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 title (DTC description) says "oxygen sensor", this DTC is related to the "A/F sensor".
- DTCs P2237, P2238, P2239, P2251, P2252 and P2253 indicate the malfunction related to the bank 1 A/F sensor circuit.
- DTCs P2240, P2241, P2242, P2254, P2255 and P2256 indicate the malfunction related to the bank 2 A/F sensor circuit.

DESCRIPTION

Refer to DTC P2195 (See page ES-271).

DTC No.	DTC Detection Conditions	Trouble Areas
P2238 P2241	• 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) Difference between AF+ and AF- terminal voltage: 0.1 V or less • Case 2: A/F sensor admittance: Less than 0.022 1/Ω (2 trip detection logic)	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater • A/F relay • Open or short in A/F sensor heater and relay circuits • ECM

DTC No.	DTC Detection Conditions	Trouble Areas
P2239 P2242	AF+ voltage more than 4.5 V for 5.0 seconds or more (2 trip detection logic)	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater • A/F relay • Open or short in A/F sensor heater and relay circuits • ECM
P2252 P2255	AF- voltage 0.5 V or less for 5.0 seconds or more (2 trip detection logic)	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater • A/F relay • Open or short in A/F sensor heater and relay circuits • ECM
P2253 P2256	AF- voltage more than 4.5 V for 5.0 seconds or more (2 trip detection logic)	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater • A/F relay • Open or short in A/F sensor heater and relay circuits • ECM

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HINT:
- Bank 1 is the bank that includes cylinder No. 1.
- Bank 2 is the bank that includes cylinder No. 2.

MONITOR DESCRIPTION

The air-fuel ratio (A/F) sensor varies its voltage output in proportion to the air-fuel ratio. If impedance (alternating current resistance) or voltage output of the sensor deviates greatly from the standard, the ECM determines that an open or short is 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 P2253: 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)	ECT sensor, Crankshaft position sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds: A/F sensor open circuit between AF+ and AF- P2238, P2241 5 seconds: Others
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	None

P2238, P2241 (open circuit between AF+ and AF-):

Duration while all of the following conditions are 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+ terminal and AF- terminal voltage	0.1 to 0.8 V
ECT	5°C (41°F) or more
Engine condition	Running
Fuel-cut	OFF
Time after fuel-cut OFF	5 seconds or more
A/F sensor heater	ON
Time after A/F sensor heating	20 seconds or more
Battery voltage	11 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 (5 seconds or more)

ES

TYPICAL MALFUNCTION THRESHOLDS

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

A/F sensor admittance	Below 0.022 1/ohm

P2238, P2241 (Short circuit between AF+ and GND):

AF+ terminal voltage	0.5 V or less

P2238, P2241 (Short circuit between AF+ and AF-):

Difference between AF+ and AF- terminal voltages	0.1 V or less

P2239, P2242 (Short circuit between AF+ and +B):

AF+ terminal voltage	More than 4.5 V

P2252, P2255 (Short circuit between AF- and GND):

AF- terminal voltage	0.5 V or less

P2253, P2256 (Short circuit between AF- and +B):

AF- terminal voltage	More than 4.5 V

WIRING DIAGRAM

Refer to DTC P2195 (See page ES-275).

HINT:
Intelligent tester only:
The malfunctioning area can be found by the ACTIVE TEST A/F CONTROL operation. The A/F CONTROL operation can determine if the A/F sensor, heated oxygen sensor or other suspected areas are malfunctioning or not.

1. **Perform the ACTIVE TEST A/F CONTROL operation.**
   HINT:
   The A/F CONTROL operation lowers the injection volume by 12.5% or increases the injection volume by 25%.
   (a) Connect the intelligent tester to the DLC3 on the vehicle.
   (b) Turn the ignition switch ON.
   (c) Warm up the engine by running the engine at 2,500 rpm for approximately 90 seconds.
   (d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.

(e) Perform the A/F CONTROL operation with the engine idling (press the right or left button).

Result:

A/F sensor reacts in accordance with increase and decrease of injection volume:

+25 % → RICH output: Less than 3.0 V

-12.5 % → LEAN output: More than 3.35 V

Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:

+25 % → RICH output: More than 0.55 V

-12.5 % → LEAN output: Less than 0.4 V

NOTICE:

The A/F sensor output has a few seconds of delay and the heated oxygen sensor output has about 20 seconds of delay at maximum.

ES

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
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 %		• A/F sensor • A/F sensor heater A/F sensor circuit
	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 %		• 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 %		• 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		

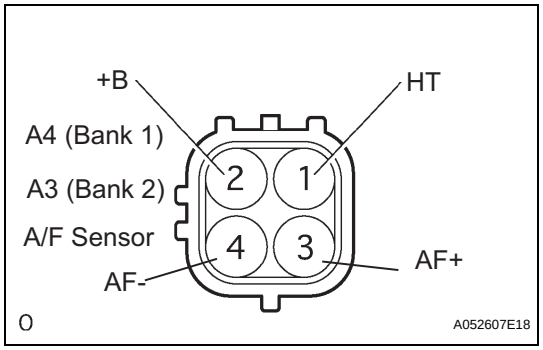
The following A/F CONTROL procedure enables the technician to check and graph the voltage outputs of both the A/F sensor and the heated oxygen sensor.

For displaying the graph, enter "ACTIVE TEST / A/F CONTROL / USER DATA", select "AFS B1S1 and O2S B1S2" by pressing "YES" and push "ENTER". Then press "F4".

HINT:

- If DTC P2237, P2238, P2239, P2251, P2252 or P2253 is displayed, check the bank 1 sensor1 circuit.
- If DTC P2240, P2241, P2242, P2254, P2255 or P2256 is displayed, check the bank 2 sensor 1 circuit.
- Read freeze frame data using the intelligent tester or the 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 help determine if the vehicle was running or stopped, 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)



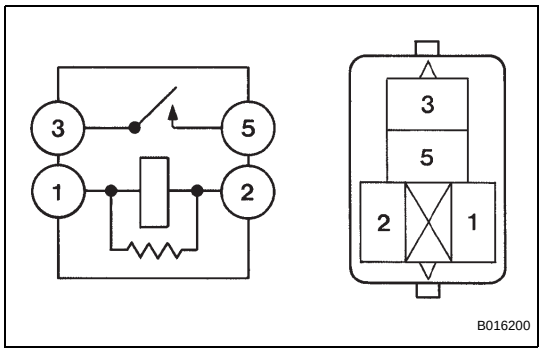
(a) Disconnect the A4 or A3 A/F sensor connector.
(b) Measure the resistance of the A/F sensor terminals.
Standard resistance

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

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

2 INSPECT AIR FUEL RATIO SENSOR RELAY



(a) Remove the A/F relay from the engine room R/B.
(b) Measure the resistance of the A/F relay.
Standard resistance

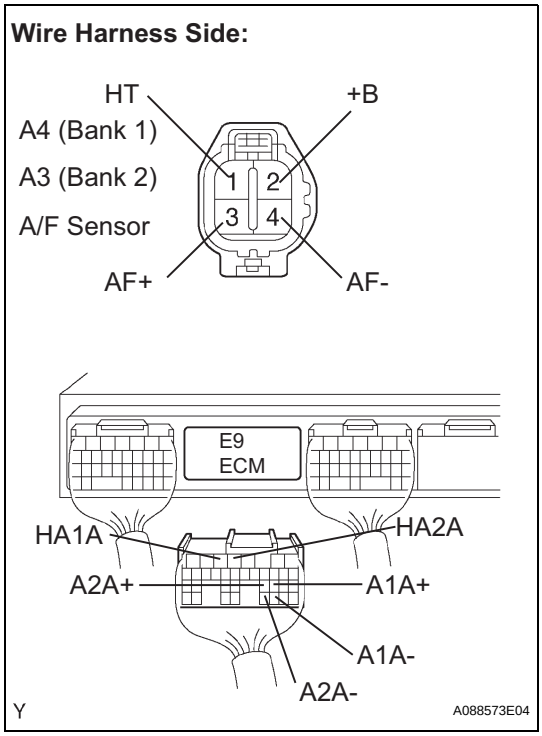
Tester Connection	Specified Condition
1 - 2	Below 1 Ω
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

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

OK

ES

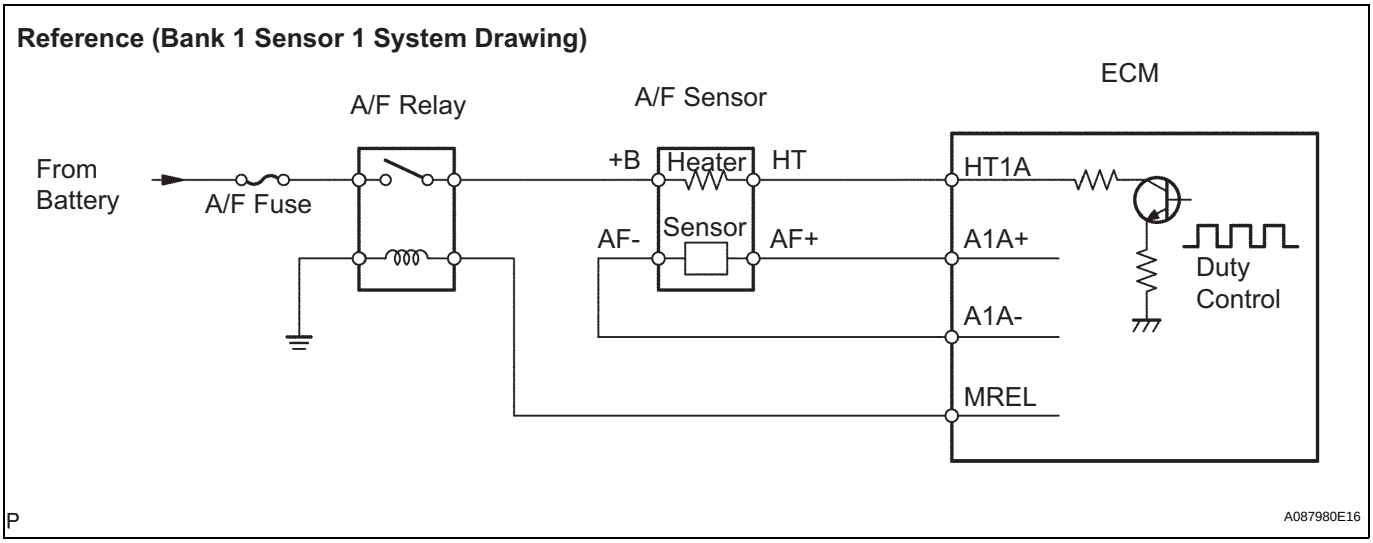
3	CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)



(a) Disconnect the A3 or A4 A/F sensor connector.
(b) Disconnect the E9 ECM connector.
(c) Measure the resistance of the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
A4-3 (AF+) - E9-22 (A1A+) A4-4 (AF-) - E9-30 (A1A-) A4-1 (HT) - E9-5 (HA1A) A3-3 (AF+) - E9-23 (A2A+) A3-4 (AF-) - E9-31 (A2A-) A3-1 (HT) - E9-4 (HA2A)	Below 1 Ω
A4-3 (AF+) or E9-22 (A1A+) - Body ground A4-4 (AF-) or E9-30 (A1A-) - Body ground A4-1 (HT) or E9-5 (HA1A) - Body ground A3-3 (AF+) or E9-23 (A2A+) - Body ground A3-4 (AF-) or E9-31 (A2A-) - Body ground A3-1 (HT) or E9-4 (HA2A) - Body ground	10 kΩ or higher



(d) Reconnect the A/F sensor connector and ECM connector.

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

OK

REPLACE ECM