

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	P2241	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)
DTC	P2242	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 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)
DTC	P2255	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)
DTC	P2256	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

## 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-304](#)).

DTC No.	DTC Detection Conditions	Trouble Areas
P2238 P2241	<ul style="list-style-type: none"> <li>• Case 1: Condition (a) or (b) continues for 5.0 seconds or more (2 trip detection logic)               <ul style="list-style-type: none"> <li>(a) AF+ voltage 0.5 V or less</li> <li>(b) (AF+) - (AF-) = 0.1 V or less</li> </ul> </li> <li>• Case 2: A/F sensor admittance: Less than 0.022 1/Ω (2 trip detection logic)</li> </ul>	<ul style="list-style-type: none"> <li>• Open or short in A/F sensor (bank 1, 2 sensor 1) circuit</li> <li>• A/F sensor (bank 1, 2 sensor 1)</li> <li>• A/F sensor heater</li> <li>• A/F sensor heater relay</li> <li>• A/F sensor heater and relay circuits</li> <li>• ECM</li> </ul>
P2239 P2242	AF+ voltage more than 4.5 V for 5.0 seconds or more (2 trip detection logic)	
P2252 P2255	AF- voltage 0.5 V or less for 5.0 seconds or more (2 trip detection logic)	
P2253 P2256	AF- voltage more than 4.5 V for 5.0 seconds or more (2 trip detection logic)	

## HINT:

- DTC P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.

- DTC P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.
- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that includes cylinder No. 2.

## 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 (Bank 1) open circuit between AF+ and AF- P2238: A/F sensor (Bank 1) short circuit between AF+ and AF- P2238: A/F sensor (Bank 1) short circuit between AF+ and GND P2239: A/F sensor (Bank 1) short circuit between AF+ and +B P2241: A/F sensor (Bank 2) open circuit between AF+ and AF- P2241: A/F sensor (Bank 2) short circuit between AF+ and AF- P2241: A/F sensor (Bank 2) short circuit between AF+ and GND P2242: A/F sensor (Bank 2) short circuit between AF+ and +B P2252: A/F sensor (Bank 1) short circuit between AF- and GND P2253: A/F sensor (Bank 1) short circuit between AF- and +B P2255: A/F sensor (Bank 2) short circuit between AF- and GND P2256: A/F sensor (Bank 2) 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- 5 seconds: Others
MIL Operation	2 driving cycles
Sequence of Operation	None

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## TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
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### P2238 and P2241 (open circuit between AF+ and AF-):

AF+ terminal voltage	0.5 to 4.5 V
AF- terminal voltage	0.5 to 4.5 V
Difference between AF+ and AF- terminal voltages	0.1 to 0.8 V
ECT	20°C (68°F) or more
Engine condition	Running
Fuel-cut	OFF
A/F sensor heater	ON
Battery voltage	11 V or more
Ignition switch	ON
Time after ignition switch is OFF to ON	5 seconds or more

### Others:

Battery voltage	11 V or more
Ignition switch	ON
Time after ignition switch is OFF to ON	5 seconds or more

## TYPICAL MALFUNCTION THRESHOLDS

### P2238 and P2241 (Open circuit between AF+ and AF-):

A/F sensor admittance	Below 0.022 1/Ω
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**P2238 and P2241 (Short circuit between AF+ and GND):**

AF+ terminal voltage	0.5 V or less
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**P2238 and P2241 (Short circuit between AF+ and AF-):**

Difference between AF+ and AF- terminal voltages	0.1 V or less
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**P2239 and P2242 (Short circuit between AF+ and +B):**

AF+ terminal voltage	More than 4.5 V
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**P2252 and P2255 (Short circuit between AF- and GND):**

AF- terminal voltage	0.5 V or less
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**P2253 and P2256 (Short circuit between AF- and +B):**

AF- terminal voltage	More than 4.5 V
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**ES****WIRING DIAGRAM**

Refer to DTC P2195 (See page [ES-309](#)).

**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 (HO<sub>2</sub>) 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) 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 HO<sub>2</sub> sensors (AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2) 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**

Tester Display (Sensor)	Injection Volumes	Status	Voltages
AFS B1S1 or AFS B2S1 (A/F)	+25 %	Rich	Less than 3.0
AFS B1S1 or AFS B2S1 (A/F)	-12.5 %	Lean	More than 3.35
O2S B1S2 or O2S B2S2 (HO <sub>2</sub> )	+25 %	Rich	More than 0.55
O2S B1S2 or O2S B2S2 (HO <sub>2</sub> )	-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 (HO<sub>2</sub>) 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 0.55 V Less than 0.4 V		
2	Injection volume +25 % -12.5 %		Injection volume +25 % -12.5 %		<ul style="list-style-type: none"> <li>A/F sensor</li> <li>A/F sensor heater</li> <li>A/F sensor circuit</li> </ul>
	Output voltage Almost no reaction		Output voltage More than 0.55 V Less than 0.4 V		
3	Injection volume +25 % -12.5 %		Injection volume +25 % -12.5 %		<ul style="list-style-type: none"> <li>HO2 sensor</li> <li>HO2 sensor heater</li> <li>HO2 sensor circuit</li> </ul>
	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"> <li>Injector</li> <li>Fuel pressure</li> <li>Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)</li> </ul>
	Output voltage Almost no reaction		Output voltage Almost no reaction		

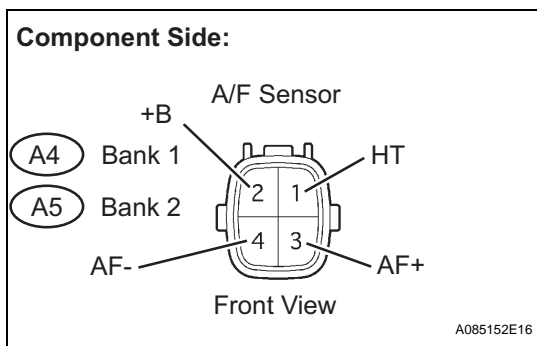
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- Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, select the following menu items on the tester: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2, 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 or A5 A/F sensor connector.
- Measure the resistance between the terminals of the A/F sensor connector.

**Standard Resistance**

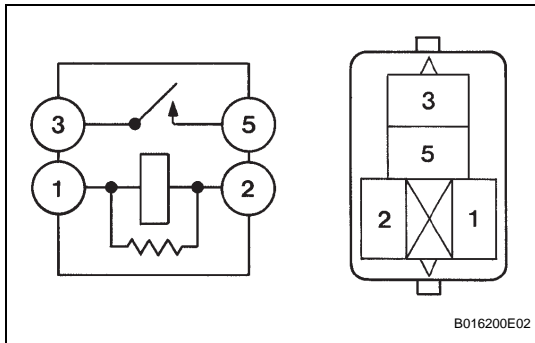
Tester Connections	Specified Conditions
HT (1) - +B (2)	1.8 to 3.4 Ω at 20°C (68°F)
HT (1) - AF- (4)	10 kΩ or higher

- Reconnect the A/F sensor connector.

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

OK

**2 INSPECT AIR FUEL RATIO SENSOR HEATER RELAY**



- (a) Remove the A/F sensor heater relay from the engine room R/B.
- (b) Check the A/F sensor 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)

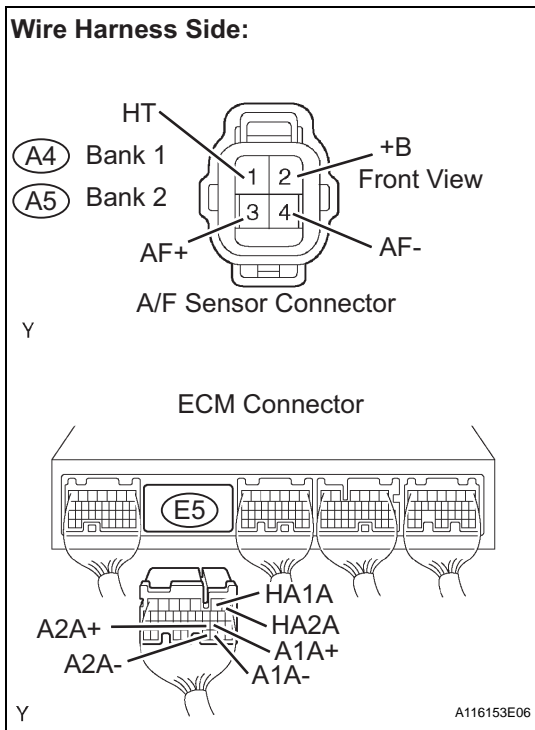
- (c) Reinstall the A/F sensor heater relay.

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**REPLACE AIR FUEL RATIO SENSOR HEATER RELAY**

OK

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



- (a) Disconnect the A4 or A5 A/F sensor connector.
- (b) Turn the ignition switch 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
+B (A5-2) - Body ground	

- (d) Turn the ignition switch OFF.
- (e) Disconnect the E5 ECM connector.
- (f) Check the resistance.

**Standard Resistance (Check for open)**

Tester Connections	Specified Conditions
HT (A4-1) - HA1A (E5-2)	Below 1 Ω
AF+ (A4-3) - A1A+ (E5-22)	
AF- (A4-4) - A1A- (E5-30)	
HT (A5-1) - HA2A (E5-1)	
AF+ (A5-3) - A2A+ (E5-23)	
AF- (A5-4) - A2A- (E5-31)	

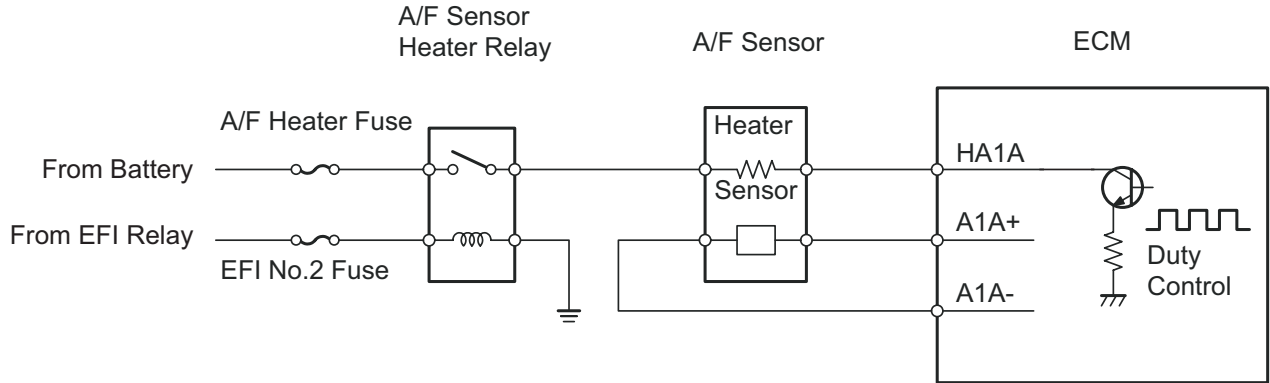
**Standard Resistance (Check for short)**

Tester Connections	Specified Conditions
HT (A4-1) or HA1A (E5-2) - Body ground	10 kΩ or higher
AF+ (A4-3) or A1A+ (E5-22) - Body ground	
AF- (A4-4) or A1A- (E5-30) - Body ground	
HT (A5-1) or HA2A (E5-1) - Body ground	
AF+ (A5-3) or A2A+ (E5-23) - Body ground	
AF- (A5-4) or A2A- (E5-31) - Body ground	

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- (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

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