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)

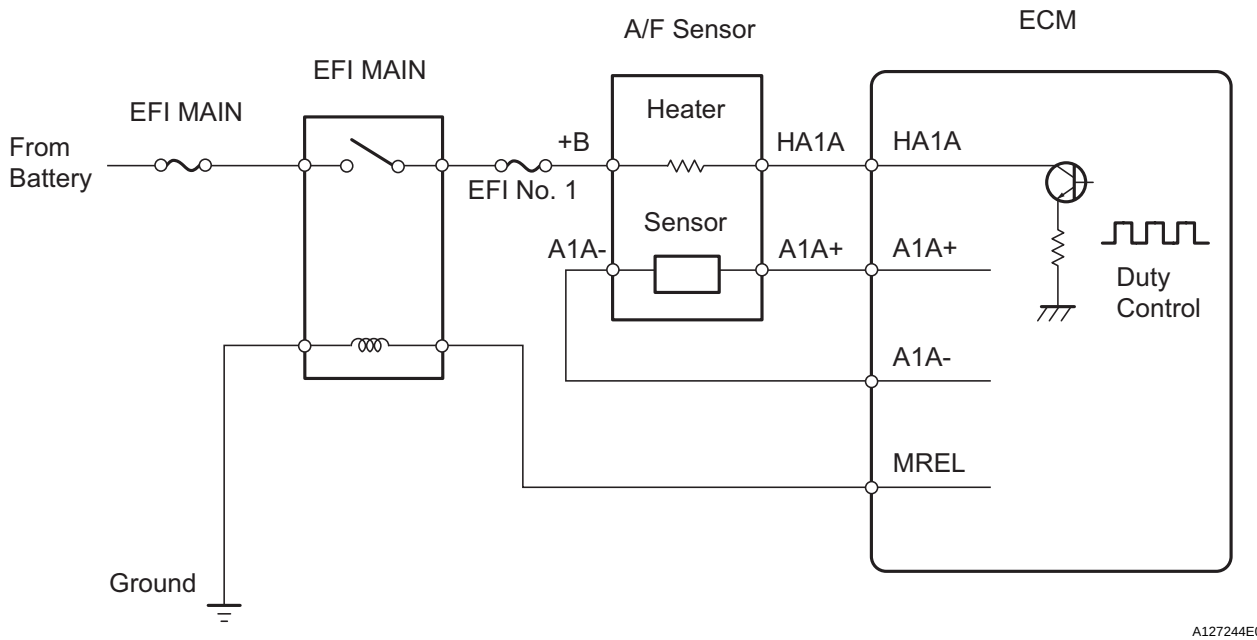
HINT:
- Although the DTC titles say oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.

ES

DESCRIPTION

Refer to DTC P2195 (see page ES-292).
HINT:
- When either 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 Sensor 1):



DTC No.	DTC Detection Conditions	Trouble Areas
P0031	Air-Fuel Ratio (A/F) sensor heater current less than 0.8 A (1 trip detection logic)	• Open in A/F sensor heater circuit • A/F sensor heater (sensor 1) • Integration relay (EFI MAIN relay) • ECM
P0032	Air-Fuel Ratio (A/F) sensor heater current more than 10 A (1 trip detection logic)	• Short in A/F sensor heater circuit • A/F sensor heater (sensor 1) • Integration relay (EFI MAIN relay) • ECM

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 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 is set.

MONITOR STRATEGY

Related DTCs	P0031: A/F sensor heater open/short (Low electrical current) P0032: A/F sensor heater 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:

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:

Time after engine start	10 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

P0031:

A/F sensor heater current	Less than 0.8 A

P0032:

A/F sensor heater current	More than 10 A

COMPONENT OPERATING RANGE

A/F sensor heater current	0.9 to 9.9 A

WIRING DIAGRAM

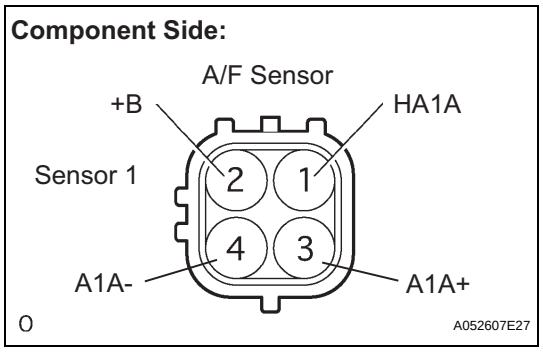
Refer to DTC P2195 (see page ES-296).

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 B7 A/F sensor connector.

(b) Measure the resistance of the A/F sensor connector.

Standard resistance

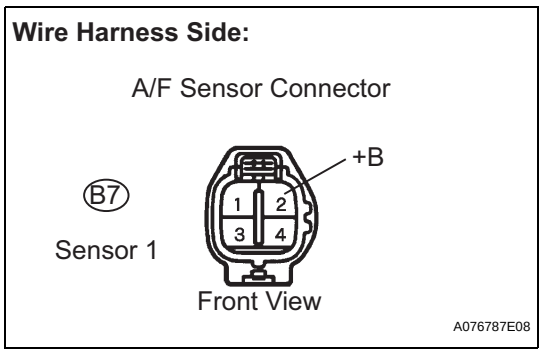
Tester Connections	Specified Conditions
1 (HA1A) - 2 (+B)	1.8 Ω to 3.4 Ω at 20°C (68°F)
1 (HA1A) - 4 (A1A-)	10 kΩ or higher

(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR-FUEL RATIO SENSOR**

OK

2 CHECK TERMINAL VOLTAGE (+B OF A/F SENSOR)



(a) Disconnect the B7 A/F sensor connector.

(b) Turn the ignition switch ON.

(c) Measure the voltage between the terminals of the B7 A/F sensor connector and body ground.

Standard voltage

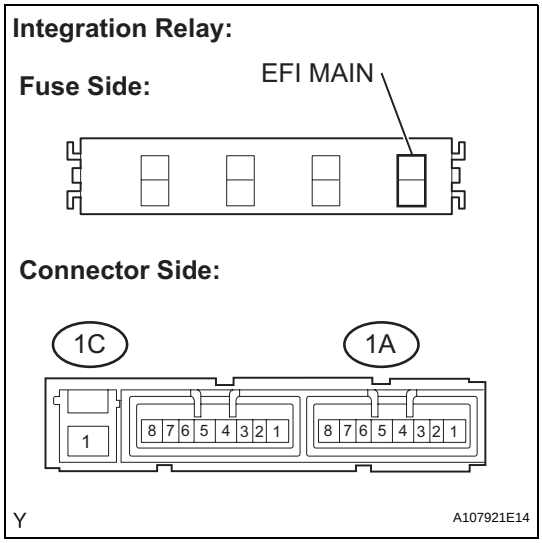
Tester Connections	Specified Conditions
B7-2 (+B) - Body ground	9 to 14 V

(d) Reconnect the A/F sensor connector.

OK → **Go to step 5**

NG

3	INSPECT INTEGRATION RELAY (EFI MAIN RELAY)



(a) Remove the integration relay from the engine room No. 1 relay block.

(b) Inspect the EFI MAIN fuse.
  (1) Remove the EFI MAIN fuse from the integration relay.
  (2) Measure the EFI MAIN fuse resistance.
    Standard resistance:
    Below 1 Ω
  (3) Reinstall the EFI MAIN fuse.

(c) Inspect the EFI MAIN relay.
  (1) Measure the EFI MAIN relay resistance.
    Standard resistance

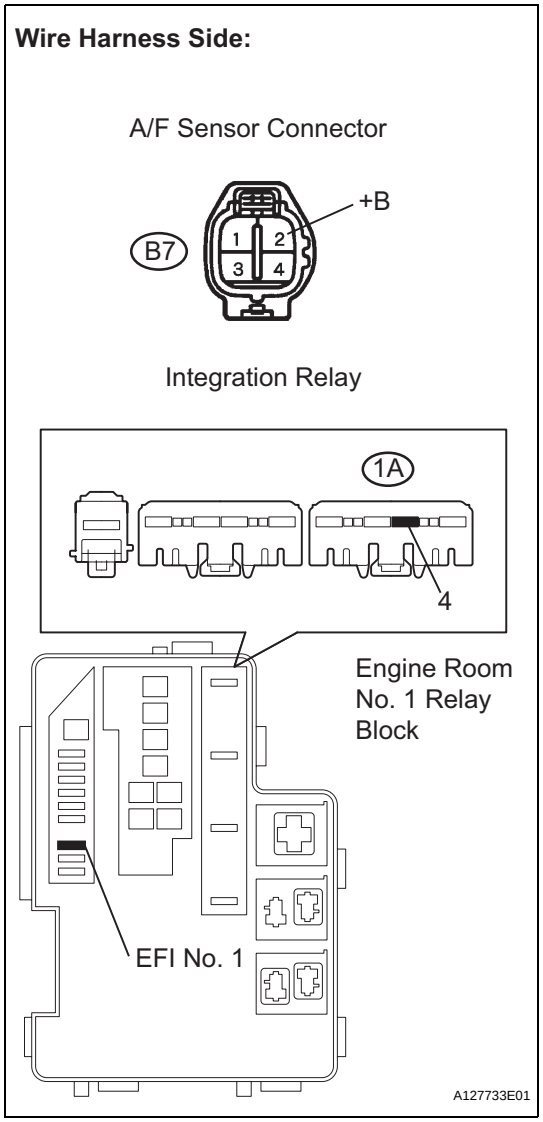
Tester Connections	Specified Conditions
1C-1 - 1A-4	10 kΩ or higher
	Below 1 Ω (Apply battery voltage between terminals 1A-2 and 1A-3)

(d) Reinstall the integration relay.

NG → **REPLACE INTEGRATION RELAY**

OK

4	CHECK HARNESS AND CONNECTOR (A/F SENSOR - EFI RELAY)



(a) Check the EFI No. 1 fuse.
(b) Disconnect the B7 A/F sensor connector.
(c) Remove the integration relay from the engine room No. 1 relay block.
(d) Check the resistance.

Standard resistance (Check for open)

Tester Connections	Specified Conditions
B7-2 (+B) - 1A-4 (Engine room No. 1 R/B)	Below 1 Ω

Standard resistance (Check for short)

Tester Connections	Specified Conditions
B7-2 (+B) or 1A-4 (Engine room No. 1 R/B) - Body ground	10 kΩ or higher

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

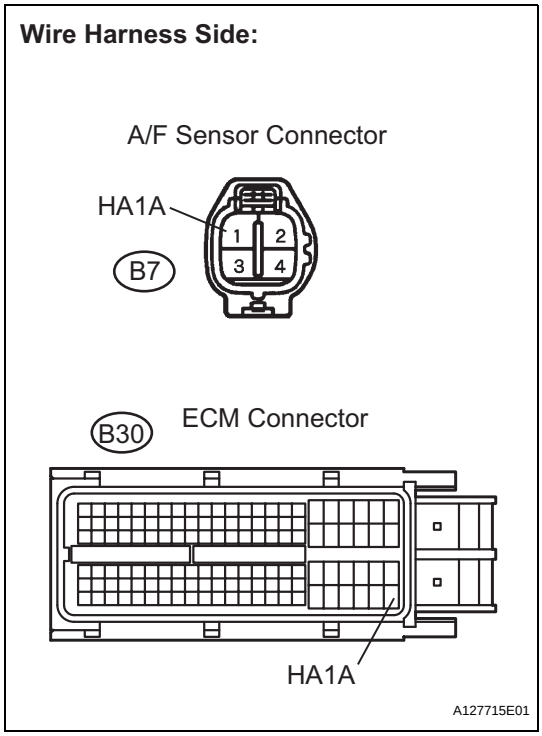
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

CHECK ECM POWER SOURCE CIRCUIT

ES

5	CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)



(a) Disconnect the B7 A/F sensor connector.
(b) Disconnect the B30 ECM connector.
(c) Measure the resistance.

Standard resistance (Check for open)

Tester Connections	Specified Conditions
B7-1 (HA1A) - B30-109 (HA1A)	Below 1 Ω

Standard resistance (Check for short)

Tester Connections	Specified Conditions
B7-1 (HA1A) or B30-109 (HA1A) - Body ground	10 kΩ or higher

(d) Reconnect the A/F sensor connector.
(e) Reconnect the ECM connector.

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

6	CHECK WHETHER DTC OUTPUT RECURS

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Clear DTCs (see page ES-35).
(e) Start the engine.
(f) Allow the engine to idle for 1 minute or more.
(g) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(h) Read DTCs.

Result

Display (DTC Output)	Proceed To
No output	A
P0031 or P0032	B

B → **REPLACE ECM**

A

CHECK FOR INTERMITTENT PROBLEMS