DTC	P0031	OXYGEN (A/F) SENSOR HEATER CONTROL CIRCUIT LOW (BANK 1 SENSOR 1)

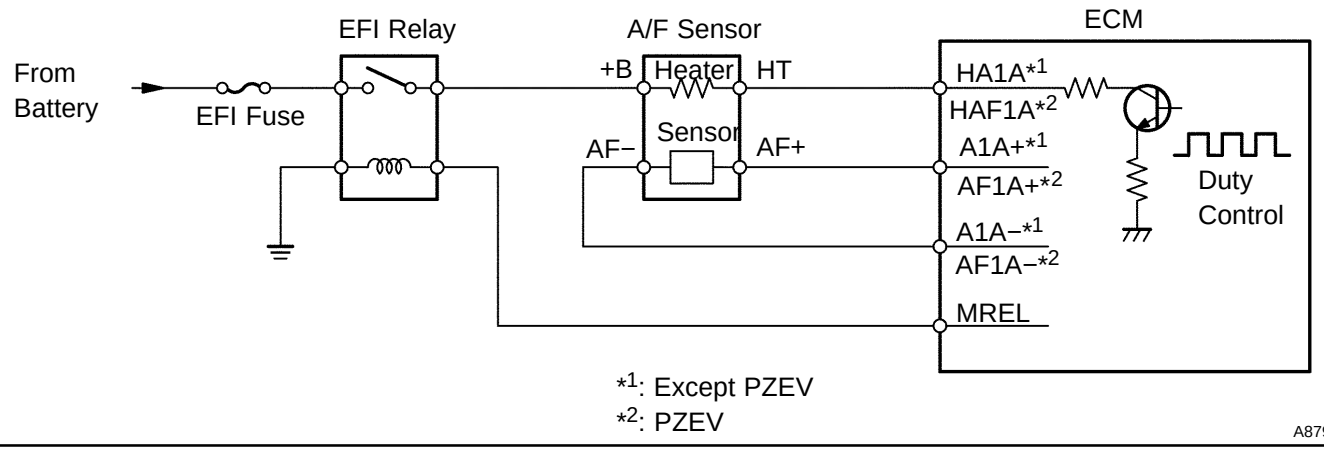
DTC	P0032	OXYGEN (A/F) SENSOR HEATER CONTROL CIRCUIT HIGH (BANK 1 SENSOR 1)

HINT:
Although the title (DTC description) says ”oxygen sensor”, this DTC is related to the ”A/F sensor”.

CIRCUIT DESCRIPTION

Refer to DTC P2195 on page 05−269.
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.

Reference



DTC No.	DTC Detection Condition	Trouble Area
P0031	Heater current of 0.8 A or less when heater operates (1 trip detection logic)	• Open in heater circuit of A/F sensor • A/F sensor heater • EFI relay • ECM
P0032	When heater operates, heater current exceeds 10 A (1 trip detection logic)	• Short in heater circuit of A/F sensor • A/F sensor heater • EFI relay • ECM

HINT:
Sensor 1 refers to the sensor closest to the engine assembly.

MONITOR DESCRIPTION

The ECM uses A/F sensor information to keep 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 cannot regulate the A/F 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 Range Check (Low current) P0032: A/F Sensor Heater 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

All:

The monitor will run whenever these DTCs are not present	See page 05−16
Time after engine start	10 seconds

P0031:

Battery voltage	10.5 V or more
A/F sensor heater duty ratio	50% 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	1.8 to 3.4 A at 20°C (68°F)

MONITOR RESULT

Refer to page 05−25 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 05−27).

- 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

WIRING DIAGRAM

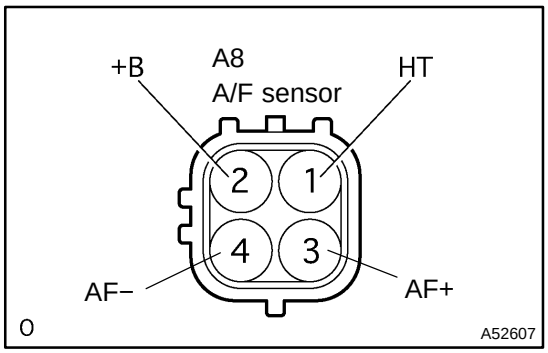
Refer to DTC P2195 on page 05−269.

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.

1 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



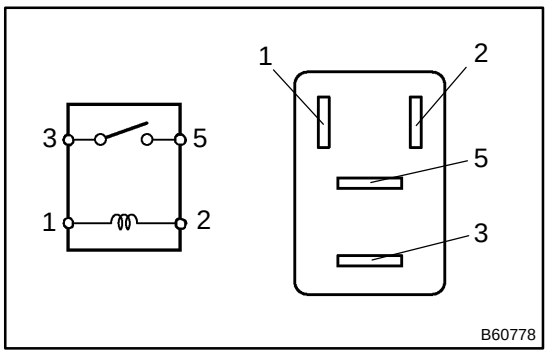
(a) Disconnect the A8 A/F sensor connector.
(b) Check the resistance between the terminals of the A/F sensor.
Standard:

Tester Connection	Specified Condition
1 (HT) − 2 (+B)	1.8 to 3.4 Ω
1 (HT) − 4 (AF−)	10 kΩ or higher

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

2 INSPECT RELAY (EFI)



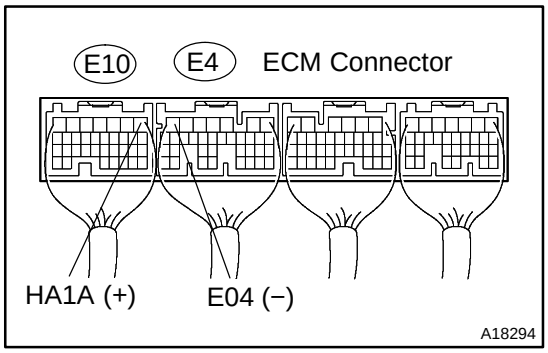
(a) Remove the EFI relay from the engine room J/B.
(b) Check the resistance of the EFI relay.
Standard:

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

NG → **REPLACE RELAY**

OK

3 CHECK ECM (HA1A VOLTAGE)



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

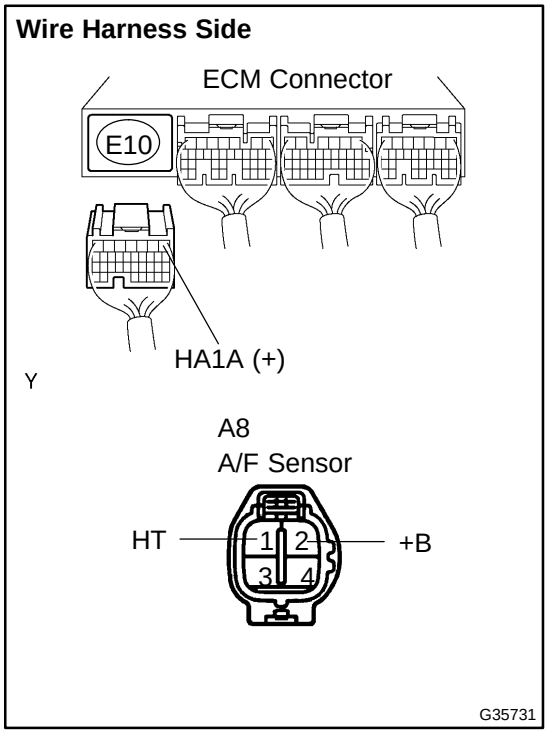
Standard:

Tester Connection	Specified Condition
E10−1 (HA1A) − E4−7 (E04)	9 to 14 V

OK → **REPLACE ECM (See page 10−9)**

NG

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

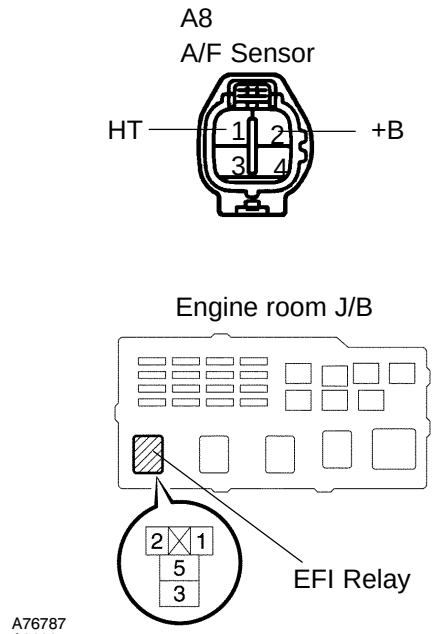


(a) Check the wire harness between the ECM and A/F sensor.
(1) Disconnect the E10 ECM connector.
(2) Disconnect the A8 A/F sensor connector.
(3) Check the resistance of the wire harness side connectors.

Standard:

Tester Connection	Specified Condition
A8−1 (HT) − E10−1 (HA1A)	Below 1 Ω
A8−1 (HT) or E10−1 (HA1A) − Body ground	10 kΩ or higher

Wire Harness Side



(b) Check the wire harness between the A/F sensor and EFI relay.

(1) Disconnect the A8 A/F sensor connector.

(2) Remove the EFI relay from the engine room J/B.

(3) Check the resistance of the wire harness side connectors.

Standard:

Tester Connection	Specified Condition
A8−2 (+B) − J/B EFI relay terminal 3	Below 1 Ω
A8−2 (+B) or J/B EFI relay terminal 3 − Body ground	10 kΩ or higher

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

OK

REPLACE ECM (See page 10−9)