

DTC	P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)
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DTC	P0032	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)
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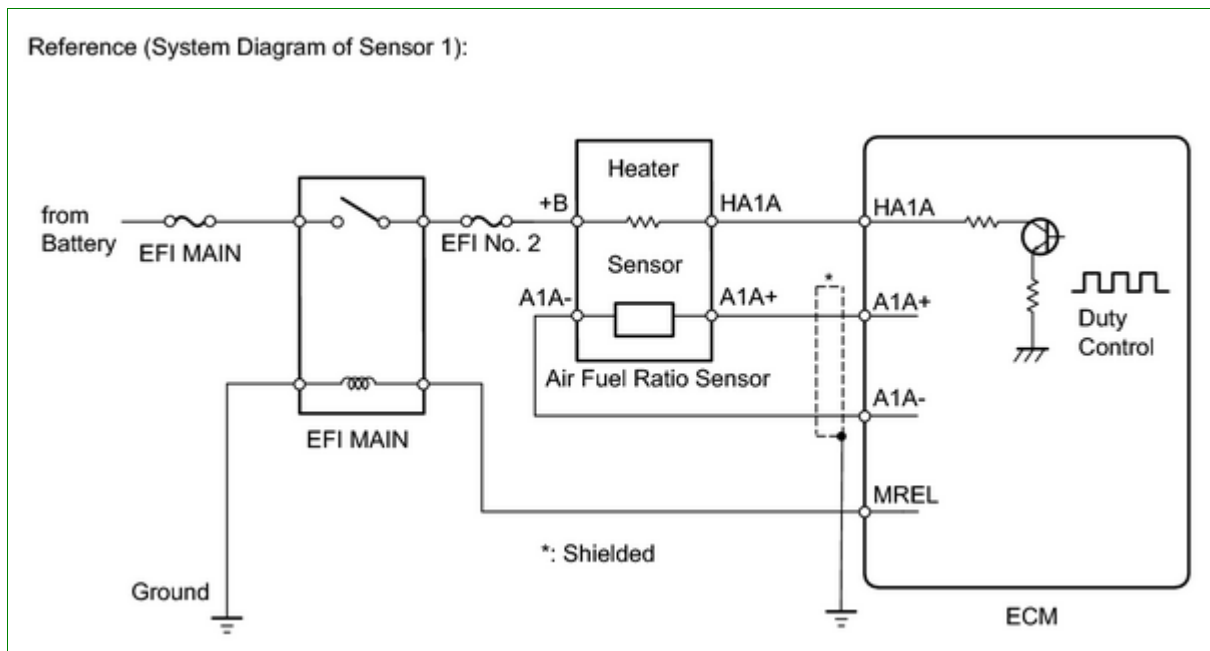
DTC	P101D	A/F Sensor Heater Circuit Performance Bank 1 Sensor 1 Stuck ON
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DESCRIPTION

Refer to DTC P2195 INFO .

HINT:

- When either of these DTCs is set, the ECM enters fail-safe mode. The ECM turns off the air fuel ratio sensor heater in fail-safe mode. Fail-safe mode continues until the power switch is turned off.
- Although the DTC titles say the oxygen sensor, these DTCs relate to the air fuel ratio sensor.
- Sensor 1 refers to the sensor mounted in front of the Three-way catalytic converter and located near the engine assembly.
- The ECM uses pulse width modulation to adjust the current through the heater. The air fuel ratio sensor heater circuit uses a relay on the +B side of the circuit.



DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0031	The heater current is less than the specified value while the heater is operating (1 trip detection logic).	<ul style="list-style-type: none"> • Open in air fuel ratio sensor (sensor 1) heater circuit • Air fuel ratio sensor heater (sensor 1) • ECM
P0032	An air fuel ratio sensor heater current failure (1 trip detection logic).	<ul style="list-style-type: none"> • Short in air fuel ratio sensor (sensor 1) heater circuit • Air fuel ratio sensor heater

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
		(sensor 1) • ECM
P101D	The heater current is higher than the specified value while the heater is not operating (1 trip detection logic).	ECM

MONITOR DESCRIPTION

The ECM uses information from the air fuel ratio 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 to purify the exhaust gases.

The air fuel ratio 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 air fuel ratio 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 air fuel ratio sensor becomes inaccurate, as a result, the ECM is unable to regulate air fuel ratio properly.

When the current in the air fuel ratio sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0031: Air fuel ratio sensor heater open/short (Low electrical current) P0032: Air fuel ratio sensor heater open/short (High electrical current) P101D: Air fuel ratio sensor heater performance
Required Sensors/Components (Main)	Air fuel ratio sensor heater
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	10 seconds: P0031 10.24 seconds: P0032 1 second: P101D
MIL Operation	Immediately
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0031:

Battery voltage	10.5 V or more
Time after heater ON	5 seconds or more
Active heater OFF control	Not operating
Active heater ON control	Not operating

Heater output duty	10% or more
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P0032:

Battery voltage	10.5 V or more
Time after heater ON	5 seconds or more
Active heater OFF control	Not operating
Active heater ON control	Not operating
Heater output duty	More than 0%

P101D:

Battery voltage	10.5 V or more
Time after heater ON	5 seconds or more
Air fuel ratio sensor heater duty-cycle ratio	10 to 60%
Air fuel ratio sensor heater ON current	0.8 A or more
Air fuel ratio sensor heater range check low current fail (P0031)	Not detected
Active heater OFF control	Not operating
Active heater ON control	Not operating

TYPICAL MALFUNCTION THRESHOLDS

P0031:

Air fuel ratio sensor heater ON current	Less than 0.8 A
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P0032:

Air fuel ratio sensor heater output	ON
Hybrid IC high current limiter monitor input	Fail

P101D:

Air fuel ratio sensor heater OFF current	More than 11 A
Active heater OFF control flag for ON stuck	ON
Hybrid IC high current limiter monitor input	Fail

COMPONENT OPERATING RANGE

P0031:

Air fuel ratio sensor heater ON current	0.8 A or more
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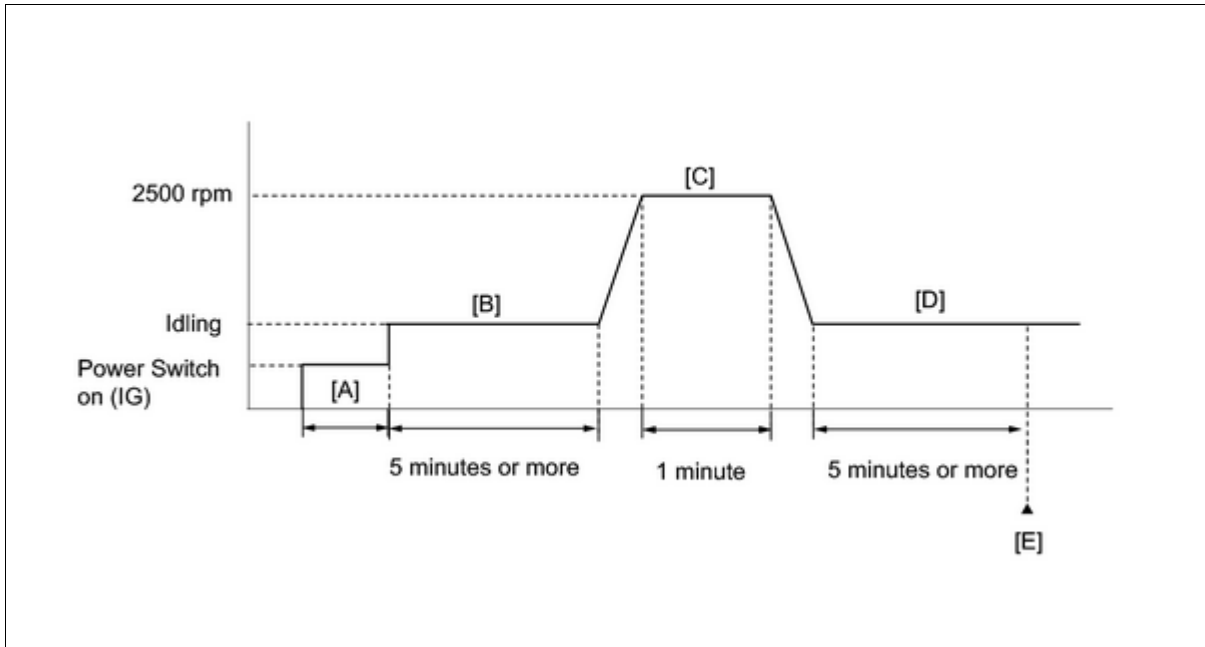
P0032:

All of the following conditions are met	-
1. Air fuel ratio sensor heater output	ON

P101D:

Air fuel ratio sensor heater OFF current

11 A or less

CONFIRMATION DRIVING PATTERN

1. Connect the Techstream to the DLC3.
2. Turn the power switch on (IG) and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the power switch off and wait for 30 seconds.
5. Turn the power switch on (IG) and turn the Techstream on [A].
6. Put the engine in inspection mode **INFC**.
7. Start the engine and idle it for 5 minutes or more [B].
8. With the vehicle stationary, depress the accelerator pedal and maintain an engine speed of 2500 rpm for 1 minute [C].
9. Idle the engine for 5 minutes or more [D].
10. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.
11. Read the DTC [E].

HINT:

- If a DTC is output, the system is malfunctioning.
- If a DTC is not output, perform the following procedure.

12. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
13. Input the DTC: P0031, P0032, or P101D.
14. Check the DTC judgment result.

TECHSTREAM DISPLAY	DESCRIPTION
NORMAL	<ul style="list-style-type: none"> ◦ DTC judgment completed ◦ System normal

TECHSTREAM DISPLAY	DESCRIPTION
ABNORMAL	<ul style="list-style-type: none"> ○ DTC judgment completed ○ System abnormal
INCOMPLETE	<ul style="list-style-type: none"> ○ DTC judgment not completed ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	<ul style="list-style-type: none"> ○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows NORMAL, the system is normal.
- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform step [B] through [D] again.

15. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
16. Check the judgment result.

HINT:

- If the judgment result shows NORMAL, the system is normal.
- If the judgment result shows ABNORMAL, the system has a malfunction.

17. If the test result is INCOMPLETE or UNKNOWN and no DTC is output, perform a universal trip and check for permanent DTCs INFO.

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P2195 INFO.

INSPECTION PROCEDURE

NOTICE:

Inspect the fuses for circuits related to this system before performing the following inspection procedure.

HINT:

- Read freeze frame data using the Techstream. 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.
- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.
- Change the fuel injection volume using the Control the Injection Volume for A/F Sensor function provided in the Active Test and monitor the air fuel ratio sensor output voltage INFO. If the sensor output voltage does not change (almost no reaction) while performing the Active Test, the sensor may be malfunctioning.

PROCEDURE

1.	INSPECT AIR FUEL RATIO SENSOR NO.2 (HEATER RESISTANCE)
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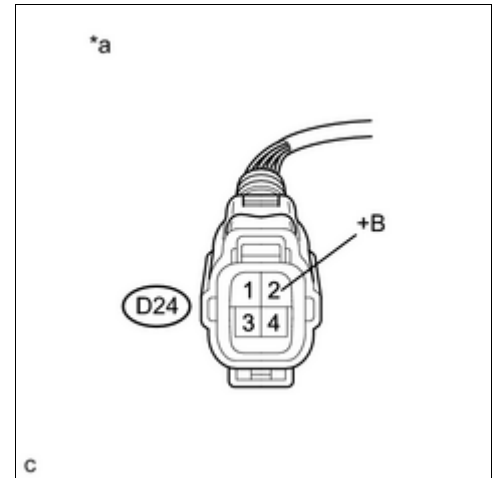
(a) Inspect the air fuel ratio sensor INFO .

NG ▶ **REPLACE AIR FUEL RATIO SENSOR NO.2**

OK
▼

2.	CHECK TERMINAL VOLTAGE (POWER SOURCE)
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(a) Disconnect the air fuel ratio sensor connector.



(b) Turn the power switch on (IG).

(c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
D24-2 (+B) - Body ground	Power switch on (IG)	11 to 14 V

Text in Illustration

*a	Front view of wire harness connector (to Air Fuel Ratio Sensor)
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(d) Reconnect the air fuel ratio sensor connector.

NG ▶ **REPAIR OR REPLACE HARNESS OR CONNECTOR (AIR FUEL RATIO SENSOR - EFI MAIN RELAY)**

OK
▼

3. CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - ECM)

- (a) Disconnect the air fuel ratio sensor connector.
- (b) Disconnect the ECM connector.
- (c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
D24-1 (HA1A) - D28-18 (HA1A)	Always	Below 1 Ω

Standard Resistance (Check for Short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
D24-1 (HA1A) or D28-18 (HA1A) - Body ground	Always	10 k Ω or higher



- (d) Reconnect the air fuel ratio sensor connector.
- (e) Reconnect the ECM connector.

NG  **REPAIR OR REPLACE HARNESS OR CONNECTOR (AIR FUEL RATIO SENSOR - ECM)**

OK



4. CHECK WHETHER DTC OUTPUT RECURS (DTC P0031, P0032 OR P101D)

- (a) Connect the Techstream to the DLC3.
- (b) Turn the power switch on (IG).
- (c) Turn the Techstream on.
- (d) Clear the DTCs  .
- (e) Put the engine in inspection mode  .
- (f) Drive the vehicle in accordance with the driving pattern described in the Confirmation Driving Pattern.
- (g) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.
- (h) Read the DTCs.

RESULT	PROCEED TO
DTC is not output	A
DTC P0031, P0032 or P101D is output	B

B ▶ REPLACE ECM

A ▶ CHECK FOR INTERMITTENT PROBLEMS