

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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DESCRIPTION**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.

Refer to DTC P2195 (See page [ES-293](#)).

DTC No.	DTC Detection Conditions	Trouble Areas
P2238	- Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) AF+ voltage 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 (1 trip detection logic)	- Open or short in A/F sensor (sensor 1) circuit - A/F sensor (sensor 1) - A/F sensor heater - EFI relay - A/F sensor heater and relay circuits - ECM
P2239	AF+ voltage more than 4.5 V for 5.0 seconds or more (1 trip detection logic)	- Open or short in A/F sensor (sensor 1) circuit - A/F sensor (sensor 1) - A/F sensor heater - EFI relay - A/F sensor heater and relay circuits - ECM
P2252	AF- voltage 0.5 V or less for 5.0 seconds or more (1 trip detection logic)	- Open or short in A/F sensor (sensor 1) circuit - A/F sensor (sensor 1) - A/F sensor heater - EFI relay - A/F sensor heater and relay circuits - ECM
P2253	AF- voltage more than 4.5 V for 5.0 seconds or more (1 trip detection logic)	- Open or short in A/F sensor (sensor 1) circuit - A/F sensor (sensor 1) - A/F sensor heater - EFI 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 AF+ and AF- P2238: A/F sensor short circuit between AF+ and AF- P2238: A/F sensor short circuit between AF+ and GND P2239: A/F sensor short circuit between AF+ and +B P2252: A/F sensor short circuit between AF- and GND P2253: A/F sensor short circuit between AF- 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: A/F sensor open circuit between AF+ and AF-
MIL Operation	2 driving cycles
Sequence of Operation	None

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TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever the following DTCs are not present	None
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P2238 (open circuit between AF+ and AF-):

Duration while all following conditions met	10 seconds or more
AF+ terminal voltage	0.5 to 4.5 V
AF- terminal voltage	0.5 to 4.5 V
Difference between AF+ and AF- terminal voltage	0.1 to 0.8 V
ECT	5°C (41°F) or more
Engine condition	Running
Time after fuel-cut OFF	25 seconds or more
Fuel-cut	OFF
A/F sensor heater	ON
Battery voltage	10.5 V or more
Ignition switch	ON
Time after ignition switch is OFF to ON	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 AF+ and AF-):

A/F sensor admittance	Below 0.0221/ohm
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P2238 (Short circuit between AF+ and GND):

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

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

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

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

AF- terminal voltage	More than 4.5 V
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P2238 (Short circuit between AF+ and AF-):

Difference between AF+ terminal and AF- terminal voltage	0.1 V or less
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WIRING DIAGRAM

Refer to DTC P2195 (See page [ES-296](#)).

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 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 0.55
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.

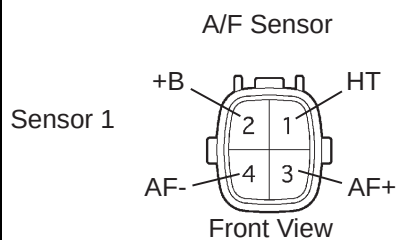
Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Areas
Case 1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.55 V Less than 0.4 V		

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Areas
Case 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		
Case 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		Output Voltage Almost no reaction	————— NG	
Case 4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		- Injector - Fuel pressure - Gas leakage from exhaust system (Air-fuel ratio extremely rich or lean)
	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, and press the YES button and then the ENTER button followed by the F4 button.

HINT:

Read freeze frame data using an intelligent tester or 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.

1**INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)****Component Side:**

A085152E58

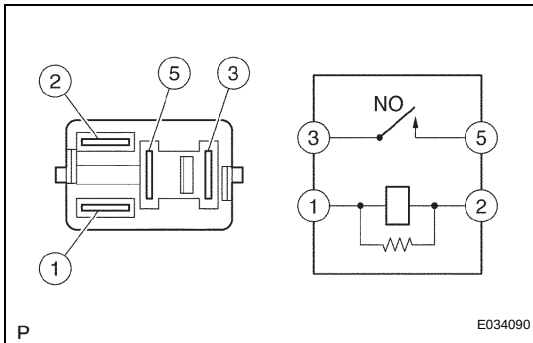
- Disconnect the A24 Air-Fuel Ratio (A/F) sensor connector.
- Measure the resistance between the terminals of the A/F sensor connector.

Standard resistance

Tester Connections	Specified Conditions
HT (1) - +B (2)	Between 1.8 Ω and 3.4 Ω at 20 C (68 F)
HT (1) - AF- (4)	10 k Ω or higher

- Reconnect the A/F sensor connector.

NG**REPLACE AIR FUEL RATIO SENSOR****OK**

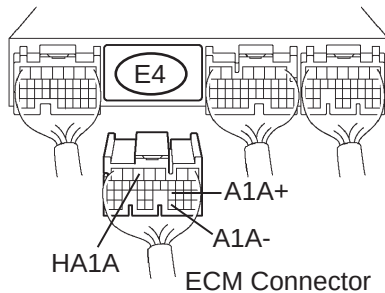
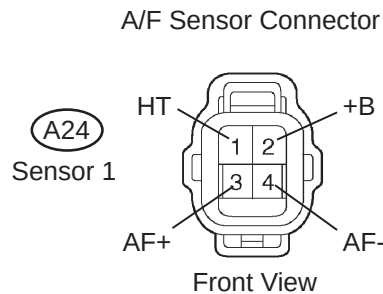
2 INSPECT EFI RELAY

- (a) Remove the EFI relay from the engine room R/B.
 (b) Check the EFI relay resistance.

Standard resistance

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

- (c) Reinstall the EFI relay.

NG**REPLACE EFI RELAY****OK****3 CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)****Wire Harness Side:**

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A136257E02

- (a) Disconnect the A24 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 (A24-2) - Body ground	Between 9 V and 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
HT (A24-1) - HA1A (E4-5)	Below 1 Ω
AF+ (A24-3) - A1A+ (E4-23)	Below 1 Ω
AF- (A24-4) - A1A- (E4-31)	Below 1 Ω

Standard resistance (Check for short)

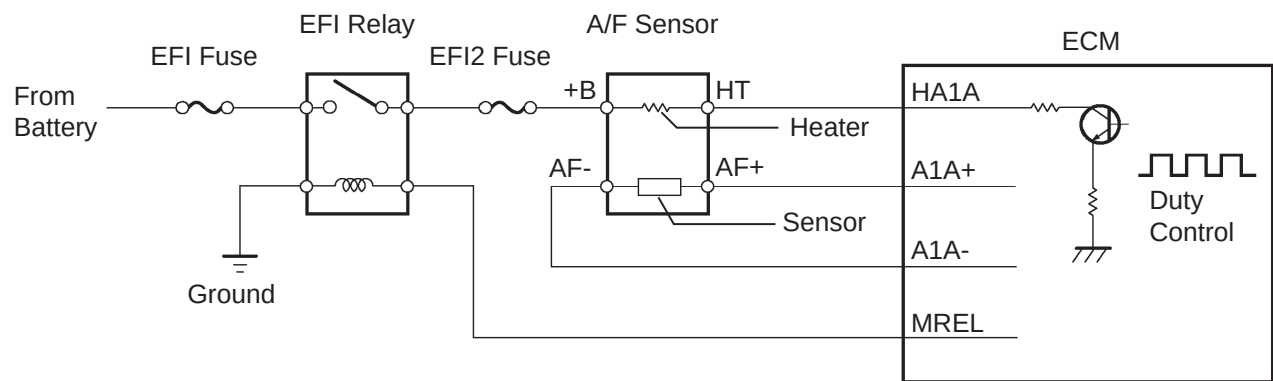
Tester Connections	Specified Conditions
HT (A24-1) or HA1A (E4-5) - Body ground	10 k Ω or higher
AF+ (A24-3) or A1A+ (E4-23) - Body ground	10 k Ω or higher
AF- (A24-4) or A1A- (E4-31) - Body ground	10 k Ω or higher

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

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Reference (System Diagram of Sensor 1):



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A093757E01

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REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM