| 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) |
|---|---|---|

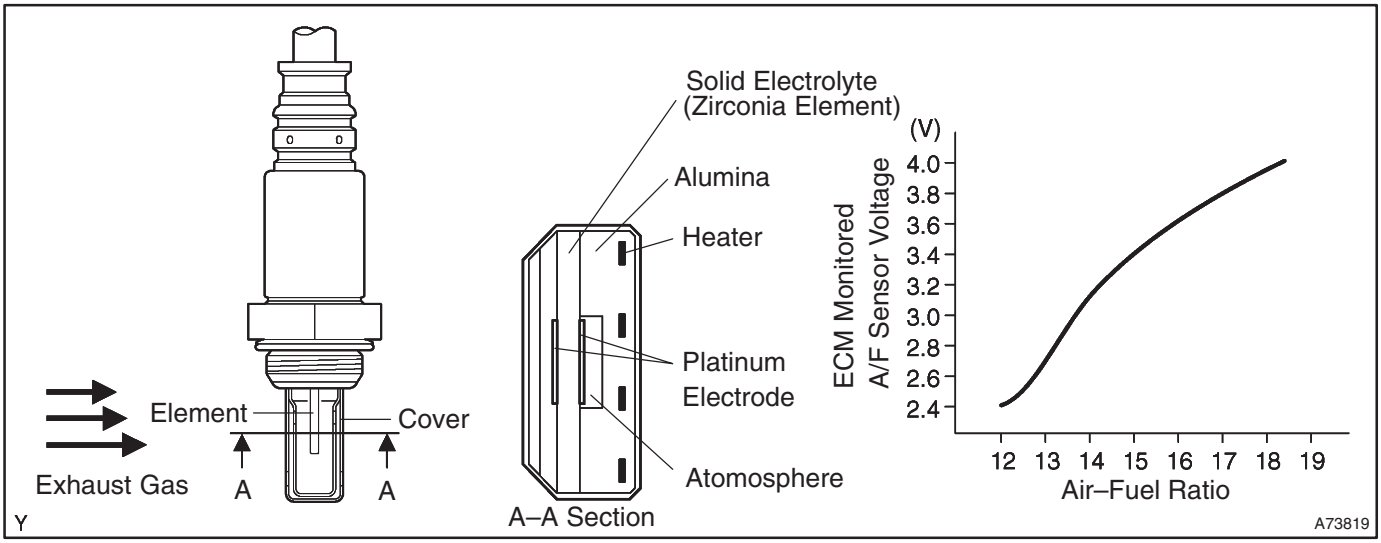
| DTC | P2197 | OXYGEN (A/F) SENSOR SIGNAL STUCK LEAN (BANK 2 SENSOR 1) |
|---|---|---|

| DTC | P2198 | OXYGEN (A/F) SENSOR SIGNAL STUCK RICH (BANK 2 SENSOR 1) |
|---|---|---|

HINT:
These DTCs are recorded when air–fuel ratio (A/F) sensor has a malfunction, although the caption is oxygen sensor.

## CIRCUIT DESCRIPTION

The A/F sensor is the planar type. Compared to the conventional type, the sensor and heater portions of the planar type are narrower overall. Because the heat of the heater is conducted through the alumina to zirconia (of the sensor portion) it accelerates the activation of the 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. 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 the characteristic that it provides output voltage* being 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 is out of order, 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.

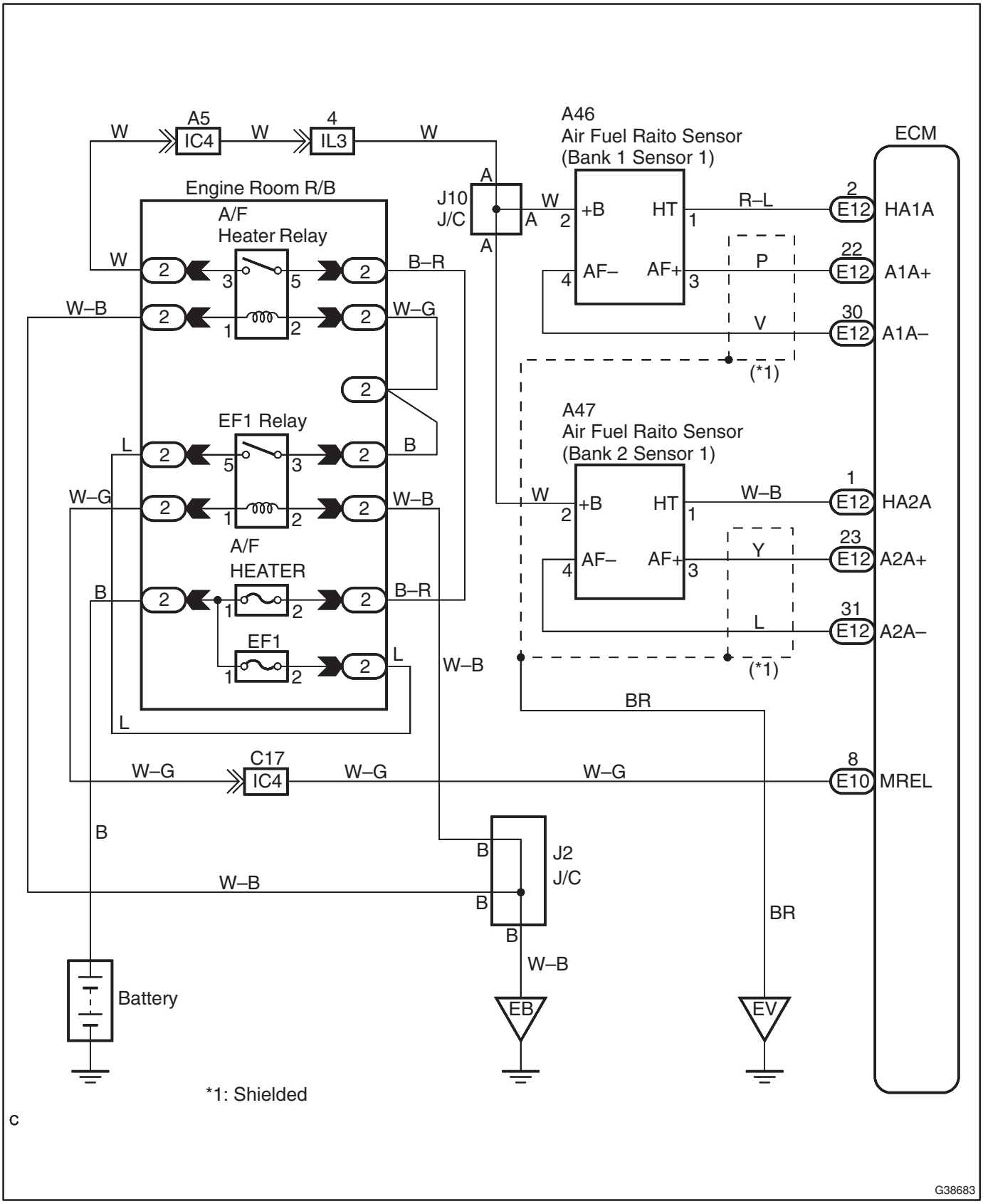


| DTC No. | DTC Detecting Condition | Trouble Area |
|---|---|---|
| P2195<br>P2197 | Condition (a) continues for 10.0 sec. or more :<br>(a) AF sensor voltage > 3.8 V | • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit<br>• A/F sensor (bank 1, 2 sensor 1)<br>• A/F sensor heater<br>• A/F sensor heater relay<br>• A/F sensor heater and A/F heater relay circuit<br>• Air induction system<br>• Fuel pressure<br>• Injector<br>• ECM |
| P2195<br>P2197 | While fuel–cut operation performing (during vehicle deceleration), air–fuel ratio sensor current is 3.6 mA or more for 3 seconds. | • A/F sensor (sensor 1)<br>• ECM |
| P2196<br>P2198 | Condition (a) continues for 10.0 sec. or more :<br>(a) AF sensor voltage < 2.8 V | • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit<br>• A/F sensor (bank 1, 2 sensor 1)<br>• A/F sensor heater<br>• A/F sensor heater relay<br>• A/F sensor heater and A/F heater relay circuit<br>• Air induction system<br>• Fuel pressure<br>• Injector<br>• ECM |
| P2196<br>P2198 | While fuel–cut operation performing (during vehicle deceleration), air–fuel ratio sensor current is less than 1.4 mA for 3 seconds. | • A/F sensor (sensor 1)<br>• ECM |

HINT:

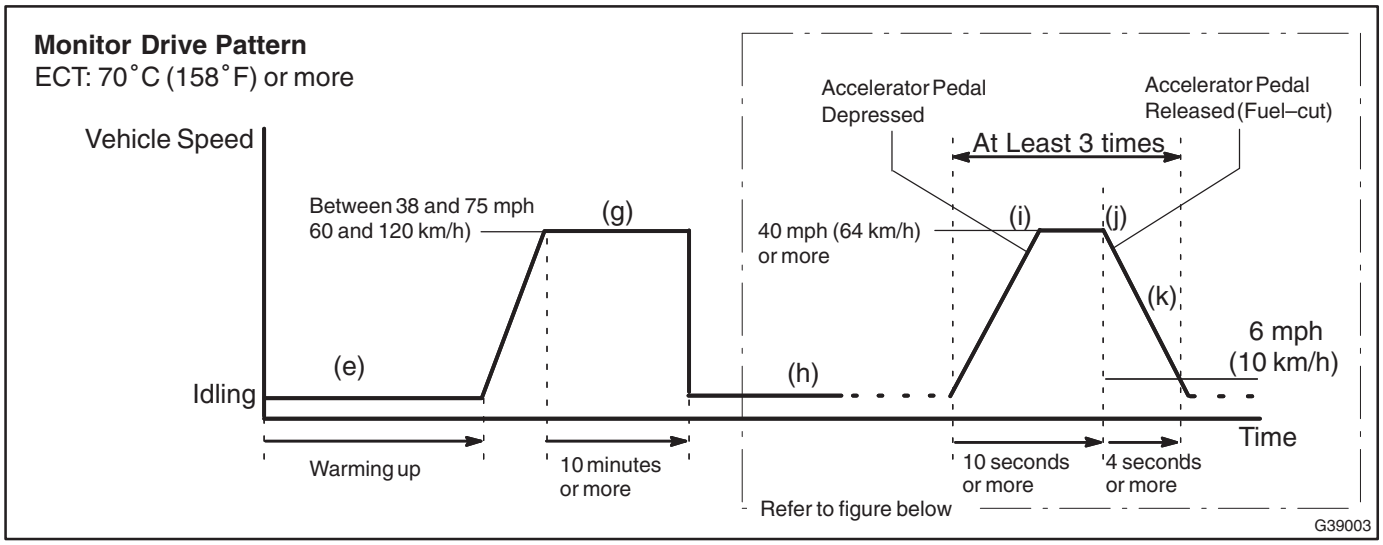
- DTCs P2195 and P2196 means malfunction related to the bank 1 A/F sensor circuit.
- DTCs P2197 and P2198 means malfunction related to the bank 2 A/F sensor circuit.
- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that includes cylinder No. 2.
- Sensor 1 refers to the sensor closest to the engine assembly.
- After confirming DTC P2195, P2196, P2197 and P2198 use the Intelligent Tester II to confirm voltage output of A/F sensor (AFS B1 S1/AFS B2 S1) from the ”DIAGNOSIS / OBD/MOBD / DATA LIST / ALL”.
- The A/F sensor’s output voltage and the short−term fuel trim value can be read using the OBD II scan tool or the Intelligent Tester II.
- The ECM controls the voltage of the A1A+, A2A+, A1A− and A2A− terminals of the ECM to the fixed voltage. Therefore, it is impossible to confirm the A/F sensor output voltage without the Intelligent Tester II.

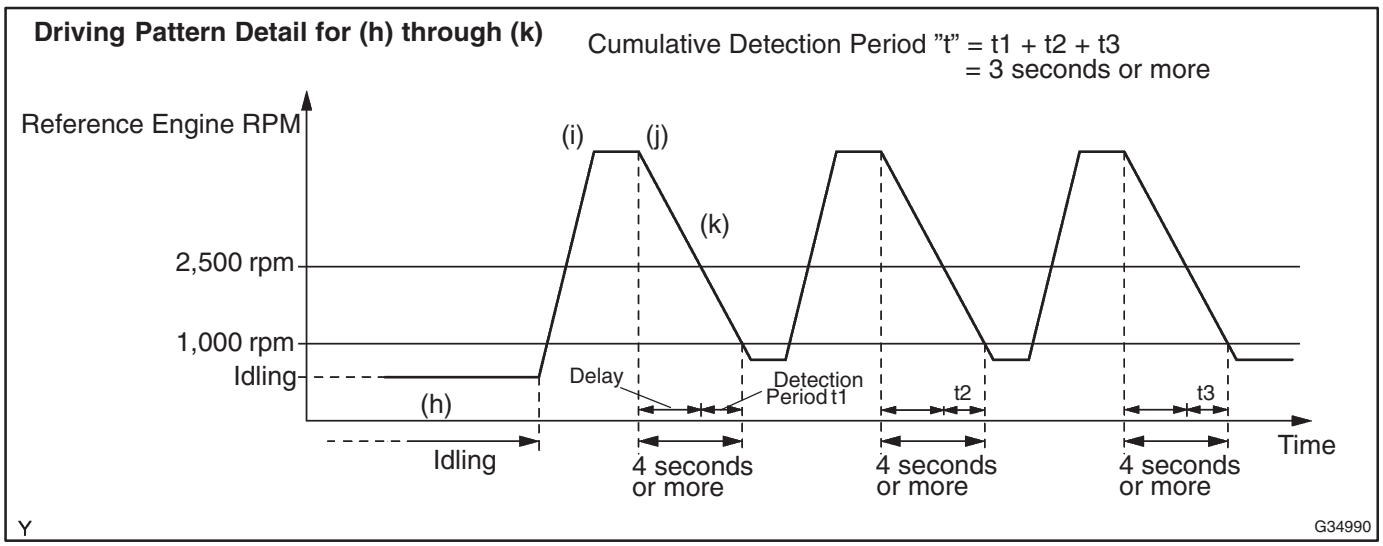
# WIRING DIAGRAM



# CONFIRMATION DRIVING PATTERN

This confirmation driving pattern is used in steps 2, 4, 7, 17, and 21 of the following diagnostic troubleshooting procedure when using a hand–held tester.




(a) Connect a hand–held tester to the DLC3.
(b) Turn the ignition switch to ON.
(c) Turn the tester ON.
(d) Clear DTCs (see page 05–209).
(e) Start the engine, and warm it up until the ECT reaches 70°C (158°F) or higher.
(f) On the hand–held tester, select the following menu items to check the fuel–cut status: DIAGNOSIS / ENHANCED OBD II / DATA LIST / USER DATA / FC IDLE.
(g) Drive the vehicle at between 38 mph (60 km/h) and 75 mph (120 km/h) for at least 10 minutes.
(h) Change the transmission to 2nd gear.
(i) Drive the vehicle at proper vehicle speed to perform fuel–cut operation (refer to the following HINT).

HINT:

Fuel–cut is performed when the following conditions are met:

- Accelerator pedal fully released.
- Engine speed is 2,500 rpm or more (fuel injection returns at 1,000 rpm).

(j) Accelerate the vehicle to 40 mph (64 km/h) or more by depressing the accelerator pedal for at least 10 seconds.

(k) Soon after performing step (j) above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal, in order to execute fuel–cut control.
(l) Allow the vehicle to decelerate until the vehicle speed declines to less than 6 mph (10 km/h).
(m) Repeat steps from (h) through (k) above at least 3 times in one driving cycle.

HINT:

Completion of all A/F sensor monitors is required to change the value in TEST RESULT.

**CAUTION:**

**Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.**

## INSPECTION PROCEDURE

| 1 | CHECK OTHER DTC OUTPUT(BESIDES A/F SENSOR DTC) |
|---|---|

(a) Connect the intelligent tester II to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the intelligent tester II ON.
(d) On the intelligent tester II, select the item: Powertrain / Engine and ECT / DTC.
(e) Read DTCs.

**Result :**

| Display | Proceed to |
|---|---|
| A/F sensor circuit DTC are output. | A |
| A/F sensor circuit DTC and other codes are output. | B |

HINT:

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

B → GO TO RELEVANT DTC CHART

A

| 2 | READ VALUE OF HAND–HELD TESTER(OUTPUT VOLTAGE OF A/F SENSOR) |
|---|---|

(a) Connect the Intelligent Tester II to the DLC 3.
(b) Warm up the A/F sensors (bank 1, 2 sensor 1) with the engine at 2,500 rpm for approximately 90 seconds.
(c) Read A/F sensor voltage output on the Intelligent Tester II.
(d) Select the ”DIAGNOSIS / OBD/MOBD / SNAPSHOT / MANUAL SNAPSHOT / USER DATA” mode on the Intelligent Tester II.
(e) Select ”AFS B1 S1 or AFS B2 S1/ENGINE SPD” and press button ”YES”.
(f) Monitor the A/F sensor voltage carefully.
(g) 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.

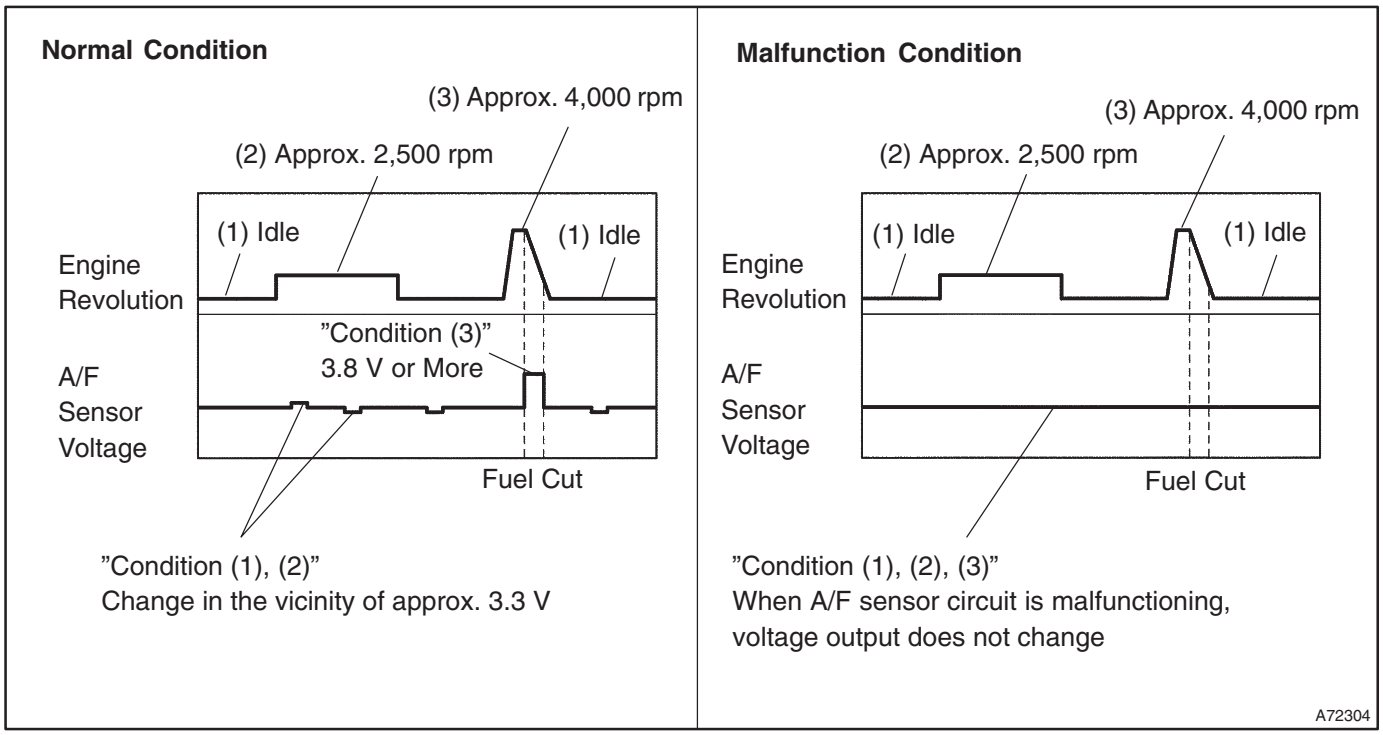
    **Standard:**

    **Condition (1) and (2)**

    **Voltage change in the vicinity of 3.3 V (0.66 V)* (between approx. 3.1 to 3.5 V) as shown in the illustration.**

    **Condition (3)**

    **A/F sensor voltage increase to 3.8 V (0.76 V)* or more during engine deceleration (when fuel cut) as shown in the illustration.**




HINT:

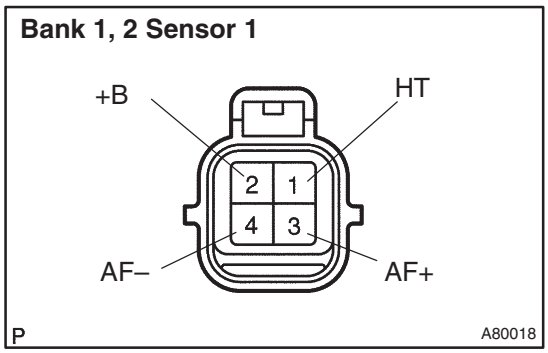
- Whenever the output voltage of the A/F sensor remains at approx. 3.3 V (0.660 V)* (see dwg. 2) under any condition as well as the above conditions, the A/F sensor may have an open–circuit. (This will happen also when the A/F sensor heater has an open–circuit.)
- Whenever the output voltage of the A/F sensor remains at a certain value of approx. 3.8 V (0.76 V)* or more, or 2.8 V (0.56 V)* or less (see dwg. 2) 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 a lean condition and should result in a momentary increase in A/F sensor voltage output.
- 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 learn 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 is 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 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 A/F sensor connector.
(b) Measure resistance between the terminals HT and +B of the A/F sensor.

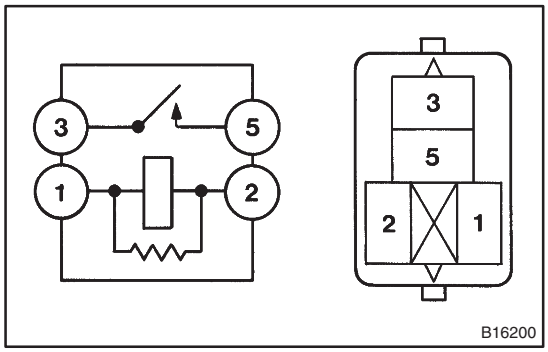
**Standard:**

| Terminal No. | Specified condition |
|---|---|
| 1 (HT) – 2(+B) | 1.8 to 3.4 Ω at 20°C (68°F) |
| 1 (HT) – 4(AF–) | 10 kΩ or higher |

**NG** → **REPLACE AIR FUEL RATIO SENSOR**

**OK**

## 4 INSPECT A/F HEATER RELAY




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

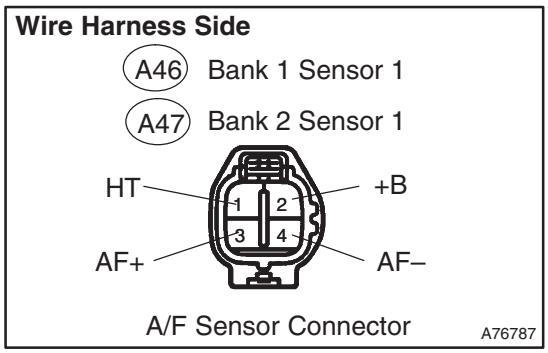
**Standard:**

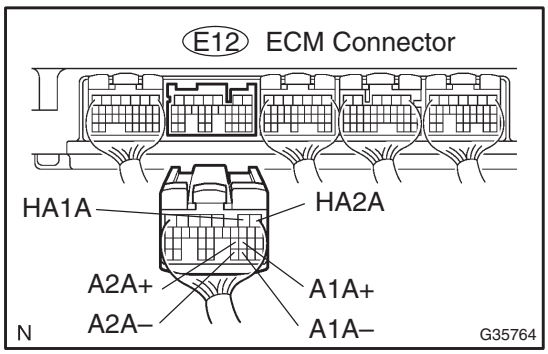
| Terminal No. | Specified condition |
|---|---|
| 1 – 2 | Continuity |
| 3 – 5 | No Continuity |
| | Continuity (Apply battery voltage terminals 1 and 2) |

**NG** → **REPAIR OR REPLACE A/F HEATER RELAY**

**OK**

## 5 CHECK HARNESS AND CONNECTOR(A/F SENSOR – ECM)




(a) Disconnect the A46 or A47 A/F sensor connector.
(b) Disconnect the E12 ECM connector.
(c) Check for continuity between the wire harness side connectors.

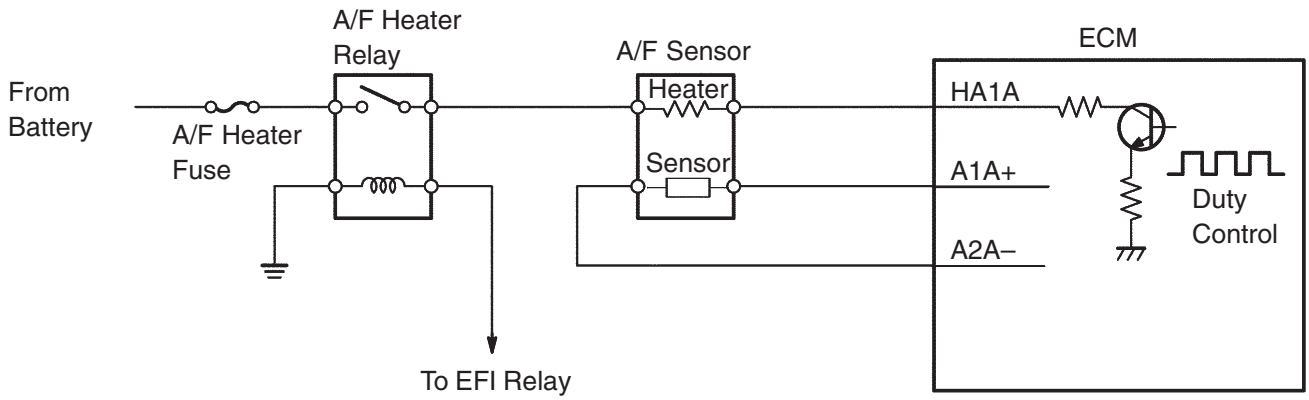
**Standard (Check for open):**

| Symbols (Terminal No.) | Specified condition |
|---|---|
| AF+ (A46–3) – A1A+ (E12–22) | Continuity |
| AF– (A46–4) – A1A– (E12–30) | |
| HT (A46–1) – HA1A (E12–5) | |
| AF+ (A47–3) – A2A+ (E12–23) | |
| AF– (A47–4) – A2A– (E12–31) | |
| HT (A47–1) – HA2A (E12–4) | |

**Standard (Check for short):**

| Symbols (Terminal No.) | Specified condition |
|---|---|
| AF+ (A46–3) or A1A+ (E12–22) – Body ground | No continuity |
| AF– (A46–4) or A1A– (E12–30) – Body ground | |
| HT (A46–1) or HA1A (E12–5) – Body ground | |
| AF+ (A47–3) or A2A+ (E12–23) – Body ground | |
| AF– (A47–4) or A2A– (E12–31) – Body ground | |
| HT (A47–1) or HA2A (E12–4) – Body ground | |

**Reference (Bank 1 Sensor 1 System Drawing)**




NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

| 6 | CHECK AIR INDUCTION SYSTEM |
|---|---|

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

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

| 7 | CHECK FUEL PRESSURE |
|---|---|

(a) Check fuel pressure (High or low fuel pressure).

NG → REPAIR OR REPLACE FUEL SYSTEM

OK

| 8 | INSPECT FUEL INJECTOR ASSY |
|---|---|

(a) Check injector injection (High or low fuel pressure).

NG → REPLACE FUEL INJECTOR ASSY

OK

| 9 | REPLACE AIR FUEL RATIO SENSOR |
|---|---|

NEXT

| 10 | PERFORM CONFIRMATION DRIVING PATTERN |
|---|---|

HINT:
Clear all DTCs prior to perform the confirmation driving pattern.

NEXT

| 11 | READ OUTPUT DTC(A/F SENSOR DTC OUTPUT AGAIN) |
|---|---|

(a) Connect the Intelligent Tester II to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the Intelligent Tester II ON.
(d) On the Intelligent Tester II, select the item: Powertrain / Engine and ECT / DTC / Pending.
(e) Read DTCs.

**Result :**

| Display | Proceed to |
|---|---|
| A/F sensor circuit DTC are not output. | A |
| A/F sensor circuit DTC are output. | B |

B → CHECK AND REPLACE ECM

A

| 12 | CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST |
|---|---|

NO → CHECK FOR INTERMITTENT PROBLEMS

YES

DTC IS CAUSED BY RUNNING OUT OF FUEL

| 13 | PERFORM CONFIRMATION DRIVING PATTERN |
|---|---|

HINT:
Clear all DTCs prior to perform the confirmation driving pattern.

NEXT

| 14 | READ OUTPUT DTC(A/F SENSOR DTC OUTPUT AGAIN) |
|---|---|

(a) Connect the Intelligent Tester II to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the Intelligent Tester II ON.
(d) On the Intelligent Tester II, select the item: Powertrain / Engine and ECT / DTC / Pending.
(e) Read DTCs.

**Result :**

| Display | Proceed to |
|---|---|
| A/F sensor circuit DTC are output. | A |
| A/F sensor circuit DTC are not output. | B |

B → Go to step 18

A

| 15 | REPLACE AIR FUEL RATIO SENSOR |
|---|---|

NEXT

| 16 | PERFORM CONFIRMATION DRIVING PATTERN |
|---|---|

HINT:
Clear all DTCs prior to perform the confirmation driving pattern.

NEXT

| 17 | READ OUTPUT DTC(A/F SENSOR DTC OUTPUT AGAIN) |
|---|---|

(a) Connect the Intelligent Tester II to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the Intelligent Tester II ON.
(d) On the Intelligent Tester II, select the item: Powertrain / Engine and ECT / DTC / Pending.
(e) Read DTCs.

**Result :**

| Display | Proceed to |
|---|---|
| A/F sensor circuit DTC are not output. | A |
| A/F sensor circuit DTC are output. | B |

**B** → **REPLACE ECM (See Pub. No. RM1017E, page 10–11)**

**A**

| 18 | CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST |
|---|---|

**NO** → **CHECK FOR INTERMITTENT PROBLEMS (SEE PAGE 05–199)**

**YES**

**DTC IS CAUSED BY RUNNING OUT OF FUEL**