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)

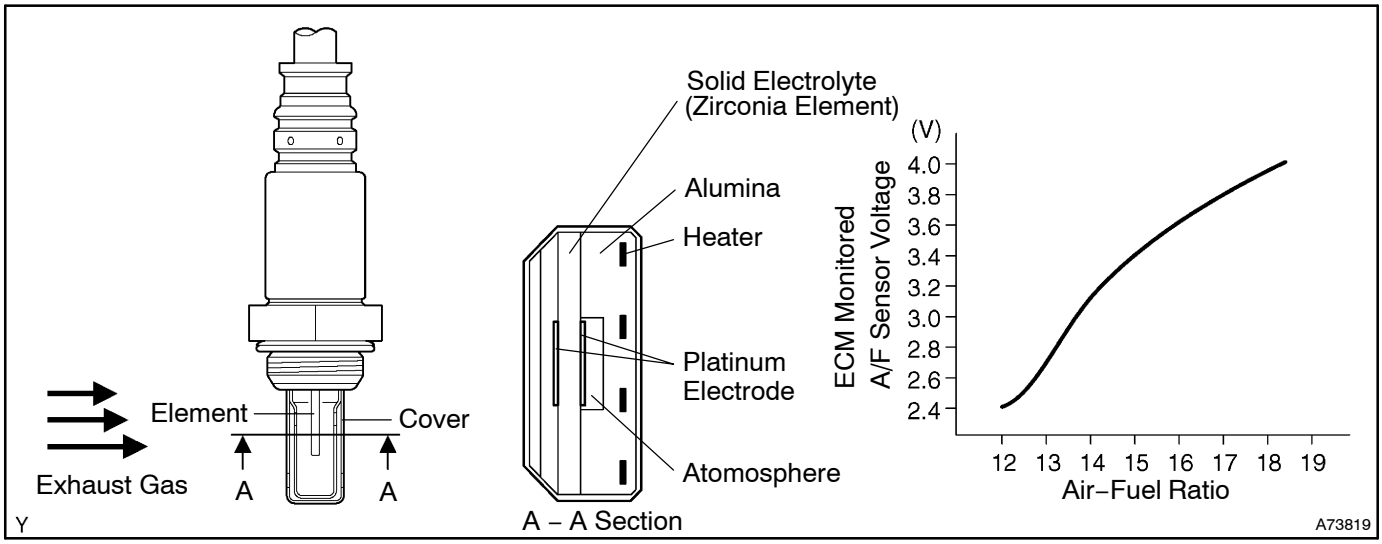
DTC	P0051	OXYGEN (A/F) SENSOR HEATER CONTROL CIRCUIT LOW (BANK 2 SENSOR 1)

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

HINT:
Although the title (DTC description) says ”oxygen sensor”, this DTC is related to the ”A/F sensor”.

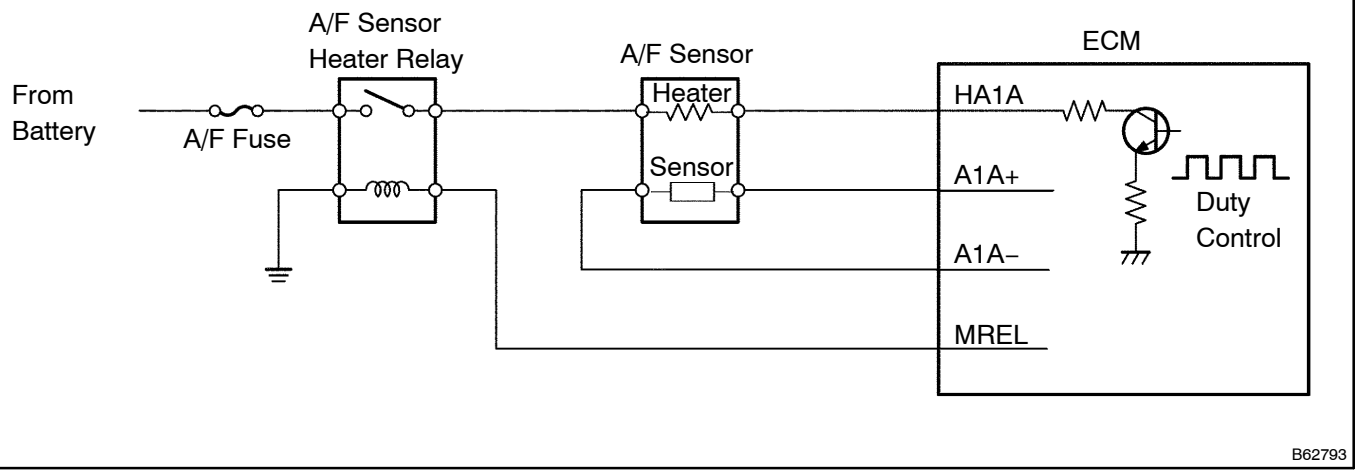
CIRCUIT DESCRIPTION

The Air–Fuel ratio (A/F) sensor provides output voltage* approximately equal 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.
With the A/F sensor output, the ECM can determine deviation from the stoichiometric air–fuel ratio and control proper injection time. If the A/F sensor is malfunctioning, the ECM is unable to accurately control air–fuel ratio.
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), current flows to the heater which heats the sensor to facilitate detection of accurate oxygen concentration.
The A/F sensor is a planar type. Compared to a conventional type, the sensor and heater portions are narrower. Because the heat of the heater is conducted through the alumina to zirconia (of the sensor portion), sensor activation is accelerated.
To obtain a high purification rate of the CO, HC and NOx components of the exhaust gas, a three–way catalytic converter is used. The converter is most efficient when the air–fuel ratio is maintained near the stoichiometric air–fuel ratio.
HINT:
*: The voltage value changes 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.

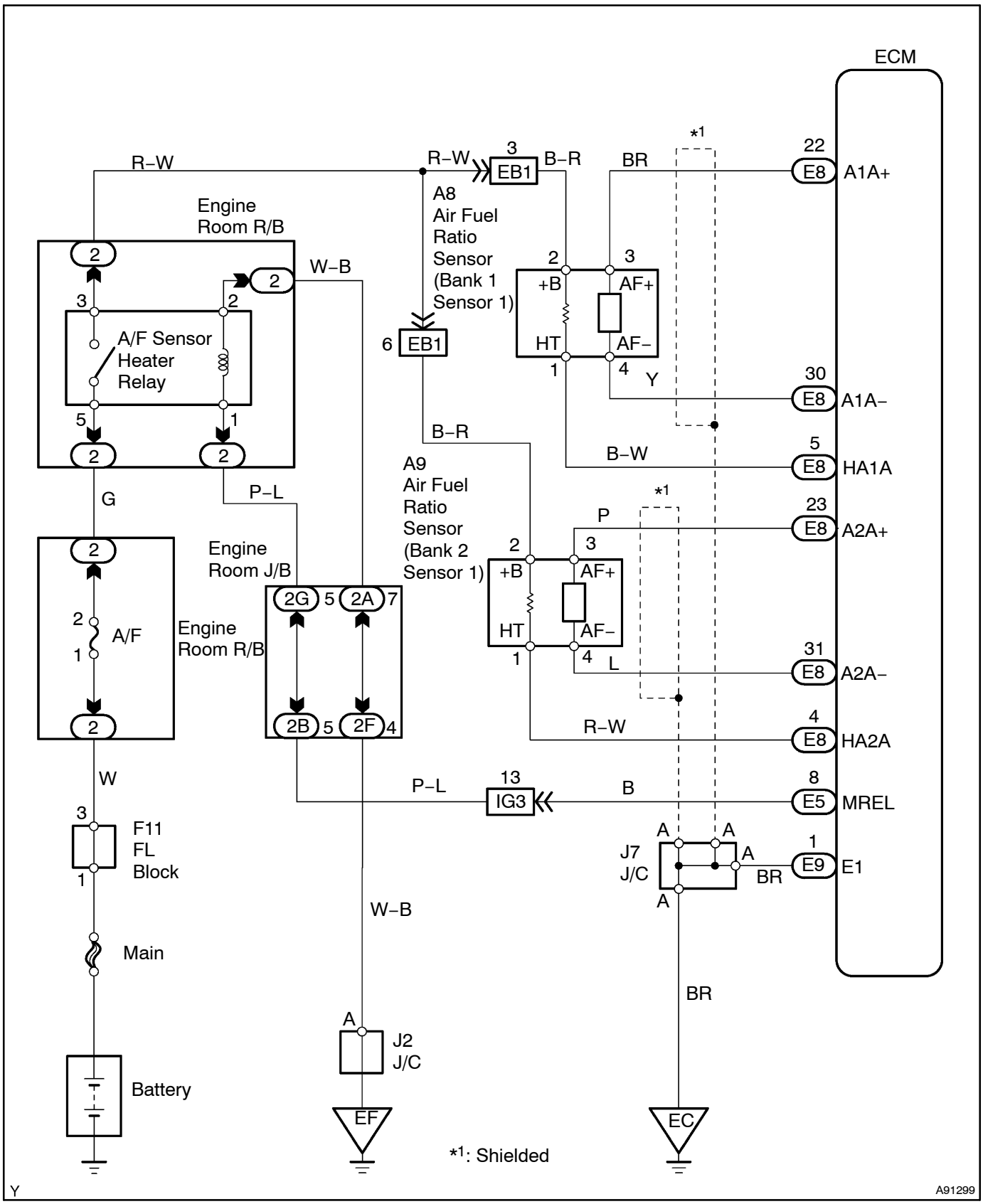
Reference (Bank 1 Sensor 1 System Drawing)



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

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

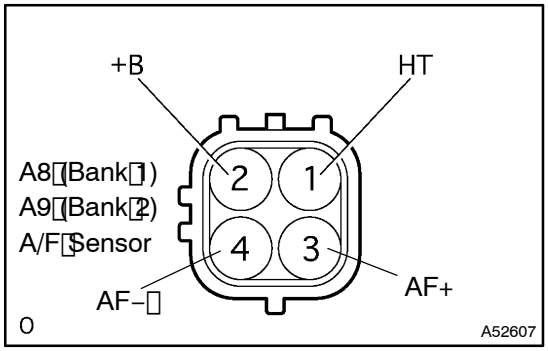


INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand–held tester. 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 A8 or A9 A/F sensor connector.

(b) Check the resistance between the terminals of the A/F sensor.

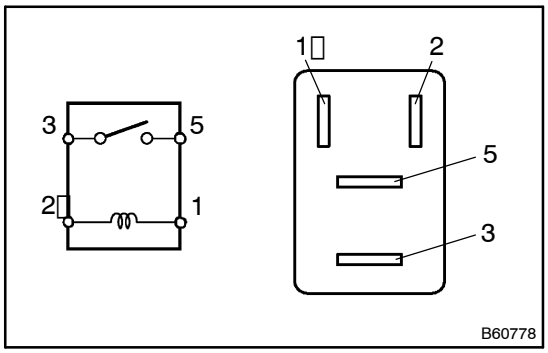
Resistance:

Tester Connection	Condition	Specified Condition
1 (HT) – 2 (+B)	20°C (68°F)	1.9 to 3.0 Ω
1 (HT) – 2 (+B)	750°C (1,382°F)	5.0 to 8.4 Ω

NG → REPLACE AIR FUEL RATIO SENSOR

OK

2 INSPECT RELAY (A/F)



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

(b) Check the resistance of the A/F relay.

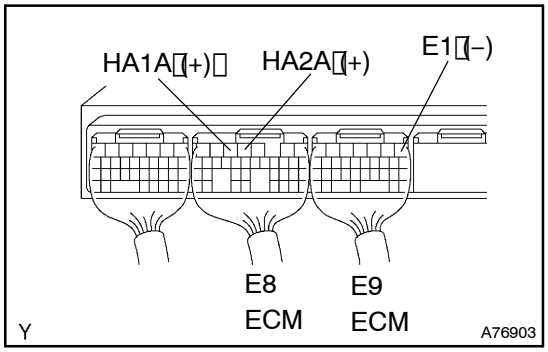
Standard:

Tester Connection	Specified Condition
3 – 5	10 kΩ or higher
3 – 5	Continuity (when battery voltage is applied to terminals 1 and 2)

NG → REPLACE RELAY

OK

3 CHECK ECM (HA1A OR HA2A VOLTAGE)



(a) Turn the ignition switch ON.

(b) Check the voltage of the ECM connectors.

Standard:

Tester Connection	Specified Condition
E8–5 (HA1A) – E9–1 (E1) E8–4 (HA2A) – E9–1 (E1)	9 to 14 V

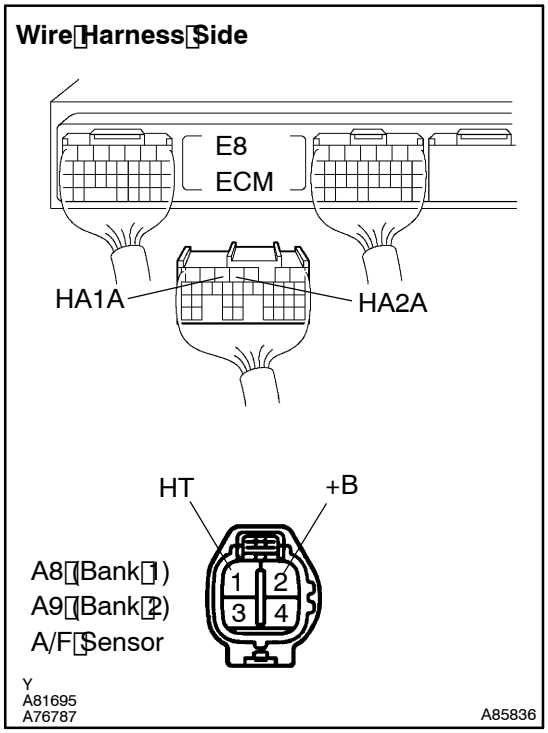
HINT:

- 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 page 10–13)

NG

4 CHECK WIRE HARNESS (A/F SENSOR – ECM, A/F SENSOR – A/F RELAY)



(a) Check the wire harness between the ECM and A/F sensors.

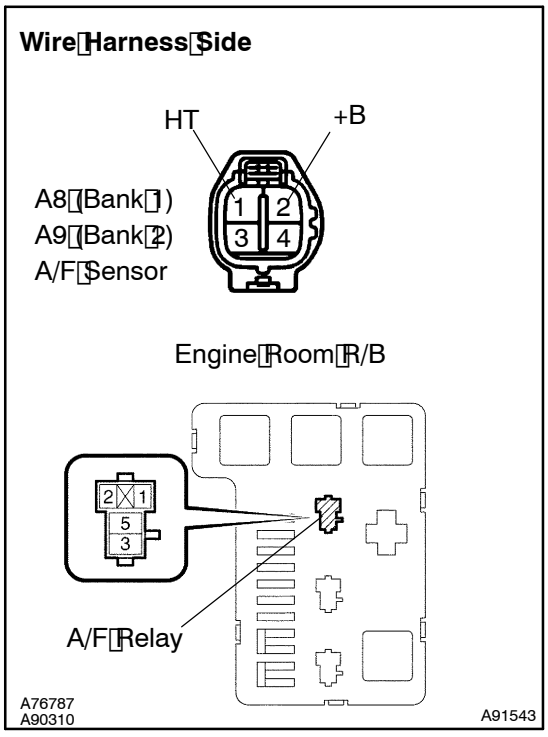
(1) Disconnect the E8 ECM connector.

(2) Disconnect the A8 or A9 A/F sensor connector.

(3) Check the resistance of the wire harness side connectors.

Standard:

Tester Connection	Specified Condition
A8–1 (HT) – E8–5 (HA1A) A9–1 (HT) – E8–4 (HA2A)	Below 1 Ω
A8–1 (HT) or E8–5 (HA1A) – Body ground A9–1 (HT) or E8–4 (HA2A) – Body ground	10 kΩ or higher



(b) Check the wire harness between the A/F sensor and A/F relay.

(1) Disconnect the A8 or A9 A/F sensor connector.

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

(3) Check the resistance of the wire harness side connectors.

Standard:

Tester Connection	Specified Condition
A8–2 (+B) – R/B A/F relay terminal 3 A9–2 (+B) – R/B A/F relay terminal 3	Below 1 Ω
A8–2 (+B) or J/B A/F relay terminal 3 – Body ground A9–2 (+B) or J/B A/F relay terminal 3 – Body ground	10 kΩ or higher

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

OK

REPLACE ECM (See page 10–13)