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)

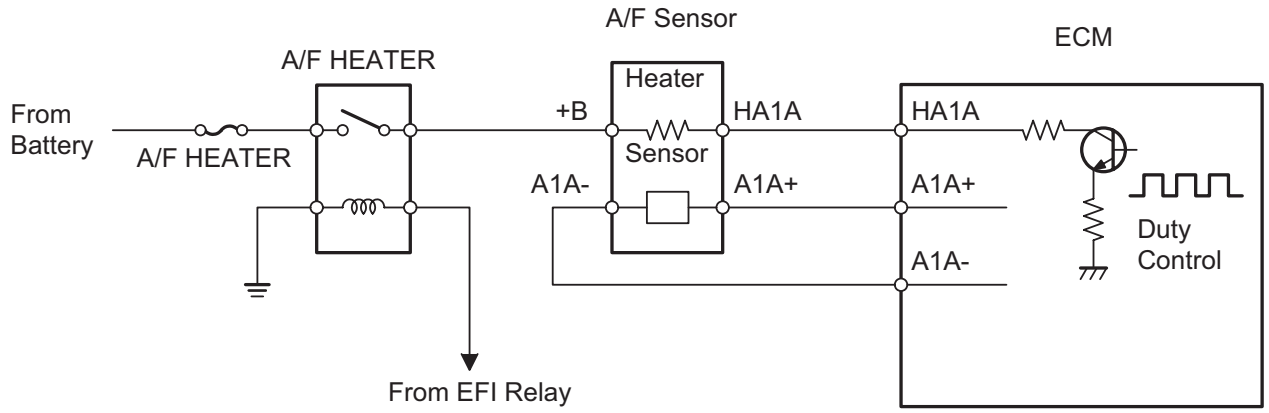
HINT:
- Although the DTC titles say the oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.

DESCRIPTION

ES

Refer to DTC P2195 (See page ES-312).
HINT:
- When either of these DTCs are 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 to 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 (Bank 1 Sensor 1 System Diagram)



P

A118002E04

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 • A/F HEATER 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 • A/F HEATER 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 will be inaccurate, as a result, the ECM will be 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 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 of Operation	None

TYPICAL ENABLING CONDITIONS

P0031:

Monitor runs whenever following DTCs not present	None
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:

Monitor runs whenever following DTCs not present	None
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	1.8 to 3.4 A at 20°C (68°F)

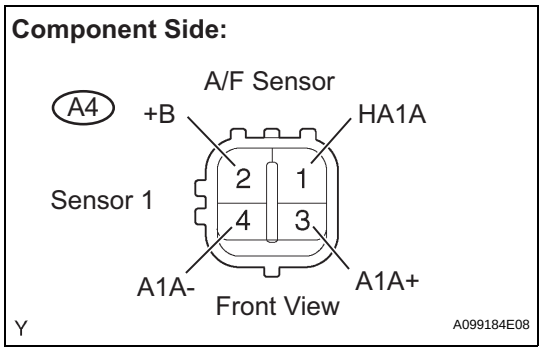
WIRING DIAGRAM

Refer to DTC P2195 (See page ES-316).

HINT:
Read freeze frame data using a intelligent tester. Freeze frame data record 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.

ES

1 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the A4 Air-Fuel Ratio (A/F) sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor connector.
Standard Resistance

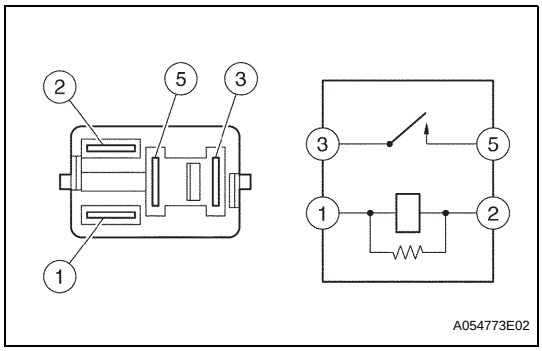
Tester Connections	Specified Conditions
HA1A (1) - +B (2)	1.8 Ωto 3.4 Ω at 20°C (68°F)
HA1A (1) - A1A- (4)	10 kΩ or higher

(c) Reconnect the A/F sensor connector.

NG → REPLACE AIR FUEL RATIO SENSOR

OK

2 INSPECT AIR FUEL RATIO SENSOR HEATER RELAY (A/F HEATER RELAY)



(a) Remove the A/F HEATER relay from the engine room R/B.
(b) Check the A/F HEATER relay resistance.
Standard Resistance

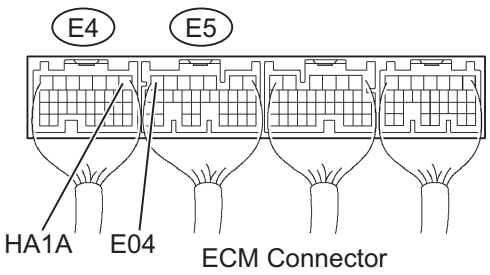
Tester Connections	Specified Conditions
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the A/F HEATER relay.

NG → REPLACE AIR FUEL RATIO SENSOR HEATER RELAY

OK

3 INSPECT ECM (HA1A VOLTAGE)



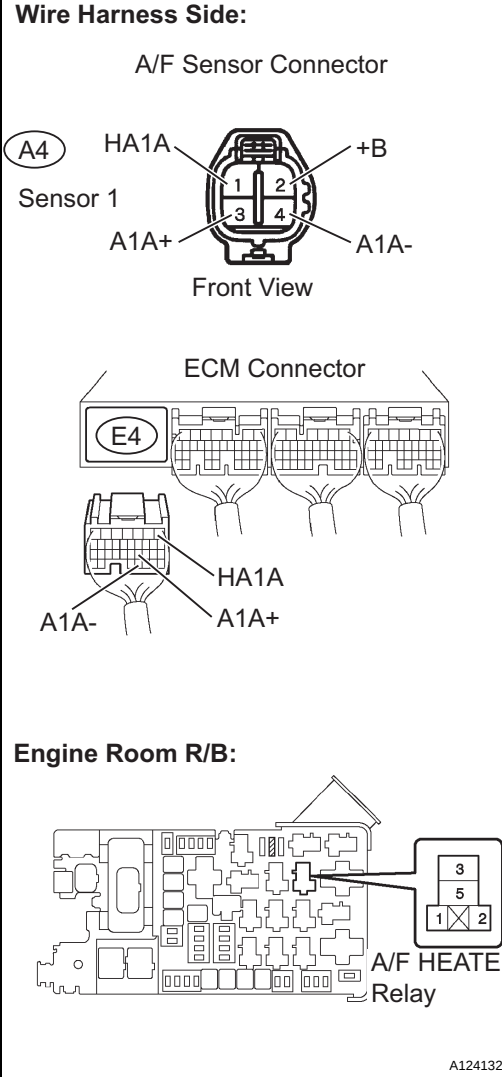
(a) Turn the ignition switch to ON.
(b) Measure the voltage between the terminals of the E4 and E5 ECM connectors.
Standard Voltage

Tester Connections	Specified Conditions
HA1A (E4-1) - E04 (E5-7)	9 to 14 V

OK → **REPLACE ECM**

NG

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



(a) Check the harness and connectors between the ECM and A/F sensor.
(1) Disconnect the A4 A/F sensor connector.
(2) Disconnect the E4 ECM connector.
(3) Check the resistance.
Standard Resistance (Check for open)

Tester Connections	Specified Conditions
HA1A (A4-1) - HA1A (E4-1)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
HA1A (A4-1) or HA1A (E4-1) - Body ground	10 kΩor higher

(4) Reconnect the A/F sensor connector.
(5) Reconnect the ECM connector.
(b) Check the harness and connector between the A/F sensor and A/F HEATER relay.
(1) Disconnect the A4 A/F sensor connector.
(2) Remove the A/F HEATER relay from the engine room R/B.
(3) Check the resistance.
Standard Resistance (Check for open)

Tester Connections	Specified Conditions
+B (A4-2) - A/F HEATER relay (3)	Below 1 Ω

Standard Resistance (Check for short)

Tester Connections	Specified Conditions
+B (A4-2) or A/F HEATER relay (3) - Body ground	10 kΩor higher

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

OK → **REPLACE ECM**

ES

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR