

DTC	P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)
DTC	P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)
DTC	P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)
DTC	P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

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HINT:

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

DESCRIPTION

Refer to DTC P2195 (See page [ES-312](#)).

DTC No.	DTC Detection Conditions	Trouble Areas
P2238	<ul style="list-style-type: none"> • Case 1: Condition (a) or (b) continues for 5.0 seconds or more (2 trip detection logic) (a) A1A+ voltage 0.5 V or less (b) (A1A+) - (A1A-) = 0.1 V or less • Case 2: A/F sensor admittance: Less than 0.022 1/Ω (2 trip detection logic) 	<ul style="list-style-type: none"> • Open or short in Air-Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater • A/F HEATER relay • A/F sensor heater and relay circuits • ECM
P2239	A1A+ voltage more than 4.5 V for 5.0 seconds or more (2 trip detection logic)	<ul style="list-style-type: none"> • Open or short in Air-Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater • A/F HEATER relay • A/F sensor heater and relay circuits • ECM
P2252	A1A- voltage 0.5 V or less for 5.0 seconds or more (2 trip detection logic)	<ul style="list-style-type: none"> • Open or short in Air-Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater • A/F HEATER relay • A/F sensor heater and relay circuits • ECM
P2253	A1A- voltage more than 4.5 V for 5.0 seconds or more (2 trip detection logic)	<ul style="list-style-type: none"> • Open or short in Air-Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater • A/F HEATER relay • A/F sensor heater and relay circuits • ECM

MONITOR DESCRIPTION

The Air-Fuel Ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or voltage output deviates greatly from the standard range, the ECM determines that there is an open or short malfunction in the A/F sensor circuit.

MONITOR STRATEGY

Related DTCs	P2238: A/F sensor open circuit between A1A+ and A1A- P2238: A/F sensor short circuit between A1A+ and A1A- P2238: A/F sensor short circuit between A1A+ and GND P2239: A/F sensor short circuit between A1A+ and +B P2252: A/F sensor short circuit between A1A- and GND P2253: A/F sensor short circuit between A1A- and +B
Required Sensors/Components (Main)	A/F sensor
Required Sensors/Components (Related)	Engine Coolant Temperature (ECT) sensor, Crankshaft position sensor
Frequency of Operation	Once per driving cycle
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
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P2238 (open circuit between A1A+ and A1A-):

Duration while all following conditions met	20 seconds or more
A1A+ terminal voltage	0.5 to 4.5 V
A1A- terminal voltage	0.5 to 4.5 V
Difference between A1A+ and A1A- terminal voltages	0.1 to 0.8 V
ECT	8°C (46°F) or more: closed loop fuel control enable temperature
Engine condition	Running
Time after engine start	20 seconds or more
Fuel-cut	OFF (for 25 seconds or more)
A/F sensor heater duty ratio	0 % or more
Time after A/F sensor heating	20 seconds or more
Battery voltage	10.5 V or more
Ignition switch	ON (for 5 seconds or more)

Others:

Battery voltage	10.5 V or more
Ignition switch	ON (for 5 seconds or more)

TYPICAL MALFUNCTION THRESHOLDS**P2238 (Open circuit between A1A+ and A1A-):**

A/F sensor admittance	Below 0.022 1/Ω
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P2238 (Short circuit between A1A+ and GND):

A1A+ terminal voltage	0.5 V or less
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P2238 (Short circuit between A1A+ and A1A-):

Difference between A1A+ and A1A- terminal voltages	0.1 V or less
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P2239 (Short circuit between A1A+ and +B):

A1A+ terminal voltage	More than 4.5 V
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P2252 (Short circuit between A1A- and GND):

A1A- terminal voltage	0.5 V or less
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P2253 (Short circuit between A1A- and +B):

A1A- terminal voltage	More than 4.5 V
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WIRING DIAGRAM

Refer to DTC P2195 (See page [ES-316](#)).

HINT:

Intelligent tester only:

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

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

1. Connect an intelligent tester to the DLC3.
2. Start the engine and turn the tester ON.
3. Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
4. On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
5. Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
6. Monitor the voltage outputs of the A/F and HO2 sensors (AFS B1S1 and OS2 B1S2) displayed on the tester.

HINT:

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

Standard Voltage

Tester Display (Sensor)	Injection Volumes	Status	Voltages
AFS B1S1 (A/F)	+25 %	Rich	Less than 3.0
AFS B1S1 (A/F)	-12.5 %	Lean	More than 3.35
O2S B1S2 (HO2)	+25 %	Rich	More than 0.5
O2S B1S2 (HO2)	-12.5 %	Lean	Less than 0.4

NOTICE:

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

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Areas
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.5 V Less than 0.4 V		
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		<ul style="list-style-type: none"> • A/F sensor • A/F sensor heater • A/F sensor circuit
	Output Voltage Almost no reaction		Output Voltage More than 0.5 V Less than 0.4 V		

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Areas
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		<ul style="list-style-type: none"> HO2 sensor HO2 sensor heater HO2 sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage Almost no reaction		
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		<ul style="list-style-type: none"> Injector Fuel pressure Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction		Output voltage Almost no reaction		

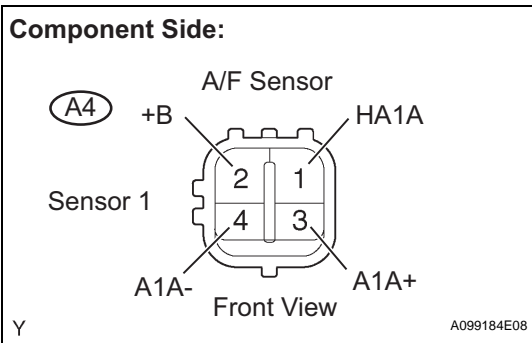
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- Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, select the following menu items on the tester: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2, and press the YES button and then the ENTER button followed by the F4 button.

HINT:

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

1 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



- Disconnect the A4 Air-Fuel Ratio (A/F) sensor connector.
- Measure the resistance between the terminals of the A/F sensor connector.

Standard Resistance

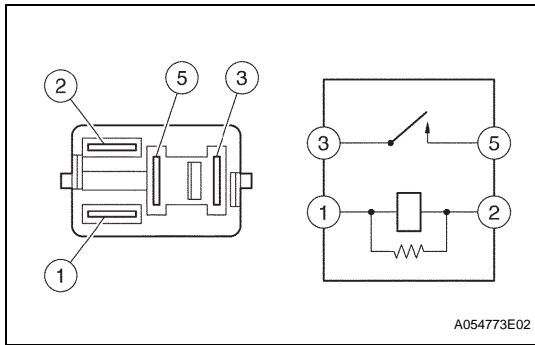
Tester Connections	Specified Conditions
HA1A (1) - +B (2)	1.8 to 3.4 Ω at 20°C (68°F)
HA1A (1) - A1A- (4)	10 kΩ or higher

- Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

2 INSPECT AIR FUEL RATIO SENSOR HEATER RELAY (A/F HEATER RELAY)



(a) Remove the A/F HEATER relay from the engine room R/B.

(b) Check the A/F HEATER relay resistance.
Standard Resistance

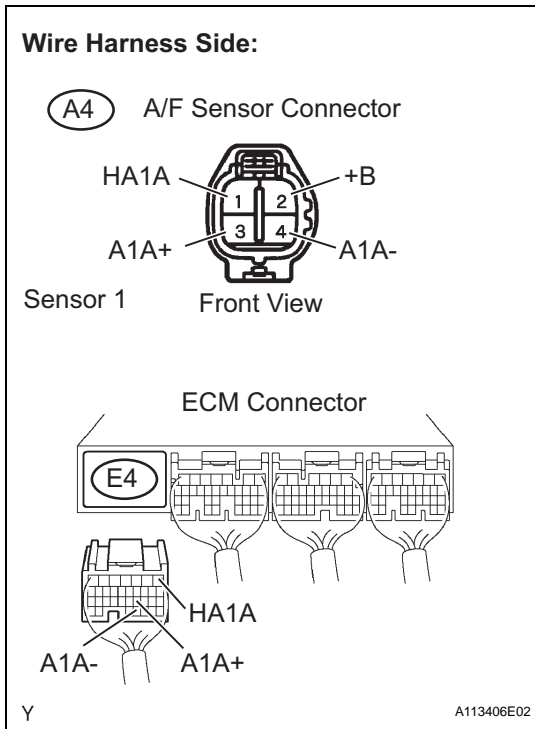
Tester Connections	Specified Conditions
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the A/F HEATER relay.

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

OK

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



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

Standard Voltage

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

(d) Turn the ignition switch to OFF.
(e) Disconnect the E4 ECM connector.
(f) Check the resistance.

Standard Resistance (Check for open)

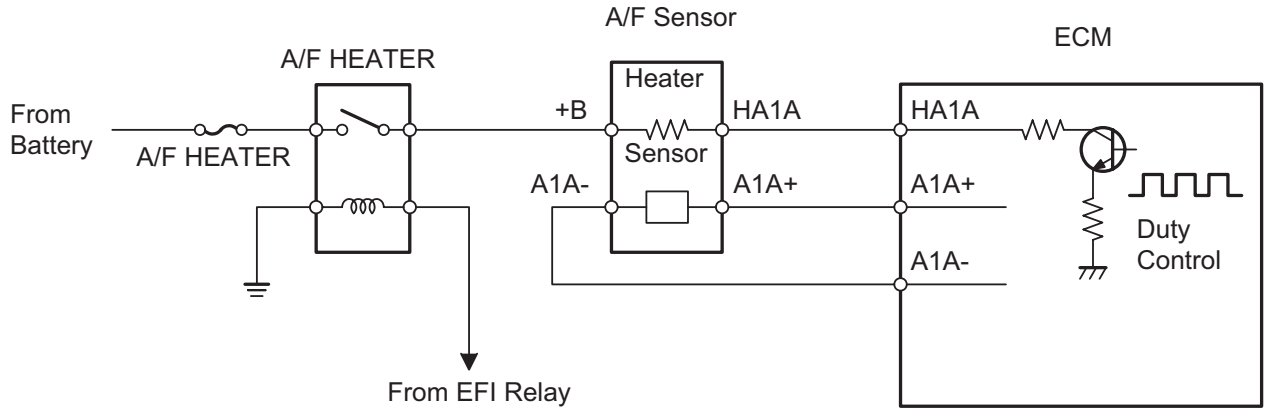
Tester Connections	Specified Conditions
HA1A (A4-1) - HA1A (E4-1)	Below 1 Ω
A1A+ (A4-3) - A1A+ (E4-21)	Below 1 Ω
A1A- (A4-4) - A1A- (E4-31)	Below 1 Ω

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
HA1A (A4-1) or HA1A (E4-1) - Body ground	10 kΩ or higher
A1A+ (A4-3) or A1A+ (E4-21) - Body ground	10 kΩ or higher
A1A- (A4-4) or A1A- (E4-31) - Body ground	10 kΩ or higher

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

Reference (Bank 1 Sensor 1 System Diagram)



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REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM