

DTC	P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)
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DTC	P0032	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)
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DTC	P0051	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)
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DTC	P0052	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)
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HINT:

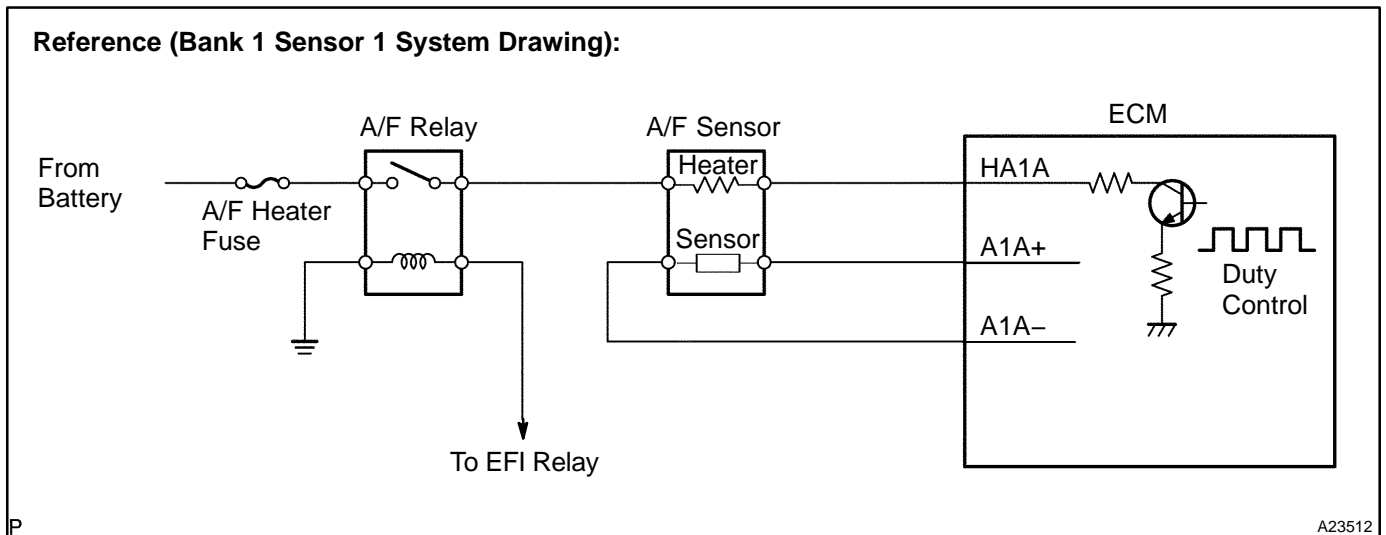
Although each DTC title (DTC description) says "oxygen sensor", these DTCs are related to the "A/F sensor".

CIRCUIT DESCRIPTION

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

HINT:

The ECM provides a pulse width modulated control circuit to adjust current through the heater. The A/F sensor heater circuit uses a relay on the B+ side of the circuit.



DTC No.	DTC Detection Condition	Trouble Area
P0031 P0051	Heated current is 0.8 A or less when heater operates (1 trip detection logic)	<ul style="list-style-type: none"> • Open or short in heater circuit of A/F sensor • A/F sensor heater
P0032 P0052	When the heater operates, heated current exceeds 19.7 A (1 trip detection logic)	<ul style="list-style-type: none"> • A/F sensor heater relay • ECM

HINT:

- Bank 1 refers to the bank that includes cylinder No.1.
- Bank 2 refers to the bank that does not include cylinder No.1.
- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

MONITOR DESCRIPTION

The ECM uses the Air–Fuel Ratio sensor (A/F sensor) information to regulate the air–fuel ratio close to the stoichiometric ratio. This maximizes the catalytic converter’s ability to purify exhaust gases. The sensor detects oxygen levels in the exhaust gas and sends this signal to the ECM.

The inner surface of the sensor element is exposed to outside air. The outer surface of the sensor element is exposed to exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element. The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations of the exhaust and the outside air. The platinum coating amplifies the voltage generation. When heated, the sensor becomes very efficient. If the temperature of the exhaust is low, the sensor will not generate useful voltage signals without supplemental heating. The ECM regulates the supplemental heating using a duty–cycle approach to regulate the average current in the heater element. If the heater current is out of the normal range, the sensor’s output signals will be inaccurate and the ECM can not regulate the air–fuel ratio properly.

When the heater current is out of the normal operating range, the ECM interprets this as a malfunction and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0031	A/F sensor heater (Bank 1) range check (Low current)
	P0032	A/F sensor heater (Bank 1) range check (High current)
	P0051	A/F sensor heater (Bank 2) range check (Low current)
	P0052	A/F sensor heater (Bank 2) range check (High current)
Required sensors/components	Main sensors/components	A/F sensor heater
	Related sensors/components	–
Frequency of operation	Continuous	
Duration	10 sec.	
MIL operation	Immediate	
Sequence of operation	None	

TYPICAL ENABLING CONDITIONS

Item	Specification	
	Minimum	Maximum
The monitor will run whenever this DTC is not present	See page DI-437	
P0031, P0051 (Low current):		
Battery voltage	10.5 V	—
A/F sensor heater duty ratio	50%	—
Time after engine start	10 sec.	—

P0032, P0052 (High current):

Time after engine start

10 sec.

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TYPICAL MALFUNCTION THRESHOLDS

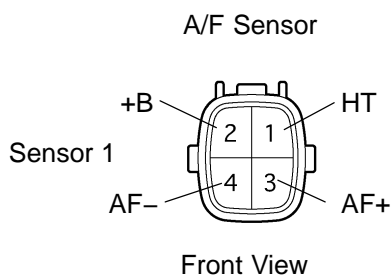
Detection Criteria	Threshold
P0031, P0051 (Low current):	
A/F sensor heater current	Less than 0.8 A
P0032, P0052 (High current):	
A/F sensor heater current	More than 10 A

COMPONENT OPERATING RANGE

Parameter	Standard Value
A/F sensor heater current	1.8 to 3.4 A at 20°C (68°F)

WIRING DIAGRAMRefer to DTC P2195 on page [DI-806](#).**INSPECTION PROCEDURE****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.****Component Side:**

B17396

PREPARATION:

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

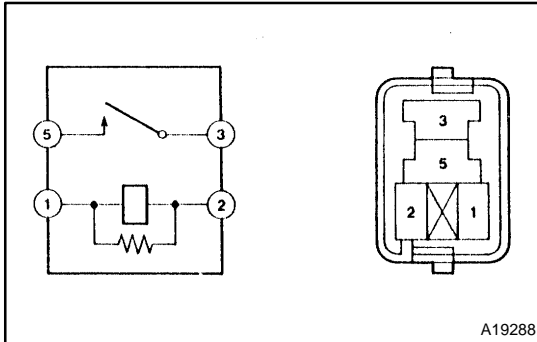
CHECK:

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

OK:**Standard:**

Tester Connection	Specified Condition
HT (1) – +B (2)	1.8 Ω to 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:**

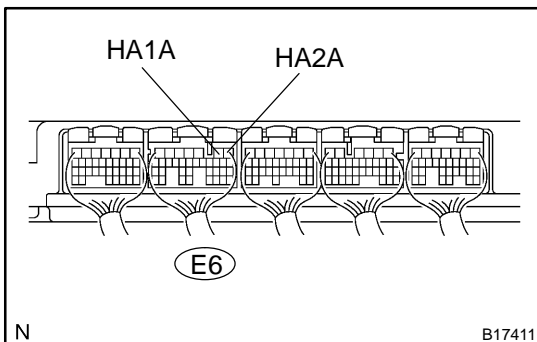
Remove the A/F relay from the engine room R/B No.2.

CHECK:

Inspect the A/F relay.

OK:**Standard:**

Terminal No.	Condition	Specified Condition
3 – 5	Always	10 K Ω or higher
3 – 5	Apply B+ between terminals 1 and 2	Below 1 Ω

NG**Replace A/F relay.****OK****3 Check voltage between terminals HA1A, HA2A of ECM connectors and body ground.****PREPARATION:**

Turn the ignition switch ON.

CHECK:

Measure the voltage between terminals of the ECM connectors and body ground.

HINT:

- Connect terminal HA1A to the bank 1 sensor 1.
- Connect terminal HA2A to the bank 2 sensor 1.

OK:**Standard:**

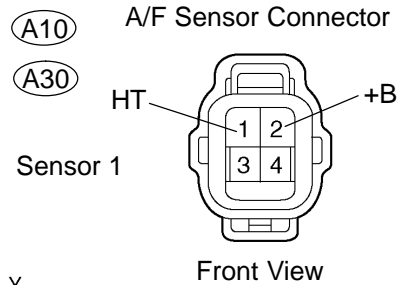
Tester Connection	Specified Condition
HA1A (E6-2) – Body ground	9 V to 14 V
HA2A (E6-1) – Body ground	9 V to 14 V

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

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Check for open and short in harness and connector between ECM and A/F sensor.

Wire Harness Side:



PREPARATION:

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

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

PREPARATION:

- Turn the ignition switch to OFF.
- Disconnect the A10 or A30 A/F sensor connector.
- Remove A/F relay from engine room R/B No.2.

CHECK:

Check the resistance.

OK:

Standard (Check for open):

Tester Connections	Specified Conditions
+B (A10-2) – A/F relay (3) +B (A30-2) – A/F relay (3)	Below 1 Ω

Standard (Check for short):

Tester Connections	Specified Conditions
+B (A10-2) or A/F relay (3) – Body ground +B (A30-2) or A/F relay (3) – Body ground	10 k Ω or higher

NG

Repair or replace harness or connector.

OK

**Check for intermittent problems
(See page DI-430).**