

DTC	P2237	OXYGEN SENSOR PUMPING CURRENT CIRCUIT/OPEN (FOR A/F SENSOR)(BANK 1 SENSOR 1)
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	P2251	OXYGEN SENSOR REFERENCE GROUND CIRCUIT/OPEN (FOR A/F SENSOR)(BANK 1 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)

HINT:

Although the title (DTC description) says "oxygen sensor", this DTC is related to the "A/F sensor".

CIRCUIT DESCRIPTION

Refer to DTC P2195 on page [05-269](#).

DTC No.	DTC Detection Condition	Trouble Area
P2237	<ul style="list-style-type: none"> • A/F sensor (bank 1 sensor 1) circuit • Conditions (a) or (b) continue for 5.0 seconds or more : <ul style="list-style-type: none"> (a) AF+ is 0.5 V or less (b) AF+ is more than 4.5 V • Conditions (a) or (b) continue for 5.0 seconds or more : <ul style="list-style-type: none"> (a) (AF+) – (AF–) is 0.1 V or less (b) (AF+) – (AF–) is more than 0.8 V 	HINT: Main trouble area <ul style="list-style-type: none"> • Open or short in A/F sensor circuit • A/F sensor • A/F sensor heater • EFI relay • A/F sensor heater and EFI relay circuit • ECM
P2238	A/F sensor (bank 1 sensor 1) circuit low A/F sensor admittance is less than 0.022 1/Ω	HINT: Main trouble area <ul style="list-style-type: none"> • Open in A/F sensor circuit
P2238	<ul style="list-style-type: none"> • Condition (a) continues for 5.0 seconds or more : <ul style="list-style-type: none"> (a) AF+ is 0.5 V or less • Condition (a) continues for 5.0 seconds or more : <ul style="list-style-type: none"> (a) (AF+) – (AF–) is 0.1 V or less 	<ul style="list-style-type: none"> • Same as DTC No. P2237
P2239	A/F sensor (bank 1 sensor 1) circuit high	HINT: Main trouble area <ul style="list-style-type: none"> • Short in A/F sensor circuit

P2239	<ul style="list-style-type: none"> Condition (a) continues for 5.0 seconds or more : (a) AF+ is more than 4.5 V Condition (a) continues for 5.0 seconds or more : (a) (AF+) – (AF–) is more than 0.8 V 	• Same as DTC No. P2237
P2251	Conditions (a) or (b) continue for 5.0 seconds or more : (a) AF– is 0.5 V or less (b) AF– is more than 4.5 V	• Same as DTC No. P2237
P2252	Condition (a) continues for 5.0 seconds or more : (a) AF– is 0.5 V or less	• Same as DTC No. P2237
P2253	Condition (a) continues for 5.0 seconds or more : (a) AF– is more than 4.5 V	• Same as DTC No. P2237

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 (Bank1) open circuit between AF+ and AF– P2238: A/F sensor (Bank1) 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 P2252: A/F sensor (Bank 1) short circuit between AF– and GND P2253: A/F sensor (Bank 1) 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 (Bank 1) open circuit between AF+ and AF– 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	See page 05-16
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P2238 (open circuit between AF+ and AF–):

Duration while all of the following conditions met	20 seconds or more
AF+ terminal voltage	More than 0.5 V, and 4.5 V or less
AF– terminal voltage	More than 0.5 V, and 4.5 V or less
Difference between AF+ terminal and AF– terminal voltage	More than 0.1 V, and 0.8 V or less
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 cycle	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

TYPICAL MALFUNCTION THRESHOLDS

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

A/F sensor admittance	Below 0.022 1/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+ terminal and AF- terminal voltage	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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WIRING DIAGRAM

Refer to DTC P2195 on page [05-269](#).

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

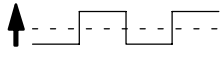

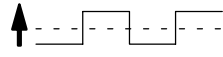

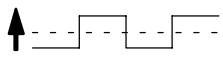

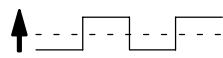
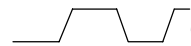
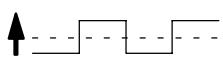

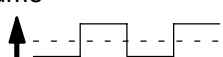
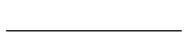
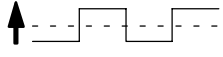
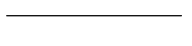
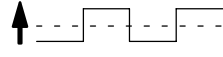
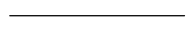
Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:

+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 suspect trouble area
Case 1	Injection volume +25 %  -12.5 % Output voltage More than 3.35 V  OK Less than 3.0 V	Injection volume +25 %  -12.5 % Output voltage More than 0.55 V  OK Less than 0.4V	—
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  OK Less than 0.4V	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  OK Less than 3.0V	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.

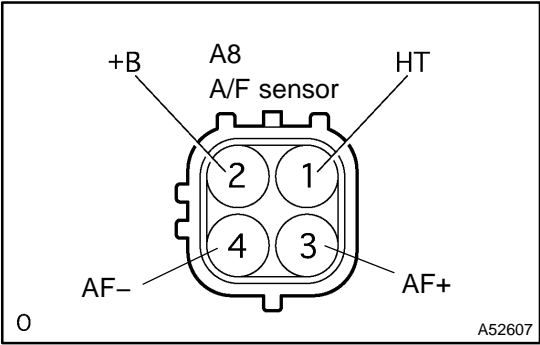
For displaying the graph, enter "ACTIVE TEST / A/F CONTROL / USER DATA", select "AFS B1S1 and O2S B1S2" by pressing "YES" and push "ENTER". Then press "F4".

HINT:

- If DTC P2237, P2238, P2239, P2251, P2252 or P2253 is displayed, check the bank 1 sensor 1 circuit.
- 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 A8 A/F sensor connector.
(b) Check the resistance of the A/F sensor terminals.
Standard:

Tester Connection	Specified Condition
1 (HT) - 2 (+B)	1.8 to 3.4 Ω
1 (HT) - 2 (AF-)	10 k Ω or higher

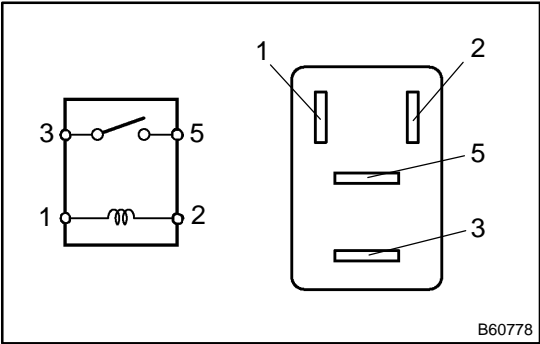
NG

REPLACE AIR FUEL RATIO SENSOR

OK

2

INSPECT RELAY (EFI)



- (a) Remove the EFI relay from the engine room J/B.
(b) Check the resistance of the EFI relay.
Standard:

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

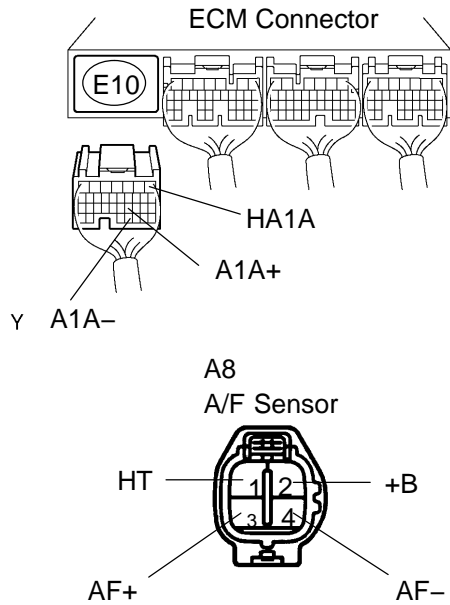
NG

REPLACE RELAY

OK

3 CHECK WIRE HARNESS (A/F SENSOR - ECM)

Wire Harness Side



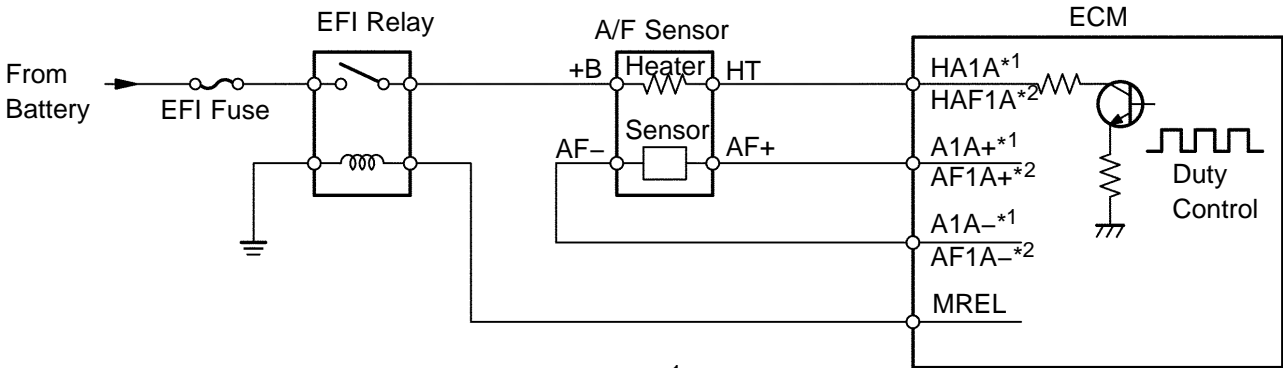
G35731

- (a) Check the wire harness between the ECM and A/F sensor.
- (1) Disconnect the A8 A/F sensor connector.
 - (2) Disconnect the E10 ECM connector.
 - (3) Check the resistance of the wire harness side connectors.

Standard:

Tester Connection	Specified Condition
A8-3 (AF+) - E10-21 (A1A+) A8-4 (AF-) - E10-31 (A1A-) A8-1 (HT) - E10-1 (HA1A)	Below 1 Ω
A8-3 (AF+) or E10-21 (A1A+) - Body ground A8-4 (AF-) or E10-31 (A1A-) - Body ground A8-1 (HT) or E10-1 (HA1A) - Body ground	10 k Ω or higher

Reference



*1: Except PZEV
*2: PZEV

A87980

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

REPLACE ECM (See page 10-9)