DTC	**P2238**	**OXYGEN SENSOR PUMPING CURRENT CIRCUIT LOW (FOR A/F SENSOR)(BANK 1 SENSOR 1)**

DTC	**P2239**	**OXYGEN SENSOR PUMPING CURRENT CIRCUIT HIGH (FOR A/F SENSOR)(BANK 1 SENSOR 1)**

DTC	**P2241**	**OXYGEN SENSOR PUMPING CURRENT CIRCUIT LOW (FOR A/F SENSOR)(BANK 2 SENSOR 1)**

DTC	**P2242**	**OXYGEN SENSOR PUMPING CURRENT CIRCUIT HIGH (FOR A/F SENSOR)(BANK 2 SENSOR 1)**

DTC	**P2252**	**OXYGEN SENSOR REFERENCE GROUND CIRCUIT LOW (FOR A/F SENSOR)(BANK 1 SENSOR 1)**

DTC	**P2253**	**OXYGEN SENSOR REFERENCE GROUND CIRCUIT HIGH (FOR A/F SENSOR)(BANK 1 SENSOR 1)**

DTC	**P2255**	**OXYGEN SENSOR REFERENCE GROUND CIRCUIT LOW (FOR A/F SENSOR)(BANK 2 SENSOR 1)**

DTC	**P2256**	**OXYGEN SENSOR REFERENCE GROUND CIRCUIT HIGH (FOR A/F SENSOR)(BANK 2 SENSOR 1)**

HINT:

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

CIRCUIT DESCRIPTION

Refer to DTC P2195 on page 05−771.

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) (AF+) − (AF−) = 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 • EFI relay • A/F sensor heater and relay circuits • ECM
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 • EFI relay • 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 • EFI relay • 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 • EFI relay • A/F sensor heater and relay circuits • ECM

HINT:

- 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 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 if an open or short malfunction 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
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	See page 05−507

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

Duration while all of the following conditions met	20 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 voltages	0.1 to 0.8 V
ECT	20°C (68°F) or more
Engine condition	Running
Time after engine start	20 seconds or more
Fuel−cut	OFF
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 (5 seconds or more)

Others:

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

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 on page 05−771.

INSPECTION PROCEDURE

HINT:

Hand−held tester only:

It is possible the malfunctioning area can be found using the ACTIVE TEST A/F CONTROL operation. The A/F CONTROL operation can determine if the A/F sensor, heated oxygen sensor or other potential trouble areas are malfunctioning or not.

(a) Perform the ACTIVE TEST A/F CONTROL operation.

HINT:

The A/F CONTROL operation lowers the injection volume 12.5% or increases the injection volume 25%.

(1) Connect the hand−held tester to the DLC3 on the vehicle.
(2) Turn the ignition switch ON.
(3) Warm up the engine by running the engine at 2,500 rpm for approximately 90 seconds.
(4) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
(5) Perform the A/F CONTROL operation with the engine idle (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

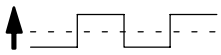
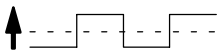
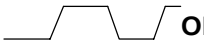
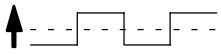
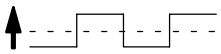
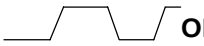
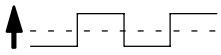
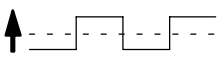
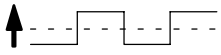
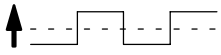
−12.5 % → LEAN output: More than 3.35 V

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

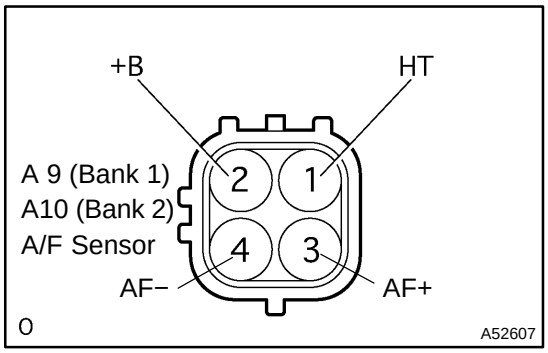
NOTICE:
The A/F sensor output has a few seconds of delay and the heated oxygen sensor output has about 20 seconds of delay at maximum.

	Output voltage of A/F sensor (sensor 1)	Output voltage of heated oxygen sensor (sensor 2)	Mainly suspected Trouble Area
Case 1	Injection volume +25 % −12.5 %  Output voltage More than 3.35 V Less than 3.0 V  **OK**	Injection volume +25 % −12.5 %  Output voltage More than 0.55 V Less than 0.4V  **OK**	—
Case 2	Injection volume +25 % −12.5 %  Output voltage Almost No reaction **NG**	Injection volume +25 % −12.5 %  Output voltage More than 0.55 V Less than 0.4V  **OK**	A/F sensor (A/F sensor, heater, A/F sensor circuit)
Case 3	Injection volume +25 % −12.5 %  Output voltage More than 3.35 V Less than 3.0V  **OK**	Injection volume +25 % −12.5 %  Output voltage Almost No reaction **NG**	Heated oxygen sensor (heated oxygen sensor, heater, heated oxygen sensor circuit)
Case 4	Injection volume +25 % −12.5 %  Output voltage Almost No reaction **NG**	Injection volume +25 % −12.5 %  Output voltage Almost No reaction **NG**	Extremely rich or lean actual air−fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

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 sensor 1 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 hand−held tester or the OBD II scan tool. Freeze frame data records the engine conditions when a malfunction is detected. 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)



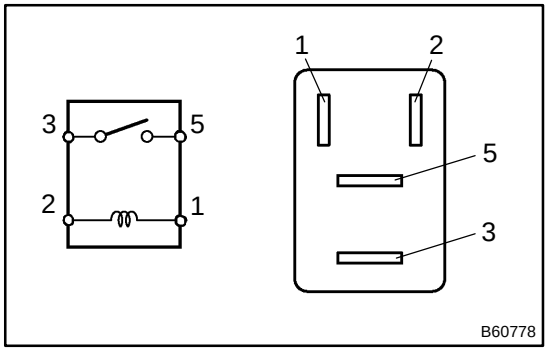
(a) Disconnect the A9 or A10 A/F sensor connector.
(b) Check the resistance of the A/F sensor terminals.
Standard:

Tester Connection	Condition	Specified Condition
1 (HT) − 2 (+B)	20°C (68°F)	0.8 to 1.4 Ω
1 (HT) − 2 (+B)	800°C (1,472°F)	1.8 to 3.4 Ω

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

2 INSPECT RELAY (A/F HTR)



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

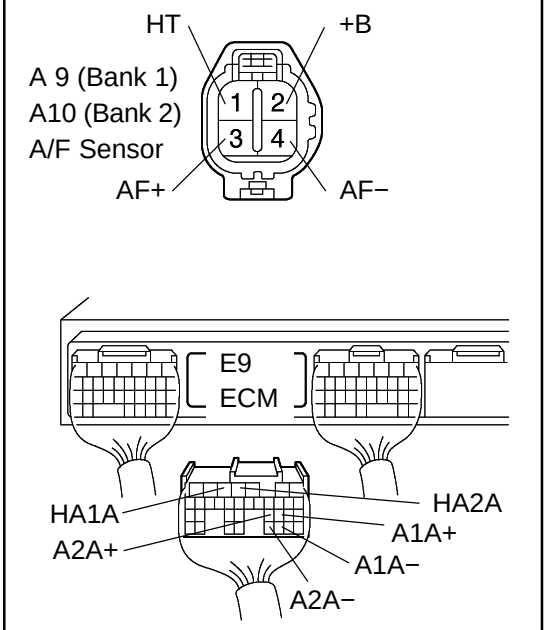
Tester Connection	Specified Condition
3 − 5	10 kΩ or higher
3 − 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

NG → **REPLACE RELAY**

OK

3 CHECK WIRE HARNESS (HEATER RESISTANCE)

Wire Harness Side

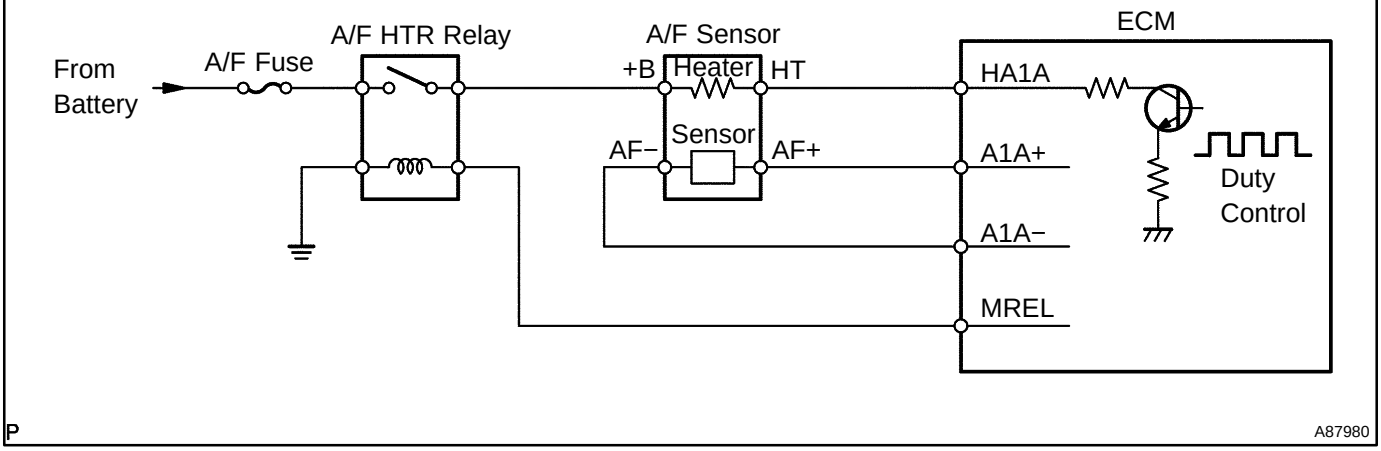


(a) Disconnect the A9 or A10 A/F sensor connector.
(b) Disconnect the E9 ECM connector.
(c) Check the resistance of the wire harness side connectors.

Standard:

Tester Connection	Specified Condition
A9−3 (AF+) − E9−22 (A1A+) A9−4 (AF−) − E9−30 (A1A−) A9−1 (HT) − E9−5 (HA1A) A10−3 (AF+) − E9−23 (A2A+) A10−4 (AF−) − E9−31 (A2A−) A10−1 (HT) − E9−4 (HA2A)	Below 1 Ω
A9−3 (AF+) or E9−22 (A1A+) − Body ground A9−4 (AF−) or E9−30 (A1A−) − Body ground A9−1 (HT) or E9−5 (HA1A) − Body ground A10−3 (AF+) or E9−23 (A2A+) − Body ground A10−4 (AF−) or E9−31 (A2A−) − Body ground A10−1 (HT) or E9−4 (HA2A) − Body ground	10 kΩ or higher

Reference (Bank 1 Sensor 1 System Drawing)



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

OK →

REPLACE ECM (See page 10−25)