

<b>DTC</b>	<b>P0031</b>	<b>OXYGEN (A/F) SENSOR HEATER CONTROL CIRCUIT LOW (BANK 1 SENSOR 1)</b>
<b>DTC</b>	<b>P0032</b>	<b>OXYGEN (A/F) SENSOR HEATER CONTROL CIRCUIT HIGH (BANK 1 SENSOR 1)</b>
<b>DTC</b>	<b>P0051</b>	<b>OXYGEN (A/F) SENSOR HEATER CONTROL CIRCUIT LOW (BANK 2 SENSOR 1)</b>
<b>DTC</b>	<b>P0052</b>	<b>OXYGEN (A/F) SENSOR HEATER CONTROL CIRCUIT HIGH (BANK 2 SENSOR 1)</b>

**HINT:**

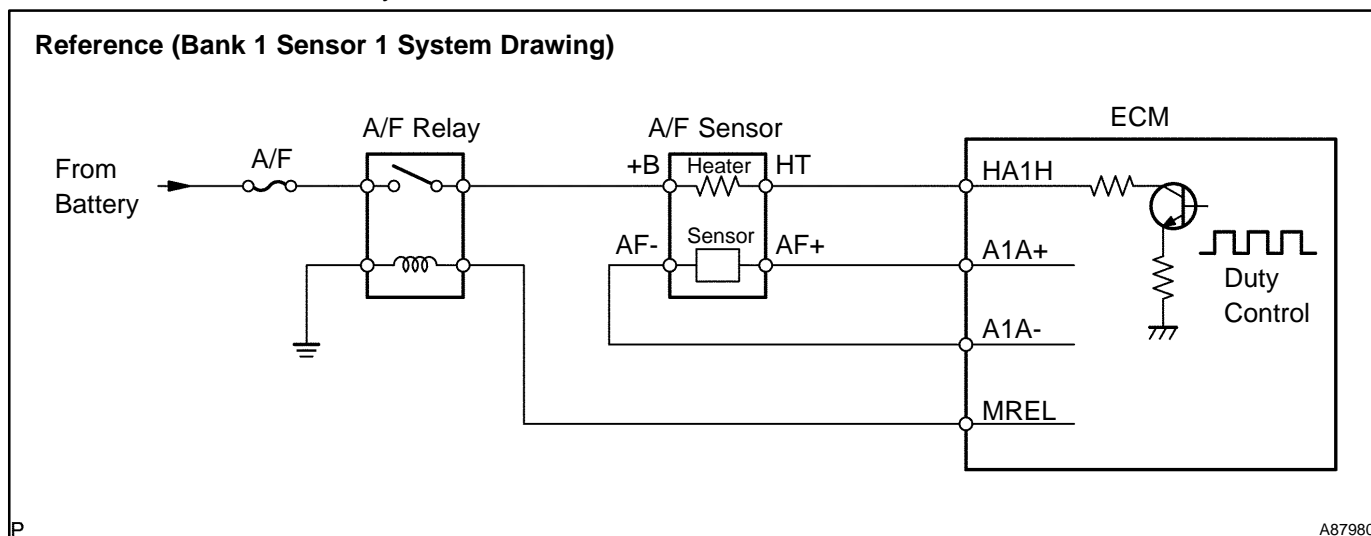
Although the caption of detection item (DTC description) says "oxygen sensor", this DTC is related to the "air fuel ratio sensor (A/F sensor)".

**CIRCUIT DESCRIPTION**

Refer to DTC P2195 on page [05-629](#) .

**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"> <li>• Open or short in heater circuit of A/F sensor</li> <li>• A/F sensor heater</li> <li>• A/F relay</li> <li>• ECM</li> </ul>
P0032 P0052	Hybrid IC high current limiter port is fail (1 trip detection logic)	<ul style="list-style-type: none"> <li>• Open or short in heater circuit of A/F sensor</li> <li>• A/F sensor heater</li> <li>• A/F relay</li> <li>• ECM</li> </ul>

**HINT:**

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

**MONITOR DESCRIPTION**

The ECM uses the Air-Fuel Ratio (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 gas. 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 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 cannot 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)	A/F sensor heater
Required sensors / components (Related)	-
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	Immediate
Sequence operation	None

**TYPICAL ENABLING CONDITIONS****P0031 and P0051**

The monitor will run whenever these DTCs are not present	See page <a href="#">05-377</a>
Battery voltage	10.5 V or more
A/F sensor heater duty ratio	50 % or more
Time after engine start	10 seconds or more

**P0032 and P0052**

The monitor will run whenever these DTCs are not present	See page <a href="#">05-377</a>
Time after engine start	10 seconds or more

**TYPICAL MALFUNCTION THRESHOLDS****P0031 and P0051:**

A/F sensor heater current	Less than 0.8 A
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**P0032 and P0052:**

Hybrid IC high current limiter port	Fail
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## COMPONENT OPERATING RANGE

A/F sensor heater current	1.8 to 3.4 A at 20°C (68°F)
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## MONITOR RESULT

Refer to page [05-385](#) for detailed information.

The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (see page [05-387](#) ).

- TID (Test Identification Data) is assigned to each emissions-related component.
- TLT (Test Limit Type):  
If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.  
If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component Identification Data) is assigned to each test value.
- Unit Conversion is used to calculate the test value indicated on generic OBD II scan tools.

### TID \$07: A/F sensor heater

TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
1	\$01	Multiply by 0.00017 (A)	Maximum heater current (Bank 1)	Malfunction criterion for A/F sensor heater
1	\$10	Multiply by 0.00017 (A)	Maximum heater current (Bank 2)	Malfunction criterion for A/F sensor heater

## WIRING DIAGRAM

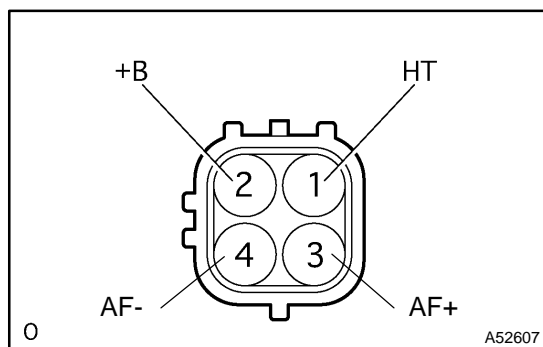
Refer to DTC P2195 on page [05-629](#) .

## INSPECTION PROCEDURE

### HINT:

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.

<b>1</b>	<b>INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)</b>
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- Disconnect the A6 or A7 A/F sensor connector.
- Check the resistance between the terminals of the A/F sensor.

### Resistance:

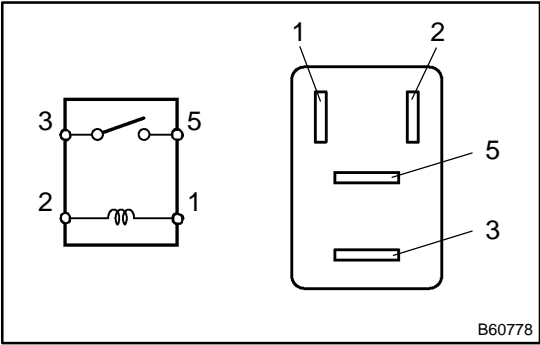
Tester Connection	Condition	Specified Condition
1 (HT) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HT) - 4 (AF-)	-	10 kΩ or higher

**NG**

**REPLACE AIR FUEL RATIO SENSOR**

**OK**

**2 INSPECT RELAY (A/F)**



- (a) Remove the A/F relay from the engine room R/B No. 2.
- (b) Check the resistance of the A/F relay.

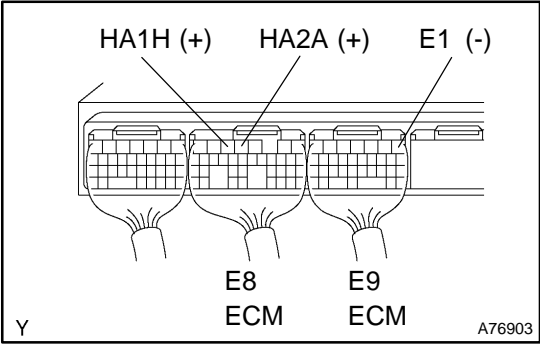
**Standard:**

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

**OK**

**NG** **REPLACE RELAY**

**3 CHECK ECM (HA1H, HA2A VOLTAGE)**



- (a) Turn the ignition switch ON.
- (b) Check the voltage of the ECM connectors.

**Standard:**

Tester Connection	Specified Condition
E8-5 (HA1H) - E9-1 (E1) E8-4 (HA2A) - E9-1 (E1)	9 to 14 V

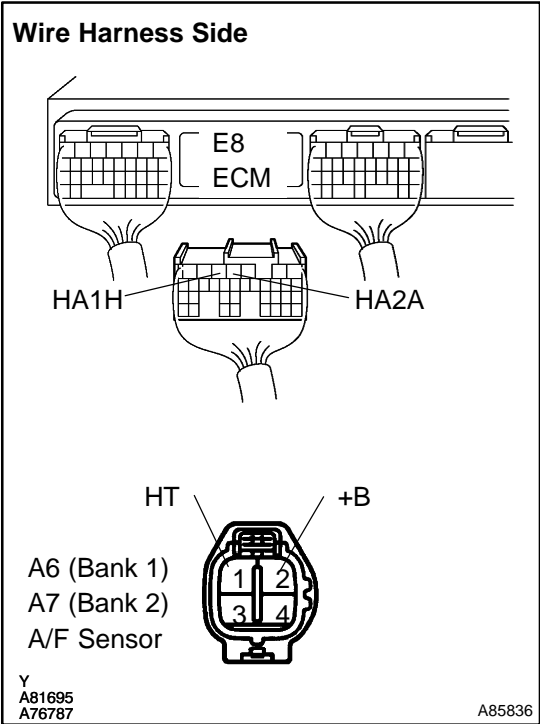
**HINT:**

- The HA1H stands for the A/F sensor bank 1 sensor 1.
- The HA2A stands for the A/F sensor bank 2 sensor 1.

**NG**

**OK** **REPLACE ECM (See page 10-24 )**

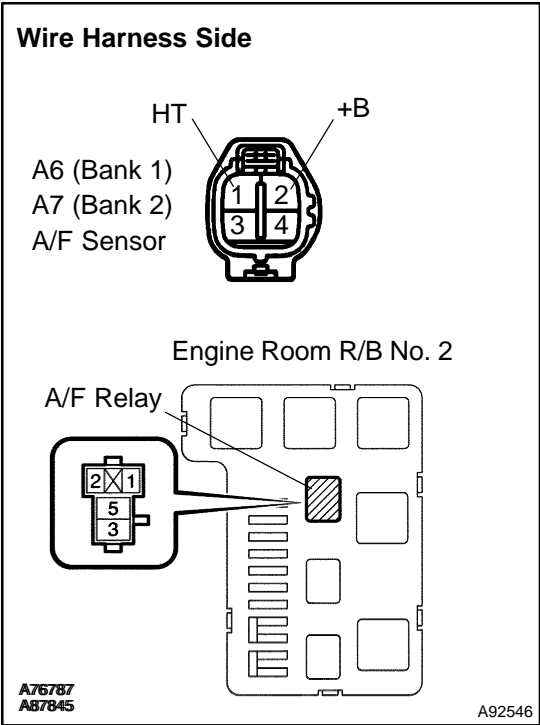
4 CHECK WIRE HARNESS (A/F SENSOR - ECM, A/F SENSOR - A/F RELAY)



- (a) Check the wire harness between the ECM and A/F sensors.
- (1) Disconnect the E8 ECM connector.
  - (2) Disconnect the A6 or A7 A/F sensor connector.
  - (3) Check the resistance of the wire harness side connectors.

**Standard:**

Tester Connection	Specified Condition
A6-1 (HT) - E8-5 (HA1H) A7-1 (HT) - E8-4 (HA2A)	Below 1 $\Omega$
A6-1 (HT) or E8-5 (HA1H) - Body ground A7-1 (HT) or E8-4 (HA2A) - Body ground	10 k $\Omega$ or higher



- (b) Check the wire harness between the A/F sensor and A/F relay.
- (1) Disconnect the A6 or A7 A/F sensor connector.
  - (2) Remove the A/F relay from the engine room R/B No. 2.
  - (3) Check the resistance of the wire harness side connectors.

**Standard:**

Tester Connection	Specified Condition
A6-2 (+B) - R/B No. 2 A/F relay terminal 3 A7-2 (+B) - R/B No. 2 A/F relay terminal 3	Below 1 $\Omega$
A6-2 (+B) or R/B No. 2 A/F relay terminal 3 - Body ground A7-2 (+B) or R/B No. 2 A/F relay terminal 3 - Body ground	10 k $\Omega$ or higher

**NG** REPAIR OR REPLACE HARNESS AND CONNECTOR

**OK**

REPLACE ECM (See page 10-24 )