

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

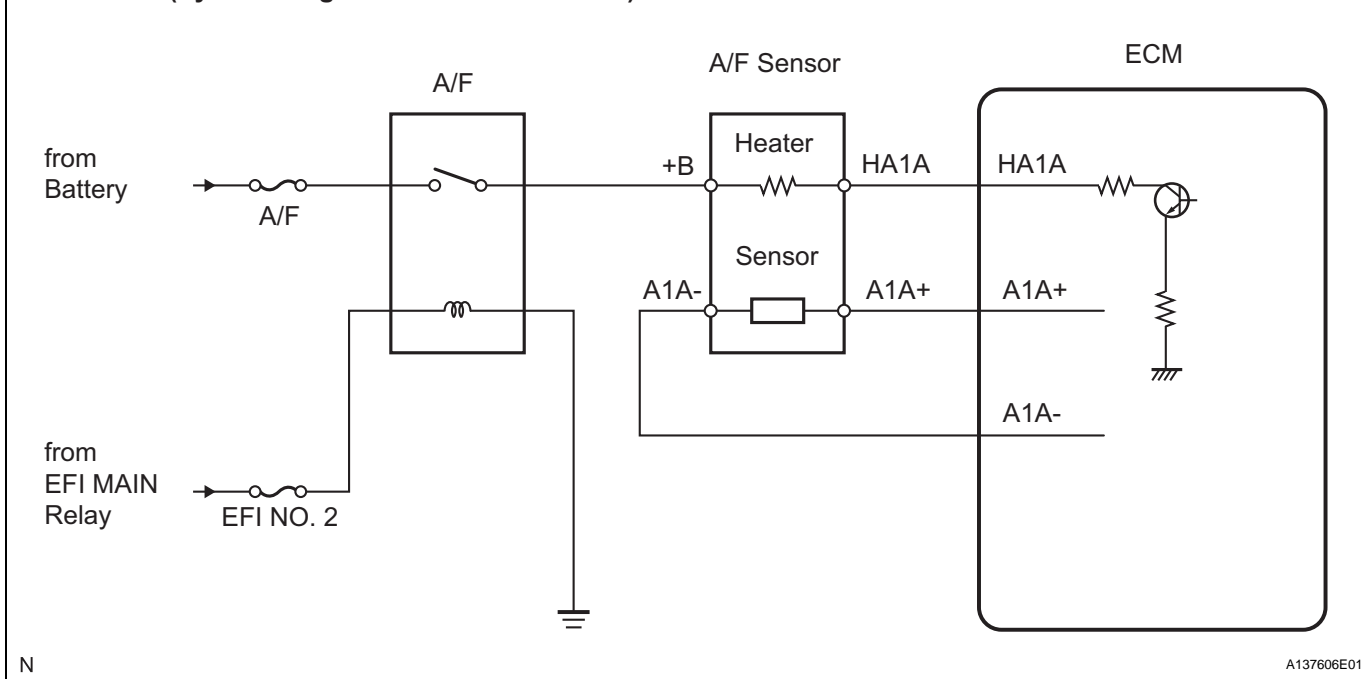
## DESCRIPTION

Refer to DTC P2195 (see page [ES-334](#)).

### 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.
- When one of these DTCs is set, the ECM enters fail-safe mode. The ECM turns off the A/F sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned OFF.
- The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the B+ side of the circuit.

### Reference (System Diagram of Bank 1 Sensor 1):



DTC No.	DTC Detection Condition	Trouble Area
P0031 P0051	Air-Fuel Ratio (A/F) sensor heater current less than 0.8 A (1 trip detection logic)	<ul style="list-style-type: none"> <li>Open in A/F sensor heater circuit</li> <li>A/F sensor heater (sensor 1)</li> <li>Integration relay</li> <li>ECM</li> </ul>

DTC No.	DTC Detection Condition	Trouble Area
P0032 P0052	Air-Fuel Ratio (A/F) sensor heater current fail (1 trip detection logic)	<ul style="list-style-type: none"> <li>• Short in A/F sensor heater circuit</li> <li>• A/F sensor heater (sensor 1)</li> <li>• Integration relay</li> <li>• ECM</li> </ul>

**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 information from the Air-Fuel Ratio (A/F) sensor to regulate the air-fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-Way Catalytic Converter (TWC) to purify the exhaust gases.

The A/F sensor detects oxygen levels in the exhaust gas and transmits the information to the ECM. The inner surface of the sensor element is exposed to the outside air. The outer surface of the sensor element is exposed to the 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 between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.

The A/F sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the A/F sensor becomes inaccurate. As a result, the ECM is unable to regulate air-fuel ratio properly.

When the current in the A/F sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and sets a DTC.

**Example:**

The ECM sets DTC P0032 or P0052 when the current in the A/F sensor heater is more than 10 A.

Conversely, when the heater current is less than 0.8 A, DTC P0031 or P0051 is set.

**MONITOR STRATEGY**

Related DTCs	P0031: A/F sensor heater (bank 1) open/short (Low electrical current) P0032: A/F sensor heater (bank 1) open/short (High electrical current) P0051: A/F sensor heater (bank 2) open/short (Low electrical current) P0052: A/F sensor heater (bank 2) open/short (High electrical current)
Required Sensors/Components (Main)	A/F sensor heater
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	10 seconds
MIL Operation	Immediate
Sequence of Operation	None

**TYPICAL ENABLING CONDITIONS****All:**

Monitor runs whenever following DTCs not present	None
--	------

**P0031 and P0051:**

Battery voltage	10.5 V or more
A/F sensor heater duty-cycle ratio	50% or more
Time after engine start	10 seconds or more

P0032 and P0052:

Time after engine start	10 seconds or more
-------------------------	--------------------

TYPICAL MALFUNCTION THRESHOLDS

P0031 and P0051:

A/F sensor heater current	Less than 0.8 A
---------------------------	-----------------

P0032 and P0052:

Hybrid IC high current limiter port	Fail
-------------------------------------	------

COMPONENT OPERATING RANGE

A/F sensor heater current	0.9 to 9.9 A
---------------------------	--------------

ES

WIRING DIAGRAM

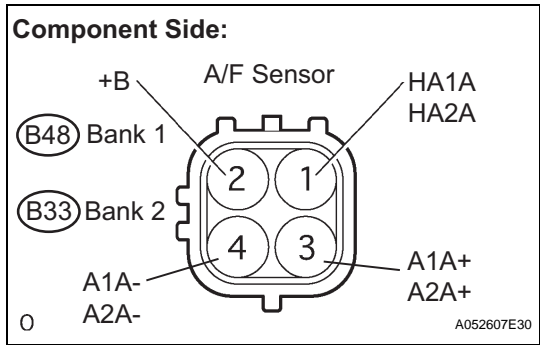
Refer to DTC P2195 (see page ES-339).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records 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 INSPECT AIR-FUEL RATIO SENSOR (HEATER RESISTANCE)



- (a) Disconnect the B33 or B48 A/F sensor connector.
- (b) Measure the resistance of the A/F sensor connector.

Standard resistance  
Bank 1

Tester Connection	Specified Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA1A) - 4(A1A-)	-	10 kΩ or higher

Standard resistance  
Bank 2

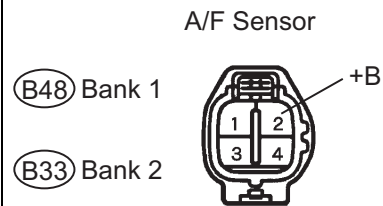
Tester Connection	Specified Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HA2A) - 4 (A2A-)	-	10 kΩ or higher

- (c) Reconnect the A/F sensor connector.

NG

REPLACE AIR-FUEL RATIO SENSOR

OK

**2 CHECK TERMINAL VOLTAGE (+B OF A/F SENSOR)****Wire Harness Side:**

A076787E12

- (a) Disconnect the B33 or B48 A/F sensor connector.
- (b) Turn the ignition switch ON.
- (c) Measure the voltage between the terminals of the B33 or B48 A/F sensor connector and body ground.

**Standard voltage**

Tester Connection	Specified Condition
B33-2 (+B) - Body ground	9 to 14 V
B48-2 (+B) - Body ground	9 to 14 V

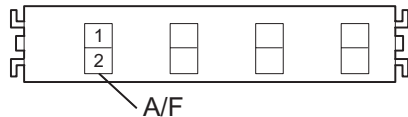
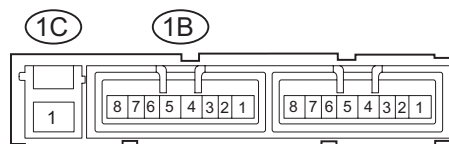
- (d) Reconnect the A/F sensor connector.

OK

Go to step 5

ES

NG

**3 INSPECT INTEGRATION RELAY (A/F RELAY)****Integration Relay****Fuse Side:****Connector Side:**

Y

A107921E15

- (a) Remove the integration relay from the engine room No. 1 relay block.
- (b) Inspect the A/F fuse.
  - (1) Remove the A/F fuse from the integration relay.
  - (2) Measure the A/F fuse resistance.

**Standard resistance:****Below 1  $\Omega$** 

- (3) Reinstall the A/F fuse.
- (c) Inspect the A/F relay.
  - (1) Measure the A/F relay resistance.

**Standard resistance**

Tester Connection	Specified Condition
1C-1 - 1B-8	10 k $\Omega$ or higher
	Below 1 $\Omega$ (Apply battery voltage between terminals 1B-6 and 1B-7)

- (d) Reinstall the integration relay.

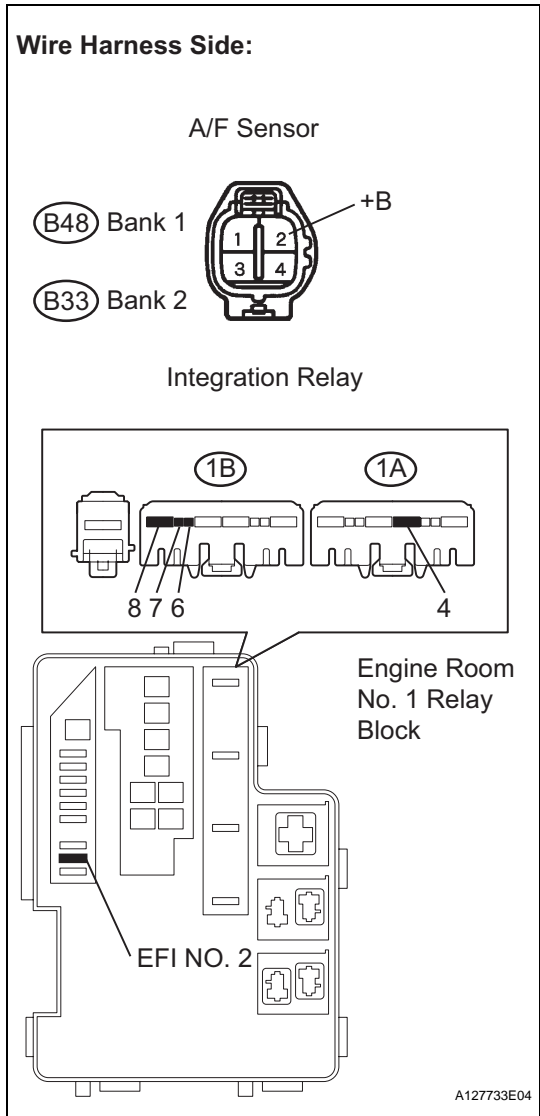
NG

REPLACE INTEGRATION RELAY

OK

4

CHECK WIRE HARNESS (INTEGRATION RELAY - A/F SENSOR AND BODY GROUND)



- (a) Check the EFI NO. 2 fuse.
- (b) Disconnect the B33 or B48 A/F sensor connector.
- (c) Remove the integration relay from the engine room No. 1 relay block.
- (d) Measure the resistance.

Standard resistance

Tester Connection	Specified Condition
B48-2 (+B) - 1B-8	Below 1 Ω
B33-2 (+B) - 1B-8	Below 1 Ω
1A-4 - 1B-6	Below 1 Ω
1B-7 - Body ground	Below 1 Ω
B48-2 (+B) or 1B-8 - Body ground	10 kΩ or higher
B33-2 (+B) or 1B-8 - Body ground	10 kΩ or higher
1A-4 or 1B-6 - Body ground	10 kΩ or higher

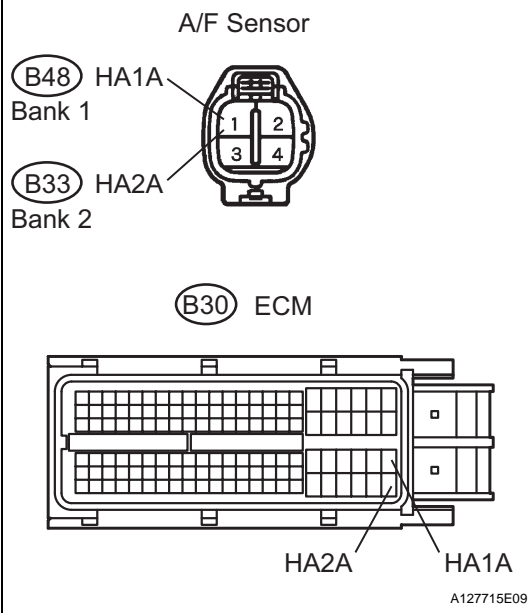
- (e) Reconnect the A/F sensor connector.
- (f) Reinstall the integration relay.

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT

**5 CHECK WIRE HARNESS (A/F SENSOR - ECM)****Wire Harness Side:****OK**

- Disconnect the B33 or B48 A/F sensor connector.
- Disconnect the B30 ECM connector.
- Measure the resistance.

**Standard resistance**

Tester Connection	Specified Condition
B48-1 (HA1A) - B30-86 (HA1A)	Below 1 $\Omega$
B33-1 (HA2A) - B30-109 (HA2A)	Below 1 $\Omega$
B48-1 (HA1A) or B30-86 (HA1A) - Body ground	10 k $\Omega$ or higher
B33-1 (HA2A) or B30-109 (HA2A) - Body ground	10 k $\Omega$ or higher

- Reconnect the A/F sensor connector.
- Reconnect the ECM connector.

**NG****REPAIR OR REPLACE HARNESS AND CONNECTOR****6 CHECK WHETHER DTC OUTPUT RECURS**

- Connect the intelligent tester to the DLC3.
- Turn the ignition switch ON.
- Turn the tester ON.
- Clear DTCs (see page [ES-39](#)).
- Start the engine.
- Allow the engine to idle for 1 minute or more.
- Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- Read DTCs.

**Result**

Display (DTC Output)	Proceed to
No output	A
P0031, P0032, P0051 or P0052	B

**B****REPLACE ECM****A****CHECK FOR INTERMITTENT PROBLEMS**