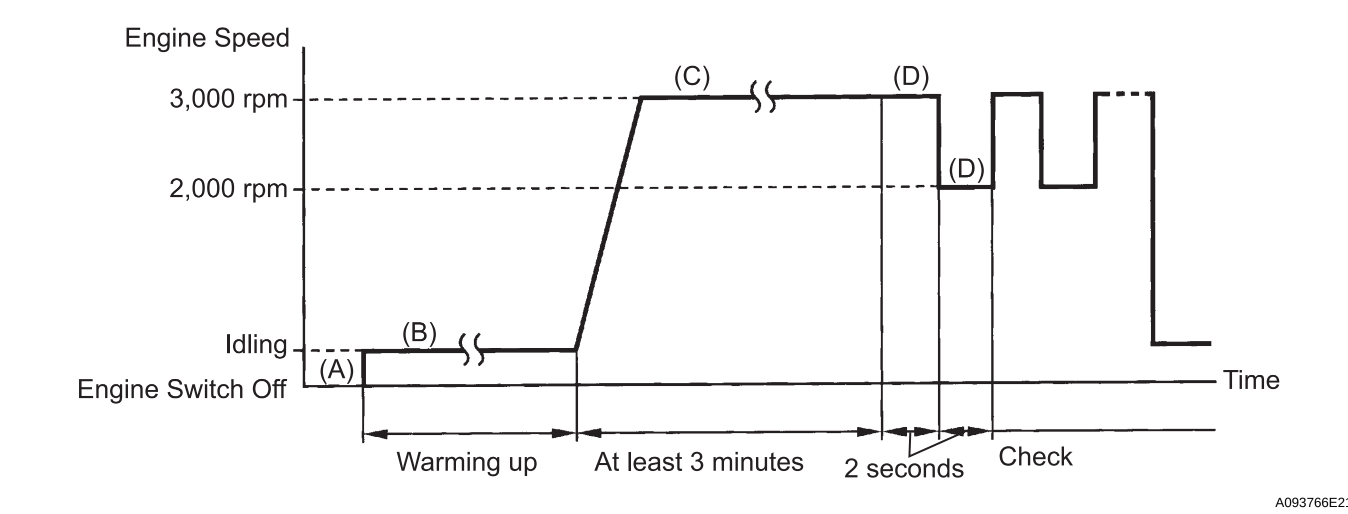
OSC (Oxygen Storage Capacity) of Catalyst	Less than 0.046 g

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-25).

CONDITIONING FOR SENSOR TESTING

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 performed in order to heat the sensors sufficiently to obtain the appropriate inspection results.



1. Connect the intelligent tester to the DLC3 (Procedure "A").
2. Start the engine and warm it up with all the accessories switched OFF, until the engine coolant temperature stabilizes (Procedure "B").
3. Run the engine at an engine speed of between 2,500 rpm and 3,000 rpm for at least 3 minutes (Procedure "C").
4. While running the engine at 3,000 rpm for 2 seconds and 2,000 rpm for 2 seconds, check the waveforms of the A/F and HO2 sensors using the tester or scan tool (Procedure "D").

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

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

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

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

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

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

Result

Display (DTC output)	Proceed to
P0420 and/or P0430	A
P0420 and/or P0430 and other DTCs	B

HINT:

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

B → **GO TO DTC CHART (See page ES-63)**

A

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

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

HINT:

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

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

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

Result

Status AFS B1 S1 or AFS B2 S1	Status O2S B1 S2 or O2S B2 S2	A/F Condition and A/F and HO2 Sensor Conditions	Misfire	Main Suspected Trouble Areas	Proceed to
Lean/Rich	Lean/Rich	Normal	-	• Three-Way Catalytic Converter (TWC) • Gas leakage from exhaust system	A
Lean	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	May occur	• A/F sensor	B
Lean/Rich	Lean	HO2 sensor malfunction	-	• HO2 sensor • Gas leakage from exhaust system	C
Lean/Rich	Rich	HO2 sensor malfunction	-	• HO2 sensor • Gas leakage from exhaust system	C
Lean	Lean	Actual air-fuel ratio lean	May occur	• Extremely rich or lean actual air-fuel ratio • Gas leakage from exhaust system	A
Rich	Rich	Actual air-fuel ratio lean	-	• Extremely rich or lean actual air-fuel ratio • Gas leakage from exhaust system	A

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

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

Lean/Rich:
During A/F CONTROL of the ACTIVE TEST, the output voltage of the HO2 sensor alternates correctly.

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

ES

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 P2401 Evaporative Emission System Leak Detection Pump Control Circuit Low

DTC P2402 Evaporative Emission System Leak Detection Pump Control Circuit High

DTC P2419 Evaporative Emission System Switching Valve Control Circuit Low

DTC SUMMARY

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

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

DESCRIPTION

The circuit description can be found in the EVAP (Evaporative Emission) System (See page ES-400).

INSPECTION PROCEDURE

Refer to the EVAP System (See page ES-400).

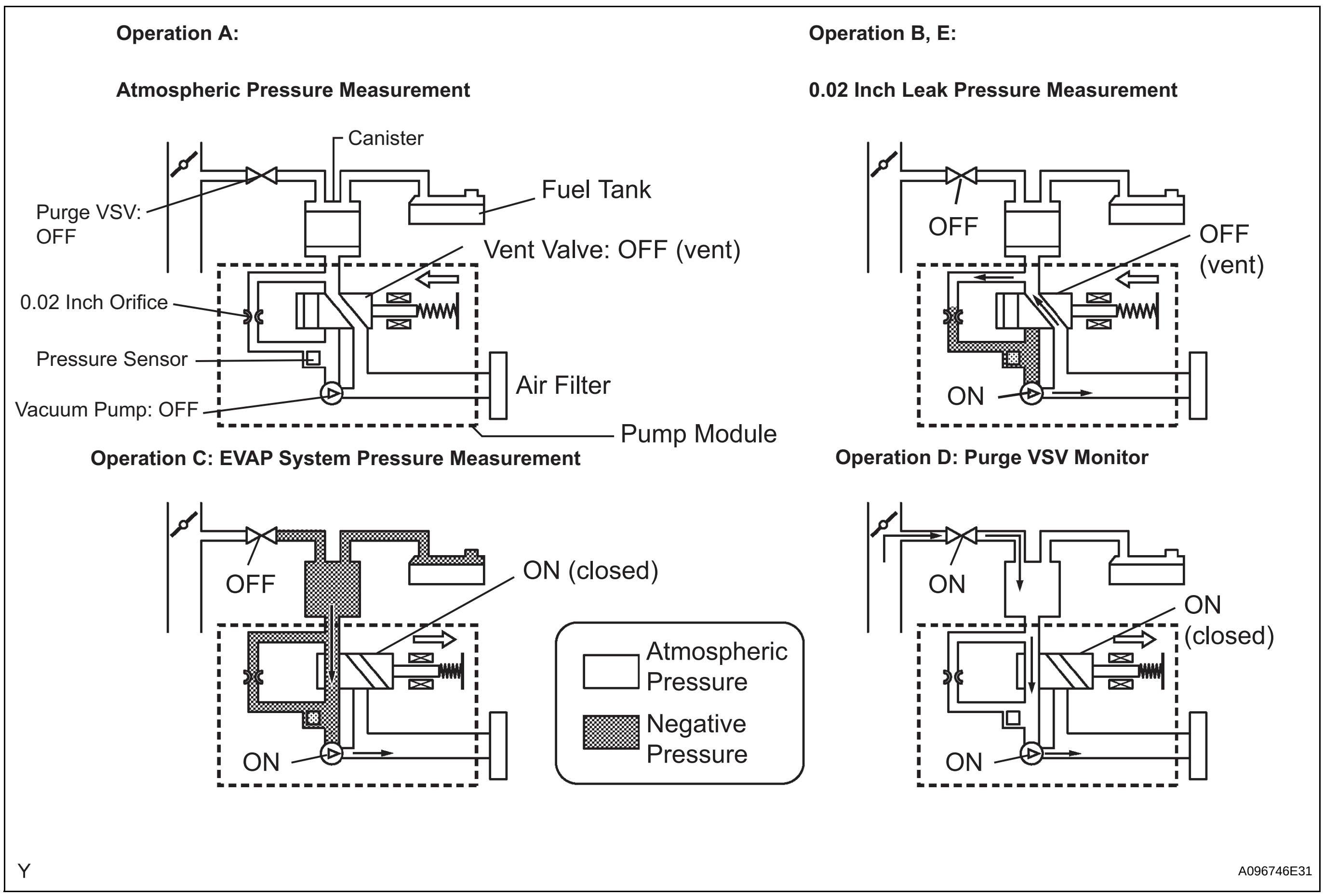
MONITOR DESCRIPTION

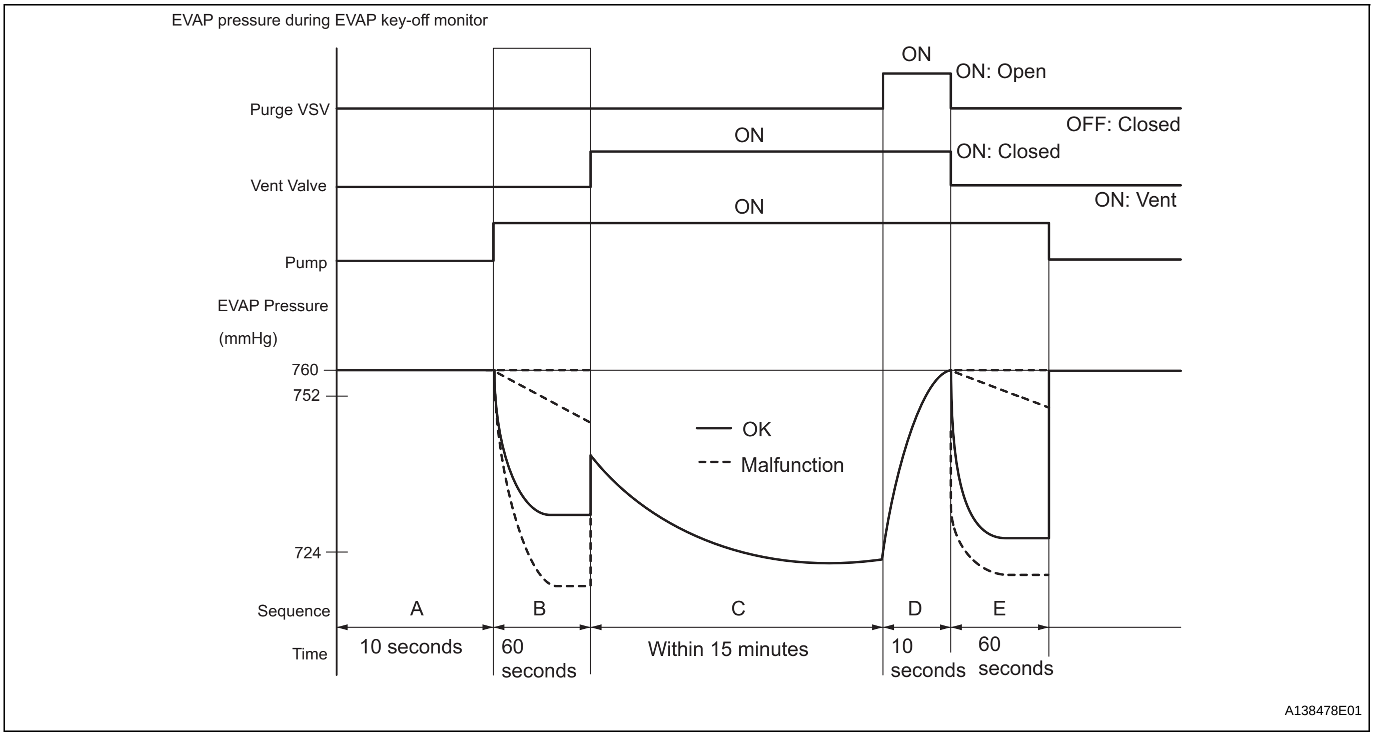
5 hours[*1] after the ignition switch is turned off, the electric vacuum pump creates negative pressure (vacuum) in the EVAP (Evaporative Emission) system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.
HINT:
[*1]: If the engine coolant temperature is not below 35°C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

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

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

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





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

*: Typical valve

MONITOR STRATEGY

Related DTCs	P043E: 0.02 inch orifice clog (built-in pump module) P043F: 0.02 inch orifice high-flow (built-in pump module) P2401: Vacuum pump stuck OFF P2402: Vacuum pump stuck ON P2419: Vent valve stuck open (vent)
Required Sensors / Components	Pump module
Frequency of Operation	Once per driving cycle
Duration	Within 2 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None
EVAP key-off monitor is run when all of the following conditions are met	-
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Vehicle speed	Below 2.5 mph (4 km/h)
Ignition switch	OFF
Time after key-off	5 or 7 or 9.5 hours
EVAP pressure sensor malfunction (P0450, P0451, P0452, P0453)	Not detected
EVAP canister purge valve	Not operated by scan tool

EVAP canister vent valve	Not operated by scan tool
EVAP leak detection pump	Not operated by scan tool
Both of the following conditions 1 and 2 are met before key-off	Conditions 1 and 2
1. Duration that vehicle driven	5 minutes or more
2. EVAP purge operation	Performed
ECT	4.4 to 35°C (40 to 95°F)
IAT	4.4 to 35°C (40 to 95°F)

Key-off monitor sequence 1 to 8

1. Atmospheric pressure measurement

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

2. First reference pressure measurement

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

3. EVAP canister vent valve close stuck check

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

4. Vacuum introduction

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

5. EVAP canister purge valve close stuck check

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

6. Second reference pressure measurement

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

7. Leak check

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

8. Atmospheric pressure measurement

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

TYPICAL MALFUNCTION THRESHOLDS

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

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-25).

DTC P0441 Evaporative Emission Control System Incorrect Purge Flow

DTC SUMMARY

DTC No.	Monitoring Item	DTC Detection Condition	Trouble Area	Detection Timing	Detection Logic
P0441	EVAP VSV (Vacuum Switching Valve) stuck open	Vacuum pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. 0.02 inch leak pressure standard measured at start and at end of leak check. If stabilized pressure higher than [second 0.02 inch leak pressure standard x 0.2], ECM determines that EVAP VSV stuck open	• EVAP VSV • Connector/wire harness (EVAP VSV - ECM) • ECM • Pump module • Leakage from EVAP system	While engine switch off	2 trip
P0441	EVAP VSV stuck closed	After EVAP leak check performed, EVAP VSV turned ON (open), and atmospheric air introduced into EVAP system. 0.02 inch leak pressure standard measured at start and at end of the check. If pressure does not return to near atmospheric pressure, ECM determines that purge valve stuck closed	• EVAP VSV • Connector/wire harness (EVAP VSV - ECM) • ECM • Pump module • Leakage from EVAP system	While engine switch off	2 trip
P0441	Purge flow	While engine running, following conditions are successively met: • Negative pressure not created in EVAP system when EVAP 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)	• EVAP VSV • Connector/wire harness (EVAP VSV - ECM) • Leakage from EVAP line (EVAP 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-400).

INSPECTION PROCEDURE

Refer to the EVAP System (See page ES-400).

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 engine switch is turned off. The purge flow monitor runs while the engine is running.

1. KEY-OFF MONITOR

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

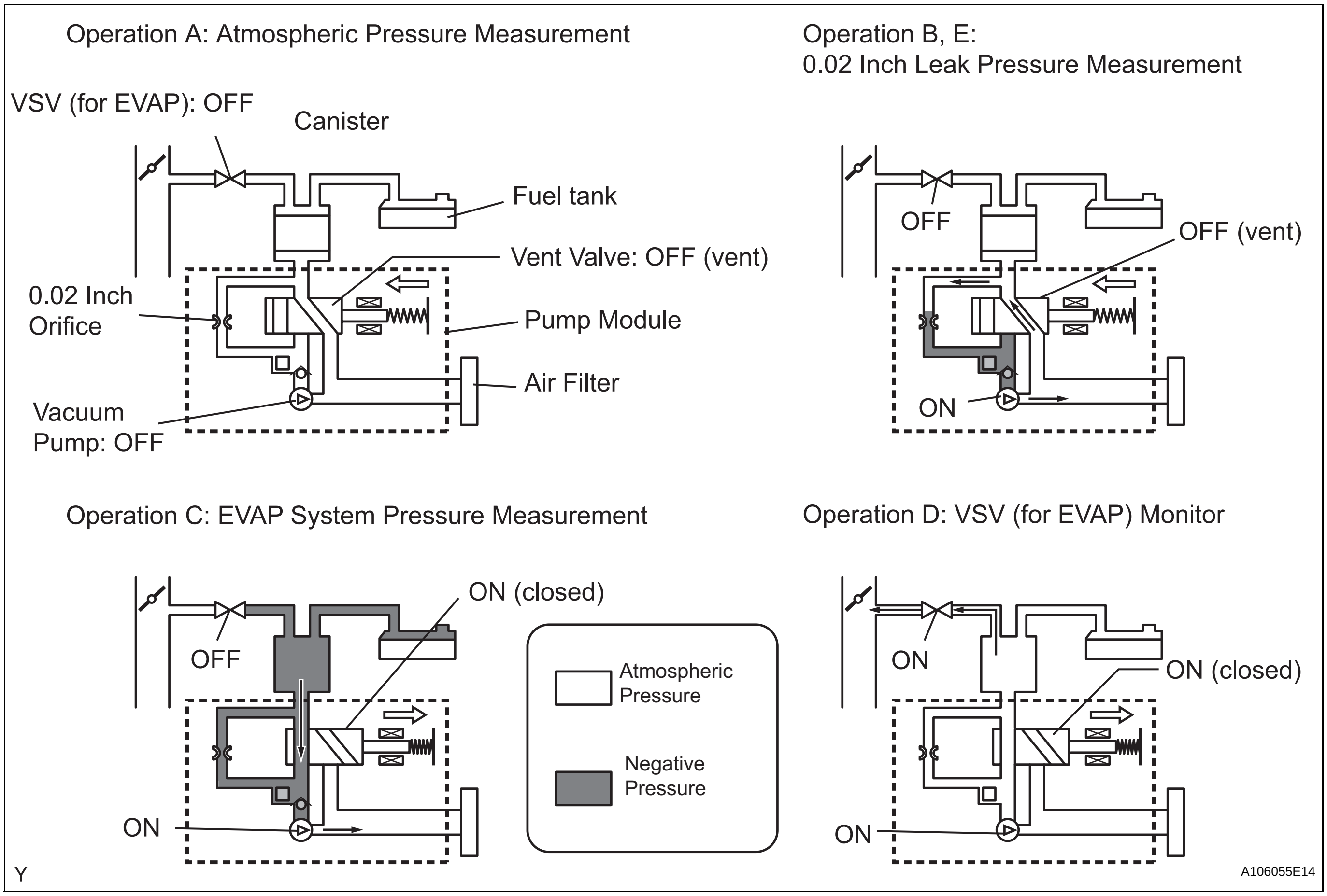
HINT:

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

Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer, 5 hours (7 or 9.5 hours) after engine 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 pressure measurement	In order to determine 0.02 inch leak pressure standard, vacuum pump creates negative pressure (vacuum) through 0.02 inch orifice and then ECM checks if vacuum pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) 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 seconds*
D	EVAP VSV monitor	EVAP VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak pressure measurement	After second 0.02 inch leak pressure measurement, leak check performed by comparing first and second 0.02 inch leak pressure standards. If stabilized system pressure higher than second 0.02 inch leak pressure standard, ECM determines that EVAP system leaking.	60 seconds
F	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

HINT:

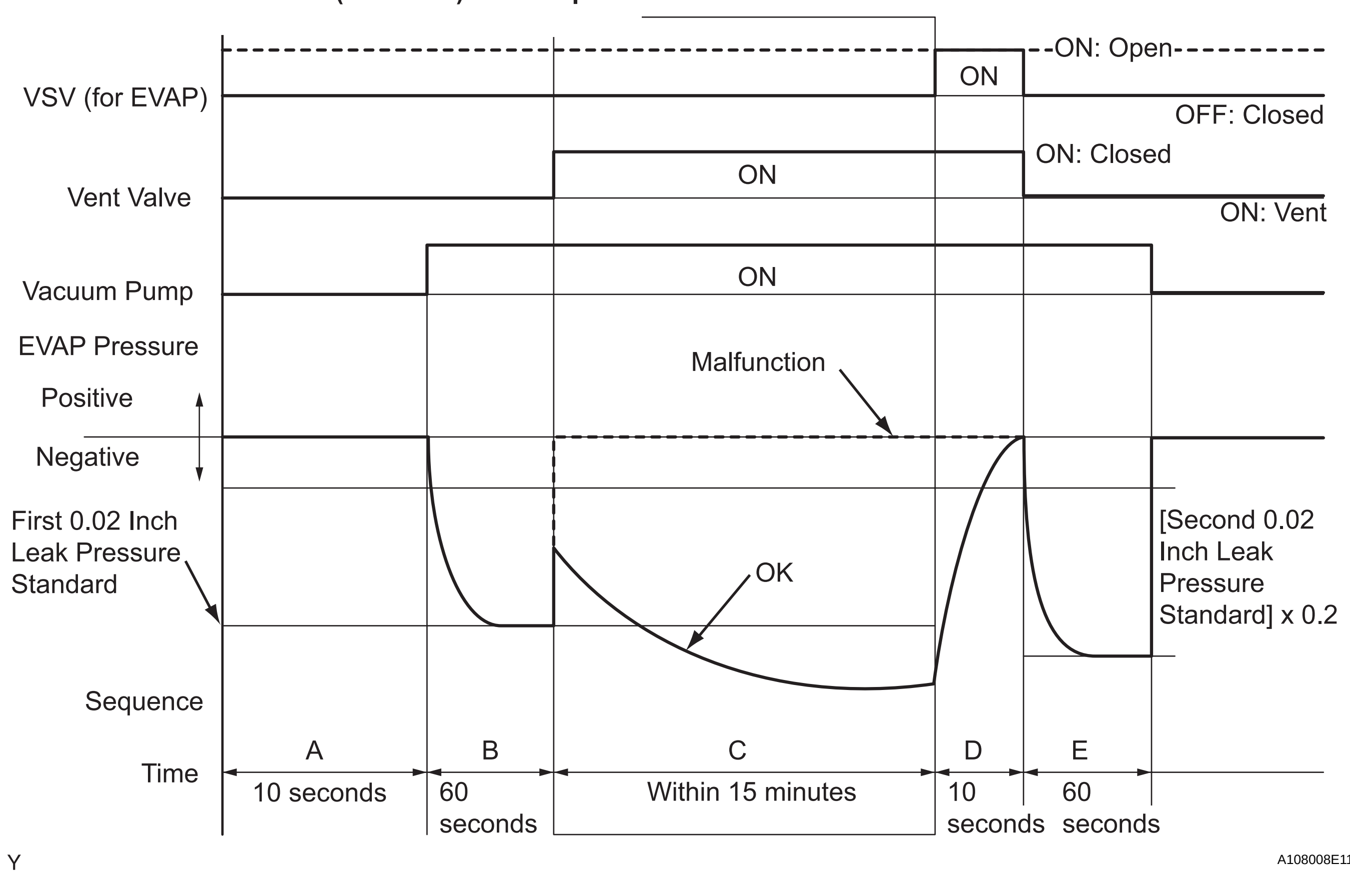
*: If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.


Operation A: Atmospheric Pressure Measurement
VSV (for EVAP): OFF
Canister
Fuel tank
Vent Valve: OFF (vent)
0.02 Inch
Orifice
Pump Module
Air Filter
Vacuum
Pump: OFF
Operation B, E:
0.02 Inch Leak Pressure Measurement
OFF
OFF (vent)
ON
Operation C: EVAP System Pressure Measurement
ON (closed)
OFF
ON
Atmospheric
Pressure
Negative
Pressure
Operation D: VSV (for EVAP) Monitor
ON
ON (closed)
ON
Y
A106055E14

(a) EVAP VSV stuck open

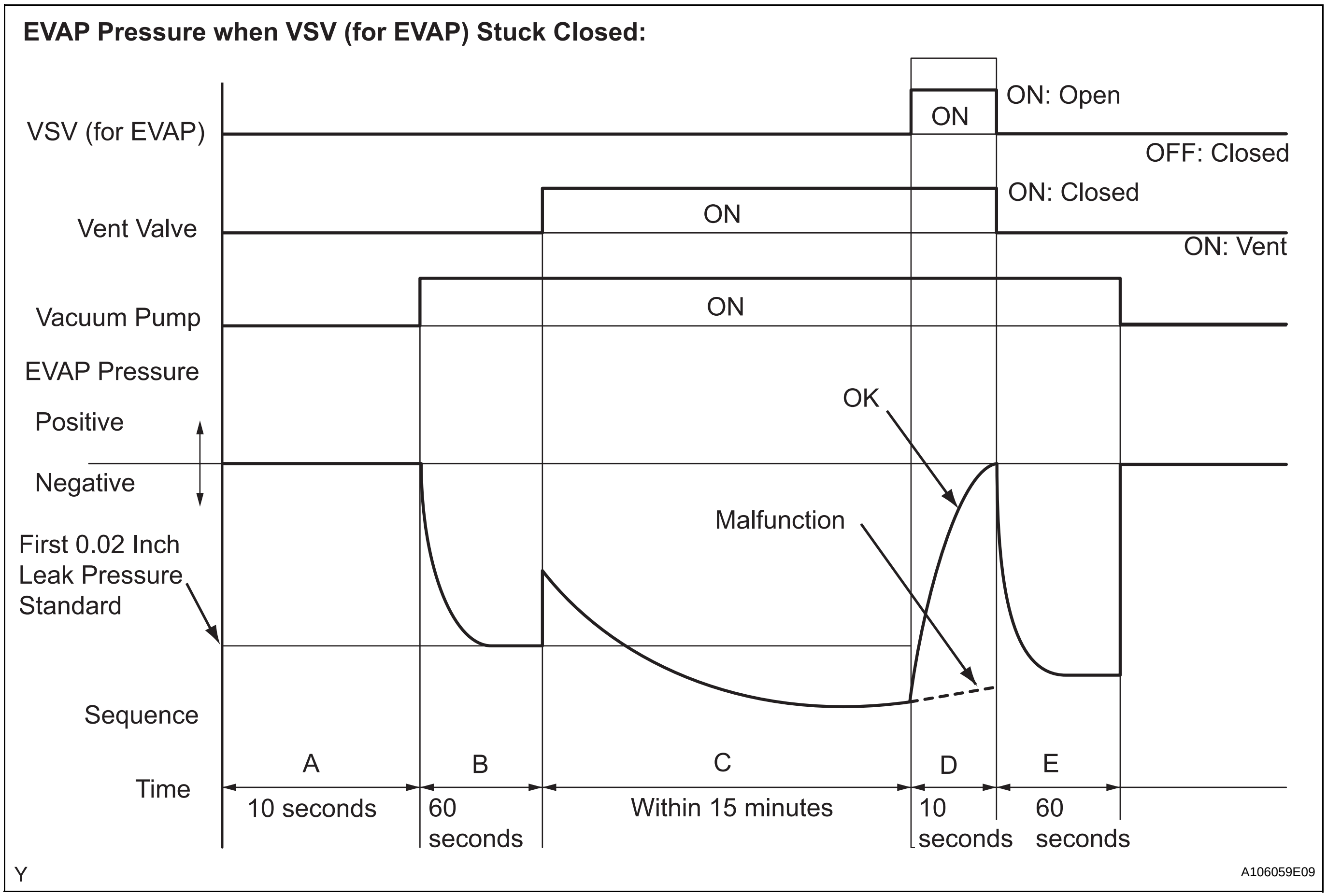
In operation C, the vacuum pump creates negative pressure (vacuum) in the EVAP (Evaporative Emission) system. The EVAP system pressure is then measured by the ECM using the pressure sensor. If the stabilized system pressure is higher than [second 0.02 inch leak pressure standard x 0.2], the ECM interprets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

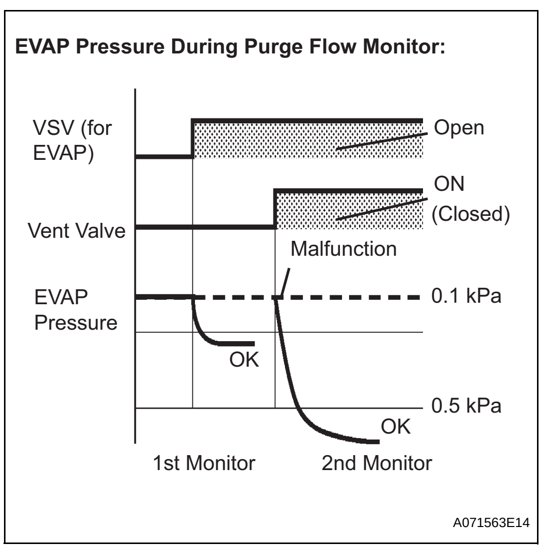
EVAP Pressure when VSV (for EVAP) Stuck Open:



(b) EVAP VSV stuck closed

In operation D, the pressure sensor measures the EVAP (Evaporative Emission) system pressure. The pressure measurement for EVAP VSV monitor is begun when the EVAP 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 EVAP VSV is functioning normally. If the pressure does not increase, the ECM interprets this as the EVAP 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 EVAP 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 EVAP VSV being stuck closed, and illuminates the MIL and sets DTC P0441 (2 trip detection logic).

Atmospheric pressure check:

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

OBD II MONITOR SPECIFICATIONS

1. Key-off Monitor

Monitor Strategy:

Required Sensors/Components	EVAP VSV and pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

Typical Enabling Conditions:

EVAP key-off monitor runs when all of following conditions are met:	-
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Vehicle speed	Below 2.5 mph (4 km/h)
Engine switch	OFF
Time after key off	5, 7 or 9.5 hours
EVAP pressure sensor malfunction (P0450, P0451, P0452 and/or P0453)	Not detected
EVAP 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 are met before key off:	Conditions 1 and 2
1. Duration that vehicle is being 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)

(a) Key-off monitor sequence 1 to 8

1. Atmospheric pressure

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

2. First reference pressure

Next sequence is run if all of following conditions are met:	Conditions 1, 2 and 3
1. EVAP pressure when 4 seconds. after reference pressure measurement	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.05 kPa (-36.38 to -7.87 mmHg)
3. Reference pressure	Saturated within 1 minute

3. Vent valve stuck closed check

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

4. Vacuum introduction and leak

Next sequence is run if both of following condition is met:	-
Vacuum introduction time	15 minutes or less

5. EVAP VSV stuck closed check

Next sequence is run if following condition is met:	-

EVAP pressure change after purge VSV ON	0.3 kPa (2.25 mmHg) or more

6. Second reference pressure measurement

Next sequence is run if all of following conditions are met:	Conditions 1, 2, 3 and 4
1. EVAP pressure just after reference pressure measurement	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.05 kPa (-36.38 to -7.87 mmHg)
3. Reference pressure	Saturated within 1 minute
4. Reference pressure difference between first and second	Less than 0.7 kPa (5.25 mmHg)

7. Leak check

Next sequence is run if following condition is met:	-
EVAP pressure when vacuum introduction was complete	Less than second reference pressure

8. Atmospheric pressure

Monitor is complete	-
Atmospheric pressure difference between sequence 1 and 8	0.3 kPa (2.25 mmHg) or less

Typical Malfunction Thresholds:

One of the following conditions is met:	-
(a) EVAP VSV stuck open	-
EVAP pressure when vacuum introduction is complete	Higher than reference pressure x 0.2
(b) EVAP VSV stuck closed	-
EVAP pressure change after EVAP canister purge valve is open	Less than 0.3 kPa (2.25 mmHg)

2. Purge Flow Monitor

Monitor Strategy:

Required Sensors/Components	EVAP VSV and pump module
Frequency of Operation	Once per driving cycle
Duration	Within 10 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

Typical Enabling Conditions:

Monitor runs whenever these DTCs are not present	-
Engine	Running
ECT	4.4°C (40°F) or more
IAT	4.4°C (40°F) or more
EVAP pressure sensor malfunction	Not detected
EVAP VSV	Not operated by scan tool
EVAP system check	Not detected by scan tool
Battery voltage	10 V or more
Purge duty cycle	8 % or more

Typical Malfunction Thresholds:

Both of following conditions are met:	Condition 1 or 2
1. EVAP pressure change when purge operation is started	Less than 0.1 kPa (0.75 mmHg)
2. EVAP pressure change during purge operation when vent valve is closed	Less than 0.5 kPa (3.75 mmHg)

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-25).

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 No.	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection logic
P0450	Pressure sensor voltage abnormal fluctuation	Sensor output voltage rapidly fluctuates beyond upper and lower malfunction thresholds for 0.5 seconds.	• Pump module • ECM	• EVAP monitoring (engine switch off) • Engine switch on	1 trip
P0451	Pressure sensor noising	Sensor output voltage fluctuates frequently in a certain time period.	• Pump module • Connector / wire harness (Pump module - ECM) • ECM	• EVAP monitoring (engine switch off) • Engine switch running	2 trip
P0451	Pressure sensor stuck	Sensor output voltage does not vary in a certain time period.	• Pump module • Connector / wire harness (Pump module - ECM) • ECM	• EVAP monitoring (engine switch off)	2 trip
P0452	Pressure sensor voltage low	Sensor output voltage less than 0.45 V for 0.5 seconds.	• Pump module • Connector / wire harness (Pump module - ECM) • ECM	• EVAP monitoring (engine switch off) • Engine switch on	1 trip
P0453	Pressure sensor voltage high	Sensor output voltage more than 4.9V for 0.5 seconds.	• Pump module • Connector / wire harness (Pump module - ECM) • ECM	• EVAP monitoring (engine switch off) • Engine switch on	1 trip

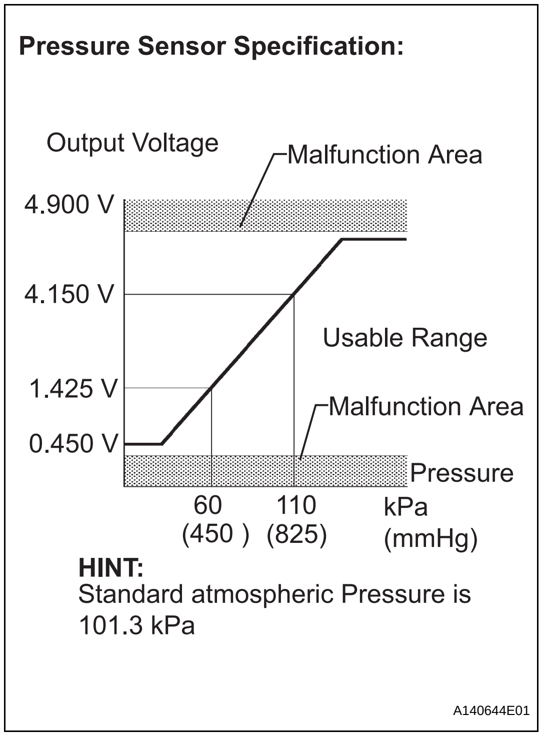
HINT:
The pressure sensor is built into the pump module.

DESCRIPTION

The circuit description can be found in the EVAP (Evaporative Emission) System (See page ES-400).

MONITOR DESCRIPTION

1. DTC P0450: Pressure sensor voltage abnormal fluctuation
   If the pressure sensor output voltage 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 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: Pressure sensor noising or stuck
   If the pressure sensor output voltage fluctuates rapidly for 10 seconds, the ECM stops the EVAP system monitor. The ECM interprets this as noise from the pressure sensor, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC.
   Alternatively, if the sensor output voltage does not change for 10 seconds, the ECM interprets this as the sensor 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: Pressure sensor voltage low
   If the pressure sensor output voltage is below 0.45 V, the ECM interprets this as an open or short circuit malfunction in the pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).
4. DTC P0453: Pressure sensor voltage high
   If the pressure sensor voltage output is 4.9 V or more, the ECM interprets this as an open or short circuit malfunction in the pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).

MONITOR STRATEGY

Related DTCs	P0450: Pressure sensor chattering P0451: Pressure sensor noise P0451: Pressure sensor stuck P0452: Pressure sensor low voltage P0453: Pressure sensor high voltage
Required Sensors/Components	Pump module
Frequency of Operation	Once per driving cycle: P0451 sensor stuck Continuous: P0451 sensor noising, P0450, P0452 and P0453
Duration	0.5 seconds: P0450, P0452, P0453 Within 15 seconds: P0451

MIL Operation	Immediate: P0450, P0452, P0453 2 driving cycles: P0451
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0450, P0452 and P0453 (Pressure sensor chattering, low voltage, high voltage):

Monitor runs whenever following DTCs are not present:	None
Battery voltage	8 V or more
Starter	OFF
Engine switch	ON

P0451 (Pressure sensor noise):

Atmospheric pressure	70 kPa (525 mmHg) to 110 kPa (825 mmHg)
Battery voltage	10.5 V or more
Intake air temperature	4.4 to 35°C (40 to 95°F)
EVAP pressure sensor malfunction (P0450, P0452, P0453)	Not detected
Either of following conditions is met:	1 or 2
1. Engine	Running
2. Time after key off	5, 7 or 9.5 hours

P0451 (Pressure sensor stuck):

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)
EVAP pressure sensor malfunction (P0450, P0452, P0453)	Not detected
Time after key off	5, 7 or 9.5 hours

TYPICAL MALFUNCTION THRESHOLDS

P0450: Pressure sensor chattering

EVAP Pressure	Less than 42.11 kPa (315.82 mmHg), or more than 123.761 kPa (928.207 mmHg)

P0451: Pressure sensor noise

Frequency that EVAP pressure change is 0.3 kPa or more	10 times or more in 10 seconds

P0451: Pressure sensor stuck

EVAP pressure change during reference pressure	Less than 0.65 kPa (4.87 mmHg)

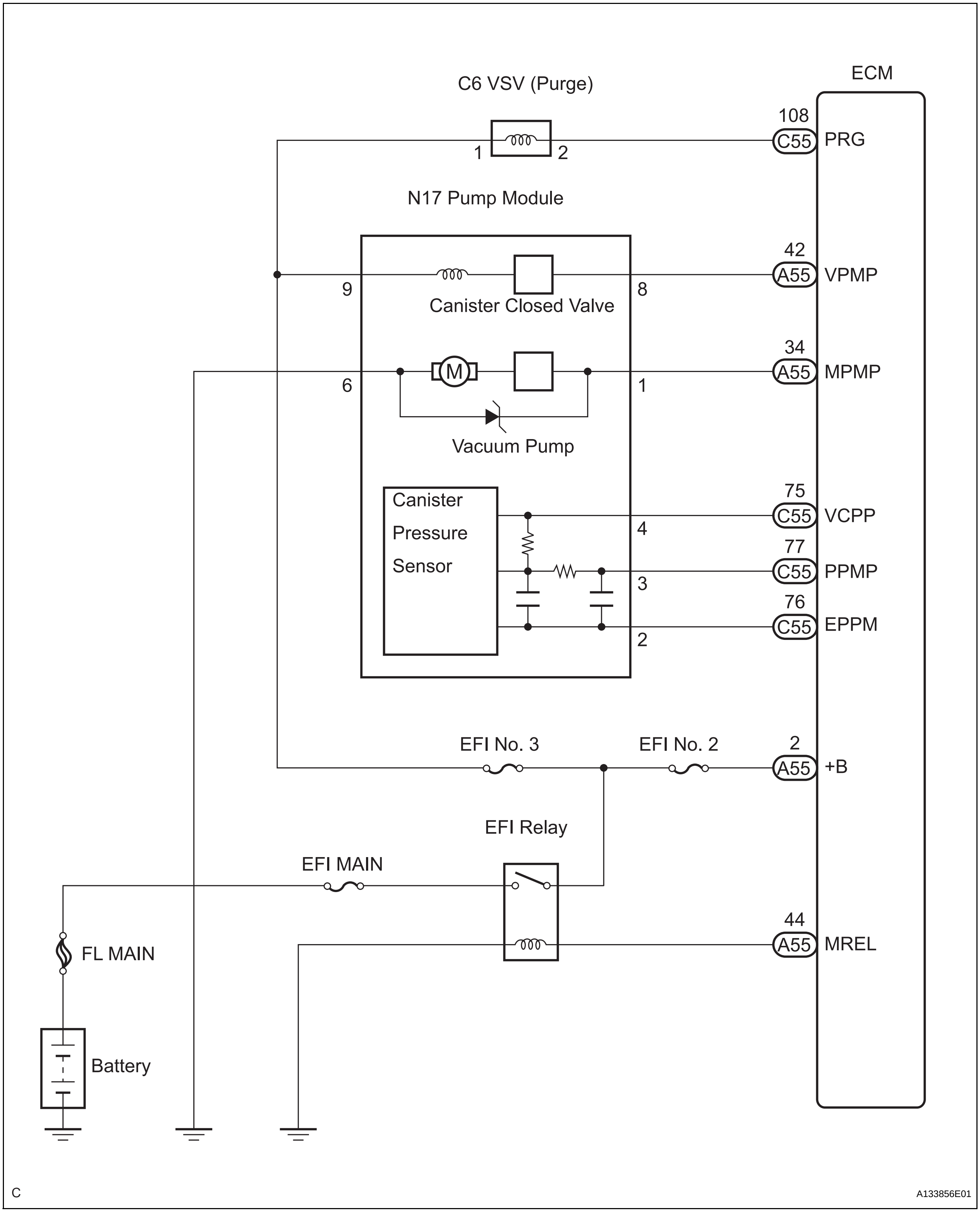
P0452: Pressure sensor low voltage

EVAP Pressure	Less than 42.11 kPa (315.82 mmHg)

P0453: Pressure sensor high voltage

EVAP Pressure	More than 123.761 kPa (928.207 mmHg)

WIRING DIAGRAM

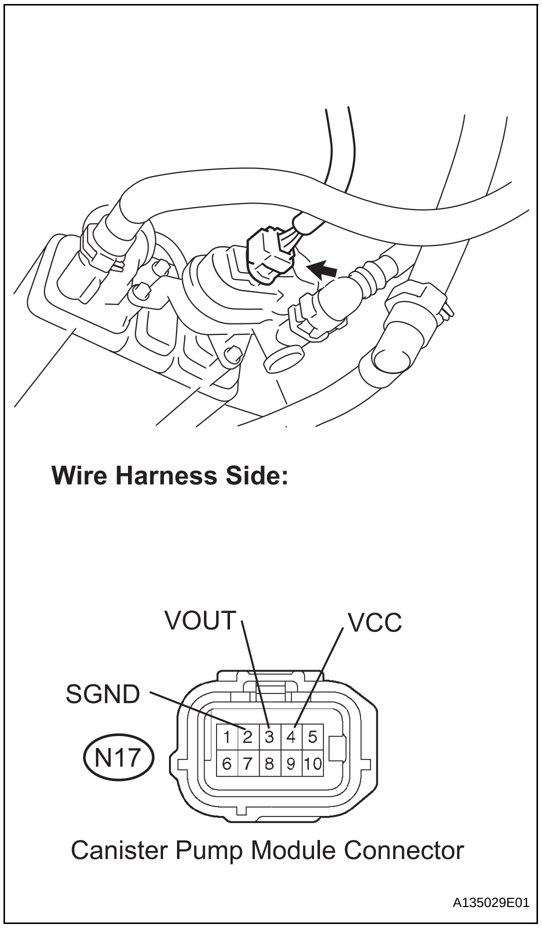


INSPECTION PROCEDURE

NOTICE:

- **When a vehicle is brought into a workshop, leave it as it is. Do not change the vehicle condition. For example, do not tighten the fuel tank cap.**
- **Do not disassemble the pump module.**
- **The intelligent tester is required to conduct the following diagnostic troubleshooting procedure.**

1 CHECK HARNESS AND CONNECTOR (PUMP MODULE - ECM)



(a) Disconnect the N17 canister connector.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage and resistance according to the value(s) in the table below.
Standard voltage

Tester Connection	Specified Condition
N17-4 - Body ground	4.5 to 5.0 V
N17-3 - Body ground	4.5 to 5.0 V
N17-2 - Body ground	100 Ω or less

Result

Test Result	Suspected Trouble Area	Proceed to
Voltage and resistance within standard ranges	Open in pressure sensor circuit	A
Voltage and resistance outside standard ranges	Open in wire harness/ connector (ECM - pressure sensor)	B

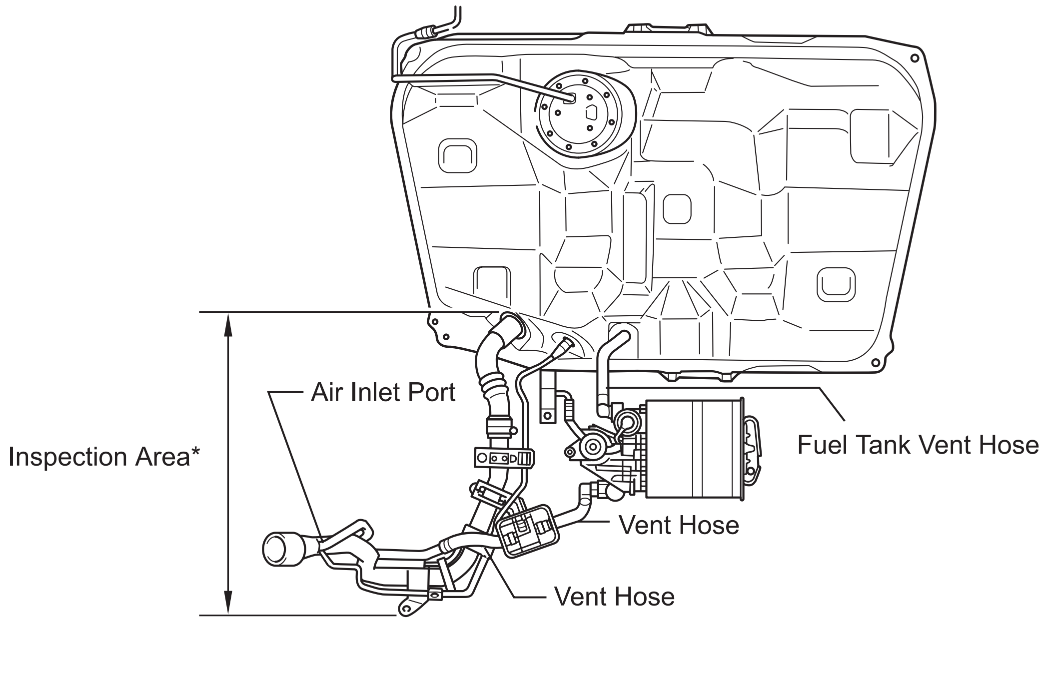
(d) Reconnect the canister connector.

B → **Go to step 3**

A

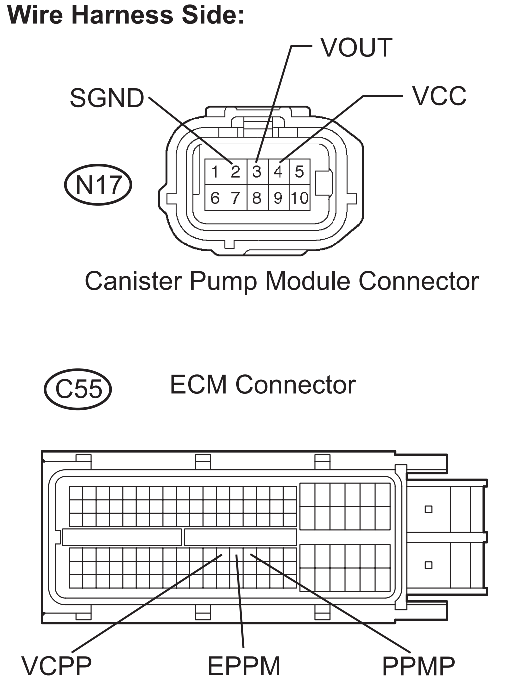
2 REPLACE CHARCOAL CANISTER ASSEMBLY

(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 and 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 5**

3 CHECK HARNESS AND CONNECTOR



(a) Disconnect the N17 canister pump module connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance between the terminals of the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
N17-4 (VCC) - C55-75 (VCPP)	Below 1 Ω
N17-3 (VOUT) - C55-77 (PPMP)	Below 1 Ω
N17-2 (SGND) - C55-76 (EPPM)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
N17-4 (VCC) or C55-75 (VCPP) - Body ground	10 kΩ or higher
N17-3 (VOUT) or C55-77 (PPMP) - Body ground	10 kΩ or higher
N17-2 (SGND) or C55-76 (EPPM) - Body ground	10 kΩ or higher

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

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

OK

4	REPLACE ECM

(a) Replace the ECM (See page ES-518).

NEXT

5	CHECK WHETHER DTC OUTPUT RECURS (AFTER REPAIR)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) (do not start the engine).
(c) Turn the tester on.
(d) Wait for at least 60 seconds.
(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.
HINT:
If no pending DTCs are displayed on the tester, the repair has been successfully completed.

ES

NEXT

COMPLETED

DTC	P0455	Evaporative Emission Control System Leak Detected (Gross Leak)

DTC	P0456	Evaporative Emission Control System Leak Detected (Very Small Leak)

ES

DTC SUMMARY

DTC No.	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection logic
P0455	EVAP gross leak	Vacuum pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. 0.02 inch leak pressure standard measured at start and at end of leak check. If stabilized pressure higher than [second 0.02 inch leak pressure standard x 0.2], ECM determines that EVAP system has a large leak	• Fuel tank cap (loose) • Leakage from EVAP line (Canister - Fuel tank) • Leakage from EVAP line (EVAP VSV - Canister) • Pump module • Leakage from fuel tank • Leakage from canister	While engine switch off	2 trip
P0456	EVAP small leak	Vacuum pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. 0.02 inch leak pressure standard measured at start and at end of leak check. If stabilized pressure higher than second 0.02 inch leak pressure standard, ECM determines that EVAP system has a small leak	Same above	While engine switch off	2 trip

DESCRIPTION

The circuit description can be found in the EVAP (Evaporative Emission) System (See page ES-400).

INSPECTION PROCEDURE

Refer to the EVAP System (See page ES-400).

MONITOR DESCRIPTION

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

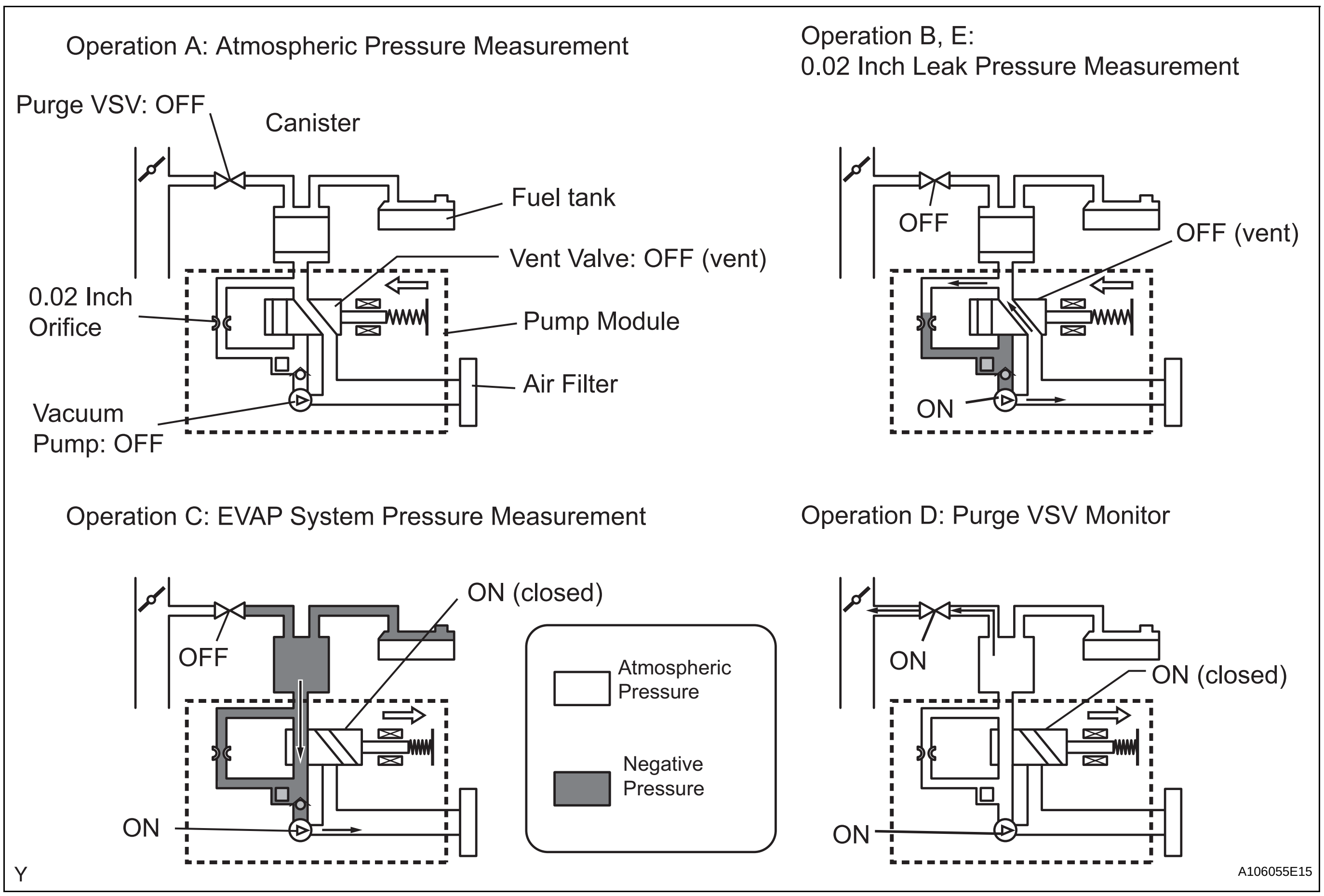
HINT:

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

Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer, 5 hours (7 or 9.5 hours) after engine 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

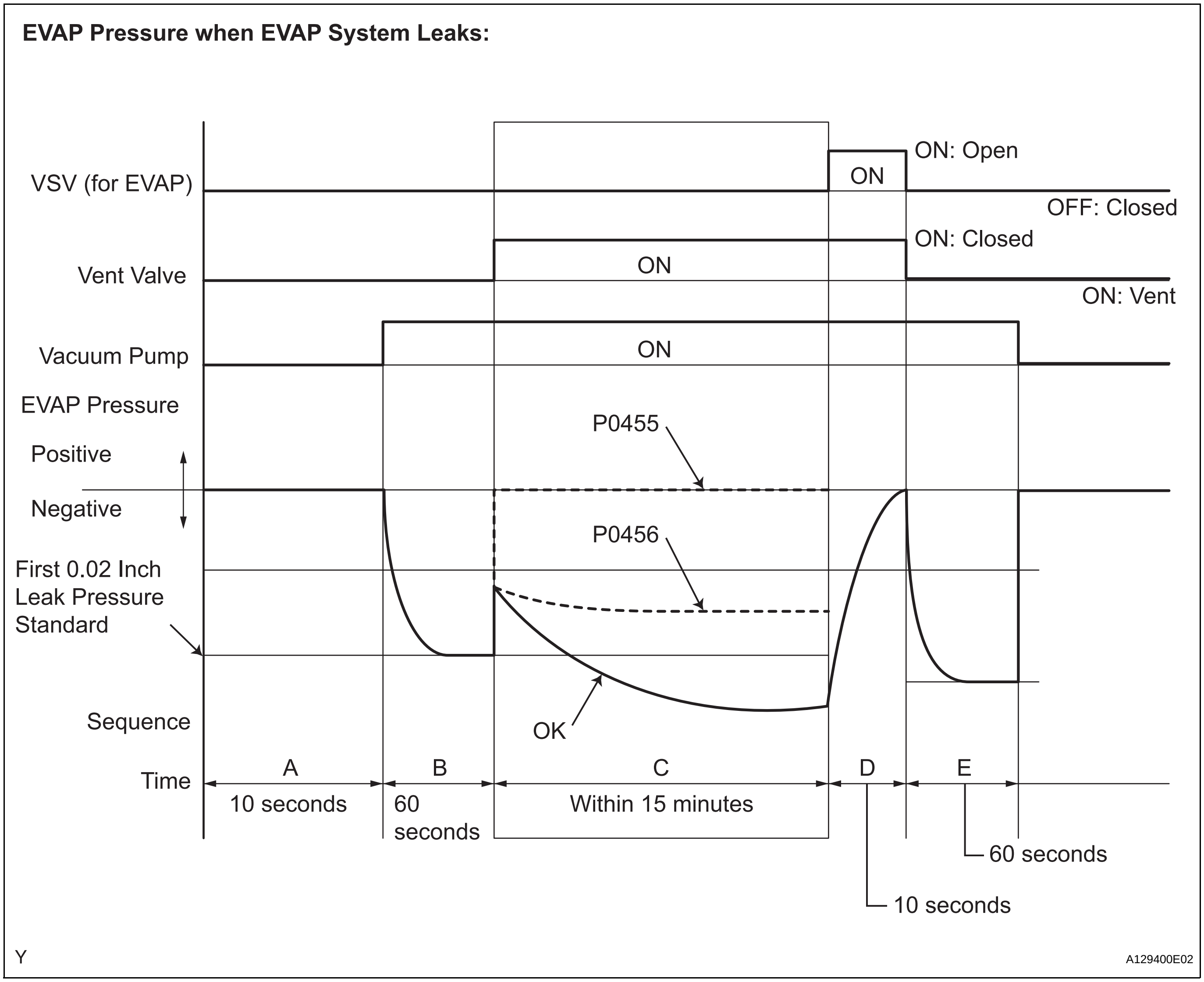
Sequence	Operation	Description	Duration
B	First 0.02 inch leak pressure measurement	In order to determine 0.02 inch leak pressure standard, vacuum pump creates negative pressure (vacuum) through 0.02 inch orifice and then ECM checks if vacuum pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) 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	EVAP VSV monitor	EVAP VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak pressure measurement	After second 0.02 inch leak pressure measurement, leak check performed by comparing first and second 0.02 inch leak pressure standards. If stabilized system pressure higher than second 0.02 inch leak pressure standard, 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.



1. P0455: EVAP (Evaporative Emission) gross leak
   In operation C, the vacuum pump creates negative pressure (vacuum) in the EVAP system and the EVAP system pressure is measured. If the stabilized system pressure is higher than [second 0.02 inch leak pressure standard x 0.2] (near atmospheric pressure), the ECM determines that the EVAP system has a large leak, illuminates the MIL and sets the DTC (2 trip detection logic).

2. P0456: EVAP very small leak
   In operation C, the vacuum pump creates negative pressure (vacuum) in the EVAP system and the EVAP system pressure is measured. If the stabilized system pressure is higher than the second 0.02 inch leak pressure standard, the ECM determines that the EVAP system has a small leak, illuminates the MIL and sets the DTC (2 trip detection logic).



ES

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

EVAP key-off monitor runs when all of following conditions are met:	-
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Vehicle speed	Below 2.5 mph (4 km/h)
Engine switch	OFF

Time after key off	5, 7 or 9.5 hours
EVAP pressure sensor malfunction (P0450, P0451, P0452 and P0453)	Not detected
EVAP 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 are met before key OFF:	Conditions 1 and 2
1. Duration that vehicle is being driven	5 minutes or more
2. EVAP purge operation	Performed
ECT	4.4 to 35°C (40 to 95°F)
IAT	4.4 to 35°C (40 to 95°F)

1. Key-off monitor sequence 1 to 8

1. Atmospheric pressure

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

2. First reference pressure

Next sequence is run if all of following conditions are met:	Conditions 1, 2 and 3
1. EVAP pressure when 4 seconds after reference pressure measurement	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.05 kPa (-36.38 to -7.87 mmHg)
3. Reference pressure	Saturated within 1 minute

3. Vent valve stuck closed check

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

4. Vacuum introduction and leak

Next sequence is run if both of following conditions are met:	-
Vacuum introduction time	15 minutes or less

5. EVAP VSV stuck closed check

Next sequence is run if following condition is met:	-
EVAP pressure change after purge VSV ON	0.3 kPa (2.25 mmHg) or more

6. Second reference pressure measurement

Next sequence is run if all of following conditions are met:	Conditions 1, 2, 3 and 4
1. EVAP pressure just after reference pressure measurement	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.05 kPa (-36.38 to -7.87 mmHg)
3. Reference pressure	Saturated within 1 minute
4. Reference pressure difference between first and second	Less than 0.7 kPa (5.25 mmHg)

7. Leak check

Next sequence is run if following condition is met:	-
EVAP pressure when vacuum introduction was complete	Less than second reference pressure

8. Atmospheric pressure

Monitor is complete	-
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.

P0455: EVAP gross leak

EVAP pressure when vacuum introduction is complete	Higher than reference pressure x 0.2

P0456: EVAP small leak

EVAP pressure when vacuum introduction is complete	Between reference pressure and reference pressure x 0.2

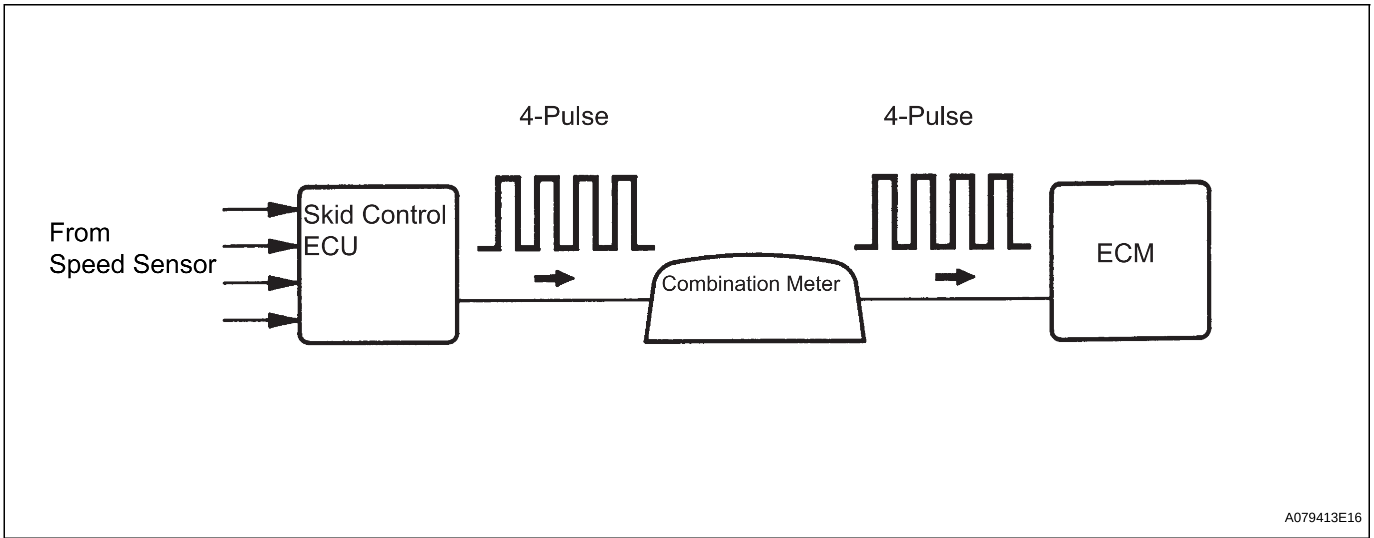
MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-25).

DTC P0500 Vehicle Speed Sensor "A"

DESCRIPTION

The speed sensor detects the wheel speed and sends the appropriate signals to the skid control ECU. The skid control ECU converts these wheel speed signals into a 4-pulse signal and outputs it to the ECM via the combination meter. The ECM determines the vehicle speed based on the frequency of these pulse signals.



DTC No.	DTC Detection Condition	Trouble Area
P0500	Vehicle speed signal from vehicle speed sensor is cut for 0.14 sec. or more while cruise control is in operation	• Vehicle speed sensor • Vehicle speed sensor signal circuit • Combination meter • ECM • Skid control ECU

MONITOR DESCRIPTION

The ECM assumes that the vehicle is being driven when the transmission counter gear indicates more than 300 rpm and over 30 seconds have passed since the park/neutral position switch was turned OFF. If there is no signal from the vehicle speed sensor with these conditions satisfied, the ECM concludes that the vehicle speed sensor is malfunctioning. The ECM will turn on the MIL and a DTC will be set.

MONITOR STRATEGY

Related DTCs	P0500: Vehicle Speed Sensor Circuit
Required sensors / components (Main)	Vehicle speed sensor, Combination meter, ABS ECU
Required sensors / components (Sub)	Counter gear Speed (CS) sensor, ECT sensor
Frequency of operation	Continuous
Duration	8 seconds
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

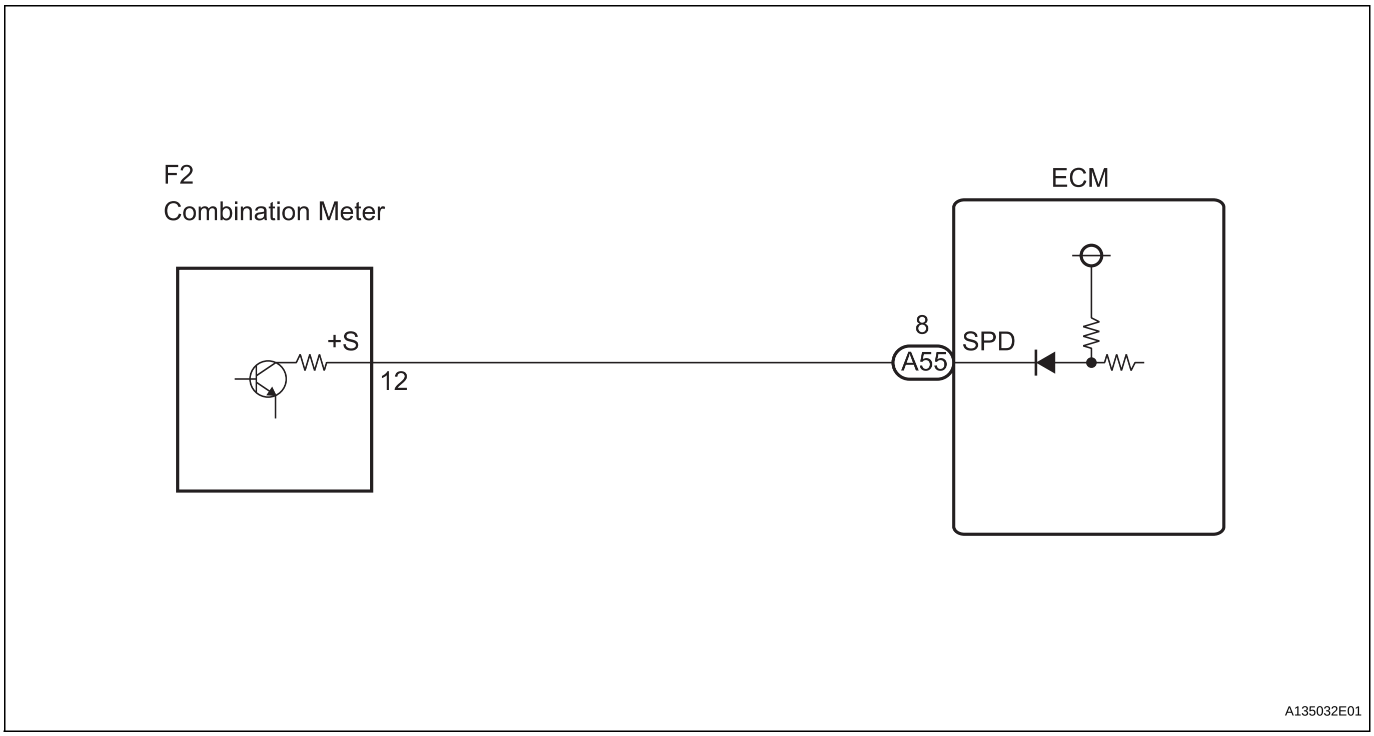
The monitor will run whenever these DTCs are not present	P0100 - P0103 (MAF sensor) P0105 - P0108 (MAP sensor) P0115 - P0118 (ECT sensor) P0120 - P02238 (TP sensor) P0125 (VSS/ECT1 sensor, non-ECT)
Engine coolant temperature	70°C (158°F) or more

Engine speed	2,000 to 5,000 rpm
Engine load	30.37 % or more
Fuel cut high engine speed	Not executing
Battery voltage	8 V or more
Engine switch	ON
ETC sensor circuit fail	Not detected
MAF sensor circuit fail	Not detected
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

Vehicle speed sensor signal	No pulse input

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	CHECK SPEEDOMETER

(a) Drive the vehicle and check whether 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.

- If the speedometer does not operate, check it by following the procedure described in speedometer malfunction.

NG → **GO TO SPEEDOMETER CIRCUIT**

OK

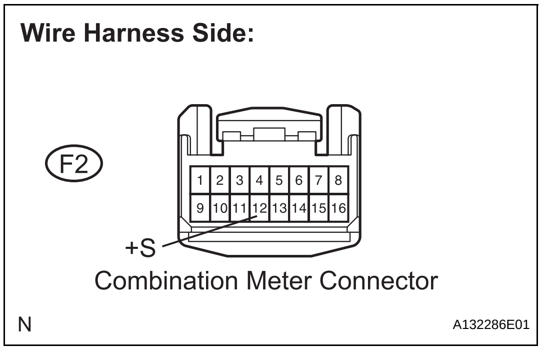
2 READ VALUE OF INTELLIGENT TESTER (VEHICLE SPEED)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the tester on.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / VEHICLE SPD.
(e) Drive the vehicle.
(f) Read the value displayed on the tester.
OK:
Vehicle speeds displayed on tester and speedometer display are equal.

NG → **CHECK INTERMITTENT PROBLEMS**

OK

3 CHECK COMBINATION METER ASSEMBLY (+S VOLTAGE)



(a) Disconnect the F2 combination meter connector.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage between the terminal of the combination meter and body ground.
Standard voltage

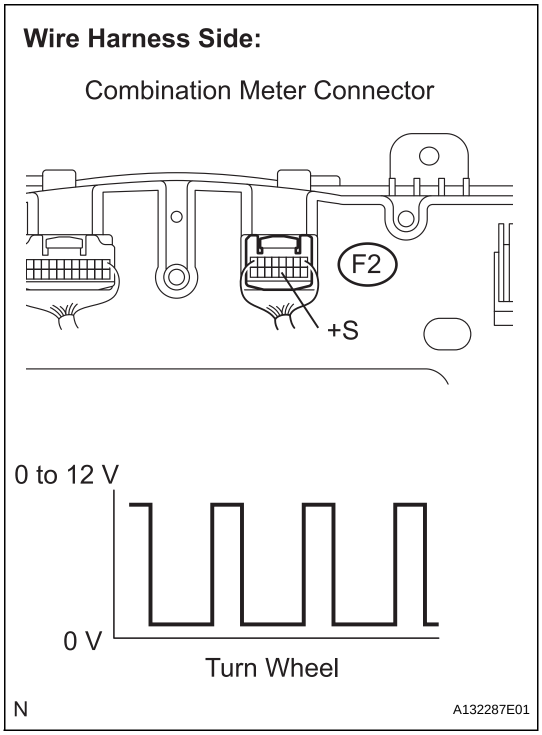
Tester Connection	Specified Condition
F2-12 (+S) - Body ground	4.5 to 5.5 V

(d) Reconnect the combination meter connector.

NG → **Go to step 5**

OK

4	CHECK COMBINATION METER ASSEMBLY (SPD SIGNAL WAVEFORM)



(a) Shift the transmission gear selector lever to the neutral position.
(b) Jack up the vehicle.
(c) Turn the ignition switch on (IG).
(d) Measure the voltage between the terminal of the combination meter and body ground while the wheel is turned slowly.

Standard voltage

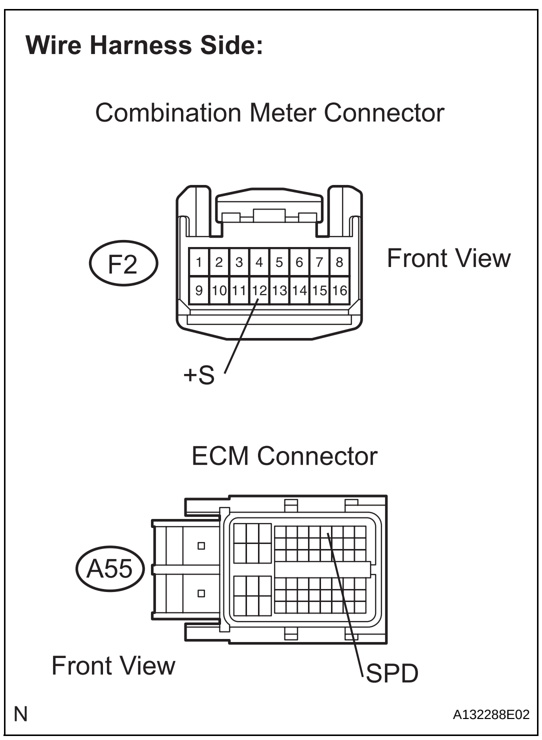
Tester Connection	Specified Condition
F2-12 (+S) - Body ground	Voltage generated intermittently

HINT:
The output voltage should fluctuate up and down, similarly to the diagram, when the wheel is turned slowly.

NG → **REPLACE COMBINATION METER ASSEMBLY (See page ME-63)**

OK

5	CHECK HARNESS AND CONNECTOR (COMBINATION METER ASSEMBLY - ECM)



(a) Disconnect the F2 combination meter connector.
(b) Disconnect the A55 ECM connector.
(c) Measure the resistance.

Standard resistance (Check for open)

Tester Connection	Specified Condition
+S (F2-12) - SPD (A55-8)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
+S (F2-12) or SPD (A55-8) - Body ground	10 kΩ or higher

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

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

OK

REPLACE ECM (See page ES-518)

DTC	P0504	Brake Switch "A" / "B" Correlation

DTC	P0724	Brake Switch "B" Circuit High

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.

Signal	Brake Pedal Released	In Transition	Brake Pedal Depressed
STP	OFF	ON	ON
ST1-	ON	ON	OFF

DTC No.	DTC Detection Condition	Trouble Area
P0504	Conditions (a), (b) and (c) continue for 0.5 seconds or more (1 trip detection logic): (a) Ignition switch on (IG) (b) Brake pedal released (c) STP signal OFF when ST1- signal OFF	• Short in stop light switch signal circuit • Stop light switch • ECM
P0724	The stop light switch remains ON even when the vehicle is driven in a STOP (less than 2 mph (3 km/h)) and GO (19 mph (30 km/h) or more) fashion 5 times. (2 trip detection logic)	• Short in stop light switch signal circuit • Stop light switch • ECM

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 2 mph (3 km/h)) and go (19 mph (30 km/h) or more) 5 times in two driving cycles in order to detect a malfunction.

MONITOR STRATEGY

Related DTCs	P0724: Stop light switch/Rationality
Required sensors/Components	Stop light switch, Vehicle speed sensor
Frequency of operation	Continuous
Duration	GO and STOP 5 times
MIL operation	2 driving cycles
Sequence of operation	None

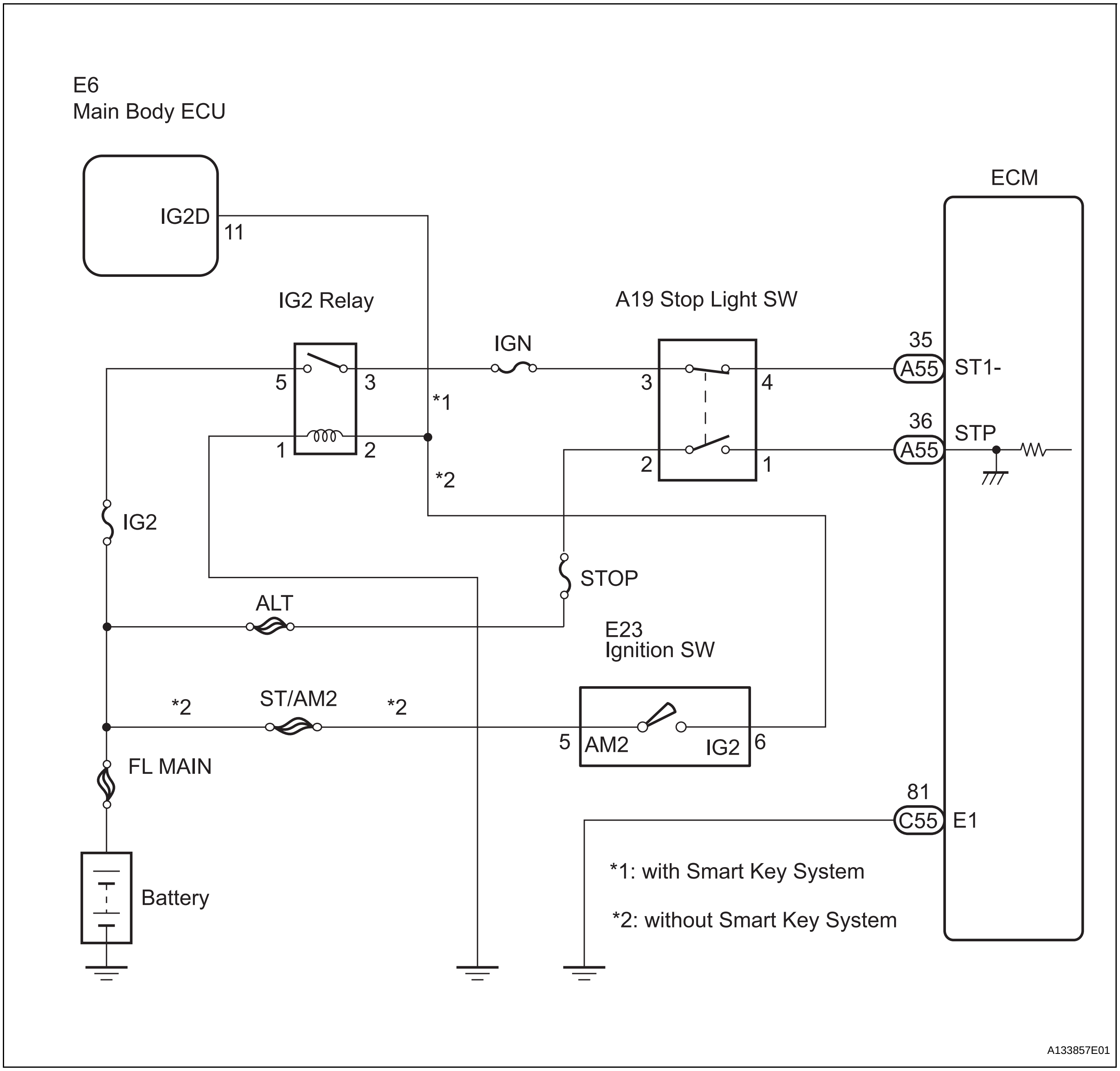
TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present	None
Engine switch	ON
Starter	OFF
Battery voltage	8 V or more
GO (Vehicle speed is 18.65 mph (30 km/h) or more)	Once
STOP (Vehicle speed is less than 1.86 mph (3 km/h))	Once

TYPICAL MALFUNCTION THRESHOLDS

Brake switch	Remain ON during GO and STOP 5 times

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

ES

1 CHECK STOP LIGHT (OPERATION OF STOP LIGHT)

(a) Check whether the stop lights turn on and off normally when the brake pedal is depressed and released.

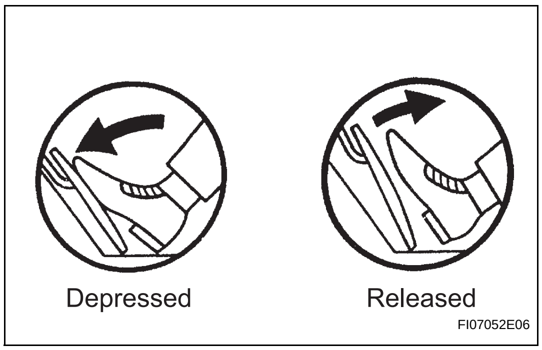
OK:

Stop lights turn ON when brake pedal is depressed.

NG → **REPAIR OR REPLACE STOP LIGHT SWITCH CIRCUIT**

OK

2 READ VALUE OF INTELLIGENT TESTER (STP SIGNAL AND ST1 - VOLTAGE)



(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) and turn the tester on.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / STOP LIGHT SW.
(d) Check the STP signal when the brake pedal is depressed and released.

OK

Brake Pedal Operation	Specified Condition
Depressed	STP signal ON
Released	STP signal OFF

(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / ST1.
(f) Check the ST1 signal when the brake pedal is depressed and released.

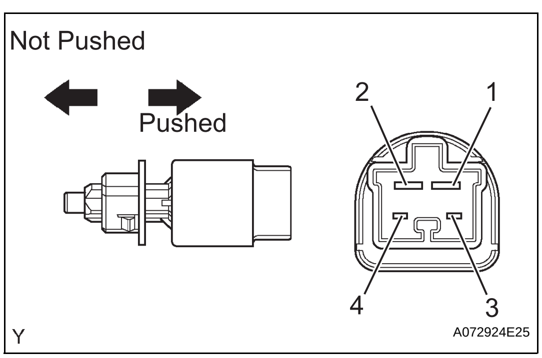
OK

Brake Pedal Operation	Specified Condition
Depressed	ST1 signal OFF
Released	ST1 signal ON

OK → **CHECK FOR INTERMITTENT PROBLEMS**

NG

3 INSPECT STOP LIGHT SWITCH ASSEMBLY



(a) Remove the stop light switch assembly.
(b) Measure the resistance according to the value(s) in the table below.

Standard resistance

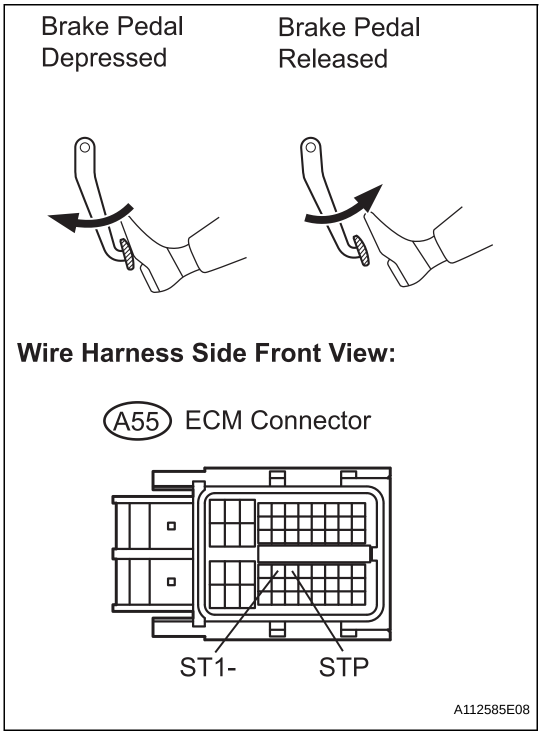
Switch Position	Tester Connection	Specified Condition
Switch pin free	1 - 2	Below 1 Ω
Switch pin free	3 - 4	10 kΩ or higher
Switch pin pushed in	1 - 2	10 kΩ or higher
Switch pin pushed in	3 - 4	Below 1 Ω

(c) Reinstall the stop light switch assembly.

NG → **REPLACE STOP LIGHT SWITCH ASSEMBLY (See page LI-125)**

OK ↓

4 CHECK ECM (STP, ST1 - VOLTAGE)



(a) Disconnect the A55 ECM connector.

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

Standard voltage

Tester Connection	Brake Pedal Operation	Specified Condition
STP (A55-36) - Body ground	Depressed	9 to 14 V
STP (A55-36) - Body ground	Released	0 to 3 V
ST1- (A55-35) - Body ground	Depressed	0 to 3 V
ST1- (A55-35) - Body ground	Released	9 to 14 V

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

OK ↓

REPLACE ECM (See page ES-518)

DTC	P0505	Idle Control System Malfunction

DESCRIPTION

The idle speed is controlled by the Electronic Throttle Control System (ETCS). The ETCS is comprised of: 1) one valve type throttle body; 2) the throttle actuator, which operates the throttle valve; 3) the throttle position sensor, which detects the opening angle of the throttle valve; 4) the accelerator pedal position sensor, which detects the accelerator pedal position; 5) the ECM, which controls the ETCS. Based on the target idle speed, the ECM controls the throttle actuator to provide the proper throttle valve opening angle.

DTC No.	DTC Detection Condition	Trouble Area
P0505	Idle speed continues to vary greatly from target speed (2 trip detection logic)	• ETCS • Air induction system • PCV hose connection • ECM

MONITOR DESCRIPTION

The ECM monitors the idling speed and idling air flow volume to conduct Idle Speed Control (ISC). The ECM determines that the ISC system is malfunctioning if the following conditions are met:

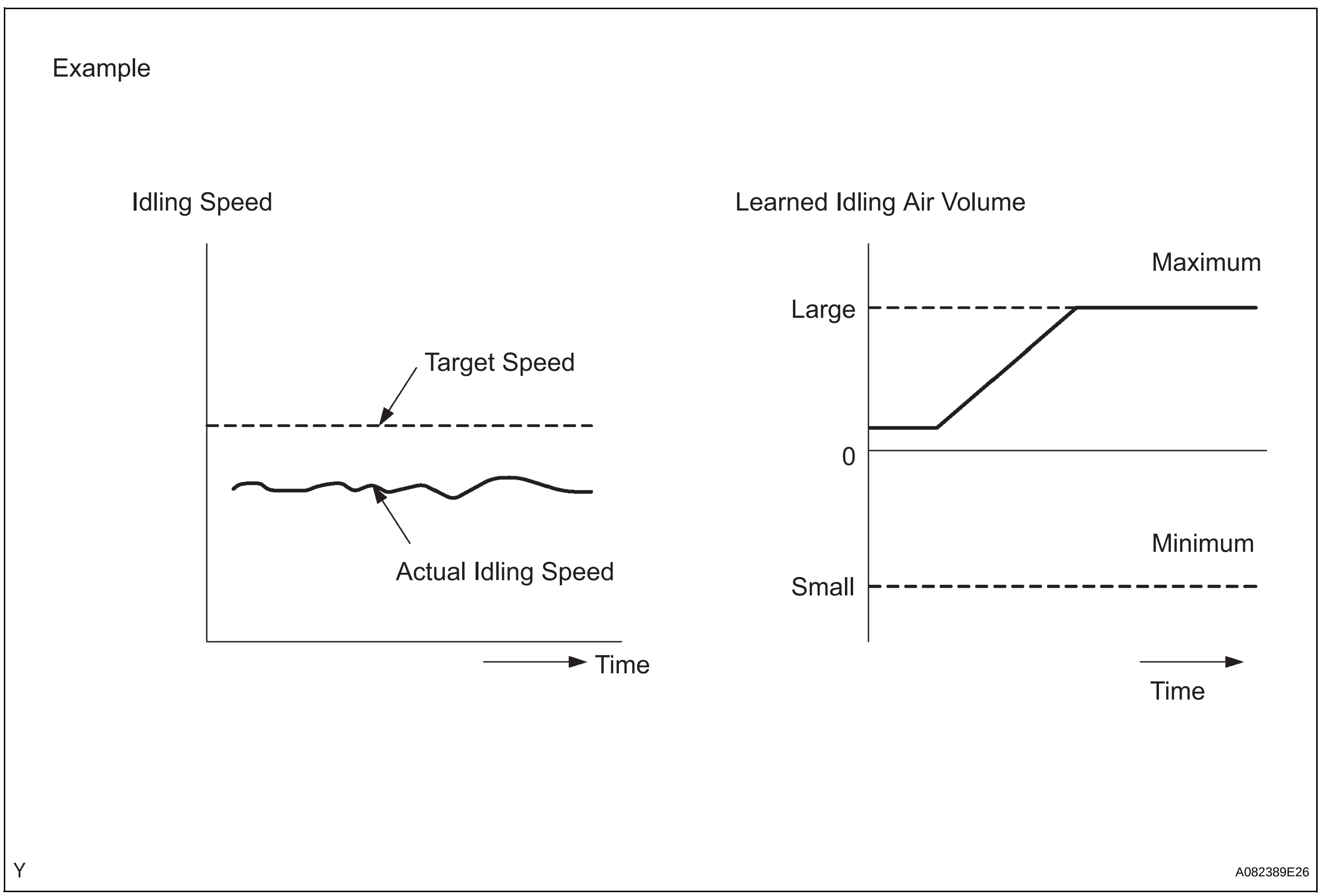
- The learned idling air flow volume remains at the maximum or minimum 5 times or more during a driving cycle
- While driving at 6 mph (10 km/h) or more, the actual engine idling speed varies from the target idling speed by between 100 rpm and 200 rpm, 5 times or more during a driving cycle.

Example:

If the actual idling speed varies from the target idling speed by more than 200 rpm* 5 times during a driving cycle, the ECM illuminates the MIL and sets the DTC.

HINT:

*: Threshold idling speed varies with engine load.



MONITOR STRATEGY

Related DTCs	P0505: ISC function
Required Sensors/Components (Main)	ETCS
Required Sensors/Components (Sub)	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 will run whenever these DTCs are not present	None
Engine	Running

TYPICAL MALFUNCTION THRESHOLDS

Functional check:

Either of the following conditions 1 or 2 is met:	-
1. Frequency that following conditions (a) and (b) are met:	5 time or more
(a) Engine RPM - target engine RPM	Below -100 rpm, or 200 rpm or more
(b) Vehicle condition	Stop after vehicle was driven by 6.25 mph (10 km/h) or more
2. Frequency that following conditions (a) and (b) are met:	Once
(a) Engine RPM - target engine RPM	Below -100 rpm, or 200 rpm or more
(b) ISC flow rate learning value	1.3 L/sec. or less. or 8.5 L/sec. or more

INSPECTION PROCEDURE

HINT:

- The following conditions may also cause DTC P0505 to be set:
  (a) The floor carpet overlapping onto the accelerator pedal, causing the accelerator pedal to be slightly depressed and therefore the throttle valve position to be slightly open.
  (b) The accelerator pedal being not fully released.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0505)

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

Result

Display (DTC output)	Proceed to
P0505	A

Display (DTC output)	Proceed to
P0505 and other DTCs	B

HINT:
If any DTCs other than P0505 are output, troubleshoot those DTCs first.

B — **GO TO DTC CHART (See page ES-63)**

A

2 CHECK PCV HOSE (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 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 contamainated with foreign objects and moves smoothly.

NG — **REPLACE THROTTLE BODY (See page ES-503)**

OK

REPLACE ECM (See page ES-518)

DTC	P050A	Cold Start Idle Air Control System Performance

DTC	P050B	Cold Start Ignition Timing Performance

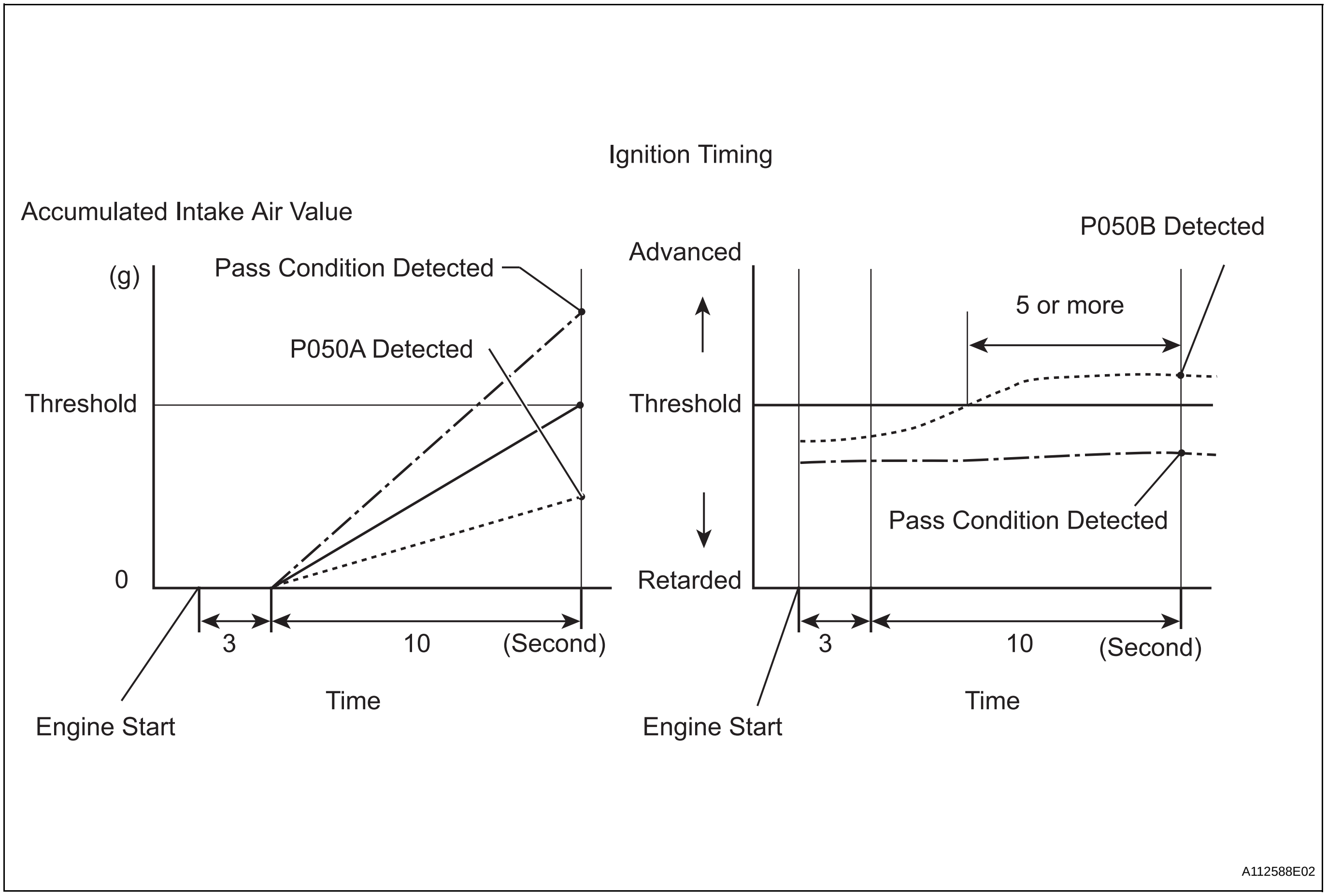
DESCRIPTION

The Electronic Throttle Control System (ETCS) controls the engine idling speed. The ETCS operates the throttle actuator to open and close the throttle valve, and adjusts the intake air amount to achieve the target idling speed.
In addition, the ECM retards the ignition timing and the ETCS increases the intake air amount to quickly increase the catalyst temperature at cold start to reduce emissions.

DTC No.	DTC Detection 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 at cold start (2 trip detection logic)	• Throttle body assembly • Mass air flow meter • Air induction system • PCV hose connections • VVT system • Air cleaner filter element • ECM

ES

MONITOR DESCRIPTION



The ECM monitors the intake air amount during idling and the ignition timing.
When the Engine Coolant Temperature (ECT) is between -10°C and 50°C (14°F and 122°F), the ECM calculates the idling intake air amount for 10 seconds, beginning 3 seconds after the engine starts.
When the accumulated value is below the threshold, the ECM interprets this as a malfunction in the Idle Speed Control (ISC) system at cold start.
The ECM also monitors the ignition timing at cold start, and judges it to be incorrect when it is advanced to the same value for a warm engine for 5 seconds or more of the 10 second monitoring period.
Example:
P050A is detected when all conditions below are met (2 trip detection logic).
1. The ECT is between -10°C and 50°C (14°F and 122°F) when the engine starts.
2. The engine idles for 13 seconds after engine start.
3. The accumulated intake air amount is below the threshold.

The ECM sets the DTC and illuminates the MIL 13 seconds after the engine is next started.

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	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 mass air flow	Varies with ECT (Example: Less than 42.5 g)

P050B:

Accumulated time when ignition timing retard is cut off	5 seconds or more

INSPECTION PROCEDURE

HINT:

Read freeze frame data using an intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

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 (IG).
(c) Turn the tester on.
(d) Select the following the menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read the DTCs.

Result

Display (DTC Output)	Proceed to
P050A and/or P050B	A
P050A and/or P050B and other DTCs	B

HINT:

If any DTCs other than P050A and P050B are output, troubleshoot those DTCs first.

B → **GO TO DTC CHART (See page ES-63)**

A

2 READ VALUE USING INTELLIGENT TESTER (FUEL TRIM)

HINT:

Calculate the total fuel trim values to check the characteristic deviation of the mass air flow meter.

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the tester on.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / SHORT FT #1 and LONG FT #1.
(e) Read the values displayed on the tester.
(f) Add together the SHORT FT #1 and LONG FT #1 values to obtain the total FUEL TRIM.

OK:
Total of SHORT FT #1 and LONG FT #1 values is between -20 % and 20 %.

OK → Go to step 12

NG

3 PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

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

OK

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

NG → Go to step 8

OK

4 CHECK PCV HOSE CONNECTIONS

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

NG → Go to step 9

OK

5 CHECK AIR INDUCTION SYSTEM

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

NG → Go to step 10

OK

6 CHECK AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY

(a) Visually check that the air cleaner filter element is not excessively contaminated with dirt or oil.
OK:
Air cleaner filter element is not excessively contaminated with dirt or oil.

NG → Go to step 11

OK

7	REPLACE MASS AIR FLOW METER

NEXT → Go to step 15

8	CHECK AND REPAIR VVT SYSTEM

NEXT → Go to step 15

ES

9	REPAIR OR REPLACE PCV HOSE

NEXT → Go to step 15

10	REPAIR OR REPLACE AIR INDUCTION SYSTEM

NEXT → Go to step 15

11	REPLACE AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY

NEXT → Go to step 15

12	CHECK THROTTLE VALVE

(a) Check for deposits around the throttle valve and throttle valve condition.

OK:

No deposits around throttle valve and throttle valve moves smoothly.

NG → Go to step 14

OK

13	REPLACE ECM

NEXT → Go to step 15

14	REPAIR OR REPLACE THROTTLE BODY ASSEMBLY

NEXT → Go to step 15

15	CHECK WHETHER DTC OUTPUT RECURS (DTC P050A AND/OR P050B)

NOTICE:
In this operation, the engine must be cold (the same level as the engine coolant temperature recorded in the freeze frame data).

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the tester on.
(d) Clear the DTCs (See page ES-45).
(e) Switch the ECM from normal mode to check mode using the tester (See page ES-49).
(f) Start the engine to idle for a minute.
OK:
Stable fast idling.
(g) Read the 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 off. This power allows the ECM to store data such as DTC history, freeze frame data and fuel trim values. If the battery voltage falls below a minimum level, these memories are cleared and the ECM determines that there is a malfunction in the power supply circuit. When the engine is next started, the ECM illuminates the MIL and sets the DTC.

DTC No.	DTC Detection Condition	Trouble Area
P0560	Open in ECM back-up power source circuit (1 trip detection logic)	• Open in back-up power source circuit • 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 (Sub)	-
Frequency of Operation	Continuous
Duration	3 seconds
MIL Operation	Immediate (MIL illuminated after next engine start)
Sequence of Operation	None

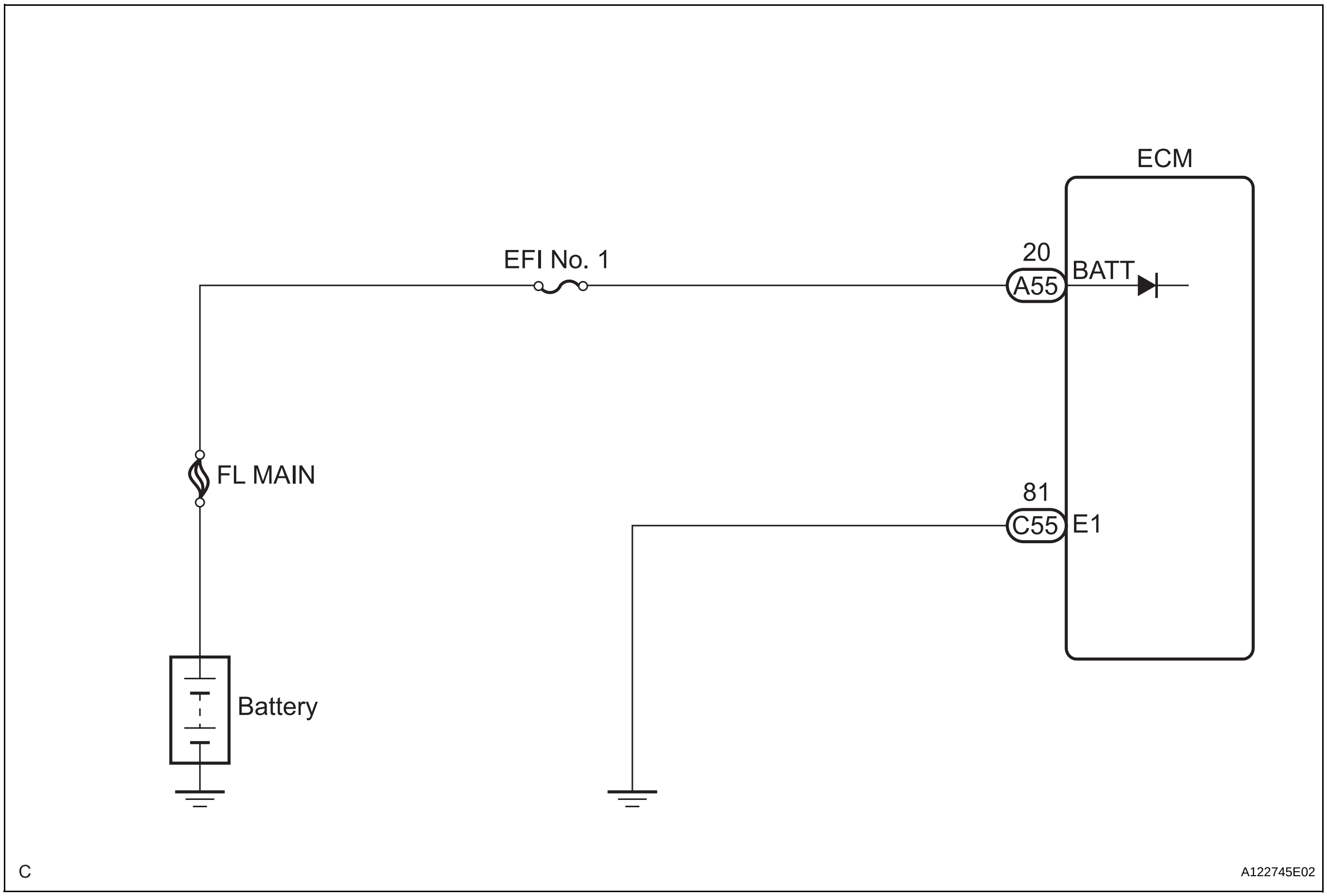
TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present:	None
Stand-by RAM	Initialized

TYPICAL MALFUNCTION THRESHOLDS

ECM power source	Less than 3.5 V

WIRING DIAGRAM

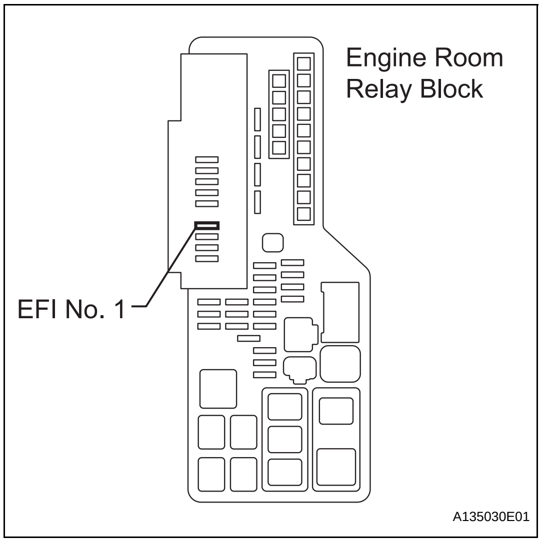


INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	INSPECT FUSE (EFI NO. 1)

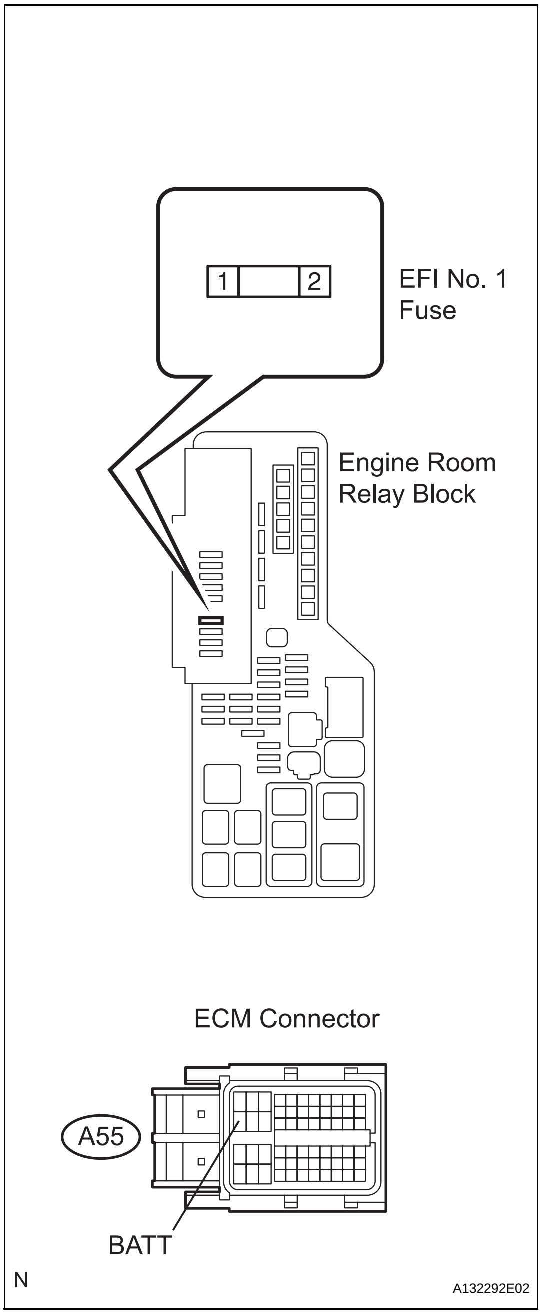


(a) Remove the EFI No. 1 fuse from the engine room R/B.
(b) Measure the EFI No. 1 fuse resistance.
Standard resistance:
Below 1 Ω
(c) Reinstall the EFI No. 1 fuse.

NG → **REPLACE EFI NO. 1 FUSE**

OK

2	CHECK HARNESS AND CONNECTOR



(a) Check the harness and connector between the EFI No. 1 fuse and ECM.
(1) Remove the EFI No. 1 fuse from the engine room R/B.
(2) Disconnect the A55 ECM connector.
(3) Measure the resistance between the terminals.
Standard resistance (Check for open)

Tester Connection	Specified Condition
Engine room R/B EFI No. 1 fuse terminal 2 - BATT (A55-20)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
Engine room R/B EFI No. 1 fuse terminal 2 or BATT (A55-20) - Body ground	10 kΩ or higher

(4) Reinstall the ECM connector.
(b) Check the harness and the connector between the EFI No. 1 fuse and battery.
(1) Disconnect the negative battery terminal.
(2) Disconnect the positive battery terminal.
(3) Measure the resistance between the terminals.
Standard resistance (Check for open)

Tester Connection	Specified Condition
Battery positive terminal - Engine room R/B EFI No 1 fuse terminal 1	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
Battery positive terminal or Engine room R/B EFI No. 1 fuse terminal 1 - Body ground	10 kΩ or higher

(4) Reconnect the positive battery terminal.
(5) Disconnect the negative battery terminal.
(6) Reinstall the EFI No. 1 fuse.

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

OK

3	INSPECT BATTERY

(a) Check that the battery is not depleted.
OK:
Battery is not depleted.

NG → **REPLACE BATTERY**

OK

4 CHECK BATTERY TERMINAL

(a) Check that the battery terminals are not loose or corroded.
OK:
Battery terminals are not loose or corroded.

NG → **REPAIR OR REPLACE BATTERY TERMINAL**

OK

5 CHECK WHETHER DTC OUTPUT RECURS

ES

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the intelligent tester on.
(d) Clear the DTCs (See page ES-45).
(e) Turn the intelligent tester off.
(f) Start the engine and turn the intelligent tester on.
(g) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(h) Read the DTCs.

Result

Display (DTC Output)	Proceed to
P0560	A
No output	B

B → **CHECK FOR INTERMITTENT PROBLEMS**

A

REPLACE ECM (See page ES-518)

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 internal memory status, internal circuits, and output signals sent to the throttle actuator. This self-check ensures that the ECM is functioning properly. If any malfunction is detected, the ECM will set the appropriate DTC and illuminate the MIL.

ES

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 2 CPUs also perform continuous mutual monitoring. The ECM illuminates the MIL and sets a DTC if: 1) outputs from the 2 CPUs are different and 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 Condition	Trouble Area
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 (Sub)	-
Frequency of Operation	Continuous
Duration	Within 1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

ECM RAM errors (P0604):

RAM mirror check	Fail

ECM CPU range check (P0606):

Either of following conditions is 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 is met	-
A. Following conditions are 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

ETCS power supply (P0657):

ETCS (Electronic Throttle Control System) power supply when ignition switch turned on (IG)	7 V or more

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0604/P0606/P0607/P0657)

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

Result

Display (DTC output)	Proceed to
P0604, P0606, P0607, P0657	A
No output DTC	B

B → **END**

A

REPLACE ECM (See page ES-518)

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 Condition	Trouble Area
P0617	When conditions (a), (b) and (c) are 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 • Starter relay circuit • Cranking holding function circuit (With smart key system) • Ignition switch (Without smart key system) • ECM

MONITOR STRATEGY

Related DTCs	P0617: Starter signal
Required Sensors/Components (Main)	STARTER relay, PMP switch, Engine switch
Required Sensors/Components (Sub)	Vehicle speed sensor (VSS), Crankshaft Position (CKP) sensor
Frequency of Operation	Continuous
Duration	20 seconds
MIL Operation	Immediate
Sequence of Operation	None

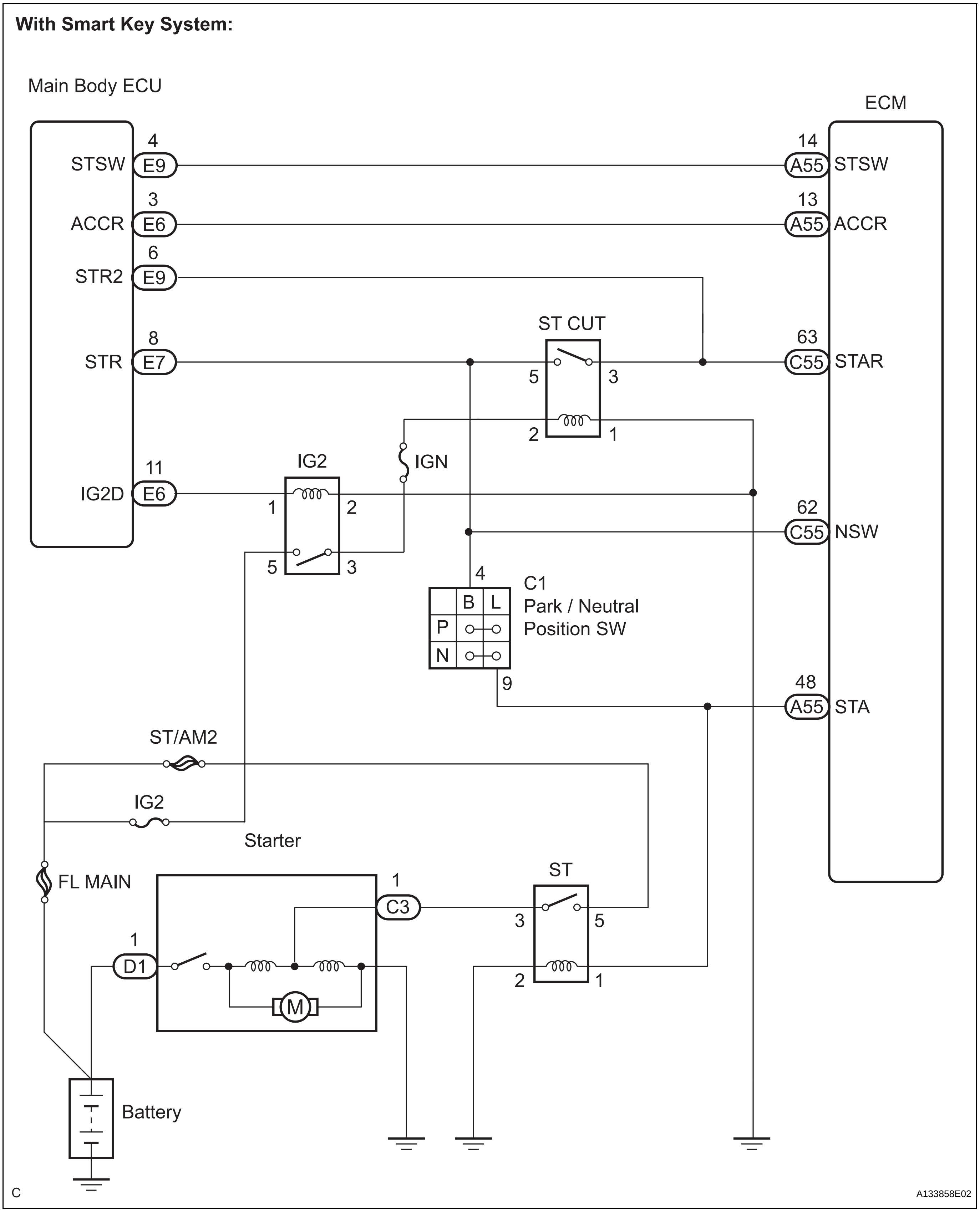
TYPICAL ENABLING CONDITIONS

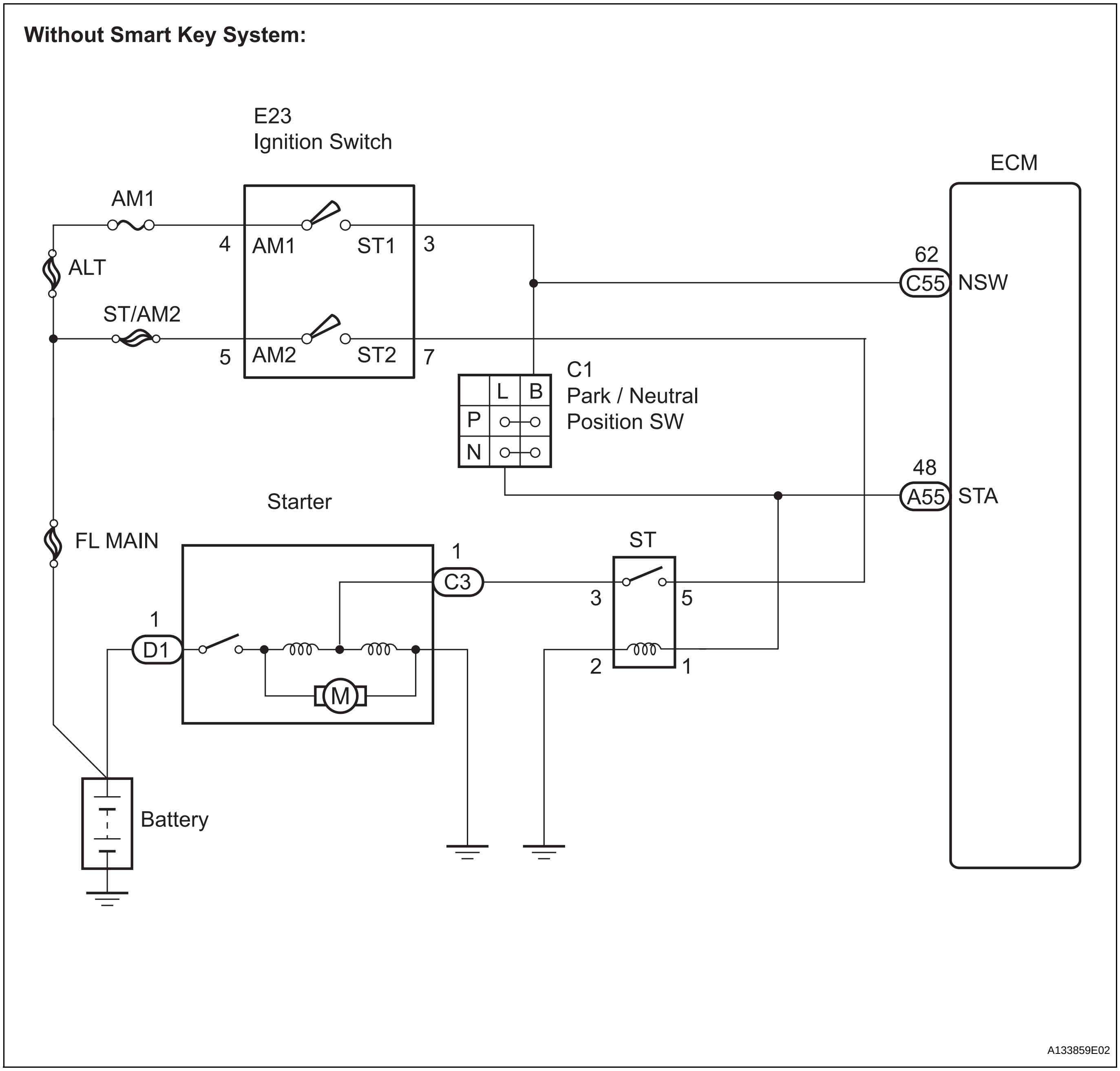
Monitor runs whenever these DTCs are not present:	None
Battery voltage	10.5 V or more
Vehicle speed	12.43 mph (20 km/h) or more
Engine speed	1,000 rpm or more

TYPICAL MALFUNCTION THRESHOLDS

Starter signal	ON

WIRING DIAGRAM





INSPECTION PROCEDURE

HINT:

- The following troubleshooting flowchart is based on the premise that the engine is cranked normally. If the engine does not crank, proceed to the problem symptoms table (See page ES-33).
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	READ VALUE OF INTELLIGENT TESTER (STARTER SIGNAL)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) and turn the tester on.

(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / STARTER SIG.

(d) Check the value displayed on the tester when the ignition switch is turned on (IG) and the engine is started.

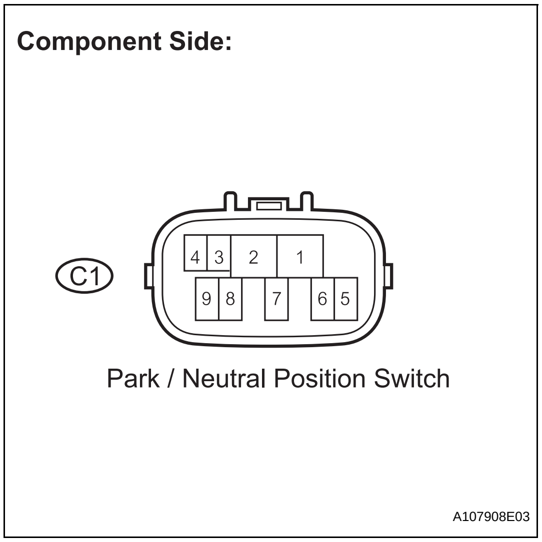
OK

Engine Switch Condition	ON (IG)	ENGINE START
STARTER SIG	OFF	ON

OK → **REPLACE ECM (See page ES-518)**

NG

2 INSPECT PARK / NEUTRAL POSITION SWITCH ASSEMBLY



(a) Inspect the Park / Neutral Position (PNP) switch.

(1) Disconnect the C1 switch connector.

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

Standard resistance

Gear Selector Lever Position	Tester Connection	Specified Condition
P	4 - 5	Below 1 Ω
N	4 - 5	Below 1 Ω

(3) Reconnect the PNP switch connector.

Result

Result	Proceed to
OK (without smart key system)	A
OK (with smart key system)	B
NG	C

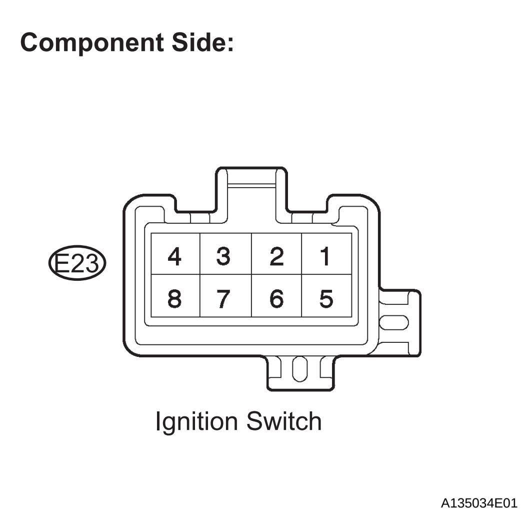
B → **CHECK CRANKING HOLDING FUNCTION CIRCUIT (See page ES-455)**

C → **REPLACE PARK / NEUTRAL POSITION SWITCH (THEN CHECK CRANKING HOLDING FUNCTION CIRCUIT) (See page AX-174)**

A

ES

3 INSPECT IGNITION SWITCH ASSEMBLY



(a) Disconnect the E23 ignition switch connector.
(b) Measure the resistance according to the value(s) in the table below.
Standard resistance

Switch Condition	Tester Connection	Specified Condition
LOCK	3-4, 5-7	10 kΩ or higher
START	3-4, 5-7	Below 1 Ω

(c) Reconnect the ignition switch connector.

NG → **REPAIR OR REPLACE IGNITION SWITCH ASSEMBLY**

OK

4 READ VALUE OF INTELLIGENT TESTER

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) and turn the tester on.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / STARTER SIG.
(d) Check the value displayed on the tester when the ignition switch is turned on (IG) and the ignition is started.

OK

Engine Switch Condition	ON (IG)	ENGINE START
STARTER SIG	OFF	ON

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

OK

SYSTEM IS OK

ES

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 Condition	Trouble Area
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 (Sub)	-
Frequency of Operation	Continuous
Duration	0.325 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Battery voltage	8 V or more
Engine switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

VIN code	Not programmed

COMPONENT OPERATING RANGE

VIN code	Programmed

INSPECTION PROCEDURE

1	READ DTC OUTPUT

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

Result

Display (DTC Output)	Proceed to
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 (See page ES-518)**

A

2	INPUT VIN WITH INTELLIGENT TESTER

NEXT

END

DTC	P0705	Transmission Range Sensor Circuit Malfunction (PRNDL Input)

DESCRIPTION

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

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

MONITOR DESCRIPTION

These DTCs indicate a problem with the park / neutral position switch and the wire harness in the park / neutral position switch circuit.
The park / neutral position switch detects the shift lever position and sends a signal to the ECM.
For security, the park / neutral position switch detects the shift lever position so that engine can be started only when the shift lever is in the P or N position.
The park / neutral position switch sends a signal to the ECM according to the shift position (P, R, N or D). The ECM determines that there is a problem with the switch or related parts if it receives more than 1 position signal simultaneously. The ECM will turn on the MIL and store the DTC.

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

All:

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

Condition (C):

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

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

TYPICAL MALFUNCTION THRESHOLDS

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

Condition (A):

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

Condition (B):

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

Condition (C):

"M" switch	ON

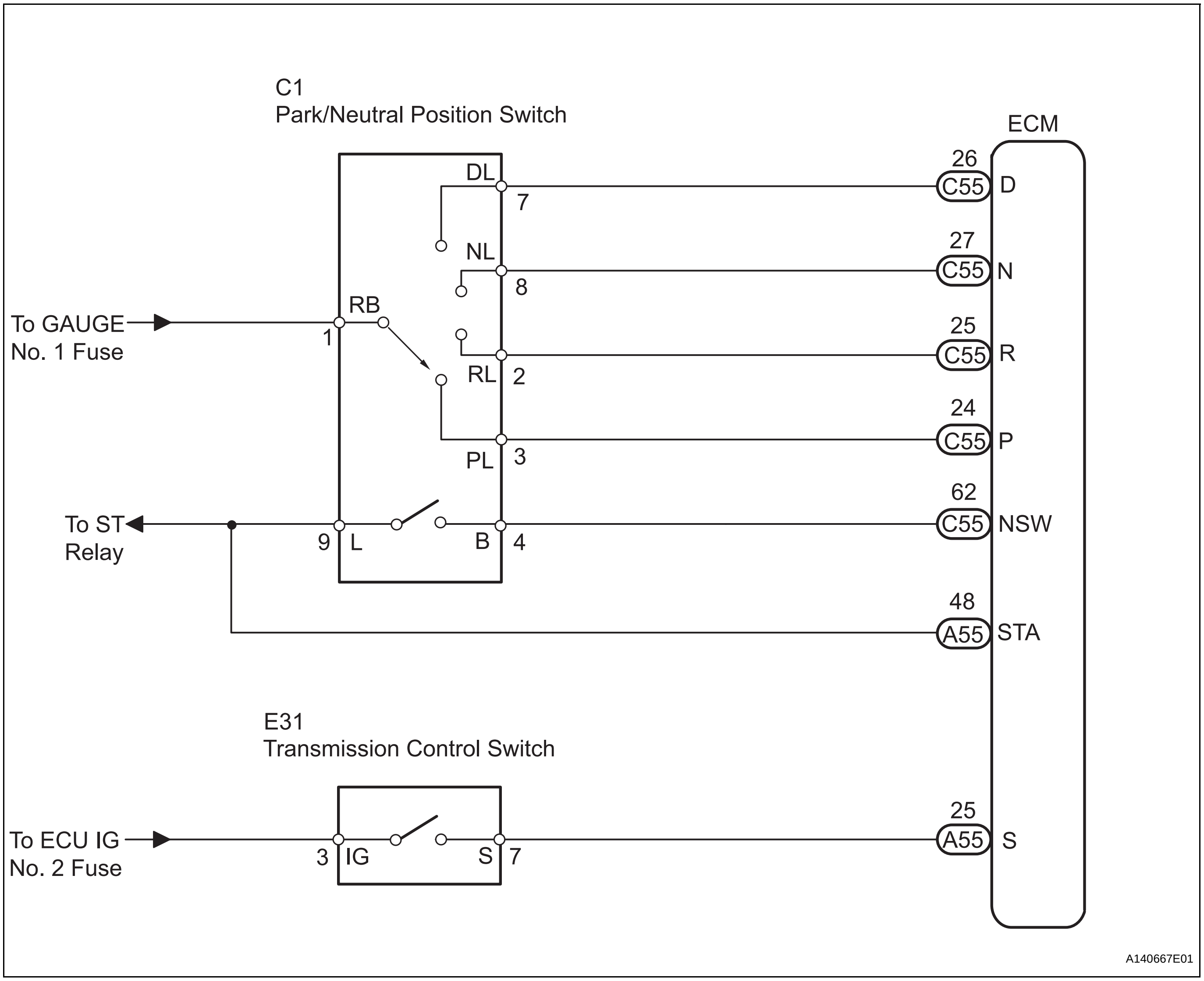
Condition (D):

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

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

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

NOTICE:

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

1. READ DATA LIST

(a) Turn the ignition switch off.

(b) Connect the intelligent tester together with the CAN VIM (controller area network vehicle interface module) to the DLC3.

(c) Turn the ignition switch on (IG).

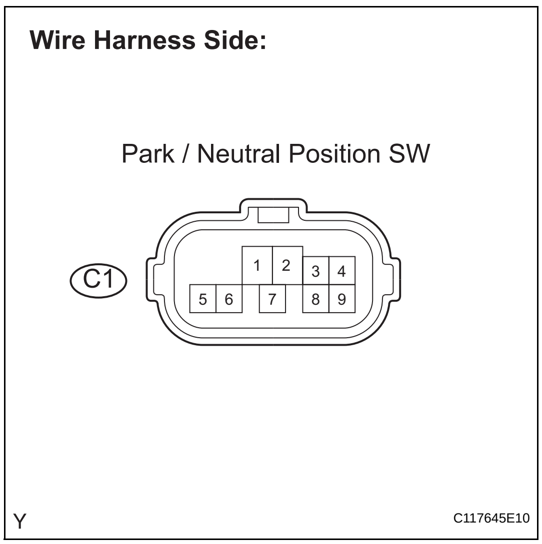
(d) Turn on the tester.

(e) Select the item "DIAGNOSIS / ENHANCED OBD II / DATA LIST".

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

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

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



(a) Disconnect the park / neutral position switch connector.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage according to the value(s) in the table below.

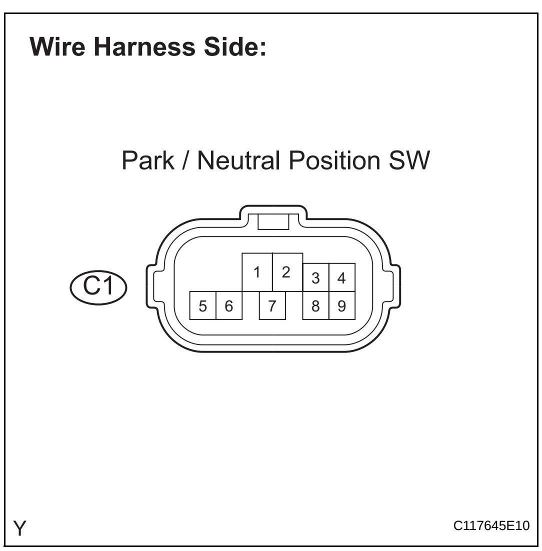
Standard voltage

Tester Connection	Specified Condition
2 - Body ground	10 to 14 V

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

OK

2 CHECK ECM (OUTPUT SIGNAL)



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

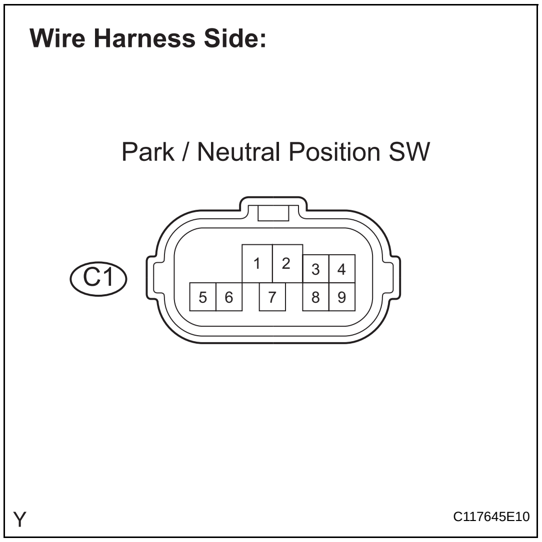
Standard voltage

Tester Connection	Specified Condition
4 - Body ground	10 to 14 V

NG → **Go to step 9**

OK

3	CHECK HARNESS AND CONNECTOR (PARK/NEUTRAL POSITION SWITCH - BODY GROUND)



(a) Disconnect the C1 park/neutral position switch connector.

(b) Measure the resistance between the terminals.

Standard resistance

Tester Connection	Specified Condition
L (C1-9) - Body ground	Below 1 Ω

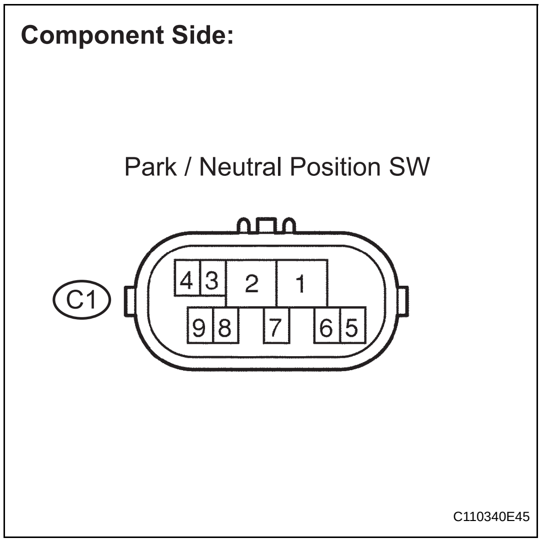
(c) Reconnect the park/neutral position switch connector.

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

ES

OK

4	INSPECT PARK / NEUTRAL POSITION SWITCH ASSEMBLY



(a) Measure the resistance according to the value(s) in the table below when the shift lever is moved to each position.

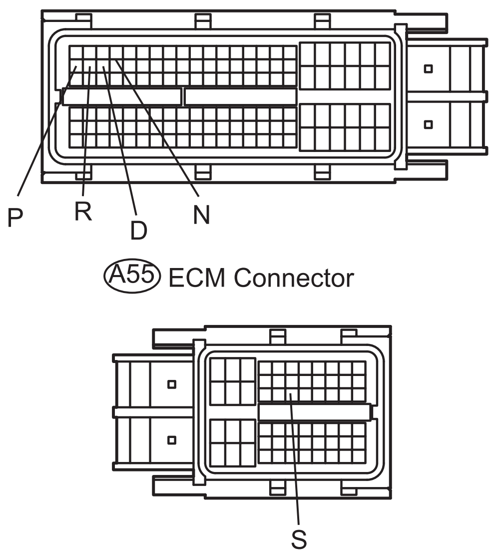
Standard resistance

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

NG → **REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY**

OK

5	CHECK HARNESS AND CONNECTOR



(a) Connect the park / neutral position switch connector.
(b) Disconnect the ECM connectors.
(c) Turn the ignition switch on (IG), and measure the voltage according to the value(s) in the table below when the shift lever is moved to each position.

Standard voltage

Shift Position	Tester Connection	Specified Condition
P	C55-24 (P) - Body ground	10 to 14 V
Except P		Below 1 V
N	C55-27 (N) - Body ground	10 to 14 V
Except N		Below 1 V
R	C55-25 (R) - Body ground	10 to 14 V*
Except R		Below 1 V
D and S	C55-26 (D) - Body ground	10 to 14 V
Except D and S		Below 1 V
S, "+" and "-"	A55-25 (S) - Body ground	10 to 14 V
Except S, "+" and "-"		Below 1 V

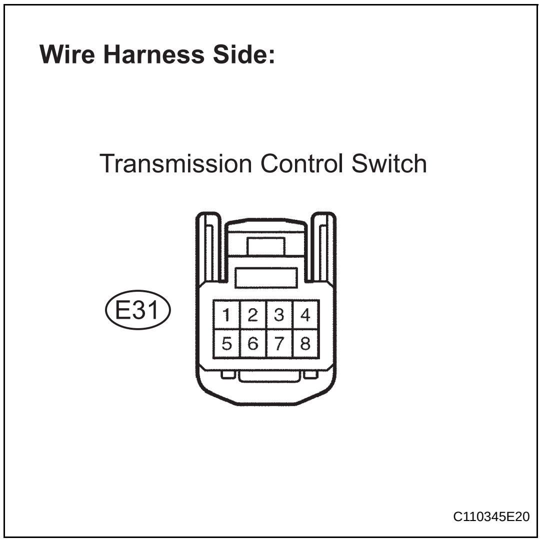
HINT:
*: The voltage will drop slightly due to lighting up of the back up light.

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

OK

ES

6	CHECK HARNESS AND CONNECTOR



(a) Disconnect the transmission control switch connector of the shift lock control unit assembly.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage between the terminals.
Standard voltage

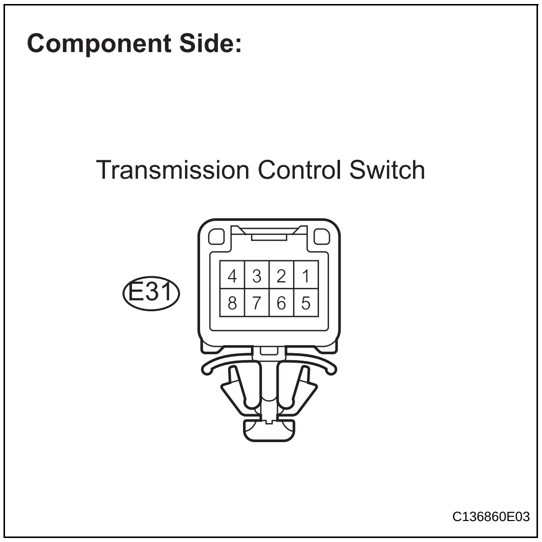
Tester Connection	Specified Condition
3 - Body ground	10 to 14 V

(d) Reconnect the transmission control switch connector.

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

OK

7	INSPECT TRANSMISSION CONTROL SWITCH



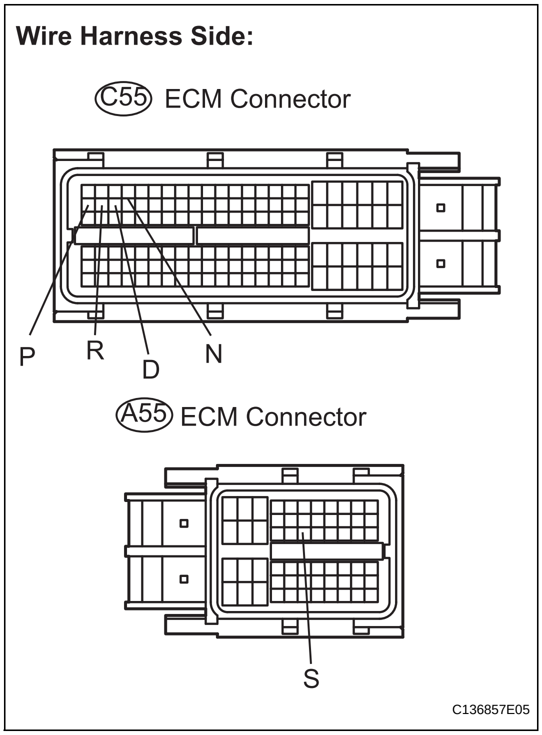
(a) Measure the resistance according to the value(s) in the table below when the shift lever is moved to each position.
Standard resistance

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

NG → **REPLACE TRANSMISSION CONTROL SWITCH**

OK

8	CHECK HARNESS AND CONNECTOR



(a) Connect the transmission control switch connector of the shift lock control unit assembly.

(b) Turn the ignition switch on (IG), and measure the voltage according to the value(s) in the table below when the shift lever is moved to each position.

Standard voltage

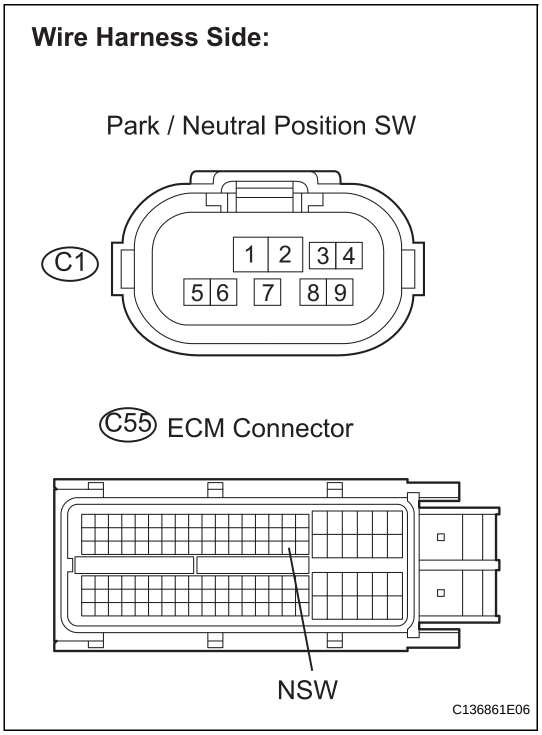
Shift Position	Tester Connection	Specified Condition
P	C55-24 (P) - Body ground	10 to 14 V
Except P	↑	Below 1 V
N	C55-27 (N) - Body ground	10 to 14 V
Except N	↑	Below 1 V
R	C55-25 (R) - Body ground	10 to 14 V *
Except R	↑	Below 1 V
D and S	C55-26 (D) - Body ground	10 to 14 V
Except D and S	↑	Below 1 V
S, "+" and "-"	A55-25 (S) - Body ground	10 to 14 V
Except S, "+" and "-"	↑	Below 1 V

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

OK ↓

REPLACE ECM

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



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

Standard resistance (Check for open)

Tester Connection	Specified Condition
B (C1-4) - NSW (C55-62)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
B (C1-4) or NSW (C55-62) - Body ground	10 kΩ or higher

ES

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

OK

REPLACE ECM

DTC	P2102	Throttle Actuator Control Motor Circuit Low

DTC	P2103	Throttle Actuator Control Motor Circuit High

SYSTEM DESCRIPTION

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

HINT:

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

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

MONITOR DESCRIPTION

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

Example:

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

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

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs are not present	None

P2102:

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

P2103:

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

TYPICAL MALFUNCTION THRESHOLDS

P2102:

Throttle actuator current	Less than 0.5 A

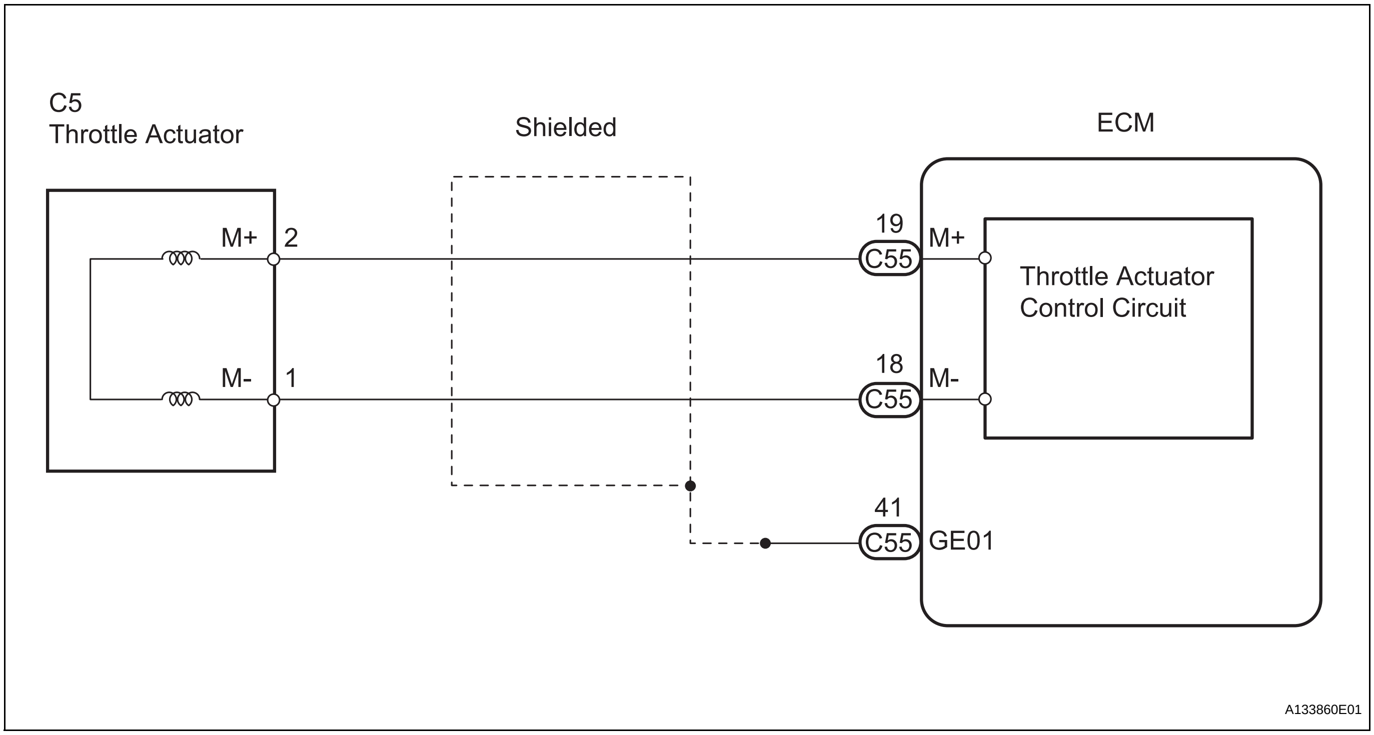
P2103:

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

FAIL-SAFE

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

WIRING DIAGRAM

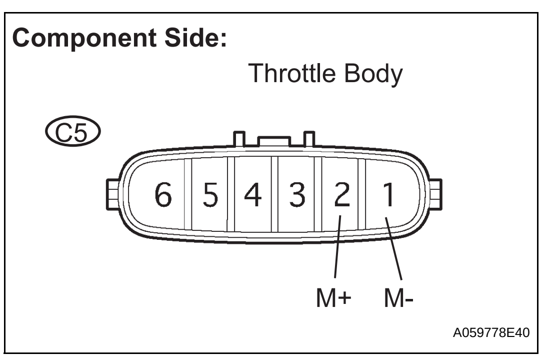


INSPECTION PROCEDURE

HINT:

- Read freeze frame data using an intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).
- The throttle actuator current (THROTTLE MOT) and the throttle actuator duty ratio (THROTTLE OPN / THROTTLE CLS) can be read using the intelligent tester. However, the ECM shuts off the throttle actuator current when the ETCS malfunctions.

1	INSPECT THROTTLE BODY (RESISTANCE OF THROTTLE CONTROL MOTOR)



(a) Disconnect the C5 throttle body connector.

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

Standard resistance

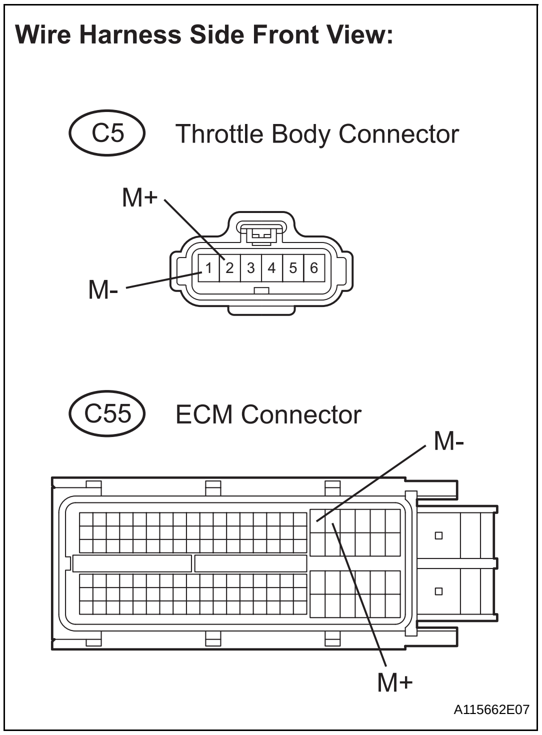
Tester Connection	Condition	Specified Condition
M+ (C5-2) - M- (C5-1)	20°C (68°F)	0.3 to 100 Ω

(c) Reconnect the throttle body connector.

NG → **REPLACE THROTTLE BODY** **(See page ES-503)**

OK

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



(a) Disconnect the C5 throttle body connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
M+ (C5-2) - M+ (C55-19)	Below 1 Ω
M- (C5-1) - M- (C55-18)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
M+ (C5-2) or M+ (C55-19) - Body ground	10 kΩ or higher
M- (C5-1) or M- (C55-18) - Body ground	10 kΩ or higher

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

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

OK

3	INSPECT THROTTLE BODY (VISUALLY CHECK THROTTLE VALVE)

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

NG → **REMOVE FOREIGN OBJECT AND CLEAN THROTTLE BODY**

OK

4	INSPECT THROTTLE VALVE

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

NG → **REPLACE THROTTLE BODY (See page ES-503)**

OK

REPLACE ECM (See page ES-518)

ES

DTC	P2111	Throttle Actuator Control System - Stuck Open

DTC	P2112	Throttle Actuator Control System - Stuck Closed

SYSTEM DESCRIPTION

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

HINT:

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

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

MONITOR DESCRIPTION

The ECM determines that there is a malfunction in the ETCS when the throttle valve remains at a fixed angle despite a high drive current from the ECM. The ECM illuminates the MIL and sets a DTC.

If the malfunction is not repaired successfully, a DTC is set when the accelerator pedal is fully depressed and released quickly (to fully open and close the throttle valve) after the engine is next started.

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs are not present	None

P2111 (Throttle actuator stuck open):

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

P2112 (Throttle actuator stuck closed):

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

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

TYPICAL MALFUNCTION THRESHOLDS

P2111 (Throttle actuator stuck open):

TP sensor voltage change	No change

P2112 (Throttle actuator stuck closed):

TP sensor voltage change	No change

FAIL-SAFE

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

WIRING DIAGRAM

Refer to DTC P2102 (See page ES-320).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

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

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

Result

Display (DTC Output)	Proceed to
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 (See page ES-63)

A

2 INSPECT THROTTLE BODY (VISUALLY CHECK THROTTLE VALVE)

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

OK:

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

NG → REPLACE THROTTLE BODY ASSEMBLY (See page ES-503)

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 on (IG).
(c) Turn the tester on.
(d) Clear the DTCs (See page ES-45).
(e) Start the engine, and fully depress and release the accelerator pedal quickly (to fully open and close the throttle valve).
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Read the DTCs.

Result

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

B → REPLACE ECM (See page ES-518)

A

CHECK FOR INTERMITTENT PROBLEMS

DTC P2118 Throttle Actuator Control Motor Current Range / Performance

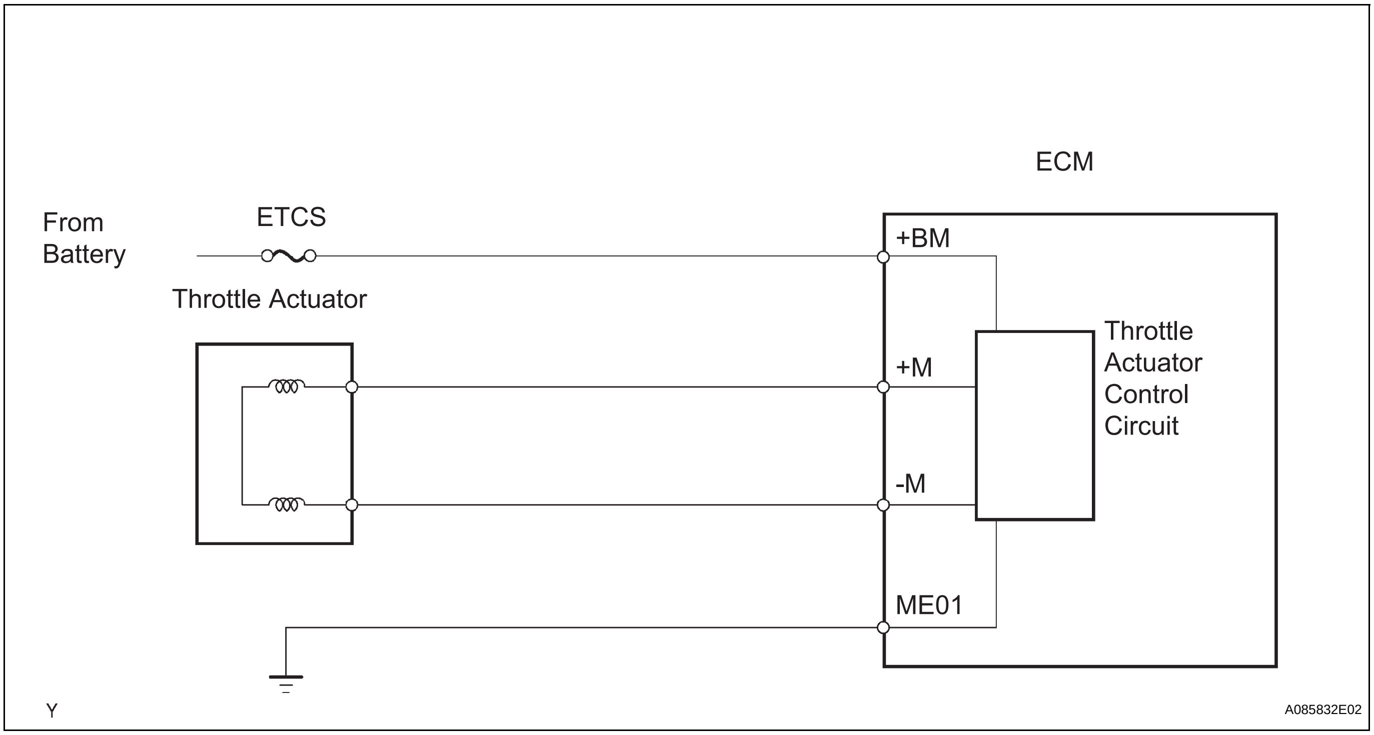
DESCRIPTION

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

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

HINT:

The ETCS does not use a throttle cable.



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

MONITOR DESCRIPTION

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

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

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

MONITOR STRATEGY

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

MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

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

TYPICAL MALFUNCTION THRESHOLDS

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

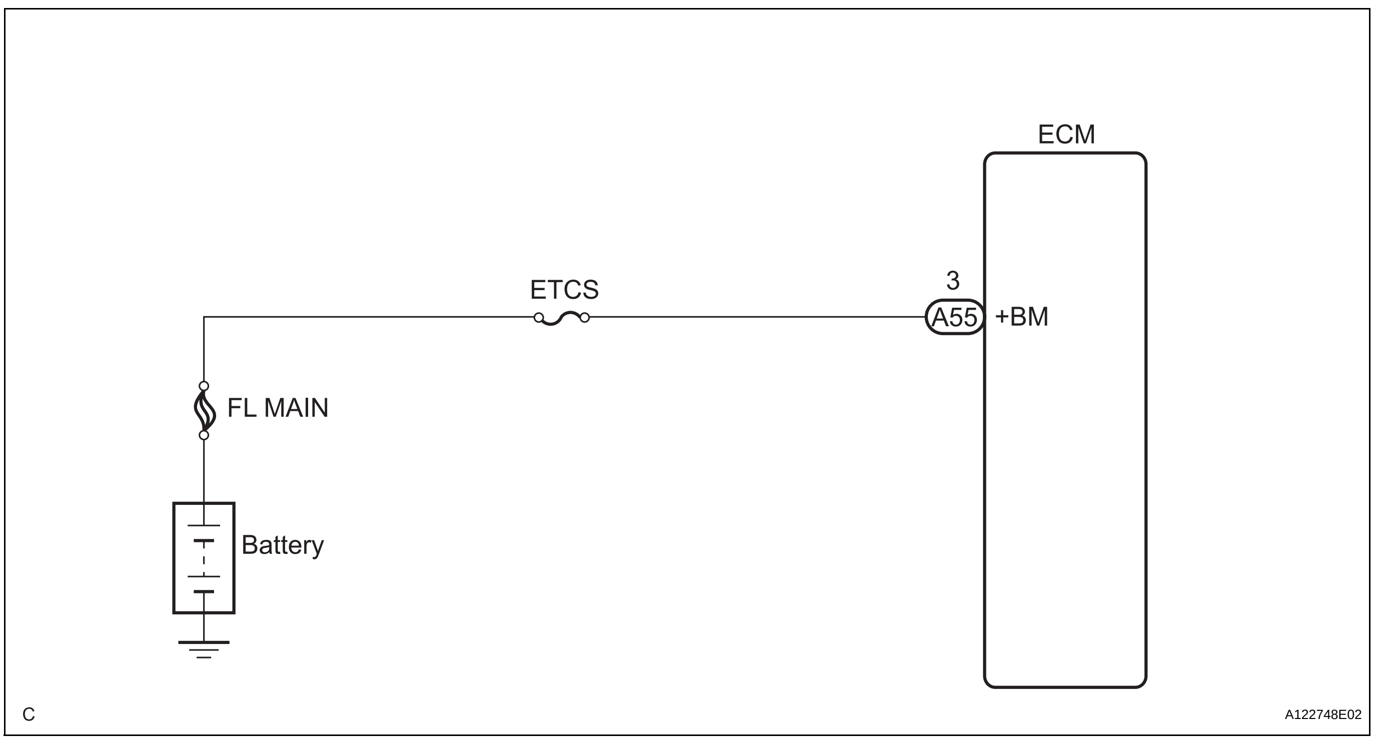
COMPONENT OPERATING RANGE

Throttle actuator power supply voltage	9 to 14 V

FAIL-SAFE

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

WIRING DIAGRAM

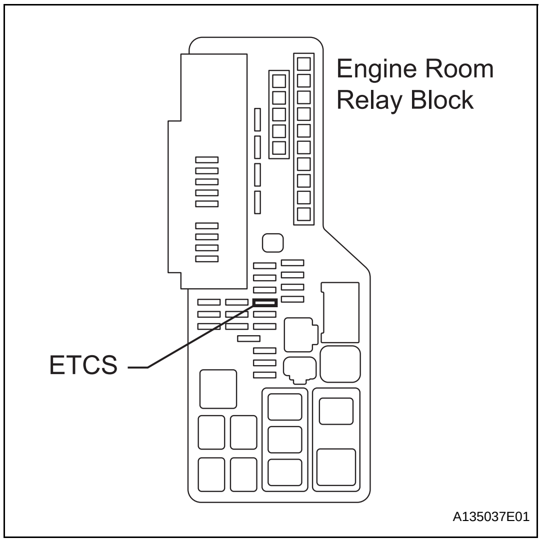


INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1 CHECK FUSE (ETCS FUSE)



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

(b) Measure the resistance of the ETCS fuse.

Standard resistance:

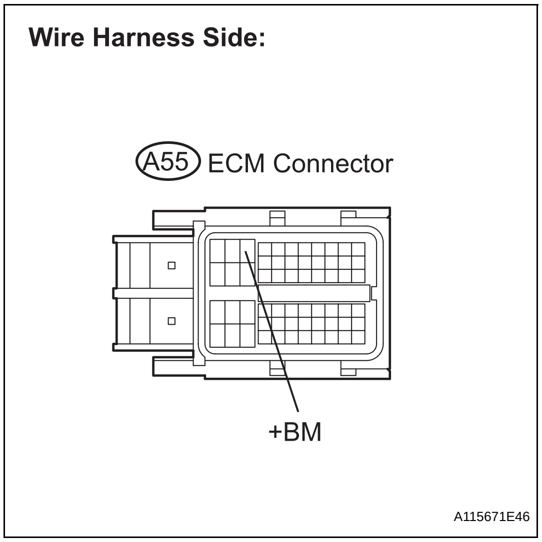
Below 1 Ω

(c) Reinstall the ETCS fuse.

NG → **REPLACE ETCS FUSE**

OK

2 INSPECT ECM (+BM VOLTAGE)



(a) Disconnect the A55 ECM connector.

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

Standard voltage

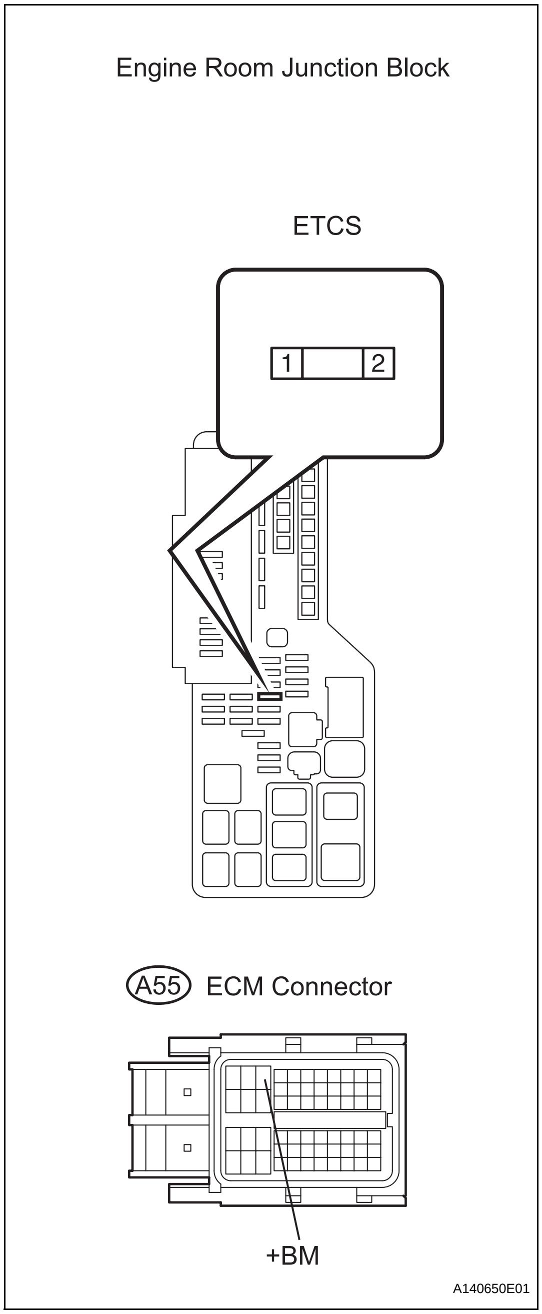
Tester Connection	Specified Condition
+BM (A55-3) - Body ground	9 to 14 V

(c) Reconnect the ECM connector.

OK → **CHECK FOR INTERMITTENT PROBLEMS**

NG

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



(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 A55 ECM connector.
(3) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
Engine room R/B ETCS fuse terminal 2 - +BM (A55-3)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
Engine room R/B ETCS fuse terminal 2 or +BM (A55-3) - 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 negative battery terminal.
(3) Disconnect the positive battery terminal.
(4) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

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

Standard resistance (Check for short)

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

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

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

OK

REPLACE ECM (See page ES-518)

DTC	P2119	Throttle Actuator Control Throttle Body Range / Performance

SYSTEM DESCRIPTION

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

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

MONITOR DESCRIPTION

The ECM determines the actual opening angle of the throttle valve from the TP sensor signal. The actual opening angle is compared to the target opening angle commanded by the ECM. If the difference between these two values is outside the standard range, the ECM interprets this as a malfunction in the ETCS. The ECM then illuminates the MIL and sets the DTC.
If the malfunction is not repaired successfully, the DTC is set when the accelerator pedal is quickly released (to close the throttle valve) after the engine speed reaches 5,000 rpm by fully depressing the accelerator pedal (fully open the throttle valve).

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

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

TYPICAL MALFUNCTION THRESHOLDS

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

FAIL-SAFE

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

WIRING DIAGRAM

Refer to DTC P2102 (See page ES-322).

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

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

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

Result

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

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

B → **GO TO DTC CHART (See page ES-63)**

A ↓

2 CHECK WHETHER DTC OUTPUT RECURS (DTC P2119)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the tester on.
(d) Clear the DTCs (See page ES-45).
(e) Allow the engine to idle for 15 seconds.

CAUTION:
Exercise extreme care and take precautions at procedure "A" and "B" below. Failure to do so may result in the vehicle unexpectedly rolling away.

(f) Securely apply the parking brake and move the gear selector lever to the D position (Procedure "A").

(g) While depressing the brake pedal securely, fully depress the accelerator pedal for 5 seconds (Procedure "B").

(h) On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.

(i) Read the DTCs.

HINT:

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

OK:

No DTC output.

NG → **REPLACE THROTTLE BODY ASSEMBLY (See page ES-503)**

OK

END

DTC	P2120	Throttle / Pedal Position Sensor / Switch "D" Circuit

DTC	P2122	Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input

DTC	P2123	Throttle / Pedal Position Sensor / Switch "D" Circuit High Input

DTC	P2125	Throttle / Pedal Position Sensor / Switch "E" Circuit

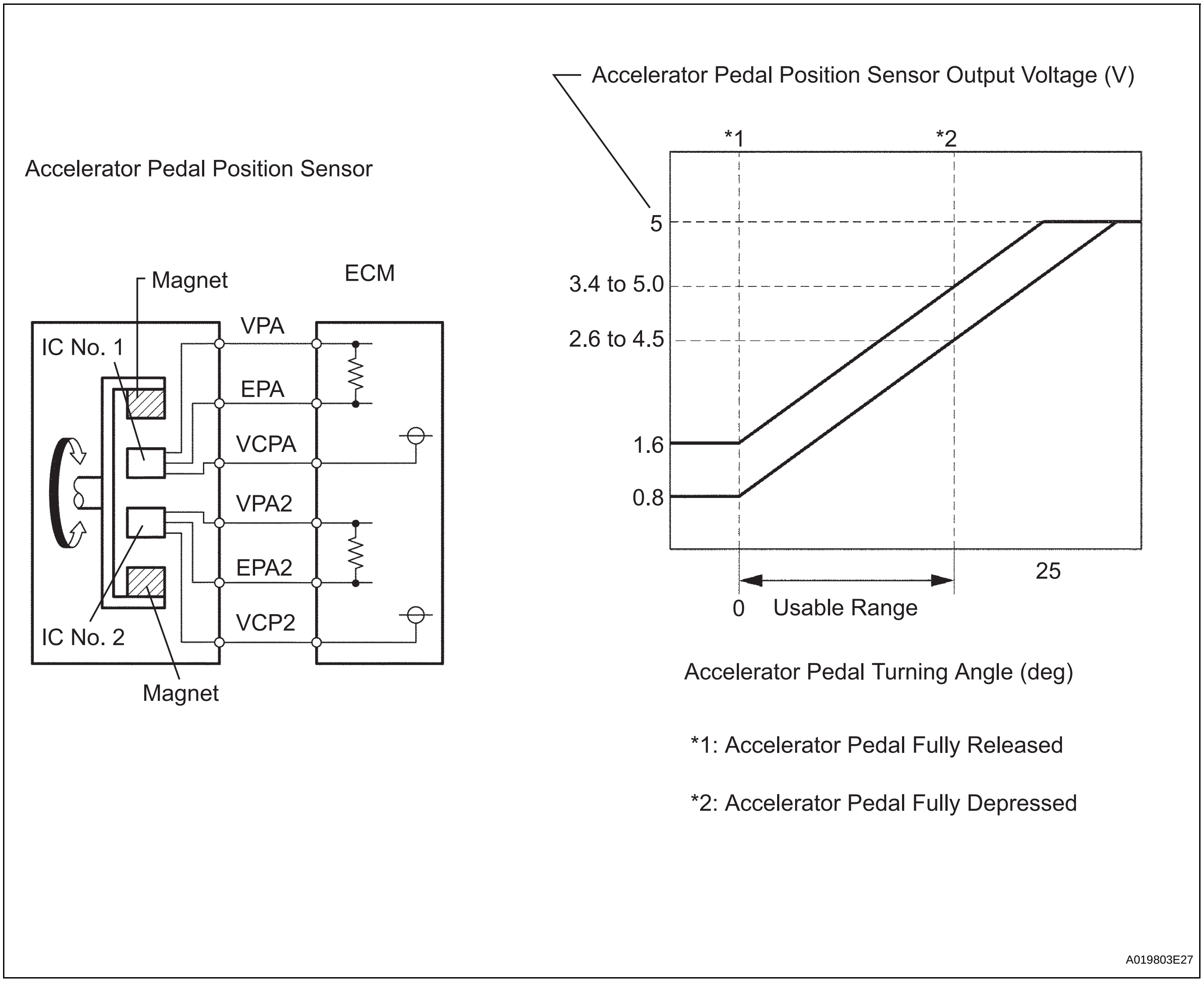
DTC	P2127	Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input

DTC	P2128	Throttle / Pedal Position Sensor / Switch "E" Circuit High Input

DTC	P2138	Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

DESCRIPTION

This ETCS (Electronic Throttle Control System) does not use a throttle cable.
The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type, and uses Hall-effect elements, in order to yield accurate signals, even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0 V and 5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.
The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



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

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

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

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

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

MONITOR DESCRIPTION

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

Example:

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

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

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

P2120:

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

P2122:

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

P2123:

VPA voltage	4.8 V or more

ES

P2125:

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

P2127:

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

P2128:

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

P2138:

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

COMPONENT OPERATING RANGE

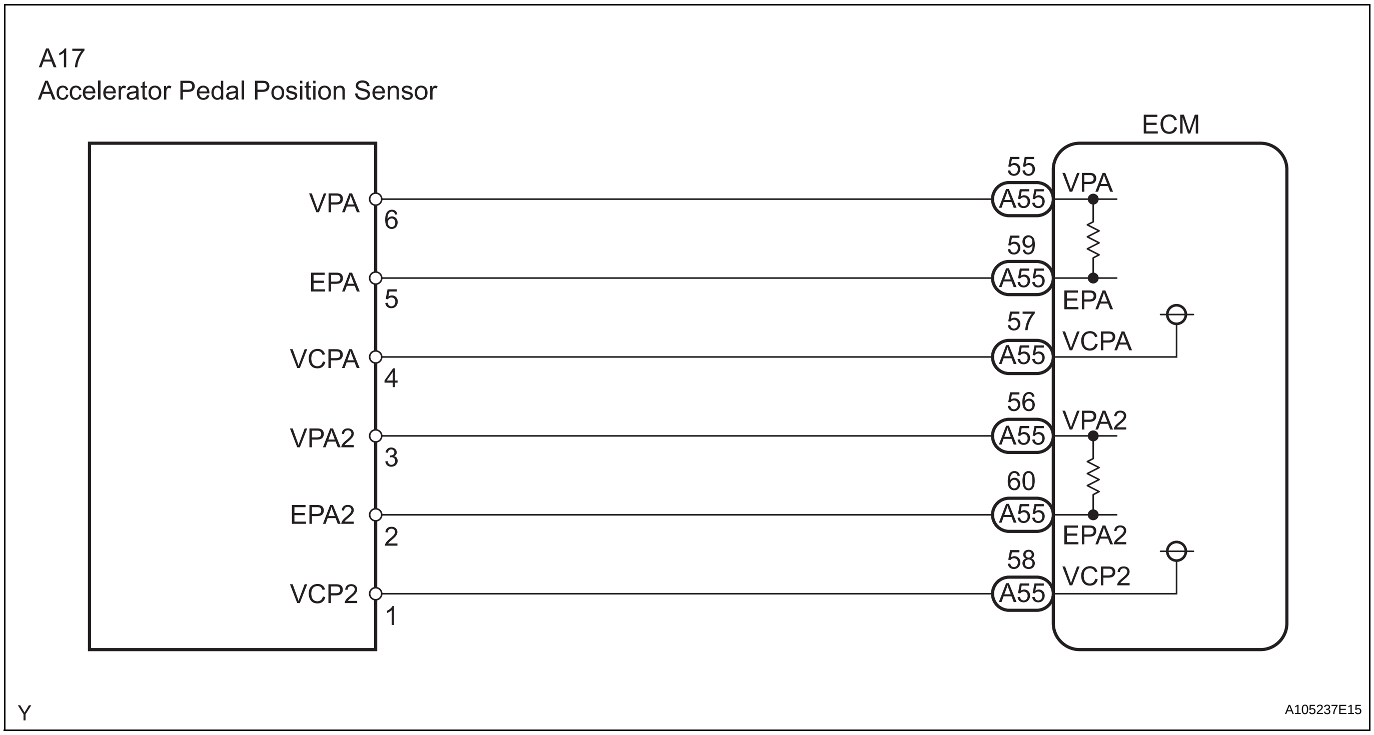
Parameter	Standard Value
VPA voltage	0.4 V to 4.8 V
VPA2 voltage	0.5 V to 4.8 V
Difference between VPA and VPA2 voltages	More than 0.02 V

FAIL-SAFE

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

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

WIRING DIAGRAM

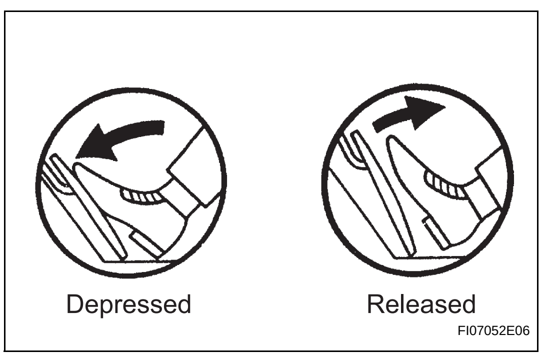


INSPECTION PROCEDURE

HINT:

- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).
- These DTCs relate to the Accelerator Pedal Position (APP) sensor.

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



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

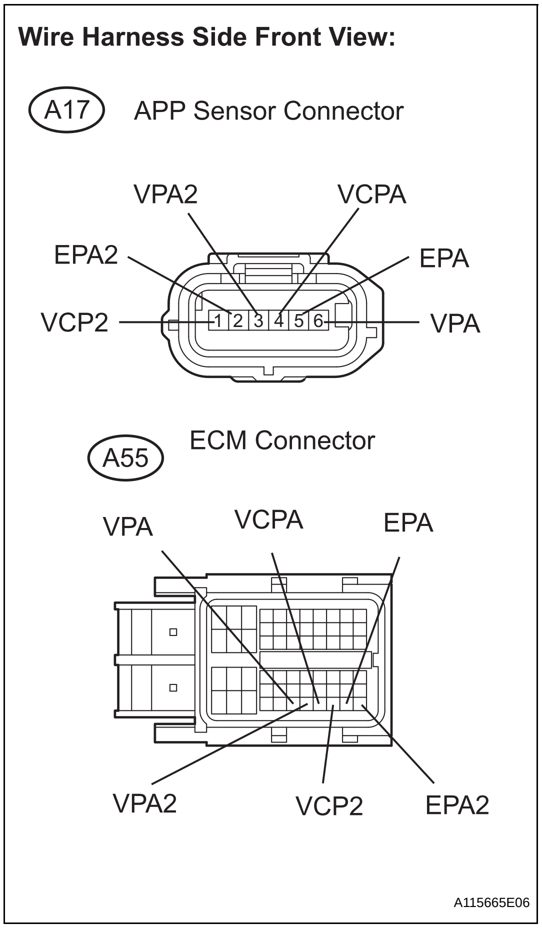
Standard voltage

Accelerator Pedal 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 A17 Accelerator Pedal Position (APP) sensor connector.
(b) Disconnect the A55 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
VPA (A17-6) - VPA (A55-55)	Below 1 Ω
EPA (A17-5) - EPA (A55-59)	Below 1 Ω
VCPA (A17-4) - VCPA (A55-57)	Below 1 Ω
VPA2 (A17-3) - VPA2 (A55-56)	Below 1 Ω
EPA2 (A17-2) - EPA2 (A55-60)	Below 1 Ω
VCP2 (A17-1) - VCP2 (A55-58)	Below 1 Ω

Standard resistance (Check for short)

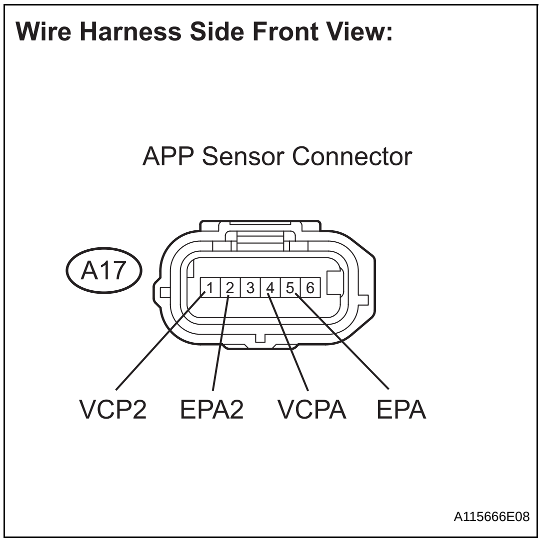
Tester Connection	Specified Condition
VPA (A17-6) or VPA (A55-55) - body ground	10 kΩ or higher
EPA (A17-5) or EPA (A55-59) - body ground	10 kΩ or higher
VCPA (A17-4) or VCPA (A55-57) - body ground	10 kΩ or higher
VPA2 (A17-3) or VPA2 (A55-56) - body ground	10 kΩ or higher
EPA2 (A17-2) or EPA2 (A55-60) - body ground	10 kΩ or higher
VCP2 (A17-1) or VCP2 (A55-58) - 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 ACCELERATOR POSITION SENSOR (VCPA AND VCP2 VOLTAGE)



(a) Disconnect the A17 APP sensor connector.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
VCPA (A17-4) - EPA (A17-5)	4.5 to 5.0 V
VCP2 (A17-1) - EPA2 (A17-2)	4.5 to 5.0 V

(d) Reconnect the APP sensor connector.

NG → **REPLACE ECM (See page ES-518)**

ES

OK

4	REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

NEXT

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

ES

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) and turn the tester on.
(c) Clear the DTCs (See page ES-45).
(d) Start the engine.
(e) Allow the engine to idle for 15 seconds.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES
(g) Read the DTCs.

Result

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

B → **SYSTEM IS OK**

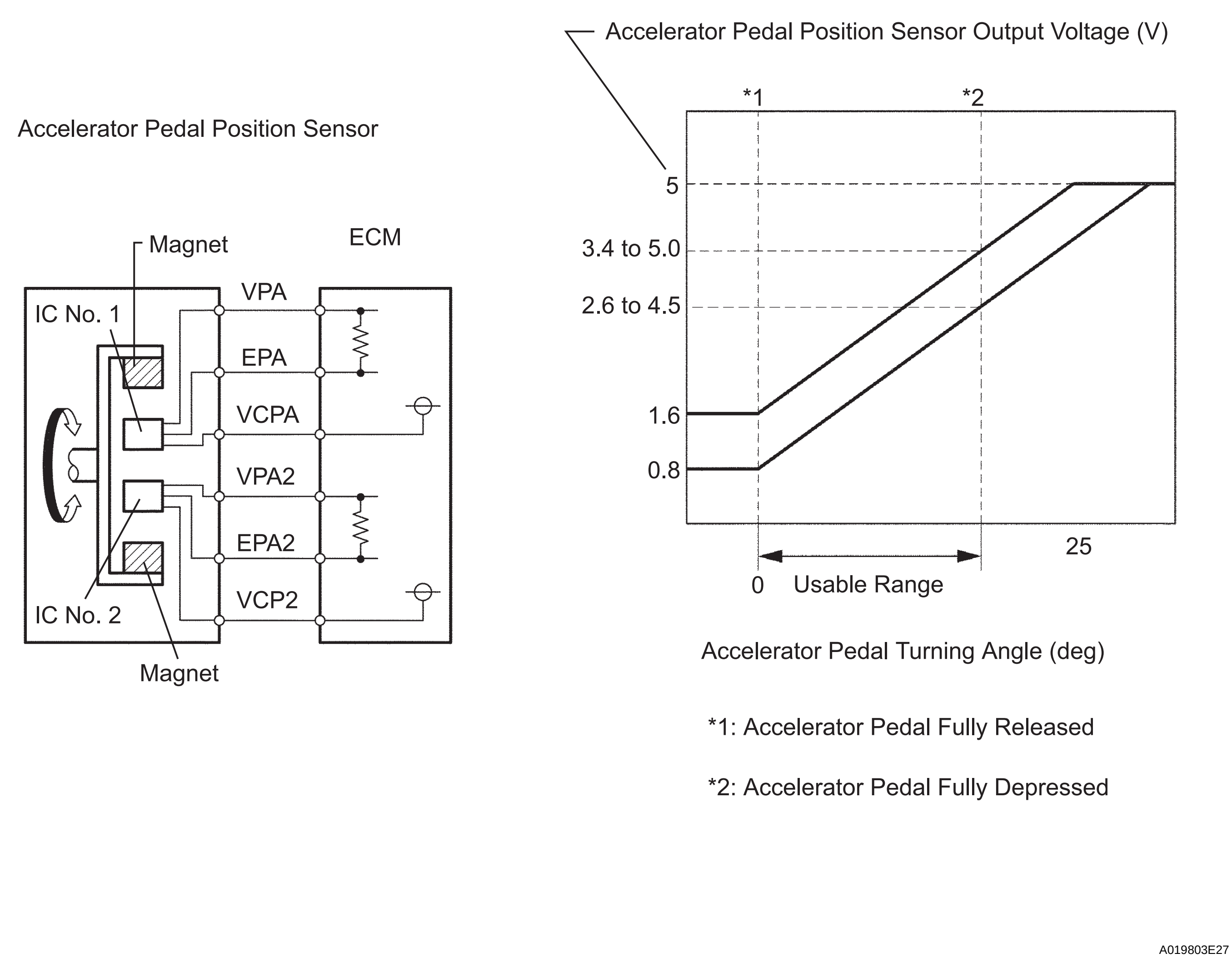
A

REPLACE ECM (See page ES-518)

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

DESCRIPTION

This ETCS (Electronic Throttle Control System) does not use a throttle cable.
The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type, and uses Hall-effect elements, in order to yield accurate signals, even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0 V and 5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.
The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



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

MONITOR DESCRIPTION

The accelerator pedal position sensor is mounted on the accelerator pedal bracket. The accelerator pedal position sensor has 2 sensor elements and 2 signal outputs: VPA and VPA2. VPA is used to detect the actual accelerator pedal angle (used for engine control) and VPA2 is used to detect malfunctions in VPA. When the difference between the output voltages of VPA and VPA2 deviates from the standard, the ECM determines that the accelerator pedal position sensor is 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 (Sub)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

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

FAIL-SAFE

The accelerator pedal position sensor has two (main and sub) sensor circuits. If a malfunction occurs in either of the sensor circuits, the ECM detects the abnormal signal voltage difference between the two sensor circuits and switches to limp mode. In limp mode, the functioning circuit is used to calculate the accelerator pedal opening angle to allow the vehicle to continue driving. If both circuits malfunction, the ECM regards the opening angle of the accelerator pedal as being fully closed. In this case, the throttle valve remains closed as if the engine is idling.
If a pass condition is detected and then the ignition switch is turned off, the fail-safe operation stops and the system returns to a normal condition.

WIRING DIAGRAM

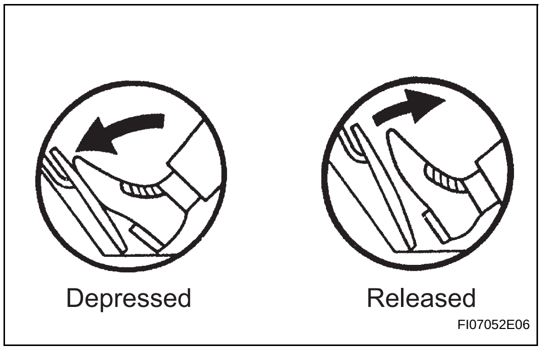
Refer to DTC P2120 (See page ES-338).

INSPECTION PROCEDURE

HINT:

- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).
- This DTC relates to the Accelerator Pedal Position (APP) sensor.

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



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

Standard voltage

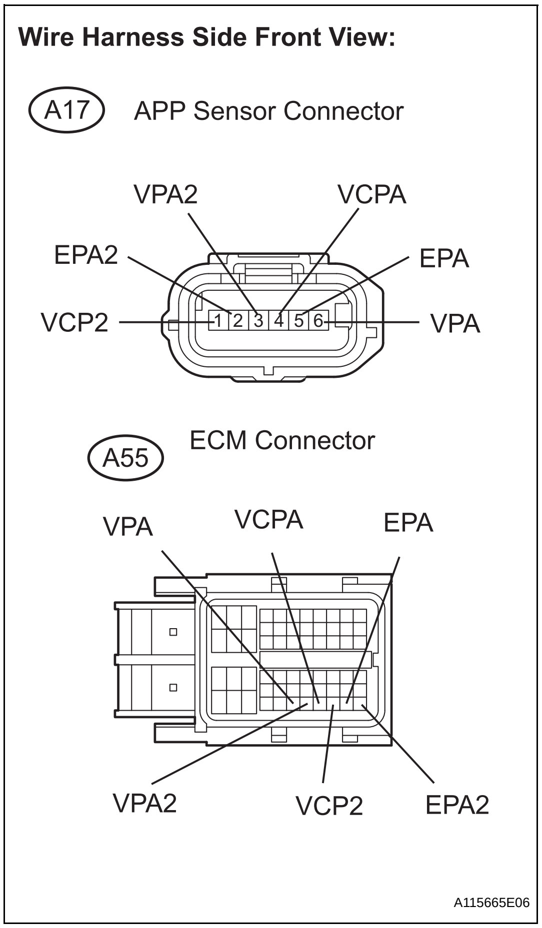
Accelerator Pedal Operations	ACCEL POS #1 (AP#1)	ACCEL POS #2 (AP#2)
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 4.7 V

OK → **Go to step 3**

ES

NG

2 CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)



(a) Disconnect the A17 Accelerator Pedal Position (APP) sensor connector.
(b) Disconnect the A55 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
VPA (A17-6) - VPA (A55-55)	Below 1 Ω
EPA (A17-5) - EPA (A55-59)	Below 1 Ω
VCPA (A17-4) - VCPA (A55-57)	Below 1 Ω
VPA2 (A17-3) - VPA2 (A55-56)	Below 1 Ω
EPA2 (A17-2) - EPA2 (A55-60)	Below 1 Ω
VCP2 (A17-1) - VCP2 (A55-58)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
VPA (A17-6) or VPA (A55-55) - body ground	10 kΩ or higher
EPA (A17-5) or EPA (A55-59) - body ground	10 kΩ or higher
VCPA (A17-4) or VCPA (A55-57) - body ground	10 kΩ or higher
VPA2 (A17-3) or VPA2 (A55-56) - body ground	10 kΩ or higher
EPA2 (A17-2) or EPA2 (A55-60) - body ground	10 kΩ or higher
VCP2 (A17-1) or VCP2 (A55-58) - 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 on (IG) and turn the tester on.
(c) Clear the DTCs (See page ES-45).
(d) Start the engine.
(e) Allow the engine to idle for 15 seconds.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Read the DTCs.

Result

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

B → END

A

REPLACE ECM (See page ES-518)

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)**

DESCRIPTION

HINT:

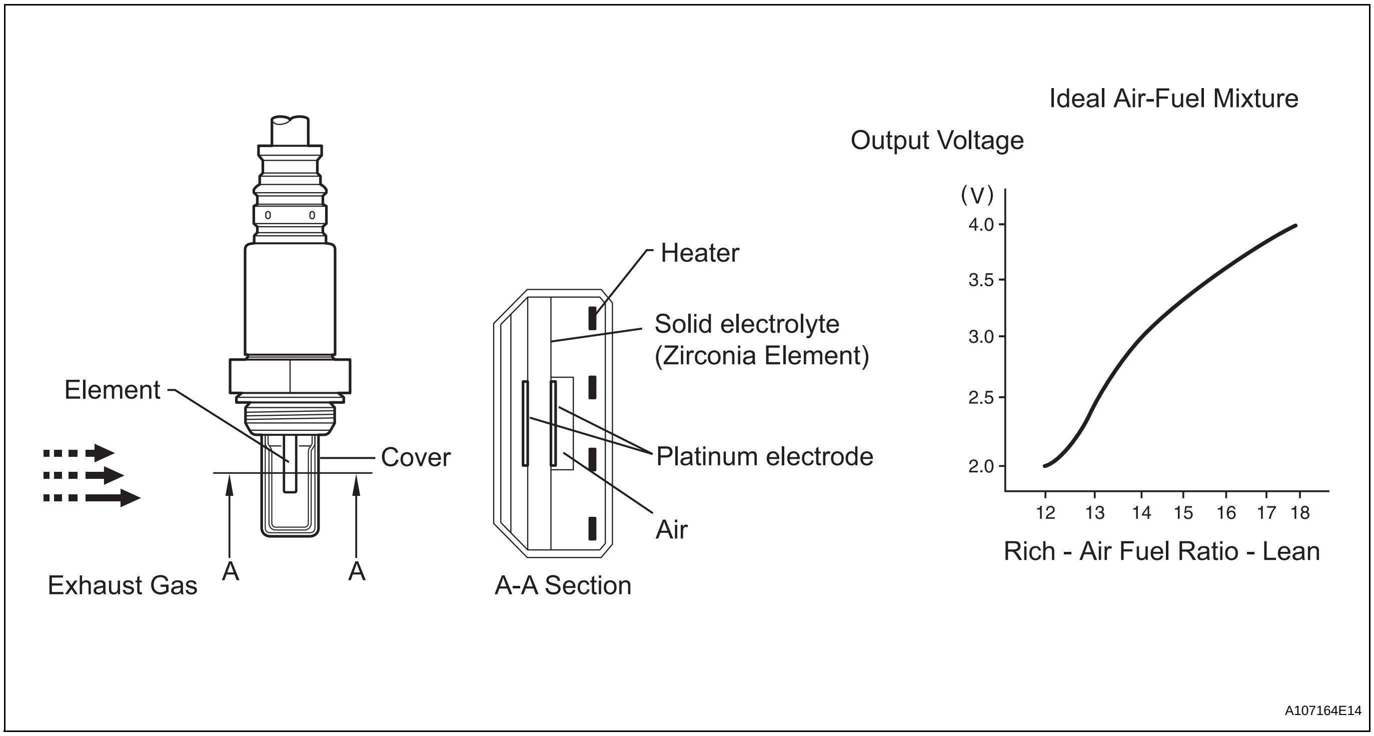
- Although the DTC titles include oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.

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

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

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

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



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

HINT:

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

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

Example:

(1) If the A/F sensor voltage output is less than 2.8 V (very rich condition) for 10 seconds, despite the HO2 sensor output voltage being less than 0.6 V, the ECM sets DTC P2196. Alternatively, if the A/F sensor output voltage is more than 3.8 V (very lean condition) for 15 seconds, despite the HO2 sensor output voltage being 0.15 V or more, DTC P2195 is set.

(2) Sensor current detection monitor

(3) A rich air-fuel mixture causes a low A/F sensor current, and a lean air-fuel mixture causes a high A/F sensor current. Therefore, the sensor output becomes low during acceleration, and it becomes high during deceleration with the throttle valve fully closed. The ECM monitors the A/F sensor current during fuel-cut and detects any abnormal current values.

(4) If the A/F sensor output is 3.6 mA or more for more than 3 seconds of cumulative time, the ECM interprets this as a malfunction in the A/F sensor and sets DTC P2195 (high-side stuck). If the A/F sensor output is 1.0 mA or less for more than 3 seconds of cumulative time, the ECM sets DTC P2196 (low-side stuck).

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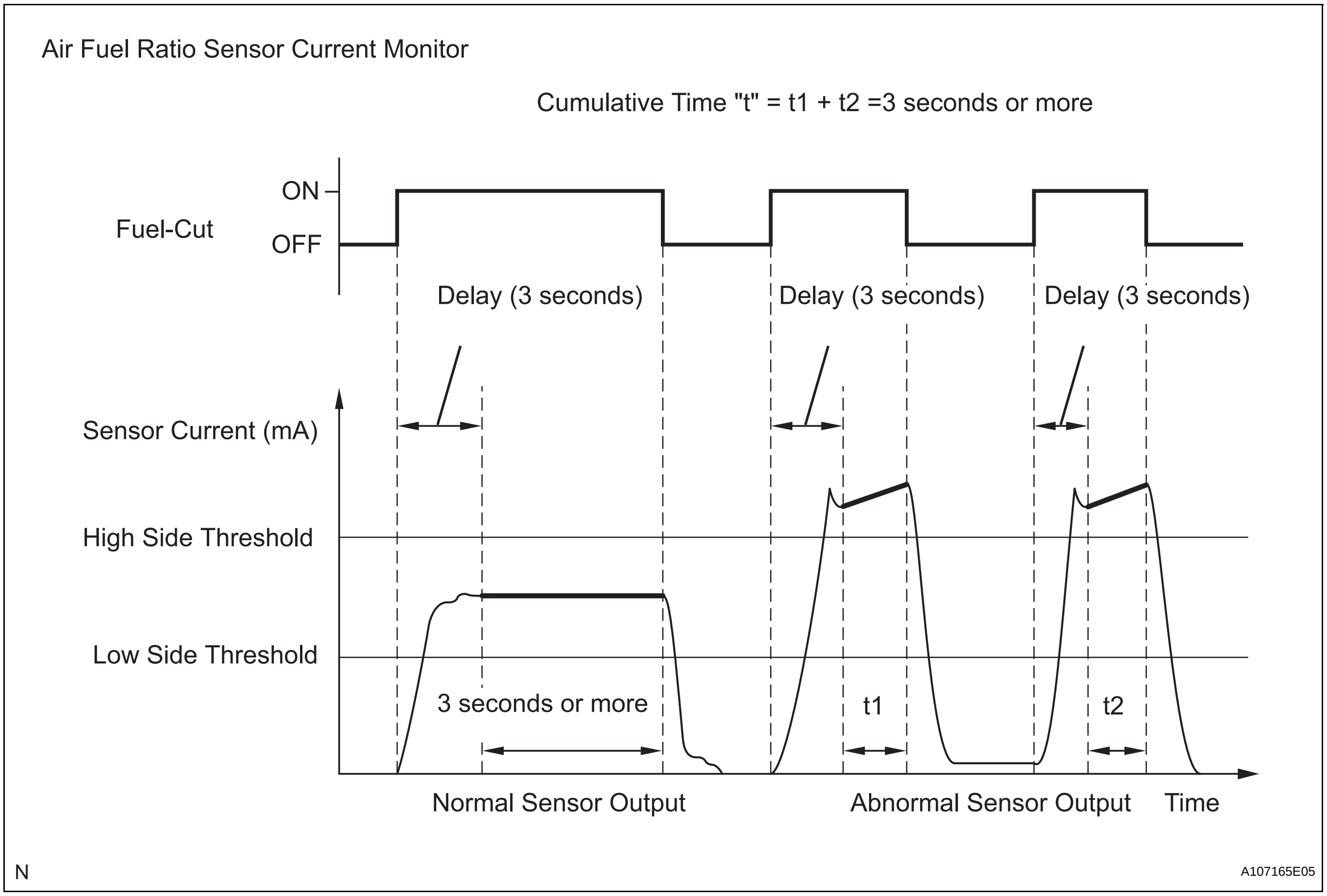


MONITOR STRATEGY

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

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

TYPICAL ENABLING CONDITIONS

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

The monitor will run whether these DTCs are not present	P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0136, P0156 (HO2 Sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0500 (VSS)
Time while all of following conditions are met:	2 seconds or more
Rear HO2 sensor voltage	0.15 V or more
Time after engine start	30 seconds or more
A/F sensor status	Activated
Fuel system status	Closed-loop
Engine	Running

Sensor voltage detection monitor (Rich side malfunction P2196, P2198):

The monitor will run whether these DTCs are not present	P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0136, P0156 (HO2 Sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0500 (VSS)
Time while all of following conditions are met:	2 seconds or more
Rear HO2 sensor voltage	Less than 0.6 V
Time after engine start	30 seconds or more
A/F sensor status	Activated
Fuel system status	Closed-loop
Engine	Running

Sensor current detection monitor (High and low side malfunction P2195, P2196, P2197 and P2198):

Monitor runs whenever following DTCs are not present	P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0037, P0038, P0057, P0058 (HO2 sensor heater - Sensor 2) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0136, P0156 (O2 Sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0500 (VSS)
Battery voltage	11 V or more
Atmospheric pressure	22.5 kPa (570 mmHg) or more
A/F sensor status	Activated
Continuous time of fuel cut	3 to 10 seconds
ECT	75°C (167°F) or more

TYPICAL MALFUNCTION THRESHOLDS

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

A/F sensor current	3.6 mA or more

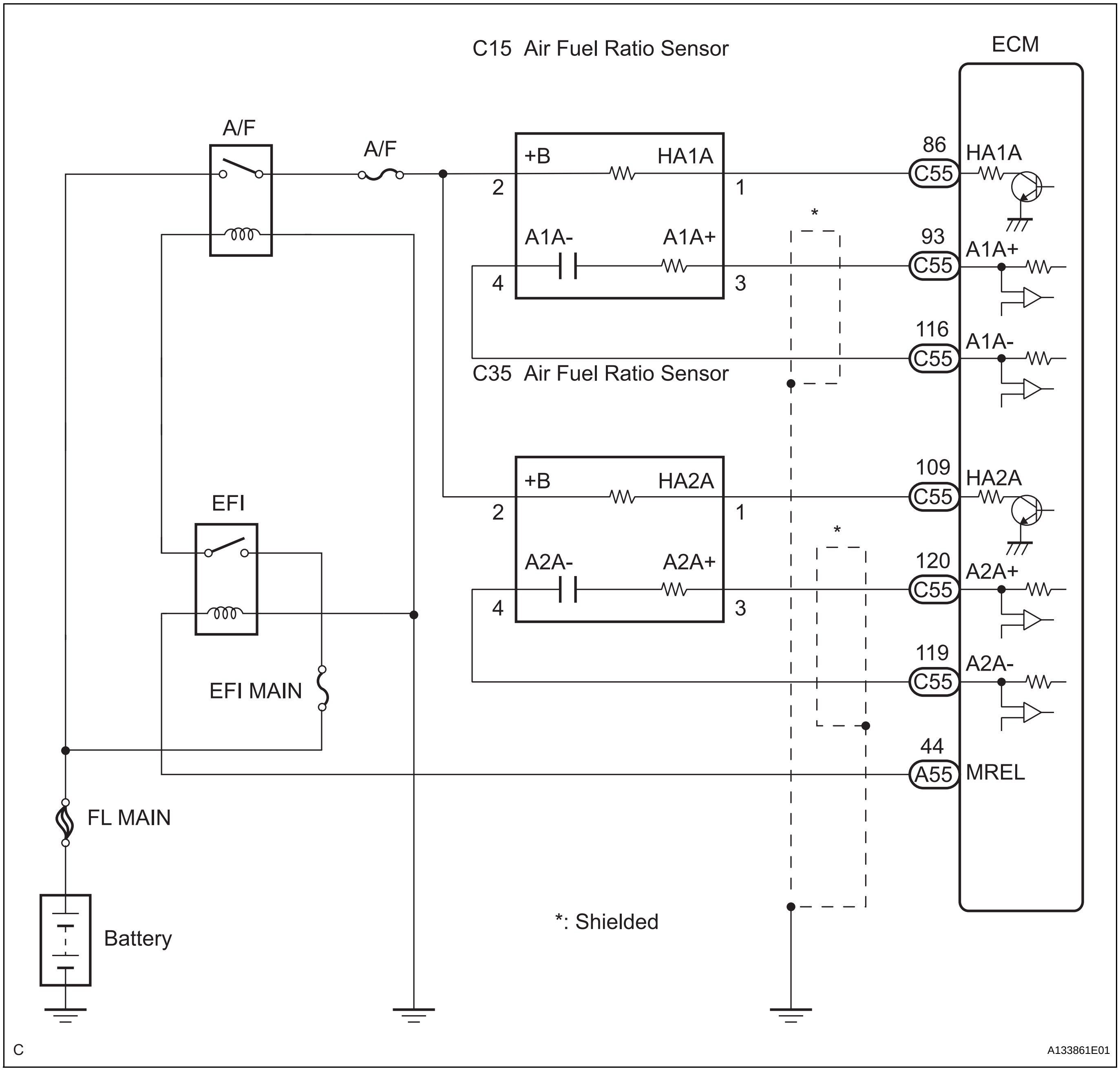
Sensor current detection monitor (Low side malfunction P2196, P2198):

A/F sensor current	Less than 1.4 mA

MONITOR RESULT

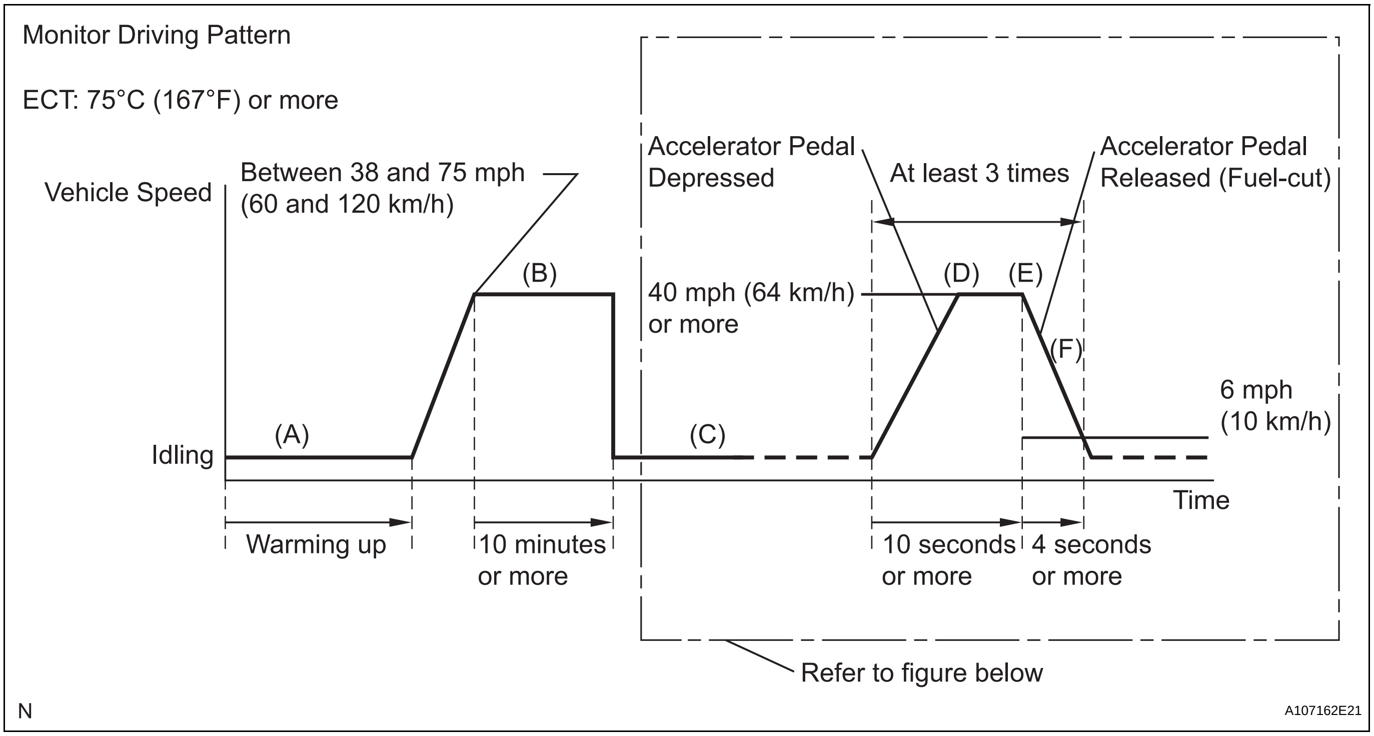
Refer to CHECKING MONITOR STATUS (See page ES-49).

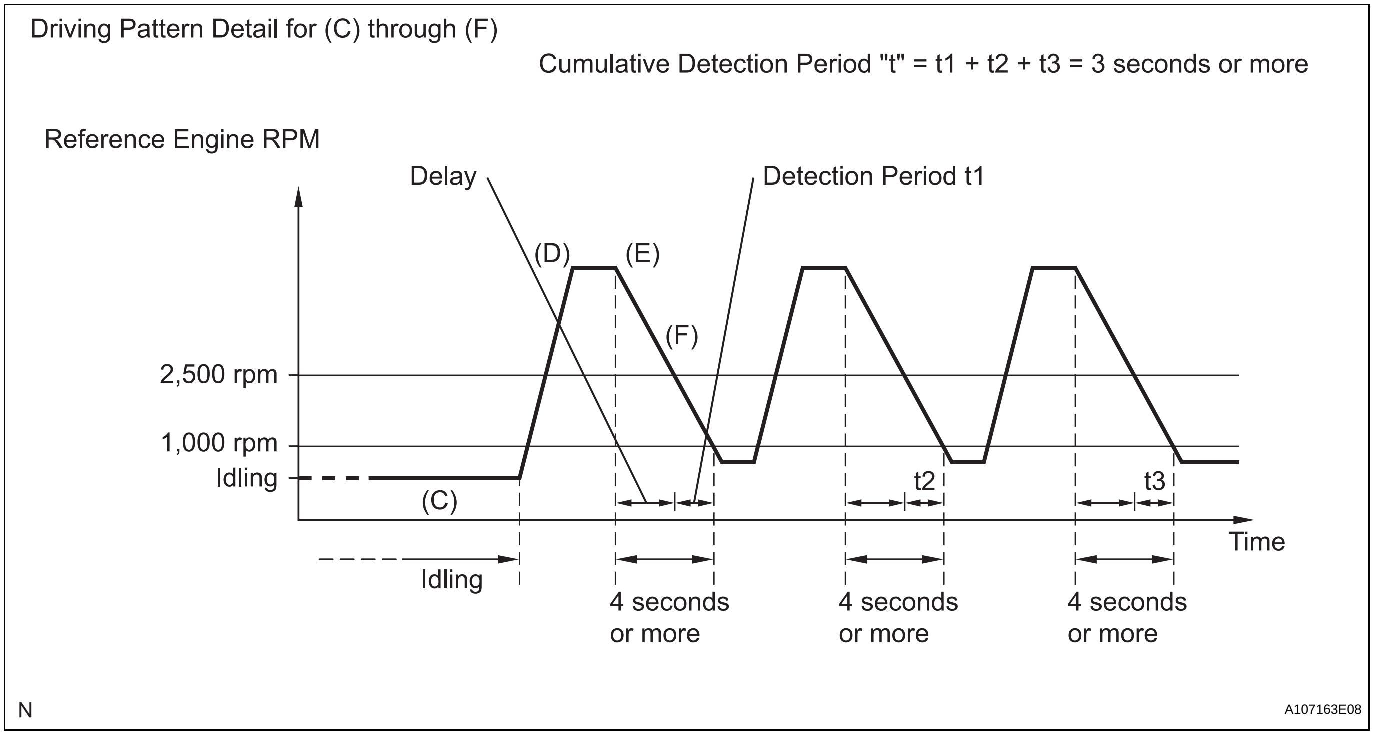
WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN

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





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

ES

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

INSPECTION PROCEDURE

HINT:
Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL function can help to determine whether the Air-fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.
The following instructions describe how to conduct the A/F CONTROL operation using the intelligent tester.

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

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

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

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

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

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

HINT:
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).
- A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.

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

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

Result

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

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

B **GO TO DTC CHART (See page ES-63)**

A

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

ES

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) and turn the tester on.
(c) Clear the DTCs.
(d) Allow the vehicle to drive in accordance with the driving pattern described in the CONFIRMATION DRIVING PATTERN.
(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / MONITOR STATUS.
(f) Check the status of O2S MON is COMPL.
If the status is still INCMPL, drive the vehicle according to the driving pattern again.
HINT:
- AVAIL indicates that the component has not been monitored yet.
- COMPL indicates that the component is functioning normally.
- INCMPL indicates that the component is malfunctioning.

(g) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / TEST RESULT / RANGE B1 S1, 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 (1.4 mA or more, and less than 3.6 mA)	A
Outside normal range (Less than 1.4 mA, or 3.6 mA or more)	B

B **Go to step 20**

A

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

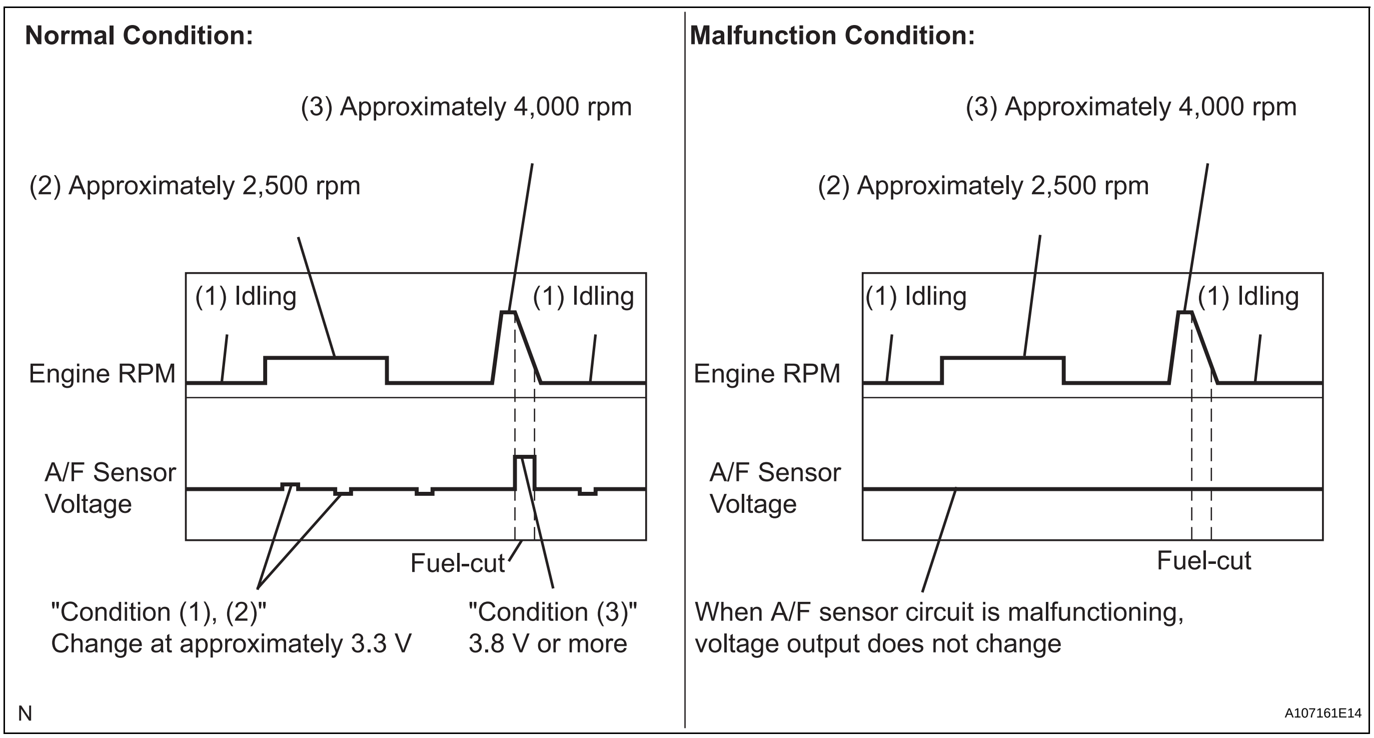
(a) Connect the intelligent tester to the DLC3.
(b) Start the engine.
(c) Turn the tester on.

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

Standard voltage

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

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



- If the output voltage of the A/F sensor remains at approximately 3.3 V (see 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 terminal to be reconnected, the vehicle must be driven at over 10 mph (16 km/h) to allow the ECM to learn the closed throttle valve position.
- When the vehicle is driven:
  The output voltage of the A/F sensor may be below 2.8 V during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- The A/F sensor is a current output element; therefore, the current is converted into a voltage inside the ECM. Measuring the voltage at the connectors of the A/F sensor or ECM will show a constant voltage result.

ES

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

Result

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

B → **Go to step 9**

A

6	REPLACE AIR FUEL RATIO SENSOR

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

NEXT

7	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

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

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

Result

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

B → **REPLACE ECM (See page ES-518)**

A

9	CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

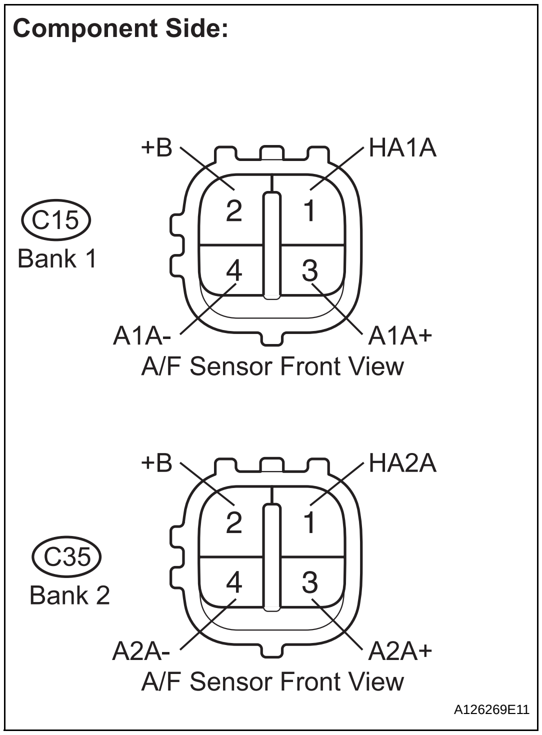
(a) Has the vehicle run out of fuel in the past?

NO → **CHECK FOR INTERMITTENT PROBLEMS**

YES

DTC CAUSED BY RUNNING OUT OF FUEL

10 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the C15 or C35 A/F sensor connector.
(b) Measure the resistance according to the value(s) in the table below.

Standard resistance (Bank 1 sensor 1)

Tester Connection	Condition	Specified Condition
HA1A (1) - +B (2)	20°C (68°F)	1.8 Ω to 3.4 Ω
HA1A (1) - A1A- (4)	Always	10 kΩ or higher

Standard resistance (Bank 2 sensor 1)

Tester Connection	Condition	Specified Condition
HA2A (1) - +B (2)	20°C (68°F)	1.8 Ω to 3.4 Ω
HA2A (1) - A2A- (4)	Always	10 kΩ or higher

(c) Reconnect the A/F sensor connector.

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

OK

11 INSPECT FUSE (A/F FUSE)

(a) Remove the A/F fuse from the integration relay.
(b) Measure the A/F fuse resistance.

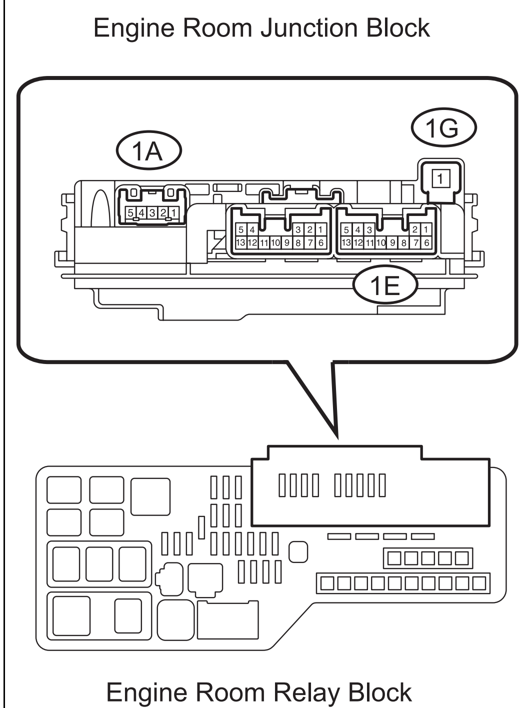
Standard resistance:
Below 1 Ω

(c) Reinstall the A/F fuse.

NG → **REPLACE A/F FUSE**

OK

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



(a) Remove the engine room junction block from the engine room R/B.

(b) Inspect the A/F relay.

(1) Measure the A/F relay resistance.

Standard resistance

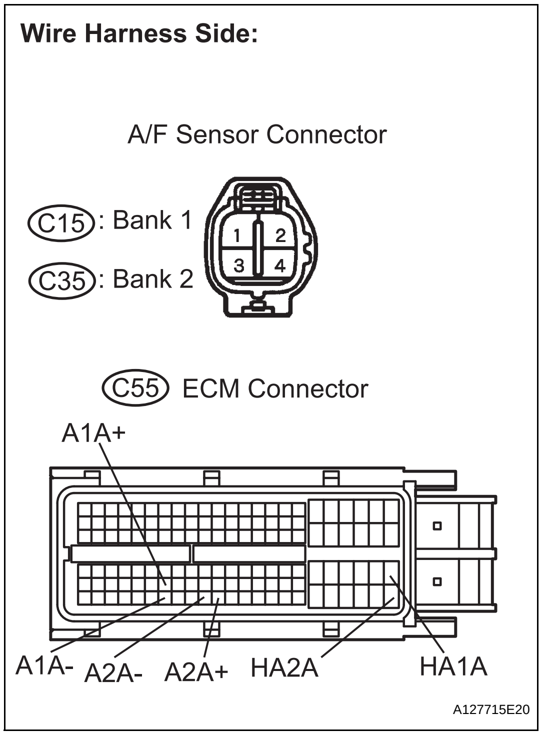
Tester Connection	Specified Condition
1G-1 - 1A-4	10 kΩ or higher
1G-1 - 1A-4	Below 1 Ω (Apply battery voltage between terminals 1E-9 and 1E-10)

(c) Reinstall the engine room junction block.

NG → **REPLACE ENGINE ROOM JUNCTION BLOCK**

OK

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



(a) Disconnect the C15 and C35 A/F sensor connectors.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
+B (C15-2) - Body ground	9 to 14 V
+B (C35-2) - Body ground	9 to 14 V

(d) Turn the ignition switch off.
(e) Disconnect the C55 ECM connector.
(f) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

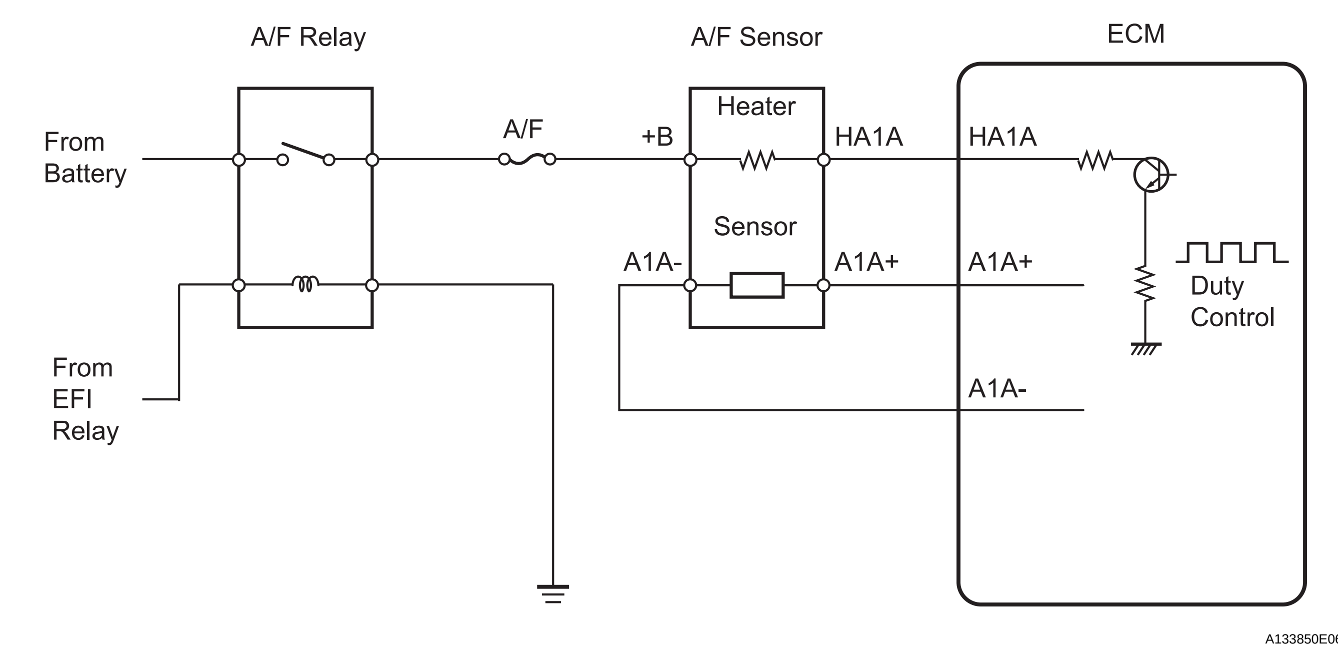
Tester Connection	Specified Condition
HA1A (C15-1) - HA1A (C55-86)	Below 1 Ω
A1A+ (C15-3) - A1A+ (C55-93)	Below 1 Ω
A1A- (C15-4) - A1A- (C55-116)	Below 1 Ω
HA2A (C35-1) - HA2A (C55-109)	Below 1 Ω
A2A+ (C35-3) - A2A+ (C55-120)	Below 1 Ω
A2A- (C35-4) - A2A- (C55-119)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
HA1A (C15-1) or HA1A (C55-86) - Body ground	10 kΩ or higher
A1A+ (C15-3) or A1A+ (C55-93) - Body ground	10 kΩ or higher
A1A- (C15-4) or A1A- (C55-116) - Body ground	10 kΩ or higher
HA2A (C35-1) or HA2A (C55-109) - Body ground	10 kΩ or higher
A2A+ (C35-3) or A2A+ (C55-120) - Body ground	10 kΩ or higher
A2A- (C35-4) or A2A- (C55-119) - Body ground	10 kΩ or higher

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

Reference (System Diagram of Bank 1 Sensor 1):



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

OK

14 CHECK AIR INDUCTION SYSTEM

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

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

OK

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

(a) Check the fuel pressure.

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

16 REPLACE AIR FUEL RATIO SENSOR

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

NEXT

17 PERFORM CONFIRMATION DRIVING PATTERN

NEXT

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

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

Result

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

B → **REPAIR OR REPLACE ECM**

A

19 CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

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

NO → **CHECK FOR INTERMITTENT PROBLEMS**

YES

DTC CAUSED BY RUNNING OUT OF FUEL

20 REPLACE AIR FUEL RATIO SENSOR

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

NEXT

21 PERFORM CONFIRMATION DRIVING PATTERN

NEXT

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

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

ES

Result

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

B

REPLACE ECM (See page ES-518)

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)**

DESCRIPTION

HINT:

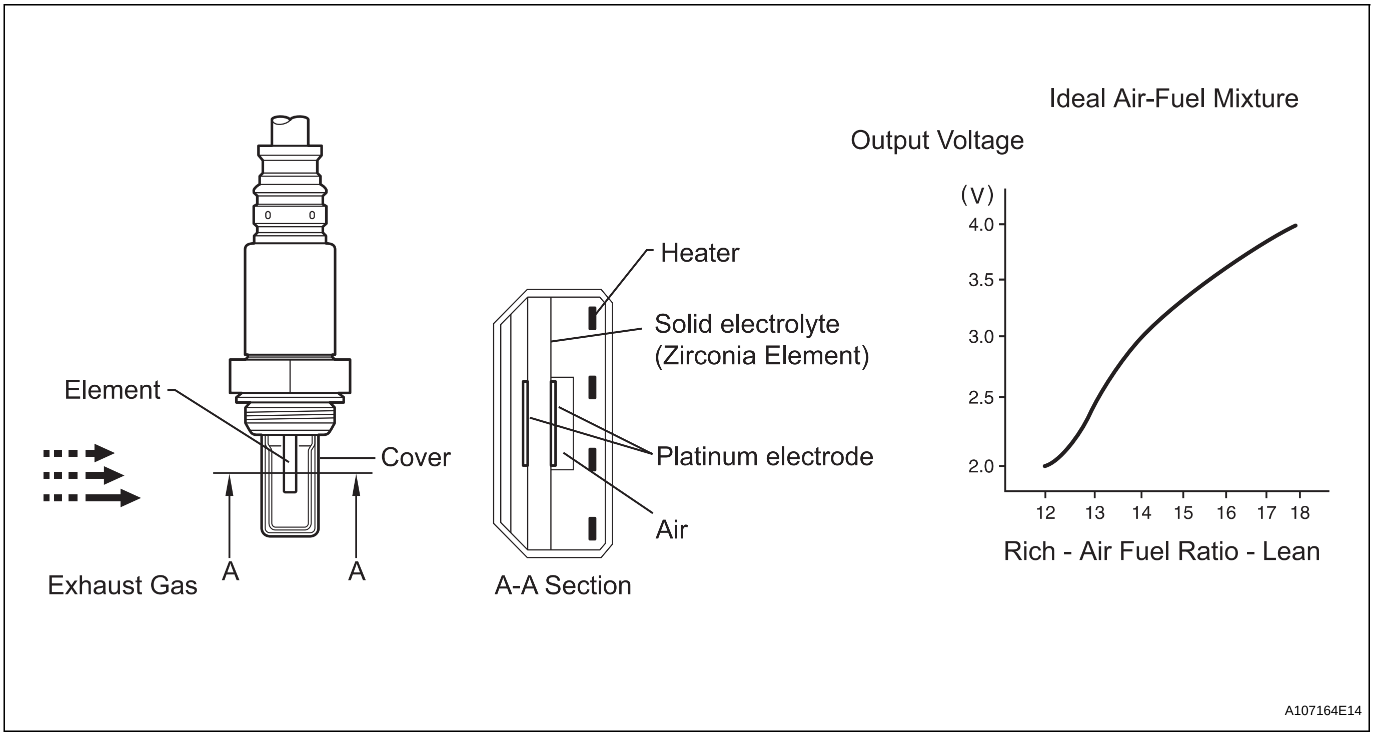
- Although the DTC titles include oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.

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

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

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

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



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

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

MONITOR DESCRIPTION

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

MONITOR STRATEGY

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

ES

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0500 (VSS)

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

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

Others:

Battery voltage	10.5 V or more
Ignition switch	ON

TYPICAL MALFUNCTION THRESHOLDS

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

A/F sensor admittance	Below 0.022 1/Ω

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

AF+ terminal voltage	0.5 V or less

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

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

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

AF+ terminal voltage	More than 4.5 V

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

AF- terminal voltage	0.5 V or less

P2253 and P2256 (Short circuit between AF- and +B):

AF- terminal voltage	More than 4.5 V

WIRING DIAGRAM

Refer to DTC P2195 (See page ES-350).

INSPECTION PROCEDURE

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

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

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

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

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

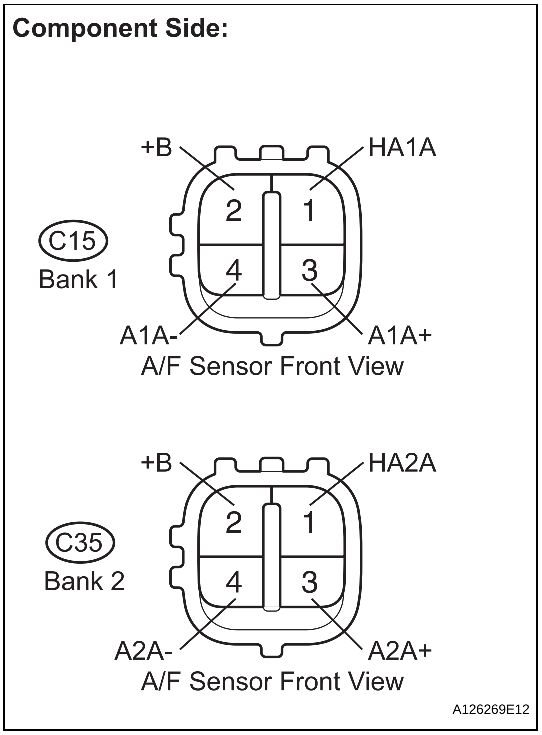
Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Areas
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V	OK	Output Voltage More than 0.55 V Less than 0.4 V	OK	
2	Injection Volume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

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

HINT:
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

ES

1	INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the C15 or C35 A/F sensor connector.

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

Standard resistance (Bank 1 sensor 1)

Tester Connection	Condition	Specified Condition
HA1A (1) - +B (2)	20°C (68°F)	1.8 to 3.4 Ω
HA1A (1) - A1A- (4)	-	10 kΩ or higher

Standard resistance (Bank 2 sensor 1)

Tester Connection	Condition	Specified Condition
HA2A (1) - +B (2)	20°C (68°F)	1.8 to 3.4 Ω
HA2A (1) - A2A- (4)	-	10 kΩ or higher

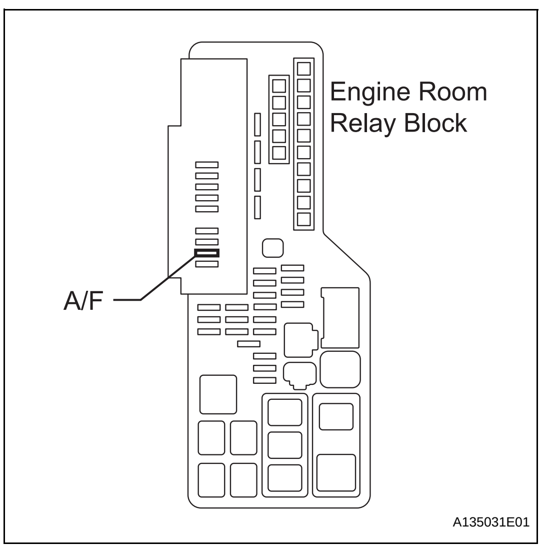
(c) Reconnect the A/F sensor connector.

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

ES

OK

2	INSPECT A/F FUSE



(a) Remove the A/F fuse from the engine room junction block.

(b) Measure the A/F fuse resistance.

Standard resistance:

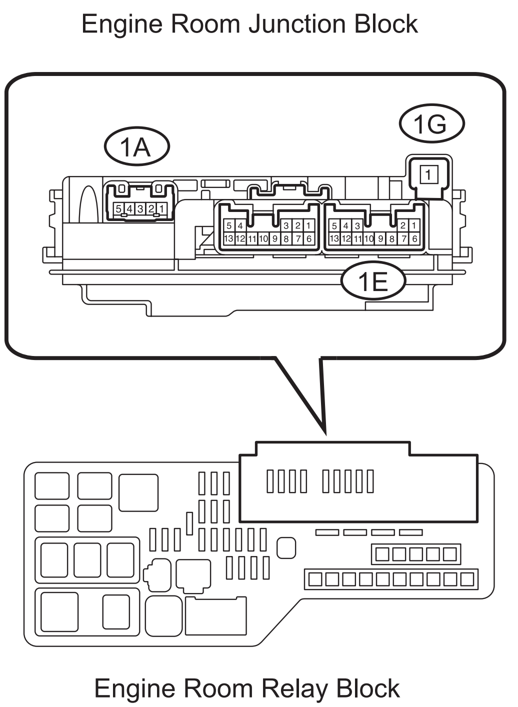
Below 1 Ω

(c) Reinstall the A/F fuse.

NG → **REPLACE A/F FUSE**

OK

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



(a) Remove the engine room junction block from the engine room R/B.

(b) Inspect the A/F relay.

(1) Measure the A/F relay resistance.

Standard resistance

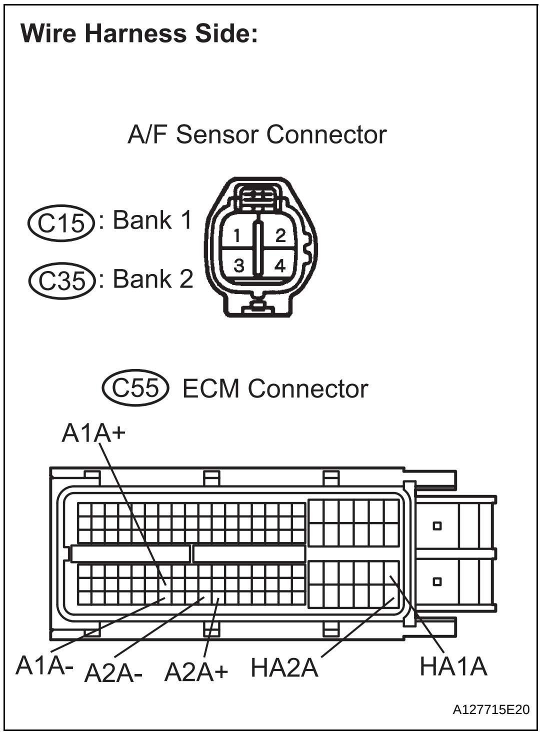
Tester Connection	Specified Condition
1G-1 - 1A-4	10 kΩ or higher
1G-1 - 1A-4	Below 1 Ω (Apply battery voltage between terminals 1E-6 and 1E-10)

(c) Reinstall the engine room junction block.

NG → **REPLACE ENGINE ROOM JUNCTION BLOCK**

OK

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



(a) Disconnect the C15 and C35 A/F sensor connectors.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
+B (C15-2) - Body ground	9 to 14 V
+B (C35-2) - Body ground	9 to 14 V

(d) Turn the ignition switch off.
(e) Disconnect the C55 ECM connector.
(f) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

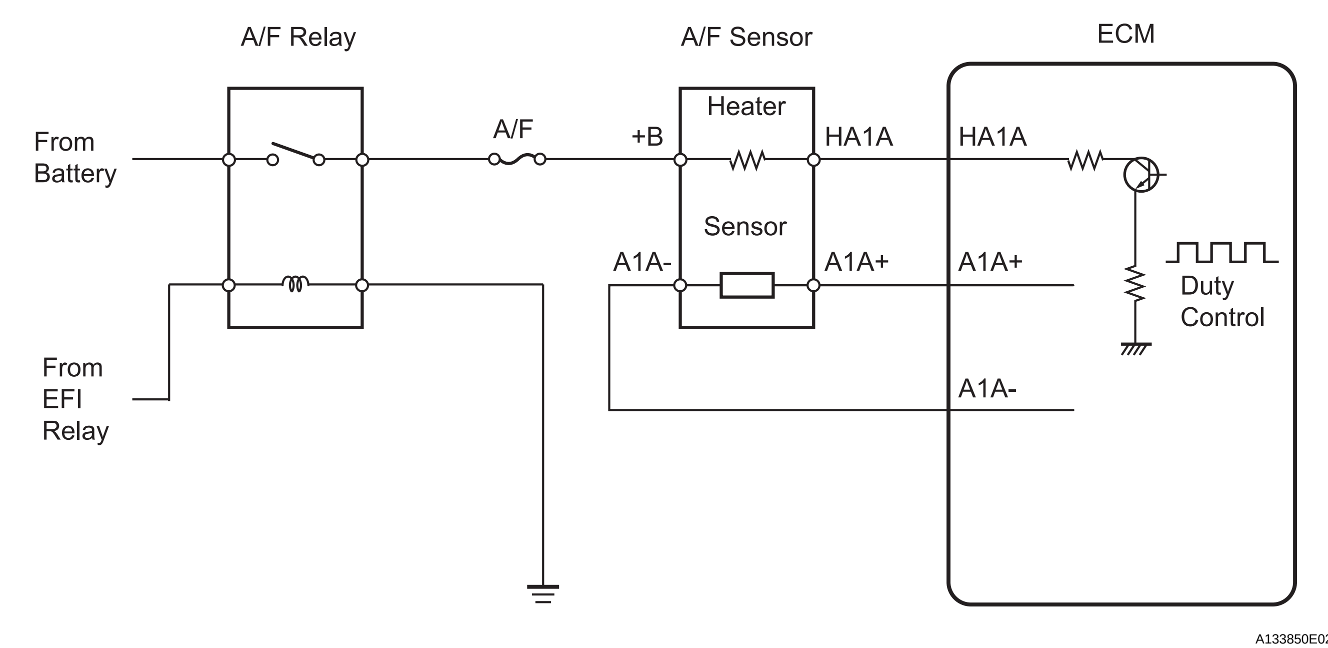
Tester Connection	Specified Condition
HA1A (C15-1) - HA1A (C55-86)	Below 1 Ω
A1A+ (C15-3) - A1A+ (C55-93)	Below 1 Ω
A1A- (C15-4) - A1A- (C55-116)	Below 1 Ω
HA2A (C35-1) - HA2A (C55-109)	Below 1 Ω
A2A+ (C35-3) - A2A+ (C55-120)	Below 1 Ω
A2A- (C35-4) - A2A- (C55-119)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
HA1A (C15-1) or HA1A (C55-86) - Body ground	10 kΩ or higher
A1A+ (C15-3) or A1A+ (C55-93) - Body ground	10 kΩ or higher
A1A- (C15-4) or A1A- (C55-116) - Body ground	10 kΩ or higher
HA2A (C35-1) or HA2A (C55-109) - Body ground	10 kΩ or higher
A2A+ (C35-3) or A2A+ (C55-120) - Body ground	10 kΩ or higher
A2A- (C35-4) or A2A- (C55-119) - Body ground	10 kΩ or higher

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

Reference (System Diagram of Bank 1 Sensor 1):



NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (See page ES-518)

DTC	P2420	Evaporative Emission System Switching Valve Control Circuit High

DTC SUMMARY

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

DESCRIPTION

The circuit description can be found in the EVAP (Evaporative Emission) System (See page ES-400).

INSPECTION PROCEDURE

Refer to the EVAP System (See page ES-400).

MONITOR DESCRIPTION

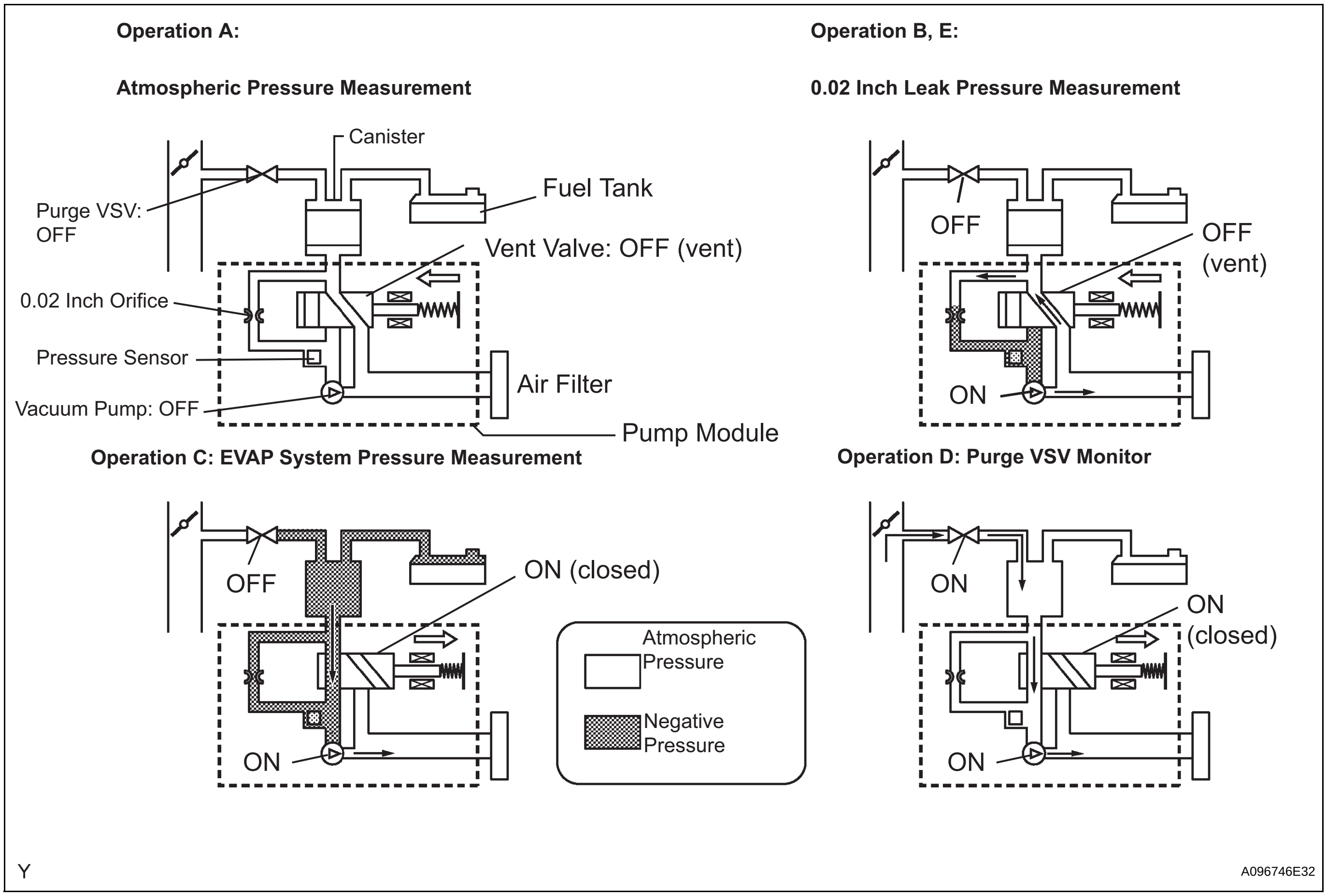
5 hours*1 after the ignition switch is turned off, the electric vacuum pump creates negative pressure (vacuum) in the EVAP (Evaporative Emission) system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

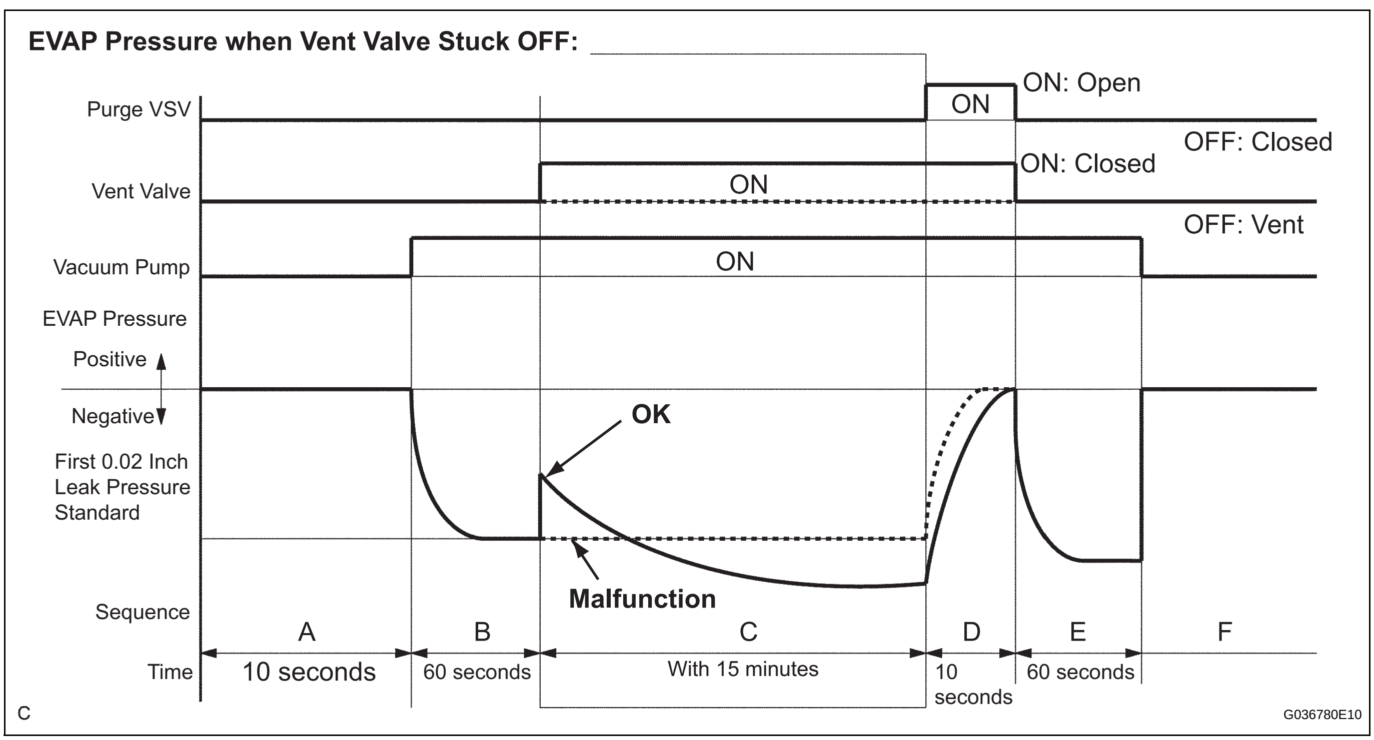
*1: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.

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

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



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



MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None
Key-off monitor is run when all of the following conditions are met	-
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Vehicle speed	2.5 mph (4 km/h) or less
Ignition switch	OFF
Time after key-off	5 or 7 or 9.5 hours
EVAP pressure sensor malfunction (P0450, P0452, P0453)	Not detected
EVAP canister purge valve	Not operated by scan tool
EVAP canister vent valve	Not operated by scan tool
EVAP leak detection pump	Not operated by scan tool
Both of the following conditions 1 and 2 are set before key-off	-
1. Duration that vehicle has been driven	5 minutes or more
2. EVAP purge operation	Performed
ECT	4.4 to 35°C (40 to 95°F)
IAT	4.4 to 35°C (40 to 95°F)

Key-off monitor sequence 1 to 8
1. Atmospheric pressure measurement

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

2. First reference pressure measurement

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

3. EVAP canister vent valve close stuck check

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

4. Vacuum introduction

Next sequence is run if the following condition is met	-
EVAP pressure	Saturated within 15 minutes

5. EVAP canister purge valve close stuck check

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

6. Second reference pressure measurement

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

7. Leak check

Next sequence is run if the following condition is met	-
EVAP pressure when vacuum introduction is complete	Lower than second reference pressure

8. Atmospheric pressure measurement

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

TYPICAL MALFUNCTION THRESHOLDS

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

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-25).

DTC	P2610	ECM / PCM Internal Engine Off Timer Performance

DTC SUMMARY

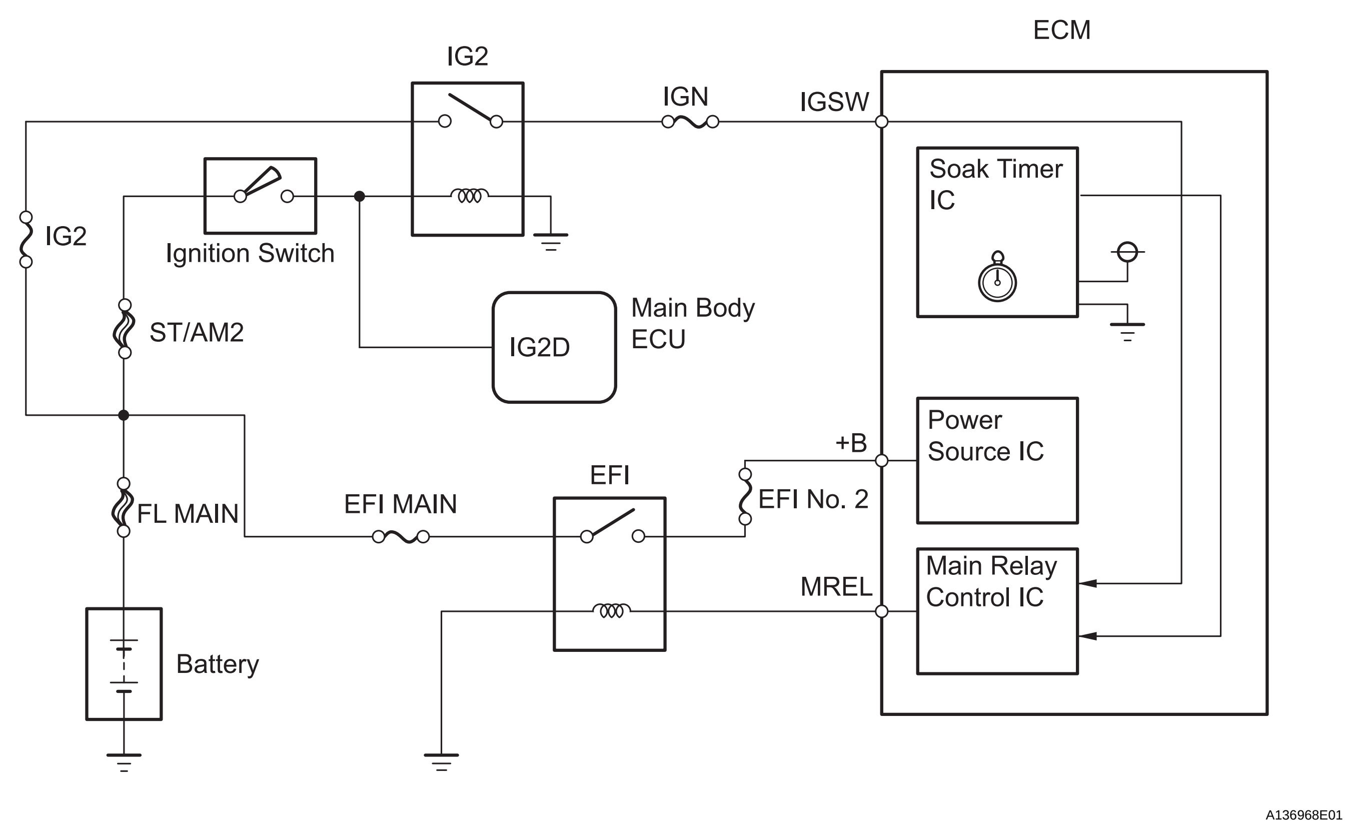
DTC No.	Monitoring Item	DTC Detection Condition	Trouble Area	Detection Timing	Detection Logic
P2610	Soak timer (built into ECM)	ECM internal malfunction	ECM	Engine running	2 trip

DESCRIPTION

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

ES

Soak Timer Circuit (fig. 3):



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

Case 1:

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

Case 2:

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

Case 3:

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

TYPICAL MALFUNCTION THRESHOLDS

Case 1:

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

Case 2:

ECM had the started record by internal engine	Yes

Case 3:

ECM had the started record by internal engine	No

INSPECTION PROCEDURE

HINT:

- DTC P2610 is set if an internal ECM problem is detected. In this case, diagnostic procedures are not required. ECM replacement is required.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	REPLACE ECM

(a) Replace the ECM (See page ES-518).

NEXT

2	CHECK WHETHER DTC OUTPUT RECURS

(a) Connect the intelligent tester to the DLC3.
(b) Turn the engine switch on.
(c) Clear the DTCs (See page ES-45).
(d) Start the engine and wait for 10 minutes or more.
(e) On the tester, enter the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC / INFO / PENDING CODEs.
(f) If no pending DTC is displayed, the repair has been successfully completed.

NEXT

END

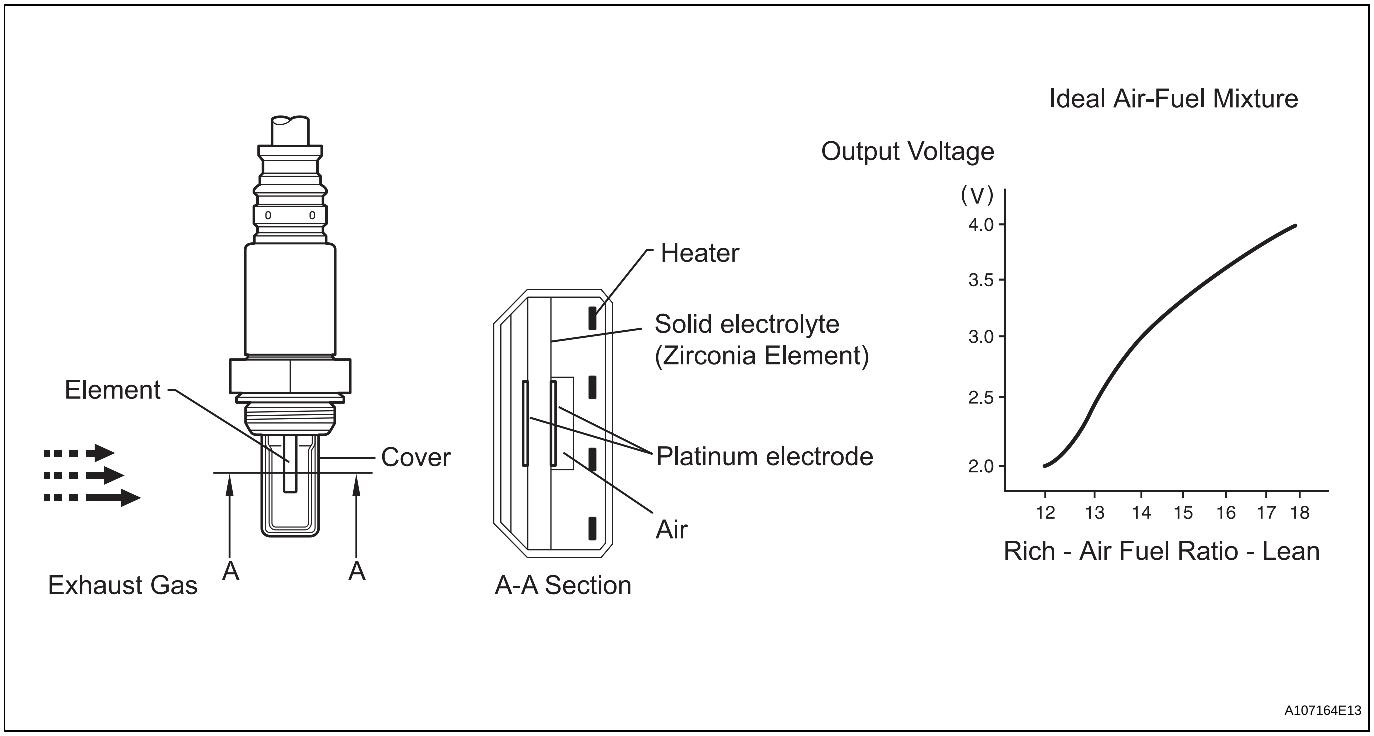
DTC	P2A00	A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)

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

DESCRIPTION

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

The A/F sensor generates voltage* that corresponds to the actual air-fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air-fuel ratio. The ECM determines the deviation from the stoichiometric air-fuel ratio level, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air-fuel ratio accurately.
The A/F sensor is the planar type and is integrated with the heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor, in order to facilitate accurate oxygen concentration detection. In addition, the sensor and heater portions are narrower than the conventional type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.
A three-way catalytic converter (TWC) is used in order to convert the carbon monoxide (CO), hydrocarbon (HC), and nitrogen oxide (NOx) into less harmful substances. To allow the TWC to function effectively, it is necessary to keep the air-fuel ratio of the engine near the stoichiometric air-fuel ratio.
*: Value changes inside the ECM. Since the A/F sensor is the current output element, a current is converted to a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.

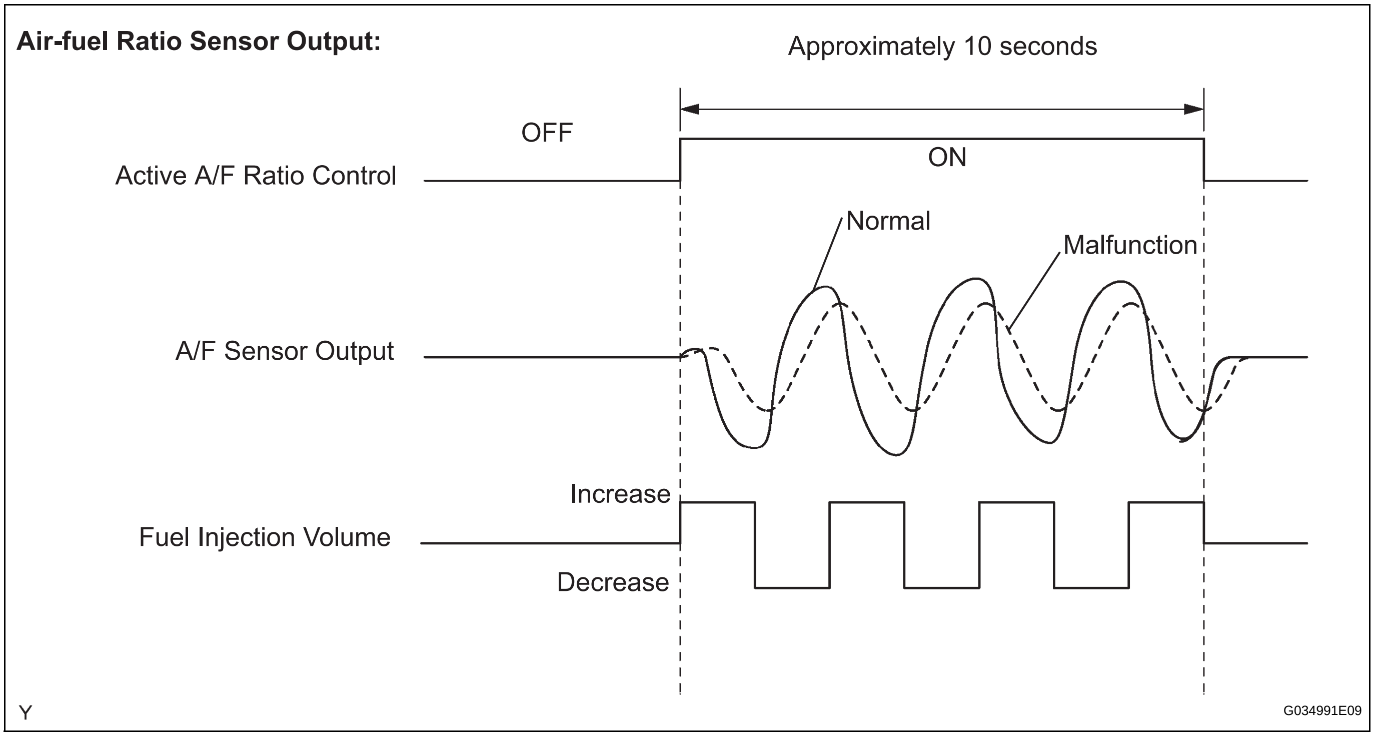


DTC No.	DTC Detection Conditions	Trouble Area
P2A00 P2A03	Calculated value for air-fuel ratio (A/F) sensor response rate deterioration level is less than threshold	• Open or short in A/F sensor circuit • A/F sensor • ECM

MONITOR DESCRIPTION

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

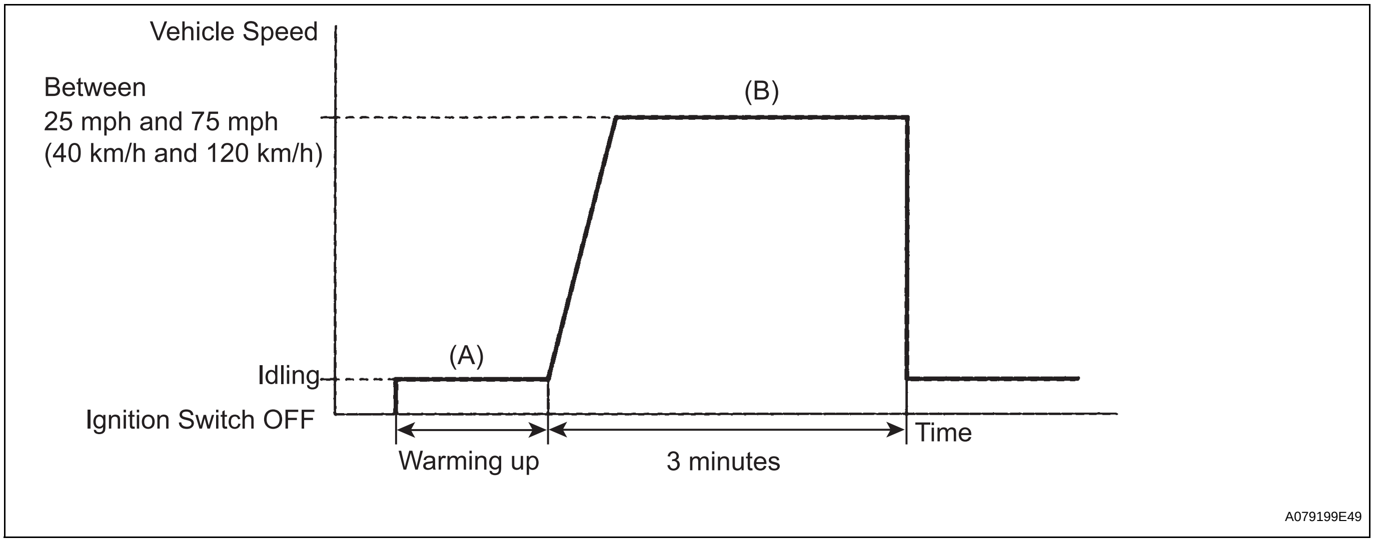
If the value for A/F sensor response rate deterioration level is less than the threshold, the ECM interprets this as a malfunction and sets the DTC.

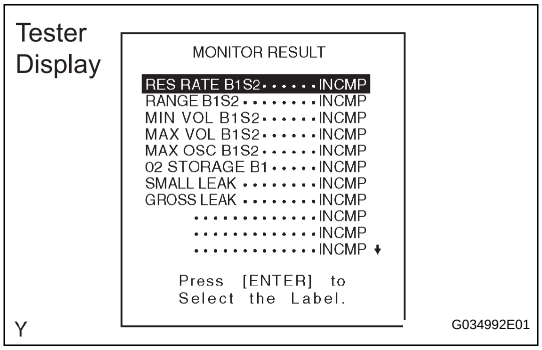


CONFIRMATION DRIVING PATTERN

HINT:

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





1. Connect an intelligent tester to the DLC3.

2. Turn the ignition switch on (IG).
3. Turn the tester on.
4. Clear the DTCs (where set).
5. Select the following menu items: DIAGNOSIS /ENHANCED OBD II / MONITOR INFO / MONITOR RESULT.
6. Check that RES RATE B1S1 is INCOMP.
7. Start the engine and warm it up (Procedure "A").
8. Drive the vehicle at between 25 mph and 75 mph (40 km/h and 120 km/h) for 3 minutes. However, the vehicle should be driven at a constant speed (Procedure "B").
9. Check the monitor result values on the intelligent tester by selecting the following menu items: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / TEST RESULT.
10. If the values indicated on the tester do not change, perform READINESS MONITOR DRIVE PATTERN for the A/F sensor and the heated oxygen sensor (See page ES-338).
HINT:
Completion of all A/F sensor monitors is required to change the value in TEST RESULT.
11. Note the value of the Monitor Result.
12. Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.
13. Check if any DTCs (any pending DTCs) are set.

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0171, P0172, P0173, P0174 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0500 (VSS) P2196, P2198 (A/F sensor - rationality)
Battery voltage	11 V or more
ECT	75°C (167°F) or more
Idle	OFF
Engine rpm	Less than 4,000 rpm
A/F sensor status	Activated
Fuel-cut	OFF
Engine load	10 to 70 %
Shift position	2 or more
Catalyst monitor	Not yet
MAF	2.5 to 15 g/sec.

TYPICAL MALFUNCTION THRESHOLDS

Response rate deterioration level	Less than 0.18 V

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-25).

WIRING DIAGRAM

Refer to DTC P2195 (See page ES-350).

INSPECTION PROCEDURE

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

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

HINT:

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

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

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

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.55 V Less than 0.4 V		

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

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

HINT:

- DTC P2A00 or P2A03 may also be set, when the air-fuel ratio is stuck rich or lean.
- A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

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

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

Result

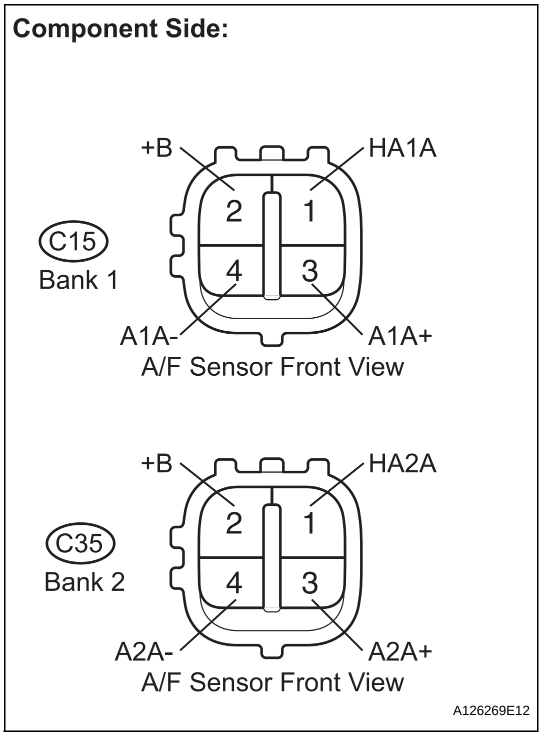
Display (DTC Output)	Proceed to
P2A00 and/or P2A03	A
P2A00 and/or P2A03 and other DTCs	B

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

B **GO TO DTC CHART (See page ES-63)**

A

2 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the C15 or C35 A/F sensor connector.
(b) Measure the resistance according to the value(s) in the table below.

Standard resistance (Bank 1 sensor 1)

Tester Connection	Condition	Specified Condition
HA1A (1) - +B (2)	20°C (68°F)	1.8 to 3.4 Ω
HA1A (1) - A1A- (4)	-	10 kΩ or higher

Standard resistance (Bank 2 sensor 1)

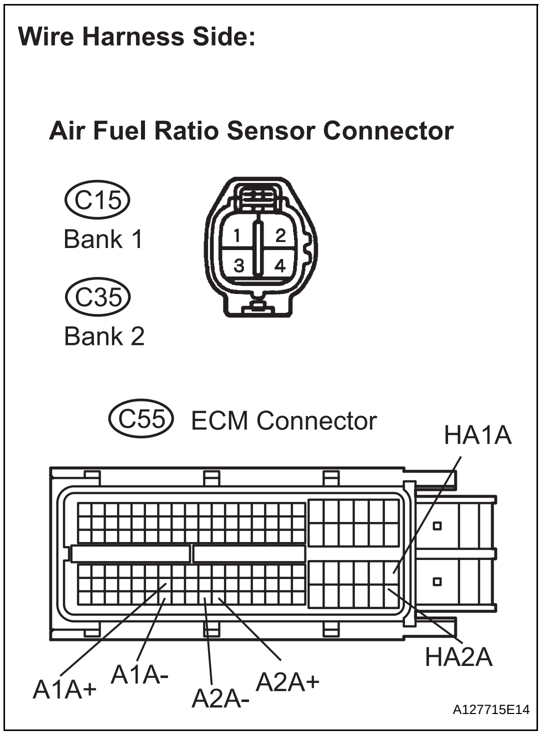
Tester Connection	Condition	Specified Condition
HA2A (1) - +B (2)	20°C (68°F)	1.8 to 3.4 Ω
HA2A (1) - A2A- (4)	-	10 kΩ or higher

(c) Reconnect the A/F sensor connector.

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

OK

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



(a) Disconnect the C15 and C35 A/F sensor connectors.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
+B (C15-2) - Body ground	9 to 14 V
+B (C35-2) - Body ground	9 to 14 V

(d) Turn the ignition switch off.
(e) Disconnect the C55 ECM connector.
(f) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
HA1A (C15-1) - HA1A (C55-86)	Below 1 Ω
A1A+ (C15-3) - A1A+ (C55-93)	Below 1 Ω
A1A- (C15-4) - A1A- (C55-116)	Below 1 Ω
HA2A (C35-1) - HA2A (C55-109)	Below 1 Ω
A2A+ (C35-3) - A2A+ (C55-120)	Below 1 Ω
A2A- (C35-4) - A2A- (C55-119)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
HA1A (C15-1) or HA1A (C55-86) - Body ground	10 kΩ or higher
A1A+ (C15-3) or A1A+ (C55-93) - Body ground	10 kΩ or higher
A1A- (C15-4) or A1A- (C55-116) - Body ground	10 kΩ or higher
HA1A (C35-1) or HA2A (C55-109) - Body ground	10 kΩ or higher
A2A+ (C35-3) or A2A+ (C55-120) - Body ground	10 kΩ or higher
A2A- (C35-4) or A2A- (C55-119) - Body ground	10 kΩ or higher

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

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

Result

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

B → **REPLACE ECM (See page ES-518)**

A

6 REPLACE AIR FUEL RATIO SENSOR

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

NEXT

7 PERFORM CONFIRMATION DRIVING PATTERN

NEXT

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

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

Result

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

B → **REPLACE ECM (See page ES-518)**

A

END

DTC	U0101	Lost Communication with TCM

DESCRIPTION

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

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

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

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

TYPICAL MALFUNCTION THRESHOLDS

Communication signal	Lost communication with TCM

INSPECTION PROCEDURE

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

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

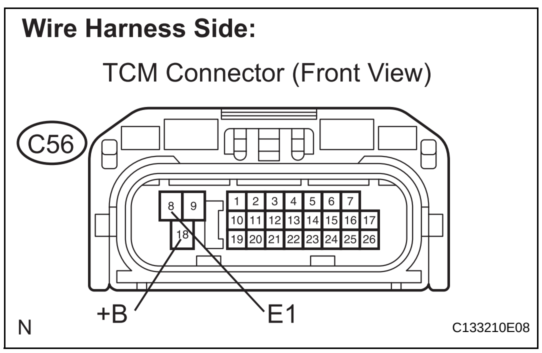
Result

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

B → **GO TO DTC CHART (See page ES-63)**

A ↓

2	CHECK TCM TERMINAL VOLTAGE (+B AND E1 TERMINALS)



(a) Disconnect the TCM connector.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage of the TCM connectors.

Standard voltage

Tester Connection	Specified Condition
C56-18 (+B) - C56-8 (E1)	9 to 14 V

(d) Turn the ignition switch off.
(e) Measure the resistance of the TCM connector.

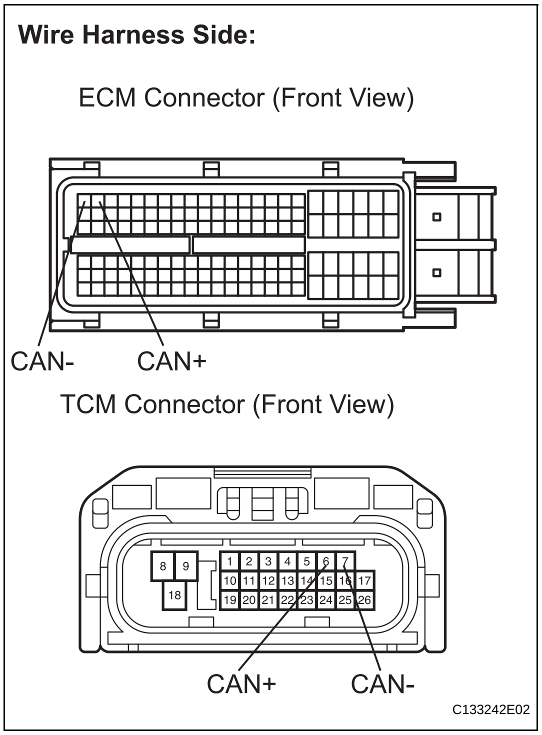
Standard resistance

Tester Connection	Specified Condition
C56-8 (E1) - Body ground	Below 1 Ω

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

OK ↓

3 CHECK HARNESS AND CONNECTOR



(a) Disconnect the C56 TCM connector.
(b) Disconnect the C55 ECM connector.
(c) Measure the resistance of the wire harness side connectors.
Standard resistance

Tester Connection	Specified Condition
C56-6 (CAN+) - C55-2 (CAN+)	Below 1 Ω
C56-7 (CAN-) - C55-1 (CAN-)	Below 1 Ω
C56-6 (CAN+) or C55-2 (CAN+) - Body ground	1 MΩ or more
C56-7 (CAN-) or C55-1 (CAN-) - Body ground	1 MΩ or more

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

OK

4 REPLACE ECM

(a) Replace the ECM (See page ES-518).
NOTICE:
Replace the ECM with a ECM from a normally functioning vehicle of the same model.

NEXT

5 CHECK IF DTC RECURS

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

Result

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

B → **REPLACE ECM**

A

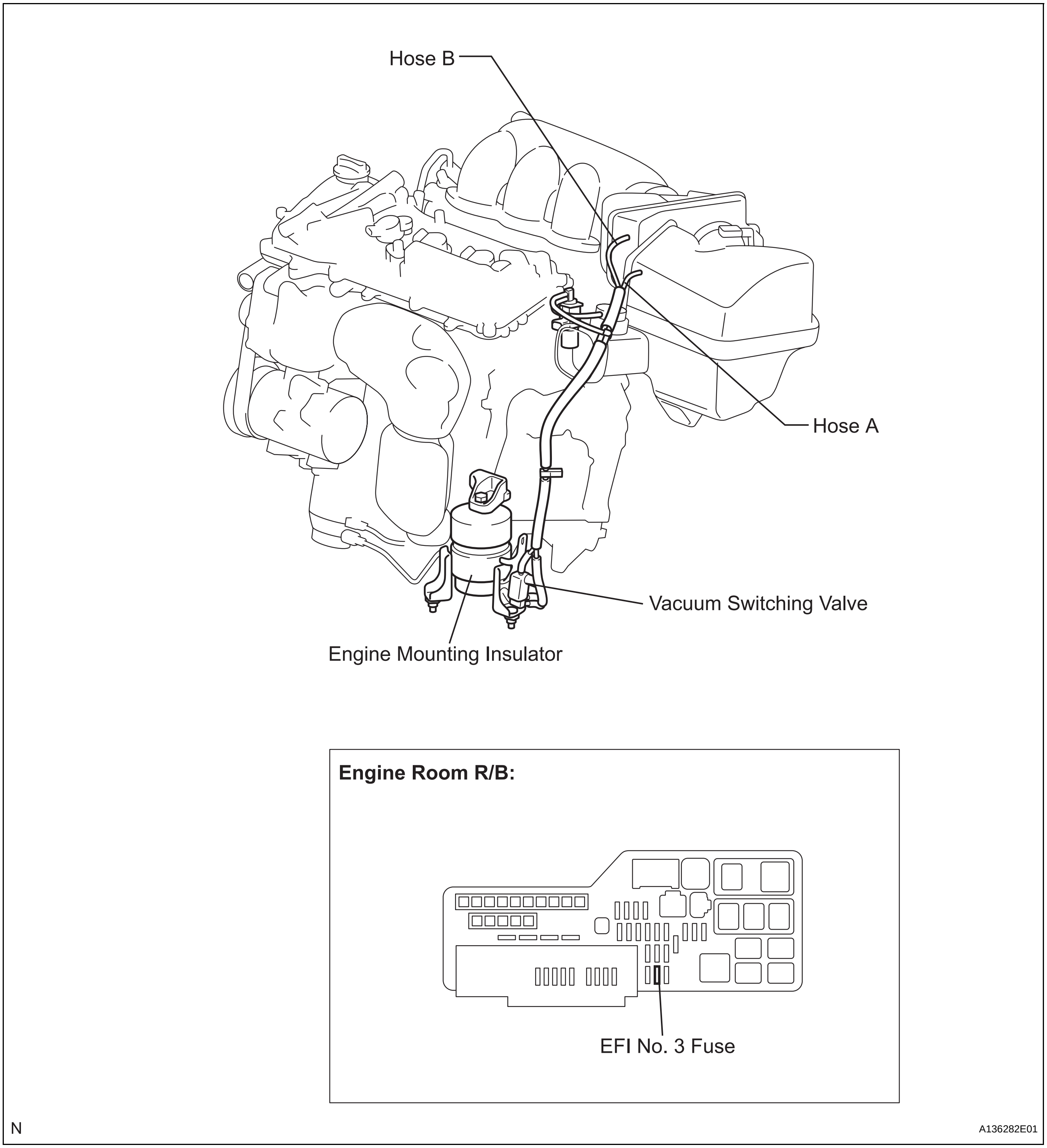
REPLACE TCM

ES

Active Control Engine Mount System

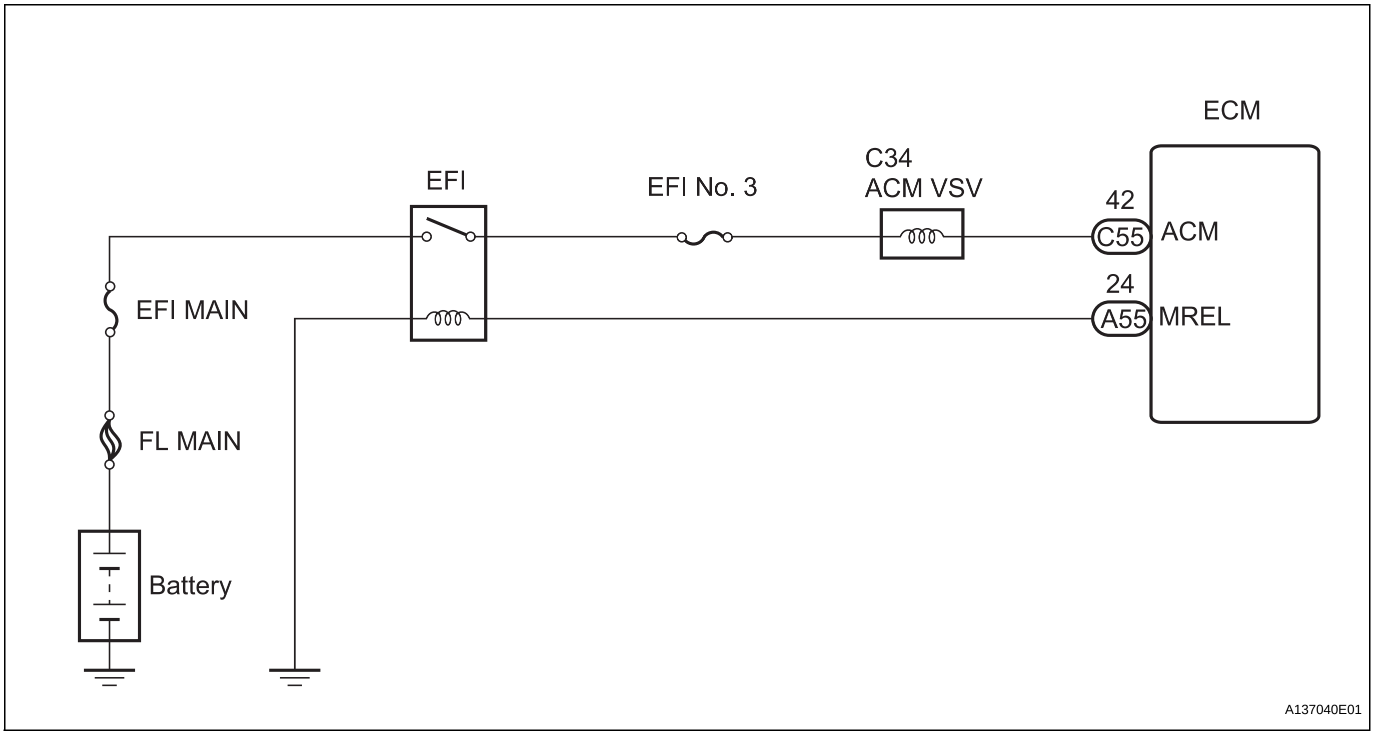
DESCRIPTION

LOCATION



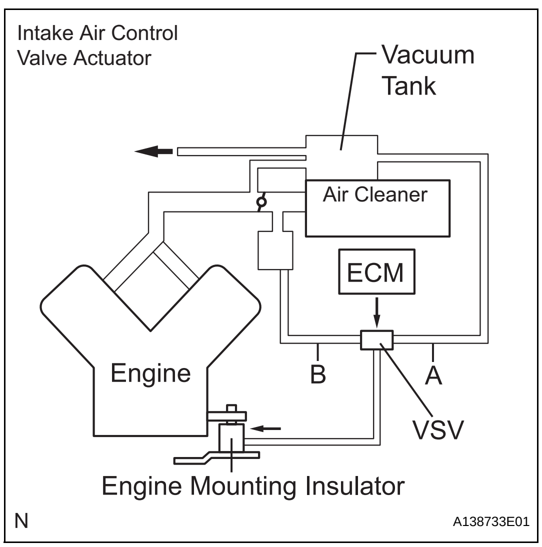
The Active Control Engine Mount (ACM) system decreases engine vibration at a low engine speed using the ACM VSV. The VSV is controlled by a pulse signal transmitted to the VSV from the ECM. The frequency of this pulse signal is matched to the engine speed to decrease engine vibration.

WIRING DIAGRAM



INSPECTION PROCEDURE

1	CHECK VACUUM HOSES



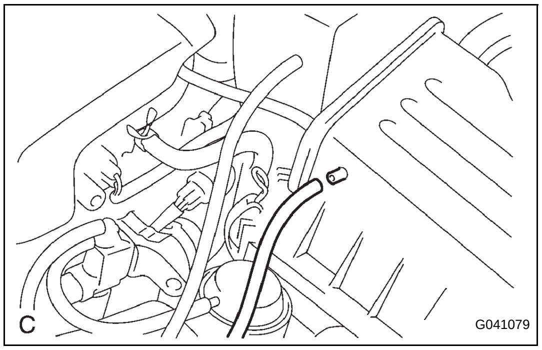
(a) If the hose is damaged, replace the vacuum hose assembly.

(b) Check the air and vacuum hoses for looseness, disconnection and blockage.

NG → **REPAIR OR REPLACE VACUUM HOSES**

OK

2	CHECK VACUUM



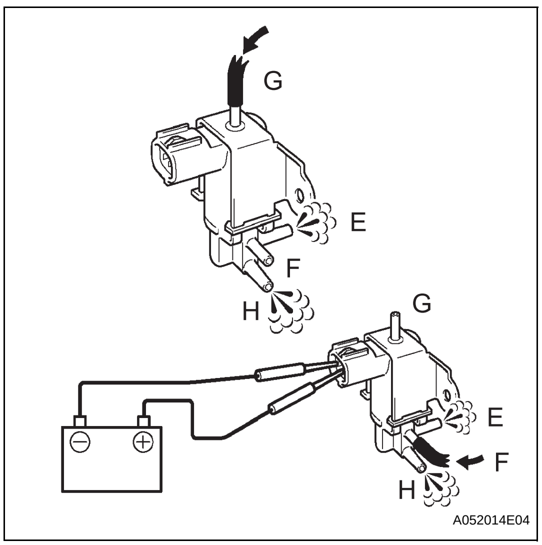
(a) Start the engine.
(b) Disconnect the vacuum hose from the air cleaner cap.
(c) Check that the disconnected port located on the vacuum tank applies suction to your finger.
OK:
Vacuum pressure exists.
(d) Reconnect the vacuum hose.

NG → **CHECK AND REPLACE VACUUM SOURCE AND HOSES**

OK

ES

3	INSPECT DUTY VACUUM SWITCHING VALVE (OPERATION)

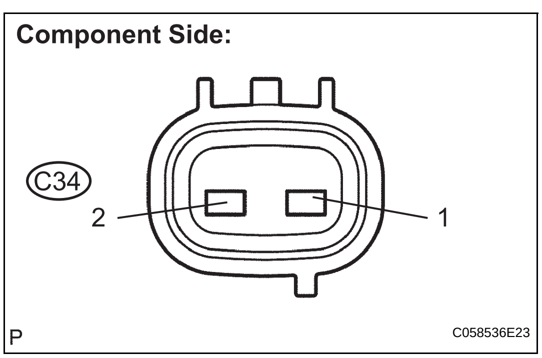


(a) Remove the VSV for ACM.
(b) Check operation of the VSV for ACM when positive battery voltage is applied to the terminals of the VSV for ACM connector.
Positive battery voltage is not applied:
The air from pipe G is flowing out through pipes E and H.
Positive battery voltage is applied:
The air from pipe F is flowing out through pipes E and H.
(c) Reinstall the VSV for ACM.

NG → **REPLACE DUTY VACUUM SWITCHING VALVE**

OK

4	INSPECT DUTY VACUUM SWITCHING VALVE (RESISTANCE)

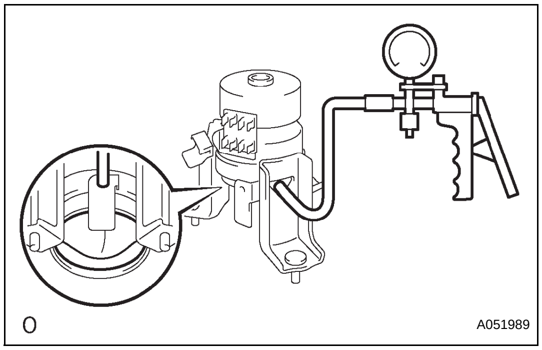


(a) Disconnect the C34 VSV for ACM connector.
(b) Measure the resistance between terminals 1 and 2.
Standard resistance:
19 to 21 Ω at 20°C (68°F)
(c) Reconnect the VSV for ACM connector.

NG → **REPLACE DUTY VACUUM SWITCHING VALVE**

OK

5	INSPECT ENGINE MOUNTING INSULATOR ASSEMBLY FRONT



(a) Disconnect the vacuum hose from the front engine mount insulator.
(b) Using a vacuum pump, apply vacuum of 80 kPa (600 mmHg, 25 in.Hg) and wait for 1 minute.
(c) Check that there is no change in the needle movement of the vacuum pump gauge.
(d) Check that there is no fluid leakage caused by a break in the diaphragm.

OK:

Vacuum pressure exists.

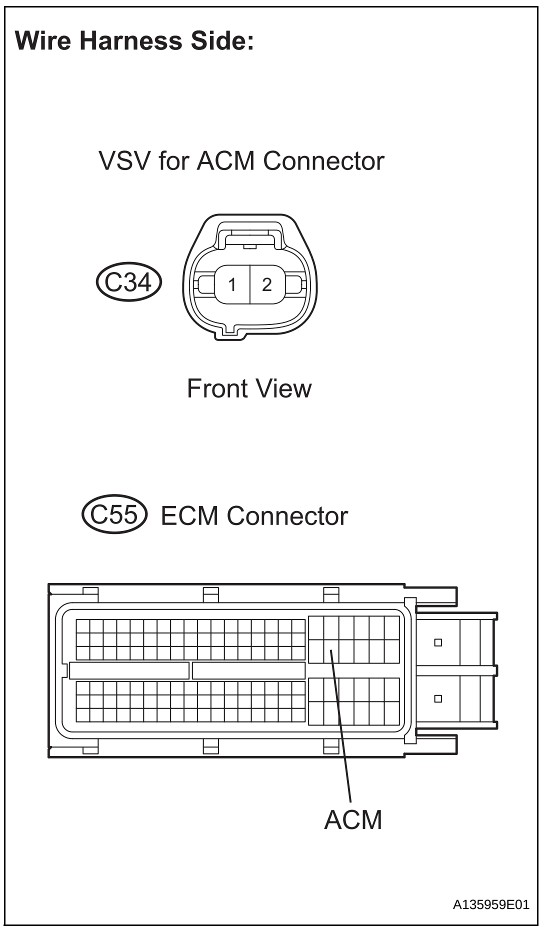
(e) Reconnect the vacuum hose.

NG → **REPLACE FRONT ENGINE MOUNTING INSULATOR ASSEMBLY**

ES

OK

6	CHECK HARNESS AND CONNECTOR (VSV FOR ACM - ECM)



(a) Check the wire harness between the VSV for ACM connector and the ECM connector.
(1) Disconnect the C34 VSV for ACM connector.
(2) Disconnect the C55 ECM connector.
(3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connections	Specified Conditions
VSV for ACM (C34-2) - ACM (C55-42)	Below 1 Ω

Standard resistance (Check for open)

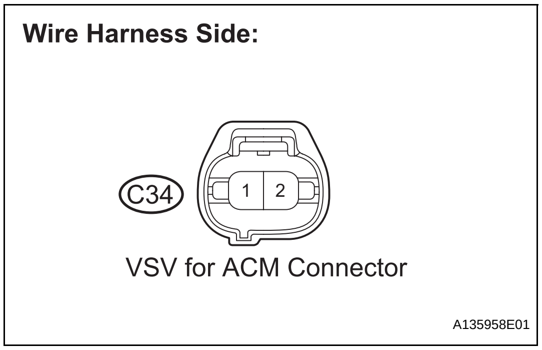
Tester Connections	Specified Conditions
VSV for ACM (C34-2) or ACM (C55-42) - Body ground	10 kΩ or higher

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

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

OK

7 INSPECT DUTY VACUUM SWITCHING VALVE (VOLTAGE)



(a) Disconnect the C34 VSV connector.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage between the terminals.
Standard voltage

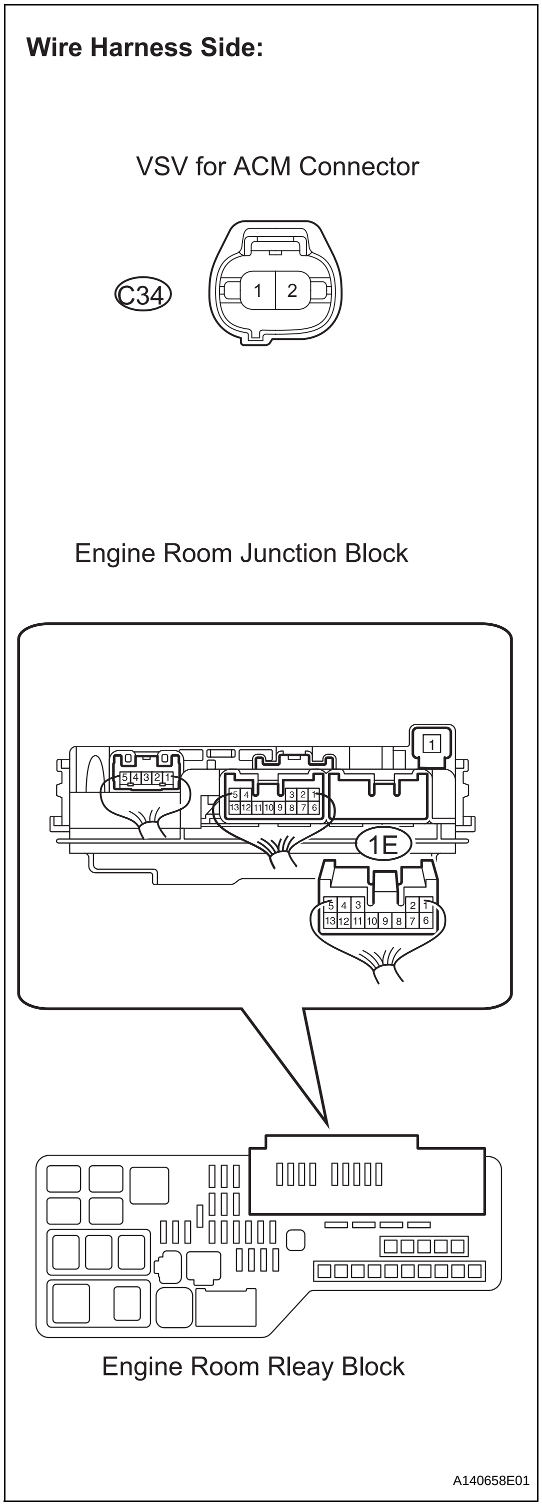
Tester Connection	Specified Condition
C34-1 - Body ground	9 to 14 V

NG → **Go to step 8**

OK

REPLACE ECM (See page ES-518)

8	CHECK HARNESS AND CONNECTOR (VSV FOR ACM - ENGINE JUNCTION BLOCK (EFI RELAY))



(a) Check the wire harness between the VSV for ACM and the EFI relay.

(1) Disconnect the C34 VSV connector.

(2) Remove the engine room junction block.

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

Standard resistance (Check for open)

Tester Connections	Specified Condition
VSV for ACM (C34-1) - 1E-6 (Engine room relay block)	Below 1 Ω

Standard resistance (Check for short)

Tester Connections	Specified Condition
VSV for ACM (C34-1) or 1E-6 (Engine room relay block) - Body ground	10 kΩ or higher

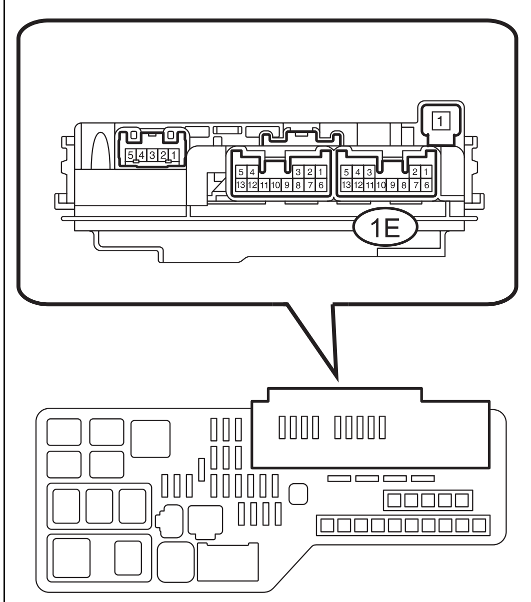
(4) Reconnect the VSV for ACM connector.

(5) Reinstall the engine room junction block.

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

OK

9	INSPECT ENGINE ROOM JUNCTION BLOCK (EFI RELAY)



(a) Remove the engine room junction block.

(b) Measure the EFI relay resistance.

Standard resistance

Tester Connection	Specified Condition
1E-12 - 1E-6	10 kΩ or higher
1E-12 - 1E-6	Bellow 1 Ω (Apply battery voltage between terminals 1E-9 and 1E-10)

(c) Reinstall the engine room junction block.

NG → **REPLACE ENGINE ROOM JUNCTION BLOCK**

ES

OK

REPLACE ECM (See page ES-518)

EVAP System

RELATED DTCS

DTCs	Monitoring Items	See page
P043E	Reference orifice clogged (built into canister pump module)	ES-255
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-260
P0450	Canister pressure sensor (built into canister pump module) voltage abnormal fluctuation	ES-267
P0451	• Canister pressure sensor (built into canister pump module) noise • Canister pressure sensor (built into canister pump module) signal becomes fixed/flat	
P0452	Canister pressure sensor (built into canister pump module) voltage low	
P0453	Canister pressure sensor (built into canister pump module) voltage high	
P0455	EVAP gross leak	ES-274
P0456	EVAP small leak	
P2401	Leak detection pump stuck OFF (built into canister pump module)	ES-255
P2402	Leak detection pump stuck ON (built into canister pump module)	
P2419	Vent valve stuck closed (built into canister pump module)	ES-255
P2420	Vent valve stuck open (vent) (built into canister pump module)	ES-373
P2610	Soak timer (built into ECM)	ES-377

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

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

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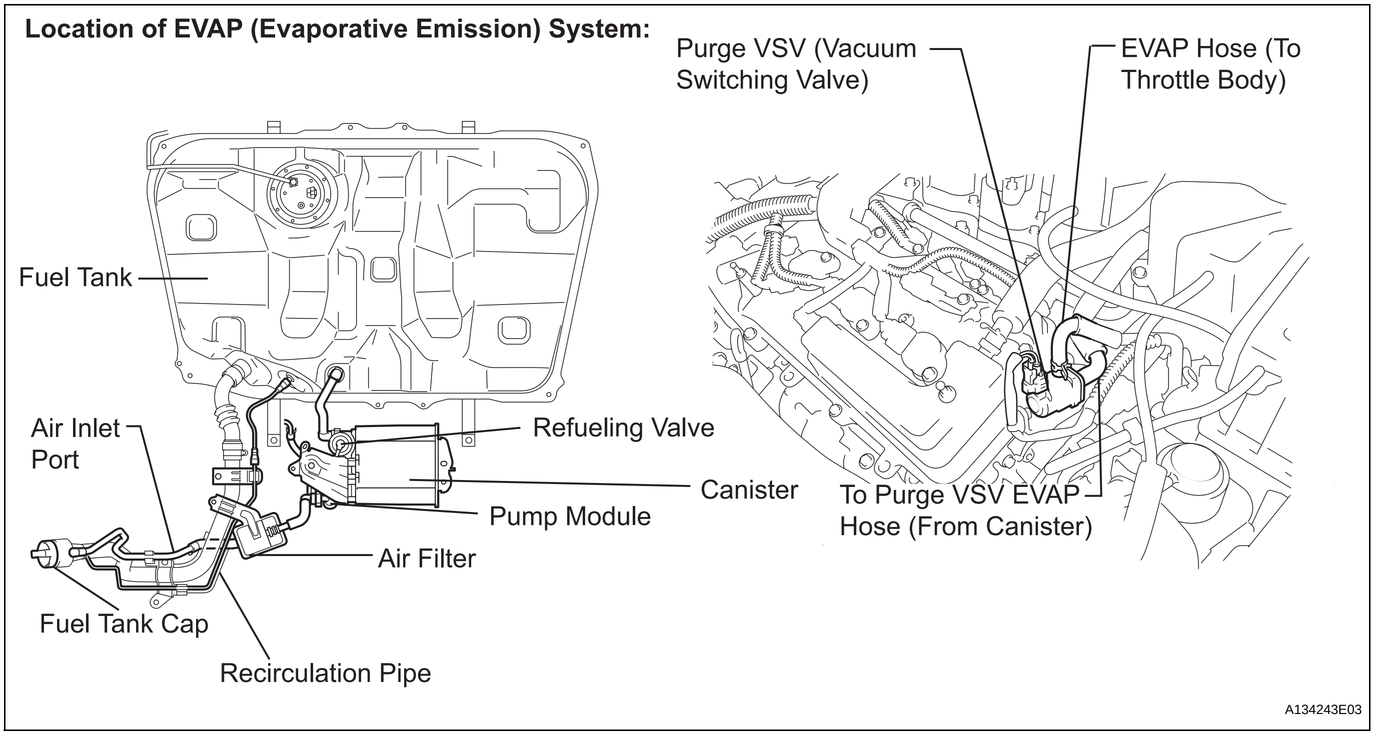
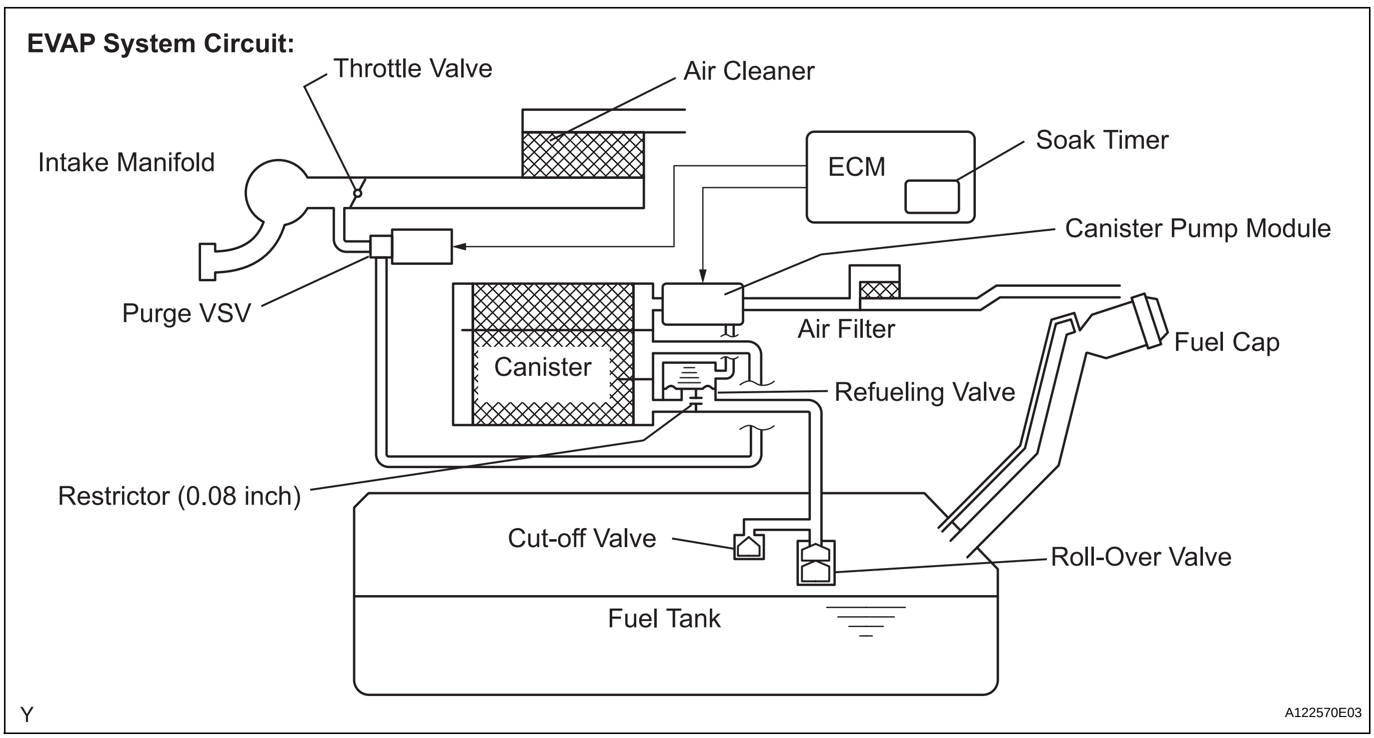
ES

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

DESCRIPTION





NOTICE:
In this vehicle's EVAP system, turning ON the vent valve does not seal off the EVAP system. To check for leaks in the EVAP system, disconnect the air inlet vent hose and apply pressure from the atmospheric side of the canister.

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

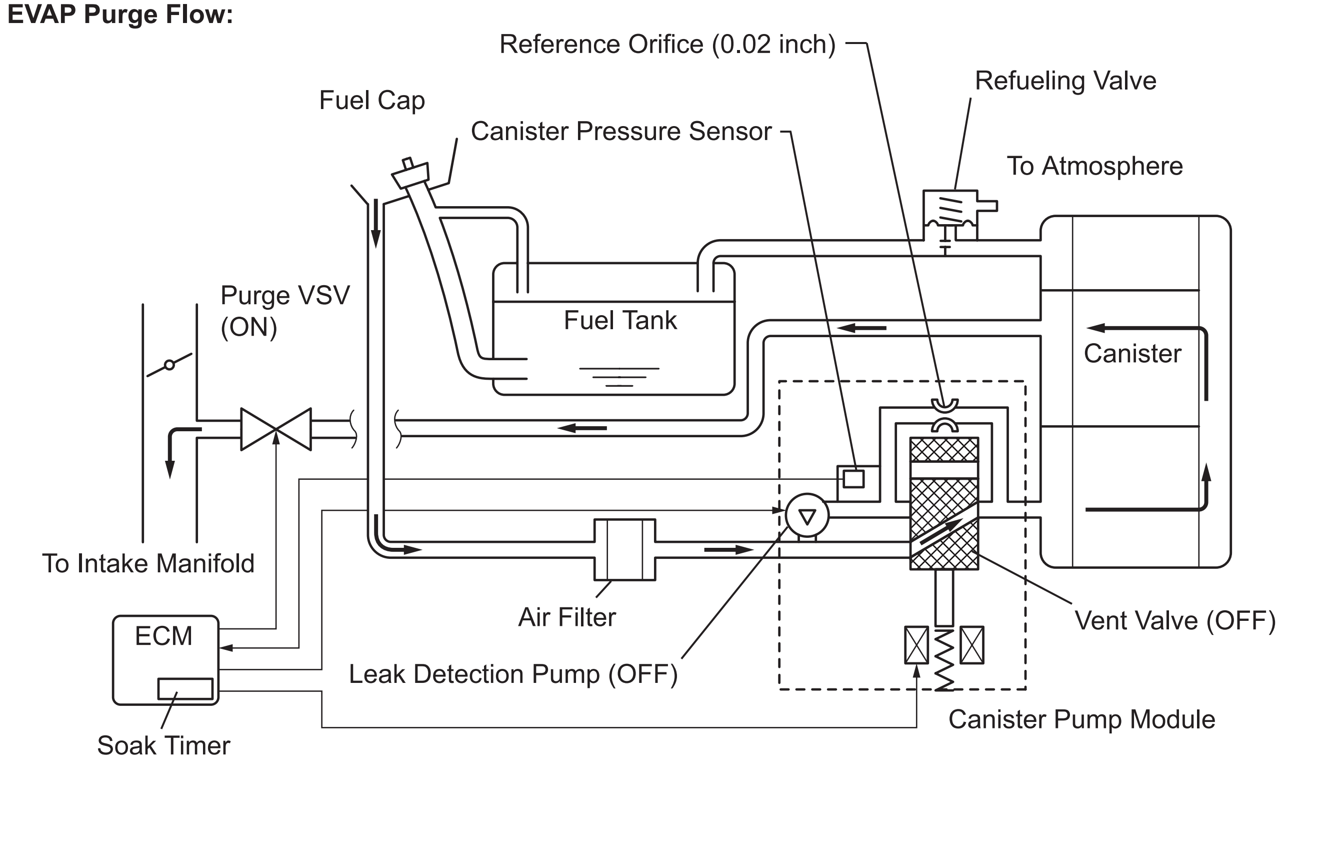
The purge flow volume is also determined by the intake manifold pressure. Atmospheric pressure is allowed into the canister through the vent valve to ensure that the purge flow is maintained when negative pressure (vacuum) is applied to the canister.

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

1. **Key-off monitor**
   This monitor checks for EVAP (Evaporative Emission) system leaks and canister pump module malfunctions. The monitor starts 5 hours* after the ignition switch is turned off. At least 5 hours are required for the fuel to cool down to stabilize the EVAP pressure, thus making the EVAP system monitor more accurate.
   The leak detection pump creates negative pressure (vacuum) in the EVAP system and the pressure is measured. Finally, the ECM monitors for leaks from the EVAP system, and malfunctions in both the canister pump module and purge VSV, based on the EVAP pressure.
   HINT:
   *: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.
2. **Purge flow monitor**
   The purge flow monitor consists of the two monitors. The 1st monitor is conducted every time and the 2nd monitor is activated if necessary.
   - The 1st monitor
     While the engine is running and the purge VSV (Vacuum Switching Valve) is ON (open), the ECM monitors the purge flow by measuring the EVAP pressure change. If negative pressure is not created, the ECM begins the 2nd monitor.
   - The 2nd monitor
     The vent valve is turned OFF (open) and the EVAP pressure is measured. If the variation in the pressure is less than 0.5 kPa-g (3.75 mmHg-g), the ECM interprets this as the purge VSV being stuck closed, and illuminates the MIL and sets DTC P0441 (2 trip detection logic).

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

EVAP Purge Flow:



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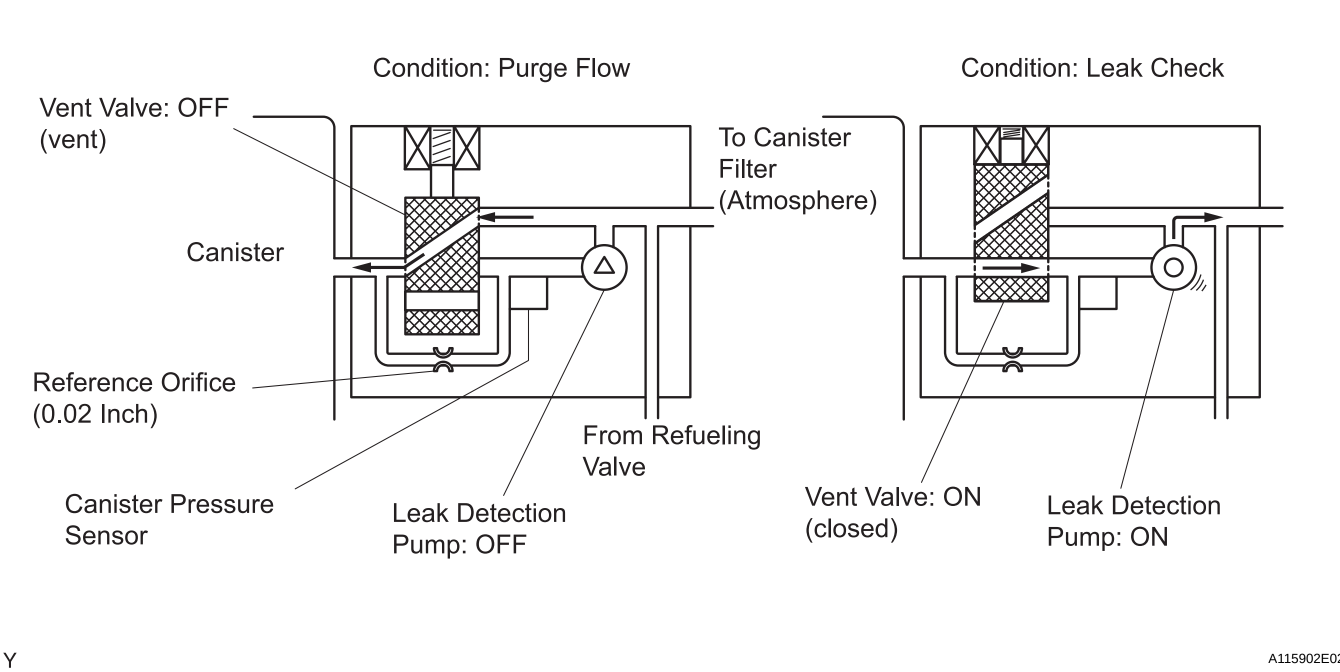
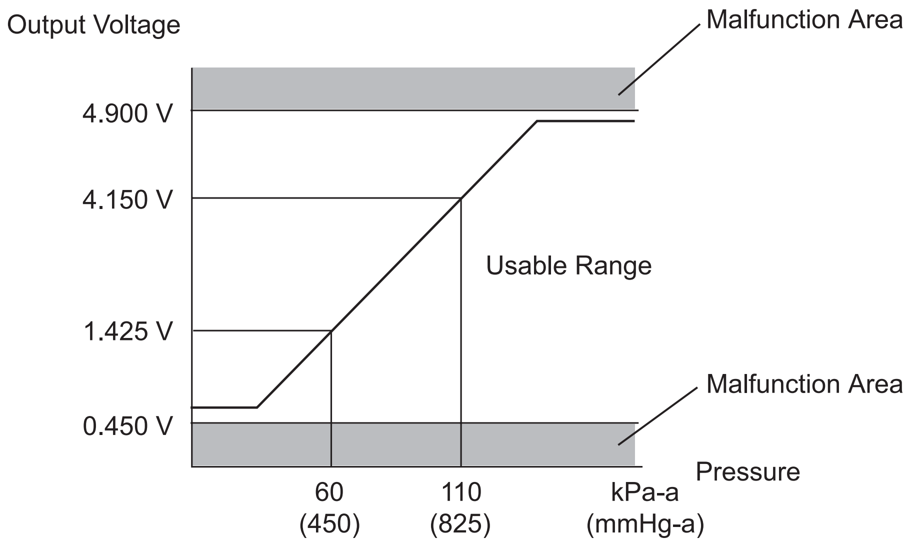
Components	Operations
Canister	Contains activated charcoal to absorb EVAP (Evaporative Emissions) generated in fuel tank.
Cut-off valve	Located in fuel tank. Valve floats and closes when fuel tank 100 % full.
Purge VSV (Vacuum Switching Valve)	Opens or closes line between canister and intake manifold. 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; Closed: OFF).
Refueling valve	Controls EVAP pressure from fuel tank to canister. Valve consists of diaphragm, spring and restrictor (diameter: 0.08 inch). When fuel vapor and pressure inside fuel tank increase, valve opens. While EVAP purged, valve closes and restrictor prevents large amount of vacuum from affecting pressure in fuel tank. Valve opened while refueling.
Roll-over valve	Located in fuel tank. Valve closed by its own weight when vehicle overturns to prevent fuel from spilling out.
Soak timer	Built into ECM. To ensure accurate EVAP monitor, measures 5 hours (+-15 min) after ignition switch turned off. This allows fuel to cool down, stabilizing EVAP pressure. When approximately 5 hours elapsed, ECM in activated (refer to fig. 3).
Canister pump module	Consists of (a) to (d) below. Canister pump module cannot be disassembled.
(a) Vent valve	Vents and closes EVAP system. When ECM turns valve ON, EVAP system 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 reference pressure. Reference pressure indicates small leak of EVAP.

Canister Pump Module (fig. 1):



Canister Pressure Sensor Specification (fig. 2):



HINT:

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

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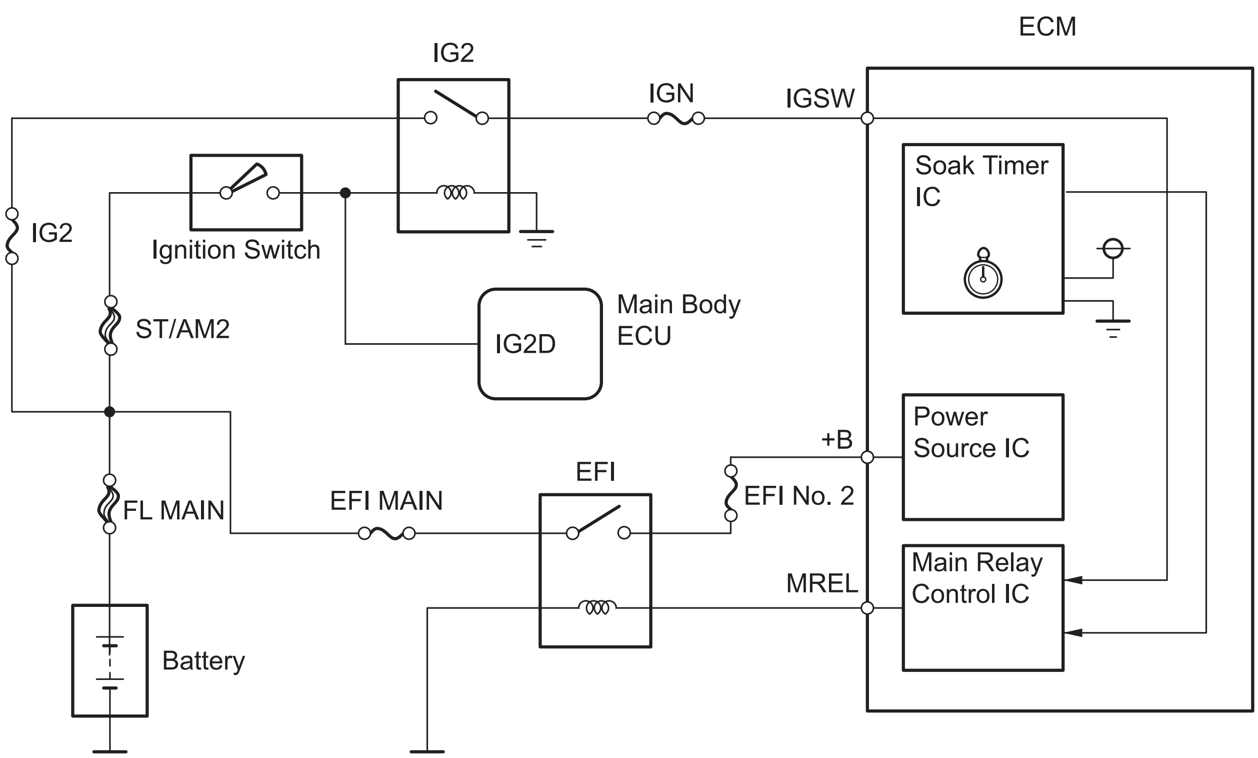
Soak Timer Circuit (fig. 3):



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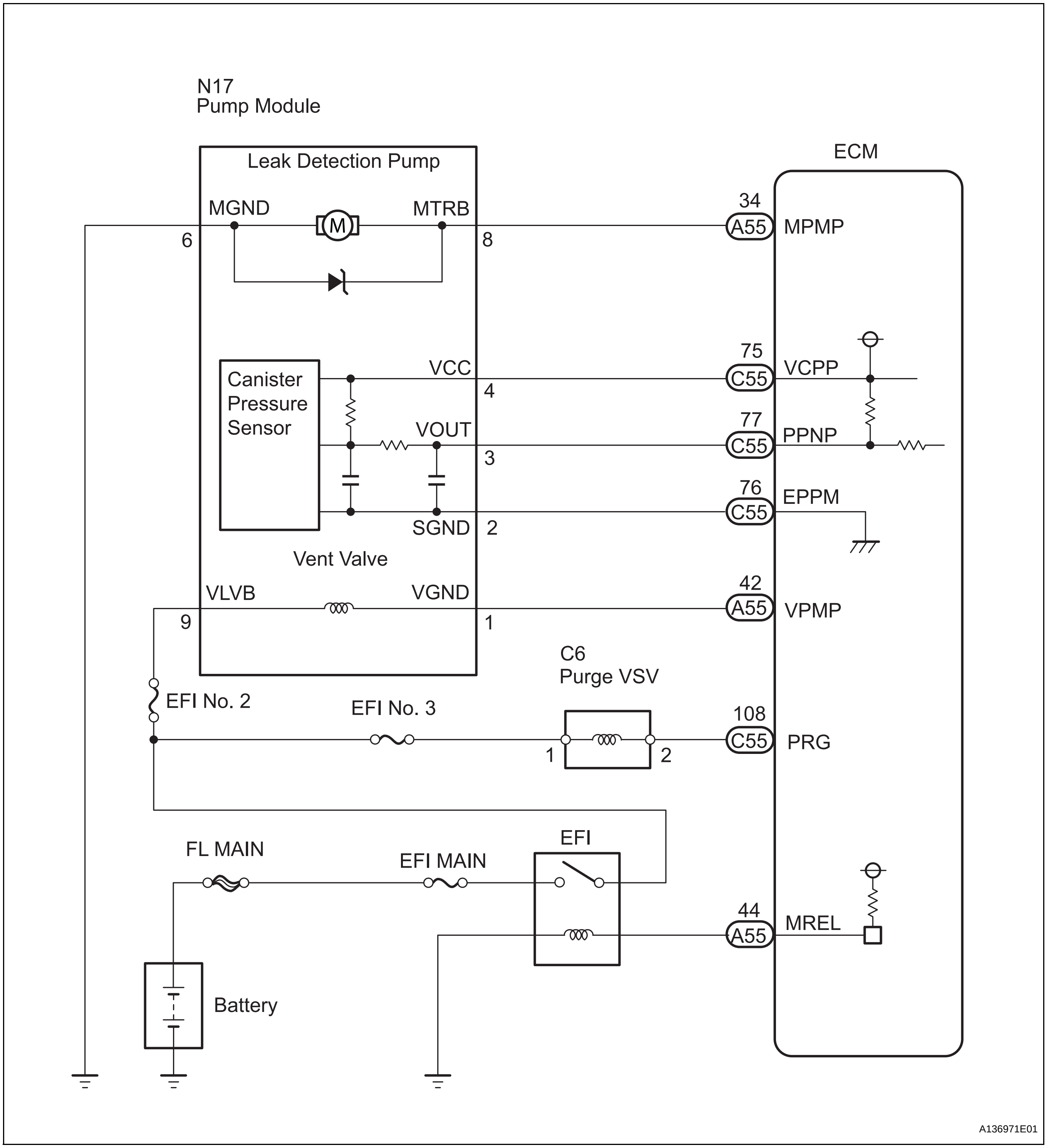
WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

The intelligent tester is required to conduct the following diagnostic troubleshooting procedure.

HINT:

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

- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-45).

1	CONFIRM DTC

(a) Turn the ignition switch off and wait for 10 seconds.
(b) Turn the ignition switch on (IG).
(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 (IG) and turn the tester ON.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Confirm DTCs and freeze frame data.
If any EVAP system DTCs are set, the malfunctioning area can be determined using the table below.
NOTICE:
If the reference pressure difference between the first and second checks is greater than the specification, all the DTCs relating to the reference pressure (P043E, P043F, P2401, P2402 and P2419) are stored.

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

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NEXT

2 PERFORM EVAP SYSTEM CHECK (AUTO OPERATION)

NOTICE:

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

(a) Clear the DTCs (See page ES-45).

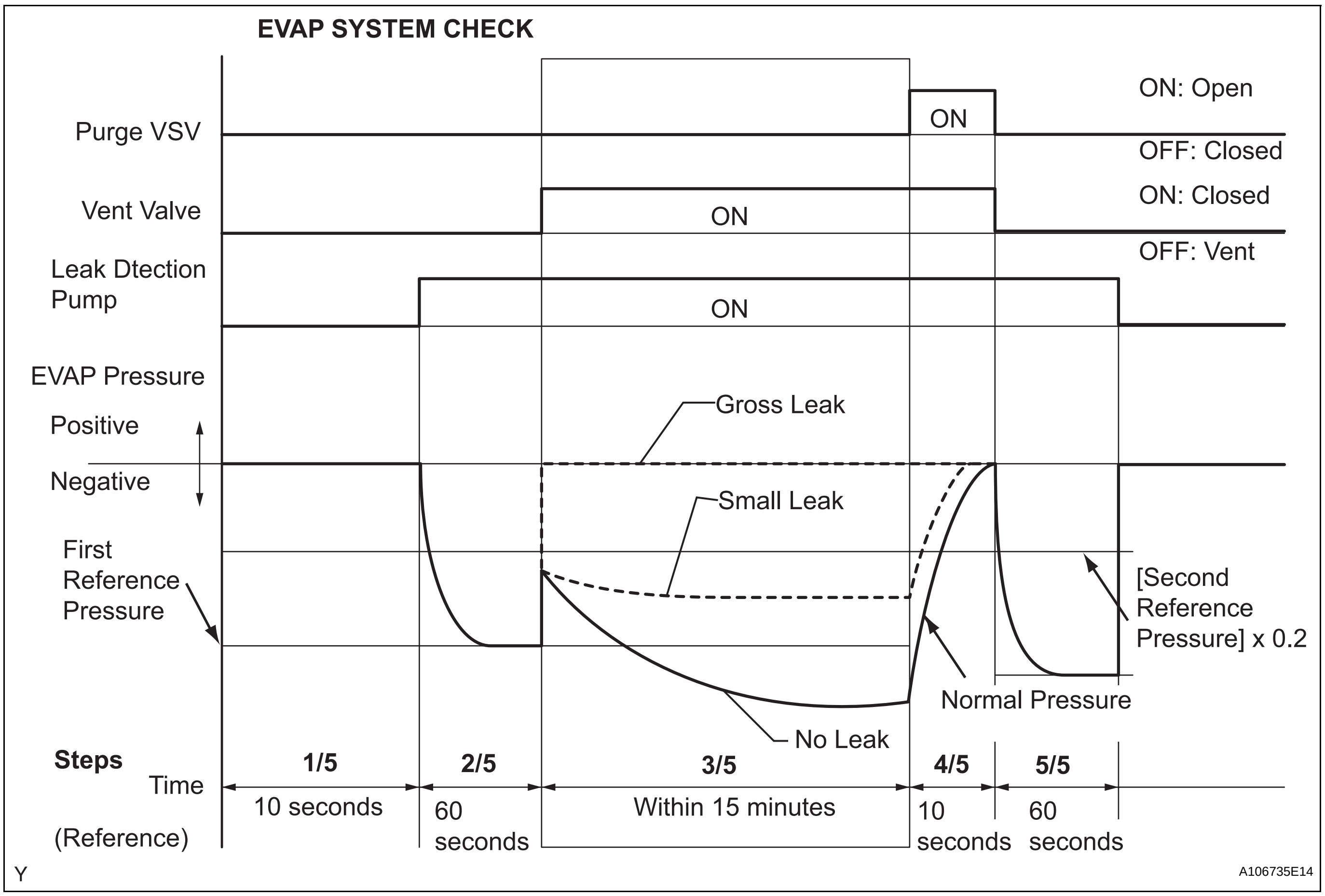
(b) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.

(c) After the EVAP SYSTEM CHECK is completed, check for pending DTCs by selecting the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.
HINT:
If no pending DTCs are displayed, perform the MONITOR CONFIRMATION (see "Diagnostic Help" menu). After this confirmation, check for pending DTCs. If no DTCs are displayed, the EVAP system is normal.

NEXT

ES

3	**PERFORM EVAP SYSTEM CHECK (MANUAL OPERATION)**



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

- **When the temperature of the fuel is 35°C (95°F) or more, a large amount of vapor forms and any check results become inaccurate. When performing the EVAP SYSTEM CHECK, keep the temperature below 35°C (95°F).**

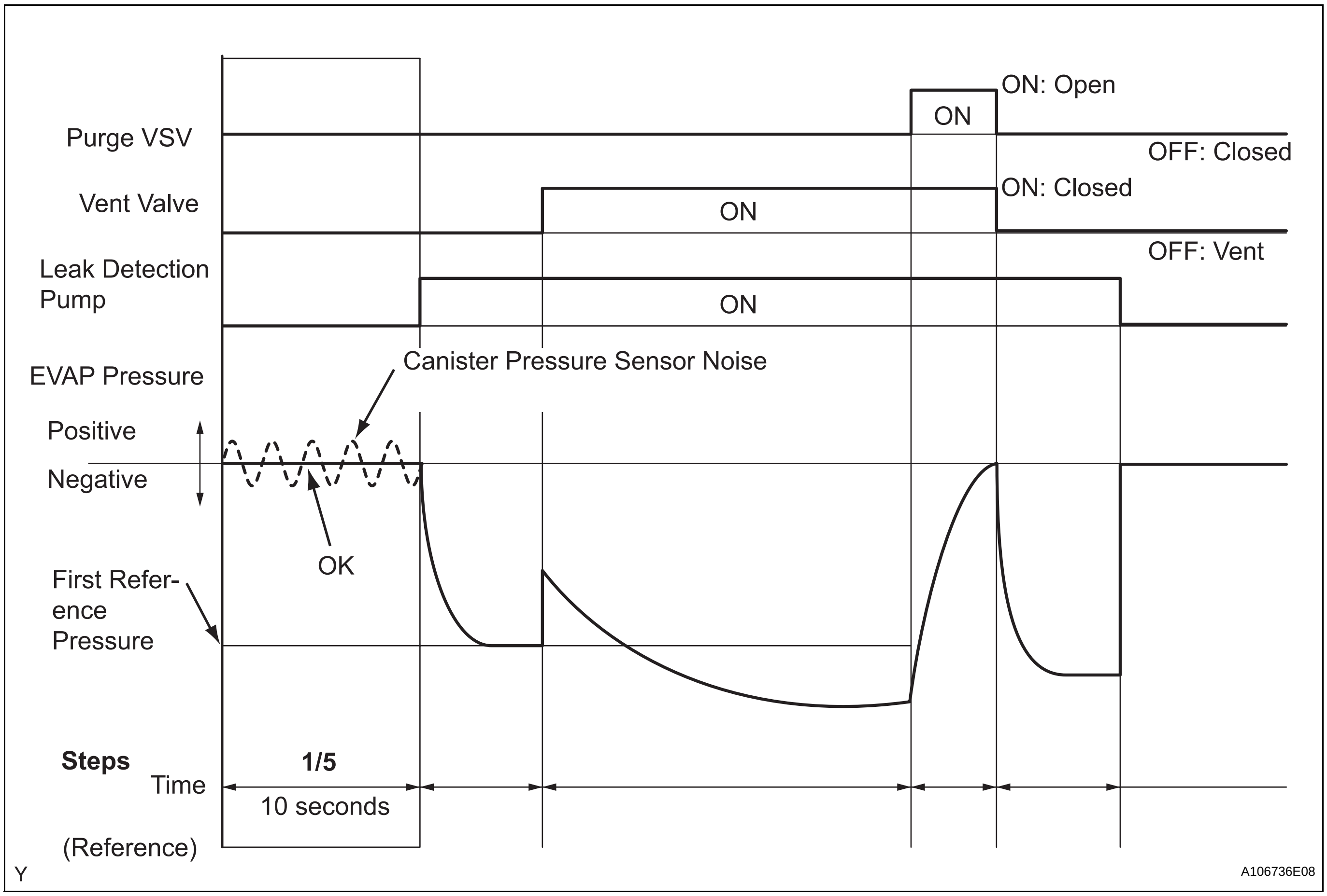
(a) Clear the DTCs (See page ES-45).

(b) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / MANUAL OPERATION.

NEXT

4	PERFORM EVAP SYSTEM CHECK (STEP 1/5)

ES



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

Result

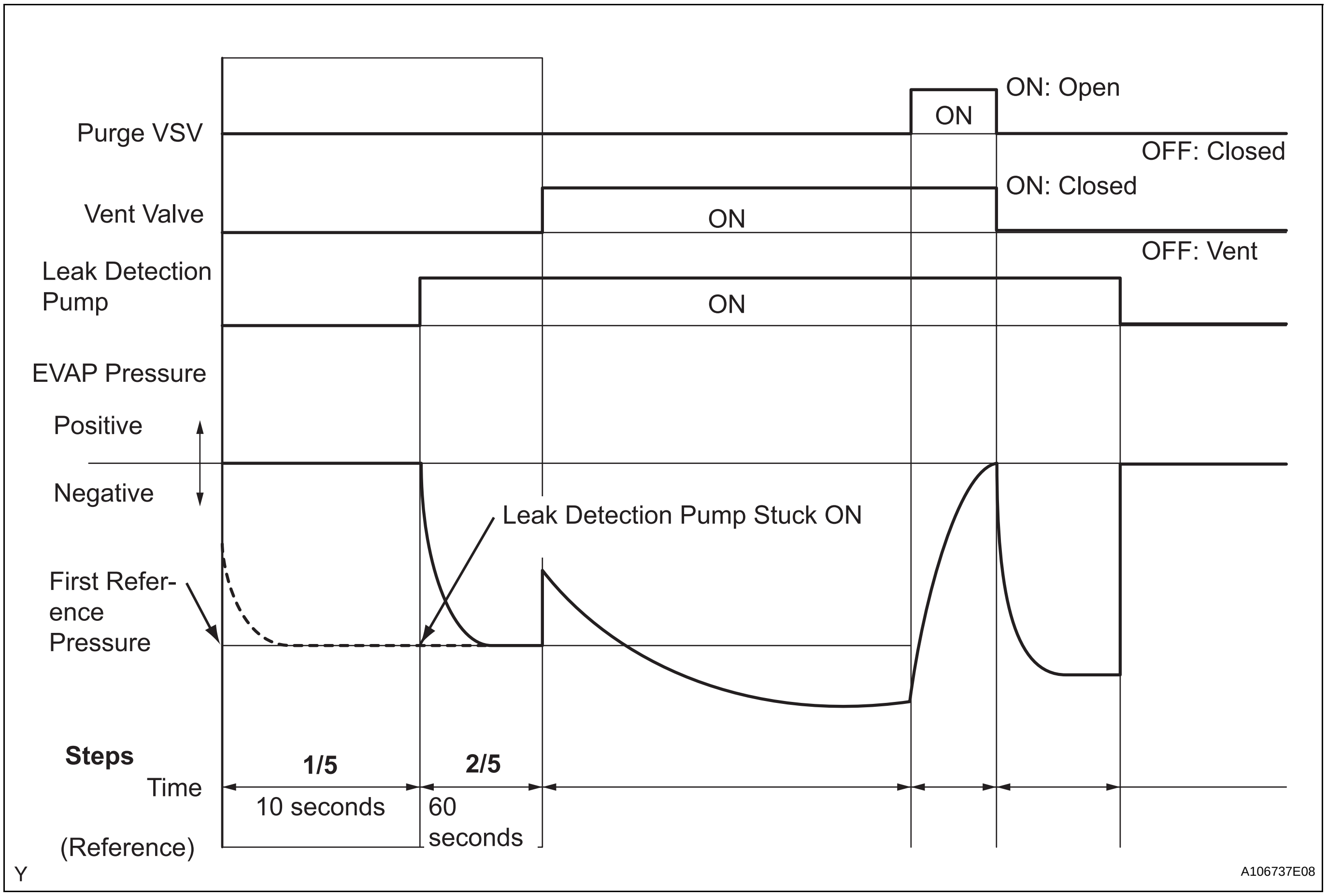
DTCs*	Test Results	Suspected Trouble Areas	Proceed to
-	Virtually no variation in EVAP pressure	Not yet determined	A
P0451	EVAP pressure fluctuates by +-0.3 kPa-g (2.25 mmHg-g) or more	Canister pressure sensor noise	B

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

B	Go to step 29

A

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



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

Result

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

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

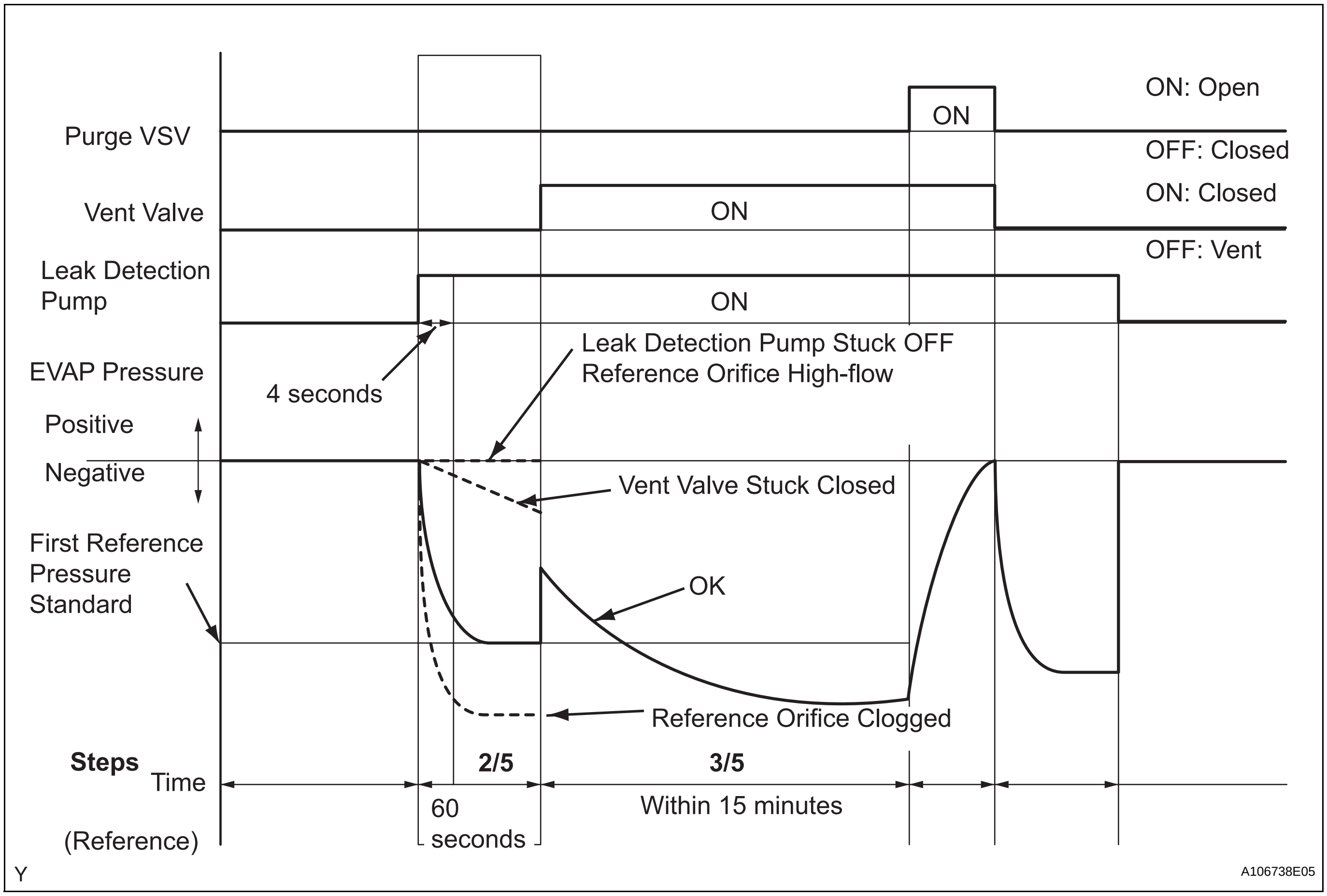
HINT:

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

B — **Go to step 22**

A

6	PERFORM EVAP SYSTEM CHECK (STEP 2/5)



HINT:
Make a note of the pressures checked in steps "A" and "B" below.
(a) Check the EVAP pressure 4 seconds after the leak detection pump is activated* (Step "A").
*: The leak detection pump begins to operate as step 1/5 finishes and step 2/5 starts.
(b) Check the EVAP pressure again when it has stabilized. This pressure is the reference pressure (Step "B").

Result

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

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

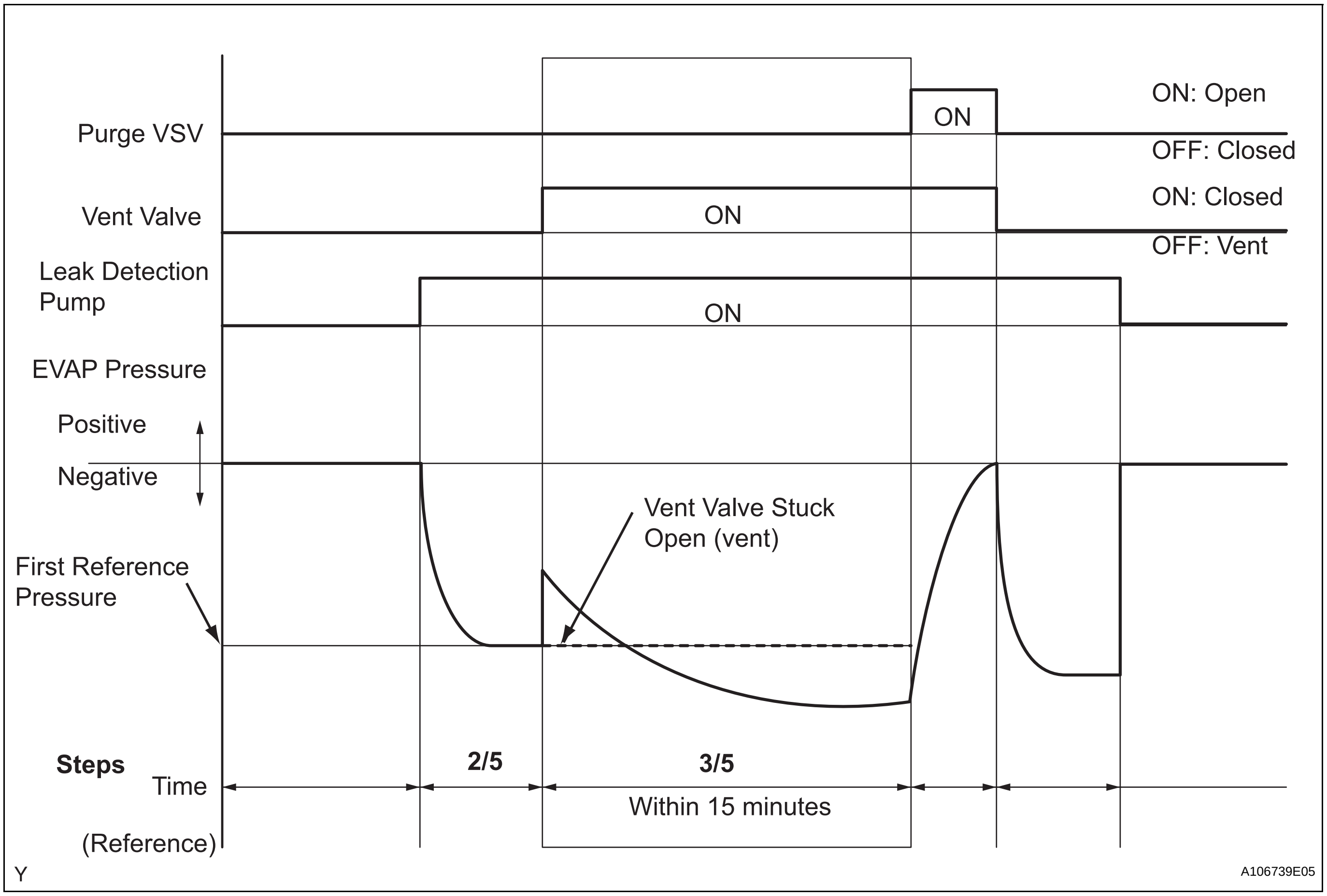
B → **Go to step 11**

C → **Go to step 29**

D → **Go to step 20**

A

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



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

Result

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

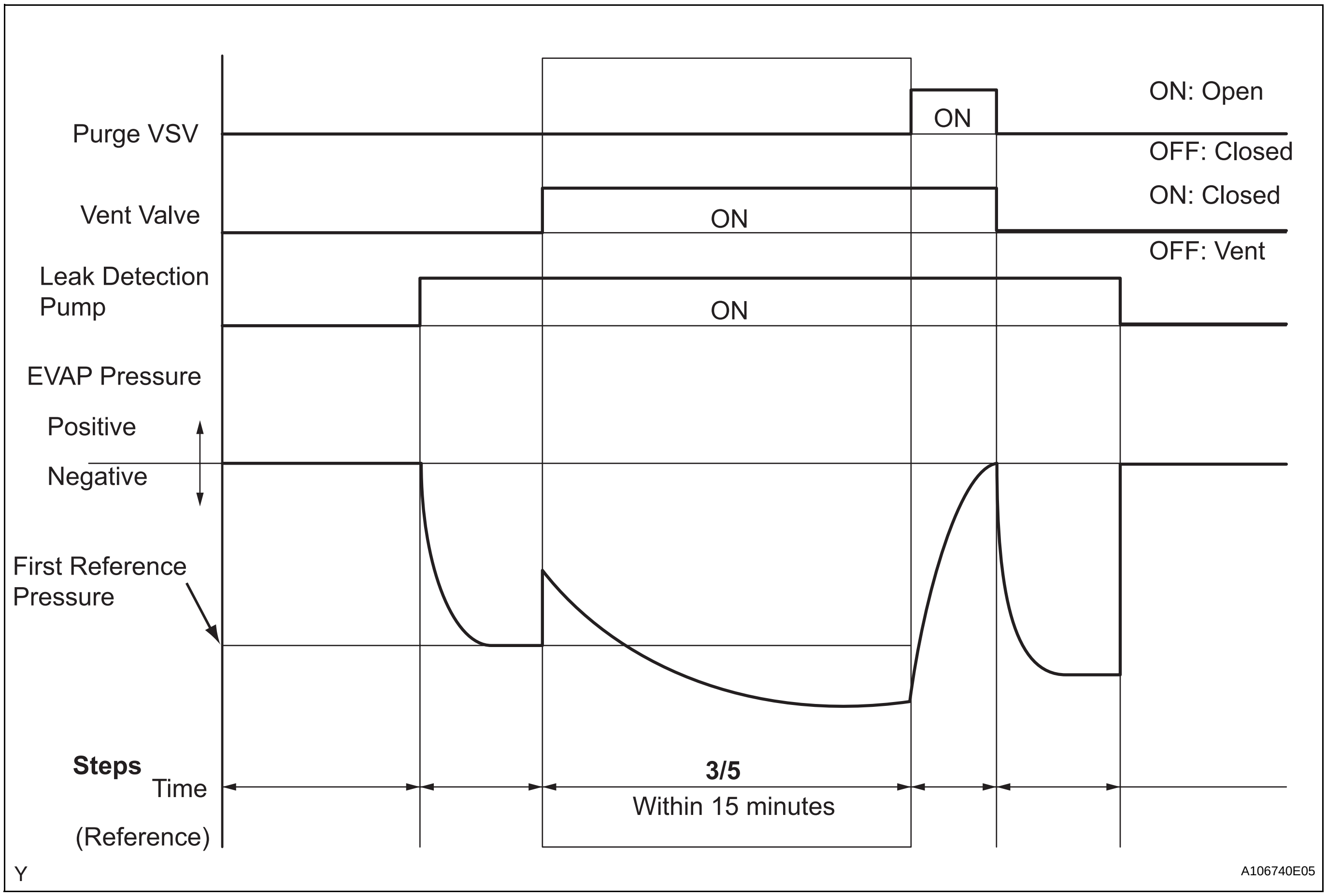
*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.

B → **Go to step 19**

C → Go to step 29

A

8 PERFORM EVAP SYSTEM CHECK (STEP 3/5)



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

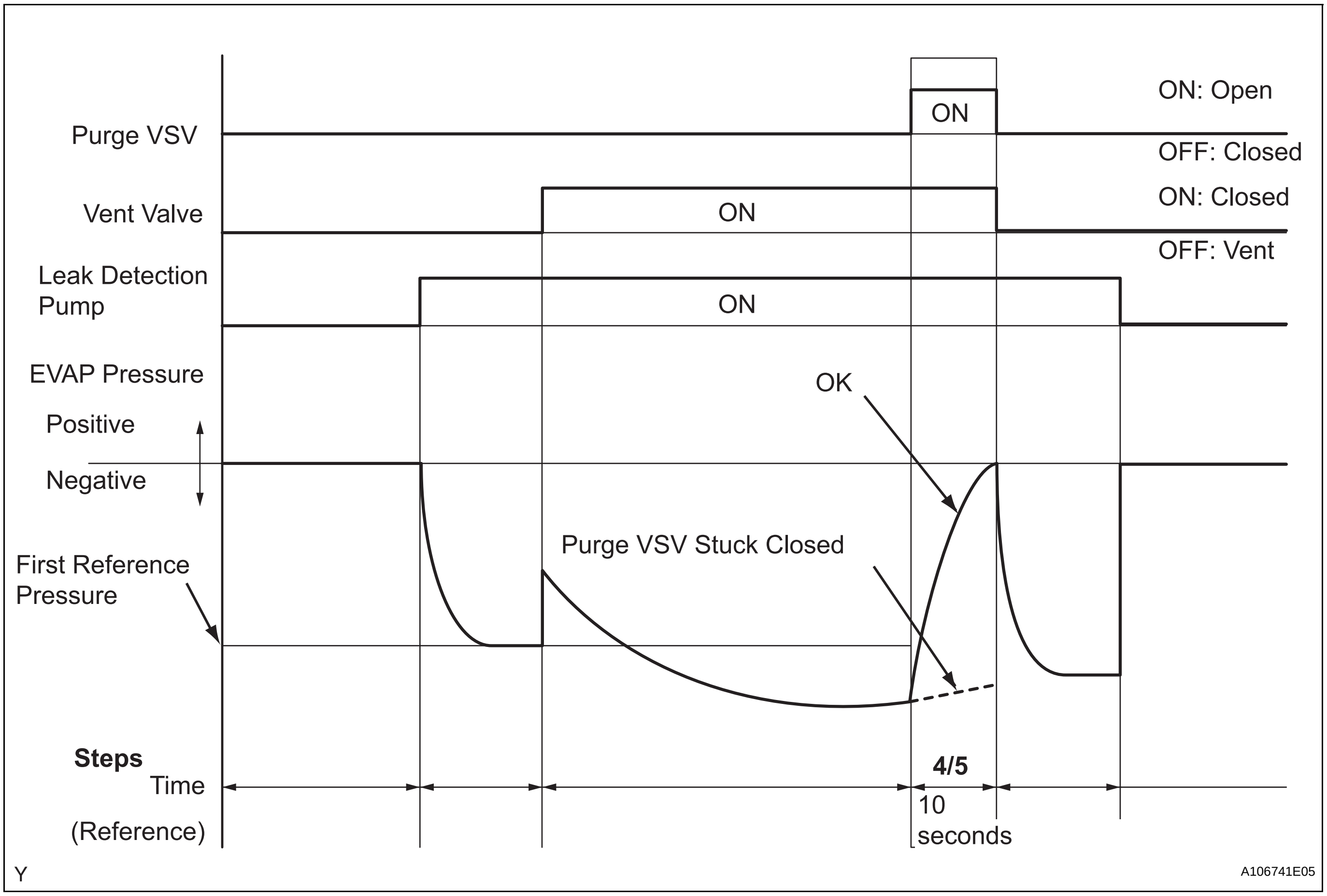
(b) Measure the EVAP pressure and record it.

HINT:

A few minutes are required for the EVAP pressure to become saturated. When there is little fuel in the fuel tank, it takes up to 15 minutes.

NEXT

9	PERFORM EVAP SYSTEM CHECK (STEP 4/5)



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

Result

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

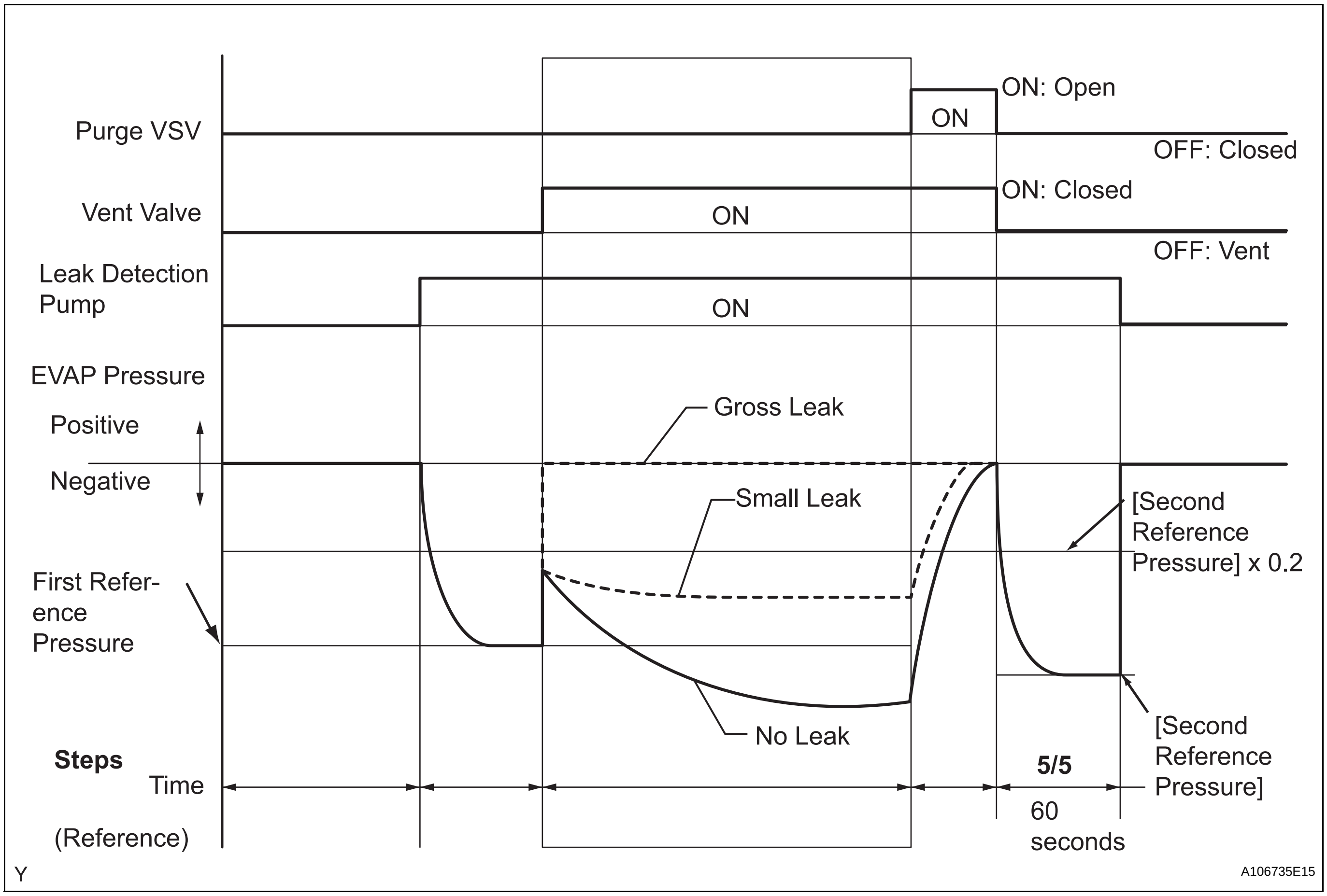
*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.

B → **Go to step 15**

C → **Go to step 12**

A

10 PERFORM EVAP SYSTEM CHECK (STEP 5/5)



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

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

Result

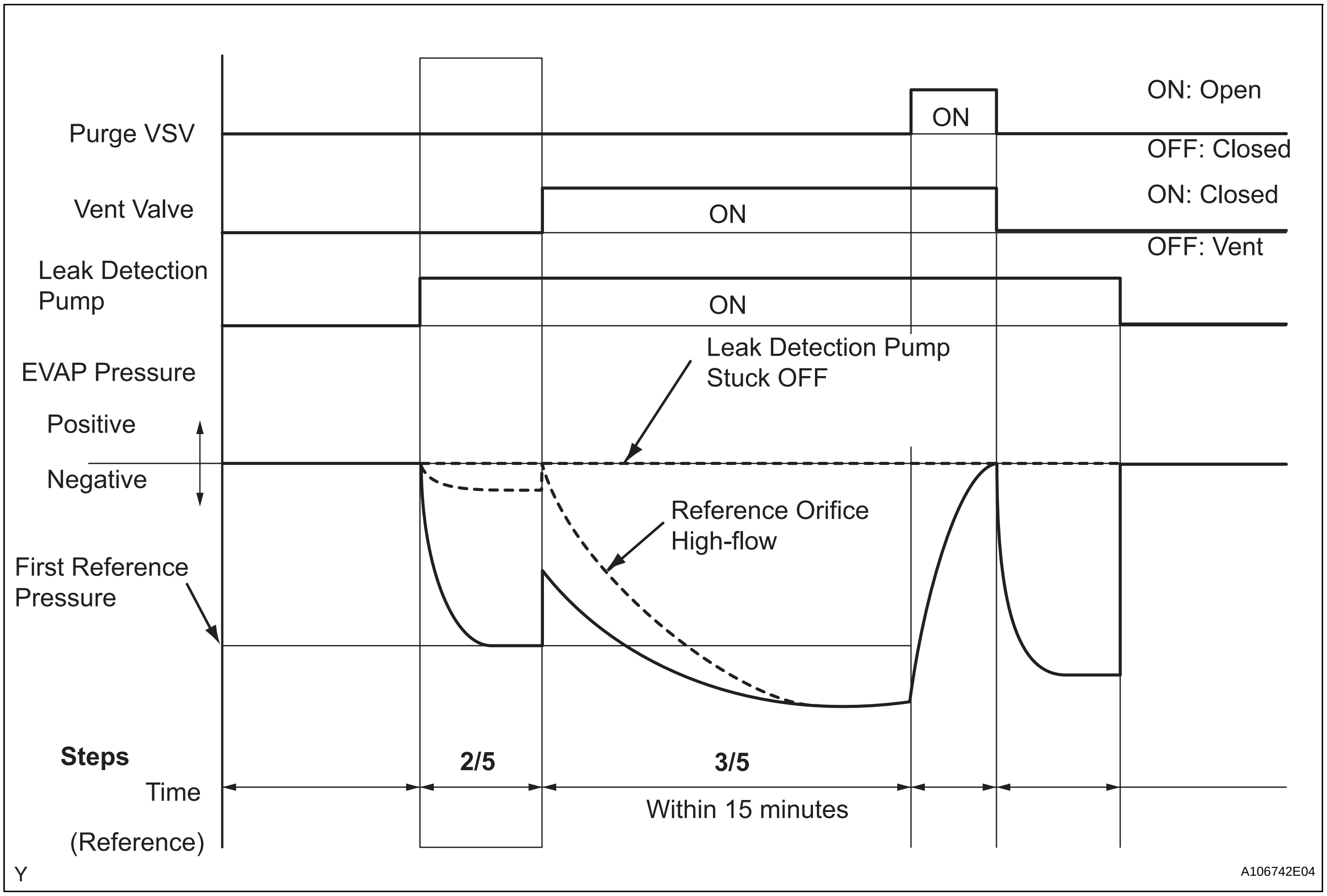
DTCs*	Test Results	Suspected Trouble Areas	Proceed to
-	EVAP pressure (step 3/5) lower than second reference pressure (step 5/5)	Not yet determined (no leakage from EVAP system)	A
P0441 and P0455	EVAP pressure (step 3/5) higher than [second reference pressure (step 5/5) x 0.2]	• Purge VSV stuck open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

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

A → Go to step 35

B → Go to step 12

11	PERFORM EVAP SYSTEM CHECK (STEP 3/5)



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

Result

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

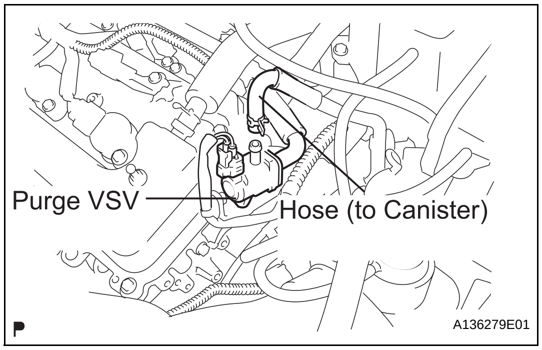
*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.

HINT:

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

A	Go to step 29
B	Go to step 22

12 PERFORM ACTIVE TEST USING INTELLIGENT TESTER (PURGE VSV)



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

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 and confirm the fuel cap meets OEM specifications.
(b) Tighten the fuel cap 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 adapter.
2. Connect an EVAP tester pump hose to the adapter, and pressurize the cap to 3.2 to 3.7 kPa (24 to 28 mmHg) using an EVAP tester pump.
3. Seal the adapter and wait for 2 minutes.
4. Check the pressure. If the pressure is 2 kPa (15 mmHg) or more, the fuel cap is normal.

Result

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

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

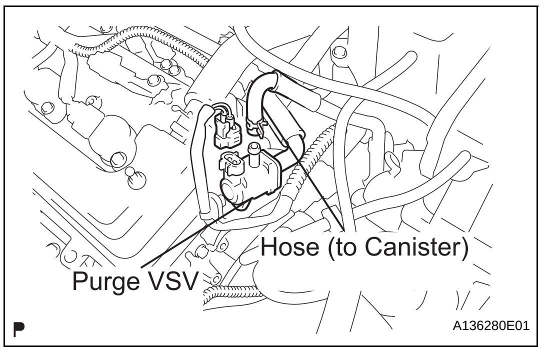
(c) Reinstall the fuel cap.

A → **Go to step 28**

B → **Go to step 26**

C → **Go to step 27**

14 INSPECT DUTY VACUUM SWITCHING VALVE (PURGE VSV)



(a) Turn the ignition switch off.
(b) Disconnect the C6 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

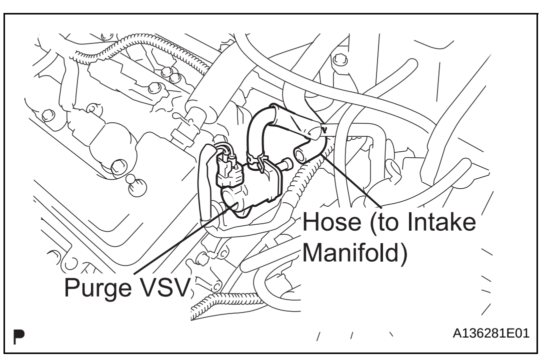
Test Results	Suspected Trouble Areas	Proceed to
No suction	**ECM**	**A**
Suction applied	**Purge VSV**	**B**

(f) Reconnect the purge VSV connector.
(g) Reconnect the hose.

A → **Go to step 34**

B → **Go to step 30**

15 CHECK EVAP HOSE (PURGE VSV - INTAKE MANIFOLD)



(a) Disconnect the hose (connected to the intake manifold) from the purge VSV.
(b) Start the engine.
(c) Use your finger to confirm that the hose has suction.

Result

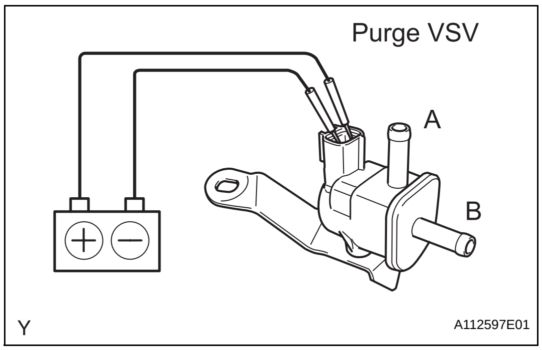
Test Results	Suspected Trouble Areas	Proceed to
Suction applied	EVAP hose between purge VSV and intake manifold normal	A
No suction	• Intake manifold port • EVAP hose between purge VSV and intake manifold	B

(d) Reconnect the hose.

B → **Go to step 25**

A

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

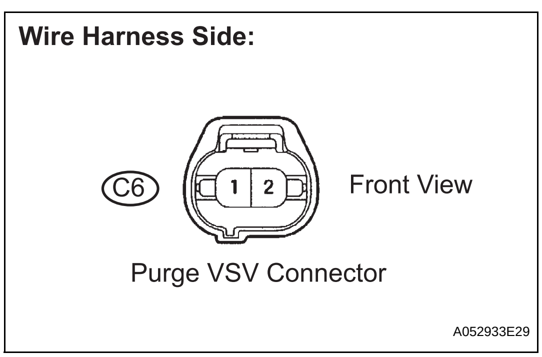
Test Results	Suspected Trouble Areas	Proceed to
Air flows	Purge VSV normal	A
No air flow	Purge VSV	B

(d) Install the purge VSV.

B → **Go to step 30**

A

17 CHECK HARNESS AND CONNECTOR (POWER SOURCE OF PURGE VSV)



(a) Disconnect the C6 purge VSV connector.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage between terminal 2 of the purge VSV connector and body ground.

Result

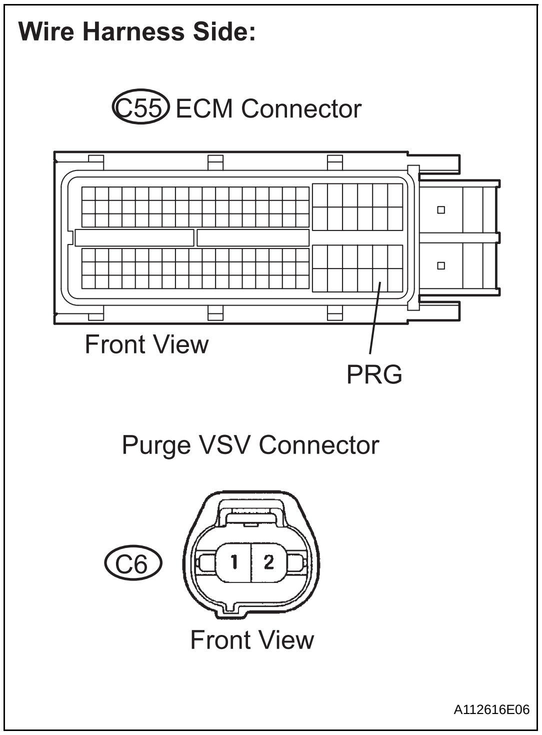
Test Results	Suspected Trouble Areas	Proceed to
9 to 14 V	Normal	A
Other than result above	Wire harness or connectors between purge VSV and ECM	B

(d) Reconnect the purge VSV connector.

B → **Go to step 31**

A

18 CHECK HARNESS AND CONNECTOR (PURGE VSV - ECM)



(a) Disconnect the C55 ECM connector and the C6 purge VSV connector.

(b) Measure the resistance.

Standard resistance

Tester Connections	Specified Conditions
C55-108 (PRG) - C6-2 (Purge VSV)	Below 1 Ω
C55-108 (PRG) - Body ground	10 kΩ or higher
C6-2 (Purge VSV) - Body ground	10 kΩ or higher

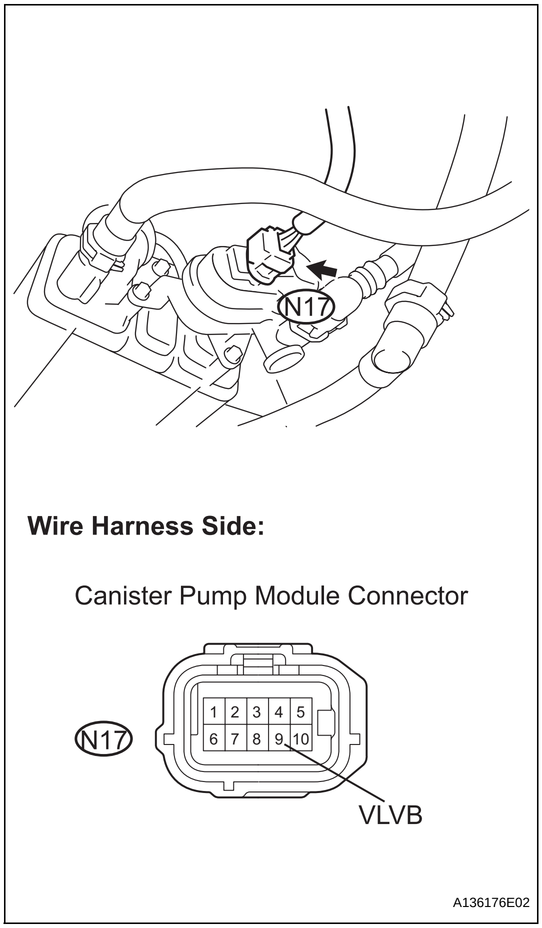
(c) Reconnect the purge VSV connector.

(d) Reconnect the ECM connector.

OK → **Go to step 34**

NG → **Go to step 31**

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



(a) Turn the ignition switch off.
(b) Disconnect the N17 canister pump module connector.
(c) Turn the ignition switch on (IG).
(d) Measure the voltage between the VLVB terminal of the canister pump module connector and body ground.

Result

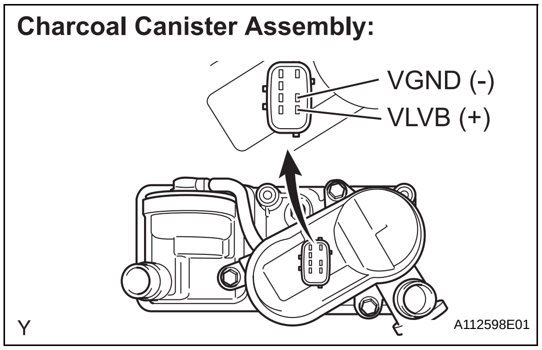
Test Results	Suspected Trouble Areas	Proceed to
9 to 14 V	1. Wire harness between vent valve and ECM 2. Vent valve 3. ECM	A
Below 3 V	Power source wire harness of vent valve	B

(e) Reconnect the canister pump module connector.

B → **Go to step 31**

A

20	INSPECT CANISTER PUMP MODULE (VENT VALVE OPERATION)



(a) Turn the ignition switch off.
(b) Disconnect the N17 canister pump module connector.
(c) Apply battery voltage to the VLVB and VGND terminals of the canister pump module.
(d) Touch the canister pump module to confirm the vent valve operation.

Result

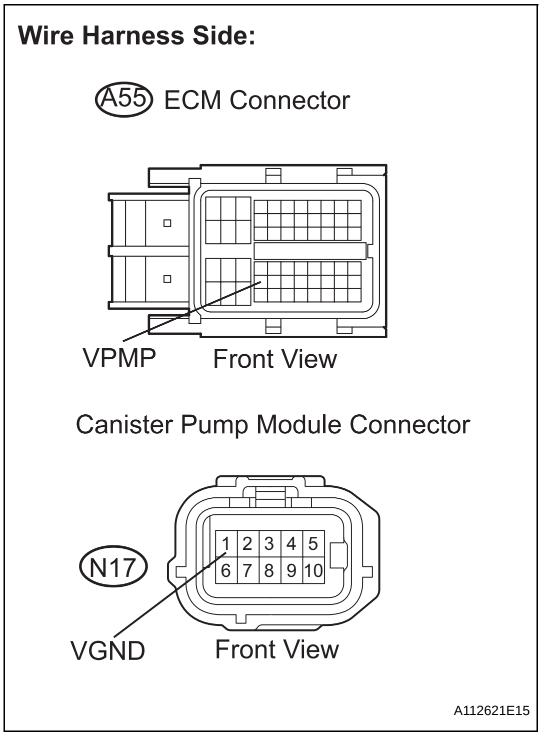
Test Results	Suspected Trouble Areas	Proceed to
Operating	1. Wire harness between vent valve and ECM 2. ECM	A
Not operating	Vent valve	B

(e) Reconnect the canister connector.

B → **Go to step 29**

A

21	CHECK HARNESS AND CONNECTOR (ECM - CANISTER PUMP MODULE)



(a) Disconnect the A55 ECM connector.
(b) Disconnect the N17 canister pump module connector.
(c) Measure the resistance between the VPMP terminal of the ECM connector and the VGND terminal of the canister pump module connector.

Result

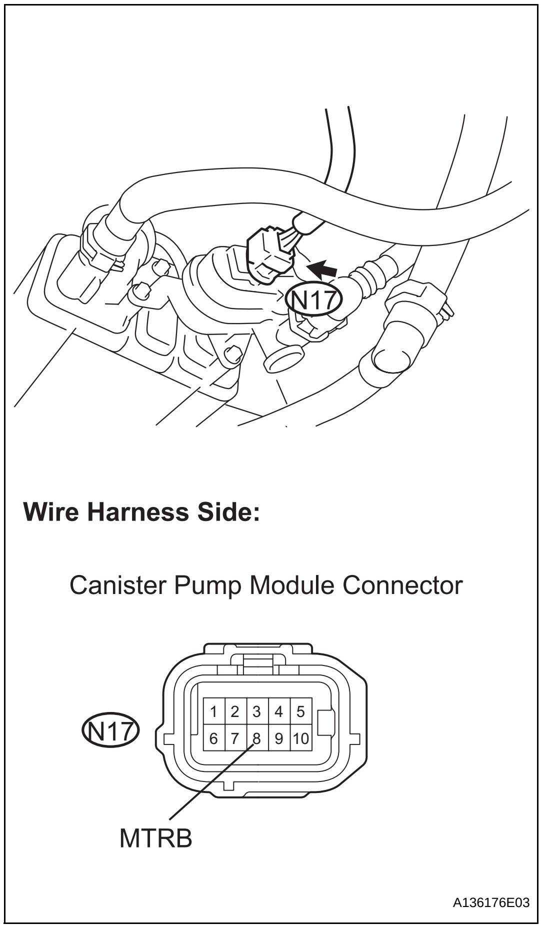
Test Results	Suspected Trouble Areas	Proceed to
Below 1 Ω	ECM	A
10 kΩ or higher	Wire harness between ECM and canister pump module	B

ES

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

A	Go to step 34
B	Go to step 31

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



(a) Turn the ignition switch off.
(b) Disconnect the N17 canister pump module connector.
(c) Turn the ignition switch on (IG).
(d) On the intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VACUUM PUMP.
(e) Measure the voltage between MTRB terminal 1 of the canister pump module connector and body ground when the leak detection pump is turned ON and OFF using the tester.

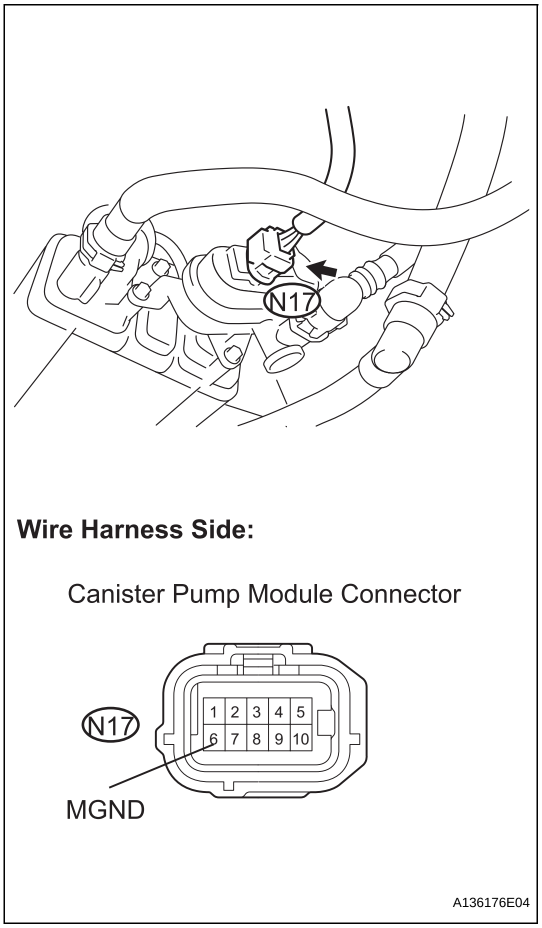
Result

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

B	Go to step 24

A

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



(a) Turn the ignition switch off.
(b) Disconnect the N17 canister pump module connector.
(c) Measure the resistance between the MGND terminal of the canister pump module connector and body ground.

ES

Result

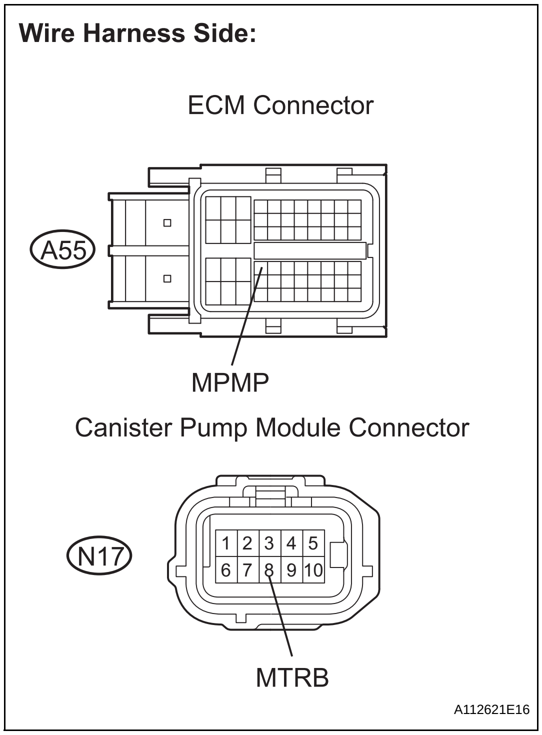
Test Results	Suspected Trouble Areas	Proceed to
Below 1 Ω	Leak detection pump	A
10 kΩ or higher	Wire harness between canister pump module and body ground	B

(d) Reconnect the canister pump module connector.

A → **Go to step 29**

B → **Go to step 31**

24 CHECK HARNESS AND CONNECTOR (ECM - CANISTER PUMP MODULE)



(a) Turn the ignition switch off.
(b) Disconnect the N17 canister pump module connector.
(c) Disconnect the C55 ECM connector.
(d) Measure the resistance between the MPMP terminal of the ECM connector and the MTRB terminal of the canister pump module connector.

Result

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

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

A → **Go to step 34**

B → **Go to step 31**

25 INSPECT INTAKE MANIFOLD (EVAP PURGE PORT)

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

Result

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

(e) Reconnect the EVAP hose.

A → **Go to step 32**

B → **Go to step 33**

26	CORRECTLY REINSTALL OR REPLACE FUEL CAP

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

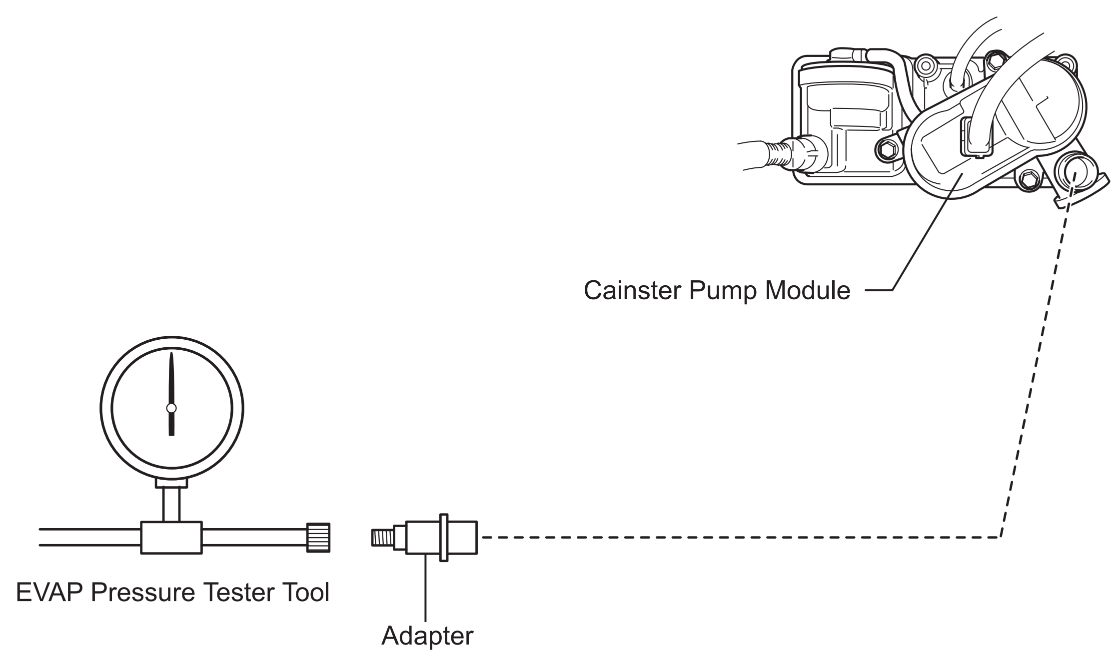
NEXT → **Go to step 36**

27	REPLACE FUEL CAP

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

NEXT → **Go to step 36**

28	LOCATE EVAP LEAK PART



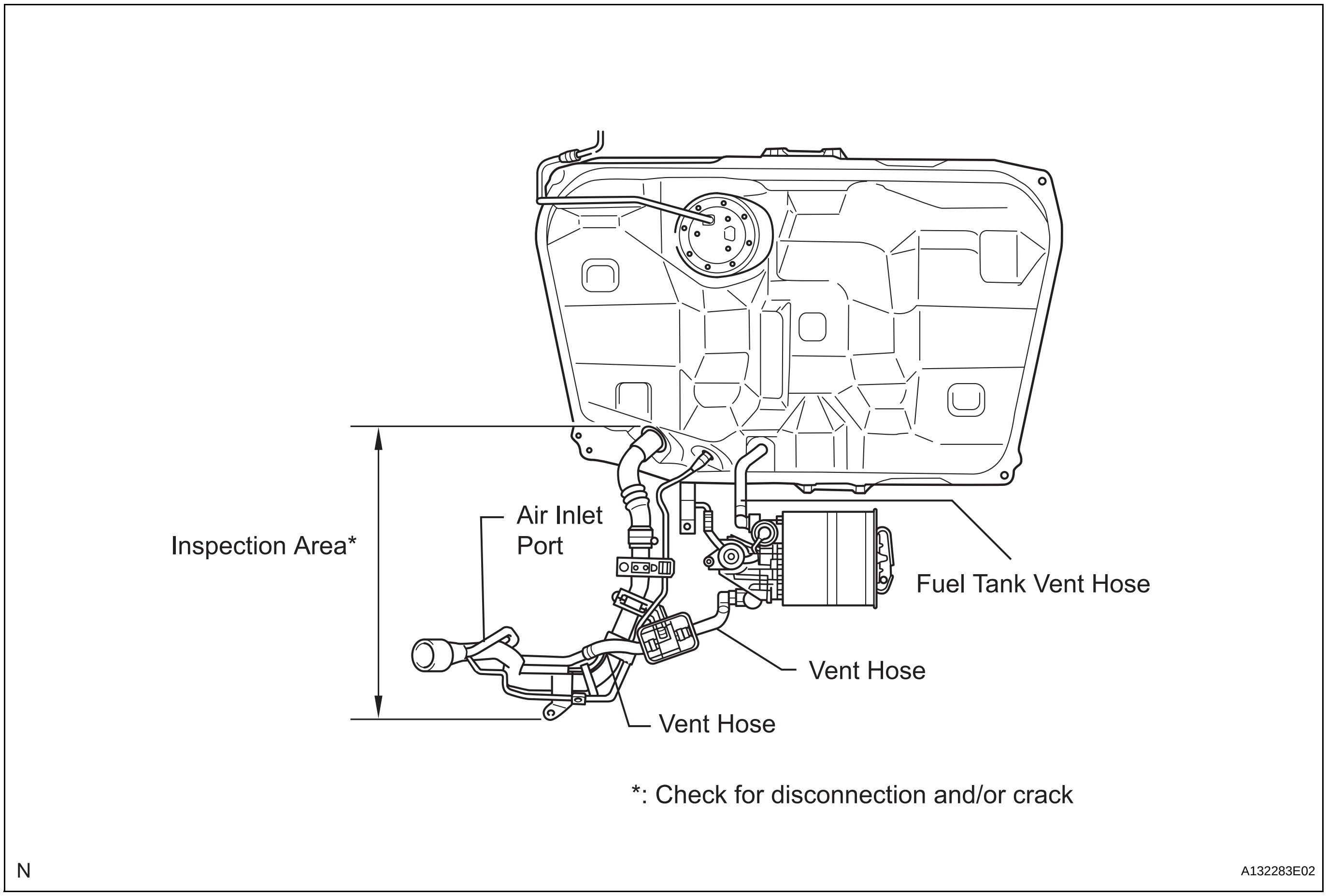
(a) Disconnect the vent hose.
(b) Connect the EVAP pressure tester tool to the canister pump module with the adapter.

(c) Pressurize the EVAP system to 3.2 to 3.7 kPa (24 to 28 mmHg).
(d) Apply soapy water to the piping and connecting parts of the EVAP system.
(e) Look for areas where bubbles appear. This indicates the leak point.
(f) Repair or replace the leak point.
HINT:
Disconnect the hose between the canister and the fuel tank from the canister. Block the canister side and conduct an inspection. In this way, the fuel tank can be excluded as an area suspected of causing fuel leaks.

NEXT	Go to step 36

29	REPLACE CHARCOAL CANISTER ASSEMBLY

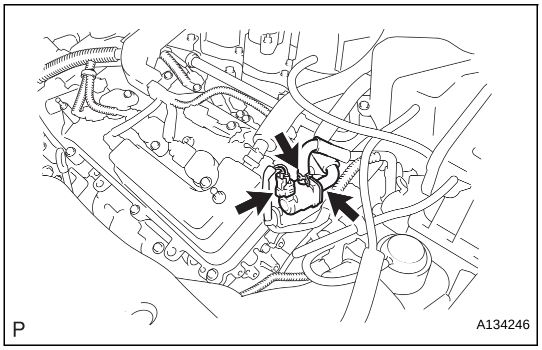
(a) Replace the canister assembly (See page EC-9).



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

NEXT Go to step 36

30 REPLACE DUTY VACUUM SWITCHING VALVE (PURGE VSV)



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

NEXT Go to step 36

31 REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT Go to step 36

32 REPLACE EVAP HOSE (INTAKE MANIFOLD - PURGE VSV)

NEXT Go to step 36

33 INSPECT INTAKE MANIFOLD (EVAP PURGE PORT)

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

NEXT Go to step 36

34 REPLACE ECM

(a) Replace the ECM (See page ES-518).

NEXT Go to step 36

35 REPAIR OR REPLACE PARTS AND COMPONENTS INDICATED BY OUTPUT DTCS

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

NEXT Go to step 36

36	PERFORM EVAP SYSTEM CHECK (AUTO OPERATION)

NOTICE:

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

(a) Clear the DTCs (See page ES-45).

(b) On the intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.

(c) After the SYSTEM CHECK is completed, check for pending DTCs by selecting the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.

HINT:

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

NEXT

COMPLETED

CONFIRMATION DRIVING PATTERN

HINT:

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

1. KEY-OFF MONITOR CONFIRMATION

(a) Preconditions

The monitor will not run unless:

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

(b) Monitor Conditions

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

   HINT:

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

(c) Monitor Status
1. Connect the intelligent tester to the DLC3.
2. Turn the ignition switch on (IG) and turn the tester on.
3. Select the following menu items: DIAGNOSIS / ENHANCED OBD II / MONITOR STATUS.
4. Check the Monitor Status displayed on the tester.
HINT:
If INCMP is displayed, the monitor is not complete. Make sure that the preconditions have been met, and perform the Monitor Conditions again.

2. PURGE FLOW MONITOR CONFIRMATION (P0441)

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

(a) Preconditions
The monitor will not run unless:
- The vehicle has been driven for 10 minutes or more (in a city area or on a freeway)
- The ECT is between 4.4°C and 35°C (40°F and 95°F)
- The IAT is between 4.4°C and 35°C (40°F and 95°F)

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

(c) Monitor Status
1. Turn the ignition switch off (if ON or the engine is running).
2. Connect the intelligent tester to the DLC3.
3. Turn the ignition switch on (IG) and turn the tester on.
4. Select the following menu items: DIAGNOSIS / ENHANCED OBD II / MONITOR STATUS.
5. Check the Monitor Status displayed on the tester.
HINT:
If INCMP is displayed, the monitor is not complete. Make sure that the preconditions have been met, and perform the Monitor Conditions again.

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-25).

ECM Power Source Circuit

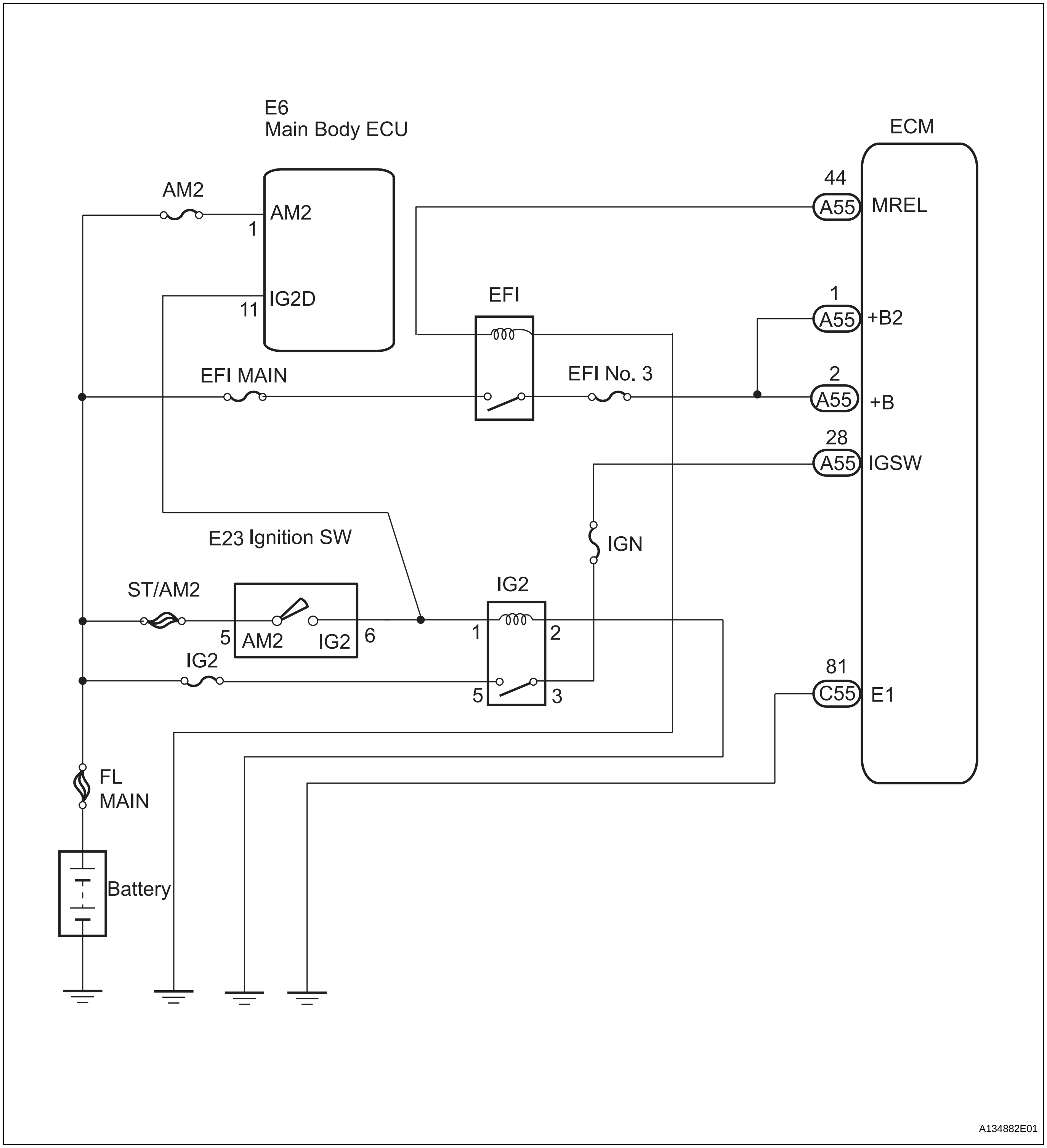
DESCRIPTION

When the ignition switch is turned on (IG), 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 MAIN relay and supplying power to terminal +B of the ECM.

If the ignition switch is turned off, the ECM holds the EFI MAIN relay ON for a maximum of 2 seconds to allow for the initial setting of the throttle valve.

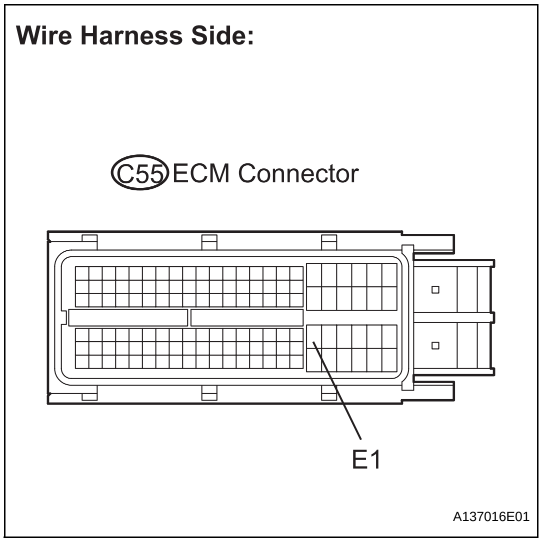
When the ignition switch is turned on (IG), voltage from the ECM's MREL terminal applies to the engine room junction block (EFI relay). This causes the contacts of the engine room junction block (EFI relay) to close, which supplies power to terminal +B or +B1 of the ECM.

WIRING DIAGRAM



INSPECTION PROCEDURE

1 CHECK HARNESS AND CONNECTOR (ECM - BODY GROUND)



(a) Disconnect the C55 ECM connector.
(b) Measure the resistance between the terminals.
Standard resistance

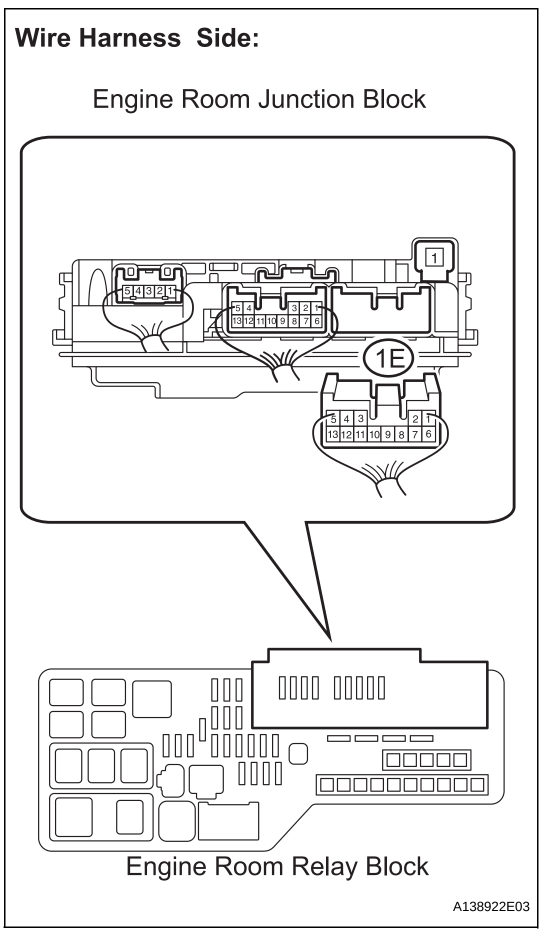
Tester Connection	Specified Condition
E1 (C55-81) - Body ground	Below 1 Ω

(c) Reconnect the ECM connector.

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

OK ↓

2 CHECK ENGINE ROOM JUNCTION BLOCK (EFI RELAY VOLTAGE)



(a) Remove the engine room junction block from the engine room R/B.
(b) Turn the ignition switch on (IG).
(c) Measure the voltage between the terminals.
Standard voltage

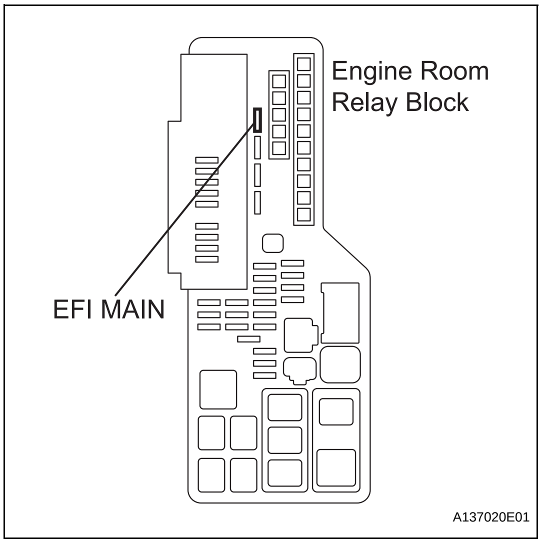
Tester Connection	Specified Condition
1E-6 - Body ground	9 to 14 V

OK → **Go to step 5**

ES

NG

3	INSPECT EFI MAIN FUSE

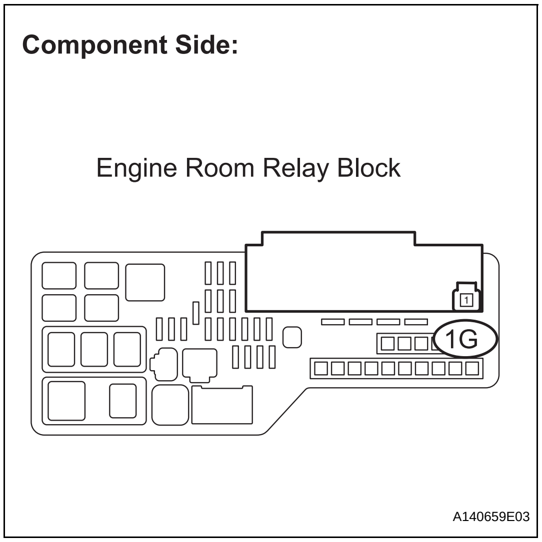


(a) Remove the EFI MAIN fuse from the engine room R/B.
(b) Measure the EFI MAIN fuse resistance.
Standard resistance:
Below 1 Ω
(c) Reinstall the EFI MAIN fuse.

NG → **REPLACE EFI MAIN FUSE**

OK

4	CHECK HARNESS AND CONNECTOR (ENGINE ROOM RELAY BLOCK - BATTERY)



(a) Disconnect the negative battery terminal.
(b) Disconnect the positive battery terminal.
(c) Remove the engine room junction block from the engine room R/B.
(d) Measure the resistance between the terminals.
Standard resistance (Check for open)

Tester Connection	Specified Condition
1G-1 - Positive battery terminal	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
1G-1 or Positive battery terminal - Body ground	10 kΩ or higher

(e) Reinstall the engine room junction block.
(f) Reconnect the positive battery terminal.
(g) Reconnect the negative battery terminal.

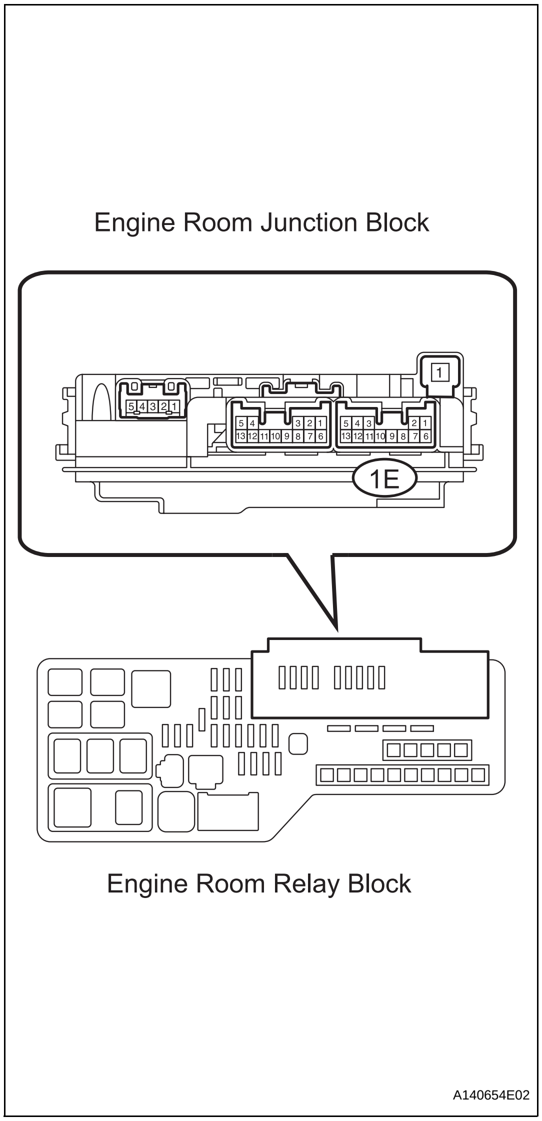
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE (See page ES-33)

ES

5	INSPECT ENGINE ROOM JUNCTION BLOCK (EFI RELAY)



(a) Remove the engine room junction block from the engine room R/B.

(b) Measure the resistance between the terminals.

Standard resistance

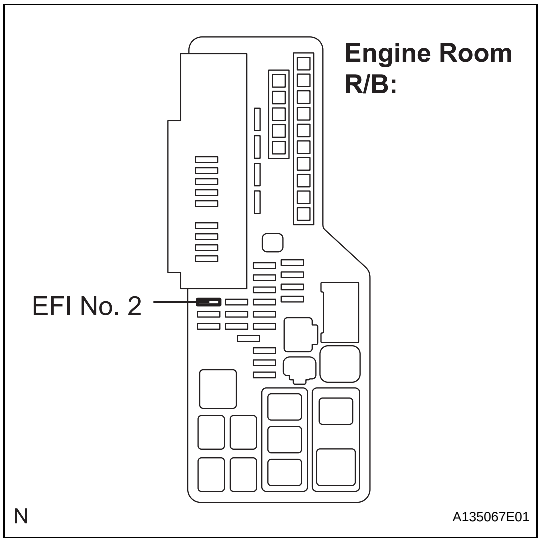
Tester Connection	Specified Condition
1E-6 - 1E-12	10 kΩ or higher
1E-6 - 1E-12	Below 1 Ω (Apply battery voltage between terminals 1E-9 and 1E-11)

(c) Reinstall the engine room junction block.

NG → **REPLACE ENGINE ROOM JUNCTION BLOCK**

OK

6	INSPECT EFI NO. 2 FUSE



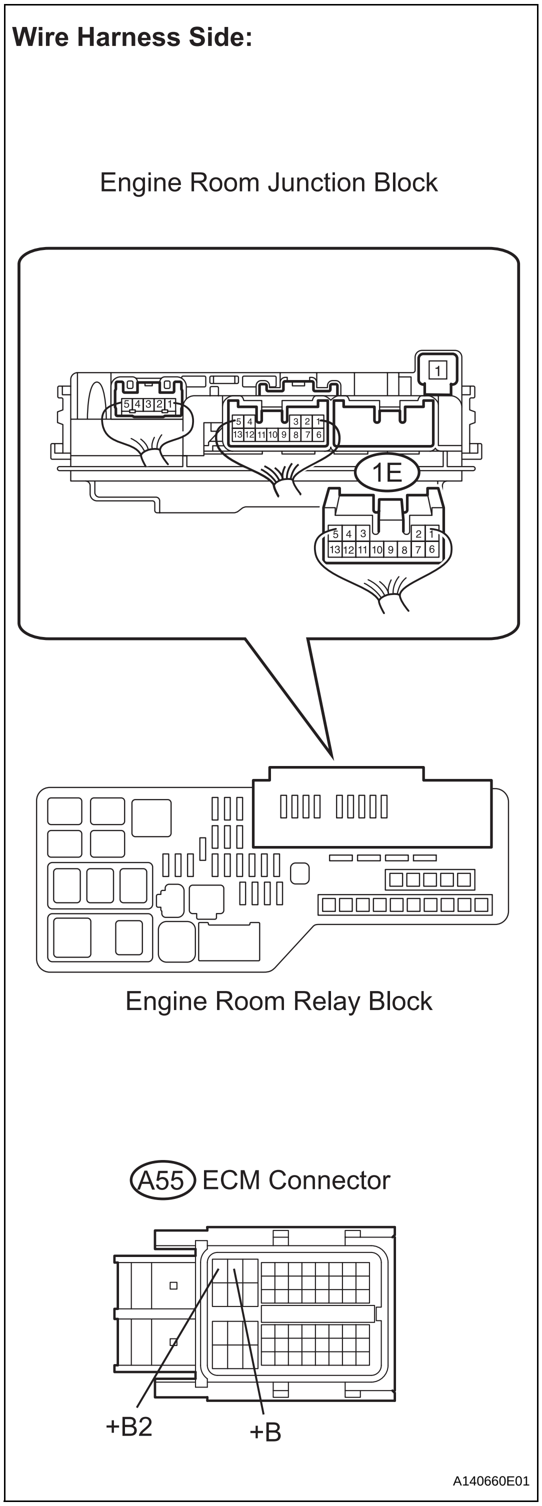
(a) Remove the EFI No. 2 fuse from the engine room R/B.
(b) Measure the EFI No. 2 fuse resistance.
Standard resistance:
Below 1 Ω
(c) Reinstall the EFI No. 2 fuse.

NG → **REPLACE EFI NO 2 FUSE**

OK

ES

7	CHECK HARNESS AND CONNECTOR (ECM - ENGINE ROOM JUNCTION BLOCK)



(a) Disconnect the A55 ECM connector.
(b) Remove the engine room junction block from the engine room R/B.
(c) Measure the resistance between the terminals.

Standard resistance (Check for open)

Tester Connection	Specified Condition
1E-6 - +B (A55-2)	Below 1 Ω
1E-6 - +B2 (A55-1)	Below 1 Ω

Standard resistance (Check for short)

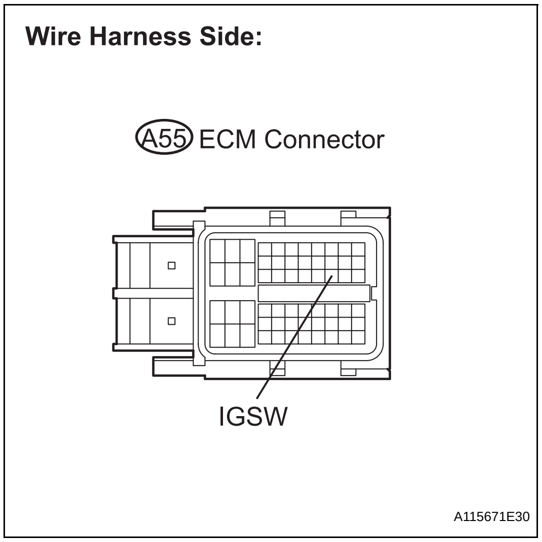
Tester Connection	Specified Condition
1E-6 or +B (A55-2) - Body ground	10 kΩ or higher
1E-6 or +B2 (A55-1) - Body ground	10 kΩ or higher

(d) Reinstall the engine room junction block.
(e) Reconnect the ECM connector.

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

OK

8 INSPECT ECM (IGSW VOLTAGE)



(a) Disconnect the A55 ECM connector.
(b) Measure the voltage between the terminals.
Standard voltage

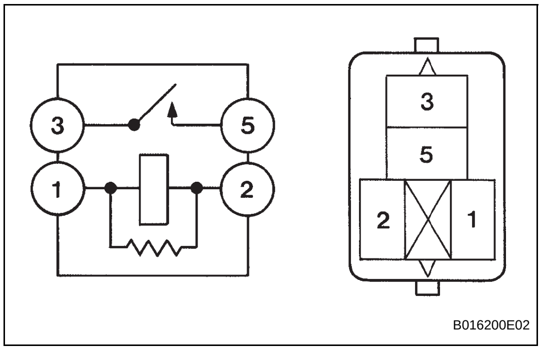
Tester Connection	Specified Condition
IGSW (A55-28) - Body ground	9 to 14 V

(c) Reconnect the ECM connector.

OK → **Go to step 12**

NG

9 INSPECT IG2 RELAY



(a) Remove the IG2 relay from the engine room R/B.
(b) Measure the resistance between the terminals.
Standard resistance

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

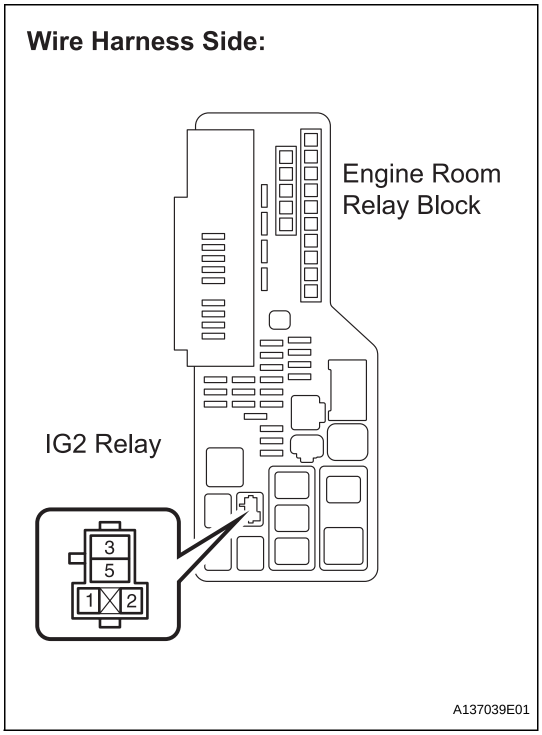
(c) Reinstall the IG2 relay.

NG → **REPLACE IG2 RELAY**

OK

ES

10 CHECK HARNESS AND CONNECTOR (IG2 RELAY - BODY GROUND)



(a) Remove the IG2 relay from the engine room R/B.

(b) Measure the resistance between the terminals.

Standard resistance

Tester Connection	Specified Condition
IG2 relay terminal 2 - Body ground	Below 1 Ω

(c) Reinstall the IG2 relay.

Result

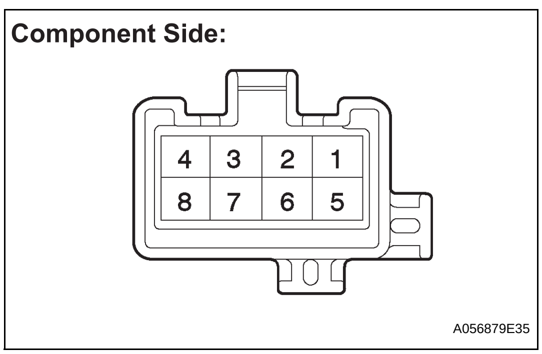
Result	Proceed to
OK (Without smart key system)	A
OK (With smart key system)	B
NG	C

B → **GO TO SMART ACCESS SYSTEM WITH PUSH-BUTTON START**

C → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

A

11 INSPECT IGNITION SWITCH ASSEMBLY



(a) Disconnect the E23 ignition switch connector.

(b) Measure the resistance between the terminals.

Standard resistance

Tester Connection	Ignition Switch Position	Specified Condition
All terminals	LOCK	10 kΩ or higher
2 - 4	ACC	Below 1 Ω
1 - 2 - 4, 5 - 6	ON	
1 - 3 - 4, 5 - 6 - 7	START	

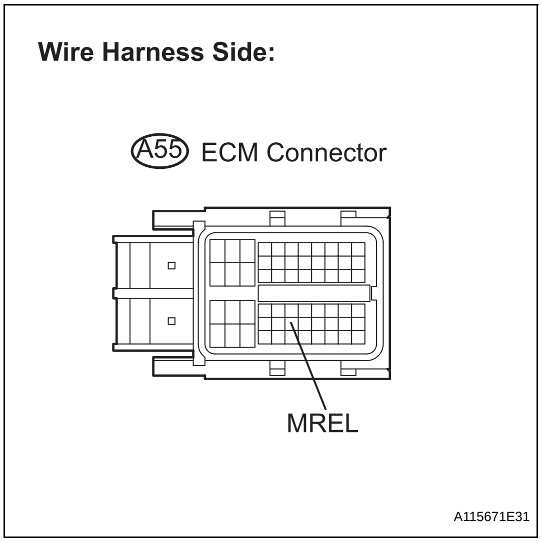
(c) Reconnect the ignition switch connector.

NG → **REPLACE IGNITION SWITCH ASSEMBLY**

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - BATTERY)

12 CHECK HARNESS AND CONNECTOR (ECM - BODY GROUND)



(a) Disconnect the A55 ECM connector.

(b) Measure the resistance between the terminals.

Standard resistance

Tester Connection	Specified Condition
MREL (A55-24) - Body ground	Below 1 Ω

(c) Reconnect the ECM connector.

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

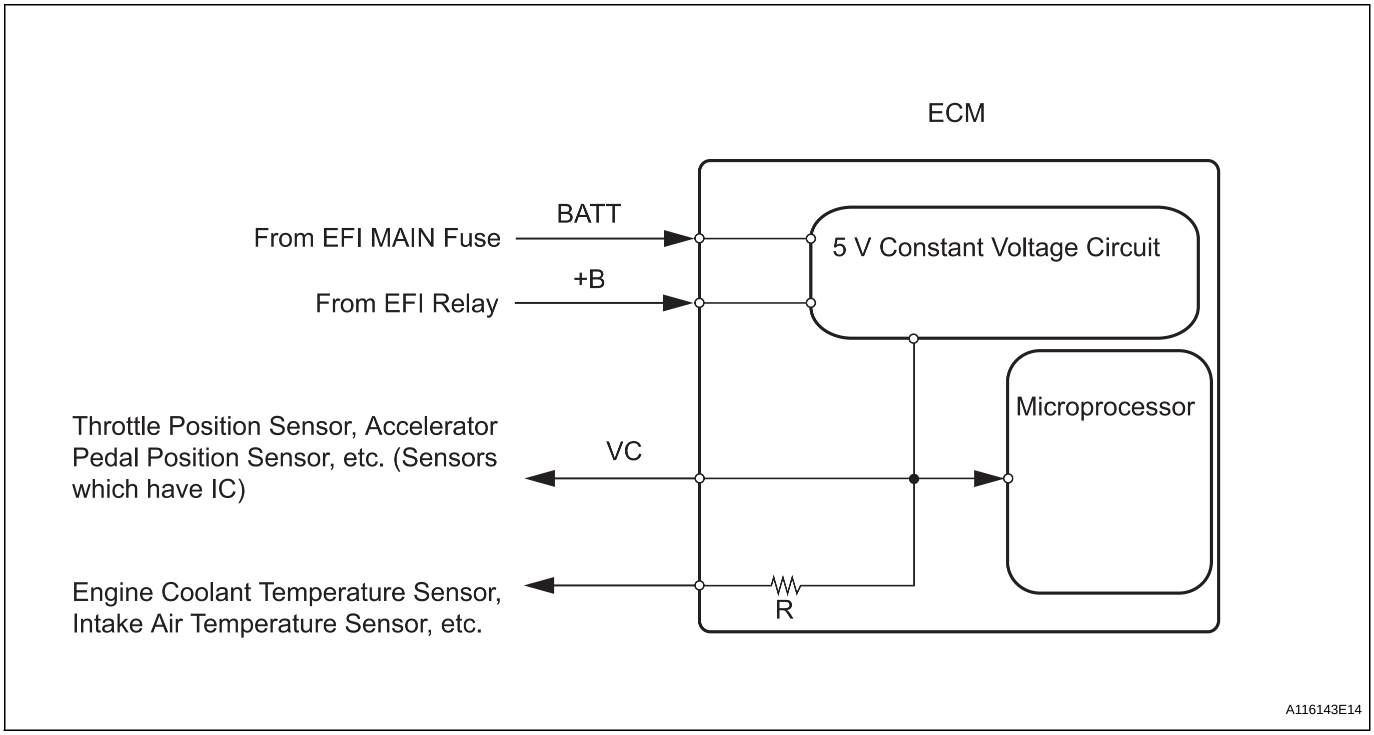
OK

REPLACE ECM (See page ES-518)

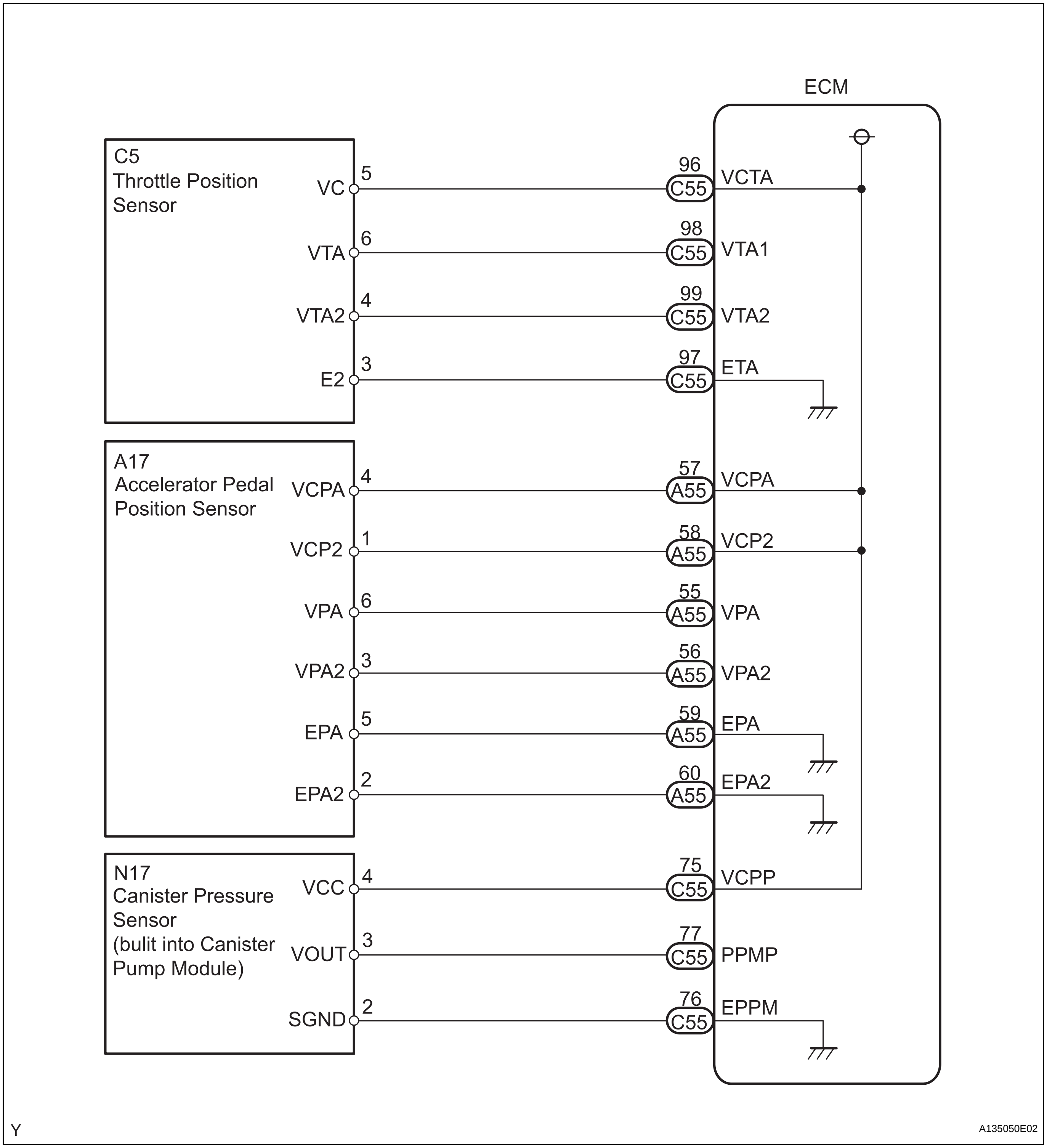
VC Output Circuit

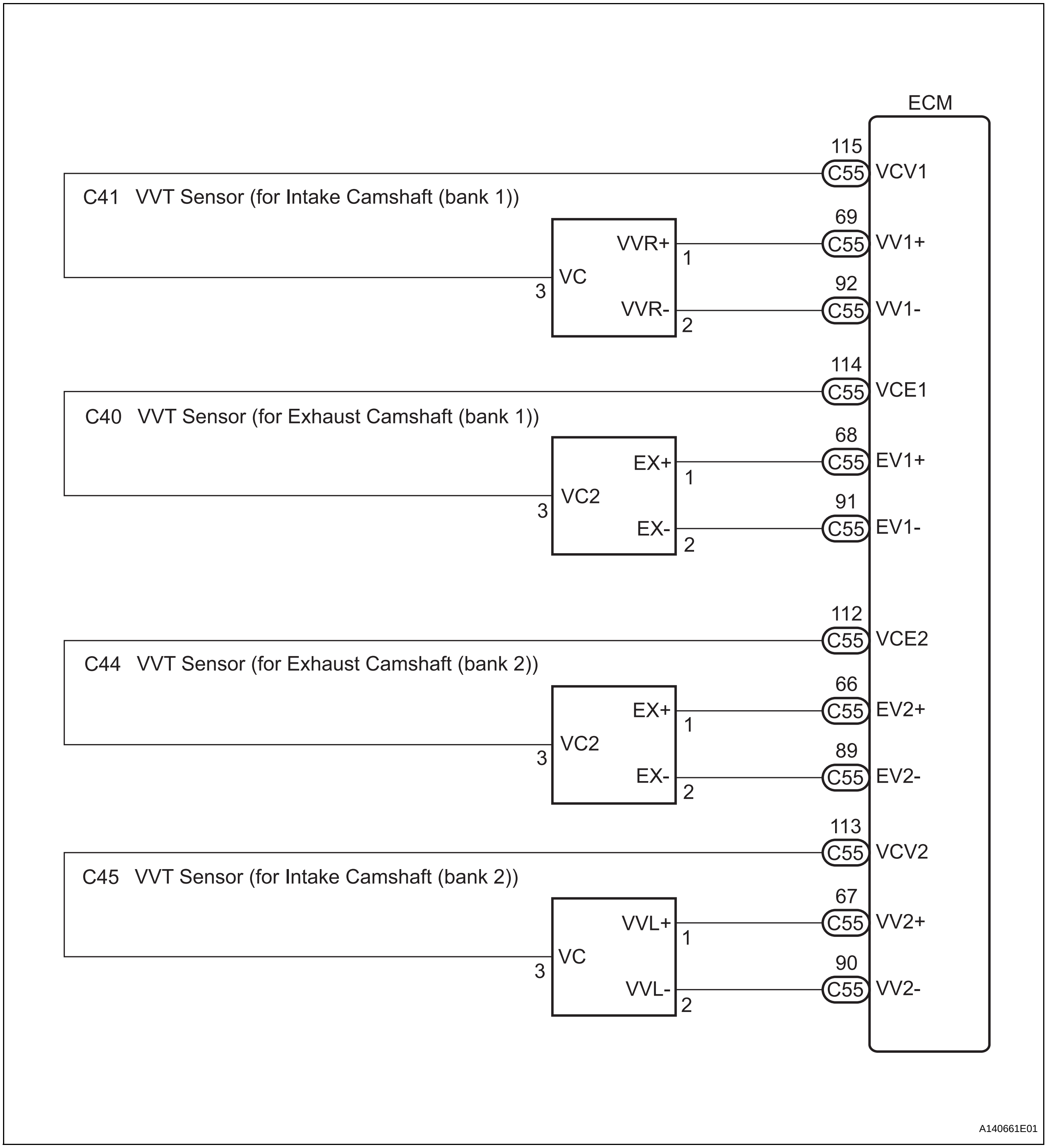
DESCRIPTION

The ECM constantly uses 5 V from the battery voltages 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 (IG). The MIL goes off when the engine is started.



WIRING DIAGRAM





INSPECTION PROCEDURE

1	CHECK MIL

(a) Check that Malfunction Indicator Lamp (MIL) lights up when turning the ignition switch on (IG).

OK:

MIL lights up.

OK

GO TO MIL CIRCUIT (See page ES-471)

NG

2 CHECK CONNECTION BETWEEN INTELLIGENT TESTER AND ECM

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) and tester on.
(c) Check the communication between the tester and ECM.

Result

Result	Proceed to
Communication is possible	A
Communication is not possible	B

A

GO TO MIL CIRCUIT (See page ES-471)

B

3 CHECK THROTTLE BODY ASSEMBLY (CHECK MIL ILLUMINATED)

(a) Disconnect the throttle body connector.
(b) Turn the ignition switch on (IG).
(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 ASSEMBLY (See page ES-503)

B

4 CHECK ACCELERATOR PEDAL ASSEMBLY (CHECK MIL ILLUMINATED)

(a) Disconnect the accelerator pedal position sensor connector.
(b) Turn the ignition switch on (IG).
(c) Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

(d) Reconnect the accelerator pedal position sensor connector.

A

REPLACE ACCELERATOR PEDAL ASSEMBLY (See page ES-521)

B

5 CHECK VVT SENSOR FOR INTAKE CAMSHAFT BANK 1 (CHECK MIL ILLUMINATED)

(a) Disconnect the VVT sensor for intake camshaft bank 1 connector.
(b) Turn the ignition switch on (IG).
(c) Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

(d) Reconnect the VVT sensor for intake camshaft bank 1 connector.

A → **REPLACE VVT SENSOR FOR INTAKE CAMSHAFT BANK 1 (See page ES-489)**

B

6 CHECK VVT SENSOR FOR EXHAUST CAMSHAFT BANK 1 (CHECK MIL ILLUMINATED)

(a) Disconnect the VVT sensor for exhaust camshaft bank 1 connector.
(b) Turn the ignition switch on (IG).
(c) Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

(d) Reconnect the VVT sensor for exhaust camshaft bank 1 connector.

A → **REPLACE VVT SENSOR FOR EXHAUST CAMSHAFT BANK 1 (See page ES-489)**

B

7 CHECK VVT SENSOR FOR INTAKE CAMSHAFT BANK 2 (CHECK MIL ILLUMINATED)

(a) Disconnect the VVT sensor for intake camshaft bank 2 connector.
(b) Turn the ignition switch on (IG).
(c) Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

(d) Reconnect the VVT sensor for intake camshaft bank 2 connector.

ES

A

REPLACE VVT SENSOR FOR INTAKE CAMSHAFT BANK 2 (See page ES-489)

B

8 CHECK VVT SENSOR FOR EXHAUST CAMSHAFT BANK 2 (CHECK MIL ILLUMINATED)

(a) Disconnect the VVT sensor for exhaust camshaft bank 2 connector.
(b) Turn the ignition switch on (IG).
(c) Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

(d) Reconnect the VVT sensor for exhaust camshaft bank 2 connector.

A

REPLACE VVT SENSOR FOR EXHAUST CAMSHAFT BANK 2 (See page ES-489)

B

9 CHECK CHARCOAL CANISTER ASSEMBLY (CHECK MIL ILLUMINATED)

(a) Disconnect the canister pump module connector.
(b) Turn the ignition switch on (IG).
(c) Check the MIL.

Result

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

(d) Reconnect the canister pump module connector.

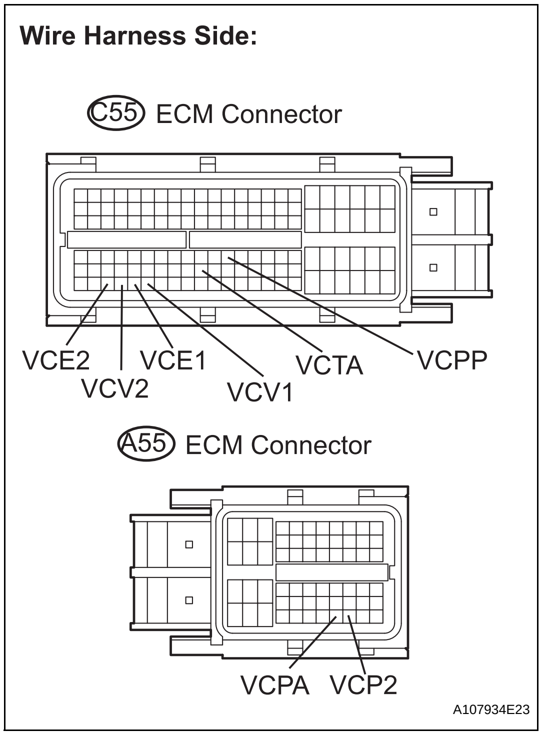
A

REPLACE CHARCOAL CANISTER ASSEMBLY (See page EC-9)

B

ES

10	CHECK HARNESS AND CONNECTOR



(a) Disconnect the throttle body connector.
(b) Disconnect the accelerator pedal position sensor connector.
(c) Disconnect the VVT sensor for intake camshaft bank 1 connector.
(d) Disconnect the VVT sensor for exhaust camshaft bank 1 connector.
(e) Disconnect the VVT sensor for intake camshaft bank 2 connector.
(f) Disconnect the VVT sensor for exhaust camshaft bank 2 connector.
(g) Disconnect the canister pump module connector.
(h) Disconnect the C55 and A55 ECM connectors.
(i) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for short)

Tester Connections	Specified Conditions
VCTA (C55-96) - Body ground	10 kΩ or higher
VCV1 (C55-115) - Body ground	10 kΩ or higher
VCV2 (C55-113) - Body ground	10 kΩ or higher
VCE1 (C55-114) - Body ground	10 kΩ or higher
VCE2 (C55-112) - Body ground	10 kΩ or higher
VCPA (A55-57) - Body ground	10 kΩ or higher
VCP2 (A55-58) - Body ground	10 kΩ or higher
VCPP (C55-75) - Body ground	10 kΩ or higher

(j) Reconnect the ECM connectors.
(k) Reconnect the canister pump module connector.
(l) Reconnect the fuel pressure sensor connector.
(m) Reconnect the VVT sensor for exhaust camshaft bank 2 connector.
(n) Reconnect the VVT sensor for intake camshaft bank 2 connector.
(o) Reconnect the VVT sensor for exhaust camshaft bank 1 connector.
(p) Reconnect the VVT sensor for intake camshaft bank 1 connector.
(q) Reconnect the accelerator pedal position sensor connector.
(r) Reconnect the throttle body connector.

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

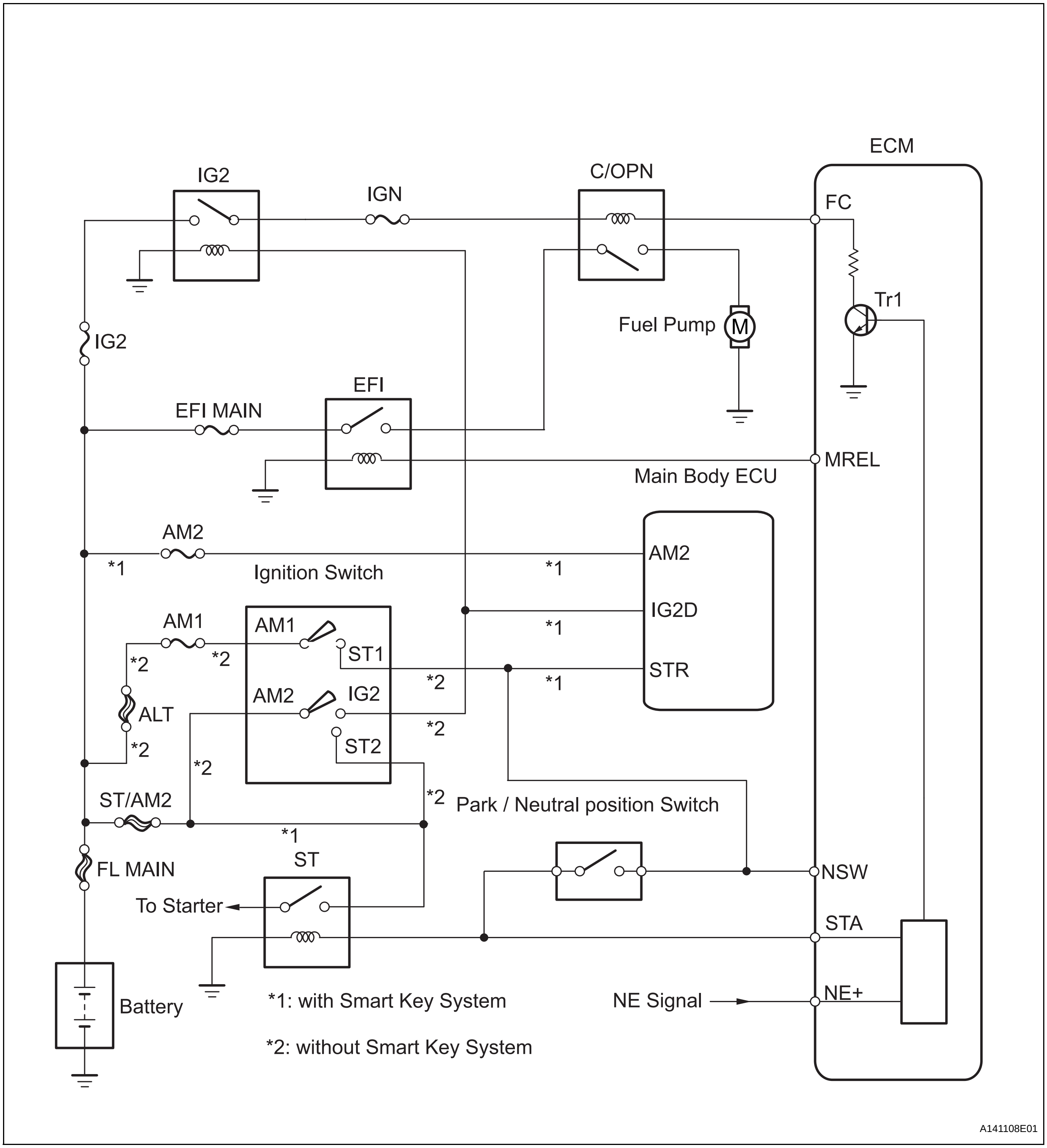
OK

REPLACE ECM (See page ES-518)

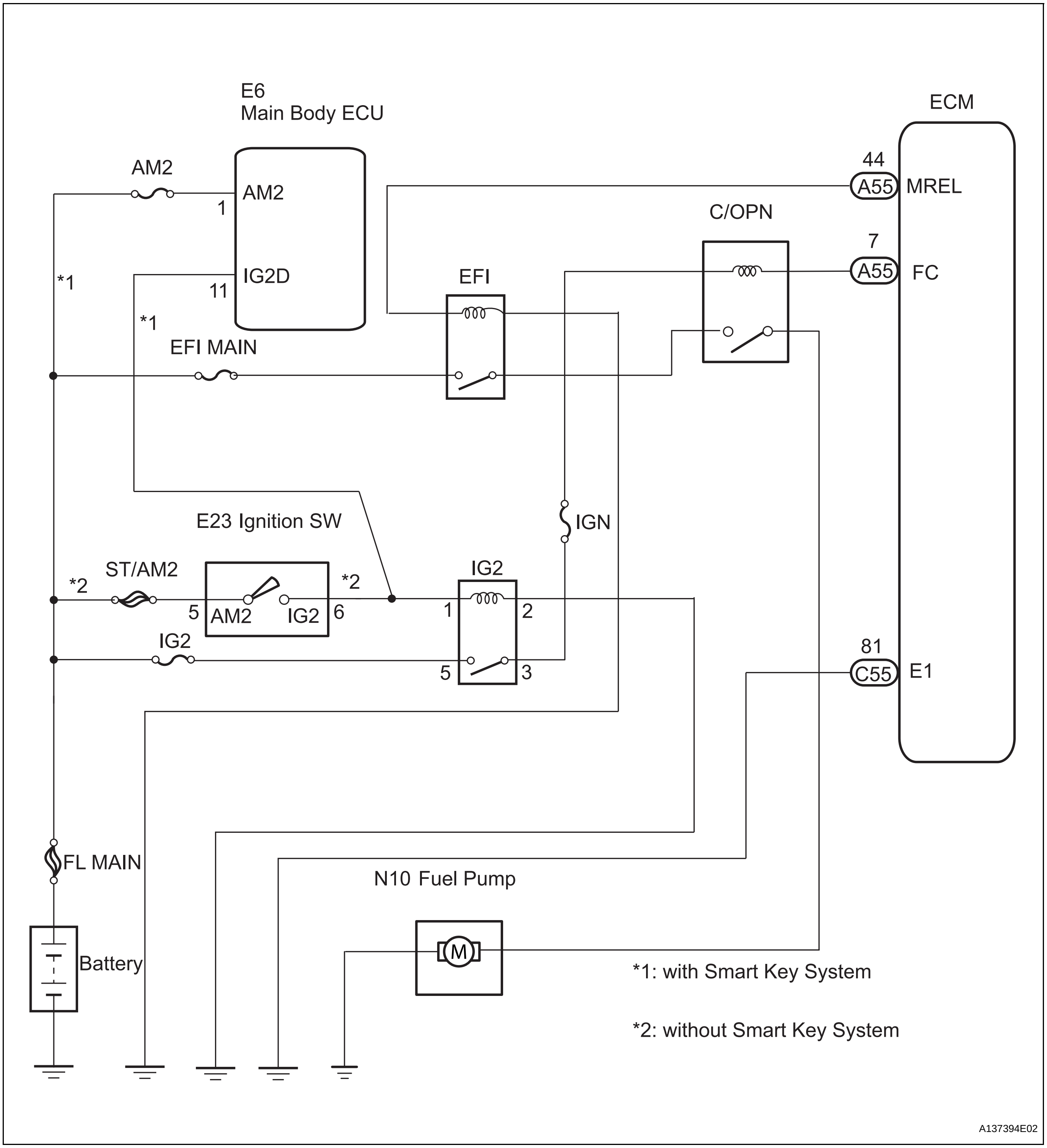
Fuel Pump Control Circuit

DESCRIPTION

In the diagram below, when the engine is cranked, current flows from terminal ST1 (STR) of the ignition switch (power source control ECU) to the starter relay (Marking: ST) coil and also current flows to terminal STA of ECM (STA signal).
When the STA signal and NE signal are input to the ECM, Tr is turned ON, current flows to coil of the circuit opening relay (Marking: C/OPN), 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 Tr ON (circuit opening relay ON) and the fuel pump also keeps operating.


ECM
IG2
IGN
C/OPN
FC
Tr1
Fuel Pump
M
IG2
EFI
EFI MAIN
MREL
Main Body ECU
AM2
*1
Ignition Switch
*1
AM2
IG2D
AM1
AM1
*1
ST1
*2
*2
STR
*2
*1
AM2
IG2
ALT
*2
ST2
*2
*2
ST/AM2
*2
Park / Neutral position Switch
*1
FL MAIN
ST
NSW
To Starter
STA
NE+
Battery
*1: with Smart Key System
NE Signal
*2: without Smart Key System
A141108E01

WIRING DIAGRAM



INSPECTION PROCEDURE

1	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OPERATE C/OPN RELAY)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) and tester on.

(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / FUEL PUMP / SPD.

(d) Check whether the fuel pump operation sound occurs when performing the Active Test on the tester.

OK:

Fuel pump operating sound occurs.

NG → **Go to step 2**

OK

PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE (See page ES-33)

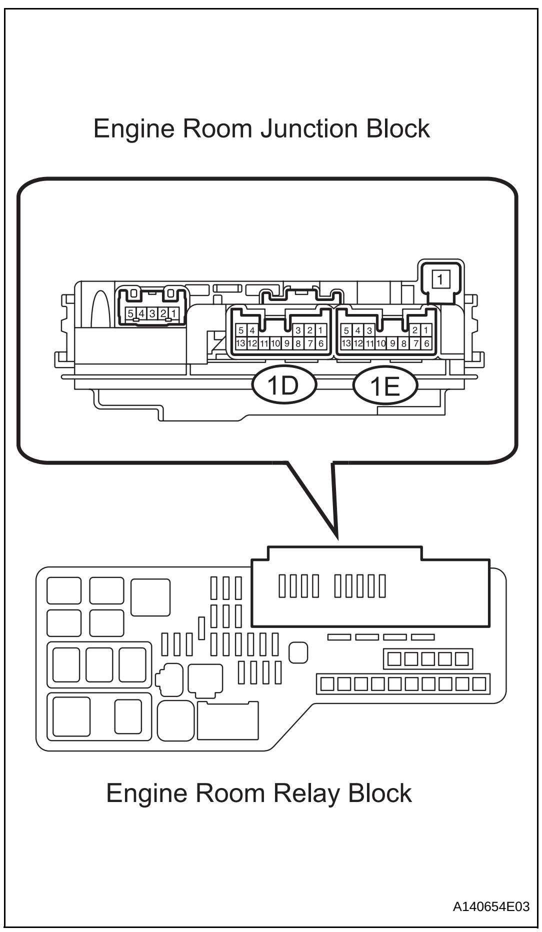
ES

2 CHECK ECM POWER SOURCE CIRCUIT

NG → **REPAIR OR REPLACE ECM POWER SOURCE CIRCUIT**

OK

3 INSPECT ENGINE ROOM JUNCTION BLOCK (C/OPN RELAY)



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

(b) Inspect the C/OPN relay.

(1) Measure the C/OPN relay resistance.

Standard resistance

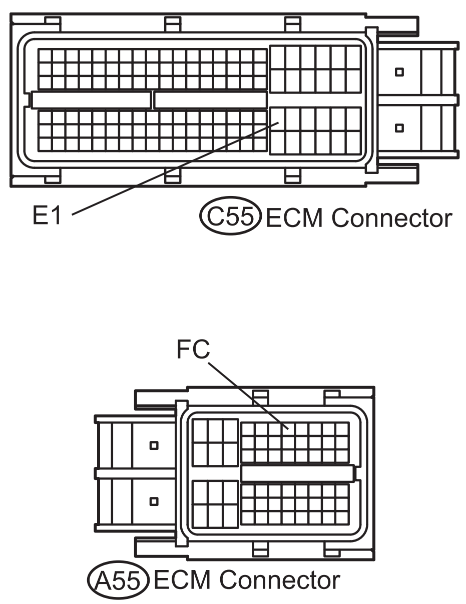
Tester Connections	Specified Conditions
1E-7 - 1E-13	10 kΩ or higher
	Below 1 Ω (Apply battery voltage between terminals 1D-12 and 1E-8)

(c) Reinstall the integration relay.

NG → **REPLACE ENGINE ROOM JUNCTION BLOCK**

OK

4	INSPECT ECM (FC VOLTAGE)



(a) Disconnect the A55 and C55 ECM connectors.

(b) Measure the voltage between the terminals of the A24 and C24 ECM connectors.

Standard voltage

Tester Connection	Specified Condition
A55-7 (FC) - C55-81 (E1)	9 to 14 V

(c) Reconnect the ECM connectors.

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - BATTERY)**

ES

OK

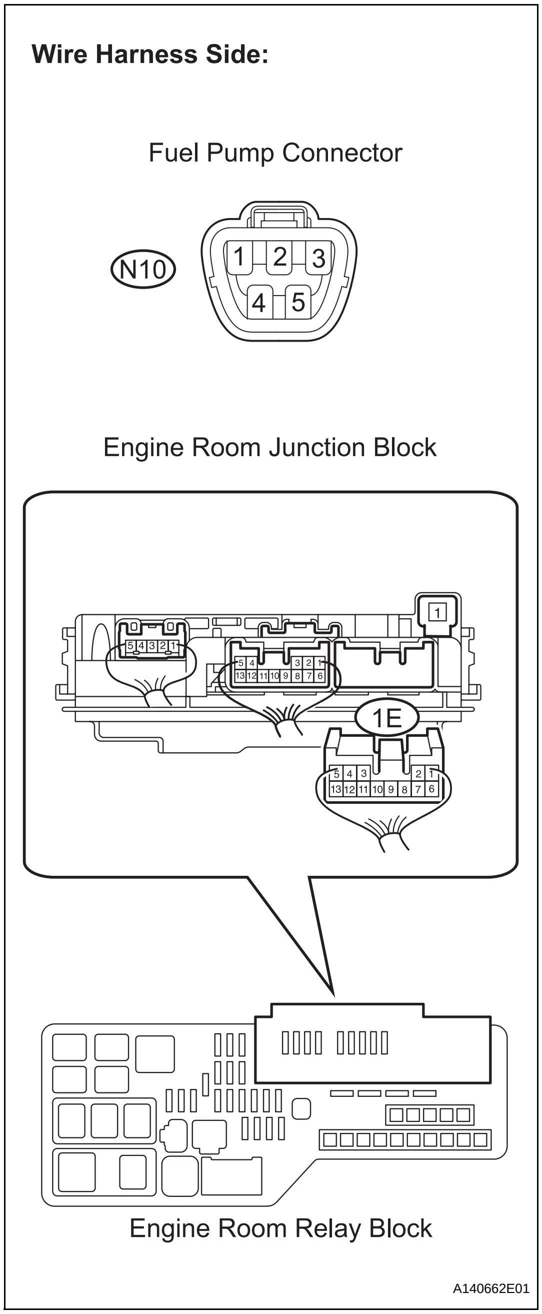
5	INSPECT FUEL PUMP

NG → **REPLACE FUEL PUMP (See page FU-27)**

OK

ES

6 CHECK HARNESS AND CONNECTOR (C/OPN RELAY - FUEL PUMP - BODY GROUND)



(a) Check the harness and the connectors between the engine room relay block and the fuel pump.
   (1) Disconnect the integration relay connector.
   (2) Disconnect the N10 fuel pump connector.
   (3) Measure the resistance.

Standard resistance (Check for open)

Tester Connections	Specified Conditions
1E-13 - N10-4 (Fuel pump)	Below 1 Ω

Standard resistance (Check for short)

Tester Connections	Specified Conditions
1E-13 or N10-4 (Fuel pump) - Body ground	10 kΩ or higher

(b) Check the harness and the connectors between the fuel pump and body ground.
   (1) Disconnect the N10 fuel pump connector.
   (2) Measure the resistance.

Standard resistance (Check for open)

Tester Connection	Specified Condition
N10-5 (Fuel pump) - Body ground	Below 1 Ω

(c) Reconnect the integration relay connector.
(d) Reconnect the fuel pump connector.

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

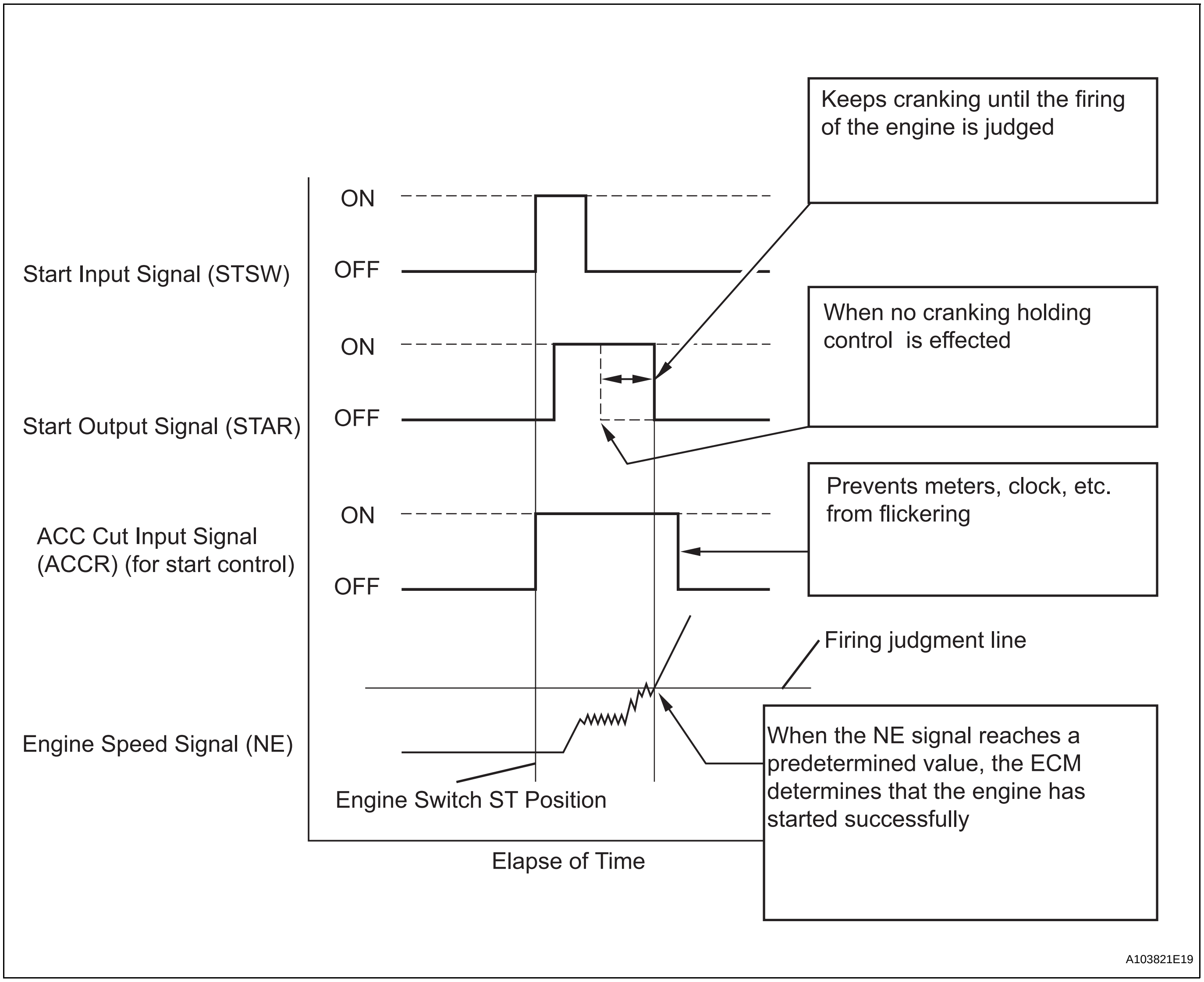
OK

REPLACE ECM (See page ES-518)

Cranking Holding Function Circuit

DESCRIPTION

The cranking holding control system provides current to the starter when the ECM detects the engine switch's start signal (STSW). When the ECM performs a firing judgment, the system cuts current to the starter. When an ECM receives the STSW signal, it turns on the ST CUT relay, which prevents flickering of the combination meter, clock, audio system, etc. Also, the ECM sends a signal to the ECM's STAR terminal. Then the STAR output signal travels through the park/neutral position (PNP) switch to the STARTER relay, causing the starter to activate.
When the engine is cranking, the starter operation signal is sent to the ECM's STA terminal.



WIRING DIAGRAM

Refer to DTC P0617 (See page ES-305).

INSPECTION PROCEDURE

1	CHECK CRANKING

(a) When starting the engine, check whether the starter motor starts.

OK → **CHECK FOR INTERMITTENT PROBLEMS**

NG

2	READ VALUE OF INTELLIGENT TESTER (STA SIGNAL)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG).
(c) Turn the intelligent tester on.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / STARTER SIG. Read the values.
(e) Check the result when the ignition switch is turned on (IG) and when the engine is started.

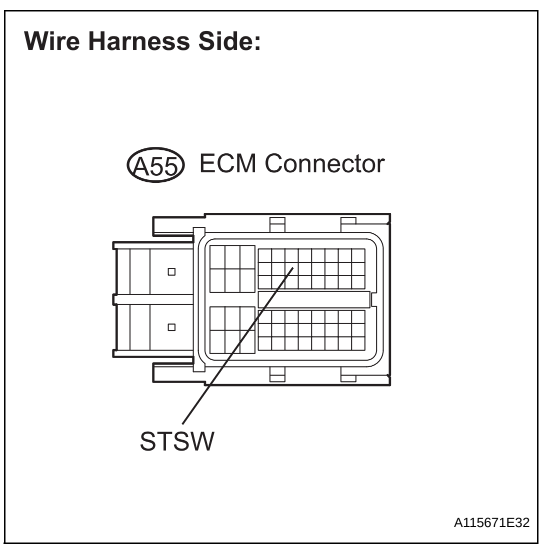
Standard

Display (STARTER SIG)	Ignition Switch Position
OFF	ON
ON	START

OK → **Go to step 7**

NG

3	INSPECT ECM (STSW VOLTAGE)



(a) Disconnect the A55 ECM Connector.
(b) Measure the voltage between the terminals of the ECM connector and body ground while cranking the engine.
Standard voltage

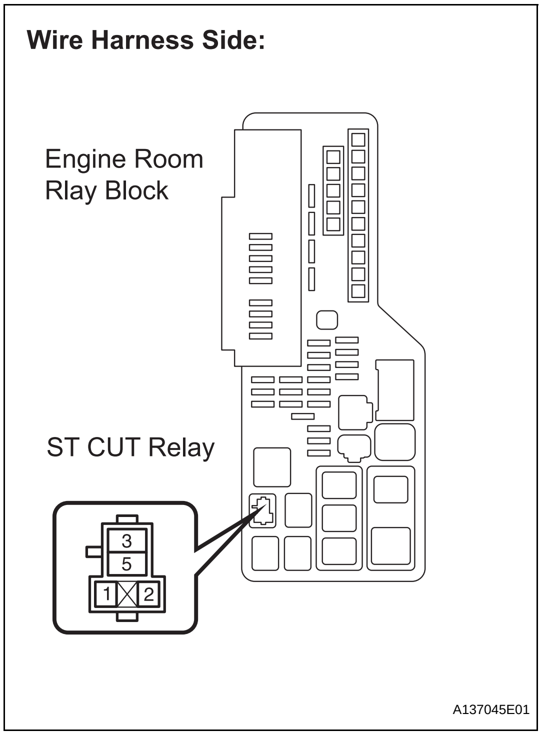
Tester Connection	Specified Condition
STSW (A55-14) - Body ground	9 to 14 V

(c) Reconnect the ECM connector.

OK → **Go to step 11**

OK

4	INSPECT ECM (STAR VOLTAGE)



(a) Remove the ST CUT relay from the engine room R/B.
(b) Measure the voltage between the terminals of the engine room R/B and body ground while cranking the engine.
Standard voltage

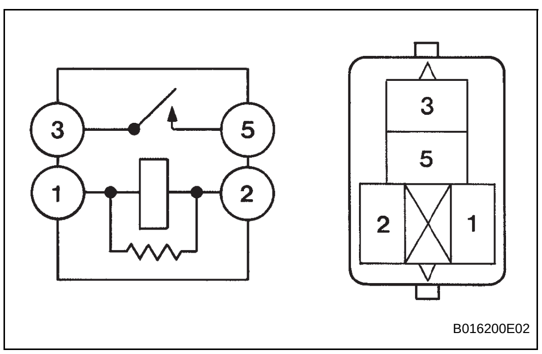
Tester Connection	Specified Condition
ST CUT relay (3) - Body ground	9 to 14 V

(c) Reinstall the ST CUT relay.

NG → **Go to step 8**

OK

5	INSPECT ST CUT RELAY



(a) Remove the ST CUT relay from the engine room R/B.
(b) Measure the resistance between the terminals.
Standard resistance

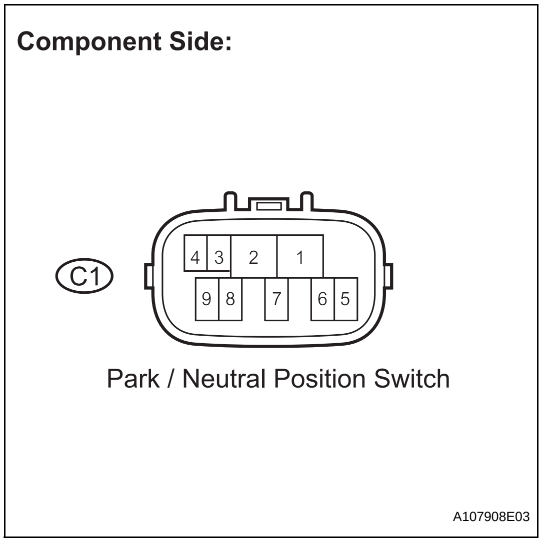
Tester Connection	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the ST CUT relay.

NG → **REPLACE ST CUT RELAY**

OK

6 INSPECT PARK/NEUTRAL SWITCH ASSEMBLY



(a) Inspect the Park / Neutral Position (PNP) switch.
(1) Disconnect the C1 switch connector.
(2) Measure the resistance according to the value(s) in the table below.

Standard resistance

Gear Selector Lever Position	Tester Connection	Specified Condition
P	4 - 5	Below 1 Ω
N	4 - 5	Below 1 Ω

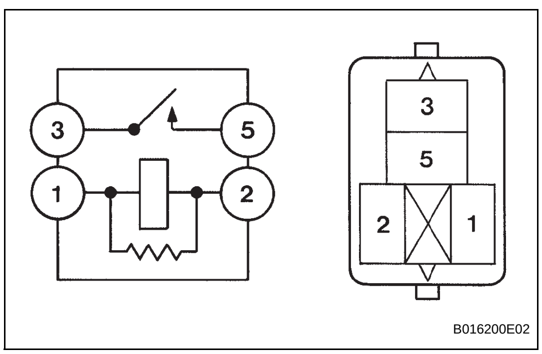
(3) Reconnect the PNP switch connector.

NG → **REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY (See page AX-174)**

OK

CHECK HARNESS AND CONNECTOR

7 INSPECT STARTER RELAY



(a) Remove the ST relay from the engine room R/B.
(b) Measure the resistance between the terminals.

Standard resistance

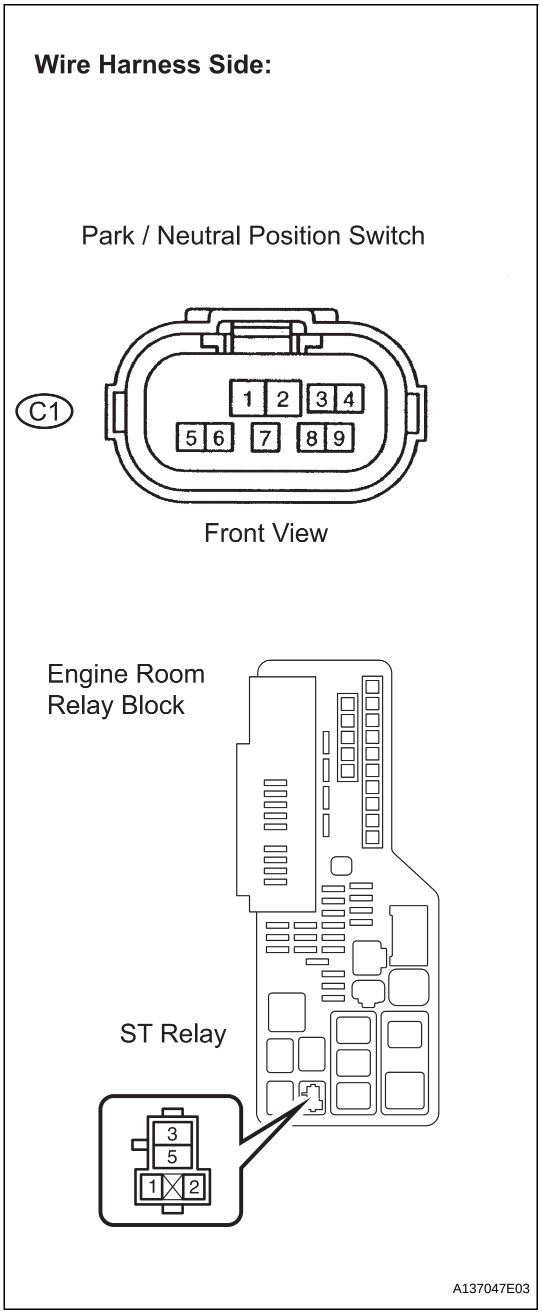
Tester Connection	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the ST relay.

NG → **REPLACE STARTER RELAY**

OK

8	CHECK HARNESS AND CONNECTOR (PARK / NEUTRAL POSITION SWITCH - STARTER RELAY)



(a) Disconnect the C1 park/neutral position switch connector.
(b) Remove the ST relay from the engine room R/B.
(c) Measure the resistance between the terminals.

Standard resistance (Check for open)

Tester Connection	Specified Condition
C1-9 - ST relay terminal (5)	Below 1 Ω

Standard resistance (Check for open)

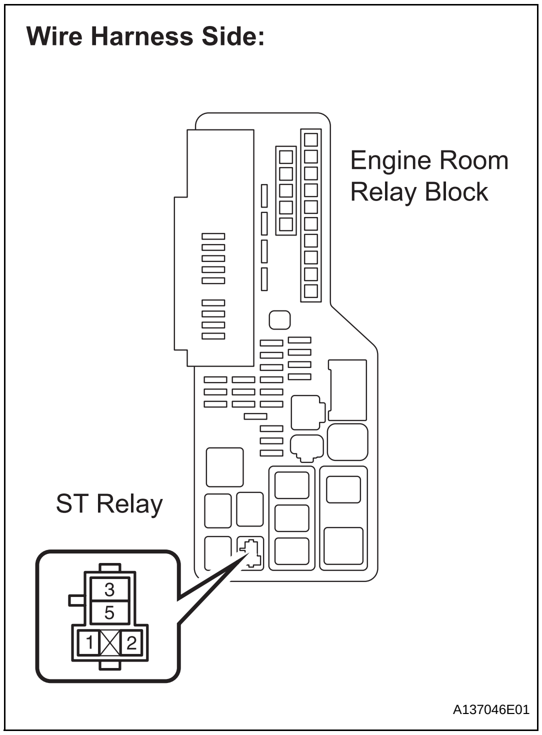
Tester Connection	Specified Condition
C1-9 or ST relay terminal (5) - Body ground	10 kΩ or higher

(d) Reinstall the ST relay.

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

OK

9	INSPECT ENGINE ROOM RELAY BLOCK (STARTER RELAY VOLTAGE)



(a) Remove the ST relay from the engine room R/B.
(b) Measure the voltage between the terminals of the engine room R/B and body ground.
Standard voltage

Tester Connection	Specified Condition
ST relay (5) - Body ground	9 to 14 V

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

OK

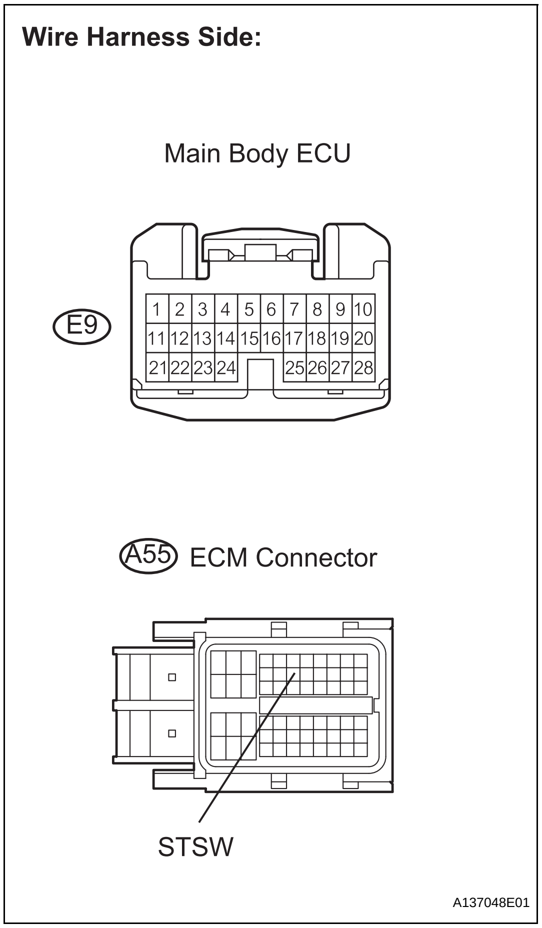
10	INSPECT STARTER ASSEMBLY

NG → **REPAIR OR REPLACE STARTER ASSEMBLY**

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR (STARTER RELAY - STARTER, STARTER - BATTERY)

11	CHECK HARNESS AND CONNECTOR (MAIN BODY ECU - ECM)



(a) Disconnect the E6 main body ECU connector.
(b) Disconnect the A55 ECM connector.
(c) Measure the resistance between the terminals.

Standard resistance (Check for open)

Tester Connection	Specified Condition
STSW (E9-4) - STSW (A55-14)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
STSW (E9-4) or STSW (A55-14) - Body ground	10 kΩ or higher

(d) Reconnect the main body ECU connector.
(e) Reconnect the ECM connector.

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

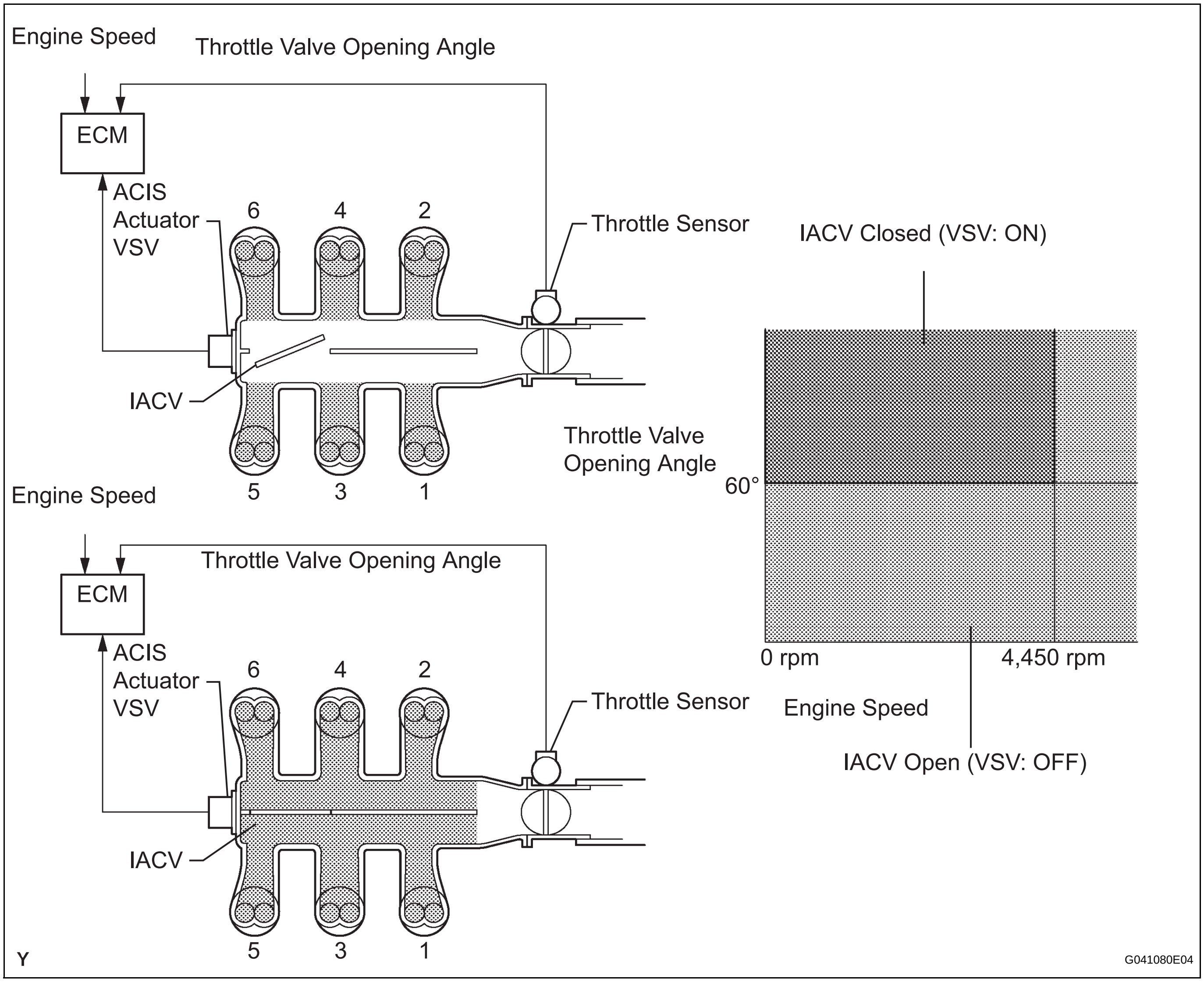
OK

GO TO SMART KEY SYSTEM

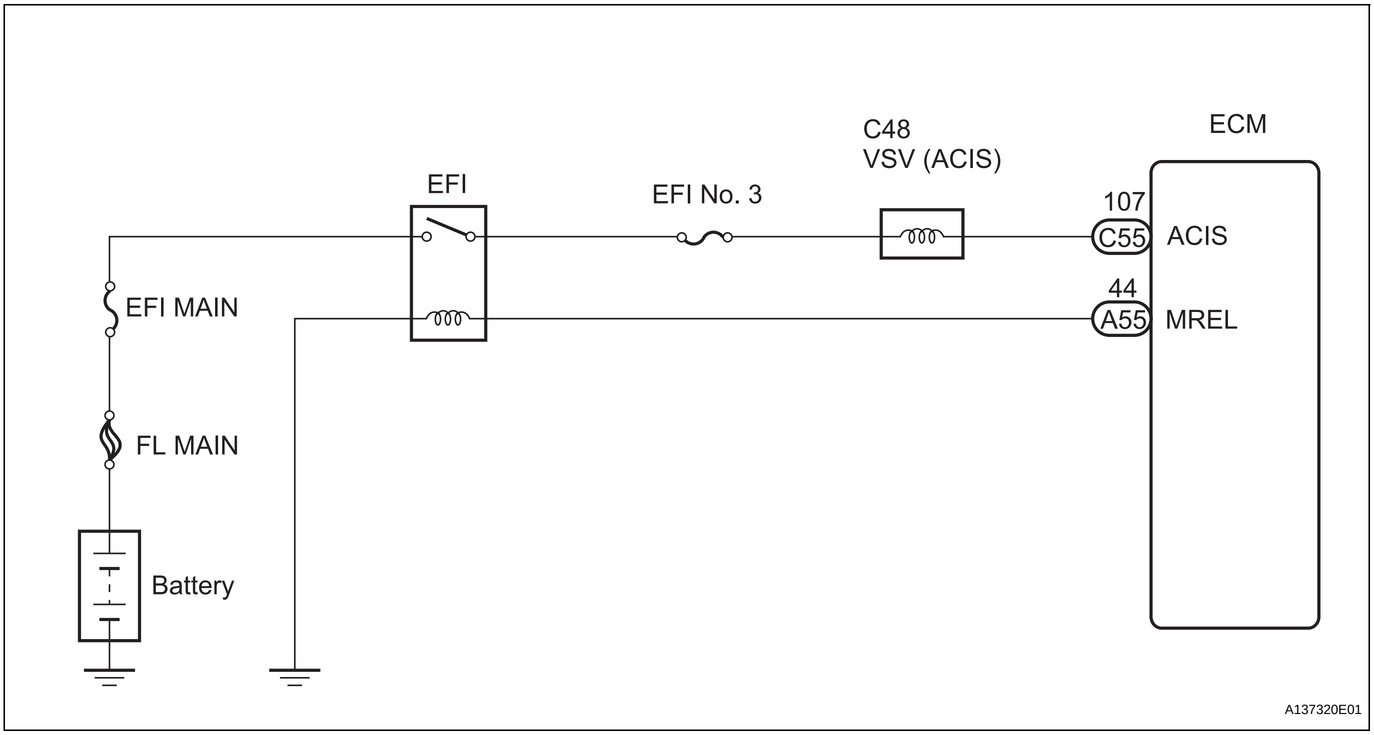
ACIS Control Circuit

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 0 and 4,450 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



INSPECTION PROCEDURE

1	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OPERATE VSV FOR ACIS)

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the intelligent tester on.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / INTAKE CTL VSC48. Operate the VSV for AICS.

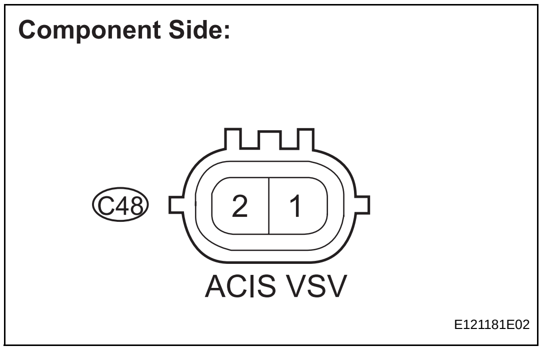
OK:

Operational noise can be heard.

OK → **PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE (See page ES-33)**

NG

2	CHECK INTAKE AIR CONTROL VALVE (OPERATION)



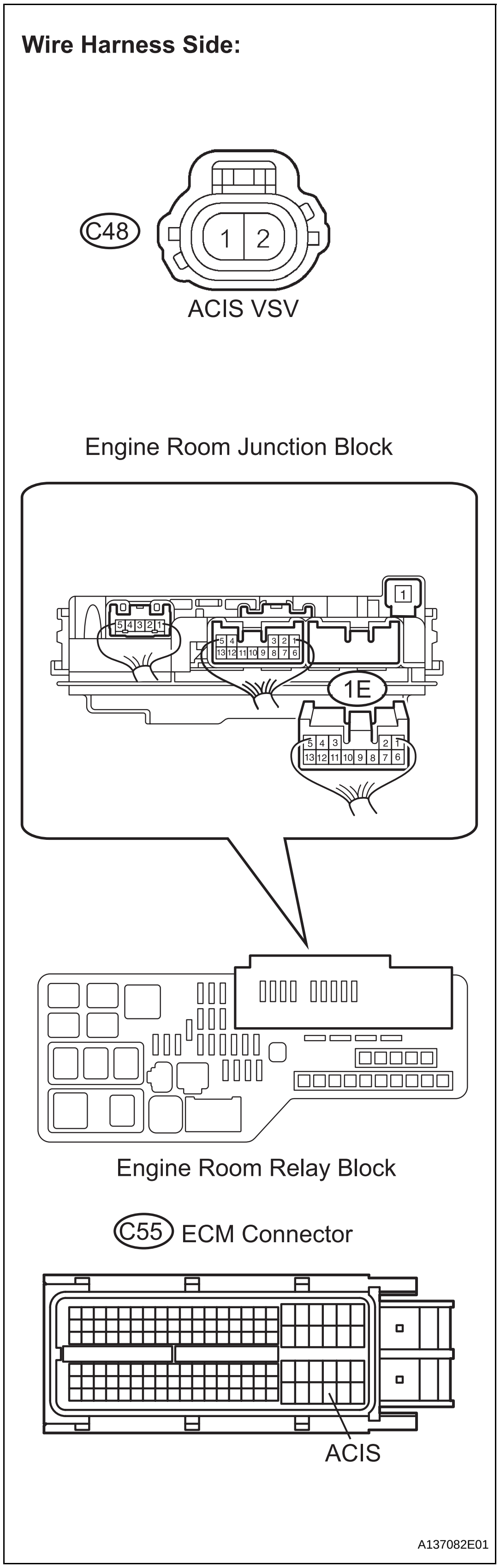
(a) Disconnect the C48 air intake valve connector.
(b) Apply battery voltage between the terminals of the air intake valve connector.
(c) Check the air intake valve operation.
OK:
Operational noise can be heard.

NG → **REPLACE INTAKE AIR SURGE TANK**

ES

OK

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 C48 VSV for ACIS connector.
(2) Disconnect the C55 ECM connector.
(3) Measure the resistance between the terminals of the VSV for ACIS connector and ECM connector.
Standard resistance (Check for open)

Tester Connections	Specified Conditions
VSV for ACIS (C48-1) - ACIS (C55-107)	Below 1 Ω

Standard resistance (Check for short)

Tester Connections	Specified Conditions
VSV for ACIS (C48-1) or ACIS (C55-107) - Body ground	10 kΩ or higher

(4) Reconnect the VSV for ACIS connector.
(5) Reconnect the ECM connector.
(b) Check the EFI No. 3 fuse.
(1) Remove the EFI No. 3 fuse from the engine room R/B.
(2) Measure the EFI No. 3 fuse resistance.
Standard resistance:
Below 1 Ω
(3) Reinstall the EFI No. 3 fuse
(c) Check the wire harness between the VSV for ACIS connector and EFI MAIN relay.
(1) Remove the engine room junction block from the engine room R/B.
(2) Disconnect the C48 VSV connector.
(3) Measure the resistance between the terminals.
Standard resistance (Check for open)

Tester Connections	Specified Conditions
VSV for ACIS (C48-2) - 1E-6	Below 1 Ω

(4) Reinstall the engine room junction block.
(5) Reconnect the VSV connector.

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

ES

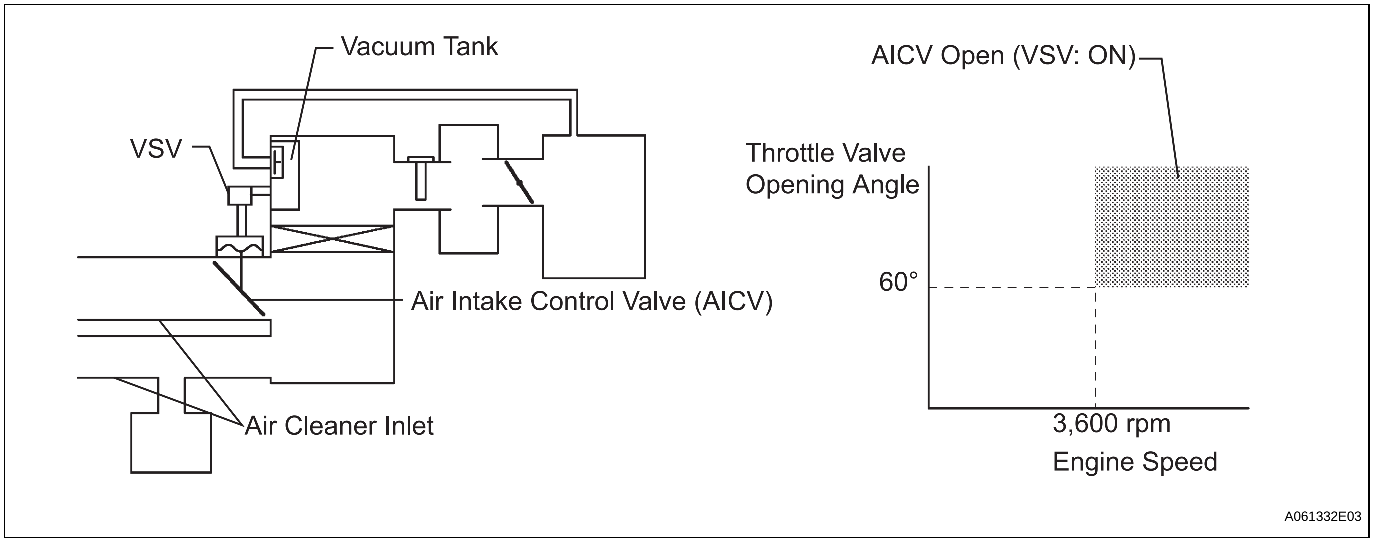
OK

REPLACE ECM (See page ES-518)

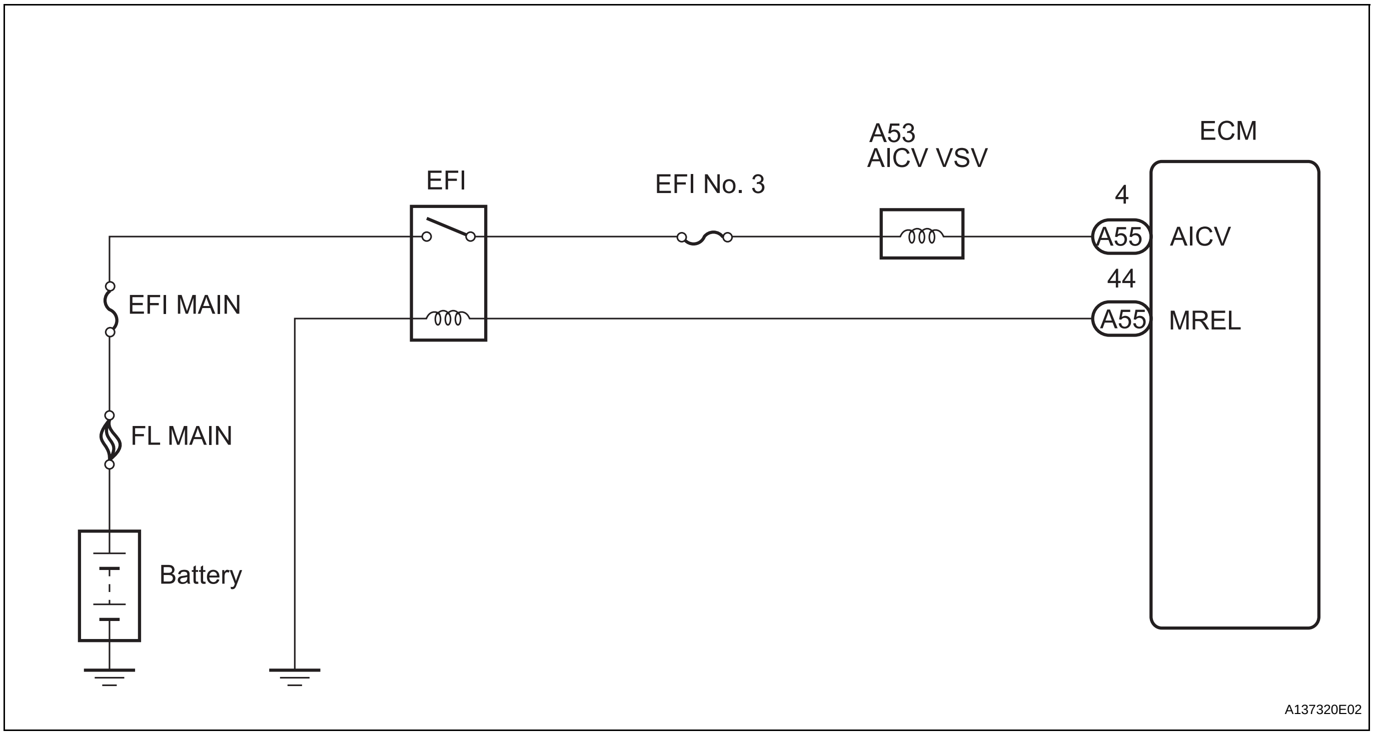
Air Intake Control Circuit

DESCRIPTION

The air cleaner is equipped with two inlets, one of which is opened or closed by the Air Intake Control Valve (AICV). This system reduces intake noise and increases engine power at low-to-high engine speeds range.
When the engine is operating in the low-to-mid speed range, this control operates the AICV to close one of the air cleaner inlets. When the engine speed is more than 3,600 rpm and the opening angle of the throttle valve is more than 60°, the ECM activates the VSV and opens the AICV.

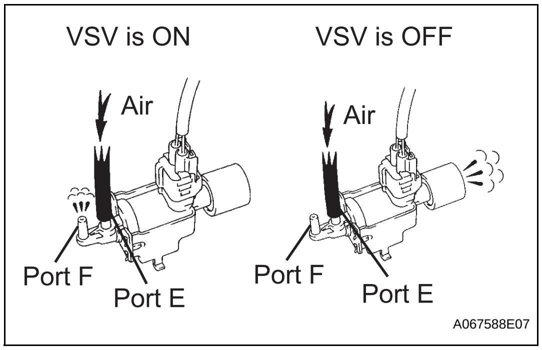


WIRING DIAGRAM



INSPECTION PROCEDURE

1	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (VSV FOR AICV)



(a) Turn the ignition switch on (IG) and turn the intelligent tester ON.

(b) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / INTAKE CTL VSV1 and operate the VSV for AICV.

(c) Check the operation of the VSV when the VSV is operated by the intelligent tester.

Standard

Tester Operation	Specified Condition
VSV is ON	Air from port E flows out through port F
VSV is OFF	Air from port E flows out through the air filter

OK → **Go to step 4**

NG ↓

2	CHECK VSV (FOR AICV)

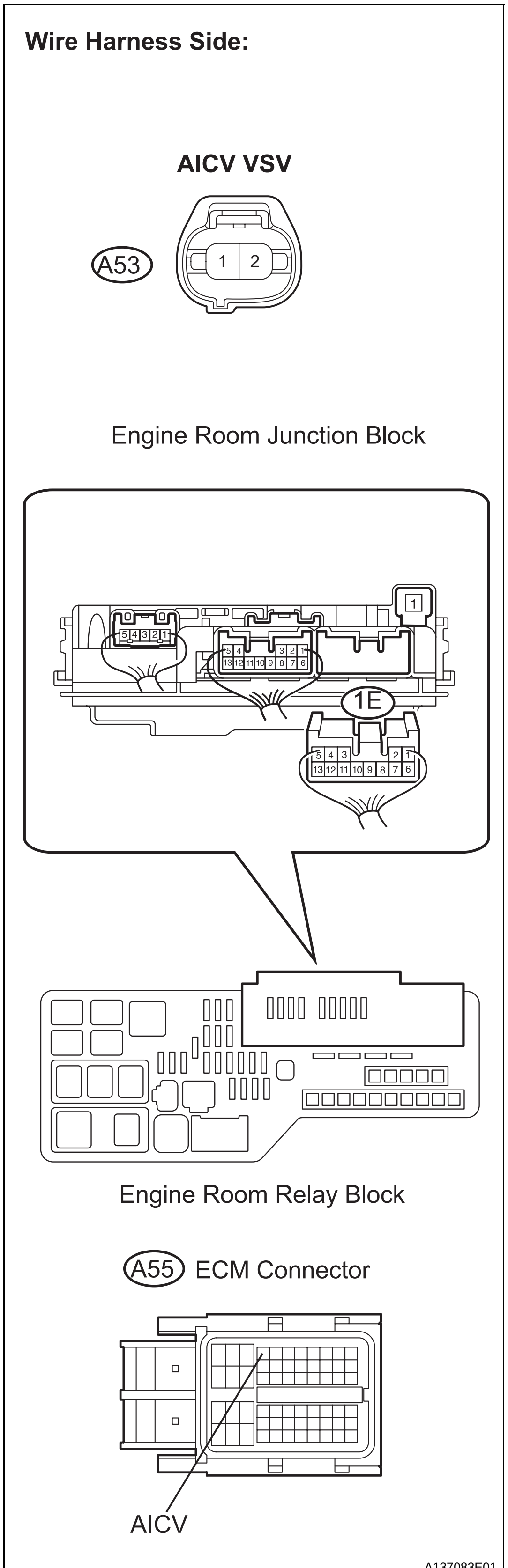
(a) Inspect the intake air control valve assembly (See page IT-5).

NG → **REPLACE INTAKE AIR CONTROL VALVE ASSEMBLY**

OK ↓

ES

3	CHECK HARNESS AND CONNECTOR (VSV FOR AICV - ECM, VSV FOR AICV - EFI RELAY)



(a) Check the wire harness between the VSV for AICV connector and the ECM connector.
   (1) Disconnect the A53 VSV for AICV connector.
   (2) Disconnect the A55 ECM connector.
   (3) Measure the resistance between the terminals of the wire harness side connectors and body ground.
   Standard resistance (Check for open)

Tester Connection	Specified Condition
VSV for AICV (A53-2) - AICV (A55-4)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
VSV for AICV (A53-2) or AICV (A55-4) - Body ground	10 kΩ or higher

   (4) Reconnect the ECM connector.

(b) Check the EFI No. 3 fuse.
   (1) Remove the EFI No. 3 fuse from the engine room R/B.
   (2) Measure the resistance EFI No. 3 fuse.
   Standard resistance:
   Below 1 Ω
   (3) Reinstall the EFI No. 3 fuse.

(c) Check the wire harness between the VSV for AICV and the EFI relay.
   (1) Remove the engine room junction block from the engine room R/B.
   (2) Measure the resistance between the terminals of the wire harness side connectors.
   Standard resistance (Check for open)

Tester Connection	Specified Condition
VSV for AICV (A53-1) - 1E-6	Below 1 Ω

   (3) Reconnect the VSV for AICV connector.
   (4) Reinstall the engine room junction block.

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

ES

OK

4	**INSPECT VACUUM TANK**

(a) Inspect the vacuum tank (See page IT-3).

NG → **REPAIR OR REPLACE AIR CLEANER CAP**

OK

REPLACE ECM (See page ES-518)

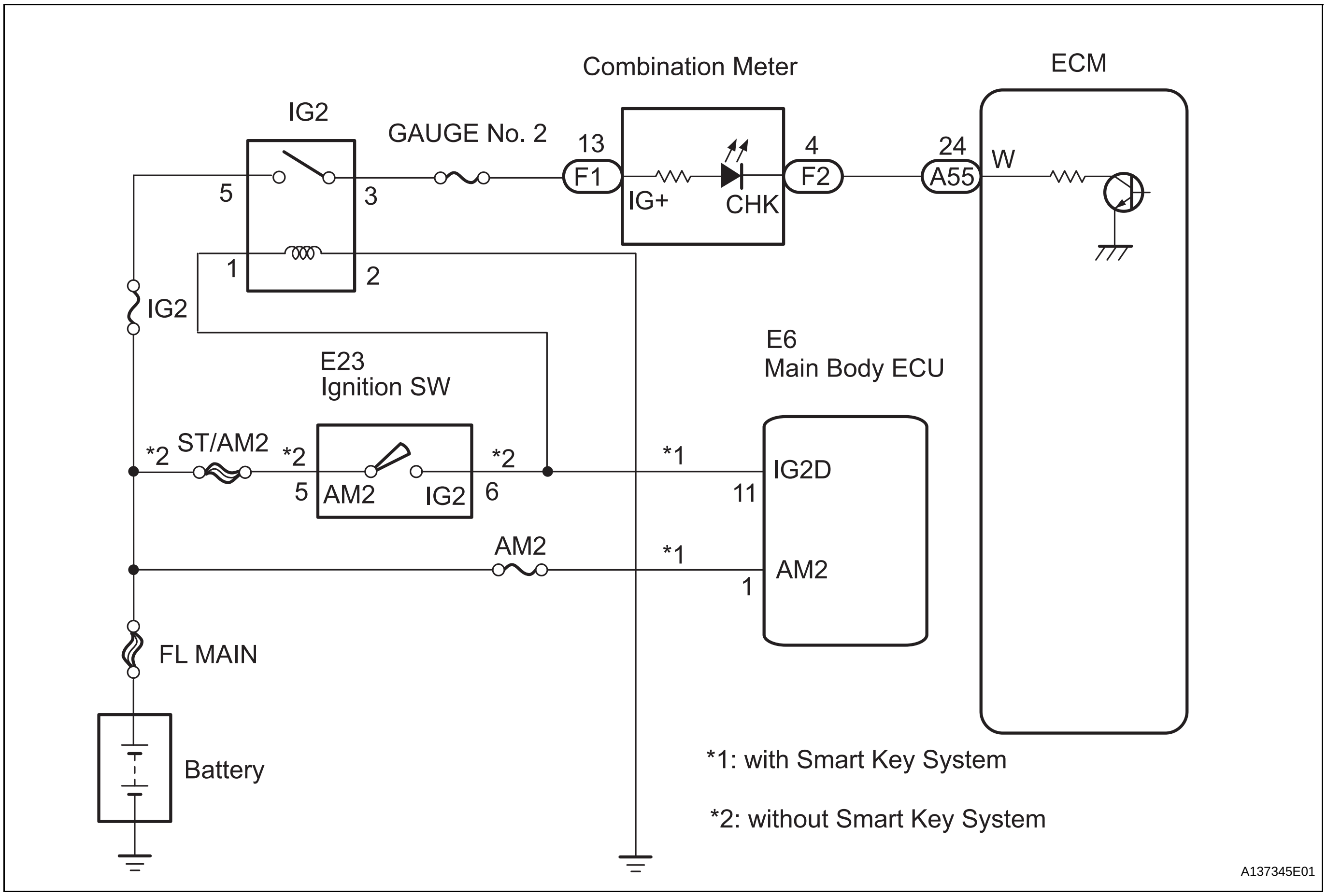
MIL Circuit

DESCRIPTION

The MIL (Malfunction Indicator Lamp) is used to indicate vehicle malfunctions detected by the ECM. When the ignition switch is turned on (IG), 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 (IG), the MIL should be illuminated and should then turn off. If the MIL remains illuminated or is not illuminated, conduct the following troubleshooting procedure using the intelligent tester.

WIRING DIAGRAM



INSPECTION PROCEDURE

1	CHECK THAT MIL IS ILLUMINATED

(a) Perform troubleshooting in accordance with the table below:

Result

Conditions	Proceed to
MIL remains ON	A
MIL does not illuminate	B

B → **Go to step 5**

A

2	CHECK WHETHER MIL TURNS OFF

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch on (IG) and turn the tester on.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(d) Check if any DTCs have been stored. Note down any DTCs.
(e) Clear the DTCs (See page ES-38).
(f) Check if the MIL goes off.

Standard:

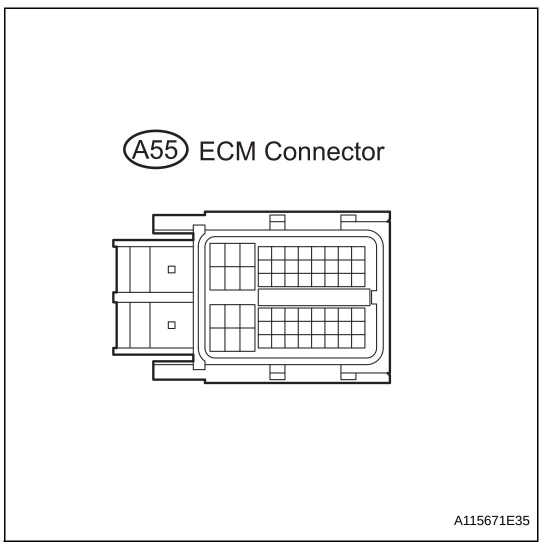
MIL goes off.

OK → **REPAIR CIRCUITS INDICATED BY OUTPUT DTCS (See page ES-63)**

ES

NG

3	CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT IN WIRE HARNESS)



(a) Disconnect the A55 ECM connector.
(b) Turn the ignition switch on (IG).
(c) Check that the MIL is not illuminated.

OK:

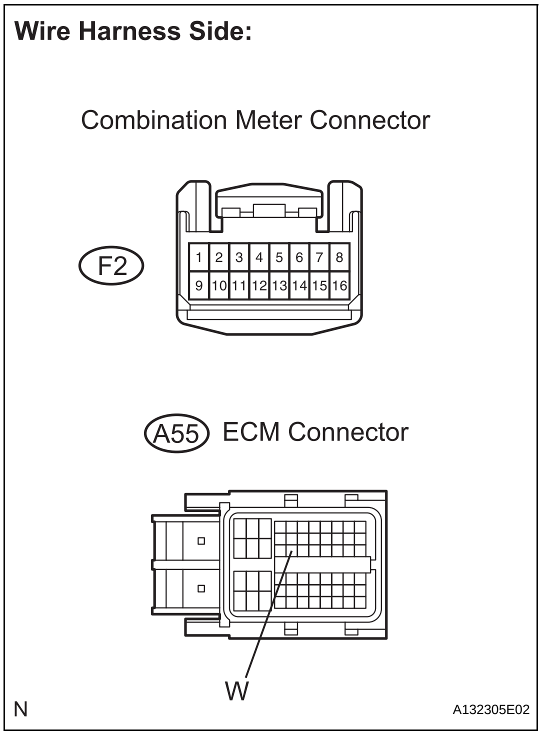
MIL is not illuminated.

(d) Reconnect the ECM connector.

OK → **REPLACE ECM (See page ES-518)**

NG

4 CHECK HARNESS AND CONNECTOR (COMBINATION METER - ECM)



(a) Disconnect the A55 ECM connector.
(b) Disconnect the F2 combination meter connector.
(c) Measure the resistance.
Standard resistance (Check for short)

Tester Connection	Specified Condition
A55-24 (W) or F2-4 (CHK) - Body ground	10 kΩ or higher

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

OK → **REPAIR OR REPLACE COMBINATION METER ASSEMBLY**

ES

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

5 CHECK THAT MIL IS ILLUMINATED

(a) Check if the MIL is illuminated when the ignition switch is turned on (IG).
OK:
MIL is illuminated.

OK → **SYSTEM OK**

NG

6 CHECK THAT ENGINE STARTS

(a) Turn the ignition switch on (IG).
(b) Start the engine.
Result

Result	Proceed to
Engine starts	A
Engine does not start*	B

HINT:
*: The intelligent tester cannot communicate with the ECM.

B

GO TO VC OUTPUT CIRCUIT (See page ES-442)

A

7 INSPECT COMBINATION METER ASSEMBLY (MIL CIRCUIT)

(a) Check the MIL circuit (See page ME-19).

NG

REPAIR OR REPLACE COMBINATION METER ASSEMBLY

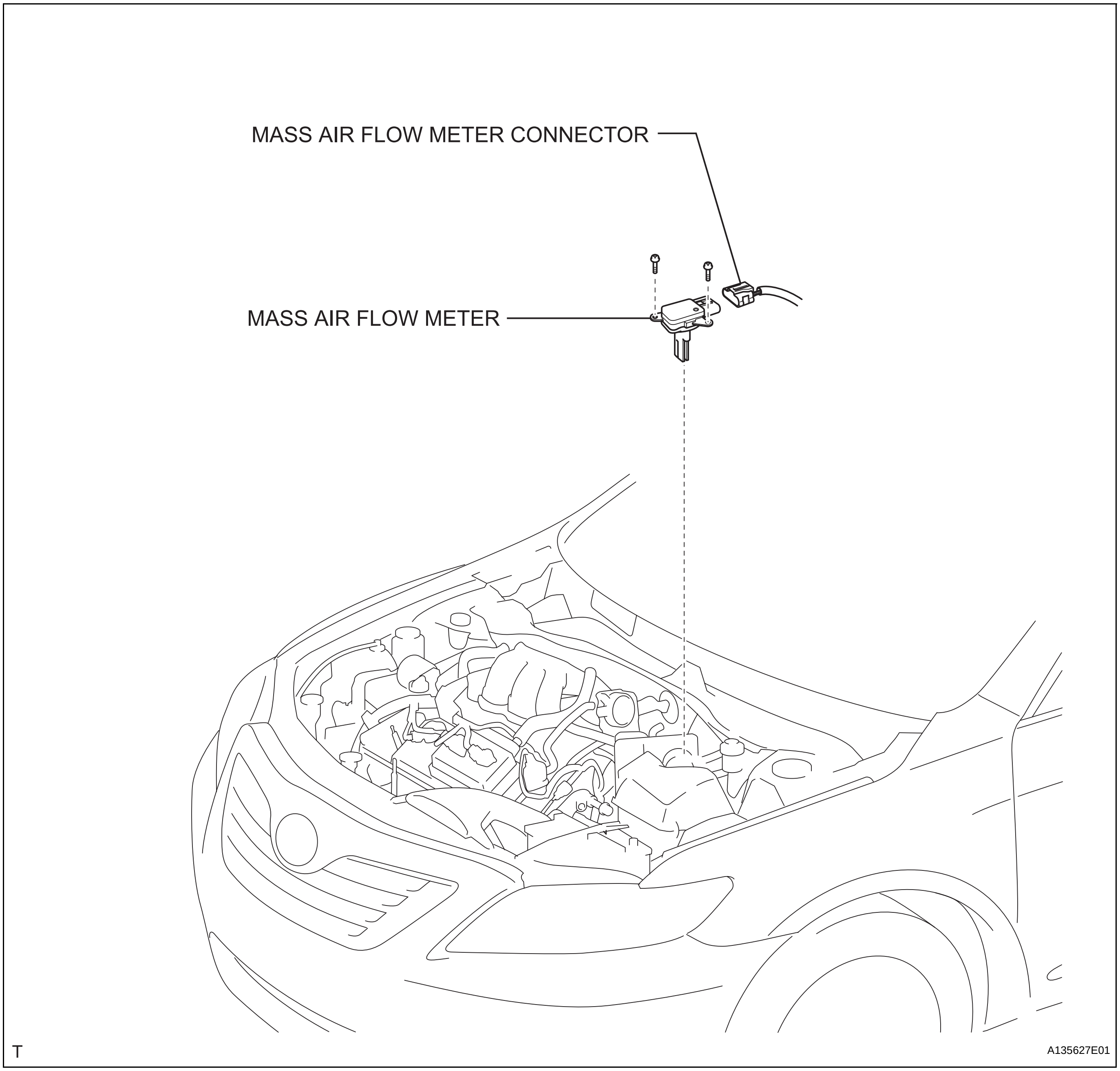
ES

OK

CHECK AND REPLACE HARNESS AND CONNECTOR (COMBINATION METER - ECM)

MASS AIR FLOW METER

COMPONENTS

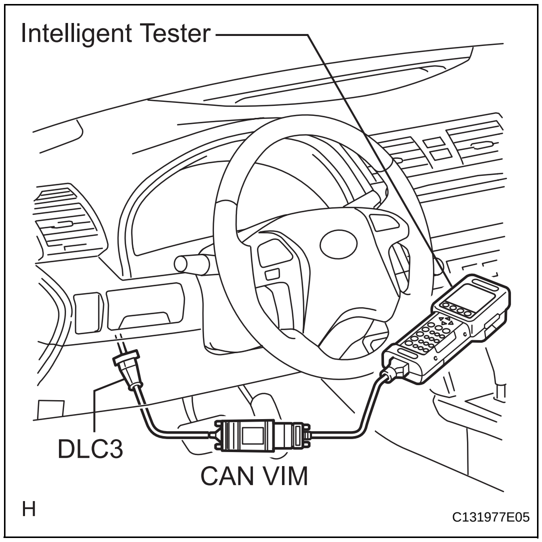


ON-VEHICLE INSPECTION

1. **CHECK MASS AIR FLOW METER**

NOTICE:

- **Perform the MAF meter inspection by following 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.**



(a) Perform confirmation driving pattern.

(1) Connect the intelligent tester to the DLC3.

(2) Turn the ignition switch on (IG).

(3) Turn the tester on.

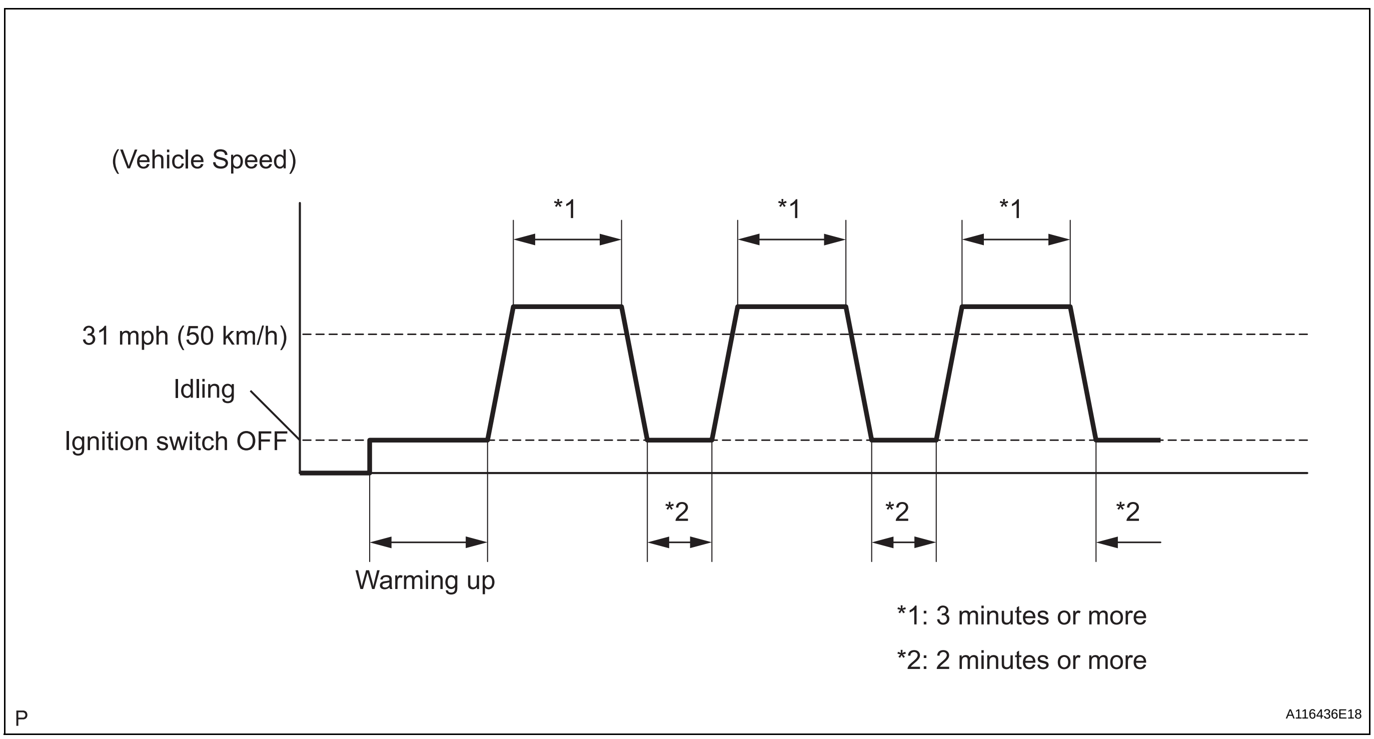
(4) Clear the DTCs (See page ES-45).

(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 31 mph (50 km/h) or more for 3 minutes or more (*1).

(7) Allow the engine to idle (accelerator pedal fulley released) for 2 minutes or more (*2).

(8) Perform steps (*1) and (*2) at least 3 times or more.



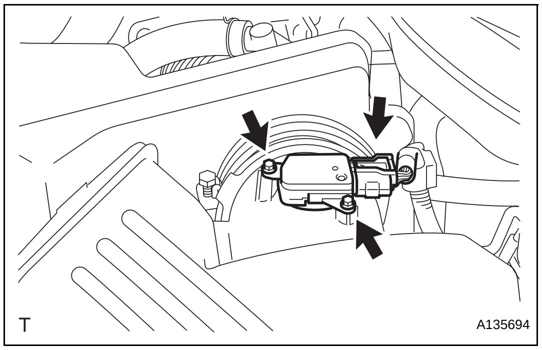
(b) Read values using the intelligent tester (LONG FT#1).

(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 values using the 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.**

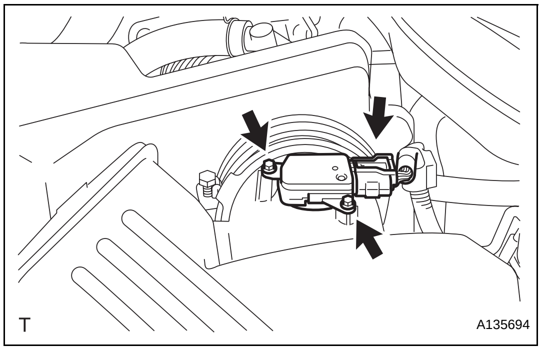
(1) Turn off the engine (do not run the engine).
(2) Turn the ignition switch on (IG).
(3) Turn the tester on.
(4) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / PRIMARY / MAF.
(5) Wait 30 seconds, and read the values on the intelligent tester.
Standard condition:
Less than 0.56 g/sec
- If the result is not as specified, replace the MAF meter.
- If the result is within the specified range, inspect the cause of the extremely rich or lean air fuel ratio (See page EC-19).



REMOVAL

1. REMOVE MASS AIR FLOW METER

(a) Disconnect the mass air flow meter connector.
(b) Remove the 2 screws and mass air flow meter.



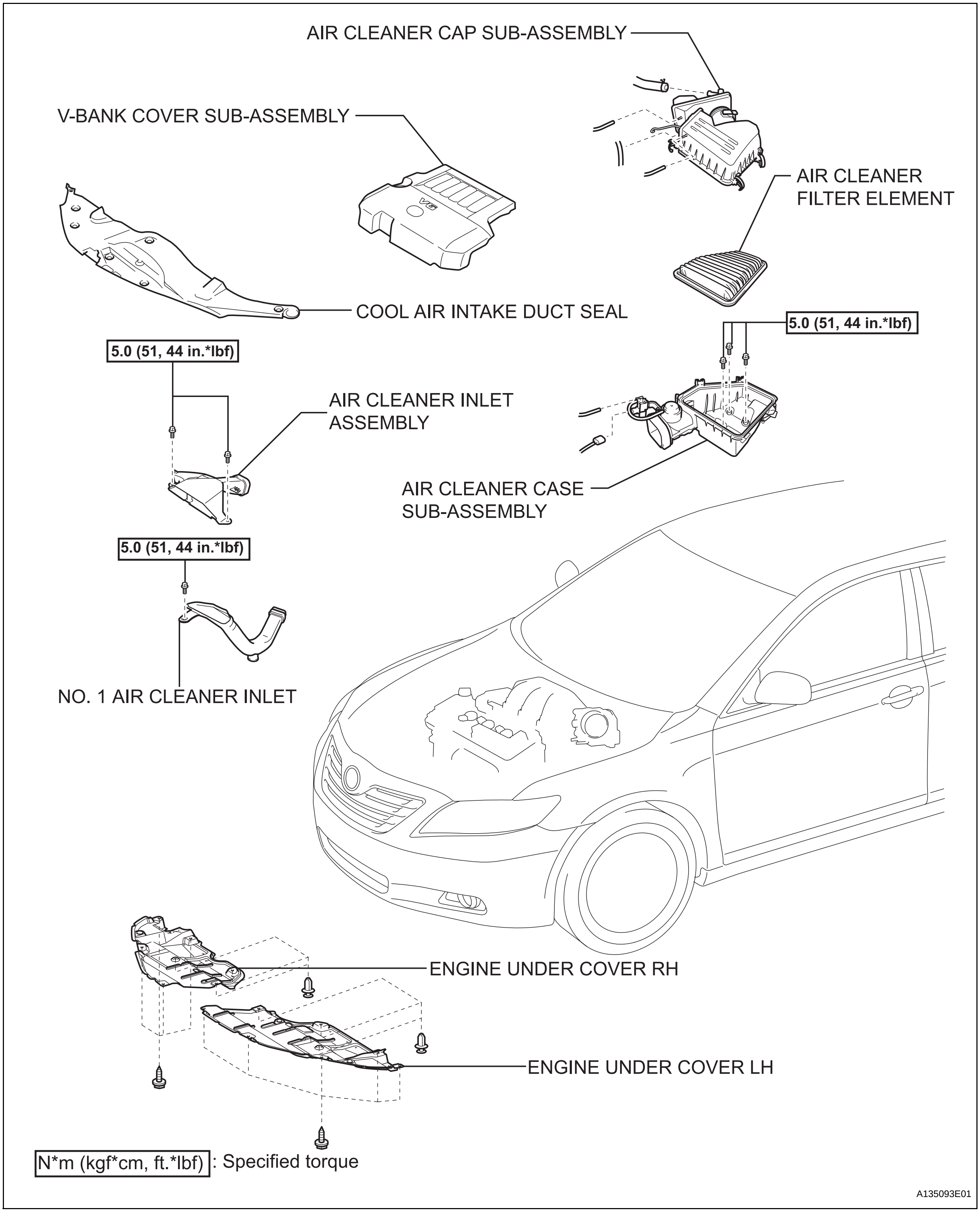
INSTALLATION

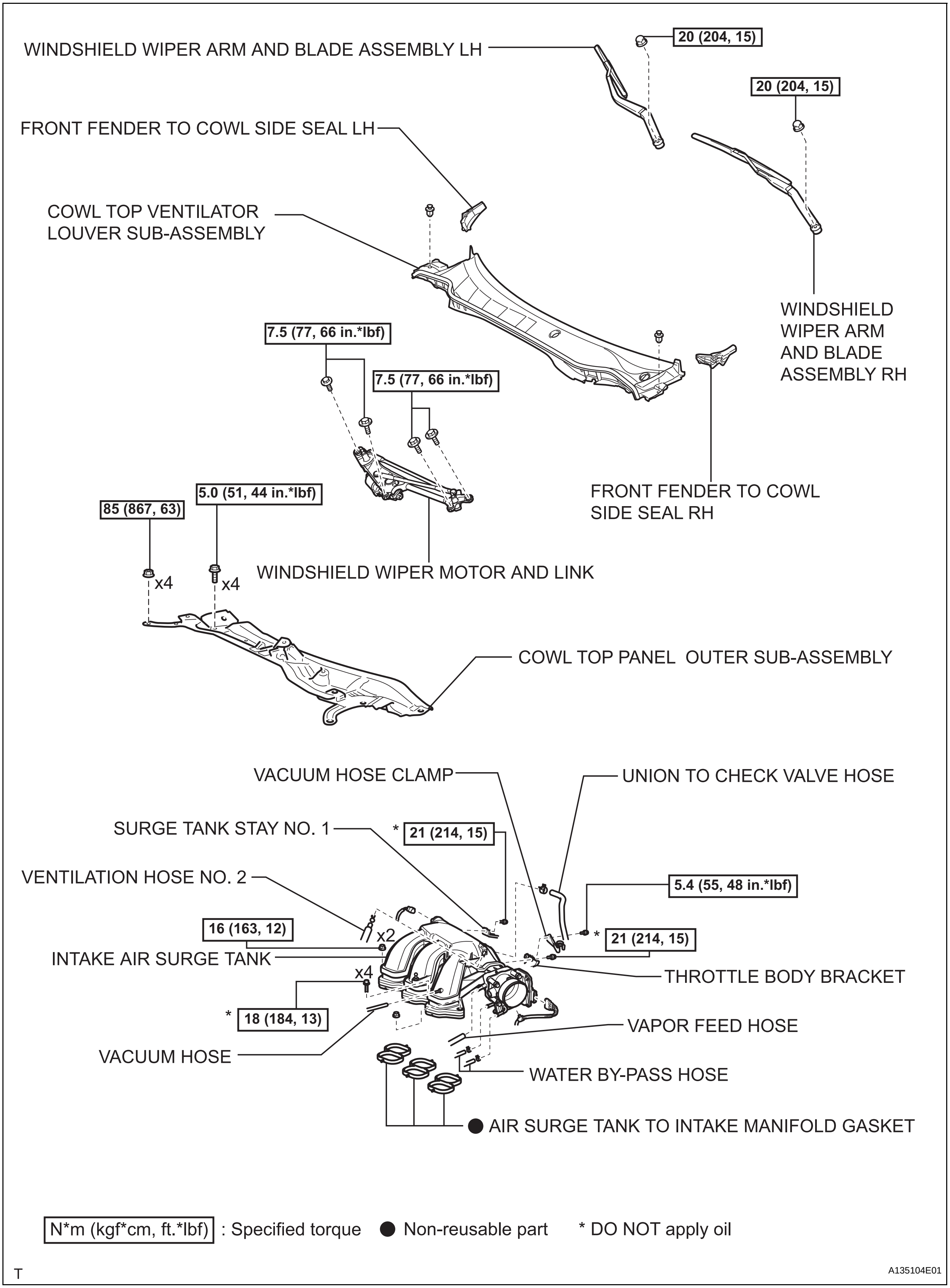
1. INSTALL MASS AIR FLOW METER

(a) Install the mass air flow meter with the 2 screws.
(b) Connect the mass air flow meter connector.

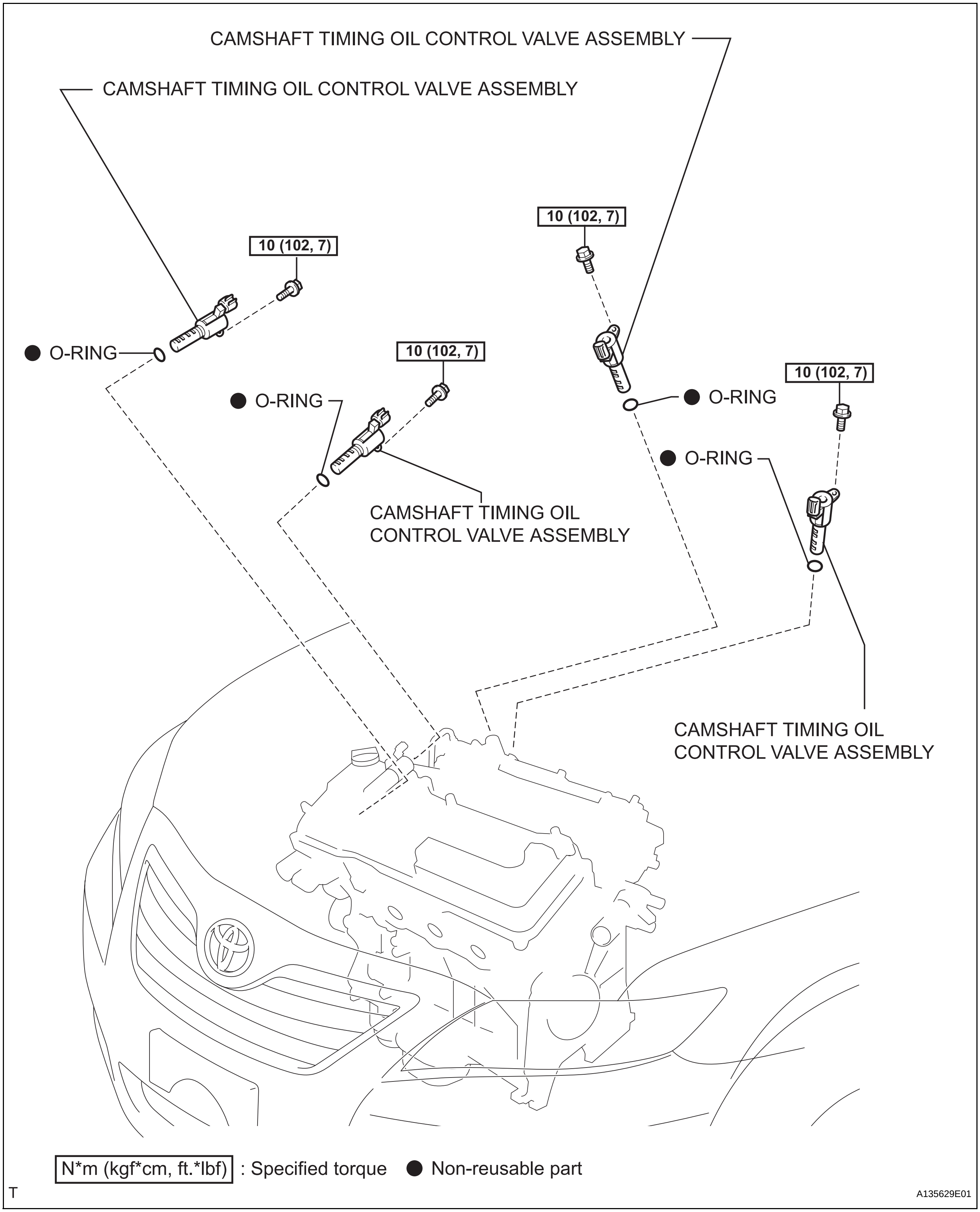
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

COMPONENTS

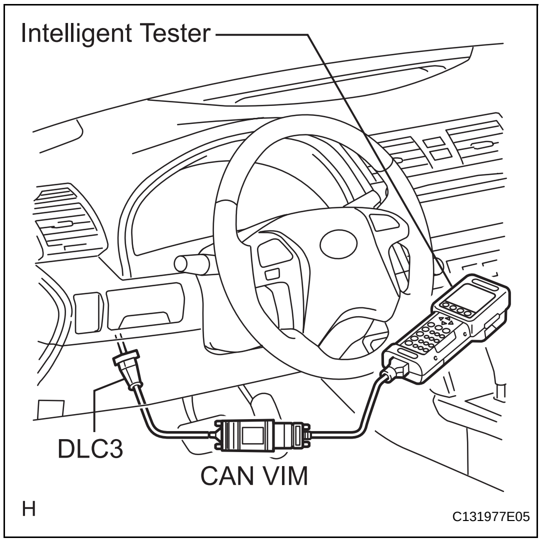



WINDSHIELD WIPER ARM AND BLADE ASSEMBLY LH
20 (204, 15)
20 (204, 15)
FRONT FENDER TO COWL SIDE SEAL LH
COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY
WINDSHIELD WIPER ARM AND BLADE ASSEMBLY RH
7.5 (77, 66 in.*lbf)
7.5 (77, 66 in.*lbf)
FRONT FENDER TO COWL SIDE SEAL RH
5.0 (51, 44 in.*lbf)
85 (867, 63)
x4
x4
WINDSHIELD WIPER MOTOR AND LINK
COWL TOP PANEL OUTER SUB-ASSEMBLY
VACUUM HOSE CLAMP
UNION TO CHECK VALVE HOSE
SURGE TANK STAY NO. 1
* 21 (214, 15)
VENTILATION HOSE NO. 2
5.4 (55, 48 in.*lbf)
16 (163, 12)
x2
* 21 (214, 15)
INTAKE AIR SURGE TANK
x4
THROTTLE BODY BRACKET
* 18 (184, 13)
VAPOR FEED HOSE
VACUUM HOSE
WATER BY-PASS HOSE
● AIR SURGE TANK TO INTAKE MANIFOLD GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque ● Non-reusable part * DO NOT apply oil
T
A135104E01

ES



CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY
10 (102, 7)
10 (102, 7)
O-RING
10 (102, 7)
O-RING
O-RING
10 (102, 7)
O-RING
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
T
A135629E01



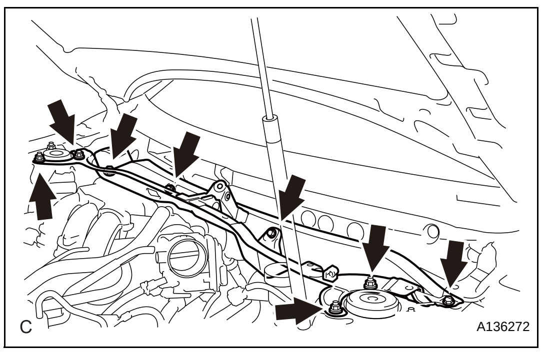
ON-VEHICLE INSPECTION

1. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   (a) Connect the intelligent tester (with CAN VIM) to the DLC3.
   (b) Turn the ignition switch on (IG).
   (c) Start and warm up the engine.
   (d) Connect the intelligent tester and select VVT from the ACTIVE TEST menu.
   (e) Check the engine speed when the OCV is operated with the intelligent tester.
   OK

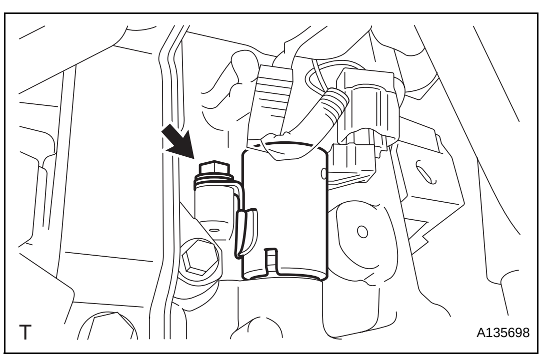
Condition	Specified Condition
VVT system is OFF (OCV is OFF)	Normal engine speed
VVT system is ON (OCV is ON)	Rough idle or engine stalled

REMOVAL

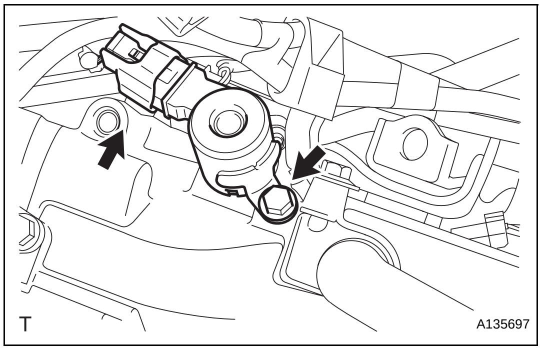
1. **REMOVE ENGINE UNDER COVER LH**
2. **REMOVE ENGINE UNDER COVER RH**
3. **DRAIN ENGINE COOLANT (See page CO-5)**
4. **REMOVE WINDSHIELD WIPER ARM AND BLADE ASSEMBLY LH (See page WW-9)**
5. **REMOVE WINDSHIELD WIPER ARM AND BLADE ASSEMBLY RH (See page WW-9)**
6. **REMOVE FRONT FENDER TO COWL SIDE SEAL LH (See page WW-9)**
7. **REMOVE FRONT FENDER TO COWL SIDE SEAL RH (See page WW-9)**
8. **REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY (See page WW-10)**
9. **REMOVE WINDSHIELD WIPER MOTOR AND LINK (See page WW-10)**



10. **REMOVE COWL TOP PANEL OUTER SUB-ASSEMBLY**
    (a) Remove the 4 bolts, 4 nuts and cowl top panel outer sub-assembly.
11. **REMOVE COOL AIR INTAKE DUCT SEAL (See page EM-23)**
12. **REMOVE V-BANK COVER SUB-ASSEMBLY (See page EM-23)**
13. **REMOVE AIR CLEANER INLET ASSEMBLY (See page EM-24)**
14. **REMOVE AIR CLEANER CAP SUB-ASSEMBLY (See page ES-503)**
15. **REMOVE AIR CLEANER CASE SUB-ASSEMBLY (See page EM-24)**
16. **REMOVE NO. 1 AIR CLEANER INLET (See page EM-24)**
17. **REMOVE INTAKE AIR SURGE TANK (See page FU-13)**



18. **REMOVE CAMSHAFT TIMING OIL CONTROL VALVE (for Bank 1 Exhaust Side)**
    (a) Disconnect the camshaft timing oil control valve connector.
    (b) Remove the bolt and camshaft timing oil control valve.
    (c) Remove the O-ring from the camshaft timing oil control valve.

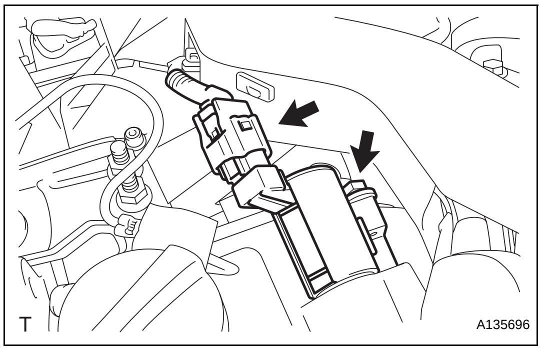


19. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE (for Bank 1 Intake Side)

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

(b) Remove the bolt and camshaft timing oil control valve.

(c) Remove the O-ring from the camshaft timing oil control valve.

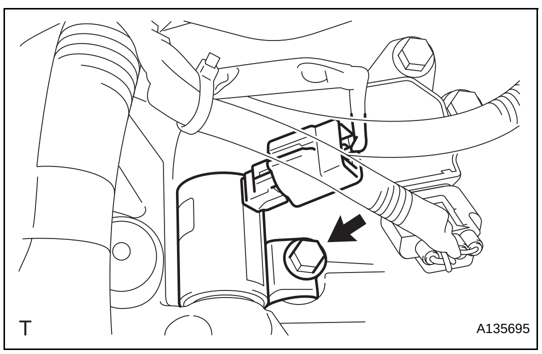


20. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE (for Bank 2 Exhaust Side)

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

(b) Remove the bolt and camshaft timing oil control valve.

(c) Remove the O-ring from the camshaft timing oil control valve.



21. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE (for Bank 2 Intake Side)

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

(b) Remove the bolt and camshaft timing oil control valve.

(c) Remove the O-ring from the camshaft timing oil control valve.

INSPECTION

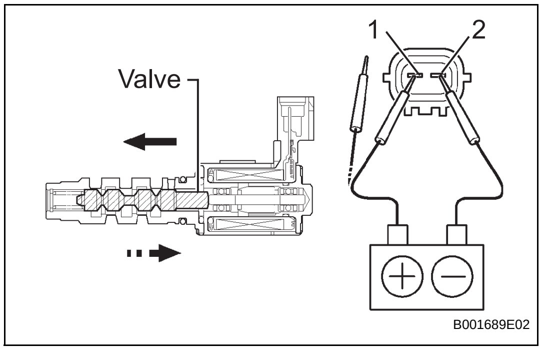
1. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**

(a) Resistance inspection.

(1) Using an ohmmeter, measure the resistance between the terminals.

Standard resistance:
6.9 to 7.9 Ω at 20°C (68°F)

If necessary, replace the camshaft timing oil control valve assembly.



(b) Movement inspection.

(1) Connect the positive (+) lead from the battery to terminal 1 and the negative (-) lead to terminal 2, and check the movement of the valve.

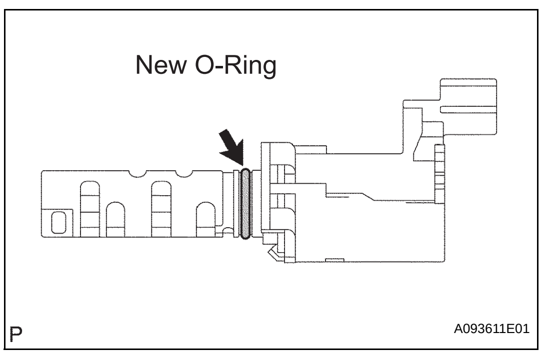
NOTICE:
Confirm that the valve moves freely and does not stick in any position.

If necessary, replace the camshaft timing oil control valve assembly.

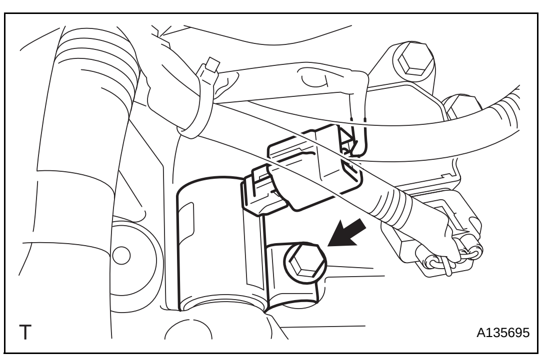
HINT:
Accumulation of foreign objects causes subtle pressure leaks. The subtle pressure leaks will cause the camshaft to advance, and this will cause a DTC to be set.

INSTALLATION

1. **INSTALL CAMSHAFT TIMING OIL CONTROL VALVE (for Bank 2 Intake Side)**



(a) Apply a light coat of engine oil to a new O-ring and install it to the camshaft timing oil control valve.

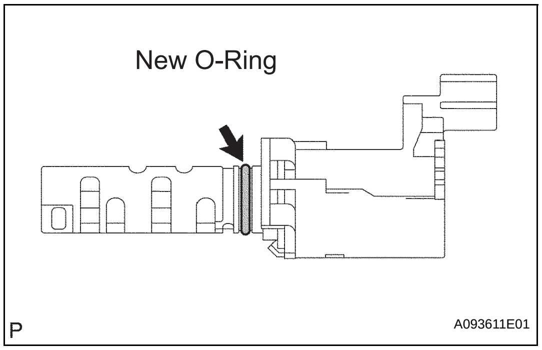


(b) Install the camshaft timing oil control valve with the bolt.

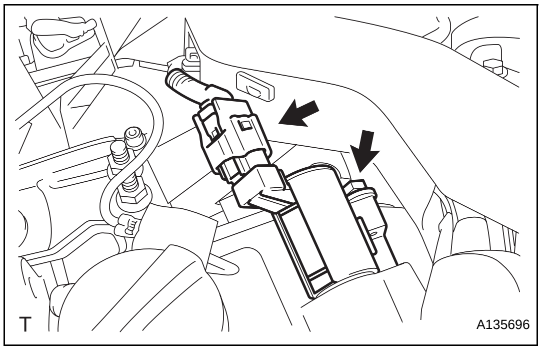
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

NOTICE:
Make sure that the O-ring is not cracked or jammed when installing the oil control valve.

(c) Connect the camshaft timing oil control valve connector.

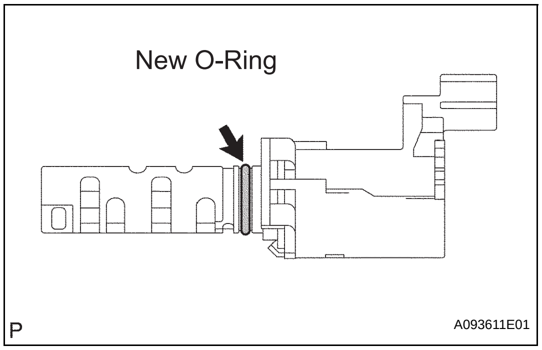


2. **INSTALL CAMSHAFT TIMING OIL CONTROL VALVE (for Bank 2 Exhaust Side)**
   (a) Apply a light coat of engine oil to a new O-ring and install it to the camshaft timing oil control valve.

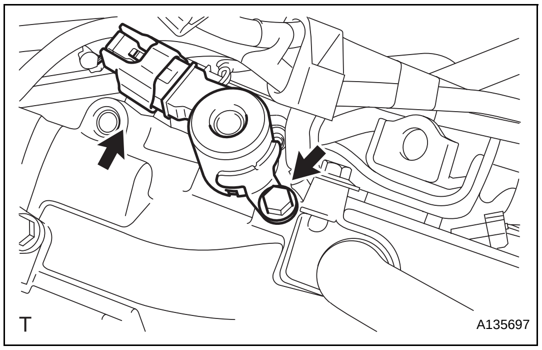


   (b) Install the camshaft timing oil control valve with the bolt.
   Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)
   NOTICE:
   Make sure that the O-ring is not cracked or jammed when installing the oil control valve.
   (c) Connect the camshaft timing oil control valve connector.

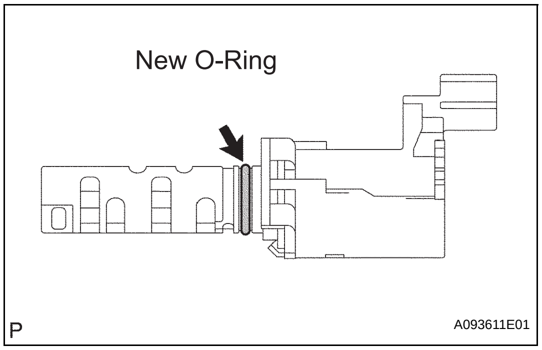
ES



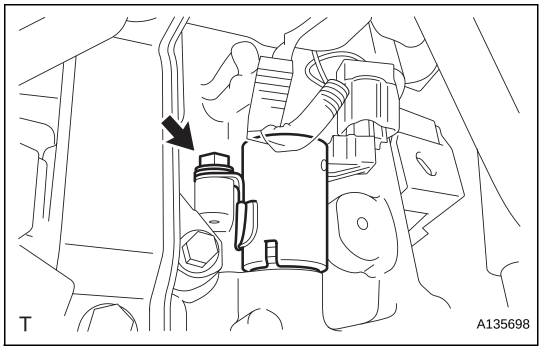
3. **INSTALL CAMSHAFT TIMING OIL CONTROL VALVE (for Bank 1 Intake Side)**
   (a) Apply a light coat of engine oil to a new O-ring and install it to the camshaft timing oil control valve.



   (b) Install the camshaft timing oil control valve with the bolt.
   Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)
   NOTICE:
   Make sure that the O-ring is not cracked or jammed when installing the oil control valve.
   (c) Connect the camshaft timing oil control valve connector.



4. **INSTALL CAMSHAFT TIMING OIL CONTROL VALVE (for Bank 1 Exhaust Side)**
   (a) Apply a light coat of engine oil to a new O-ring and install it to the camshaft timing oil control valve.



(b) Install the camshaft timing oil control valve with the bolt.
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)
NOTICE:
Make sure that the O-ring is not cracked or jammed when installing the oil control valve.

(c) Connect the camshaft timing oil control valve connector.

5. INSTALL INTAKE AIR SURGE TANK (See page FU-18)

6. INSTALL NO. 1 AIR CLEANER INLET (See page EM-49)

7. INSTALL AIR CLEANER CASE SUB-ASSEMBLY (See page EM-50)

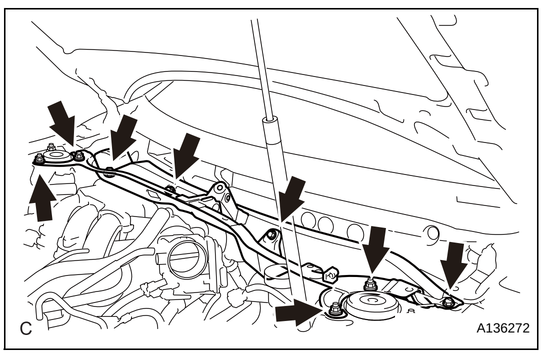
8. INSTALL AIR CLEANER CAP SUB-ASSEMBLY (See page ES-506)

9. INSTALL AIR CLEANER INLET ASSEMBLY (See page EM-50)

10. INSTALL V-BANK COVER SUB-ASSEMBLY (See page EM-52)

11. INSTALL COOL AIR INTAKE DUCT SEAL (See page EM-52)

12. INSTALL COWL TOP PANEL OUTER SUB-ASSEMBLY



(a) Install the cowl top panel outer sub-assembly with the 4 bolts and 4 nuts.
Torque: Bolt
5.0 N*m (51 kgf*cm, 44 in.*lbf)
Nut
85 N*m (867 kgf*cm, 63 ft.*lbf)

13. INSTALL WINDSHIELD WIPER MOTOR AND LINK (See page WW-14)

14. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY (See page WW-15)

15. INSTALL FRONT FENDER TO COWL SIDE SEAL RH (See page WW-15)

16. INSTALL FRONT FENDER TO COWL SIDE SEAL LH (See page WW-15)

17. INSTALL WINDSHIELD WIPER ARM AND BLADE ASSEMBLY LH (See page WW-15)

18. INSTALL WINDSHIELD WIPER ARM AND BLADE ASSEMBLY RH (See page WW-16)

19. ADD ENGINE COOLANT (See page CO-6)

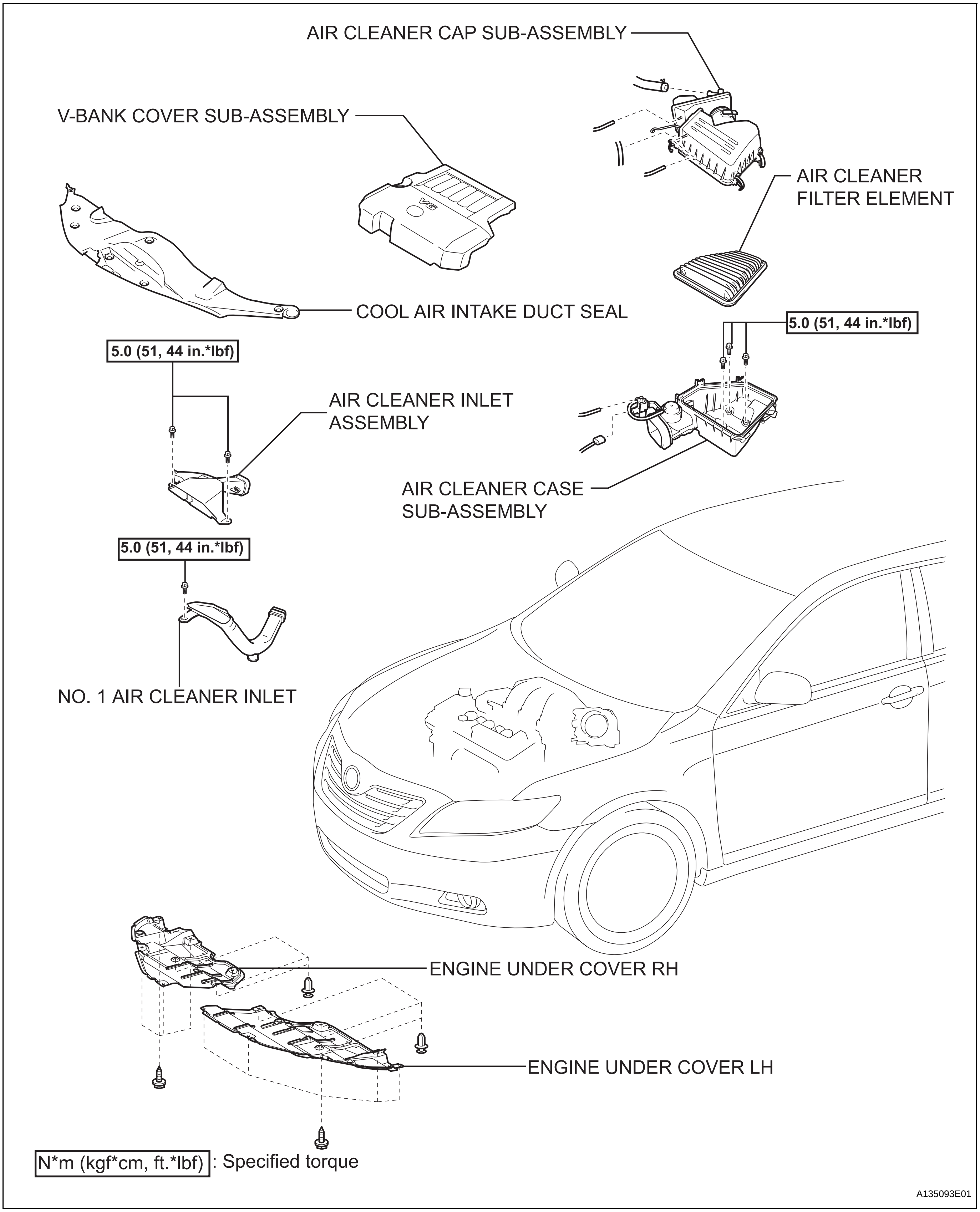
20. CHECK FOR ENGINE COOLANT LEAKS (See page CO-1)

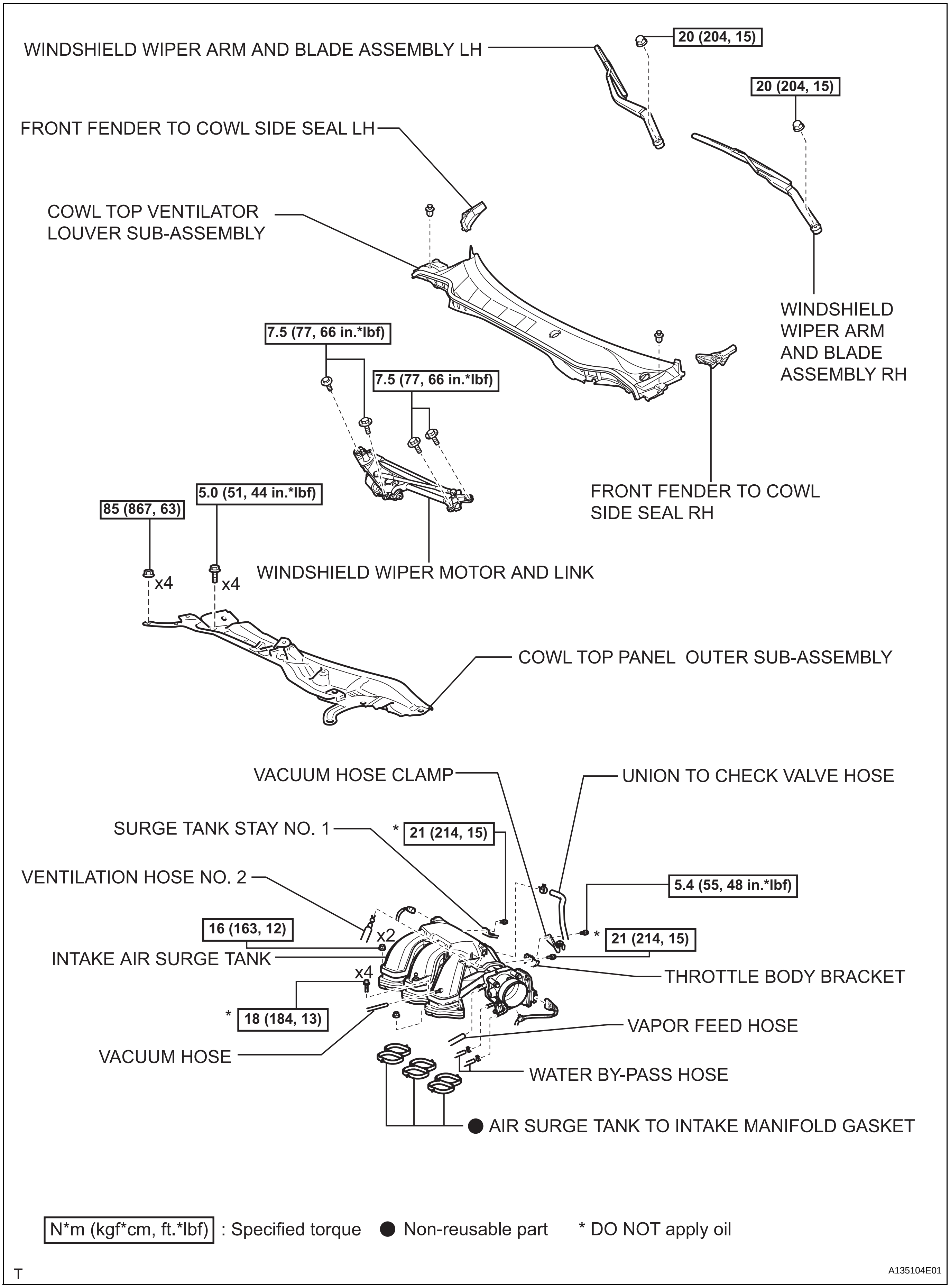
21. INSTALL ENGINE UNDER COVER RH

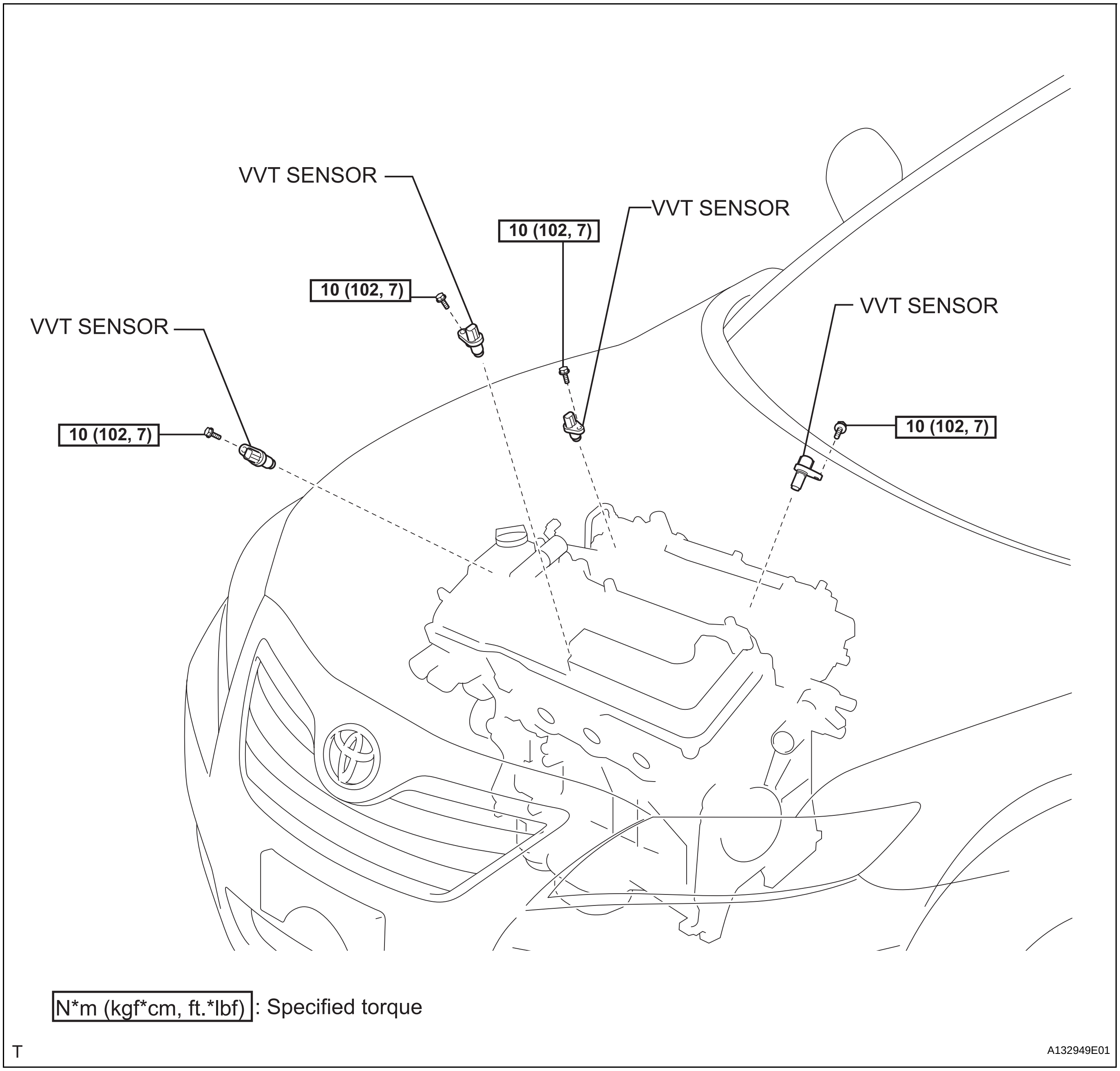
22. INSTALL ENGINE UNDER COVER LH

VVT SENSOR

COMPONENTS



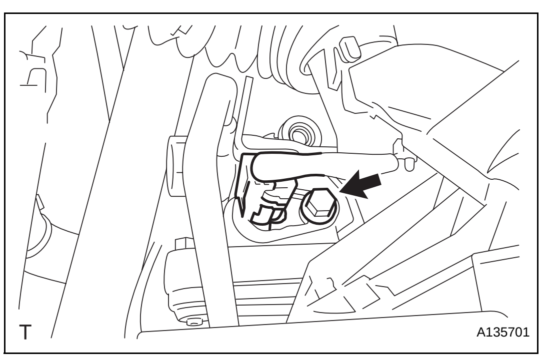

WINDSHIELD WIPER ARM AND BLADE ASSEMBLY LH
20 (204, 15)
20 (204, 15)
FRONT FENDER TO COWL SIDE SEAL LH
COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY
WINDSHIELD WIPER ARM AND BLADE ASSEMBLY RH
7.5 (77, 66 in.*lbf)
7.5 (77, 66 in.*lbf)
FRONT FENDER TO COWL SIDE SEAL RH
85 (867, 63)
5.0 (51, 44 in.*lbf)
x4
x4
WINDSHIELD WIPER MOTOR AND LINK
COWL TOP PANEL OUTER SUB-ASSEMBLY
VACUUM HOSE CLAMP
UNION TO CHECK VALVE HOSE
SURGE TANK STAY NO. 1
* 21 (214, 15)
VENTILATION HOSE NO. 2
5.4 (55, 48 in.*lbf)
16 (163, 12)
x2
* 21 (214, 15)
INTAKE AIR SURGE TANK
x4
THROTTLE BODY BRACKET
* 18 (184, 13)
VAPOR FEED HOSE
VACUUM HOSE
WATER BY-PASS HOSE
● AIR SURGE TANK TO INTAKE MANIFOLD GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
* DO NOT apply oil
T
A135104E01


VVT SENSOR
10 (102, 7)
VVT SENSOR
10 (102, 7)
VVT SENSOR
VVT SENSOR
10 (102, 7)
10 (102, 7)
N*m (kgf*cm, ft.*lbf) : Specified torque
T
A132949E01

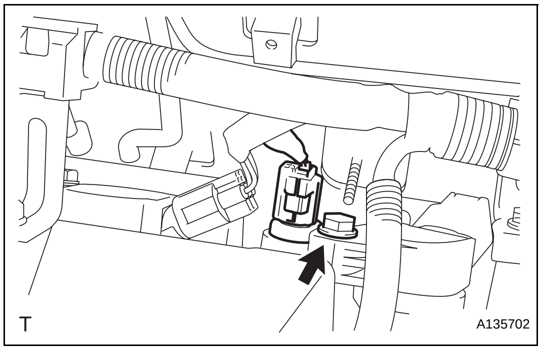
ES

REMOVAL

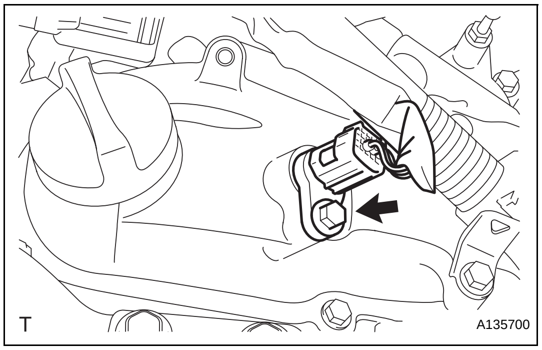
1. **REMOVE ENGINE UNDER COVER LH**
2. **REMOVE ENGINE UNDER COVER RH**
3. **DRAIN ENGINE COOLANT (See page CO-5)**
4. **REMOVE WINDSHIELD WIPER ARM AND BLADE ASSEMBLY LH (See page WW-9)**
5. **REMOVE WINDSHIELD WIPER ARM AND BLADE ASSEMBLY RH (See page WW-9)**
6. **REMOVE FRONT FENDER TO COWL SIDE SEAL LH (See page WW-9)**
7. **REMOVE FRONT FENDER TO COWL SIDE SEAL RH (See page WW-9)**
8. **REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY (See page WW-10)**
9. **REMOVE WINDSHIELD WIPER MOTOR AND LINK (See page WW-10)**
10. **REMOVE COWL TOP PANEL OUTER SUB-ASSEMBLY (See page ES-481)**
11. **REMOVE COOL AIR INTAKE DUCT SEAL (See page EM-23)**
12. **REMOVE V-BANK COVER SUB-ASSEMBLY (See page EM-23)**
13. **REMOVE AIR CLEANER INLET ASSEMBLY (See page EM-24)**
14. **REMOVE AIR CLEANER CAP SUB-ASSEMBLY (See page ES-503)**
15. **REMOVE AIR CLEANER CASE SUB-ASSEMBLY (See page EM-24)**
16. **REMOVE NO. 1 AIR CLEANER INLET (See page EM-24)**
17. **REMOVE INTAKE AIR SURGE TANK ASSEMBLY (See page FU-13)**
18. **REMOVE VVT SENSOR (for Bank 1 Intake Side)**



(a) Disconnect the VVT sensor connector.
(b) Remove the bolt and VVT sensor.

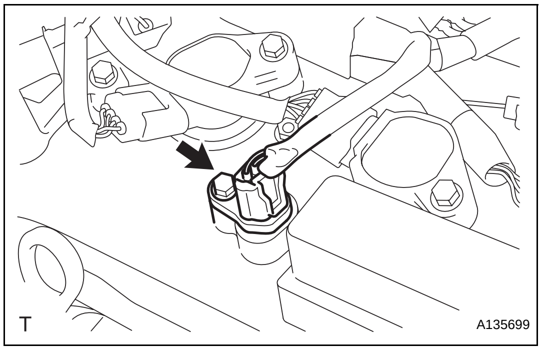


19. **REMOVE VVT SENSOR (for Bank 1 Exhaust Side)**
    (a) Disconnect the VVT sensor connector.
    (b) Remove the bolt and VVT sensor.



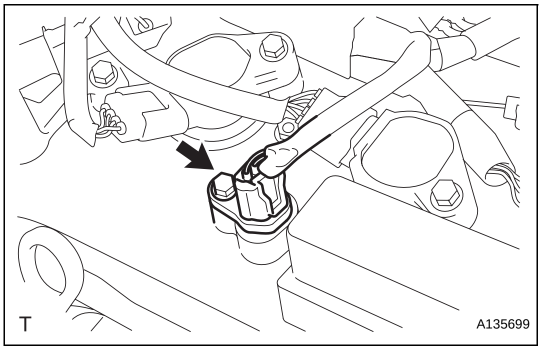
20. **REMOVE VVT SENSOR (for Bank 2 Intake Side)**
    (a) Disconnect the VVT sensor connector.
    (b) Remove the bolt and VVT sensor.

ES

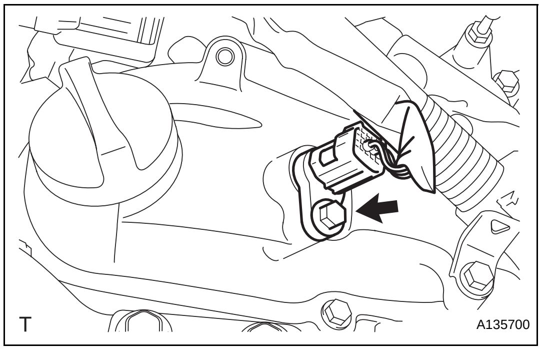


21. **REMOVE VVT SENSOR (for Bank 2 Exhaust Side)**
    (a) Disconnect the VVT sensor connector.
    (b) Remove the bolt and VVT sensor.

INSTALLATION

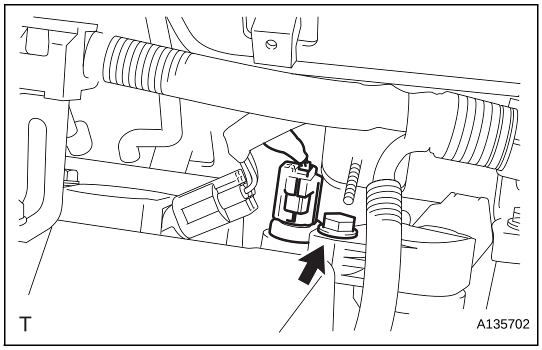


1. **INSTALL VVT SENSOR (for Bank 2 Exhaust Side)**
    (a) Install the VVT sensor with the bolt.
    Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)
    (b) Connect the VVT sensor connector.

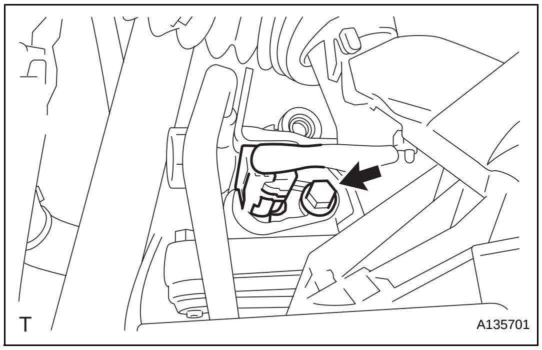


2. **INSTALL VVT SENSOR (for Bank 2 Intake Side)**
    (a) Install the VVT sensor with the bolt.
    Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)
    (b) Connect the VVT sensor connector.

ES



3. **INSTALL VVT SENSOR (for Bank 1 Exhaust Side)**
   (a) Install the VVT sensor with the bolt.
   Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)
   (b) Connect the VVT sensor connector.

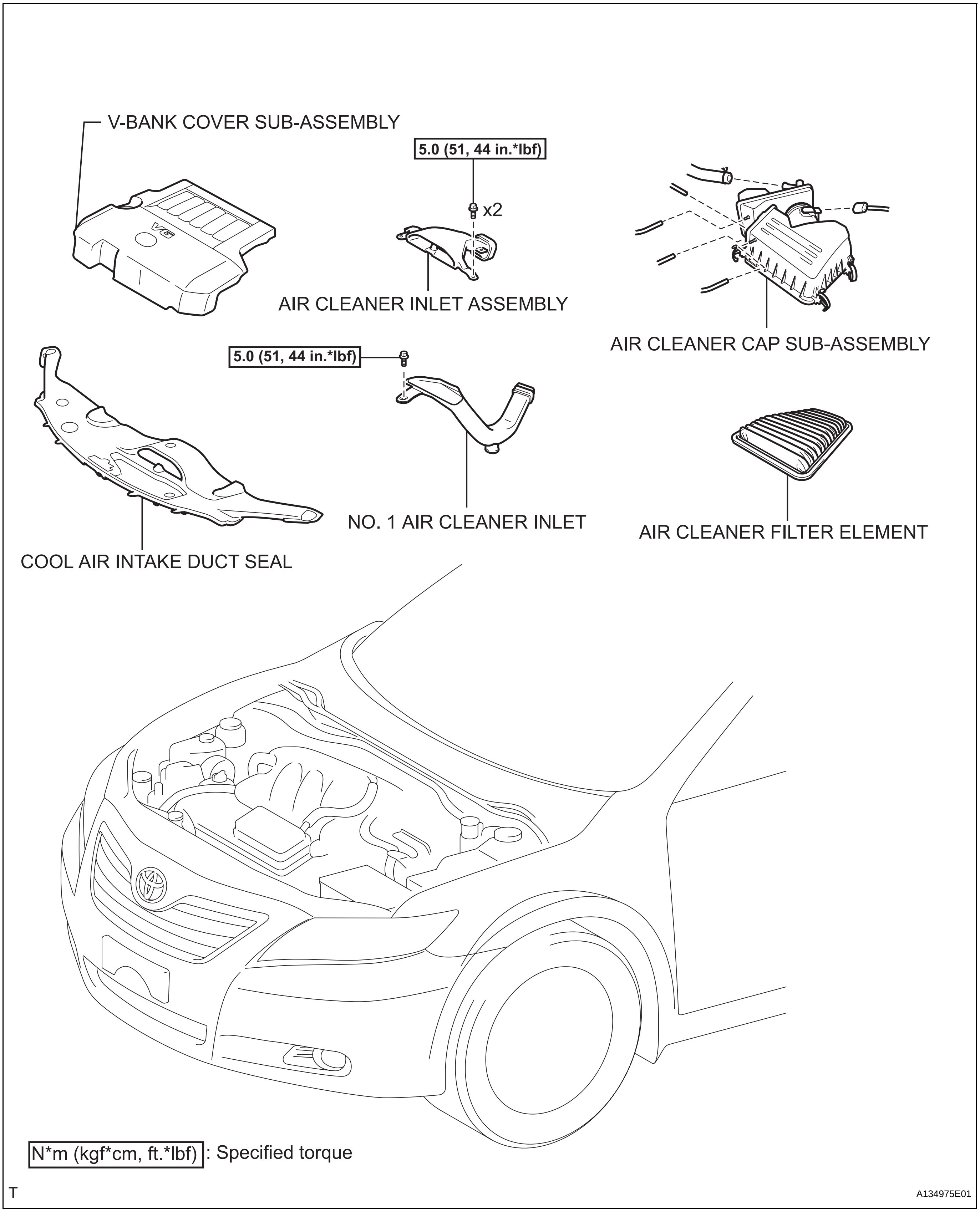


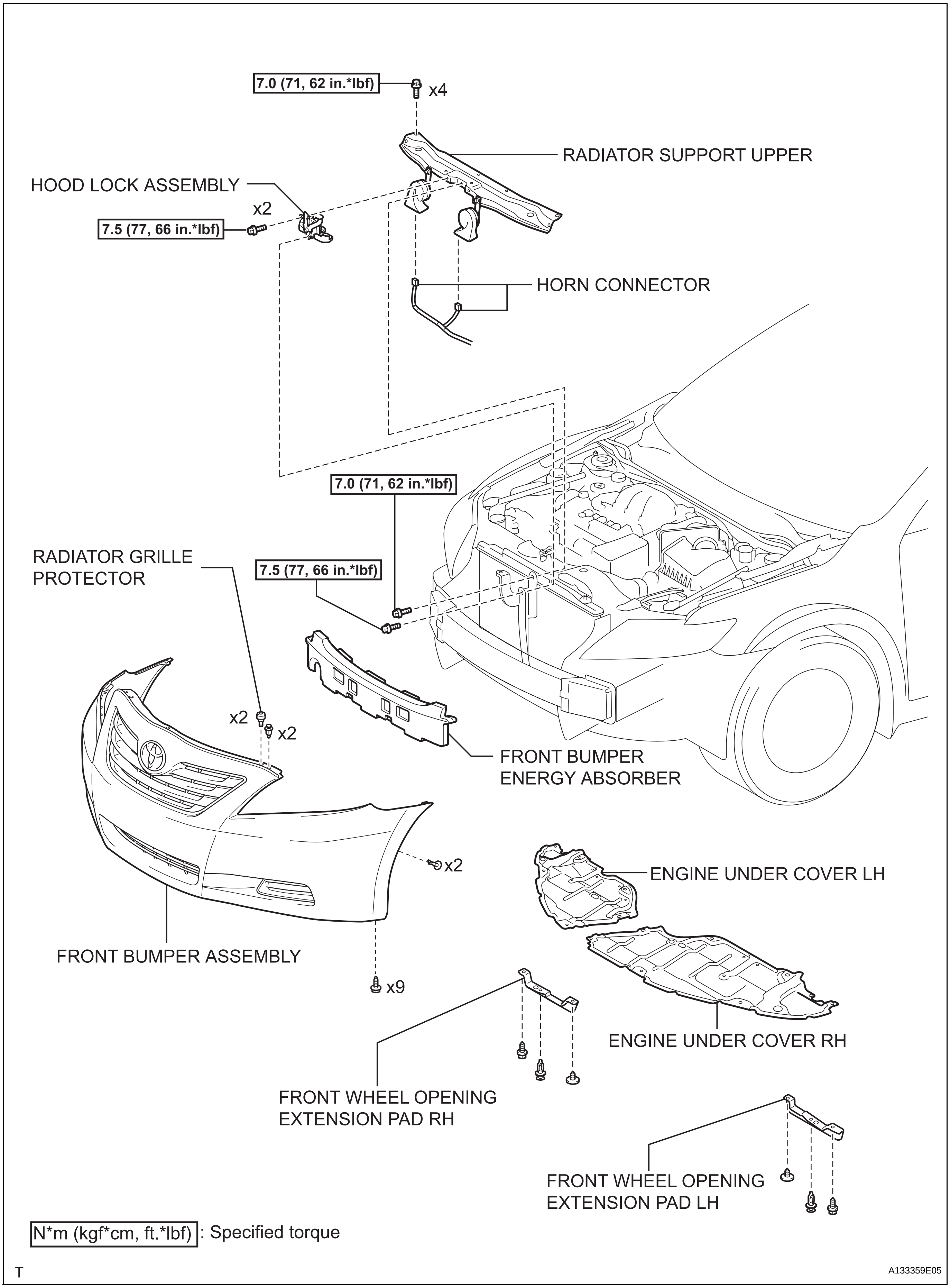
4. **INSTALL VVT SENSOR (for Bank 1 Intake Side)**
   (a) Install the VVT sensor with the bolt.
   Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)
   (b) Connect the VVT sensor connector.
5. **INSTALL INTAKE AIR SURGE TANK ASSEMBLY (See page FU-18)**
6. **INSTALL NO. 1 AIR CLEANER INLET (See page EM-49)**
7. **INSTALL AIR CLEANER CASE SUB-ASSEMBLY (See page EM-50)**
8. **INSTALL AIR CLEANER CAP SUB-ASSEMBLY (See page ES-506)**
9. **INSTALL AIR CLEANER INLET ASSEMBLY (See page EM-50)**
10. **INSTALL V-BANK COVER SUB-ASSEMBLY (See page EM-52)**
11. **INSTALL COOL AIR INTAKE DUCT SEAL (See page EM-52)**
12. **INSTALL COWL TOP PANEL OUTER SUB-ASSEMBLY (See page ES-485)**
13. **INSTALL WINDSHIELD WIPER MOTOR AND LINK (See page WW-14)**
14. **INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY (See page WW-15)**
15. **INSTALL FRONT FENDER TO COWL SIDE SEAL RH (See page WW-15)**
16. **INSTALL FRONT FENDER TO COWL SIDE SEAL LH (See page WW-15)**
17. **INSTALL WINDSHIELD WIPER ARM AND BLADE ASSEMBLY LH (See page WW-15)**
18. **INSTALL WINDSHIELD WIPER ARM AND BLADE ASSEMBLY RH (See page WW-16)**
19. **ADD ENGINE COOLANT (See page CO-6)**
20. **CHECK FOR ENGINE COOLANT LEAKS (See page CO-1)**
21. **INSTALL ENGINE UNDER COVER RH**

22. INSTALL ENGINE UNDER COVER LH

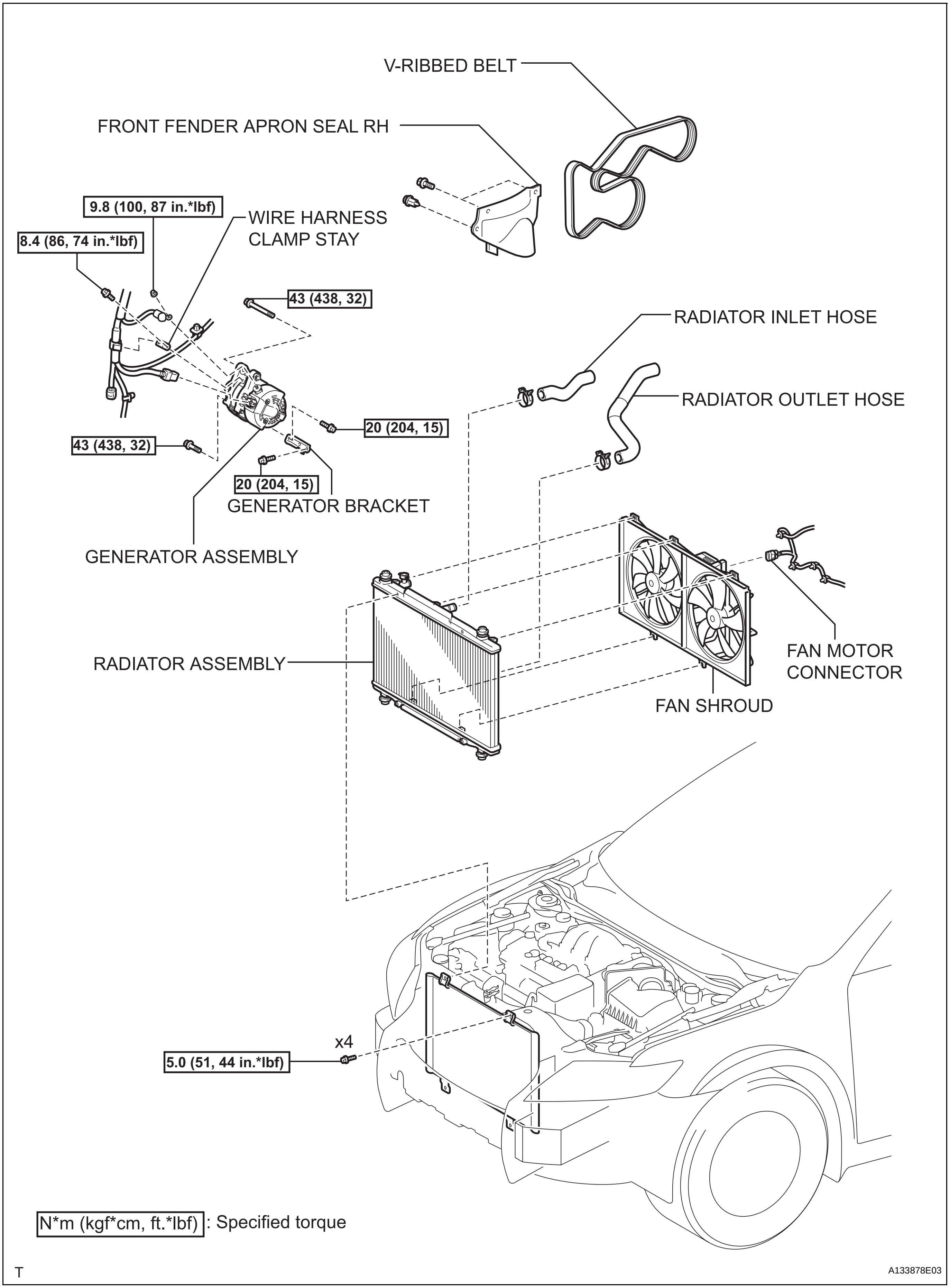
CRANKSHAFT POSITION SENSOR

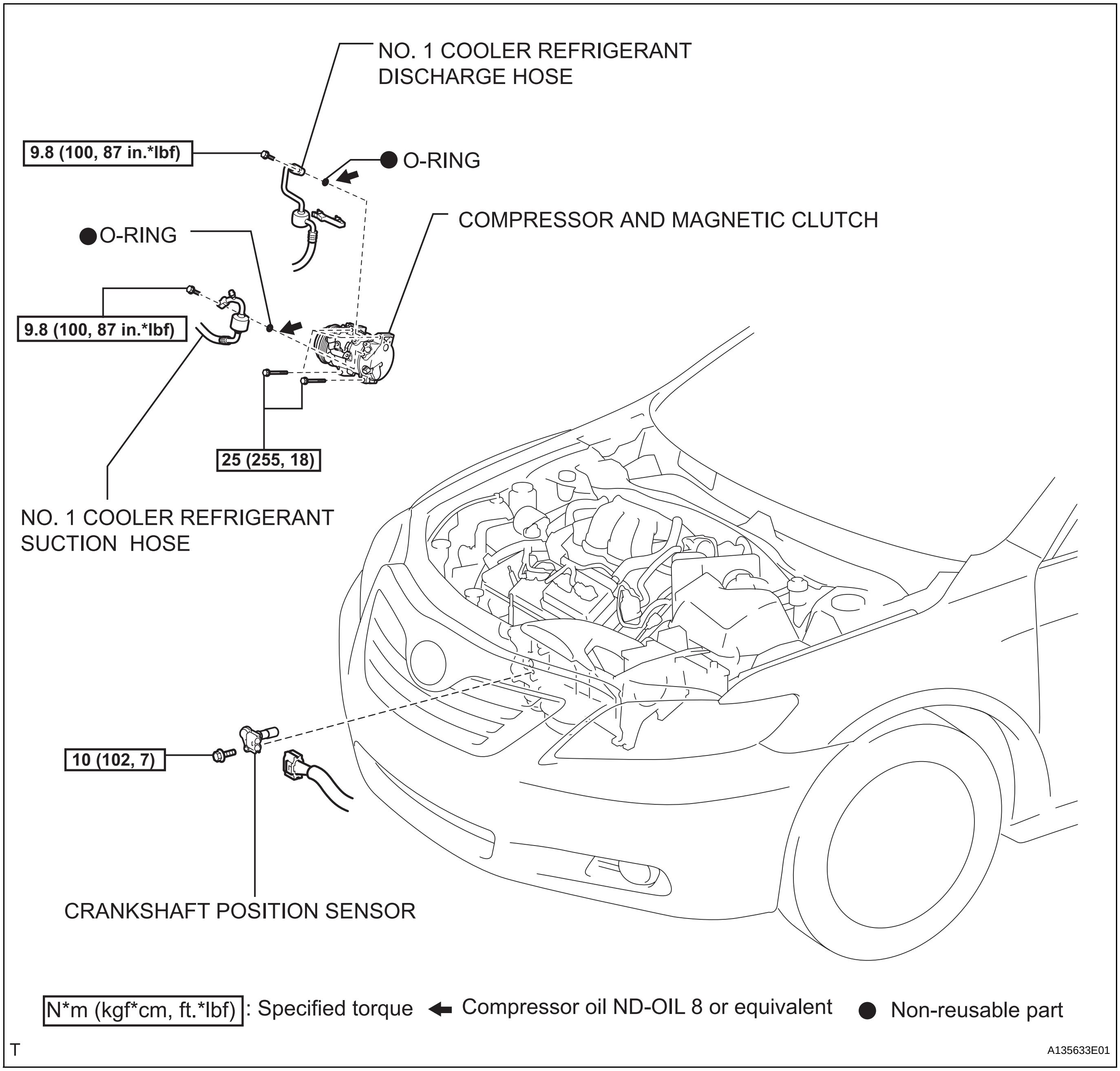
COMPONENTS





7.0 (71, 62 in.*lbf)
x4
RADIATOR SUPPORT UPPER
HOOD LOCK ASSEMBLY
x2
7.5 (77, 66 in.*lbf)
HORN CONNECTOR
7.0 (71, 62 in.*lbf)
RADIATOR GRILLE PROTECTOR
7.5 (77, 66 in.*lbf)
x2
x2
FRONT BUMPER ENERGY ABSORBER
x2
ENGINE UNDER COVER LH
FRONT BUMPER ASSEMBLY
x9
ENGINE UNDER COVER RH
FRONT WHEEL OPENING EXTENSION PAD RH
FRONT WHEEL OPENING EXTENSION PAD LH
N*m (kgf*cm, ft.*lbf) : Specified torque
T
A133359E05

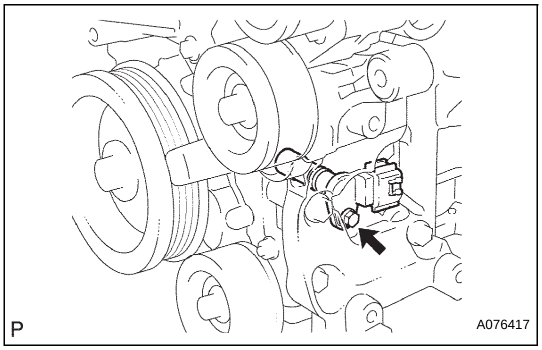

V-RIBBED BELT
FRONT FENDER APRON SEAL RH
9.8 (100, 87 in.*lbf)
WIRE HARNESS CLAMP STAY
8.4 (86, 74 in.*lbf)
43 (438, 32)
RADIATOR INLET HOSE
RADIATOR OUTLET HOSE
20 (204, 15)
43 (438, 32)
20 (204, 15)
GENERATOR BRACKET
GENERATOR ASSEMBLY
RADIATOR ASSEMBLY
FAN MOTOR CONNECTOR
FAN SHROUD
x4
5.0 (51, 44 in.*lbf)
N*m (kgf*cm, ft.*lbf) : Specified torque
T
A133878E03


NO. 1 COOLER REFRIGERANT
DISCHARGE HOSE
9.8 (100, 87 in.*lbf)
O-RING
COMPRESSOR AND MAGNETIC CLUTCH
O-RING
9.8 (100, 87 in.*lbf)
25 (255, 18)
NO. 1 COOLER REFRIGERANT
SUCTION HOSE
10 (102, 7)
CRANKSHAFT POSITION SENSOR
N*m (kgf*cm, ft.*lbf) : Specified torque
Compressor oil ND-OIL 8 or equivalent
Non-reusable part
T
A135633E01

REMOVAL

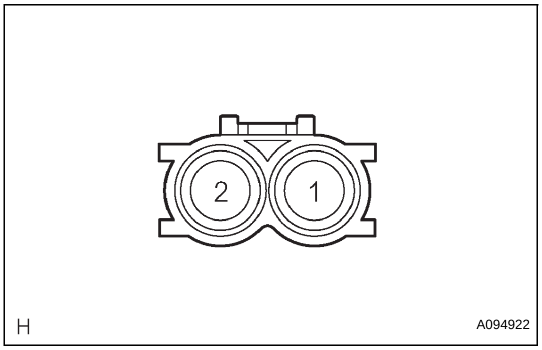
1. **REMOVE GENERATOR ASSEMBLY**
   HINT:
   (See page CH-13)

2. **DISCONNECT COOLER COMPRESSOR ASSEMBLY**
   HINT:
   (See page AC-219)



3. **REMOVE CRANKSHAFT POSITION SENSOR**
   (a) Disconnect the crankshaft position sensor connector.
   (b) Remove the bolt and crankshaft position sensor.

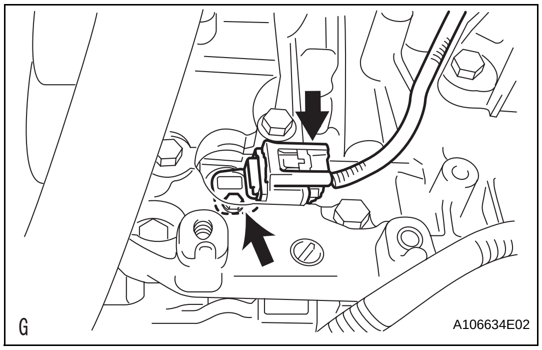
INSPECTION



1. **INSPECT CRANKSHAFT POSITION SENSOR**
   (a) Using an ohmmeter, measure the resistance between the terminals.
   Resistance:
   1,630 to 2,740 Ω at cold
   2,065 to 3,225 Ω at hot
   NOTICE:
   The 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).
   If the resistance is not as specified, replace the sensor.

INSTALLATION

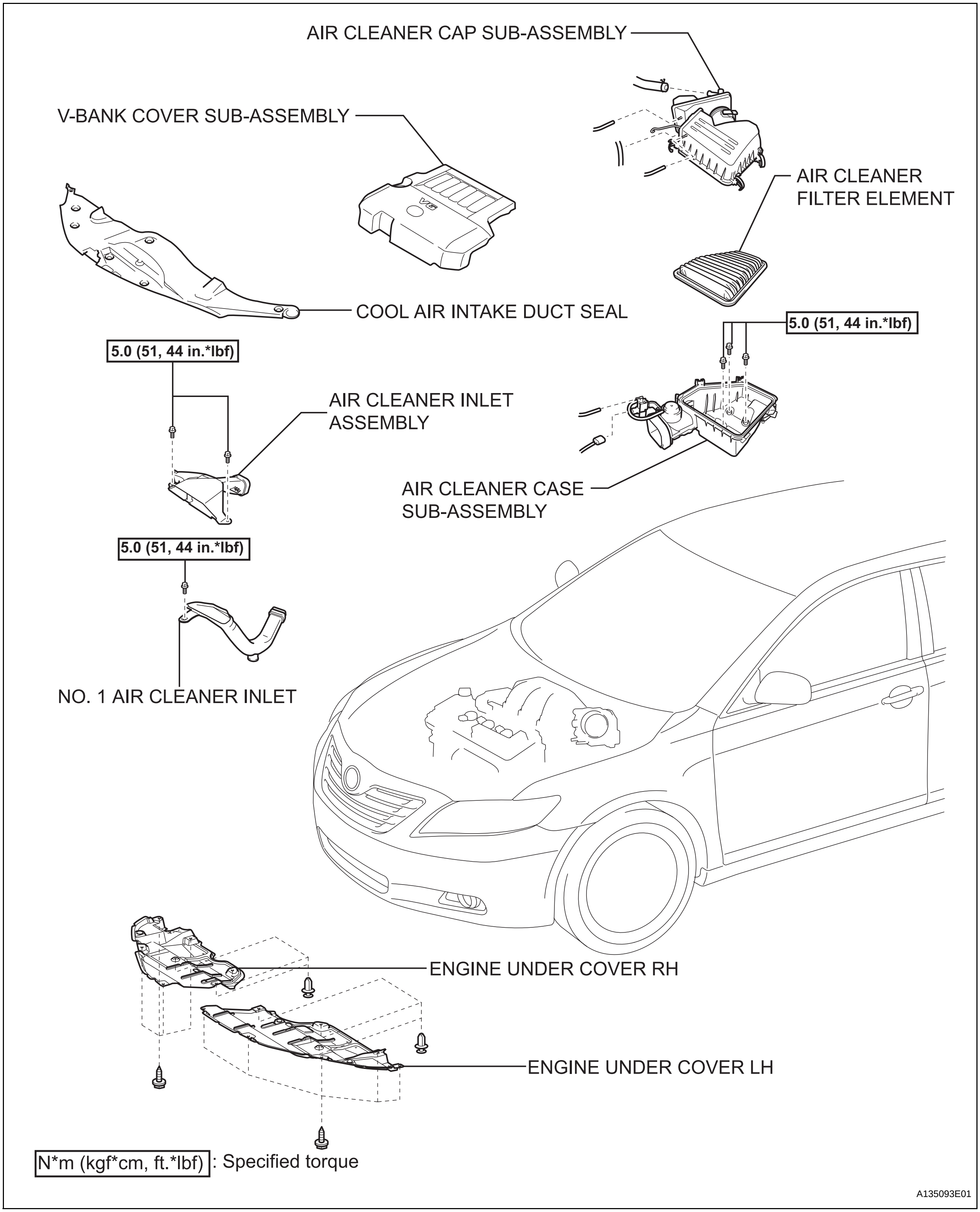
1. **INSTALL CRANKSHAFT POSITION SENSOR**
   (a) Apply a light coat of engine oil to the O-ring of the crankshaft position sensor.

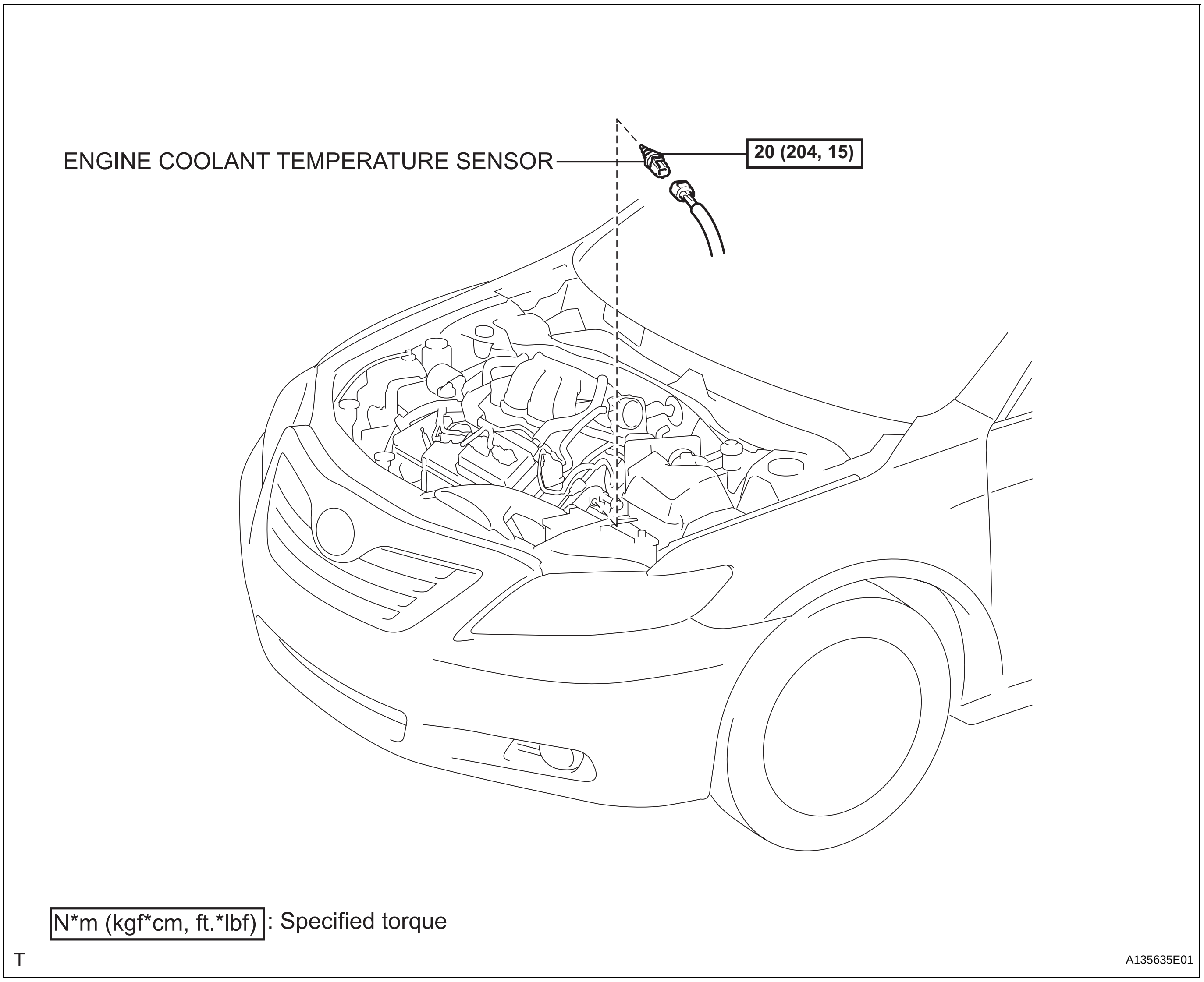


   (b) Install the crankshaft position sensor with the bolt.
   Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)
   (c) Connect the crankshaft position sensor connector.
2. **INSTALL COOLER COMPRESSOR ASSEMBLY**
   HINT:
   (See page AC-225)
3. **INSTALL GENERATOR ASSEMBLY**
   HINT:
   (See page CH-22)

ENGINE COOLANT TEMPERATURE SENSOR

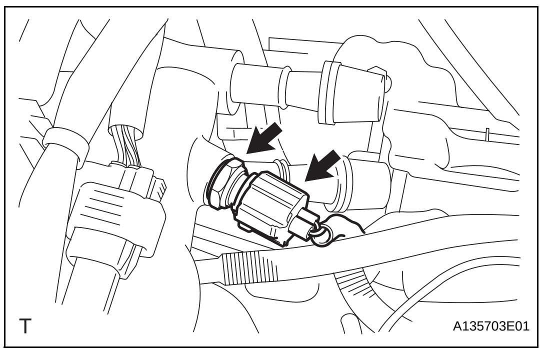
COMPONENTS




ENGINE COOLANT TEMPERATURE SENSOR
20 (204, 15)
N*m (kgf*cm, ft.*lbf) : Specified torque
T
A135635E01

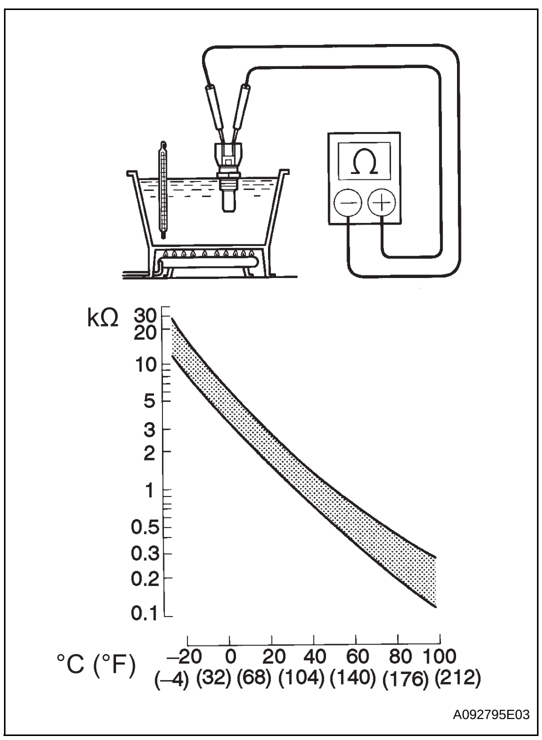
REMOVAL

1. **REMOVE ENGINE UNDER COVER LH**
2. **REMOVE ENGINE UNDER COVER RH**
3. **DRAIN ENGINE COOLANT (See page CO-5)**
4. **REMOVE V-BANK COVER SUB-ASSEMBLY (See page EM-23)**
5. **REMOVE AIR CLEANER INLET ASSEMBLY (See page EM-24)**
6. **REMOVE AIR CLEANER CAP SUB-ASSEMBLY (See page ES-503)**
7. **REMOVE AIR CLEANER CASE SUB-ASSEMBLY (See page EM-24)**
8. **REMOVE NO. 1 AIR CLEANER INLET (See page EM-24)**



9. **REMOVE ENGINE COOLANT TEMPERATURE SENSOR**
   (a) Remove the engine coolant temperature sensor connector.
   (b) Remove the engine coolant temperature sensor.

INSPECTION



1. **INSPECT ENGINE COOLANT TEMPERATURE SENSOR**
   (a) Measure the resistance between the terminals.
   Standard resistance

Condition	Specified Condition
Approx. 20°C (68°F)	2.32 to 2.59 kΩ
Approx. 80°C (176°F)	0.31 to 0.326 kΩ

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

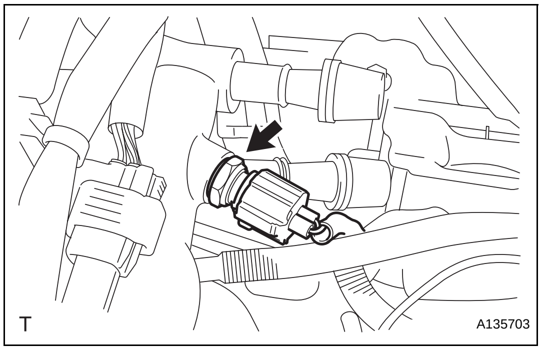
NOTICE:

If checking the ECT sensor in the water, keep the terminals dry. After checking, dry the sensor.

INSTALLATION

1. INSTALL ENGINE COOLANT TEMPERATURE SENSOR

(a) Install a new gasket to the engine coolant temperature sensor.



(b) Install the engine coolant temperature sensor.

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

(c) Connect the engine coolant temperature sensor connector.

2. INSTALL NO. 1 AIR CLEANER INLET (See page EM-49)

3. INSTALL AIR CLEANER CASE SUB-ASSEMBLY (See page EM-50)

4. INSTALL AIR CLEANER CAP SUB-ASSEMBLY (See page ES-506)

5. INSTALL AIR CLEANER INLET ASSEMBLY (See page EM-50)

6. INSTALL V-BANK COVER SUB-ASSEMBLY (See page EM-52)

7. ADD ENGINE COOLANT (See page CO-6)

8. CHECK FOR ENGINE COOLANT LEAKS (See page CO-1)

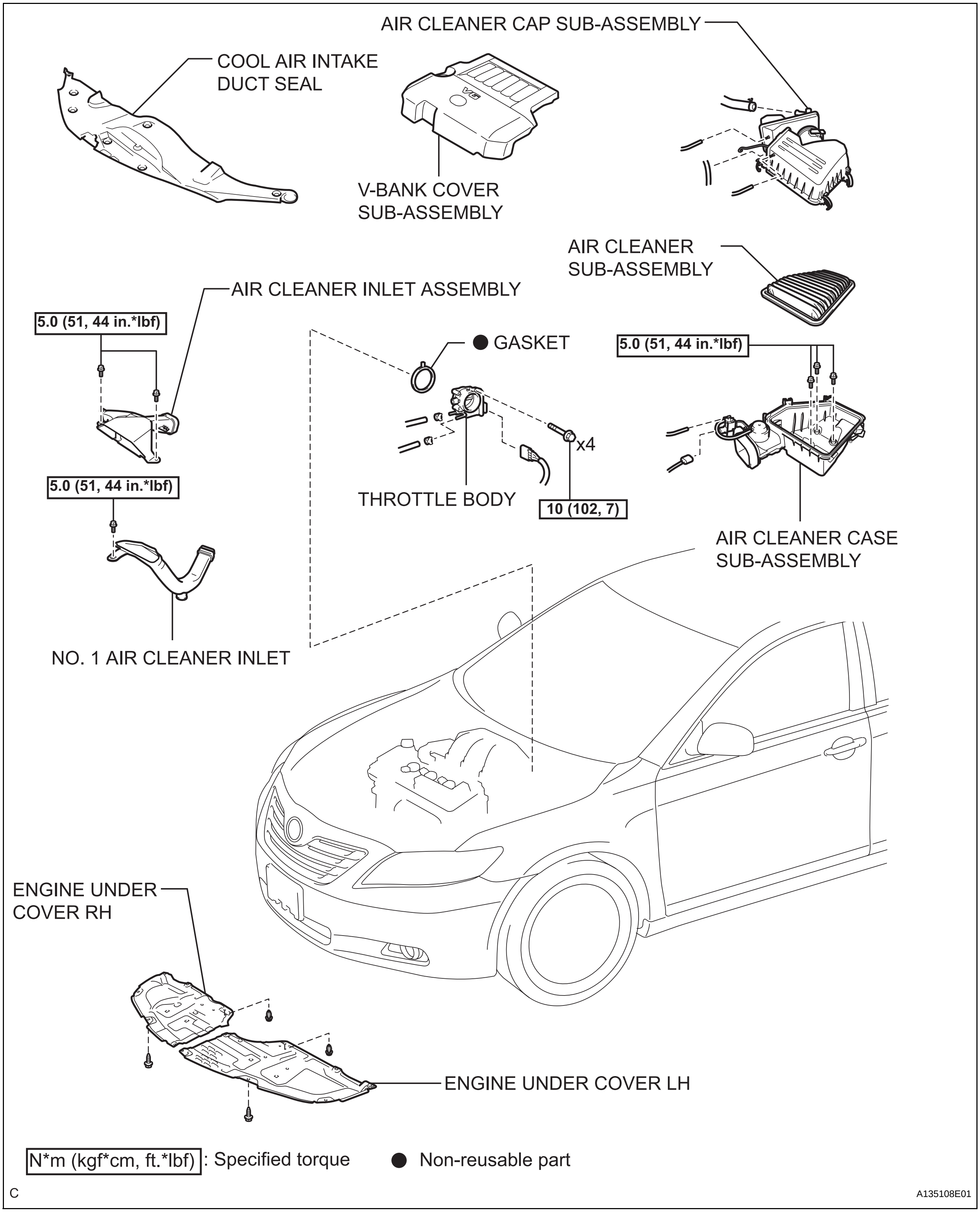
9. INSTALL ENGINE UNDER COVER RH

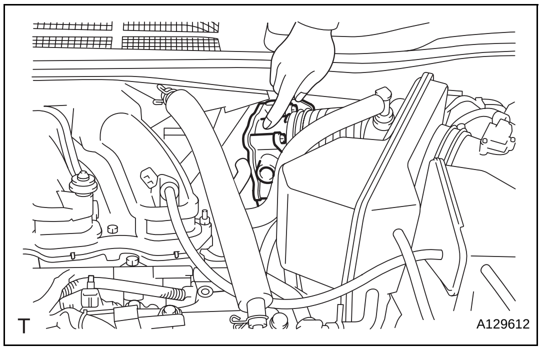
10. INSTALL ENGINE UNDER COVER LH

ES

THROTTLE BODY

COMPONENTS





ON-VEHICLE INSPECTION

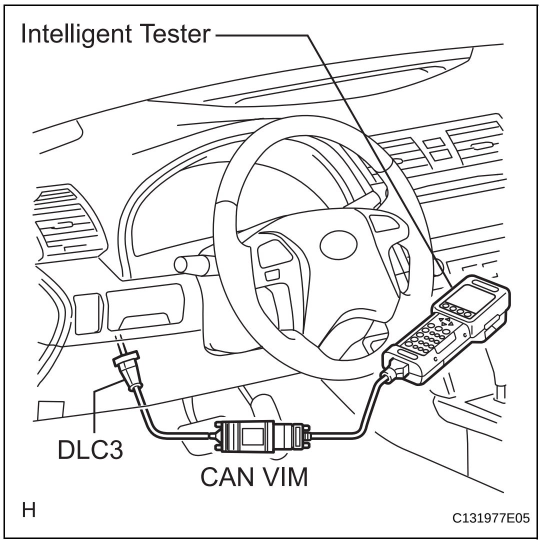
1. INSPECTION THROTTLE BODY

(a) Inspect the throttle control motor for operating sounds.

(1) Turn the ignition switch on (IG).

(2) When turning the accelerator pedal position sensor lever, check for running sounds of the motor. The motor should be running smoothly without friction sounds.

If operation is not as specified, check the throttle control motor, wiring and ECM (See page ES-505).



(b) Inspect the throttle position sensor.

(1) Connect the intelligent tester (with CAN VIM) to the DLC3.

(2) Turn the ignition switch on (IG).

(3) Check that the MIL is off.

(4) Check that, under the CURRENT DATA, THROTTLE POS (throttle valve opening percentage) is within the standard range below.

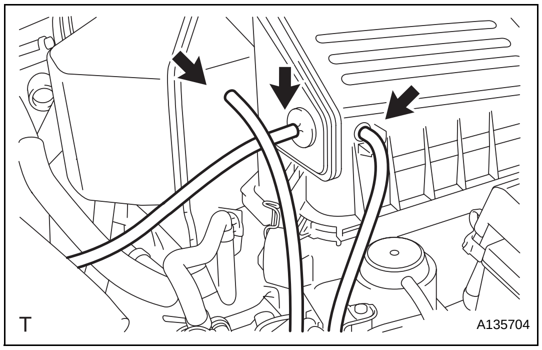
Standard throttle valve opening percentage:
60 % or more

If operation is not as specified, check the throttle position sensor, wiring and ECM (See page ES-505).

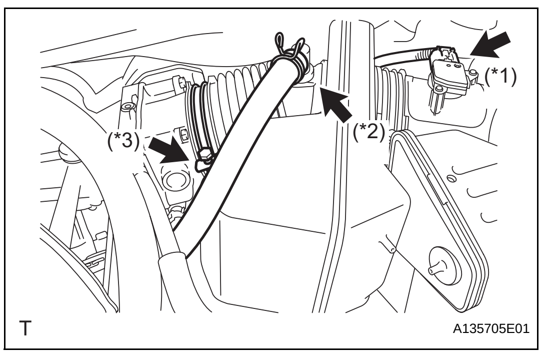
ES

REMOVAL

1. **REMOVE ENGINE UNDER COVER LH**
2. **REMOVE ENGINE UNDER COVER RH**
3. **DRAIN ENGINE COOLANT (See page CO-5)**
4. **REMOVE COOL AIR INTAKE DUCT SEAL (See page EM-23)**
5. **REMOVE V-BANK COVER SUB-ASSEMBLY (See page EM-23)**
6. **REMOVE AIR CLEANER INLET ASSEMBLY (See page EM-24)**
7. **REMOVE AIR CLEANER CAP SUB-ASSEMBLY**



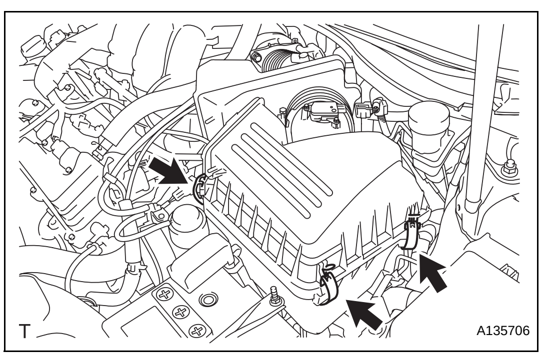
(a) Disconnect the 3 vacuum hoses.



(b) Disconnect the mass air flow meter connector (*1).

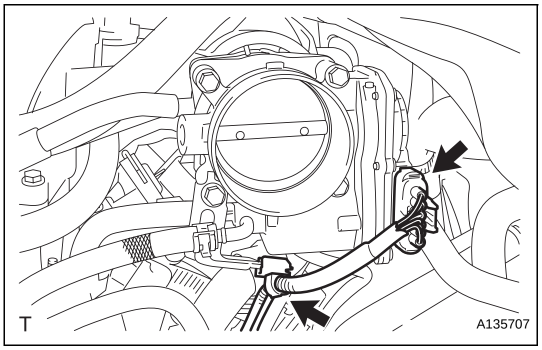
(c) Disconnect the No. 2 ventilation hose (*2).

(d) Disconnect the hose band (*3).



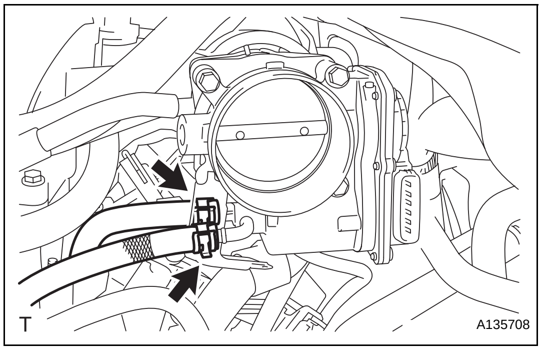
(e) Disconnect the 3 bands, and remove the air cleaner cap sub-assembly.

8. **REMOVE AIR CLEANER CASE SUB-ASSEMBLY (See page EM-24)**
9. **REMOVE NO. 1 AIR CLEANER INLET (See page EM-24)**

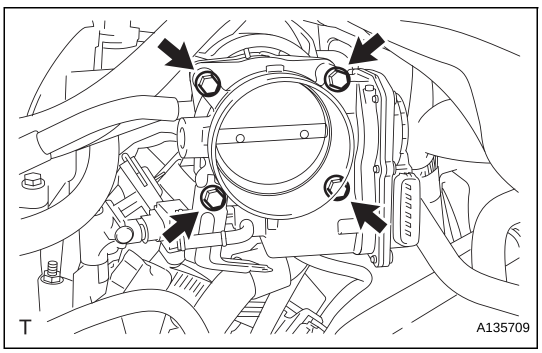


10. REMOVE THROTTLE BODY

(a) Disconnect the throttle body connector and clamp.



(b) Disconnect the 2 water by-pass hoses from the throttle body.



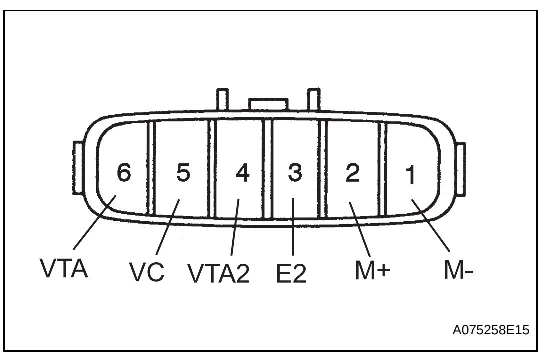
(c) Remove the 4 bolts and throttle body.

(d) Remove the throttle body gasket from the intake air surge tank.

ES

INSPECTION

1. INSPECT THROTTLE BODY



(a) Measure the resistance between the terminals.

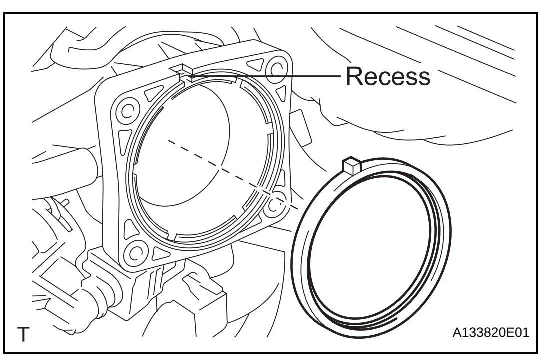
Standard resistance

Tester Connection	Condition	Specified Condition
2 (M+) - 1 (M-)	20°C (68°F)	0.3 to 100 Ω
5 (VC) - 3 (E2)	20°C (68°F)	1.2 to 3.2 kΩ

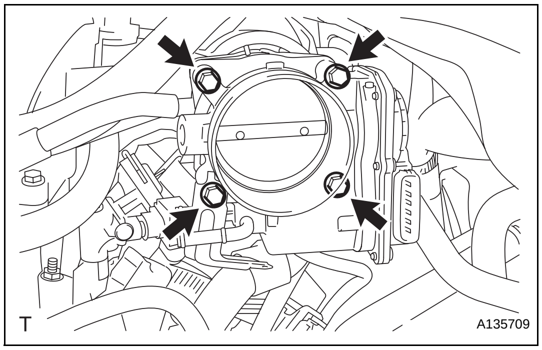
If the result is not as specified, replace the throttle body assembly.

INSTALLATION

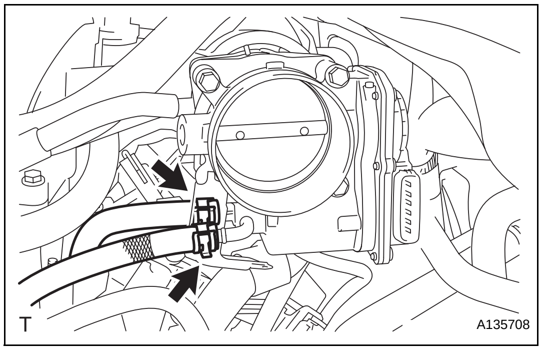
1. INSTALL THROTTLE BODY



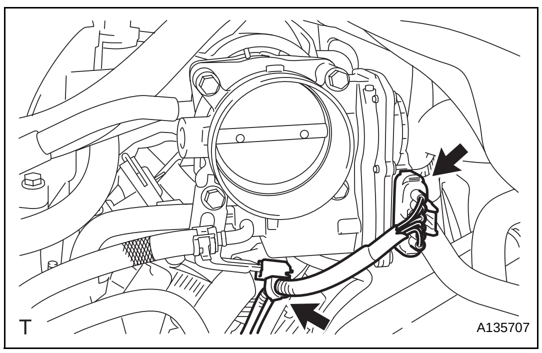
(a) Install a new throttle body gasket to the intake air surge tank.



(b) Install the throttle body with the 4 bolts.
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)



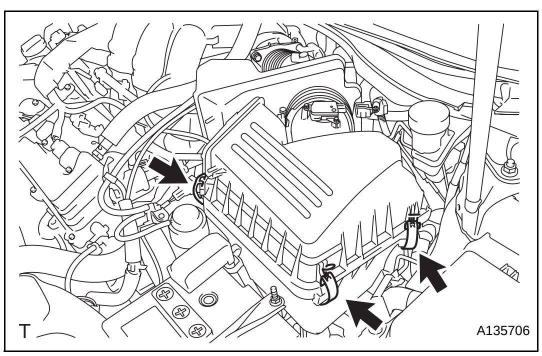
(c) Connect the 2 water by-pass hoses.



(d) Connect the throttle body connector and clamp.

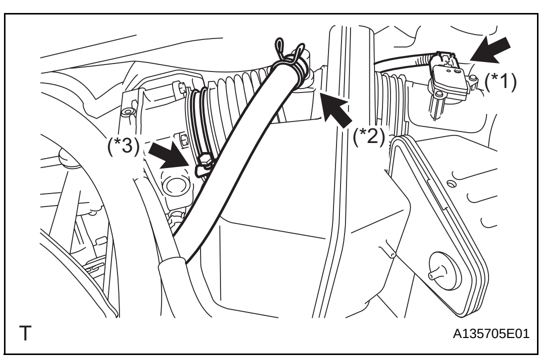
2. INSTALL NO. 1 AIR CLEANER INLET (See page EM-49)

3. INSTALL AIR CLEANER CASE SUB-ASSEMBLY (See page EM-50)



4. INSTALL AIR CLEANER CAP SUB-ASSEMBLY

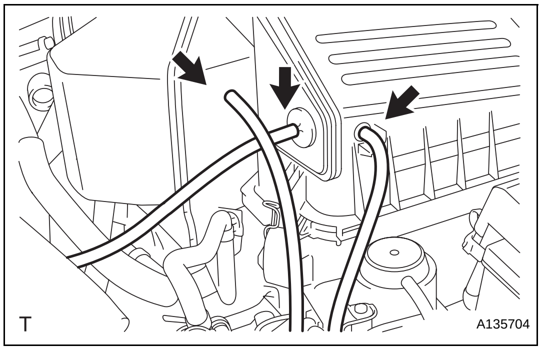
(a) Install the air cleaner cap sub-assembly, and connect the 3 bands.



(b) Connect the mass air flow meter connector (*1).

(c) Connect the No. 2 ventilation hose (*2).

(d) Connect the hose band (*3).

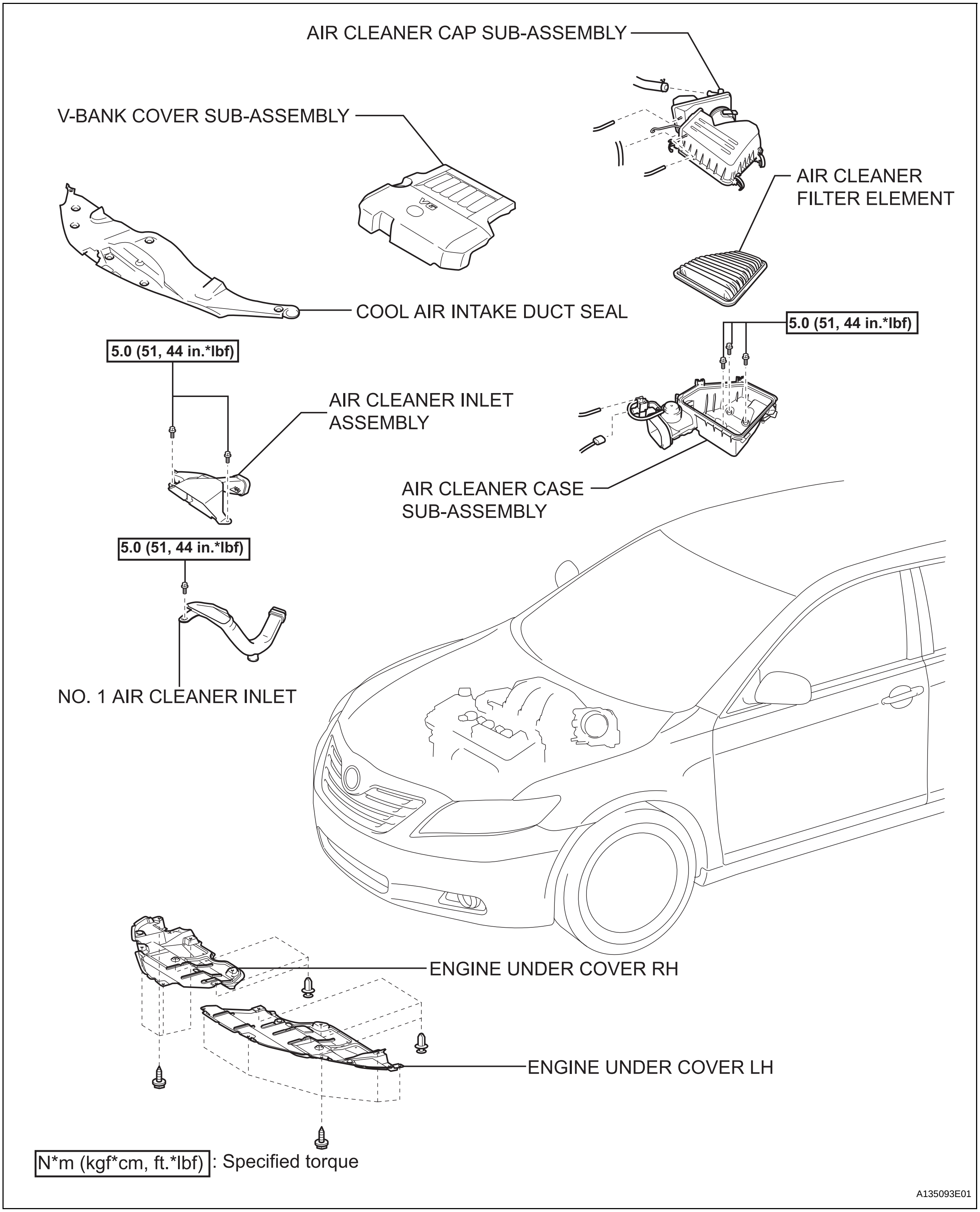


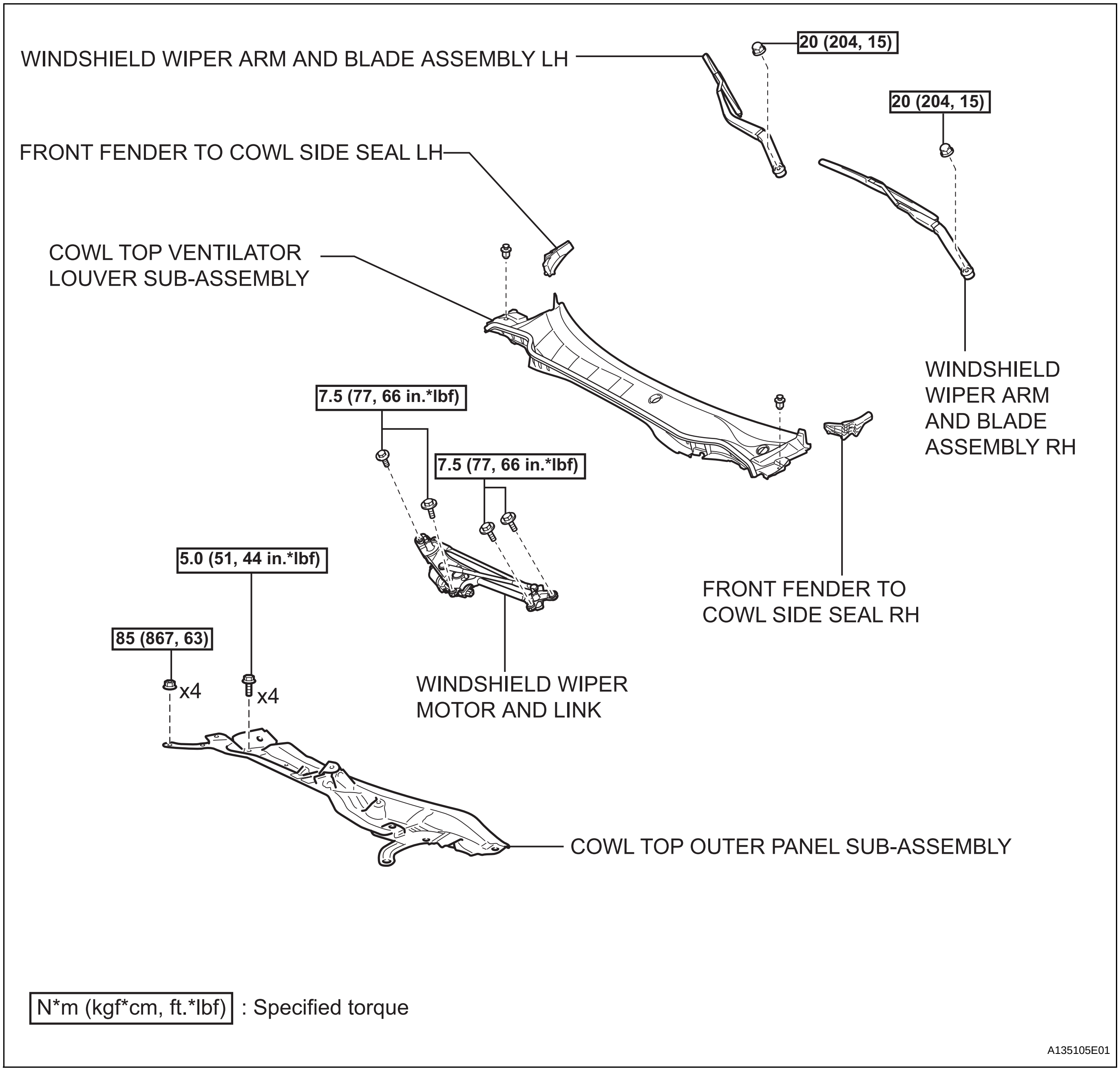
(e) Connect the 3 vacuum hoses.

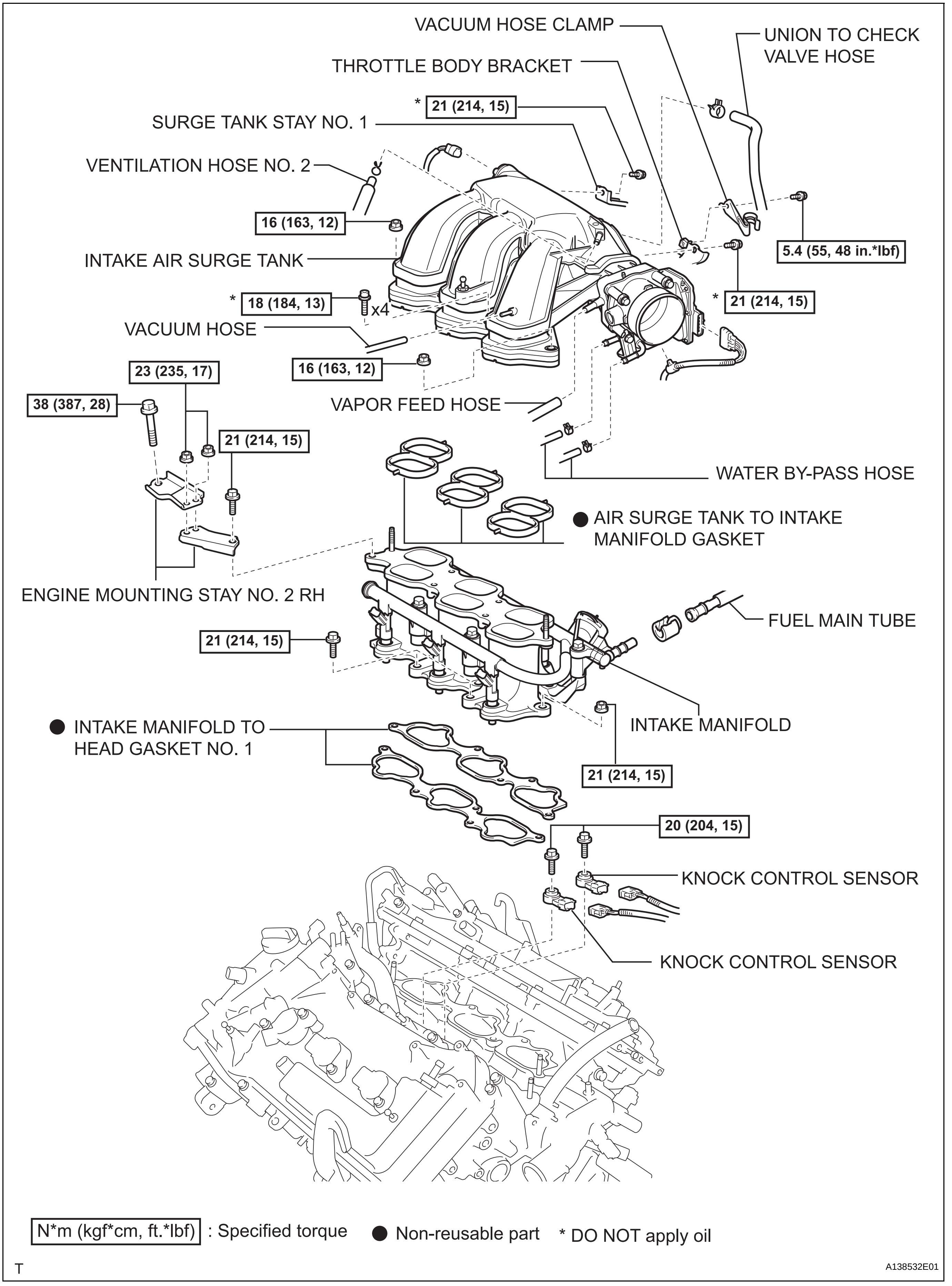
5. **INSTALL AIR CLEANER INLET ASSEMBLY (See page EM-50)**
6. **INSTALL COOL AIR INTAKE DUCT SEAL (See page EM-52)**
7. **ADD ENGINE COOLANT (See page CO-6)**
8. **CHECK FOR ENGINE COOLANT LEAKS (See page CO-1)**
9. **CHECK FUNCTION OF THROTTLE BODY (See page ES-503)**
10. **INSTALL V-BANK COVER SUB-ASSEMBLY (See page EM-52)**

KNOCK SENSOR

COMPONENTS




WINDSHIELD WIPER ARM AND BLADE ASSEMBLY LH
20 (204, 15)
20 (204, 15)
FRONT FENDER TO COWL SIDE SEAL LH
COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY
WINDSHIELD WIPER ARM AND BLADE ASSEMBLY RH
7.5 (77, 66 in.*lbf)
7.5 (77, 66 in.*lbf)
5.0 (51, 44 in.*lbf)
FRONT FENDER TO COWL SIDE SEAL RH
85 (867, 63)
x4
x4
WINDSHIELD WIPER MOTOR AND LINK
COWL TOP OUTER PANEL SUB-ASSEMBLY
N*m (kgf*cm, ft.*lbf) : Specified torque
A135105E01

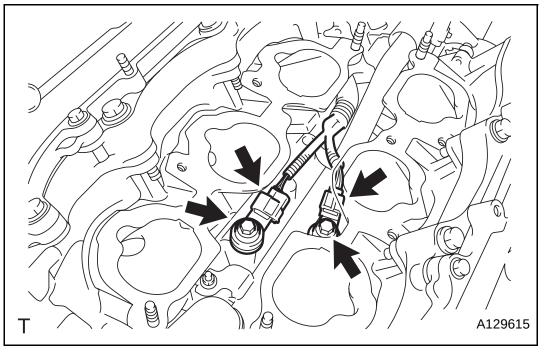

VACUUM HOSE CLAMP
UNION TO CHECK VALVE HOSE
THROTTLE BODY BRACKET
* 21 (214, 15)
SURGE TANK STAY NO. 1
VENTILATION HOSE NO. 2
16 (163, 12)
INTAKE AIR SURGE TANK
5.4 (55, 48 in.*lbf)
* 18 (184, 13)
x4
* 21 (214, 15)
VACUUM HOSE
16 (163, 12)
23 (235, 17)
38 (387, 28)
VAPOR FEED HOSE
21 (214, 15)
WATER BY-PASS HOSE
AIR SURGE TANK TO INTAKE MANIFOLD GASKET
ENGINE MOUNTING STAY NO. 2 RH
FUEL MAIN TUBE
21 (214, 15)
INTAKE MANIFOLD TO HEAD GASKET NO. 1
INTAKE MANIFOLD
21 (214, 15)
20 (204, 15)
KNOCK CONTROL SENSOR
KNOCK CONTROL SENSOR
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
* DO NOT apply oil
T
A138532E01

ES

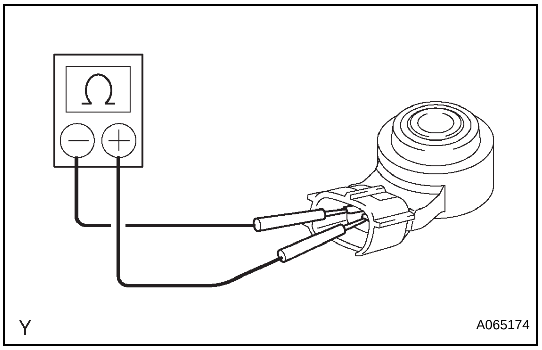
ES

REMOVAL

1. DISCHARGE FUEL SYSTEM PRESSURE (See page FU-13)
2. REMOVE ENGINE UNDER COVER LH
3. REMOVE ENGINE UNDER COVER RH
4. DRAIN ENGINE COOLANT (See page CO-5)
5. REMOVE WINDSHIELD WIPER ARM AND BLADE ASSEMBLY LH (See page WW-9)
6. REMOVE WINDSHIELD WIPER ARM AND BLADE ASSEMBLY RH (See page WW-9)
7. REMOVE FRONT FENDER TO COWL SIDE SEAL LH (See page WW-9)
8. REMOVE FRONT FENDER TO COWL SIDE SEAL RH (See page WW-9)
9. REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY (See page WW-10)
10. REMOVE WINDSHIELD WIPER MOTOR AND LINK (See page WW-10)
11. REMOVE COWL TOP PANEL OUTER SUB-ASSEMBLY (See page ES-481)
12. REMOVE COOL AIR INTAKE DUCT SEAL (See page ES-481)
13. REMOVE V-BANK COVER SUB-ASSEMBLY (See page EM-23)
14. REMOVE AIR CLEANER INLET ASSEMBLY (See page EM-24)
15. REMOVE AIR CLEANER CAP SUB-ASSEMBLY (See page ES-503)
16. REMOVE AIR CLEANER CASE SUB-ASSEMBLY (See page EM-24)
17. REMOVE NO. 1 AIR CLEANER INLET (See page EM-24)
18. REMOVE INTAKE AIR SURGE TANK (See page FU-13)
19. SEPARATE FUEL TUBE SUB-ASSEMBLY (See page EM-28)
20. REMOVE INTAKE MANIFOLD (See page EM-32)

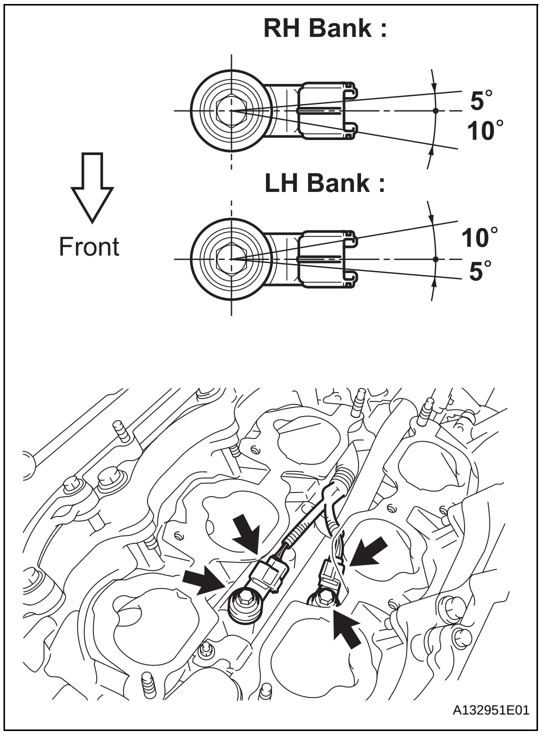


21. **REMOVE KNOCK CONTROL SENSOR**
   (a) Disconnect the 2 knock control sensor connectors.
   (b) Remove the 2 bolts and 2 knock control sensors.



INSPECTION

1. **INSPECT KNOCK CONTROL SENSOR**
   (a) Using an ohmmeter, measure the resistance between the terminals.
   Standard resistance:
   120 to 280 kΩ at 20°C (68°F)
   If the result is not as specified, replace the sensor.



INSTALLATION

1. **INSTALL KNOCK CONTROL SENSOR**
   (a) Install the 2 knock control 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 control sensor connectors.
2. **INSTALL INTAKE MANIFOLD (See page EM-41)**
3. **CONNECT FUEL TUBE SUB-ASSEMBLY (See page EM-46)**
4. **INSTALL INTAKE AIR SURGE TANK (See page FU-18)**
5. **INSTALL NO. 1 AIR CLEANER INLET (See page EM-49)**
6. **INSTALL AIR CLEANER CASE SUB-ASSEMBLY (See page EM-50)**
7. **INSTALL AIR CLEANER CAP SUB-ASSEMBLY (See page ES-506)**
8. **INSTALL AIR CLEANER INLET ASSEMBLY (See page EM-50)**
9. **INSTALL V-BANK COVER SUB-ASSEMBLY (See page EM-52)**
10. **INSTALL COOL AIR INTAKE DUCT SEAL (See page EM-52)**
11. **INSTALL COWL TOP PANEL OUTER SUB-ASSEMBLY (See page ES-485)**
12. **INSTALL WINDSHIELD WIPER MOTOR AND LINK (See page WW-14)**

13. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY (See page WW-15)

14. INSTALL FRONT FENDER TO COWL SIDE SEAL RH (See page WW-15)

15. INSTALL FRONT FENDER TO COWL SIDE SEAL LH (See page WW-15)

16. INSTALL WINDSHIELD WIPER ARM AND BLADE ASSEMBLY LH (See page WW-15)

17. INSTALL WINDSHIELD WIPER ARM AND BLADE ASSEMBLY RH (See page WW-16)

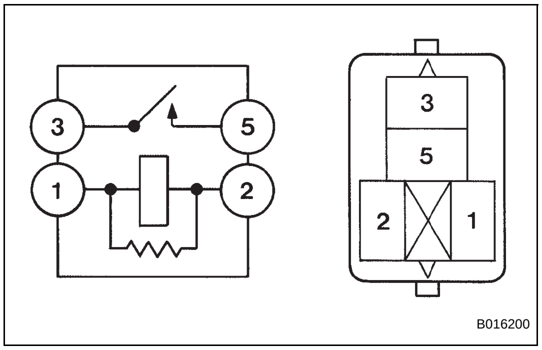
18. ADD ENGINE COOLANT (See page CO-6)

19. CHECK FOR ENGINE COOLANT LEAKS (See page CO-1)

20. CHECK FOR FUEL LEAKS (See page FU-8)

21. INSTALL ENGINE UNDER COVER RH

22. INSTALL ENGINE UNDER COVER LH



IG2 RELAY

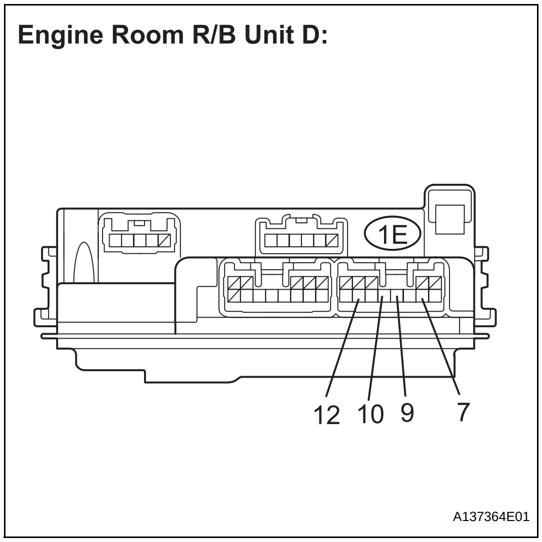
INSPECTION

1. INSPECT IG2 RELAY

(a) Using an ohmmeter, measure the resistance according to the value(s) in the table below.
Standard resistance

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

If the result is not as specified, replace the relay.



EFI RELAY

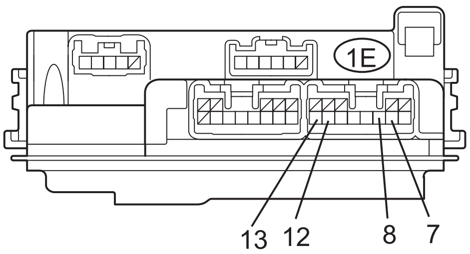
INSPECTION

1. INSPECT EFI RELAY

(a) Using an ohmmeter, measure the resistance according to the value(s) in the table below.
Standard resistance

Tester connection	Specified Condition
1E-9 - 1E-10	Below 1 Ω
1E-7 - 1E-12	10 kΩ or higher
1E-7 - 1E-12	Below 1 Ω (Battery voltage applied between terminals 1E-9 and 1E-10)

Engine Room R/B Unit D:



A137364E02

CIRCUIT OPENING RELAY

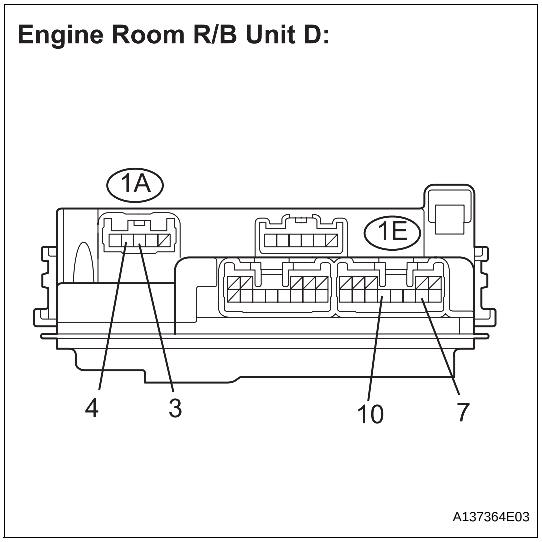
INSPECTION

1. INSPECT CIRCUIT OPENING RELAY

(a) Using an ohmmeter, measure the resistance according to the value(s) in the table below.

Standard resistance

Tester connection	Specified Condition
1E-8 - 1E-12	Below 1 Ω
1E-7 - 1E-13	10 kΩ or higher
1E-7 - 1E-13	Below 1 Ω (Battery voltage applied between terminals 1E-8 and 1E-12)



AIR FUEL RATIO SENSOR RELAY

INSPECTION

1. INSPECT AIR FUEL RATIO SENSOR RELAY

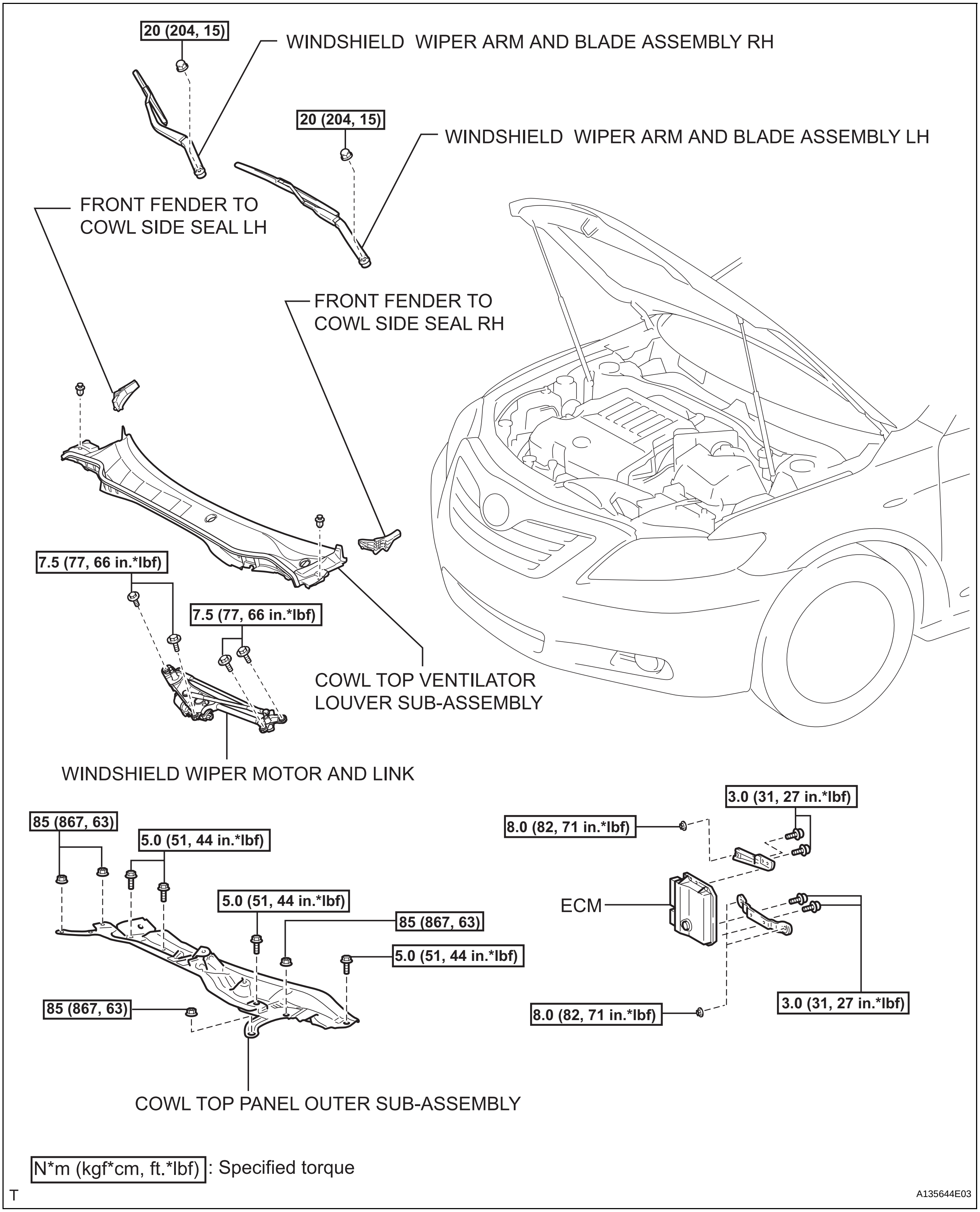
(a) Using an ohmmeter, measure the resistance according to the value(s) in the table below.

Standard resistance

Tester connection	Specified Condition
1E-7 - 1E-10	Below 1 Ω
1A-3 - 1A-4	10 kΩ or higher
1A-3 - 1A-4	Below 1 Ω (Battery voltage applied between terminals 1E-7 and 1E-10)

ECM

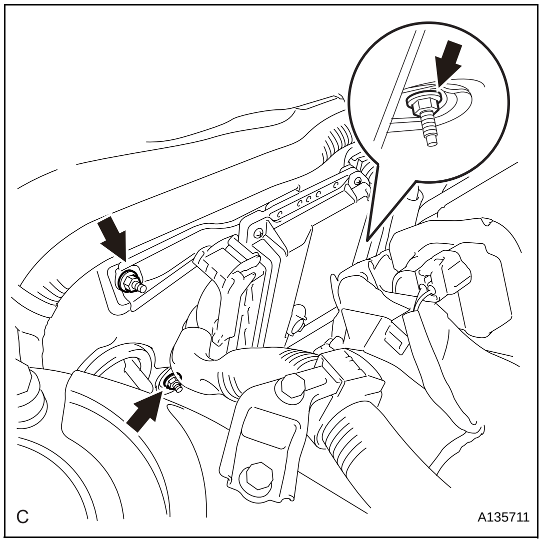
COMPONENTS



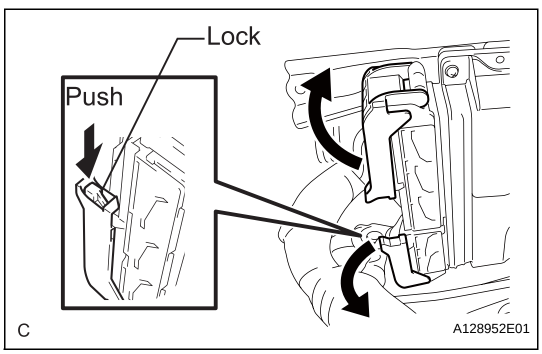
ES

REMOVAL

1. **REMOVE WINDSHIELD WIPER ARM AND BLADE ASSEMBLY LH (See page WW-9)**
2. **REMOVE WINDSHIELD WIPER ARM AND BLADE ASSEMBLY RH (See page WW-9)**
3. **REMOVE FRONT FENDER TO COWL SIDE SEAL LH (See page WW-9)**
4. **REMOVE FRONT FENDER TO COWL SIDE SEAL RH (See page WW-9)**
5. **REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY (See page WW-10)**
6. **REMOVE WINDSHIELD WIPER MOTOR AND LINK (See page WW-10)**
7. **REMOVE COWL TOP OUTER PANEL SUB-ASSEMBLY (See page ES-481)**
8. **REMOVE ECM**



(a) Remove the 3 nuts.

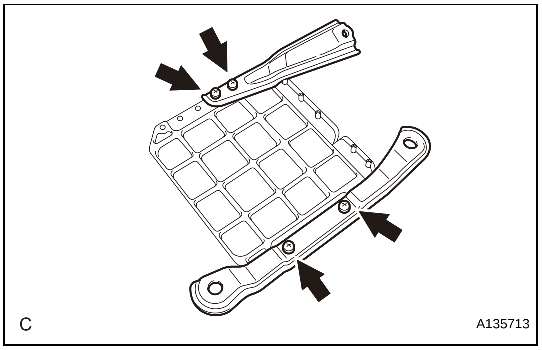


(b) Disconnect the 2 ECM connectors and remove the ECM.

(1) Raise the 2 levers while pushing the locks on the 2 levers, and disconnect the 2 ECM connectors.

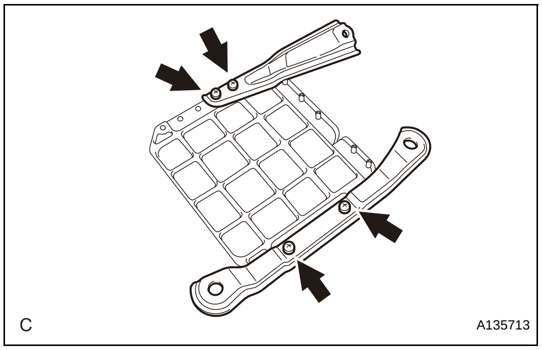
NOTICE:
After disconnecting the connector, make sure that dirt, water and other foreign matter do not contact the connecting part of the connector.

(2) Remove the ECM.



(c) Remove the 4 screws and 2 ECM brackets.

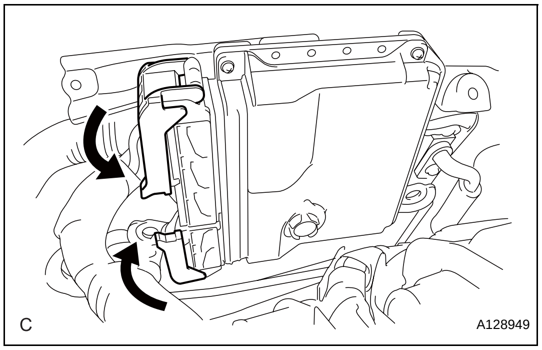
INSTALLATION



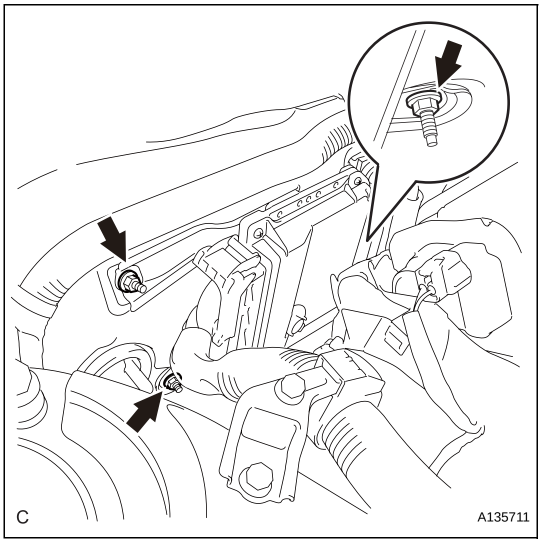
1. INSTALL ECM

(a) Install the ECM bracket with the 4 screws.
Torque: 3.0 N*m (31 kgf*cm, 27 in.*lbf)

(b) Connect the 2 ECM connectors.
NOTICE:
When connecting the connector, make sure that dirt, water and other foreign matter do not become stuck between the connector and other parts.



(1) Connect the 2 ECM connectors and lower the 2 levers.
NOTICE:
Make sure that the 2 levers are securely lowered.



(c) Install the ECM with the 3 nuts.
Torque: 8.0 N*m (82 kgf*cm, 71 in.*lbf)

2. INSTALL COWL TOP PANEL OUTER SUB-ASSEMBLY (See page ES-485)

3. INSTALL WINDSHIELD WIPER MOTOR AND LINK (See page WW-14)

4. INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY (See page WW-15)

5. INSTALL FRONT FENDER TO COWL SIDE SEAL RH (See page WW-15)

6. INSTALL FRONT FENDER TO COWL SIDE SEAL LH (See page WW-15)

7. INSTALL WINDSHIELD WIPER ARM AND BLADE ASSEMBLY LH (See page WW-15)

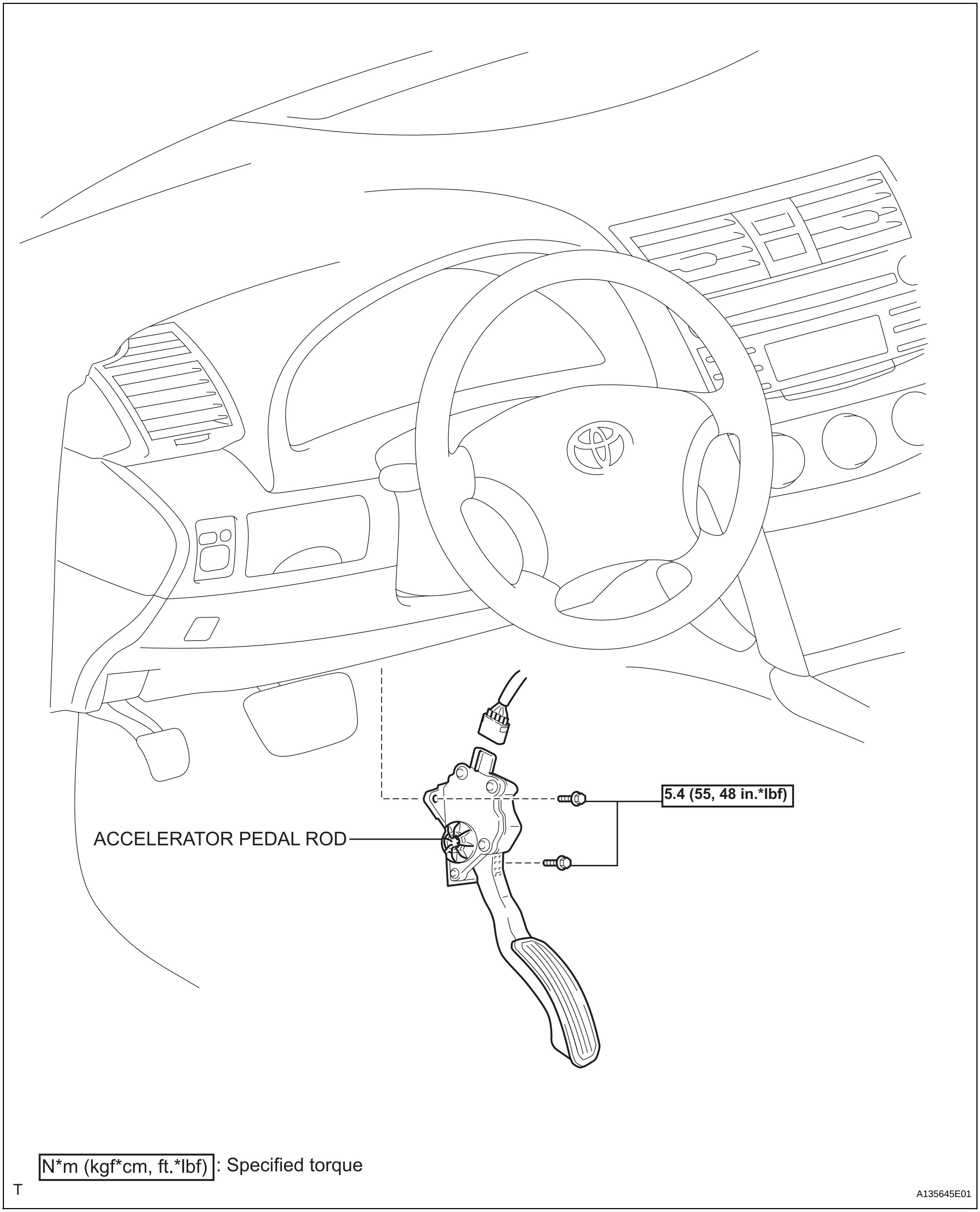
8. INSTALL WINDSHIELD WIPER ARM AND BLADE ASSEMBLY RH (See page WW-16)

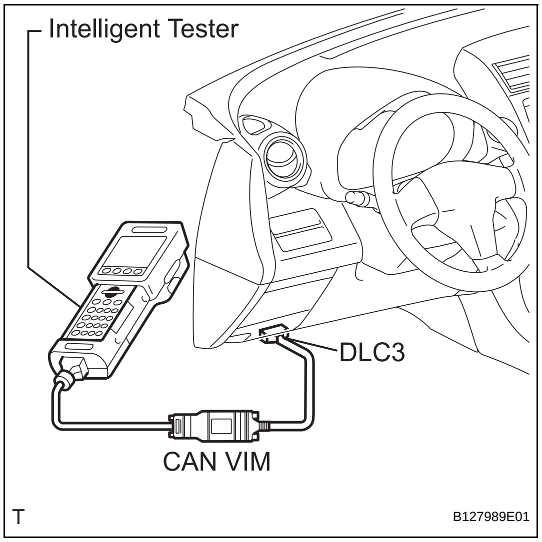
9. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL (See page EM-51)

ES

ACCELERATOR PEDAL

COMPONENTS





ON-VEHICLE INSPECTION

1. **CHECK ACCELERATOR PEDAL ROD**
   (a) Measure the voltage.
      (1) Connect the intelligent tester to the DLC3.
      (2) Turn the ignition switch on (IG).
      (3) Turn the intelligent tester ON.
      (4) Select the menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / ACCEL POS #1, ACCEL POS #2.
      (5) Operate the accelerator pedal, and then check that the ACCEL POS #1 and ACCEL POS #2 values are within the specifications.

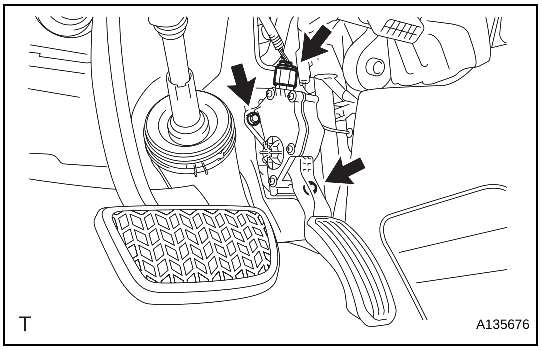
Standard voltage (ACCEL POS #1)

Accelerator Pedal Condition	Specified Condition
Released	**0.5 to 1.1 V**
Depressed	**2.5 to 4.5 V**

Standard voltage (ACCEL POS #2)

Accelerator Pedal Condition	Specified Condition
Released	**1.2 to 2.0 V**
Depressed	**3.4 to 5.0 V**

If the result is not as specified, check the accelerator pedal rod, wire harness or ECM.



REMOVAL

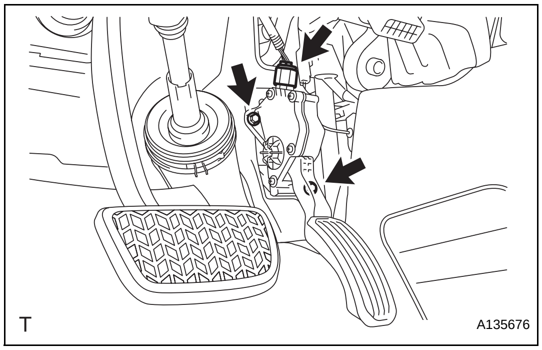
1. **REMOVE ACCELERATOR PEDAL**
   (a) Disconnect the accelerator pedal connector.
   (b) Remove the 2 bolts and the accelerator pedal assembly.

INSTALLATION

1. **INSTALL ACCELERATOR PEDAL**

NOTICE:

- **Avoid physical shock to the accelerator pedal assembly.**
- **Do not disassemble the accelerator pedal assembly.**



(a) Install the accelerator pedal assembly with the 2 bolts.

Torque: 5.4 N*m (55 kgf*cm, 48 in.*lbf)

(b) Connect the accelerator pedal connector.