

ES

Refer to DTC P2195 (See page [ES-364](#)).

- Although the DTC titles refer to the "oxygen sensor", these DTCs relate to the Air Fuel Ratio (A/F) sensor.
- 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.



DTC No.	DTC Detection Condition	Trouble Area
P0031 P0051	Air Fuel Ratio (A/F) sensor heater current less than 0.8 A (1 trip detection logic)	• Open in Air Fuel Ratio (A/F) sensor heater circuit • Air Fuel Ratio (A/F) sensor heater • A/F relay • ECM
P0032 P0052	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 relay • ECM

HINT:

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

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.

ES**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 of operation	None

TYPICAL ENABLING CONDITIONS**All:**

Monitor runs whenever following DTCs not present	None
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P0031 and P0051 (Low current):

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 (High current):

Time after engine start	10 seconds or more
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TYPICAL MALFUNCTION THRESHOLDS**P0031 and P0051 (Low current):**

A/F sensor heater current	Less than 0.8 A
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P0032 and P0052 (High Current):

A/F sensor heater current	More than 10 A
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COMPONENT OPERATING RANGE**P0031 and P0051:**

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

Refer to CHECKING MONITOR STATUS (See page [ES-17](#)).

WIRING DIAGRAM

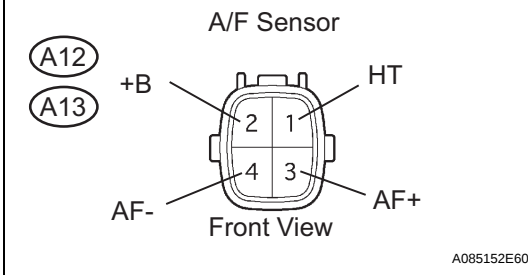
Refer to DTC P2195 (See page [ES-368](#)).

ES**INSPECTION PROCEDURE****HINT:**

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)

Component Side



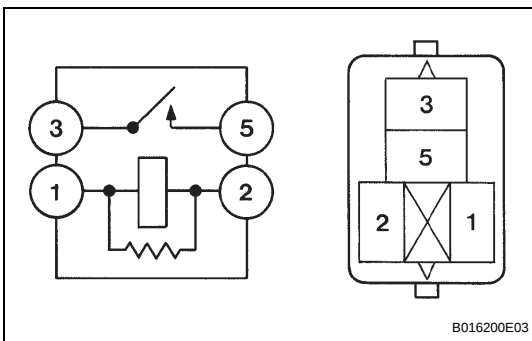
(a) Disconnect the A12 and A13 Air Fuel Ratio (A/F) sensor connectors.

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

Standard resistance

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

(c) Reconnect the A/F sensor connectors.

NG**REPLACE AIR FUEL RATIO SENSOR****OK****2 INSPECT A/F RELAY**

(a) Remove the A/F relay from the engine room R/B.

(b) Measure the resistance of the A/F relay.

Standard resistance

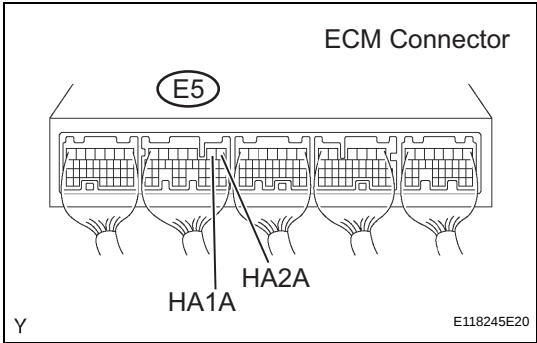
Tester Connection	Specified Condition
3 - 5	10 k Ω or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the A/F relay.

NG**REPLACE A/F RELAY**

OK

3 INSPECT ECM (HA1A OR HA2A VOLTAGE)



- (a) Turn the ignition switch ON.
(b) Measure the voltage of the E5 ECM connector.

Standard voltage

Tester Connection	Specified Condition
HA1A (E5-2) - Body ground	9 to 14 V
HA2A (E5-1) - Body ground	

HINT:

- The HA1A means the A/F sensor bank 1 sensor 1.
- The HA2A means the A/F sensor bank 2 sensor 1.

OK

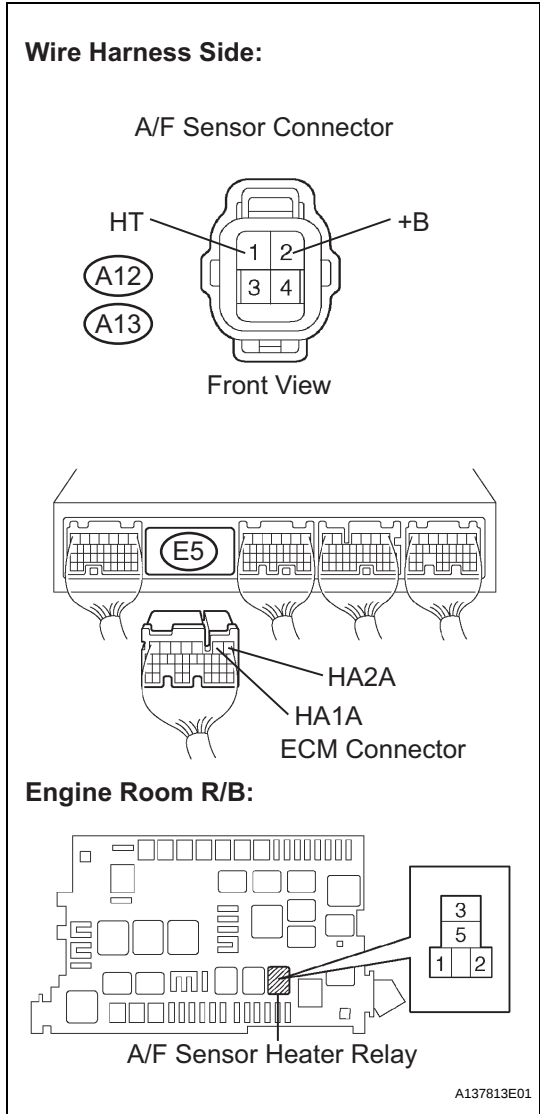
REPLACE ECM

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



- (a) Turn the ignition switch OFF.
(b) Disconnect the A12 or A13 A/F sensor connector.
(c) Disconnect the E5 ECM connector.
(d) Measure the resistance.

Standard resistance (Check for open)

Tester Connection	Specified Condition
HT (A12-1) - HA1A (E5-2)	Below 1 Ω
HT (A13-1) - HA2A (E5-1)	

Standard resistance (Check for short)

Tester Connection	Specified Condition
HT (A12-1) or HA1A (E5-2) - Body ground	10 kΩ or higher
HT (A13-1) or HA2A (E5-1) - Body ground	

- (e) Remove A/F relay from engine room R/B.
(f) Measure the resistance.

Standard resistance (Check for open)

Tester Connection	Specified Condition
+B (A12-2) - A/F relay (3)	Below 1 Ω
+B (A13-2) - A/F relay (3)	

Standard resistance (Check for short)

Tester Connection	Specified Condition
+B (A12-2) or A/F relay (3) - Body ground	10 kΩ or higher
+B (A13-2) or A/F relay (3) - Body ground	

- (g) Reinstall the A/F relay from engine room R/B.
(h) Reconnect the ECM connector.
(i) Reconnect the A/F sensor connectors.

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REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK FOR INTERMITTENT PROBLEMS