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)

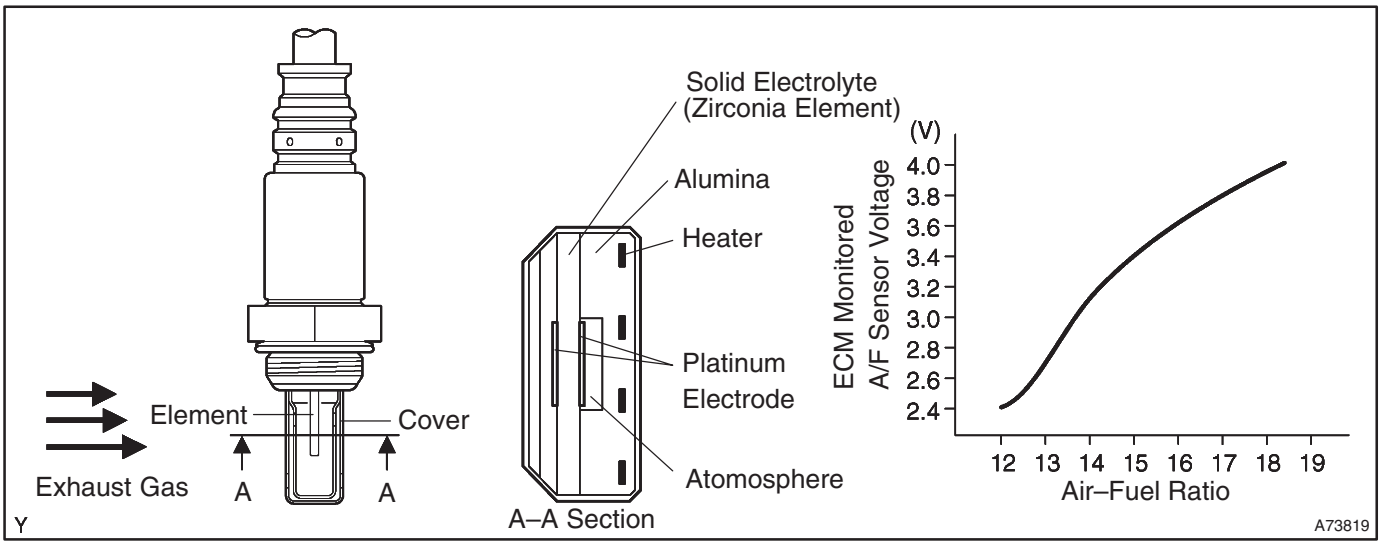
DTC	P0051	OXYGEN (A/F) SENSOR HEATER CONTROL CIRCUIT LOW (BANK 2 SENSOR 1)

DTC	P0052	OXYGEN (A/F) SENSOR HEATER CONTROL CIRCUIT HIGH (BANK 2 SENSOR 1)

HINT:
This DTC is related to the air–fuel ratio (A/F) sensor, although the caption is heated oxygen sensor.

CIRCUIT DESCRIPTION

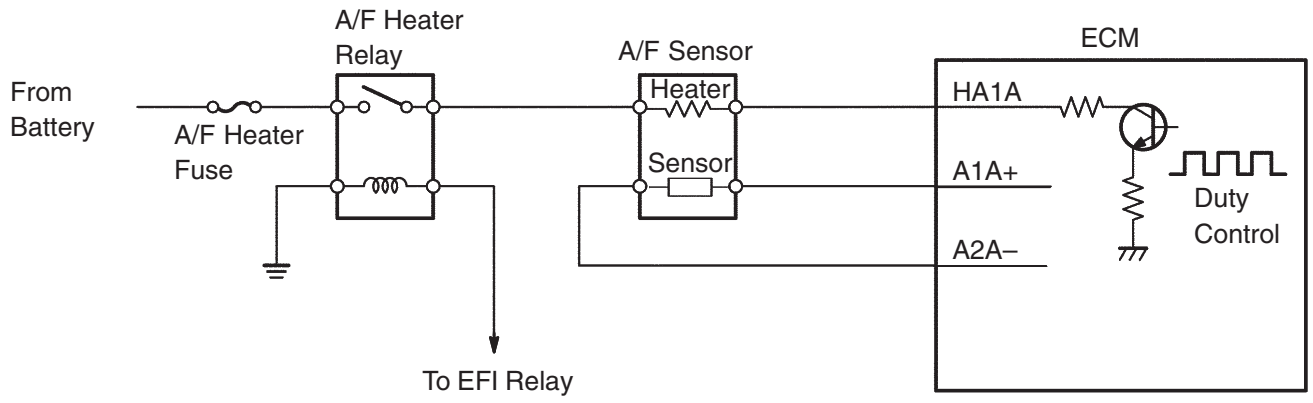
The A/F sensor is the planar type. Compared to the conventional type, the sensor and heater portions of the planar type are narrower overall. Because the heat of the heater is conducted through the alumina to zirconia (of the sensor portion) it accelerates the activation of the sensor.
To obtain a high 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.



HINT:

The ECM provides a pulse width modulated control circuit to adjust current through the heater. The A/F sensor heater circuit uses a relay on the B+ side of the circuit.

Reference (Bank 1 Sensor 1 System Drawing)

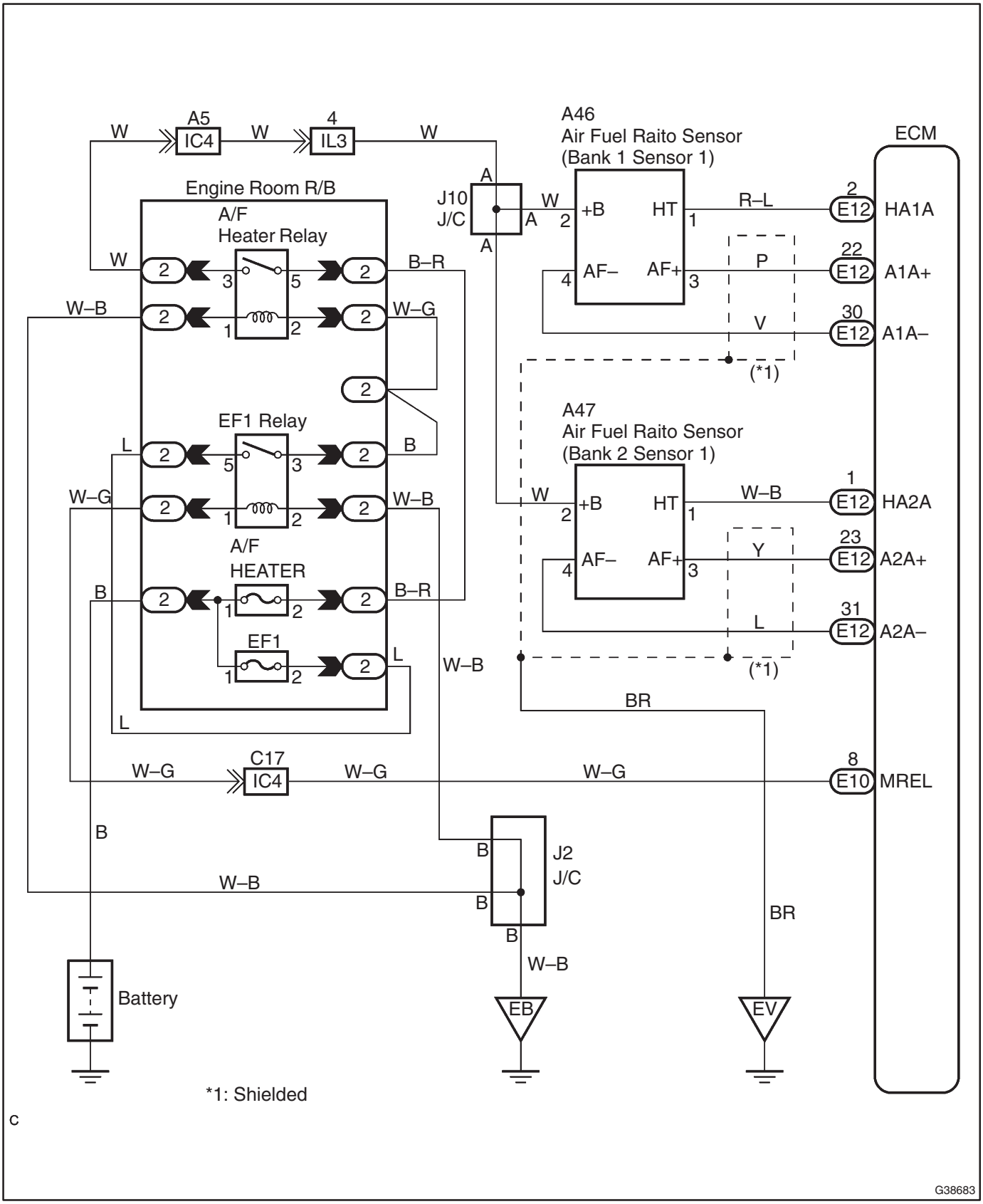


DTC No.	DTC Detection Condition	Trouble Area
P0031 P0051	Heated current is 0.8 A or less when the heater operates (1 trip detection logic)	• Open or short in the heater circuit of A/F sensor • A/F sensor heater • A/F heater relay • ECM
P0032 P0052	When the heater operates, heated current exceeds 19.7 A (1 trip detection logic)	

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 sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

WIRING DIAGRAM

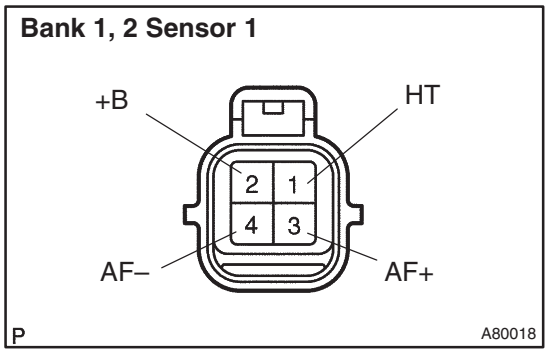


INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Intelligent Tester II. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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.

1 INSPECT AIR FUEL RATIO SENSOR(HEATER RESISTANCE)



(a) Disconnect the A/F sensor connector.

(b) Measure resistance between the terminals HT and +B of the A/F sensor.

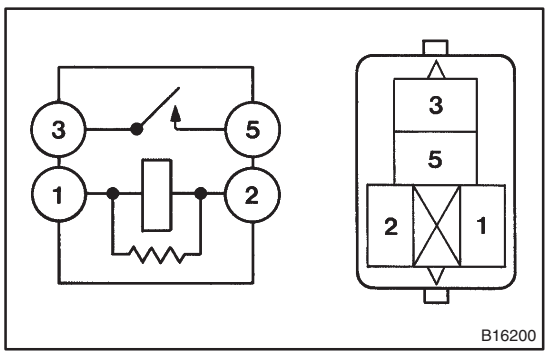
Standard:

Terminal No.	Resistance
1 (HT) – 2 (+B)	1.8 to 3.4 Ω at 20 °C (68 °F)
1 (HT) – 4 (AF–)	No Continuity

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

2 INSPECT A/F HEATER RELAY ASSY



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

(b) Inspect the A/F heater relay.

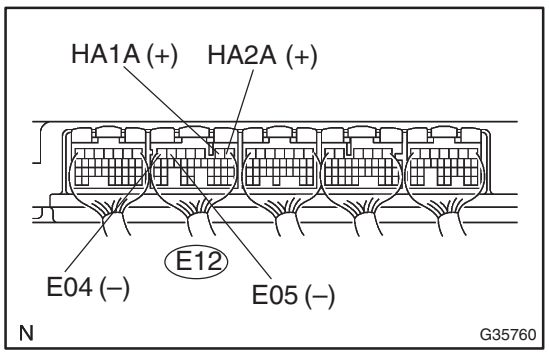
Standard:

Terminal No.	Specified condition
3 – 5	10 kΩ or higher
3 – 5	Below 1 Ω (Apply battery voltage terminals 1 and 2)

NG → **REPLACE E.F.I. CIRCUIT OPENING RELAY ASSY**

OK

3 INSPECT ECM(HA1A OR HA2A VOLTAGE)



(a) Turn the ignition switch to ON.

(b) Measure the voltage between the applicable terminals of the E12 ECM connectors.

Standard:

Symbols (Terminal No.)	Specified condition
HA1A (E12–2) – E04 (E12–7)	9 to 14 V
HA2A (E12–1) – E05 (E12–6)	9 to 14 V

HINT:

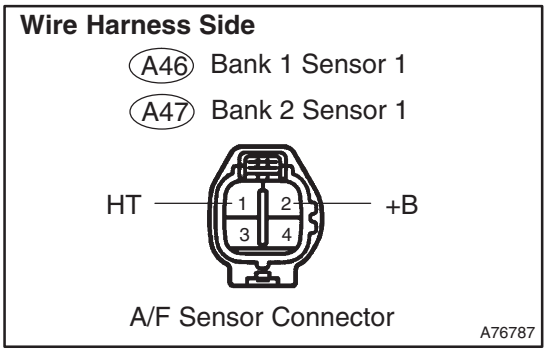
- The HA1A means the A/F sensor bank 1 sensor 1.

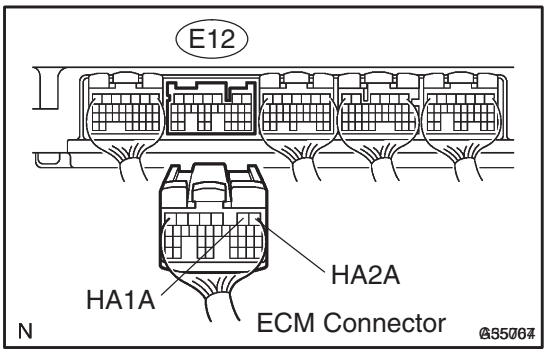
- The HA2A means the A/F sensor bank 2 sensor 1.

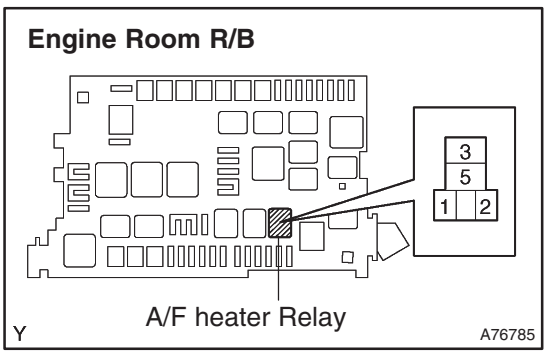
OK	REPLACE ECM (See Pub. No. RM1017E, page 10–11)

NG

4 CHECK HARNESS AND CONNECTOR(A/F SENSOR – ECM, A/F SENSOR – A/F HEATER RELAY)







(a) Check the harness and the connector between the ECM and the A/F sensor connectors.
  (1) Disconnect the A46 or A47 A/F sensor connector.
  (2) Disconnect the E12 ECM connector.
  (3) Check for resistance between the wire harness side connectors.

Standard (Check for open):

Symbols (Terminal No.)	Specified condition
HT (A46–1) – HA1A (E12–2)	Below 1 Ω
HT (A47–1) – HA2A (E12–1)	Below 1 Ω

Standard (Check for short):

Symbols (Terminal No.)	Specified condition
HT (A46–1) or HA1A (E12–2) – Body ground	10 kΩ or higher
HT (A47–1) or HA2A (E12–1) – Body ground	10 kΩ or higher

(b) Check the harness and the connector between the A/F sensor connector and the A/F heater relay.
  (1) Disconnect the A46 or A47 A/F sensor connector.
  (2) Remove the A/F heater relay from the engine room R/B.
  (3) Check for resistance between the wire harness side connectors.

Standard (Check for open):

Symbols (Terminal No.)	Specified condition
+B (A46–2) – A/F heater relay (3)	Below 1 Ω
+B (A47–2) – A/F heater relay (3)	Below 1 Ω

Standard (Check for short):

Symbols (Terminal No.)	Specified condition
+B (A46–2) or A/F heater relay (3) – Body ground	10 kΩ or higher
+B (A47–2) or A/F heater relay (3) – Body ground	10 kΩ or higher

NG	REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

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