DTC	P1613	Secondary Air Injection Driver Malfunction

DESCRIPTION

Refer to DTC P0412 (See page ES-189).

DTC No.	DTC Detection Conditions	Trouble Areas
P1613	Either of following conditions (1) or (2) met (1) All of following conditions met (1 trip detection logic): • Either of air pump or air switching valve not operating • Diagnostic signal from Air Injection Control Driver (AID) 80 % • Battery voltage 8 V or more (2) Both of following conditions met (1 trip detection logic): • Battery voltage 8 V or more • Diagnostic signal from AID abnormal (duty signal other than 0, 20, 40, 80 and 100 %)	• AID • Open in AID ground circuit
P1613	All of following conditions met (1 trip detection logic): (a) Air injection system operating (Air Switching Valve [ASV] ON and air pump ON) (b) Diagnostic signal from Air Injection Control Driver (AID) 0 % (c) Battery voltage 8 V or more	• Short in diagnostic information signal circuit (AID - ECM) • Open or short in air pump and air switching valve command signal circuit (AID - ECM) • Open in AID ground circuit • AID • ECM
P1613	Both of following conditions met (1 trip detection logic): (a) Battery voltage 8 V or more (b) Diagnostic signal from Air Injection Control Driver (AID) 100 %	• Open or short in AID power source circuit • Open in diagnostic information signal circuit (AID - ECM) • AID • ECM

MONITOR DESCRIPTION

For a short time after cold engine starts, the ECM transmits command signals to the Air Injection Control Driver (AID) to drive the air pump and the Air Switching Valve (ASV). The AID detects open and short circuits according to the voltages at the AID terminals to the air pump and ASV, and the circuit voltage of the AID power source, and transmits diagnostic information as a signal to the ECM.
If the Secondary Air Injection (AIR) system circuit or the AID itself malfunctions, the AID sends a malfunction signal (duty signal) as diagnostic information to the ECM (when the system is normal, a system normal signal is sent). The ECM sets the DTC based on the diagnostic information from the AID.
EXAMPLE:

1. The duty ratio of the diagnostic signal from the AID is 0 or 100 % (remains at 0 V or the same as battery voltage).
2. The duty ratio of the diagnostic signal from the AID shows an impossible ratio (other than 0, 20, 40, 80 and 100 %).
3. The AID outputs the normal signal (normal duty signal: 80 %) while the system is not operating.

MONITOR STRATEGY

Related DTCs	P1613: Secondary air injection system air injection control driver circuit range check
Required Sensors/Components (Main)	Air injection control driver
Required Sensors/Components (Related)	Air switching valve
Frequency of Operation	Once per drive cycle
Duration	3 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Case 1 and 4:

Monitor runs whenever following DTCs not present	None
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

Case 2:

Monitor runs whenever following DTCs not present	None
Either a or b met:	-
a. Air pump	Not operating
b. Air switching valve	Not operating
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

Case 3:

Monitor runs whenever following DTCs not present	None
Following conditions (a) and (b) met	-
a. Air pump	Operating
b. Air switching valve	Operating
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

Case 1:

One of following conditions met:	A, B, C or D
A. Diagnostic signal duty ratio from air injection control driver	1 % or more, and 10 % or less
B. Diagnostic signal duty ratio from air injection control driver	30 %
C. Diagnostic signal duty ratio from air injection control driver	49 %
D. Diagnostic signal duty ratio from air injection control driver	91 % or more, and 99 % or less

Case 2:

Diagnostic signal duty ratio from air injection control driver	70 % or more, and 90 % or less

Case 3:

Diagnostic signal duty ratio from air injection control driver	0 %

Case 4:

Diagnostic signal duty ratio from air injection control driver	100 %

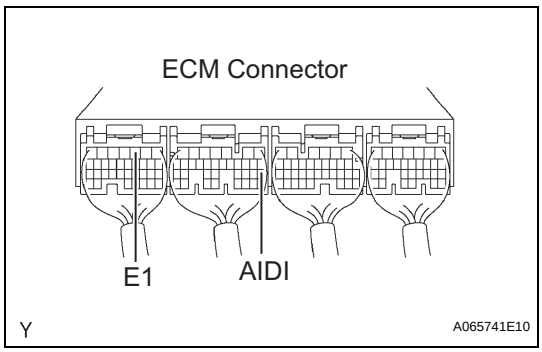
COMPONENT OPERATING RANGE

Diagnostic signal duty ratio from air injection control driver	70 % or more, and 90 % or less when secondary air injection system operating. 0 % when secondary air injection system not operating.

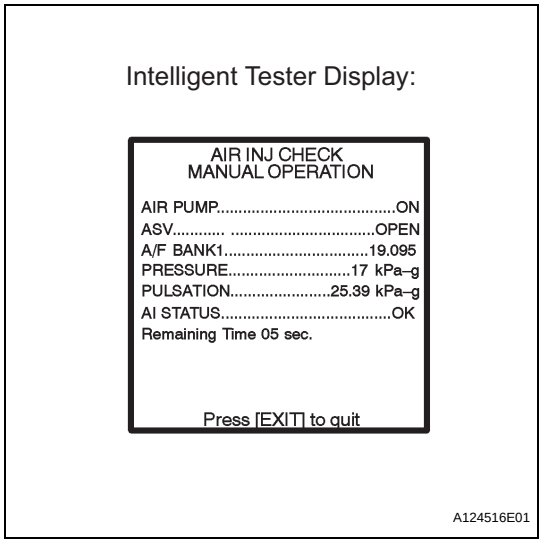
WIRING DIAGRAM

Refer to DTC P0412 (See page ES-192).

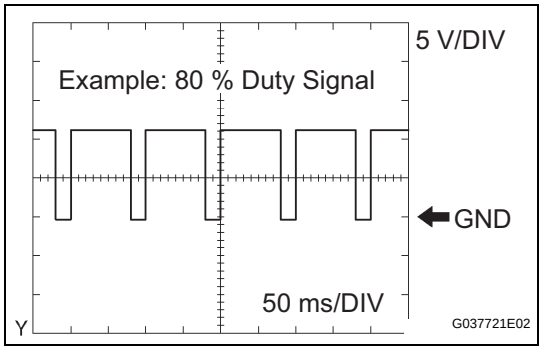
HINT:
Diagnostic information output by the AID can be confirmed by connecting an oscilloscope to the diagnostic information terminal of the AID. Reading the waveform while performing the AIR system intrusive operation provided in the SYSTEM CHECK function, allows the possible trouble areas to be narrowed down.
(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect an intelligent tester to the DLC3.



(d) Connect oscilloscope probes to the AIDI and E1 terminals of the ECM.
(e) Turn the ignition switch to ON and turn the tester ON.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV: OPEN and AP: OFF, ASV CLOSE.
HINT:
When MANUAL OPERATION is selected, the tester initialization (atmospheric pressure measurement) is performed automatically. The initialization takes 10 seconds. After the initialization, AP and ASV operation can be selected.
(g) Start the engine.
(h) Perform the AIR system intrusive operation while the engine is idling.



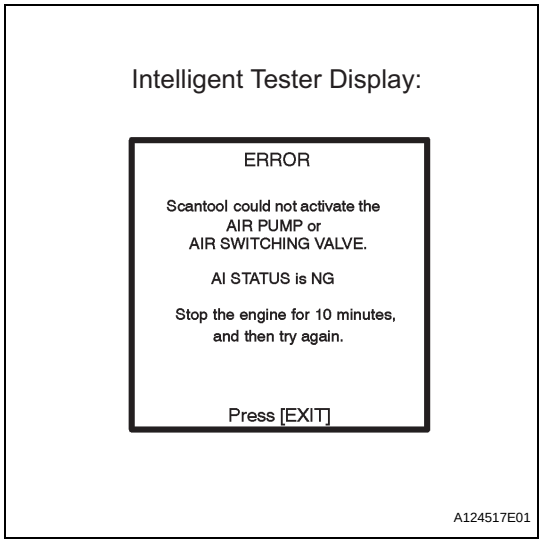
(i) Monitor the AID voltage output (duty ratio signal).



Oscilloscope range

Items	Contents
Terminals	CH1: AIDI - E1
Equipment Settings	5 V/Division, 20 to 50 ms/Division
Conditions	Idling

(j) Turn the ignition switch to OFF.

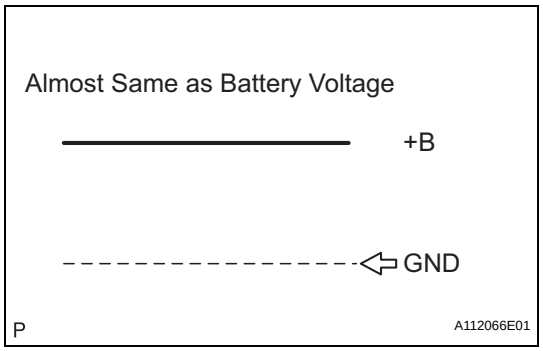


NOTICE:

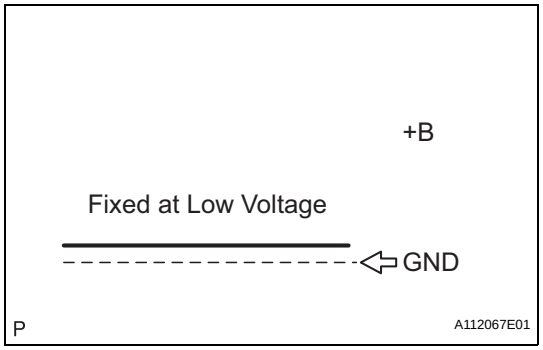
- **This AIR INJECTION CHECK only allows technicians to operate the AIR system for a maximum of 5 seconds. Furthermore, the check can only be performed up to 4 times per trip. If the test is repeated, intervals of at least 30 seconds are required between checks. While AIR system operation using the intelligent tester is prohibited, the tester display indicates the prohibition (WAIT or ERROR).**
  If an ERROR as shown in the illustration is displayed on the tester during the test, stop the engine for 10 minutes, and then try again.
- **Performing the AIR INJ CHECK repetitively may cause damage to the AIR system. If necessary, leave an interval of several minutes between SYSTEM CHECK operations to prevent the system from overheating.**
- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

AID Diagnostic Signal Waveforms	ECM Commands	DTCs (ECM Output)	Suspected Trouble Areas
100 % Duty Ratio See waveform 1	Any Air Injection (AIR) System operation	P1613	• Open in diagnostic signal circuit • Air Injection Control Driver (AID) • Open in AID+B circuit (AID power source) • Short between +B and diagnostic signal circuits
0 % Duty Ratio See waveform 2	AIR System: ON (Air pump ON, ASV ON)	P1613	• Open or short in air pump or Air Switching Valve (ASV) command signal circuit (ECM-AID) • Open in AID ground circuit • Short between diagnostic signal circuit and body ground • AID • ECM
	AIR System: OFF (Air pump OFF, ASV OFF)	-	Normal
20 % Duty Ratio See waveform 3	Air Pump: ON	P0418	Short between air pump drive circuit and body ground • Harness and connector (AID-Pump) • Air pump • AID • ECM
	Air Pump: OFF	P0418	Open in air pump drive circuit (AID-Pump), or short between air pump drive circuit and +B • Harness and connector (AID-Pump) • Air pump • AID • ECM
40 % Duty Ratio See waveform 4	ASV: ON	P0412	Short between ASV drive circuit and body ground • Harness and connector (AID-ASV) • ASV • AID • ECM
	ASV: OFF	P0412	Open in ASV drive circuit (AID-ASV), or short between ASV drive circuit and +B • Harness and connector (AID-ASV) • AID • ASV • ECM
80 % Duty Ratio See waveform 5	AIR System: OFF (Air pump OFF, ASV OFF)	P1613	• AID • ECM
	AIR System: ON (Air pump ON, ASV ON)	-	Normal
Other than above (other than 0, 20, 40, 80 and 100 % duty)	-	P1613	• AID • Open in AID ground circuit

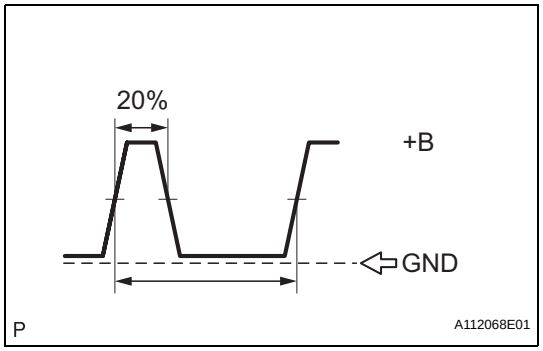
ES



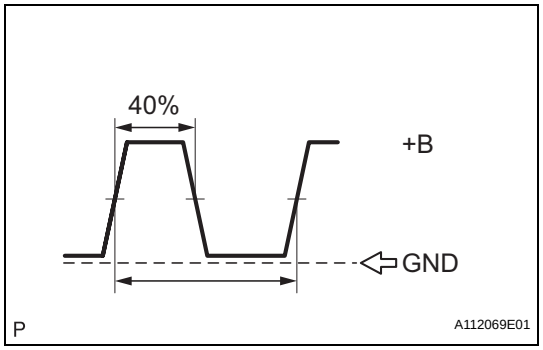
1. Waveform 1
100 % Duty Ratio



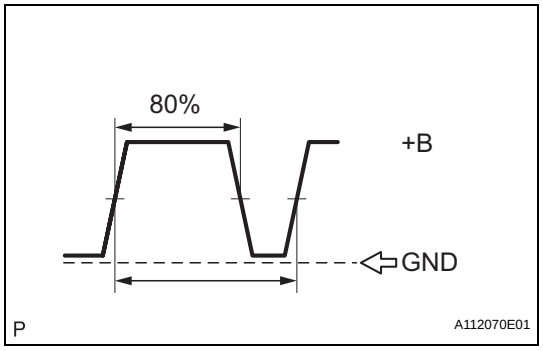
2. Waveform 2
0 % Duty Ratio



3. Waveform 3
20 % Duty Ratio



4. Waveform 4
40 % Duty Ratio



5. Waveform 5
80 % Duty Ratio

ES

HINT:

- By using an intelligent tester to perform the AIR INJ CHECK operation in the SYSTEM CHECK, the air-fuel ratio and the pressure in the secondary air injection system passage can be checked while the secondary air injection system is operating. This helps technicians to troubleshoot the system when it malfunctions.
- Read freeze frame data using an intelligent tester. Freeze frame data record the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P1613)

ES

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

Result

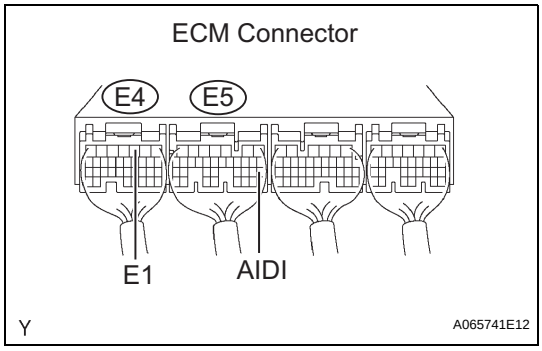
Display (DTC Output)	Proceed To
P1613	A
P1613 and other DTCs	B

If any DTCs other than P1613 are output, troubleshoot those DTCs first.

NG → GO TO DTC CHART

OK

2	PERFORM ACTIVE TEST USING INTELLIGENT TESTER (AIDI VOLTAGE)



(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Select the following menu items:
DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV: OPEN and AP: OFF, ASV CLOSE.
HINT:
When MANUAL OPERATION is selected, the tester initialization (atmospheric pressure measurement) is performed automatically. The initialization takes 10 seconds. After the initialization, AP and ASV operation can be selected.
(f) Start the engine.
(g) Perform the AIR system intrusive operation while the engine is idling.
(h) Measure the voltage between the AIDI and E1 terminals of the ECM connector when the AIR system is ON and OFF.
(i) Turn the ignition switch to OFF.

NOTICE:

- **Do not perform the SYSTEM CHECK operation repetitively. It may cause the damage in the system. If necessary, leave an interval of several minutes between SYSTEM CHECK operations.**
- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

Result

Results	Suspected Trouble Areas	Proceed To
Fixed at low (1.6 V or less) even when AIR system ON (Air pump ON, ASV OPEN)	• Short between air pump or air switching valve command signal circuit and body ground • Open in air pump command signal circuit (between ECM and AID) • Open in ASV command signal circuit (between ECM and AID) • Open in AID ground circuit (between AID and body ground) • Diagnostic signal circuit ground short • AID • ECM	A
Fixed at high (12 V or more) even when AIR system OFF (Air pump OFF, ASV CLOSE)	• Open in diagnostic signal circuit (ECM - AID) • Short between +B and diagnostic signal circuits (ECM - AID) • Open in AID power source circuit • AID • ECM	B
Other than above: Fluctuating (duty signal other than 20, 40 and 80 %)	• AID • Open in AID ground circuit (between AID and body ground)	C

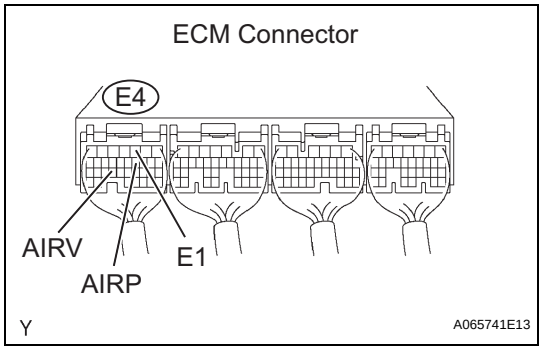
ES

B → Go to step 5

C → Go to step 8

A

3 INSPECT ECM (AIRP AND AIRV VOLTAGE)



(a) Turn the ignition switch to ON.

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

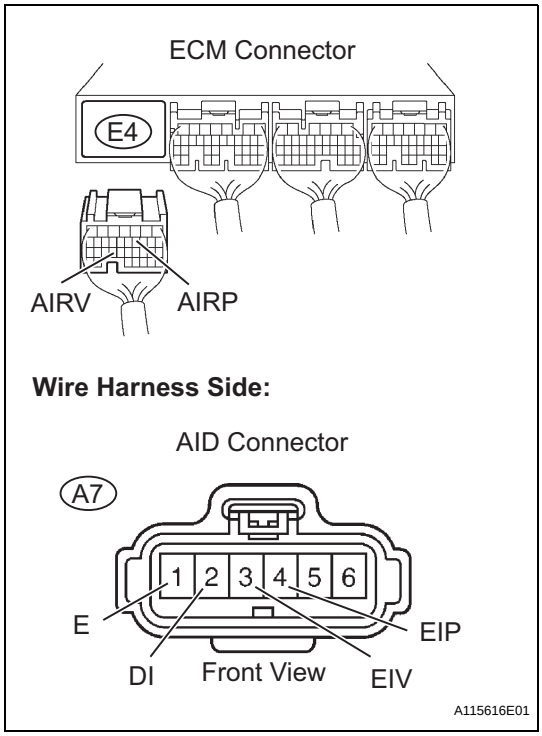
Standard Voltage

Tester Connections	Specified Conditions
AIRP (E4-11) - E1 (E4-3)	9 to 14 V (near battery voltage)
AIRV (E4-24) - E1 (E4-3)	9 to 14 V (near battery voltage)

OK → REPLACE ECM

NG

4	CHECK HARNESS AND CONNECTOR (ECM - AID, AID - BODY GROUND)



(a) Check for short in harness and connectors between the ECM and AID.
  (1) Disconnect the E4 ECM connector.
  (2) Disconnect the A7 AID connector.
  (3) Check the resistance.
  Standard Resistance (check for short)

Tester Connections	Specified Conditions
AIRP (E4-11) or EIP (A7-4) - Body ground	10 kΩ or higher
AIRV (E4-24) or EIV (A7-3) - Body ground	10 kΩ or higher

  (4) Reconnect the ECM connector and the AID connector.

(b) Check for open in harness and connector between the AID and body ground.
  (1) Disconnect the A7 AID connector.
  (2) Check the resistance.
  Standard Resistance (check for open)

Tester Connections	Specified Conditions
E (A7-1) - Body ground	Below 1 Ω

  (3) Reconnect the AID connector.

(c) Check for short in harness and connector between the diagnostic signal circuit and body ground.
  (1) Disconnect the A7 AID connector.
  (2) Turn the ignition switch to ON.
  (3) Measure the voltage between the terminals of the AID connector.
  Standard Voltage (check for short)

Tester Connections	Specified Conditions
DI (A7-2) - E (A7-1)	9 to 14 V (near battery voltage)

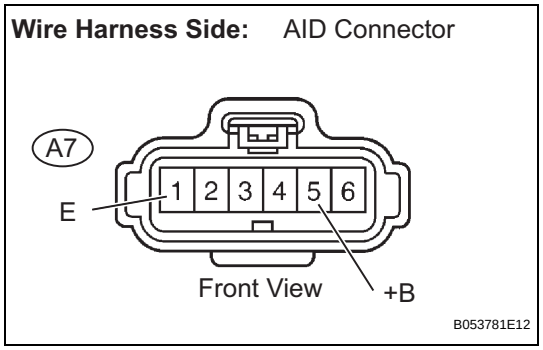
  (4) Reconnect the AID connector.

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

OK

REPLACE AIR INJECTION CONTROL DRIVER

5 CHECK AIR INJECTION CONTROL DRIVER POWER SOURCE CIRCUIT



(a) Disconnect the A7 AID connector.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between the terminal of the AID and the body ground.
Standard Voltage

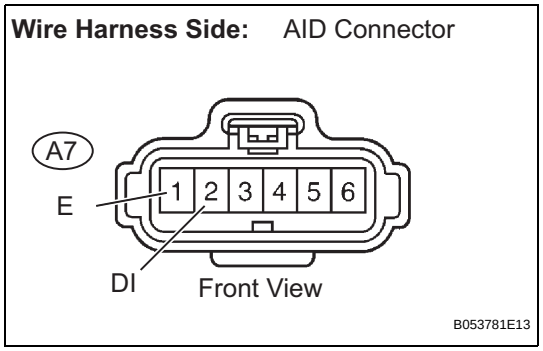
Tester Connections	Specified Conditions
+B (A7-5) - Body ground	9 to 14 V (near battery voltage)

(d) Reconnect the AID connector.

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

OK

6 INSPECT AIR INJECTION CONTROL DRIVER (DI TERMINAL VOLTAGE)



(a) Disconnect the A7 AID connector.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between the terminals of the AID connector.
Standard Voltage

Tester Connections	Specified Conditions
DI (A7-2) - E (A7-1)	9 to 14 V (near battery voltage)

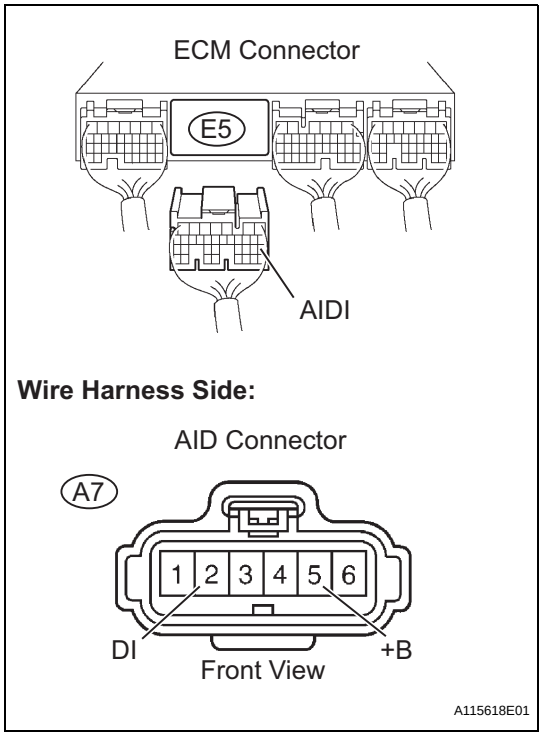
(d) Reconnect the AID connector.

OK → **REPLACE AIR INJECTION CONTROL DRIVER**

NG

ES

7	CHECK HARNESS AND CONNECTOR (ECM - AID)



(a) Disconnect the E5 ECM connector.
(b) Disconnect the A7 AID connector.
(c) Check the resistance.

Standard Resistance (check for open)

Tester Connections	Specified Conditions
DI (A7-2) - AIDI (E5-20)	Below 1 Ω

Standard Resistance (check for short)

Tester Connections	Specified Conditions
DI (A7-2) or AIDI (E5-20) - +B (A7-5)	10 kΩ or higher

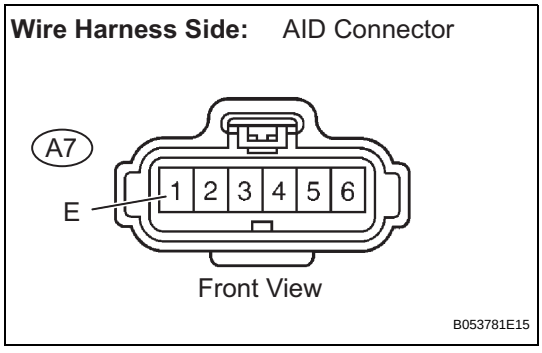
(d) Reconnect the ECM and AID connector.

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

OK

REPLACE ECM

8	CHECK HARNESS OR CONNECTOR (AID - BODY GROUND)



(a) Disconnect the A7 AID connector.
(b) Check the resistance.

Standard Resistance (check for open)

Tester Connections	Specified Conditions
E (A7-1) - Body ground	Below 1 Ω

(c) Reconnect the AID connector.

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

OK

9	REPLACE AIR INJECTION CONTROL DRIVER

NEXT

10	CHECK WHETHER DTC OUTPUT RECURS (SYSTEM CHECK AUTOMATIC OPERATION)

(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Clear DTCs (where set) (see page ES-40).
(f) Select the following menu items:
DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / AUTOMATIC OPERATION.
(g) Start the engine after the tester initialization is finished.
(h) Perform the SYSTEM CHECK operation by pressing ENTER.
(i) After operating the AIR system, press the ENTER button to confirm the AIR system pending codes.
(j) Check PENDING DTCs.
(k) Turn the ignition switch to OFF.

OK:

No pending DTC output.

NOTICE:

- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

ES

NEXT

END