

DTC	P2238	Oxygen Sensor Pumping Current Circuit Low (For A/F Sensor)(Bank 1 Sensor1)
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DTC	P2239	Oxygen Sensor Pumping Current Circuit High (For A/F Sensor)(Bank 1 Sensor1)
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DTC	P2241	Oxygen Sensor Pumping Current Circuit Low (For A/F Sensor)(Bank 2 Sensor1)
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DTC	P2242	Oxygen Sensor Pumping Current Circuit High (For A/F Sensor)(Bank 2 Sensor1)
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DTC	P2252	Oxygen Sensor Reference Ground Circuit Low (For A/F Sensor)(Bank 1 Sensor1)
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DTC	P2253	Oxygen Sensor Reference Ground Circuit High (For A/F Sensor)(Bank 1 Sensor1)
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DTC	P2255	Oxygen Sensor Reference Ground Circuit Low (For A/F Sensor)(Bank 2 Sensor1)
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DTC	P2256	Oxygen Sensor Reference Ground Circuit High (For A/F Sensor)(Bank 2 Sensor1)
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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.

CIRCUIT DESCRIPTION

Refer to DTC P2195 on page [DI-806](#).

DTC No.	DTC Detection Conditions	Trouble Areas
P2238 P2241	<ul style="list-style-type: none"> • 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) 	<ul style="list-style-type: none"> • 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 (1 trip detection logic)	<ul style="list-style-type: none"> • 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 (1 trip detection logic)	<ul style="list-style-type: none"> • 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 (1 trip detection logic)	<ul style="list-style-type: none"> • 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 (Bank 1) open circuit between AF+ and AF–
		A/F sensor (Bank 1) short circuit between AF+ and AF–
		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–
		A/F sensor (Bank 2) short circuit between AF+ and AF–
		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	A/F sensor	
Frequency of operation	Once per driving cycle	
Duration	10 sec.: A/F sensor open circuit between AF+ and AF– 5 sec.: Others	
MIL operation	Immediate	
Sequence of operation	None	

TYPICAL ENABLING CONDITIONS

Item	Specification	
	Minimum	Maximum
The monitor will run whenever these DTCs are not present	See page DI-437	
P2238, P2241 (A/F sensor 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+ terminal and AF- terminal voltage	0.1 to 0.8 V	
ECT	0°C (32°F)	-
Engine	Running	
Fuel-cut	OFF	
Time after fuel-cut OFF	5 sec.	-
A/F sensor heater	ON	
Battery voltage	11 V	-
Ignition switch	ON	

Time after ignition switch OFF to ON	5 sec.	–
Others:		
Battery voltage	11 V	–
Ignition switch	ON	
Time after ignition switch OFF to ON	5 sec.	–

TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
P2238, P2241 (A/F sensor open circuit between AF+ and AF-):	
A/F sensor admittance	Bellow 0.022 1/ohm
P2238, P2241 (A/F sensor short circuit between AF+ and GND):	
A/F+ terminal voltage	0.5 V or less
P2238, P2241 (A/F sensor short circuit between AF+ and AF-):	
Difference between A/F+ terminal and AF- terminal voltage	0.1 V or less
P2239, P2242 (A/F sensor short circuit between AF+ and +B):	
A/F+ terminal voltage	More than 4.5 V
P2252, P2255 (A/F sensor short circuit between AF- and GND):	
A/F- terminal voltage	0.5 V or less
P2253, P225+ (A/F sensor short circuit between AF- and +B):	
A/F- terminal voltage	More than 4.5 V

WIRING DIAGRAM

Refer to DTC P2195 on page [DI-806](#).

INSPECTION PROCEDURE

HINT:

Hand-held 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 a hand-held tester.

- (1) Connect a hand-held 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 (AFS B2S1) and OS2 B1S2 (OS2 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 (AFS B2S1) (A/F)	+25 %	Rich	Less than 3.0
AFS B1S1 (AFS B2S1) (A/F)	-12.5 %	Lean	More than 3.35
O2S B1S2 (O2S B2S2) (HO2)	+25 %	Rich	More than 0.55
O2S B1S2 (O2S B2S2) (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.

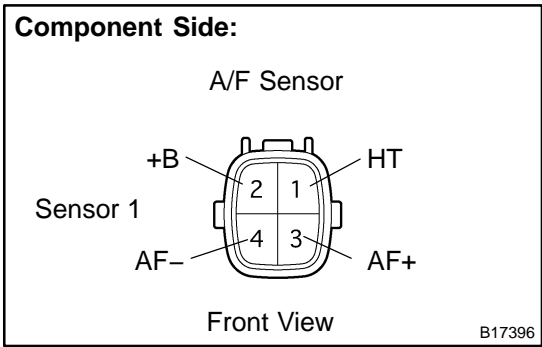
- Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, select the following menu items on the tester: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2, and press the YES button and then the ENTER button followed by the F4 button.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Areas
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	—
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	<ul style="list-style-type: none"> • A/F sensor • A/F sensor heater • A/F sensor circuit
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	<ul style="list-style-type: none"> • HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4	Injection volume +25 % ↑ - - - - - -12.5 % ↓ - - - - - Output voltage Almost no reaction ———— NG	Injection volume +25 % ↑ - - - - - -12.5 % ↓ - - - - - Output voltage Almost no reaction ———— NG	<ul style="list-style-type: none"> • Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)

HINT:

Read freeze frame data using a hand-held 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 Check resistance of air-fuel ratio (A/F) sensor heater.



PREPARATION:

Disconnect the air-fuel ratio (A/F) sensor connector.

CHECK:

Measure resistance between the terminals of the A/F sensor connector.

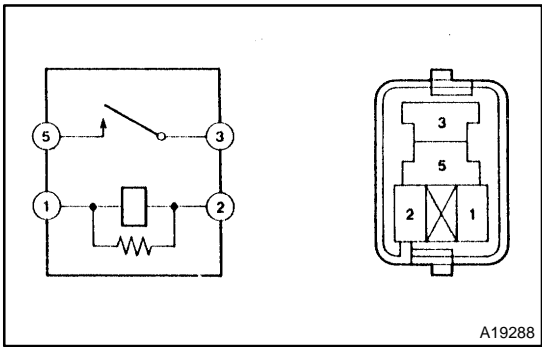
OK:

Tester Connection	Specified Condition
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

NG Replace air-fuel ratio (A/F) sensor.

OK

2 Check A/F relay.



PREPARATION:

Remove the A/F relay from the engine room J/B.

CHECK:

Inspect the A/F relay.

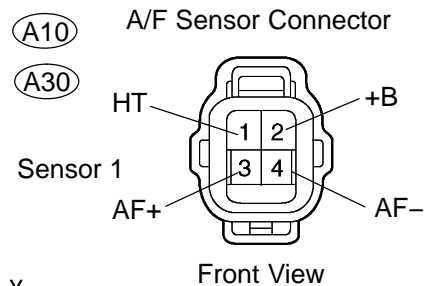
OK:

Terminal No.	Condition	Specified Condition
1 – 2	Constant	Continuity
3 – 5	Usually	No Continuity
	Apply B+ between terminals 1 and 2	Continuity

NG Replace EFI relay.

OK

3

Check for open and short in harness and connector between ECM and A/F sensor.**Wire Harness Side:****PREPARATION:**

- Disconnect the A10 or A30 A/F sensor connector.
- Turn the ignition switch to ON.

CHECK:

- Measure the voltage between the +B terminal of the A/F sensor connector and body ground.

OK:**Standard:**

Tester Connections	Specified Conditions
+B (2) - Body ground	Between 9 V and 14 V

PREPARATION:

- Turn the ignition switch to OFF.
- Disconnect the E6 ECM connector.

CHECK:

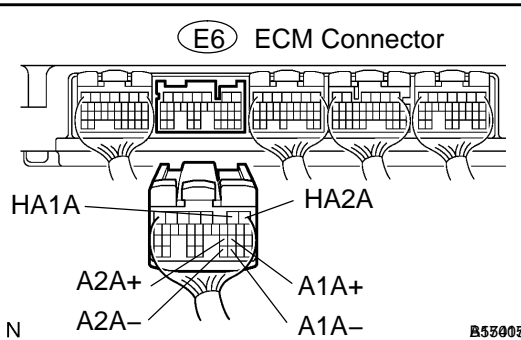
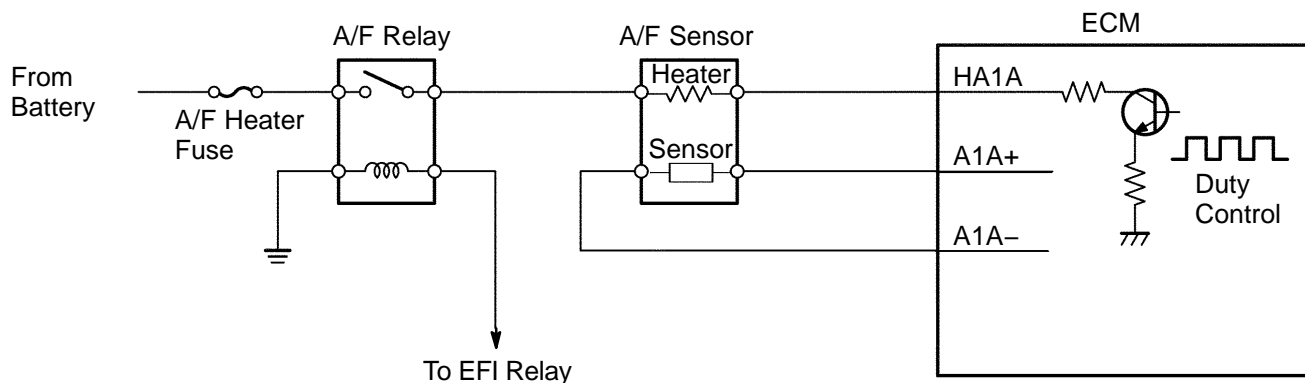
- Check the resistance.

OK:**Standard (Check for open):**

Tester Connections	Specified Conditions
HT (A10-1) - HA1A (E6-2) HT (A30-1) - HA2A (E6-1)	Below 1 Ω
AF+ (A10-3) - A1A+ (E6-22) AF+ (A30-3) - A2A+ (E6-23)	Below 1 Ω
AF- (A10-4) - A1A- (E6-30) AF- (A30-4) - A2A- (E6-31)	Below 1 Ω

Standard (Check for short):

Tester Connections	Specified Conditions
HT (A10-1) or HA1A (E6-2) - Body ground HT (A30-1) or HA2A (E6-1) - Body ground	10 k Ω or higher
AF+ (A10-3) or A1A+ (E6-22) - Body ground AF+ (A30-3) or A2A+ (E6-23) - Body ground	10 k Ω or higher
AF- (A10-4) or A1A- (E6-30) - Body ground AF- (A30-4) or A2A- (E6-31) - Body ground	10 k Ω or higher

**Reference (Bank 1 Sensor 1 System Drawing):**

NG**Replace or replace harness or connector.****OK****Replace ECM (See page [SF-82](#)).**