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)
DTC	P0051	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)
DTC	P0052	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)

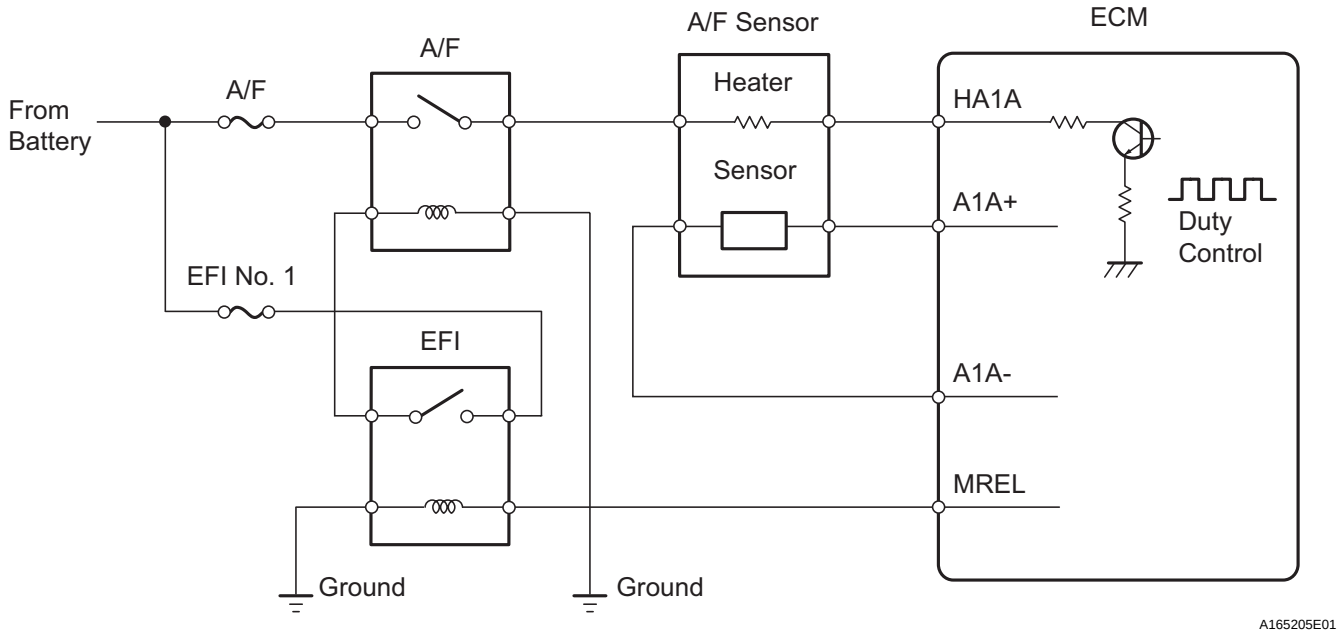
ES

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

Refer to DTC P2195 (See page ES-355).
HINT:
- When any 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 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 Bank 1 Sensor 1):



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 A/F sensor heater circuit • A/F sensor heater • A/F sensor heater relay • ECM

DTC No.	DTC Detection Condition	Trouble Area
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 sensor heater relay • ECM

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

MONITOR DESCRIPTION

ES

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 gas.

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 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 or P0052 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 or P0051 is set.

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 operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	None

P0031 and P0051:

Battery voltage	10.5 V or more
Heater ON duty ratio	50% or more

Time after engine starts	10 seconds or more

P0032 and P0052:

Time after engine starts	10 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

P0031 and P0051:

Heater current	Less than 0.8 A

P0032 and P0052:

Hybrid IC high current limit port	Fail

COMPONENT OPERATING RANGE

A/F sensor heater current	0.8 A or more

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-19).

WIRING DIAGRAM

Refer to DTC P2195 (See page ES-359).

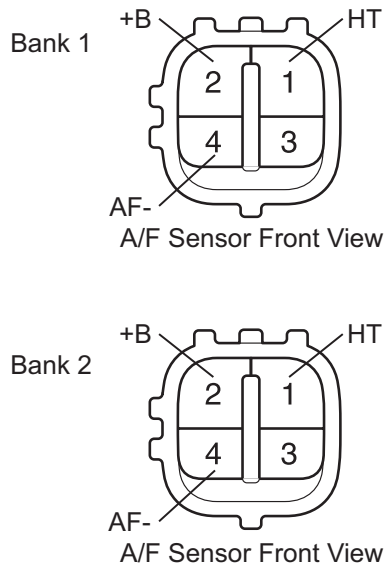
INSPECTION PROCEDURE

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:



A126269E35

(a) Disconnect the A5 or A6 A/F sensor connector.
(b) Measure the resistance according to the value(s) in the table below.

Standard resistance:

Bank 1

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

Bank 2

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

(c) Reconnect the A/F sensor connector.

Result

Result	Proceed to
OK	A
NG (for 2WD model)	B
NG (for 4WD model)	C

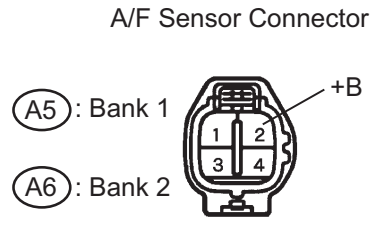
B → **REPLACE AIR FUEL RATIO SENSOR (See page EC-19)**

C → **REPLACE AIR FUEL RATIO SENSOR (See page EC-26)**

A

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

Wire Harness Side Front View:



A076787E21

(a) Disconnect the A5 or A6 A/F sensor connector.
(b) Turn the ignition switch to the ON position.
(c) Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
+B (A5-2) - Body ground	9 to 14 V
+B (A6-2) - Body ground	9 to 14 V

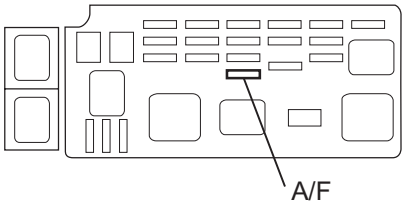
(d) Reconnect the A/F sensor connector.

OK → **Go to step 7**

NG

3 INSPECT FUSE (A/F FUSE)

Engine Room Junction Block:



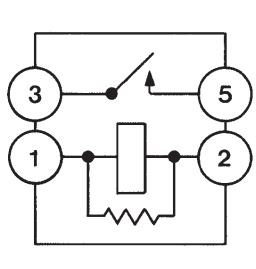
A162360E07

(a) Remove the A/F fuse from the engine room junction block.
(b) Measure the resistance according to the value(s) in the table below.
Standard resistance:
Below 1 Ω
(c) Reinstall the A/F fuse.

NG → **INSPECT FUSE (A/F FUSE)**

OK

4 INSPECT RELAY (A/F RELAY)



B016200

(a) Remove the A/F relay from the No. 6 engine room relay block.
(b) Measure the resistance according to the value(s) in the table below.
Standard resistance

Tester Connection	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (Apply battery voltage between terminals 1 and 2)

(c) Reinstall the A/F relay.

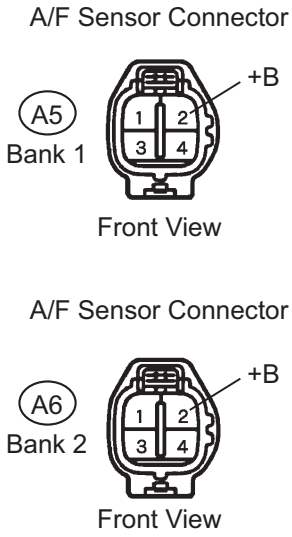
NG → **REPLACE RELAY (A/F RELAY)**

OK

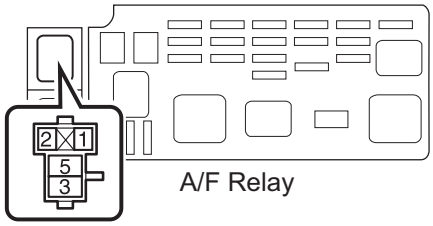
ES

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

Wire Harness Side:



No. 6 Engine Room R/B:



A165502E01

(a) Disconnect the A5 or A6 A/F sensor connector.
(b) Remove the A/F relay from the No. 6 engine room relay block.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance:

Check for open

Tester Connection	Specified Condition
A/F relay terminal (3) - +B (A5-2)	Below 1 Ω
A/F relay terminal (3) - +B (A6-2)	Below 1 Ω

Check for short

Tester Connection	Specified Condition
A/F relay terminal (3) - +B (A5-2) - Body ground	10 kΩ or higher
A/F relay terminal (3) - +B (A6-2) - Body ground	10 kΩ or higher

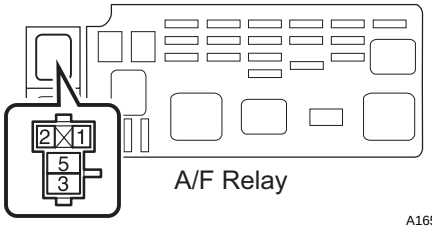
(d) Reinstall the A/F relay.
(e) Reconnect the A/F sensor connector.

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR (A/F SENSOR - A/F RELAY)**

OK

6 CHECK HARNESS AND CONNECTOR (A/F RELAY - BODY GROUND)

No. 6 Engine Room Relay Block:



A165503E02

(a) Remove the A/F relay from the No. 6 engine room relay block.
(b) Measure the resistance according to the value(s) in the table below.

Standard resistance:

Check for open

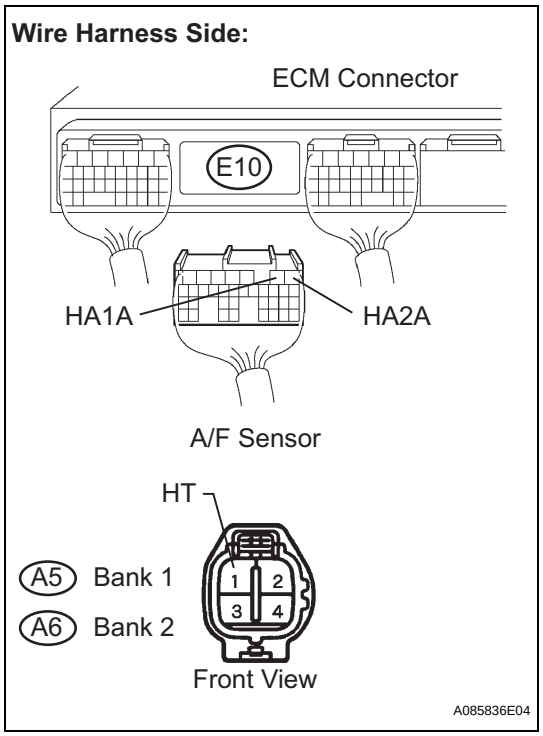
Tester Connection	Specified Condition
A/F relay terminal (2) - Body ground	Below 1 Ω

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR (A/F RELAY - BODY GROUND)**

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR (A/F RELAY - BATTERY)

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



(a) Disconnect the A5 or A6 A/F sensor connector.
(b) Disconnect the E10 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance:

Check for open

Tester Connection	Specified Condition
HT (A5-1) - HA1A (E10-2)	Below 1 Ω
HT (A6-1) - HA2A (E10-1)	Below 1 Ω

Check for short

Tester Connection	Specified Condition
HT (A5-1) or HA1A (E10-2) - Body ground	10 kΩ or higher
HT (A6-1) or HA2A (E10-1) - Body ground	10 kΩ or higher

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

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR (A/F RELAY - ECM)**

OK

8 CHECK WHETHER DTC OUTPUT RECURS

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the intelligent tester ON.
(d) Clear the DTCs (See page ES-39).
(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 the DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P0031, P0032, P0051 and/or P0052	B

B → **REPLACE ECM (See page ES-498)**

A

CHECK FOR INTERMITTENT PROBLEMS