

DTC	P1613	Air Injection System Air Injection Driver
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CIRCUIT DESCRIPTION

Refer to DTC P0412 on page [DI-656](#).

DTC No.	DTC Detection Condition	Trouble Area
P1613	Either of following condition (a) or (b) met: (a) All of following condition met (1 trip detection logic): • While either of air pump or air switching valve does not operate. • Air injection driver outputs normal signal (80% duty signal) (b) All of following condition met (1 trip detection logic): • Air injection driver outputs abnormal duty signal (duty signal excluding 0, 20, 40, 60, 80, 100%)	• Air injection driver (AID) • Open in air injection driver ground circuit
P1613	All of following condition met (1 trip detection logic): (a) While air injection system operating (Air pump ON and all ASV ON) (b) Air injection driver outputs air pump malfunction signal (0% duty signal)	• Short in diagnostic information signal circuit (AID – ECM) • Open or short in air pump and air switching valve command signal circuit (AID – ECM) • Air injection driver (AID) • Open in air injection driver ground circuit • ECM
P1613	Air injection driver outputs abnormal duty signal (100% duty signal) (1 trip detection logic)	• Open or short in AID power source circuit • Open in diagnostic information signal circuit (AID – ECM) • Air injection driver (AID) • ECM

MONITOR DESCRIPTION

When the air injection system operation is required while the engine is warming up, the ECM transmits command signals to the Air Injection Driver (AID) to drive the air pump and air switching valve.

AID detects an open and short in the air pump and air switching valve circuit according to the terminal voltage and sends a signal as the diagnostic information to the ECM.

If the air injection system drive circuit or the AID itself has a malfunction, the AID sends a malfunction signal (duty signal) as a diagnostic information signal 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 information signal output from AID is 0 or 100% (remains at 0 V or battery voltage).
- (2) The duty ratio output from AID is the ratio to output the impossible (excluding 0, 20, 40, 60, 80, 100%).
- (3) The AID outputs the normal signal (normal duty signal: 80%) while the system not operating.

MONITOR STRATEGY

Related DTCs	P1613	Secondary air injection system control module range check
Required sensors/components	Air injection driver	
Frequency of operation	Continuous	
Duration	3 sec.	
MIL operation	Immediate	
Sequence of operation	None	

TYPICAL ENABLING CONDITIONS

Item	Specification	
	Minimum	Maximum
The monitor will run whenever this DTC is not present	See page DI-437	
Case 1:		
Battery voltage	8 V	–
Ignition switch	ON	
Starter	OFF	
Case 2:		
Either of following conditions is met	Condition 1 or 2	
1. Air pump	Not operating	
2. Air switching valve	Not operating	
Battery voltage	8 V	–
Ignition switch	ON	
Starter	OFF	
Case 3:		
Air pump	Operating	
Air switching valve	Operating	
Battery voltage	8 V	–
Ignition switch	ON	
Starter	OFF	
Case 4:		
Battery voltage	8 V	–
Ignition switch	ON	
Starter	OFF	

TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
Case 1:	
One of the following conditions is met:	Condition 1, 2, 3 or 4
1. Diagnostic signal duty ratio from air injection driver	1 to 10 %
2. Diagnostic signal duty ratio from air injection driver	30 %
3. Diagnostic signal duty ratio from air injection driver	49 %
4. Diagnostic signal duty ratio from air injection driver	91 to 99 %
Case 2:	
Diagnostic signal duty ratio from air injection driver	70 to 90 %

Case 3:	
Diagnostic signal duty ratio from air injection driver	0 %
Case 4:	
Diagnostic signal duty ratio from air injection driver	100 %

COMPONENT OPERATING RANGE

Parameter	Standard Value
Diagnostic signal duty ratio from air injection driver	70 to 90% when secondary air injection system operating and 0% when secondary air injection system not operating

WIRING DIAGRAM

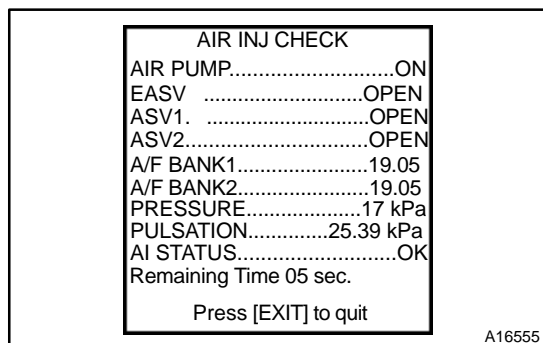
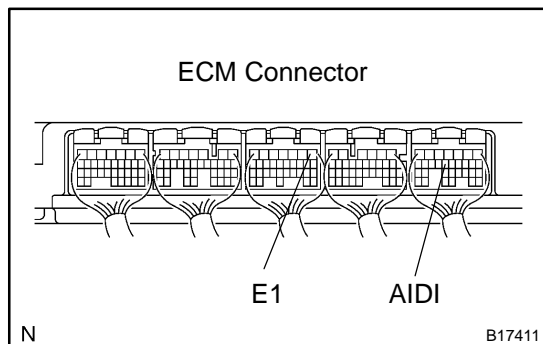
Refer to DTC P0412 on page [DI-656](#).

INSPECTION PROCEDURE

HINT:

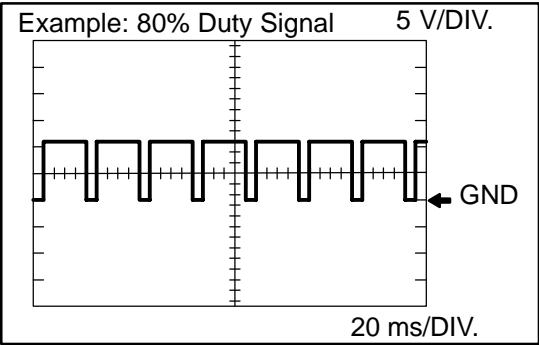
The diagnostic information output from the AID can be confirmed by connecting an oscilloscope to the diagnostic information terminal of the AID. It narrows a trouble area search to read the waveform on the oscilloscope when performing the AI system intrusive operation function provided in the SYSTEM CHECK.

- (a) Start the engine and warm it up.
- (b) Turn the ignition switch to OFF.
- (c) Connect a hand-held tester to the DLC3.
- (d) Connect an oscilloscope probe to the AIDI terminal of the ECM.
- (e) Start the engine and turn the tester ON.
- (f) On the tester, select the following menu items:
DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ SYSTEM.
- (g) On the tester, select the following menu items:
DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / OPERATION 1 and 2.



HINT:

OPERATION 1: AP: OFF, EASV:CLOSE, ASV1:CLOSE, ASV2:OFF
OPERATION 2: AP: ON, EASV:OPEN, ASV1:OPEN, ASV2:OPEN



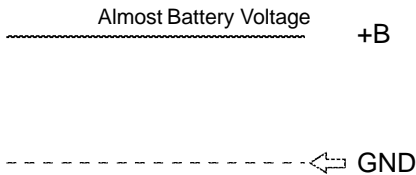
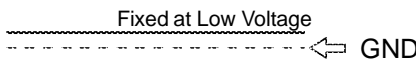
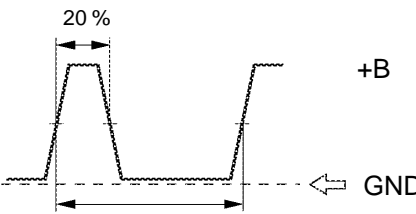
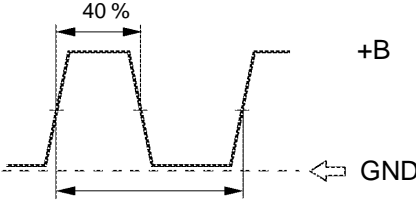
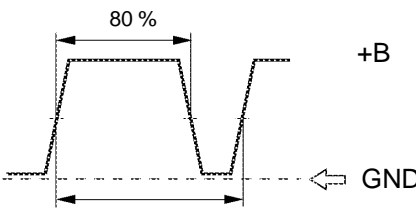
- (1) Monitor the voltage output of the AID (duty ratio signal).

Oscilloscope range:

Items	Contents
Terminals	CH1: AIDI – E1
Equipment Settings	5 V/Division, 20 to 40 ms/Division
Conditions	Idling

NOTICE:

- This **AIR INJECTION CHECK** only allows technicians to operate the AI system for 5 seconds. Furthermore, the check can be performed 4 times a trip. If the test is repeated, intervals of at least 30 seconds are required between checks.
While the AI system operation using the hand-held tester is prohibited, the tester displays the prohibition (WAIT or ERROR). If the **ERROR (AI STATUS NG)** is displayed on the tester, stop the engine for 10 minutes and then try again.
- Performing the **AIR INJ CHECK** over and over again may cause the damage in the secondary air injection system. If necessary, put an interval of several minutes between tests to prevent overheating the system.

AID Diagnostic Signal Waveforms	ECM Commands	DTCs (ECM Output)	Suspected Trouble Areas
100 % Duty ratio 	Any Air Injection (AI) System operation	P1613	<ul style="list-style-type: none"> • Open in diagnostic signal circuit • Air Injection Control Driver (AID) • Open in AID+B circuit (AID power source) • Short between +B circuit and diagnostic signal circuit
0 % Duty ratio 	AI System: ON (Air pump ON, ASV ON)	P1613	<ul style="list-style-type: none"> • 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
	AI System: OFF (Air pump OFF, ASV OFF)	—	Normal
20 % Duty ratio 	Air Pump: ON	P0418	Short between air pump drive circuit and body ground <ul style="list-style-type: none"> • Harness & 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 <ul style="list-style-type: none"> • Harness & connector (AID-Pump) • Air Pump • AID • ECM
40 % Duty ratio 	ASV: ON	P0412	Short between ASV drive circuit and body ground <ul style="list-style-type: none"> • Harness & connector (AID-ASV) • ASV • AID • ECM
	ASV: OFF	P0412	Open in ASV drive circuit (AID-ASV), or short between ASV drive circuit and +B <ul style="list-style-type: none"> • Harness & connector (AID-ASV) • AID • ASV • ECM
80 % Duty ratio 	AI System: OFF (Air pump OFF, ASV OFF)	P1613	<ul style="list-style-type: none"> • AID • ECM
	AI System: ON (Air pump ON, ASV ON)	—	Normal
Excluding above (excluding 0, 20, 40, 80, 100 % duty)	—	P1613	<ul style="list-style-type: none"> • AID • Open in AID ground circuit

HINT:

- Using the AIR INJ CHECK operation of the SYSTEM CHECK provided in the hand-held tester function, conditions for air-fuel ratio and pressure in the secondary air injection system passage can be checked while the secondary air injection system operating. It helps technicians to troubleshoot the system when it malfunctioning.
- Read freeze frame data using a hand-held 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 air injection system DTCs).
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PREPARATION:

- Connect a hand-held tester to the DLC3.
- Turn the ignition switch to ON and turn the tester ON.
- Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.

CHECK:

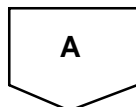
- Read DTCs.

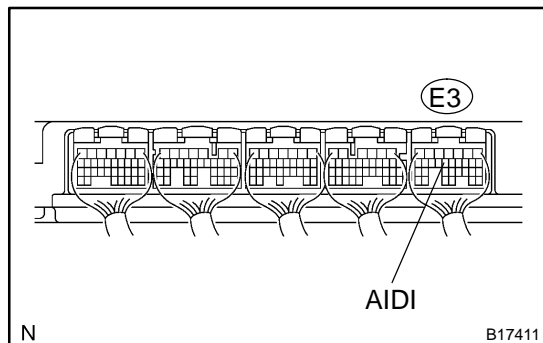
RESULT:

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

HINT:

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



2**Check voltage between AIDI terminal of ECM and body ground.****PREPARATION:**

- Start the engine and warm it up.
- Turn the ignition switch to OFF.
- Connect a hand-held tester to the DLC3.
- Turn the ignition switch ON and turn the tester ON.
- Start the engine.
- Select the following menu items: DIAGNOSIS/ENHANCED OBD II/SYSTEM CHECK/AIR INJ CHECK/AUTOMATIC OPERATION

CHECK:

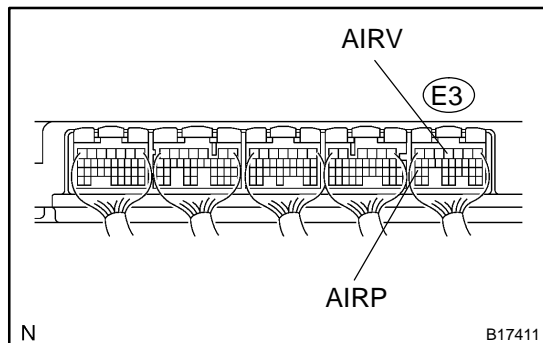
Measure voltage between terminal E3–13 (AIDI) of the ECM connector and body ground when the air injection system is ON and OFF.

RESULT:

Results	Suspected Trouble Areas	Proceed To
Fixed at Low (1.6 V or less) even when AI system ON (Air pump ON, ASV ON)	<ul style="list-style-type: none"> • 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 AI system OFF (Air pump OFF, ASV OFF)	<ul style="list-style-type: none"> • Open in diagnostic signal circuit (ECM – AID) • Short between +B circuit and diagnostic signal circuit (ECM – AID) • Open in AID power source circuit • AID • ECM 	B
Other than above: • Fluctuating (duty signal excluding 20, 40, 80%)	<ul style="list-style-type: none"> • AID • Open in AID ground circuit (between AID and body ground) 	C

B**Go to step 5.****C****Go to step 8.****A**

3 Check voltage between AIRP, AIRV terminals of ECM and body ground.

**PREPARATION:**

Turn the ignition switch ON.

CHECK:

Measure voltage between terminal E3-25 (AIRP), E3-4 (AIRV) of the ECM connector and body ground.

OK:

Tester Connection	Specified Condition
E3-25 (AIRP) – Body ground	10 V or more
E3-4 (AIRV) – Body ground	10 V or more

NG

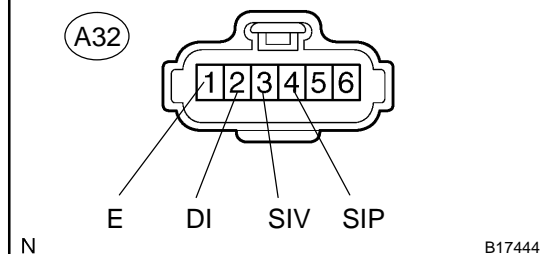
Replace ECM (See page [SF-82](#)).

OK

4 Check for short in harness and connector between SIP terminal of air injection driver and SIVP of ECM.

Wire Harness Side:

Air Injection Driver Connector

**PREPARATION:**

- Disconnect the A32 air injection driver connector.
- Disconnect the E3 ECM connector.

CHECK:

Measure the resistance between the wire harness side connectors.

OK:**Standard:**

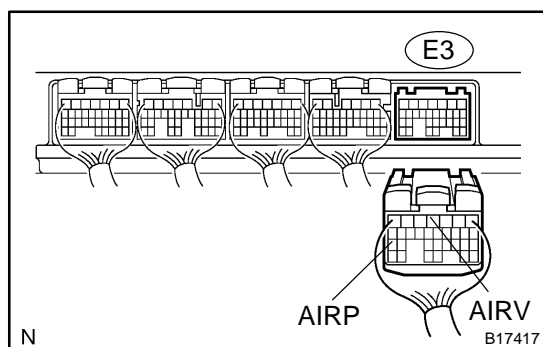
Tester Connection	Specified Condition
SIP (A32-4) or AIRP (E3-25) – Body ground	10 kΩ or higher
SIV (A32-3) or AIRV (E3-4) – Body ground	10 kΩ or higher
E (A32-1) – Body ground	Below 1 Ω

CHECK:

Measure the voltage between DI (A32-2) and E (A32-1) of the air injection driver wire harness side connectors.

OK:**Standard:**

Tester Connection	Specified Condition
DI (A32-2) – E (A32-1)	9 V or more



NG

Repair or replace harness or connector.

OK

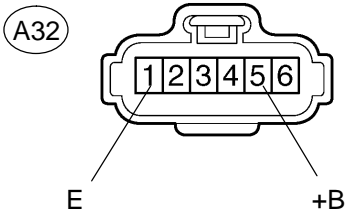
Replace air injection driver.

5

Inspect air injection driver power source circuit.

Wire Harness Side:

Air Injection Driver Connector



PREPARATION:

- (a) Disconnect the A32 air injection driver connector.
- (b) Turn the ignition switch to ON.

CHECK:

Measure the voltage between the terminal +B (A32-5) and E (A32-1) of the air injection driver connector.

OK:

Standard:

Tester Connection	Specified Condition
A32-5 (+B) - E (A32-1)	10 V or more

NG

Repair or replace harness or connector.

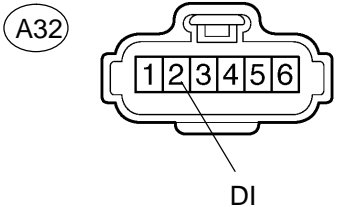
OK

6

Check voltage between DI terminals of air injection driver and body ground.

Wire Harness Side:

Air Injection Driver Connector



PREPARATION:

- (a) Disconnect the A32 air injection driver connector.
- (b) Turn the ignition switch to ON.

CHECK:

Measure the voltage between the terminal A32-2 (DI) of the air injection driver connector and body ground.

OK:

Standard:

Tester Connection	Specified Condition
A32-2 (DI) - Body ground	10 V or more

NG

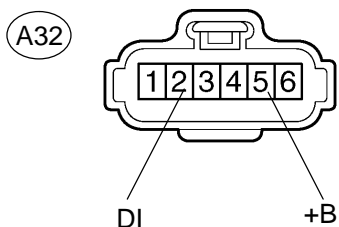
Go to step 7.

OK

7 Check for short in harness and connector between DI terminal of air injection driver and AIDI terminal of ECM.

Wire Harness Side:

Air Injection Driver Connector



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PREPARATION:

- Disconnect the A32 air injection driver connector.
- Disconnect the E3 ECM connector.

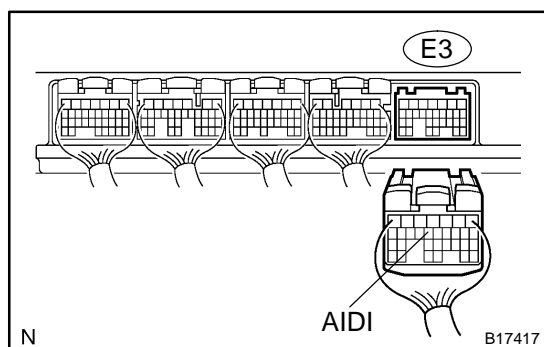
CHECK:

Measure the resistance between the wire harness side connectors.

OK:

Standard:

Tester Connection	Specified Condition
DI (A32-2) – AIDI (E3-13)	Below 1 Ω
DI (A32-2) or AIDI (E3-13) – +B (A32-5)	10 k Ω or higher



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NG

Repair or replace harness or connector.

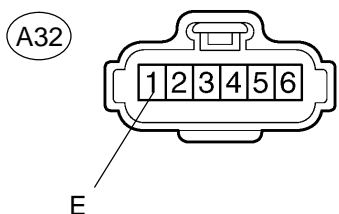
OK

Replace ECM (See page [SF-82](#)).

8 Inspect air injection driver ground circuit.

Wire Harness Side:

Air Injection Driver Connector



N

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PREPARATION:

Disconnect the A32 air injection driver connector.

CHECK:

Measure the resistance between the terminal E (A32-1) of the air injection driver connector and body ground.

OK:

Standard:

Tester Connection	Specified Condition
E (A32-1) – Body ground	10 V or more

NG

Repair or replace harness or connector.

OK

9	Replace air injection driver.
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NEXT

10	Check whether DTC output recurs.
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PREPARATION:

- (a) Connect a hand-held tester to the DLC3.
- (b) Turn the ignition switch to ON and turn the tester ON.
- (c) Clear the DTCs (see page [DI-462](#)).
- (d) Start the engine.

CHECK:

- (a) Perform ACTIVE TEST to operate the air injection system.
Select the following menu items: DIAGNOSIS/ENHANCED OBD II/SYSTEM CHECK/AIR INJ CHECK/AUTOMATIC OPERATION
- (b) After operating the secondary air injection system, confirm the pending codes of the secondary air injection system by selecting the following menu items: DIAGNOSIS/ENHANCED OBD II/DTC INFO/PENDING CODES.

OK:

DTC P1613 for the secondary air injection system is not output.

NG

Go to DTC chart (See page [DI-462](#)).

OK

END