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)

DESCRIPTION

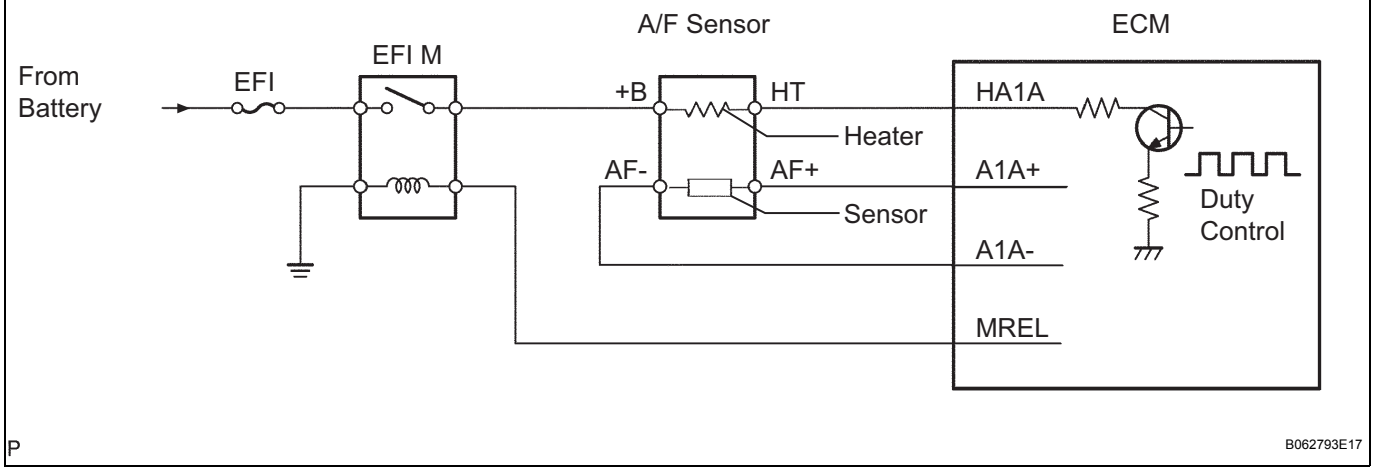
Refer to DTC P2195 (see page ES-362).

HINT:

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

ES

Reference (Bank 1 Sensor 1 System Diagram)



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

HINT:

- Sensor 1 refers to the sensor mounted before the TWC and is located near the engine assembly.
- Sensor 2 refers to the sensor mounted after the TWC and is located far 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 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 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 between 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 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 malfunction of the sensor and sensor circuit and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0031: A/F sensor heater current (low current) P0032: A/F sensor heater current (high current)
Required sensors/components	A/F sensor, ECM
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever the following DTCs are not present	P0300 - P0304 (Misfire)

P0031:

Battery voltage	10.5 V or more
Heater duty ratio-cycle	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

P0031:

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])

WIRING DIAGRAM

Refer to DTC P2195 (see page ES-365).

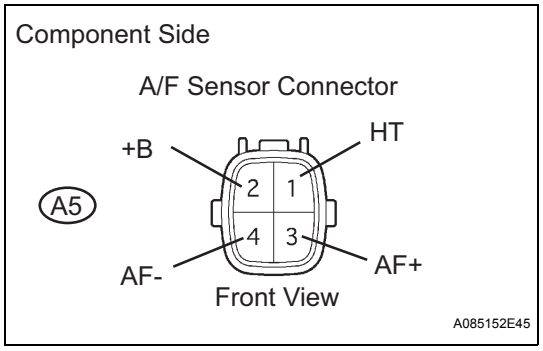
INSPECTION PROCEDURE

HINT:

- When DTC P0032 is detected, proceed to step 4 if the heater resistance is in normal range.

- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air/fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

1 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the A5 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor connector.
Standard resistance

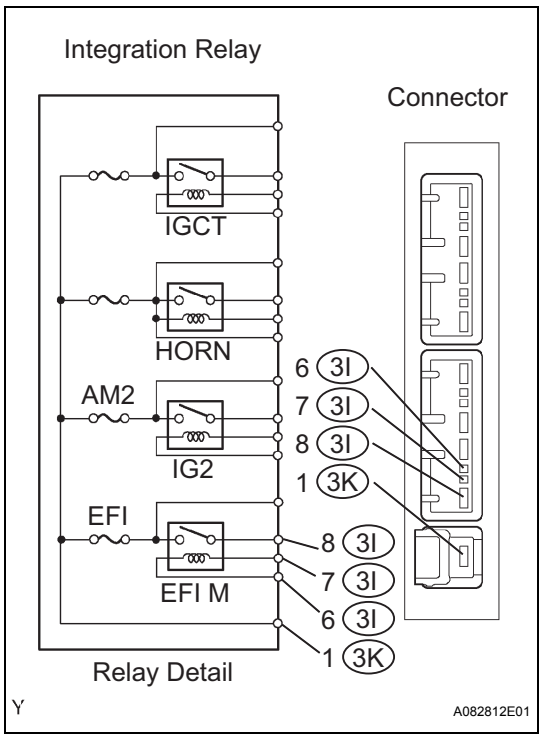
Tester Connection	Specified Condition
1 (HT) - 2 (+B)	1.8 to 3.4 Ω at 20°C (68°F)

(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

2 INSPECT INTEGRATION RELAY (EFI M RELAY)



(a) Remove the integration relay from the engine room relay block.
(b) Inspect the EFI M relay.
Standard resistance

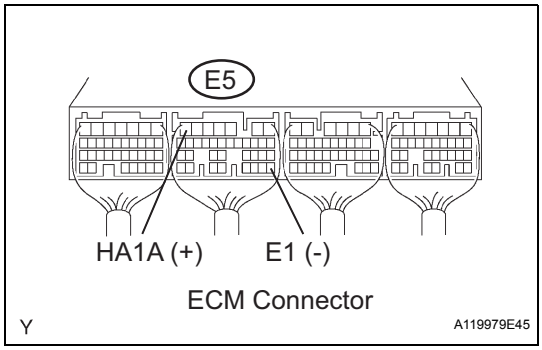
Tester Connection	Specified Condition
3K-1 - 3I-8	10 kΩ or higher
3K-1 - 3I-8	Below 1 Ω (Apply battery voltage to terminals 3I-6 and 3I-7)

(c) Reinstall the integration relay.

NG → **REPLACE INTEGRATION RELAY**

OK

3	CHECK ECM (HA1A VOLTAGE)



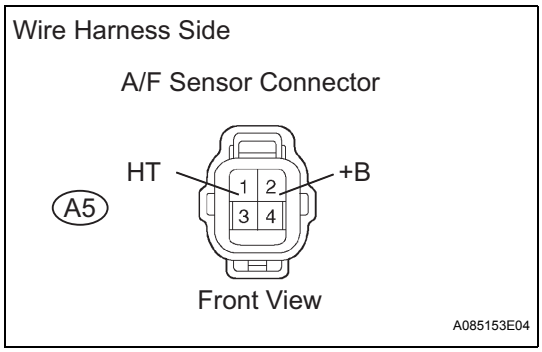
(a) Turn the power switch ON (IG).
(b) Measure the voltage between the applicable terminals of the E5 ECM connector.
Standard voltage

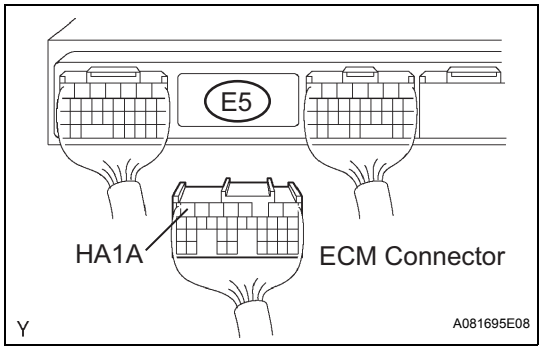
Tester Connection	Specified Condition
E5-7 (HA1A) - E5-28 (E1)	9 to 14 V

OK → **REPLACE ECM**

NG

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





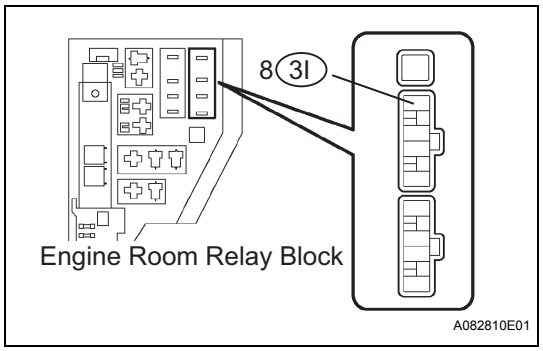
(a) Check the harness and the connectors between the ECM and the A/F sensor connectors.
(1) Disconnect the A5 A/F sensor connector.
(2) Disconnect the E5 ECM connector.
(3) Measure the resistance according to the value(s) in the table below.
Standard resistance (Check for open)

Tester Connection	Specified Condition
A5-1 (HT) - E5-7 (HA1A)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
A5-1 (HT) or E5-7 (HA1A) - Body ground	10 kΩ or higher
A5-1 (HT) - A5-2 (+B)	10 kΩ or higher

(4) Reconnect the A/F sensor connector.
(5) Reconnect the ECM connector.
(b) Check the harness and connectors between the A/F sensor connector and the EFI M relay.
(1) Disconnect the A5 A/F sensor connector.



(2) Remove the integration relay from the engine room relay block.
(3) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
A5-2 (+B) - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
A5-2 (+B) or 3I-8 (EFI M relay) - Body ground	10 kΩ or higher

(4) Reconnect the A/F sensor connector.
(5) Reinstall the integration relay.

ES

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

OK

REPLACE ECM