

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)

HINT:

These DTCs are related to the A/F sensor.

CIRCUIT DESCRIPTION

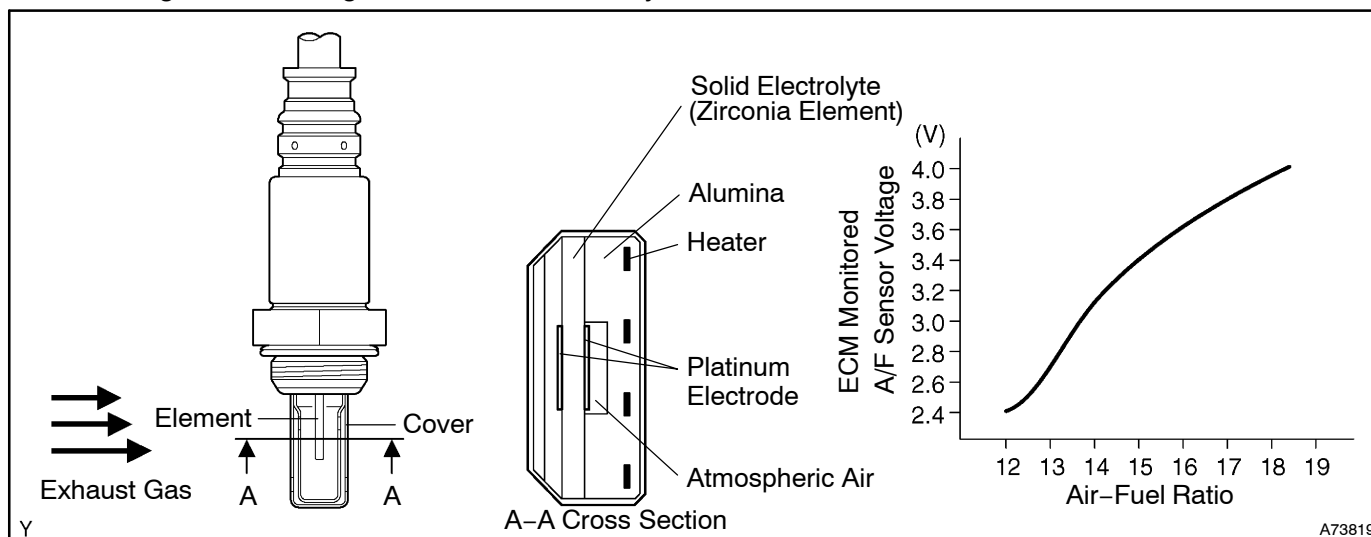
The Air-Fuel Ratio (A/F) sensor generates a voltage* in response to the actual air-fuel ratio. The sensor output voltage is used to provide feedback for the ECM in order that the ECM controls the air-fuel ratio. Using the sensor output voltage, the ECM determines the deviation from the stoichiometric air-fuel ratio, and regulates the injection time properly. If the A/F sensor is malfunctioning, the ECM is unable to control the air-fuel ratio accurately.

The A/F sensor is equipped with a heater which heats the zirconia element. The heater is also controlled by the ECM. When the intake air volume is low (the temperature of the exhaust gas is low), a current flows to the heater to heat the sensor to facilitate the detection of accurate oxygen concentration.

The A/F sensor is a planar type. Compared to the conventional type, the sensor and heater portions are narrower. The heat of the heater is conducted to the Zirconia element through the alumina to zirconia, therefore sensor activation is accelerated.

To obtain a high purification rate of carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxides (NOx) components of the exhaust gas, the Three-Way Catalytic Converter (TWC) is used. The TWC is most efficient when the air-fuel ratio is maintained near the stoichiometric air-fuel ratio.

*: The voltage value changes inside the ECM only.

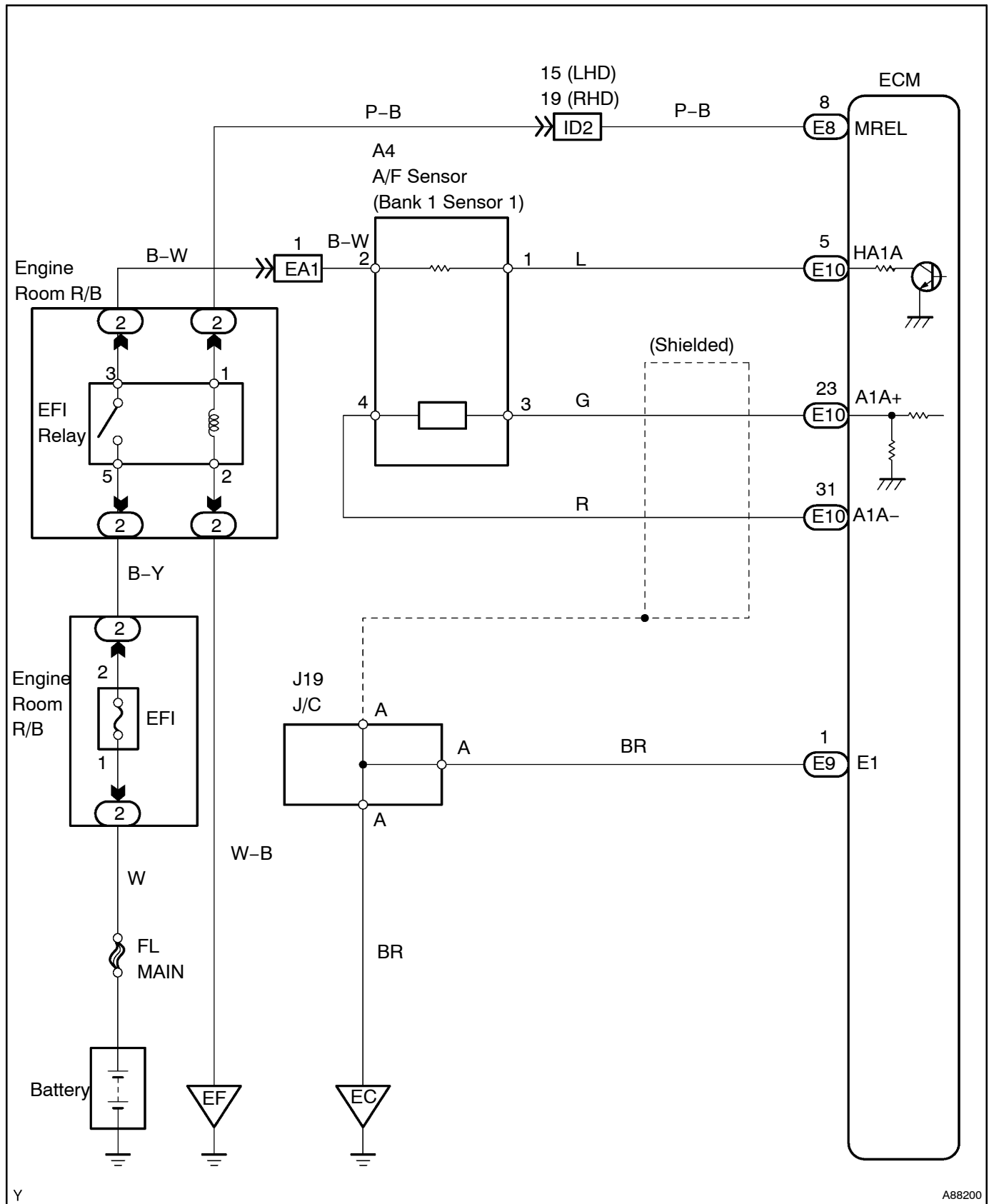


DTC No.	DTC Detection Condition	Trouble Area
P2195	Conditions (a) and (b) continue for 2 seconds or more : (a) A/F sensor voltage is more than 3.8 V (b) Rear oxygen sensor voltage is 0.15 V or more	<ul style="list-style-type: none"> • Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor (sensor 1) heater • EFI relay • A/F sensor heater and relay circuit • Air induction system • Fuel pressure • Injector • ECM
P2196	Conditions (a) and (b) continue for 2 seconds or more : (a) A/F sensor voltage is less than 2.8 V (b) Heated oxygen sensor voltage is less than 0.85 V	<ul style="list-style-type: none"> • Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor (sensor 1) heater • EFI relay • A/F sensor heater and relay circuit • Air induction system • Fuel pressure • Injector • ECM

HINT:

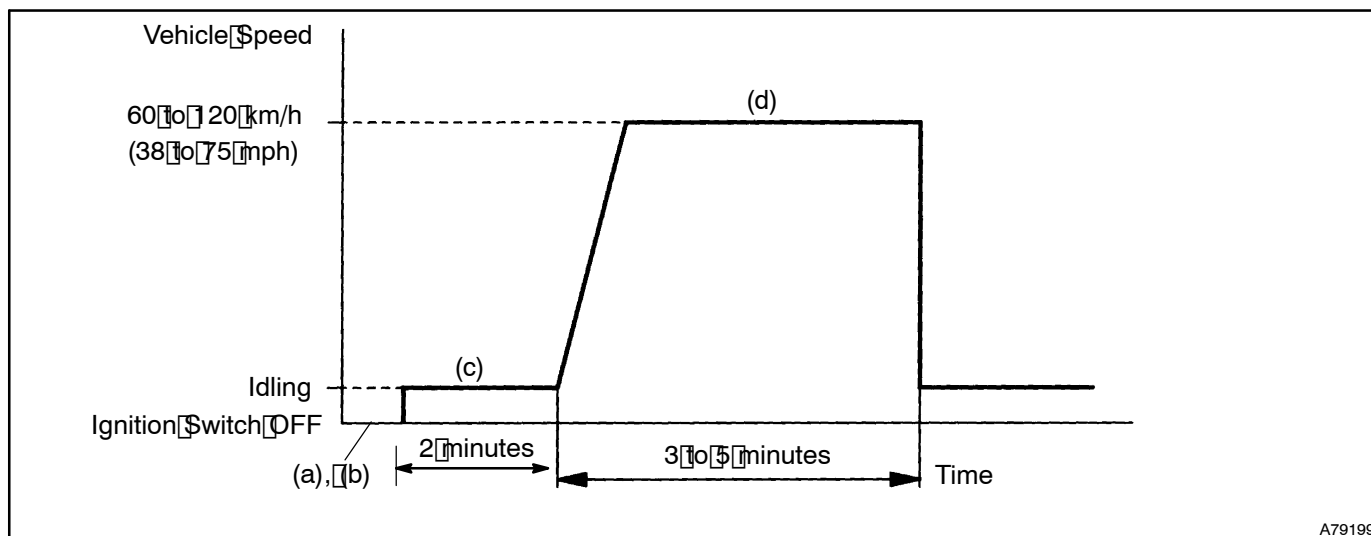
- Sensor 1 refers to the sensor mounted before the TWC and is located near the engine assembly.
- Sensor 2 refers to the sensor mounted after the TWC and is located far from the engine assembly.
- When DTC P2195 and/or P2196 is detected, check the A/F sensor output voltage (AFS B1 S1) by selecting Powertrain / Engine and ECT / Data List on the intelligent tester II.
- The short-term fuel trim value can also be read using the intelligent tester II.
- The ECM controls the voltage of the A1A+ and A1A– terminals of the ECM to the fixed voltage. Therefore, the A/F sensor output voltage cannot be confirmed without the intelligent tester II.

WIRING DIAGRAM



A88200

CONFIRMATION DRIVING PATTERN



A79199

- (a) Connect the intelligent tester II to the DLC3.
- (b) Turn the ignition switch to ON and turn the intelligent tester II ON.
- (c) Switch the ECM from normal mode to check mode using the intelligent tester II ([see page 05-22](#)).
- (d) Start the engine and warm it up with all the accessories switched OFF.
- (e) Drive the vehicle at 60 to 120 km/h (38 to 75 mph) and engine speed of 1,400 to 3,200 rpm for 3 to 5 minutes.

HINT:

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

NOTICE:

If the conditions in this test are not strictly followed, no malfunction will be detected. If you do not have the intelligent tester II, turn the ignition switch to OFF after performing steps (c) and (d), then perform steps (c) and (d) again.

INSPECTION PROCEDURE

HINT:

Intelligent tester II only:

Malfunctioning areas can be found by performing the Active Test / A/F Control operation. The A/F Control operation can determine if the A/F sensor, heated oxygen sensor or other potential trouble areas are malfunctioning or not.

- (a) Perform Active Test using the intelligent tester II.

HINT:

The A/F Control operation lowers the injection volume by 12.5 % or increases the injection volume by 25 %.

- (1) Connect the intelligent tester II to the DLC3.
- (2) Start the engine and turn the intelligent tester II ON.
- (3) Warm up the engine by running the engine at 2,500 rpm for approximately 90 seconds.
- (4) On the intelligent tester II, select the following menu items: Powertrain / Engine and ECT / Active Test / A/F Control.
- (5) Select the following monitor items: AFS B1 S1 and O2S B1 S2.
- (6) Perform the A/F Control operation with the engine in an idling condition (press the right or left button).

Result:

The A/F sensor reacts in accordance with increase and decrease of the injection volume:

+25 % → Rich output: Less than 3.0 V

-12.5 % → Lean output: More than 3.35 V

The heated oxygen sensor reacts in accordance with increase and decrease of the injection volume:

+25 % → Rich output: More than 0.55 V

-12.5 % → Lean output: Less than 0.4 V

NOTICE:

The A/F sensor output has a few seconds of delay and the heated oxygen sensor output has about 20 seconds of delay at maximum.

	Output Voltage of A/F Sensor (Sensor 1)	Output Voltage of Heated Oxygen Sensor (Sensor 2)	Main Suspect Trouble Area
Case 1	Injection volume +25 % -12.5 % Output voltage More than 3.35 V OK Less than 3.0 V	Injection volume +25 % -12.5 % Output voltage More than 0.55 V OK Less than 0.4V	—
Case 2	Injection volume +25 % -12.5 % Output voltage Almost no reaction NG	Injection volume +25 % -12.5 % Output voltage More than 0.55 V OK Less than 0.4V	A/F sensor (A/F sensor, sensor heater, sensor circuit)
Case 3	Injection volume +25 % -12.5 % Output voltage More than 3.35 V OK Less than 3.0V	Injection volume +25 % -12.5 % Output voltage Almost no reaction NG	Heated oxygen sensor (Heated oxygen sensor, sensor heater, heated oxygen sensor circuit)
Case 4	Injection volume +25 % -12.5 % Output voltage Almost no reaction NG	Injection volume +25 % -12.5 % Output voltage Almost no reaction NG	Extremely rich or lean actual air-fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

The following A/F Control procedure enables the technician to check and graph the voltage output of both A/F sensor and heated oxygen sensor.

To display the graph, select the following menu items on the tester: View / Line graph.

HINT:

- Read freeze frame data using the intelligent tester II. 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.
- 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 with the rich air-fuel mixture.
- 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 with the lean air-fuel mixture.

1 CHECK OTHER DTC OUTPUT (IN ADDITION TO A/F SENSOR DTC)

- Connect the intelligent tester II to the DLC3.
- Turn the ignition switch to ON and turn the intelligent tester II ON.
- Select the following menu items: Powertrain / Engine and ECT / DTC.
- Read DTCs.

Result

Display (DTC Output)	Proceed To
A/F sensor circuit DTCs	A
A/F sensor circuit DTCs and other DTCs	B

HINT:

If any other DTCs besides the A/F sensor DTCs are output, perform troubleshooting for those DTCs first.

B

GO TO RELEVANT DTC CHART
(See page 05-29)

A

2 READ VALUE OF INTELLIGENT TESTER II (OUTPUT VOLTAGE OF A/F SENSOR)

- Connect the intelligent tester II to the DLC 3.
- Start the engine and turn the intelligent tester II ON.
- Warm up the A/F sensor with the engine at 2,500 rpm for approximately 90 seconds.
- On the intelligent tester II, select the following menu items: Powertrain / Engine and ECT / Data List.
- Select the following monitor items: AFS B1 S1 and Engine Speed.
- Monitor the A/F sensor voltage carefully.
- Check the A/F sensor voltage under the following conditions.
 - Allow the engine to idle for 30 seconds.
 - Run the engine at approximately 2,500 rpm (where the engine RPM is not suddenly changed).
 - Raise the engine speed to 4,000 rpm and quickly release the accelerator pedal so that the throttle valve is fully closed.

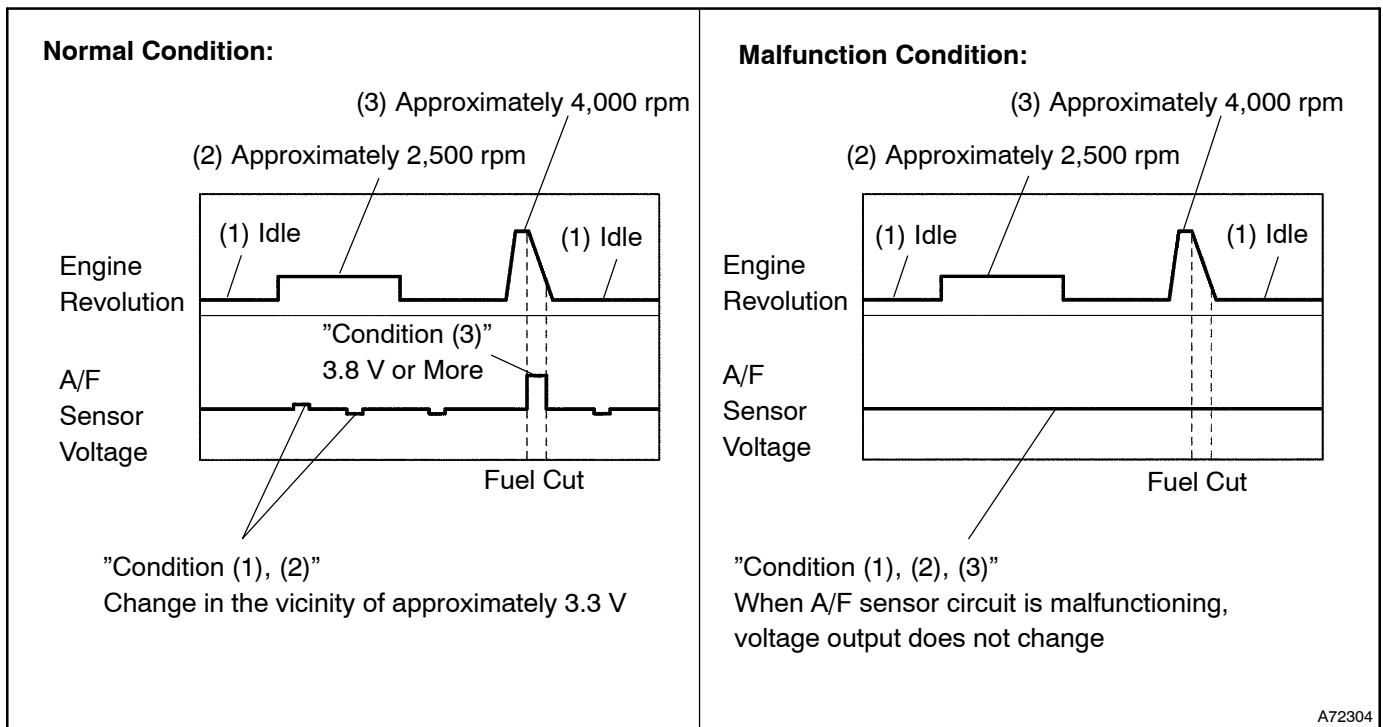
Standard:**Condition (1) and (2)**

The voltage changes in the vicinity of 3.3 V (0.66 V*) (between approximately 3.1 to 3.5 V) as shown in the illustration on the next page.

Condition (3)

The voltage increases to 3.8 V (0.76 V*) or more during engine deceleration (when fuel is cut) as shown in the illustration on the next page.

*: Voltage when not using intelligent tester II.

**HINT:**

- Whenever the output voltage of the A/F sensor remains at approximately 3.3 V (0.660 V*) (see diagram Malfunction Condition) under any condition 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 approximately 3.8 V (0.76 V*) or more, or 2.8 V (0.56 V*) or less (see diagram Malfunction Condition) under any condition 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 lean condition and should result in a momentary increase in the A/F sensor voltage output.
- The ECM must establish a closed throttle position learned value to perform fuel cut. If the battery terminal was reconnected, the vehicle must be driven over 16 km (10 mph) to allow the ECM to learn the closed throttle position.
- When the vehicle is driven:
The output voltage of the A/F sensor may be below 2.8 V (0.76 V*) during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- The A/F sensor is a current output element, therefore the current is converted into voltage inside the ECM. If measuring voltage at the connectors of the A/F sensor or ECM, you will obtain a constant voltage.

*: When not using the intelligent tester II.

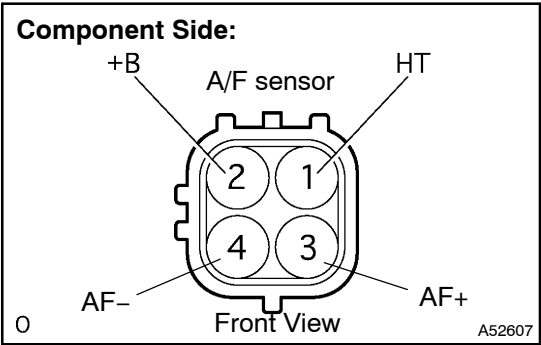
OK

Go to step 13

NG

3

INSPECT AIR FUEL RATIO SENSOR(RESISTANCE OF A/F SENSOR HEATER)



- (a) Disconnect the A4 A/F sensor connector.
- (b) Measure the resistance between the terminals of the A/F sensor.

Standard:

Tester Connection	Specified Condition
HT (1) - +B (2)	1.8 to 3.4 Ω at 20°C (68°F)

- (c) Reconnect the A/F sensor connector.

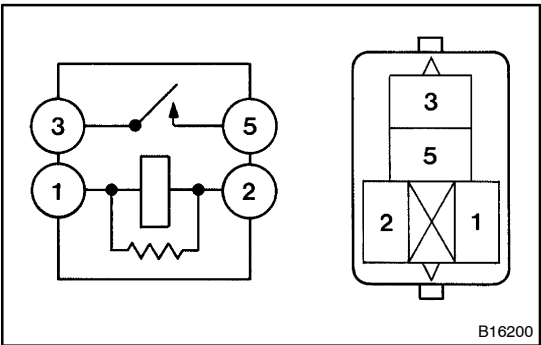
NG

REPLACE AIR FUEL RATIO SENSOR

OK

4

INSPECT EFI RELAY



- (a) Remove the EFI relay from the engine room R/B.
- (b) Check the EFI relay resistance.

Standard:

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

- (c) Reinstall the EFI relay.

NG

REPAIR OR REPLACE EFI RELAY

OK

5

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

Wire Harness Side:

A4 A/F Sensor Connector

HT +B
AF+ AF-

Front View

A76787

- (a) Disconnect the A4 A/F sensor connector.
- (b) Disconnect the E10 ECM connector.
- (c) Check the resistance.

Standard (Check for open):

Tester Connection	Specified Condition
HT (A4-1) - HA1A (E10-5)	Below 1 Ω
AF+ (A4-3) - A1A+ (E10-23)	Below 1 Ω
AF- (A4-4) - A1A- (E10-31)	Below 1 Ω

Standard (Check for short):

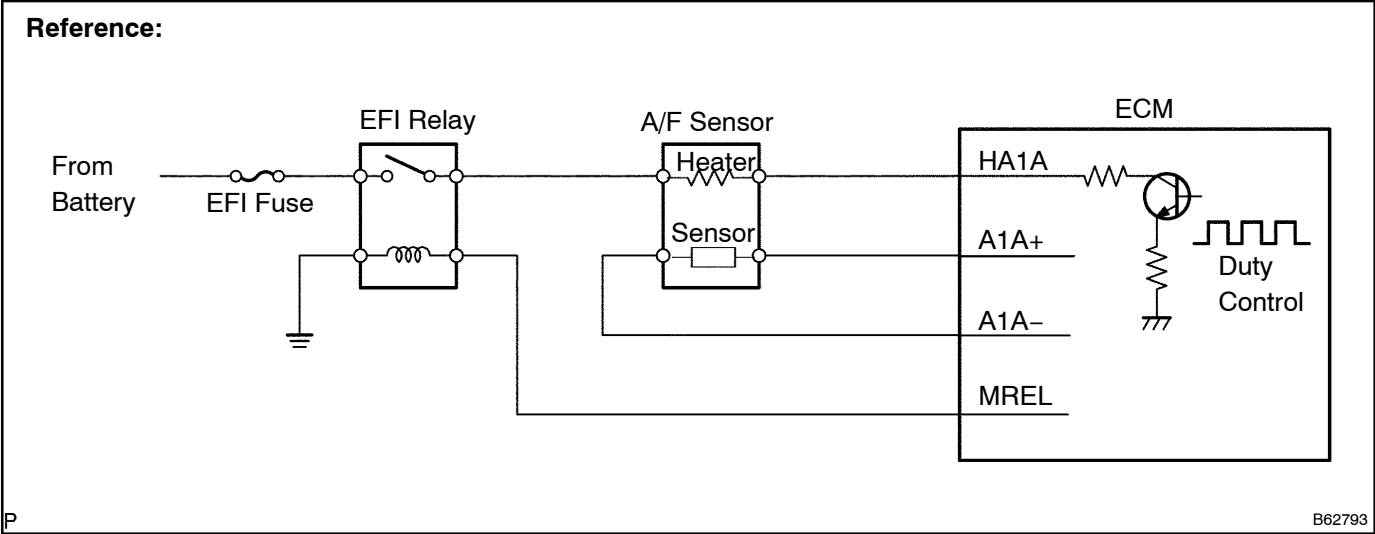
Tester Connection	Specified Condition
HT (A4-1) or HA1A (E10-5) - Body ground	10 k Ω or higher
AF+ (A4-3) or A1A+ (E10-23) - Body ground	10 k Ω or higher
AF- (A4-4) or A1A- (E10-31) - Body ground	10 k Ω or higher

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

HA1A
A1A+ A1A-

ECM Connector

A55005



NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6 CHECK AIR INDUCTION SYSTEM

- (a) Check for vacuum leaks in the air induction system.

OK: No leak in the air induction system.**NG****REPAIR OR REPLACE AIR INDUCTION SYSTEM****OK****7 CHECK FUEL PRESSURE (See page 11-5)**

- (a) Check the fuel pressure (high or low fuel pressure).

NG**REPAIR OR REPLACE FUEL SYSTEM****OK****8 INSPECT FUEL INJECTOR ASSY (See page 11-8)**

- (a) Check the injector injection (high or low fuel pressure).

NG**REPLACE FUEL INJECTOR ASSY
(See page 11-11)****OK****9 REPLACE AIR FUEL RATIO SENSOR****GO****10 PERFORM CONFIRMATION DRIVING PATTERN****HINT:**

Clear all DTCs prior to performing the confirmation driving pattern.

GO**11 CHECK IF DTC OUTPUT RECURS (A/F SENSOR DTCs)**

- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the ignition switch to ON and turn the intelligent tester ON.
- (c) Select the following menu items: Powertrain / Engine and ECT / DTC.
- (d) Read DTCs.

Result

Display (DTC Output)	Proceed To
No output	A
A/F sensor circuit DTCs	B

B**REPLACE ECM (See page 10-30) AND PERFORM CONFIRMATION DRIVING PATTERN****A**

12 CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

OK: The vehicle has run out of fuel in the past.

NO

CHECK FOR INTERMITTENT PROBLEMS
(See page 05-9)

YES

DTCS ARE CAUSED BY RUNNING OUT OF FUEL

13 PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Clear all DTCs prior to performing the confirmation driving pattern.

GO

14 CHECK IF DTC OUTPUT RECURS (A/F SENSOR DTCS)

- (a) Connect the intelligent tester II to the DLC3.
- (b) Turn the ignition switch to ON and turn the intelligent tester II ON.
- (c) Select the following menu items: Powertrain / Engine and ECT / DTC.
- (d) Read DTCs.

Result :

Display (DTC Output)	Proceed To
A/F sensor circuit DTCs	A
No output	B

B

Go to step 18

A

15 REPLACE AIR FUEL RATIO SENSOR

GO

16 PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Clear all DTCs prior to performing the confirmation driving pattern.

GO

17 CHECK IF DTC OUTPUT RECURS (A/F SENSOR DTCs)

- (a) Connect the Intelligent Tester II to the DLC3.
 (b) Turn the Ignition switch to ON and turn the Intelligent Tester II ON.
 (c) Select the following menu items: Powertrain / Engine and ECT / DTC.
 (d) Read DTCs.

Result

Display (DTC Output)	Proceed To
No Output	A
A/F sensor circuit DTCs	B

B

**REPLACE ECM (See page 10-30)
AND PERFORM CONFIRMATION DRIVING PAT-
TERN**

A**18 CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST**

OK: The vehicle has run out of fuel in the past.

NO

**CHECK FOR INTERMITTENT PROBLEMS
(See page 05-9)**

YES

DTCs ARE CAUSED BY RUNNING OUT OF FUEL