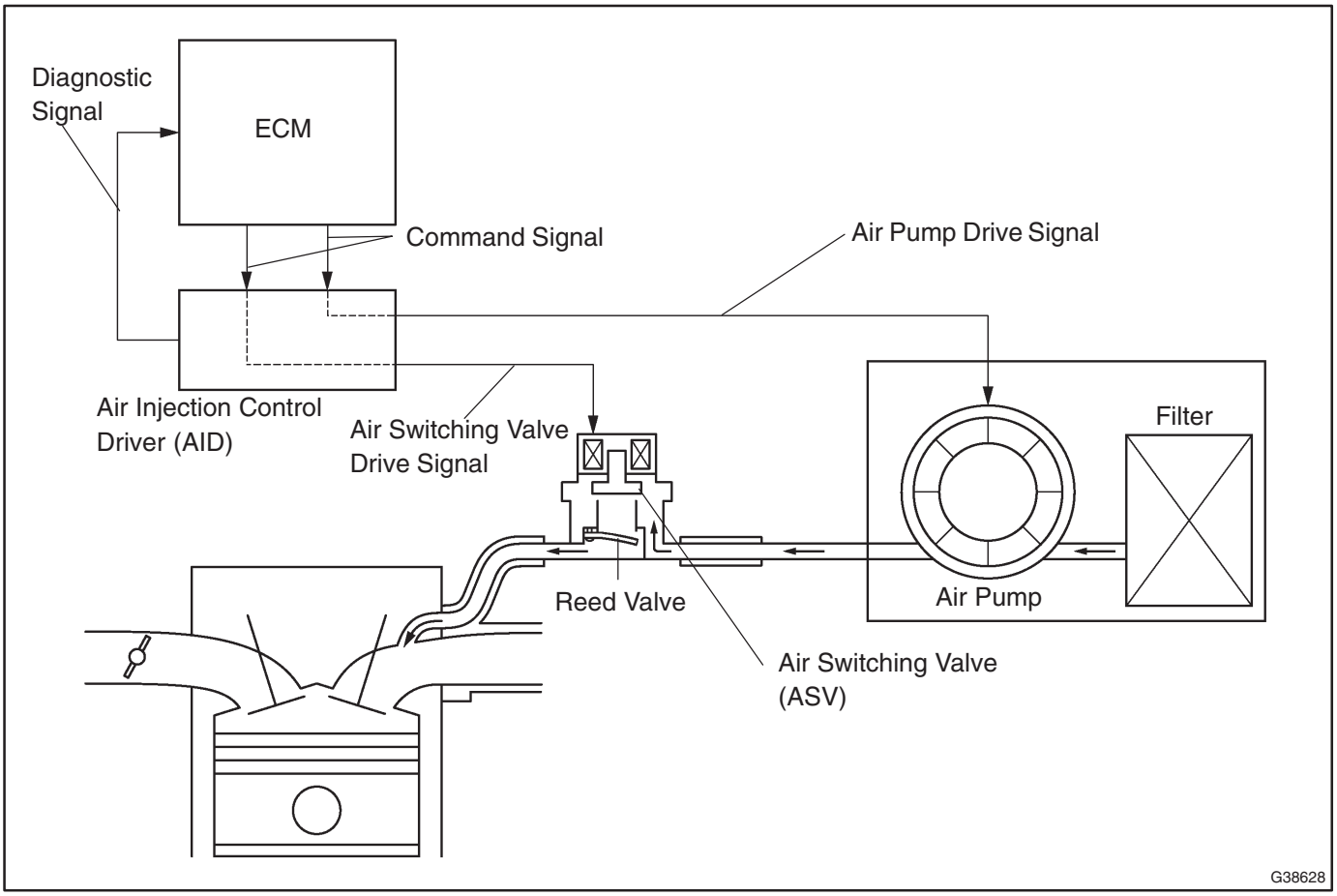
DTC	P0412	SECONDARY AIR INJECTION SYSTEM SWITCHING VALVE ”A” CIRCUIT

CIRCUIT DESCRIPTION

The Secondary Air Injection (AI) system consists of an air pump, Air Switching Valve (ASV), Air Injection Control Driver (AID) and the ECM. After the cold engine starts and it is in the short time, the AI system pumps the secondary air to the exhaust port of the cylinder head to purity the exhaust emissions.
The ECM transmits command signals to the AID to drive the ASV and the air pump, and the AID drives them.
The pressure sensor detects a pressure in the secondary air passage when the AI system is ON and OFF, and sends the pressure signal to the ECM.
The function equipped on AID is not only pump and valve driving, but also diagnosis function to detect malfunction in the AI system circuit.
HINT:
Large amount of current is required to drive air pump and ASV so that an air injection control driver is provided newly on the previous system.



DTC No.	DTC Detection Condition	Trouble Area
P0412	After cold engine starts, all of following conditions are met (1 trip detection logic): (a) Air Injection System not operate (Air pump OFF and Air Switching Valve OFF) (b) Diagnostic signal from Air Injection Control Driver 40%. (c) Battery voltage 8 V or more	• Open in air switching valve drive circuit • Short between air switching valve circuit and +B circuit • Air injection driver • Air switching valve • ECM
P0412	After cold engine starts, all of following conditions are met (1 trip detection logic): (a) While Air Injection System operating (Air pump ON and Air Switching Valve ON) (b) Diagnostic signal from Air Injection Driver 40%. (c) Battery voltage 8 V or more	• Short between air switching valve circuit and body ground • Air injection driver • Air switching valve • ECM

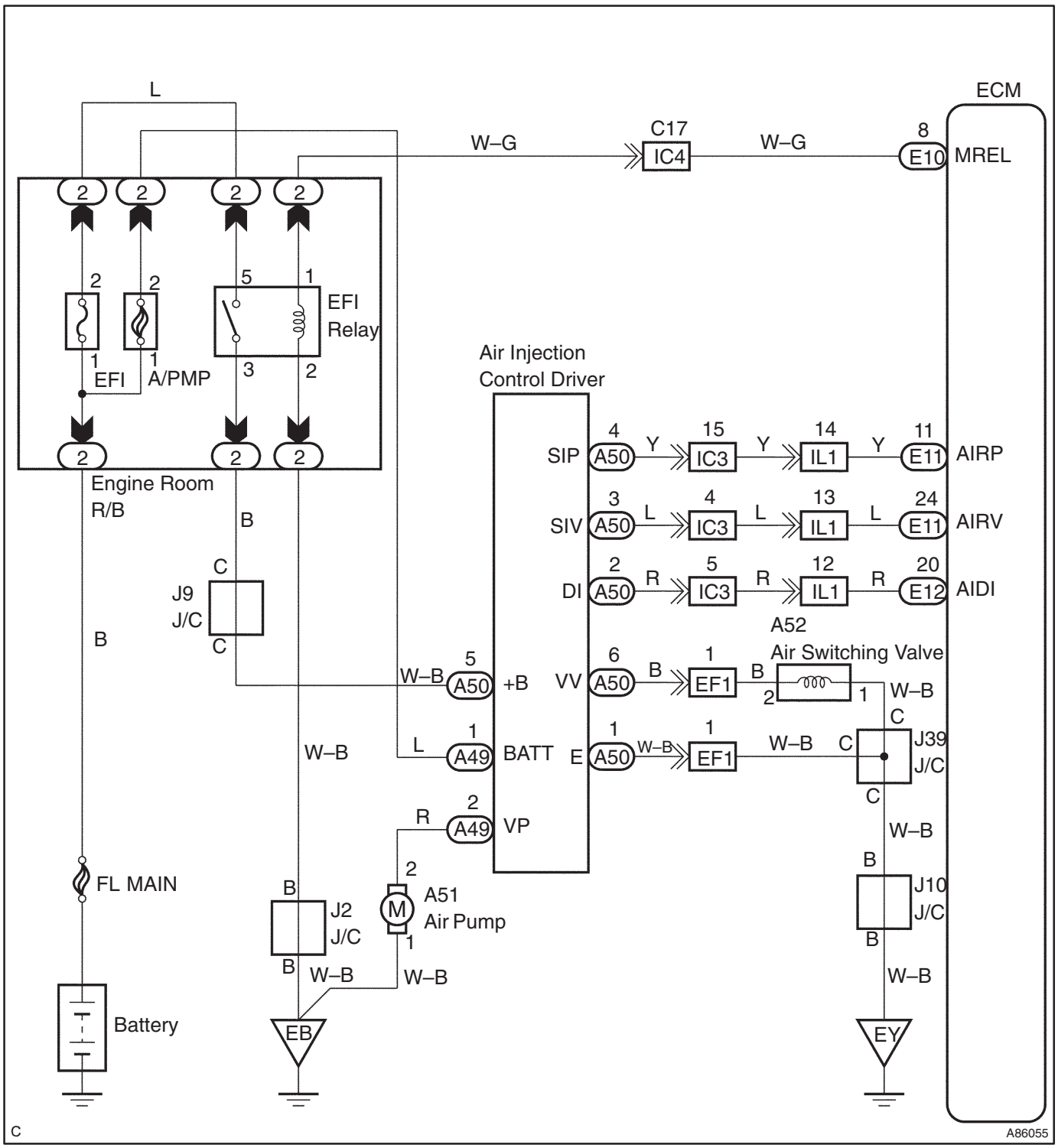
MONITOR DESCRIPTION

Air Injection Control Driver detects an open or 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.

After the cold engine starts and it is in the short time, the ECM transmits command signals to the Air Injection Driver to the drive the air pump and Air Switching Valve.

The Air Injection Driver outputs the Air Switching Valve malfunction signal to the ECM if: 1) the voltage of Air Injection Driver terminal for Air Switching Valve is low despite the Air injection Driver receives the command signal from ECM to drive the Air Switching Valve or 2) the voltage of Air Injection Driver terminal for Air Switching Valve is high despite the Air Injection Driver does not receive the command signal from ECM. The ECM sets the DTC based on the diagnostic signal from the Air Injection Driver.

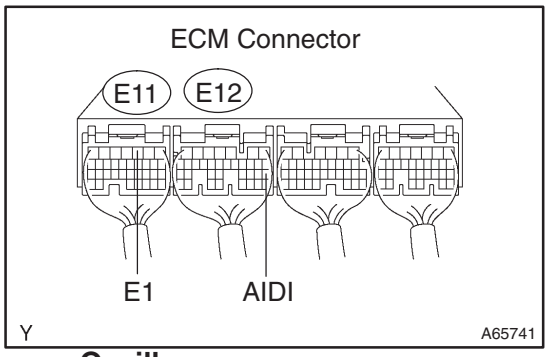
WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

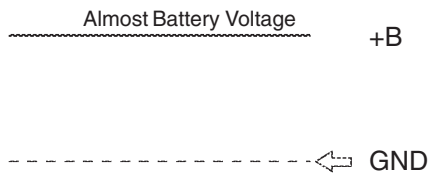
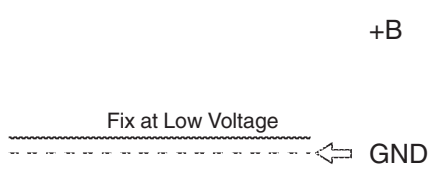
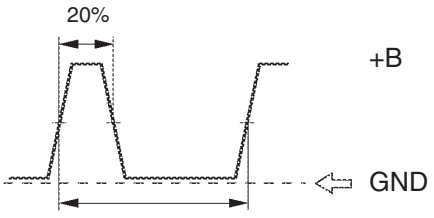
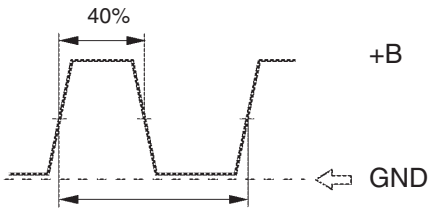
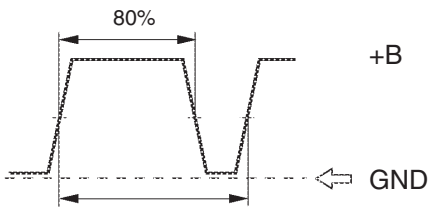
The diagnostic information output from AID can be confirmed by connecting an oscilloscope to the diagnostic information terminal of the AID.



(1) Connect the intelligent tester II to the DLC3.
(2) Connect an oscilloscope probe to the AIDI terminal of the ECM.
(3) Start the engine and turn the tester ON.
(4) Monitor the voltage output of the AID (duty ratio signal).

Oscilloscope range:

Items	Contents
Terminals	CH1: AIDI (E12–20) – E1 (E11–3)
Equipment Settings	5 V/Division, 20 to 40 ms/Division
Conditions	Idling

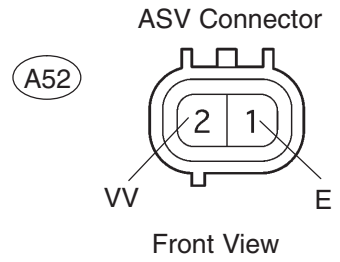
AID Diagnostic Signal Waveforms	ECM Commands	DTCs (ECM Output)	Suspected Trouble Area
100% Duty ratio 	Any Air Injection (AI) System operation	**P1613**	● Open in diagnostic signal circuit ● Air Injection Control Driver (AID) ● Open in AID +B circuit (AID power source) ● Short between +B circuit and diagnostic signal circuit
0% Duty ratio 	AI System: ON (Air pump ON, ASV ON)	**P1613**	● 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 ● 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 ● Harness & connector (AID – Pump) ● Air Pump ● AID ● ECM
40% Duty ratio 	ASV: ON	**P0412**	Short between ASV drive circuit and body ground ● Harness & connector (AID – ASV) ● Air Pump ● AID ● ECM
	ASV: OFF	**P0412**	Open in ASV drive circuit (AID – ASV), or short between ASV drive circuit and +B ● Harness & connector (AID – ASV) ● Air Pump ● AID ● ECM
80% Duty ratio 	AI System: OFF (Air pump OFF, ASV OFF)	**P1613**	● AID ● ECM
	AI System: ON (Air pump ON, ASV ON)	–	Normal
Excluding above (excluding 0, 20, 40, 80, 100% duty)	–	**P1613**	● AID ● Open in AID ground circuit

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HINT:
Read freeze frame data using the intelligent tester II. 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 AIR SWITCHING VALVE ASSY

Component Side:



(a) Disconnect the A52 ASV connector.
(b) Measure the resistance according to the value(s) in the table below.
Standard:

Tester Connection	Specified Condition
E (A52–1) – VV (A52–2)	4.5 to 5.5 Ω

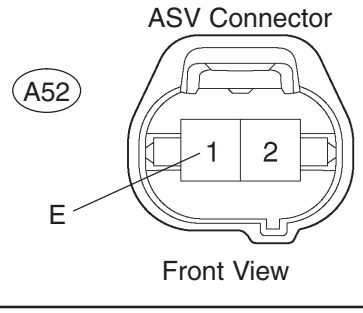
(c) Reconnect the ASV connector.

NG → **REPLACE AIR SWITCHING VALVE ASSY (See page 12–12)**

OK

2 CHECK HARNESS AND CONNECTOR(AIR SWITCHING VALVE – BODY GROUND)

Wire Harness Side:



(a) Disconnect the A52 ASV connector.
(b) Measure the resistance according to the value(s) in the table below.
Standard:

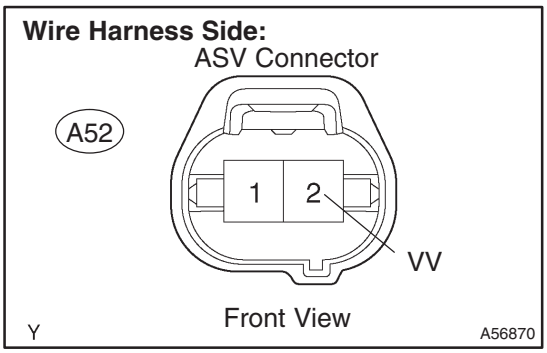
Tester Connection	Specified Condition
E(A52–1) – Body ground	Below 1 Ω

(c) Reconnect the ASV connector.

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

OK

3	CHECK HARNESS AND CONNECTOR(AIR SWITCHING VALVE – AIR INJECTION CONTROL DRIVER)

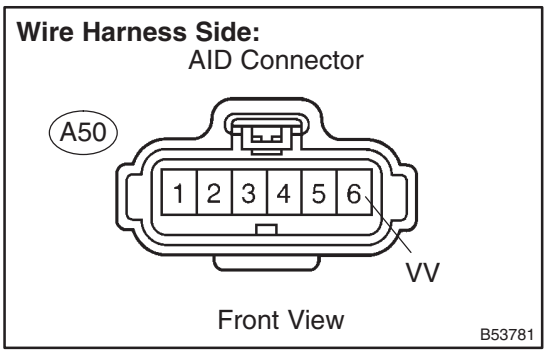


(a) Disconnect the A52 ASV connector.
(b) Disconnect the AID connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard:

Tester Connection	Specified Condition
VV (A52–2) – VV (A50–6)	Below 1 Ω

(d) Reconnect the ASV connector.
(e) Reconnect the AID connector.



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

OK

REPLACE AIR INJECTION CONTROL DRIVER