DIB27–01

DTC	P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)

DTC	P2196	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)

CIRCUIT DESCRIPTION

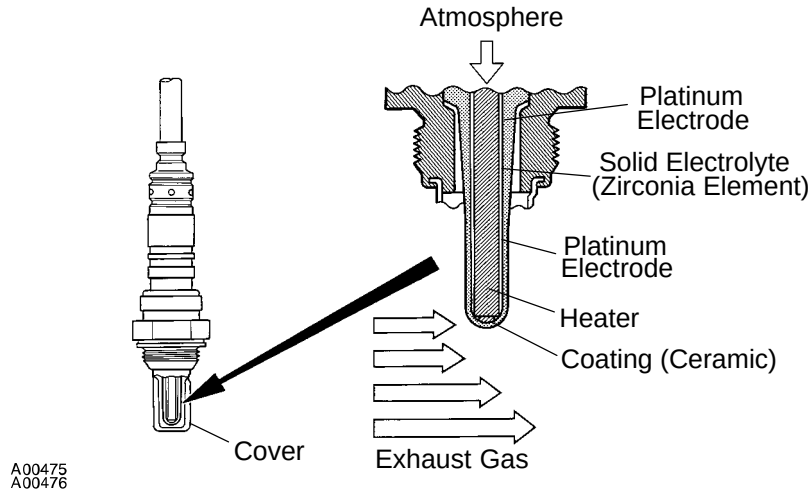
HINT:

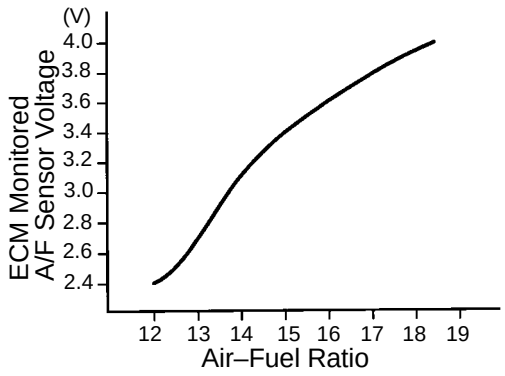
This DTC is related to A/F sensor, although the caption is oxygen sensor.

To obtain a high purification rate of the CO, HC and NOx components of the exhaust gas, a three–way catalytic converter is used. But, for the most efficient use of the three–way catalytic converter, the air–fuel ratio must be precisely controlled so that it is always close to the stoichiometric air–fuel ratio.

The A/F sensor has a characteristic that the output voltage* becomes approximately proportional to the existing air–fuel ratio. The A/F sensor output voltage* is used to provide feedback for the ECM to control the air–fuel ratio. By the A/F sensor output, the ECM can determine the deviation amount from the stoichiometric air–fuel ratio and control the proper injection time immediately. If the A/F sensor malfunctions, the ECM is unable to perform the accurate air–fuel ratio control. The A/F sensor is equipped with a heater which heats the zirconia element. The heater is controlled by the ECM. When the intake air volume is low (the temperature of the exhaust gas is low), the current flows to the heater to heat the sensor for the accurate oxygen concentration detection.

*: The voltage value changes at the inside of the ECM only.





DTC No.	DTC Detection Condition	Trouble Area
P2195	Condition (a) continues for 10.0 sec. or more: (a) A/F sensor voltage > 3.8 V	• Open or short in A/F sensor circuit • A/F sensor • A/F sensor heater • EFI main relay • Air induction system • Fuel pressure • Injector • ECM
P2196	Condition (a) continues for 10.0 sec. or more: (a) A/F sensor voltage < 2.8 V	

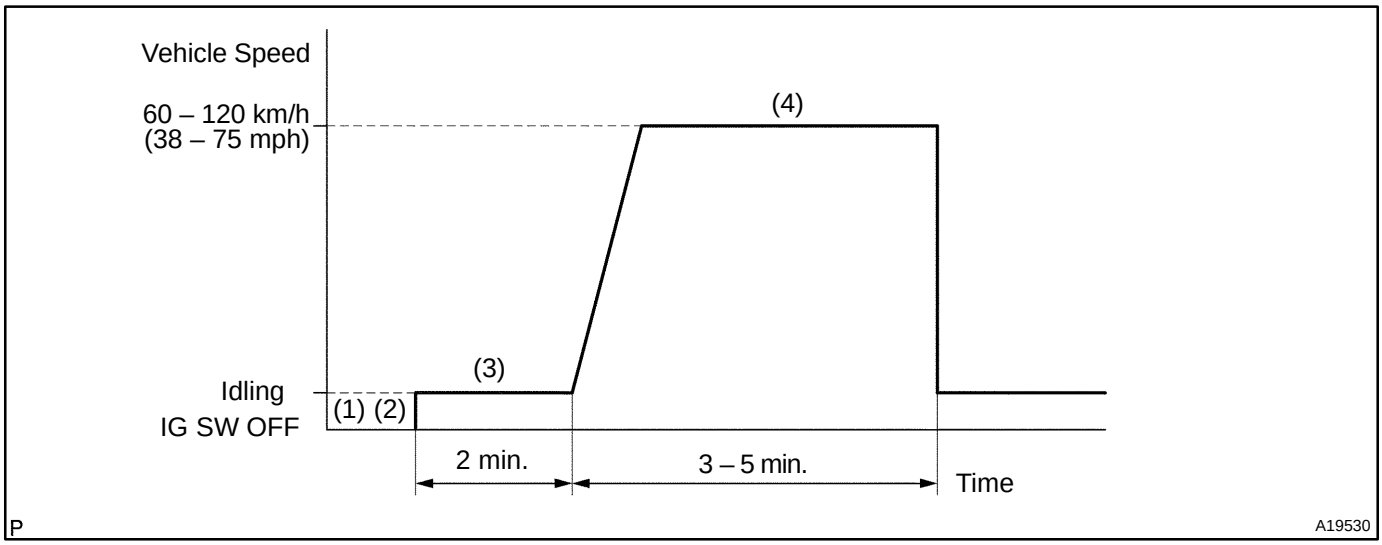
HINT:

- After confirming DTC P2195 and P2196, use the hand−held tester or the OBD II scan tool to confirm an output voltage of the A/F sensor (AFS B1 S1) from the ”DIAGNOSIS/ENHANCED OBD II/DATA LIST/ALL”.
- The A/F sensor’s output voltage and the short–term fuel value can be read using the OBD II scan tool or hand–held tester.
- The ECM controls the voltage of AF1+ and AF1– terminals of ECM to the fixed voltage. Therefore, it is impossible to confirm the A/F sensor output voltage without OBD II scan tool or hand–held tester.
- OBD II scan tool (excluding hand–held tester) displays the one fifth of the A/F sensor output voltage which is displayed on the hand–held tester.

WIRING DIAGRAM

Refer to DTC P0134 on page DI–278.

CONFIRMATION DRIVING PATTERN



(a) Connect the hand–held tester to the DLC3.
(b) Switch the hand–held tester from the normal mode to the check mode (See page DI–218).
(c) Start the engine and warm it up for 2 min. with all the accessory switched OFF.
(d) Drive the vehicle at 60 – 120 km/h (38 – 75 mph) and the engine speed at 1,600 – 3,200 rpm for 3 – 5 min.

HINT:

If a malfunction exists, the MIL will light up during step (d).

NOTICE:

- **If the conditions in this test are not strictly followed, detection of the malfunction will not be possible.**
- **If you do not have a hand–held tester, turn the ignition switch OFF after performing steps (c) and (d), then perform steps (c) and (d) again.**

INSPECTION PROCEDURE

HINT:

Hand–held tester only:

The narrowing down the trouble area is possible by performing ACTIVE TEST of the following ”A/F CONTROL” (A/F sensor, heated oxygen sensor or another can be distinguished).

Perform ACTIVE TEST by hand–held tester (A/F CONTROL).

HINT:
"A/F CONTROL" is an ACTIVE TEST which change the injection volume to –12.5 % or +25 %.

(1) Connect the hand–held tester to the DLC3 on the vehicle.
(2) Turn the ignition switch ON.
(3) Warm up the engine with the engine speed at 2,500 rpm for approx. 90 sec.
(4) Select the item "DIAGNOSIS/ENHANCED OBD II/ACTIVE TEST/ A/F CONTROL".
(5) Perform "A/F CONTROL" when idle condition (press the ← or → button).

Result:

A/F sensor reacts in synchronizing with increase and decrease of injection volume (+25 % → rich output: Less than 3.0 V, –12.5 % → lean output: More than 3.35 V)

Heated oxygen sensor reacts in synchronizing with increase and decrease of injection volume (+25 % → rich output: More than 0.55 V, –12.5 % → lean output: Less than 0.4 V)

NOTICE:

However, there is a few second delay in the A/F sensor output. And there is about 20 seconds delay in the heated oxygen sensor.

	Output voltage of A/F sensor (sensor 1)	Output voltage of heated oxygen sensor (sensor 2)	Mainly suspect trouble area
Case 1	Injection volume +25 % –12.5 % Output voltage More than 3.35 V Less than 3.0 V **OK**	Injection volume +25 % –12.5 % Output voltage More than 0.55 V Less than 0.4 V **OK**	—
Case 2	Injection volume +25 % –12.5 % Output voltage No reaction **NG**	Injection volume +25 % –12.5 % Output voltage More than 0.55 V Less than 0.4 V **OK**	A/F sensor (A/F sensor, heater, A/F sensor circuit)
Case 3	Injection volume +25 % –12.5 % Output voltage More than 3.35 V Less than 3.0 V **OK**	Injection volume +25 % –12.5 % Output voltage No reaction **NG**	Heated oxygen sensor (heated oxygen sensor, heater, heated oxygen sensor circuit)
Case 4	Injection volume +25 % –12.5 % Output voltage No reaction **NG**	Injection volume +25 % –12.5 % Output voltage No reaction **NG**	Extremely rich or lean of the actual air–fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc)

The following procedure of A/F CONTROL enable that to check its output (show its graph indication) of A/F sensor and heated oxygen sensor.

To display the graph indication. Select and push the "YES or NO" button 2 data "AFS B1S1 and O2S B1S2" or "AFS B2S1 and O2S B2S2" and press button "4" after selecting "ACTIVE TEST/ A/F CONTROL/USER DATA".

HINT:

- A low A/F sensor voltage could be caused by a rich air fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air fuel mixture. Check for conditions that would cause the engine to run lean.
- Read frame freeze data using the hand–held tester or the OBD II scan tool, as freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air–fuel ratio was lean or rich, etc. at the time of the malfunction.

1	**Are there any other codes (besides A/F sensor circuit DTC codes) being output?**

YES → **Go to relevant DTC chart (See page DI–231).**

NO

2	**Connect OBD II scan tool or Hand–held tester, and read value for voltage output of A/F sensor (bank 1 sensor 1).**

PREPARATION:

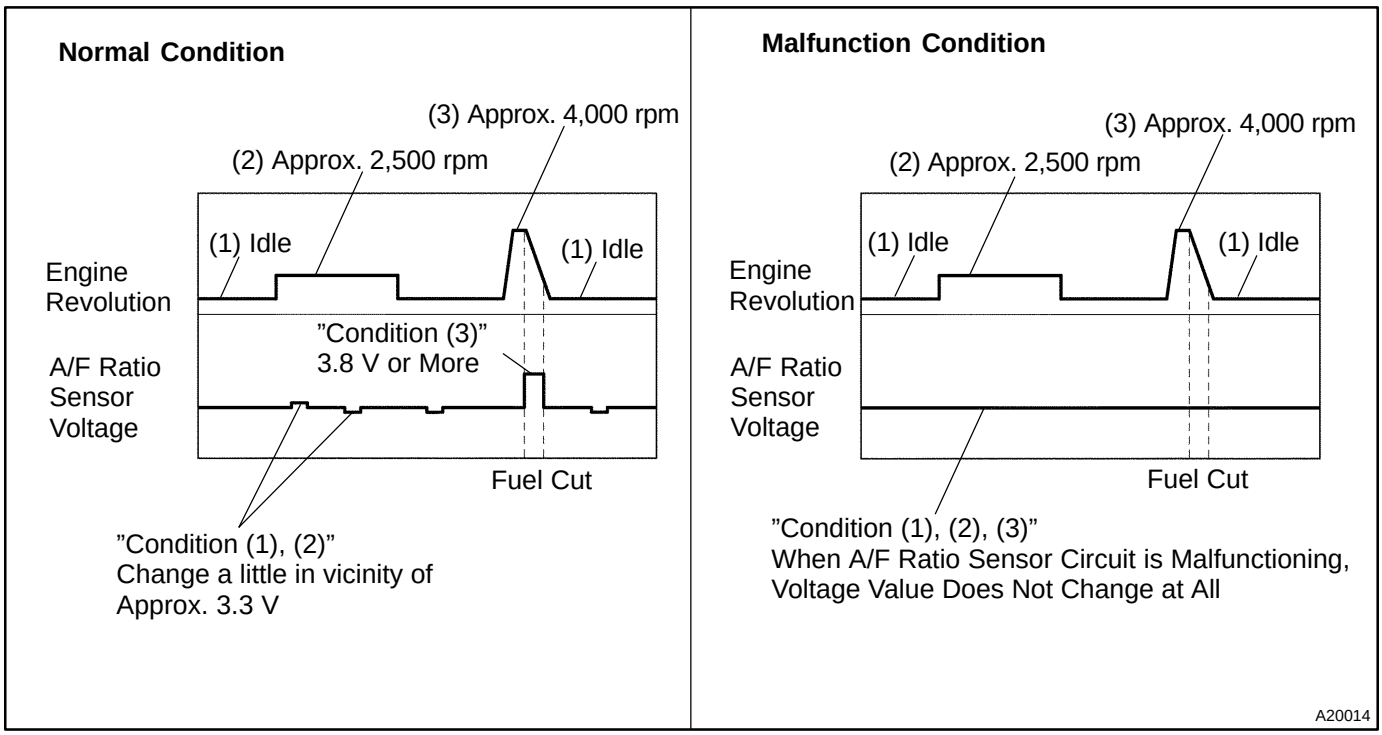
(a) Connect the hand–held tester or the OBD II scan tool to the DLC 3.
(b) Warm up the A/F sensor (bank 1 sensor 1) with the engine at 2,500 rpm for approximately 90 seconds.
(c) Read A/F sensor voltage on the OBD II scan tool or hand–held tester.

CHECK:

(a) Hand–held tester only:
Select the ”DIAGNOSIS/ENHANCED OBD II/SNAPSHOT/MANUAL SNAPSHOT/USER DATA” mode on the hand–held tester.
(b) Select ”AFS B1 S1/ENGINE SPD” and press button ”YES”.
(c) Monitor the A/F sensor voltage carefully.
(d) Check the A/F sensor voltage under the condition as follows.
(1) Allow engine to idle for 30 seconds.
(2) Engine is racing at approx. 2,500 rpm (when engine revolution is not suddenly changed).
(3) Raise the engine speed to 4,000 rpm and release the accelerator pedal fully closed quickly.

OK:

Standard:
Condition (1) and (2)
Voltage change a little in the vicinity of 3.3 V (0.66 V)* (between approx. 3.1 – 3.5 V) as shown in the illustration.
Condition (3)
A/F ratio sensor voltage increase to 3.8 V (0.76 V)* or more during engine deceleration (when fuel cut) as shown in the illustration.



HINT:

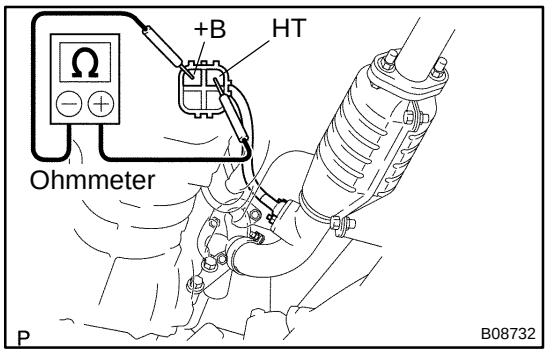
- Whenever the output voltage of the A/F sensor remains at approx. 3.3 V (0.660 V)* (see dwg. 2) under any conditions as well as the above conditions, the A/F sensor may have an open–circuit. (This will happen also when the A/F sensor heater has an open–circuit.)
- Whenever the output voltage of the A/F sensor remains at a certain value of approx. 3.8 V (0.76 V)* or more, or 2.8 V (0.56 V)* or less (see dwg. 2) under any conditions as well as the above conditions, the A/F sensor may have a short–circuit.
- The ECM will stop fuel injection (fuel cut) during engine deceleration. This will cause a lean condition and should result in a momentary increase in A/F ratio sensor voltage.
- The ECM must establish a closed throttle position learned value to perform fuel cut. If the battery terminal has been disconnected, the vehicle must be driven over 10 mph to allow the ECM to relearn the closed throttle position.
- When the vehicle is driven:
  In the case that the output voltage of the A/F sensor is below 2.8 V (0.76 V)* during fuel enrichment (for example, when the vehicle tries to overtake another vehicle on a highway, the vehicle speed is suddenly increased with the accelerator pedal fully depressed), the A/F sensor are functioning normally.
- The A/F sensor is a current output element, and therefore the current is converted into voltage inside the ECM. If measuring voltage at connectors of A/F ratio sensor or ECM, you can obtain a constant voltage.

*: When using the OBD II scan tool (excluding hand–held tester).

OK	**Go to step 13.**

NG

3	Check resistance of A/F sensor heater.



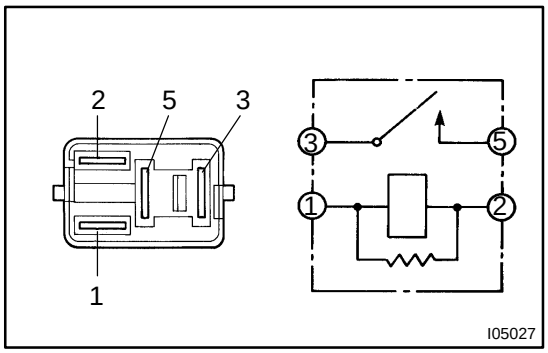
PREPARATION:
Disconnect the sensor connector.
CHECK:
Using an ohmmeter, measure the resistance between terminals +B and HT.
OK:

at 20°C (68°F)	0.8 – 1.4 Ω
at 800°C (1,472°F)	1.8 – 3.2 Ω

NG → **Replace A/F sensor.**

OK

4	Check EFI main relay (Marking: EFI).



PREPARATION:
Remove the EFI main relay from RB No. 2.
CHECK:
Inspect the EFI main relay.
OK:

Condition	Tester connection	Specified condition
Constant	1 – 2	Continuity
	3 – 5	No continuity
Apply B+ between terminals 1 and 2.	3 – 5	Continuity

NG → **Replace EFI main relay**

OK

5	Check for open and short in harness and connector between ECM and A/F sensor (See page IN–28).

NG → **Repair or replace harness or connector.**

OK

6	Check air induction system (See page SF–1).

NG → Repair or replace.

OK

7	Check fuel pressure (See page SF–5).

NG → Check and repair fuel pump, pressure regulator, fuel pipe line and filter (See page SF–1).

OK

8	Check injector injection (See page SF–19).

NG → Replace injector.

OK

9	Replace A/F sensor.

GO

10	Perform confirmation driving pattern.

GO

11	Are there A/F sensor circuit DTC codes being output again?

YES → Check and replace ECM (See page IN–28).

NO

12	Did vehicle run out of fuel in past?

NO → Check for intermittent problems (See page DI–218).

YES

A/F sensor circuit DTC codes are caused by shortage of fuel.

13	Perform confirmation driving pattern.

GO

14	Are there A/F sensor circuit DTC codes being output again ?

NO → Go to step 18.

YES

15	Replace A/F sensor.

GO

16	Perform confirmation driving pattern.

GO

17	Are there A/F sensor circuit DTC codes being output again ?

YES → Check and replace ECM (See page IN–28).

NO

18	Did vehicle run out of fuel in the past ?

NO → Check for intermittent problems (See page DI–218).

YES

A/F sensor circuit DTC codes is caused by shortage of fuel.