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)

HINT:

- Although the DTC titles say the oxygen sensor, these DTCs relate to the Air–Fuel Ratio (A/F) sensor.
- Sensor 1 refers to the sensor mounted in front of the Three–Way Catalytic Converter (TWC) and located near the engine assembly.

CIRCUIT DESCRIPTION

The A/F sensor is the planar type. Compared to the conventional type, the sensor and heater portions 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.

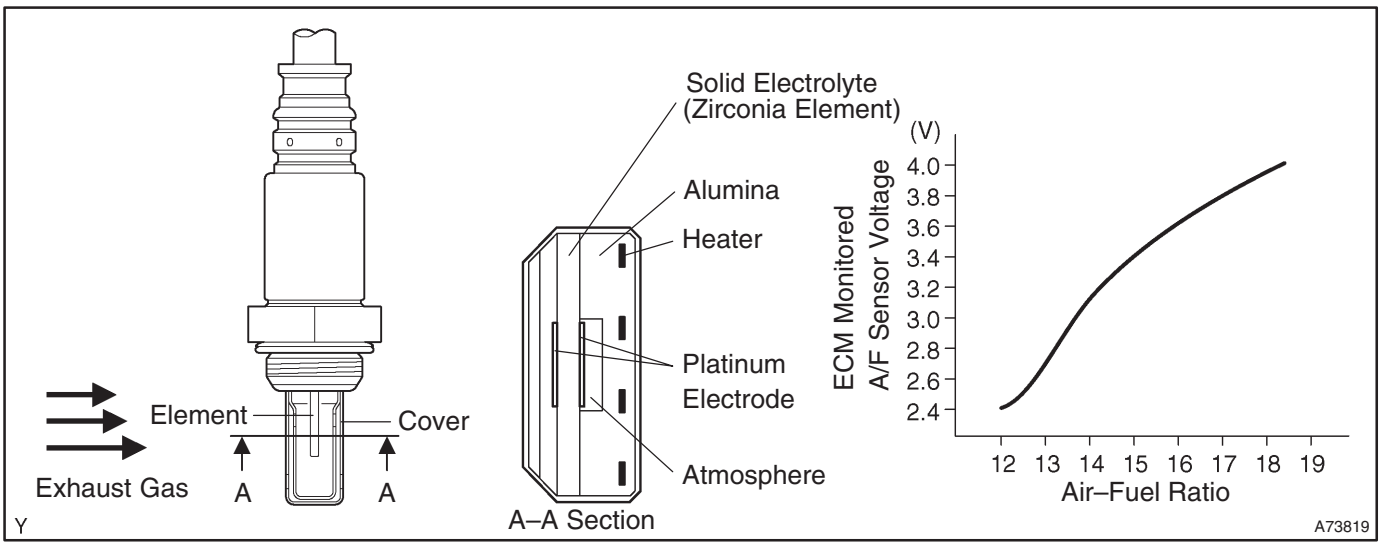
To obtain a high purification rate of the CO, HC and NOx components of the exhaust gas, a three–way catalytic converter is used. For the most efficient use of the three–way catalytic converter, the air–fuel ratio must be precisely controlled so that it is always close to the stoichiometric air–fuel ratio.

The A/F sensor has the characteristic that it provides output voltage* 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.

Through interpretation of the A/F sensor output, the ECM can determine the deviation 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 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.

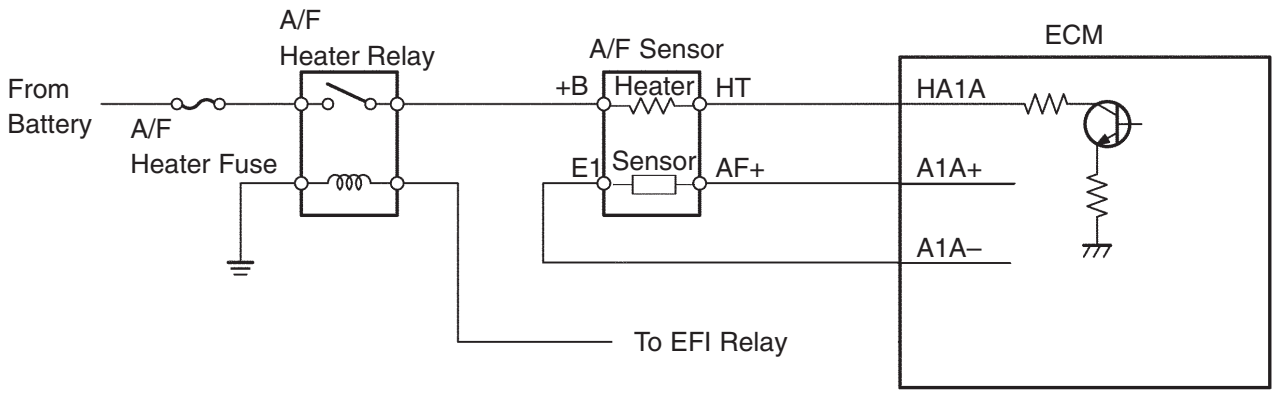
*: The voltage value changes at the inside of the ECM only.



HINT:

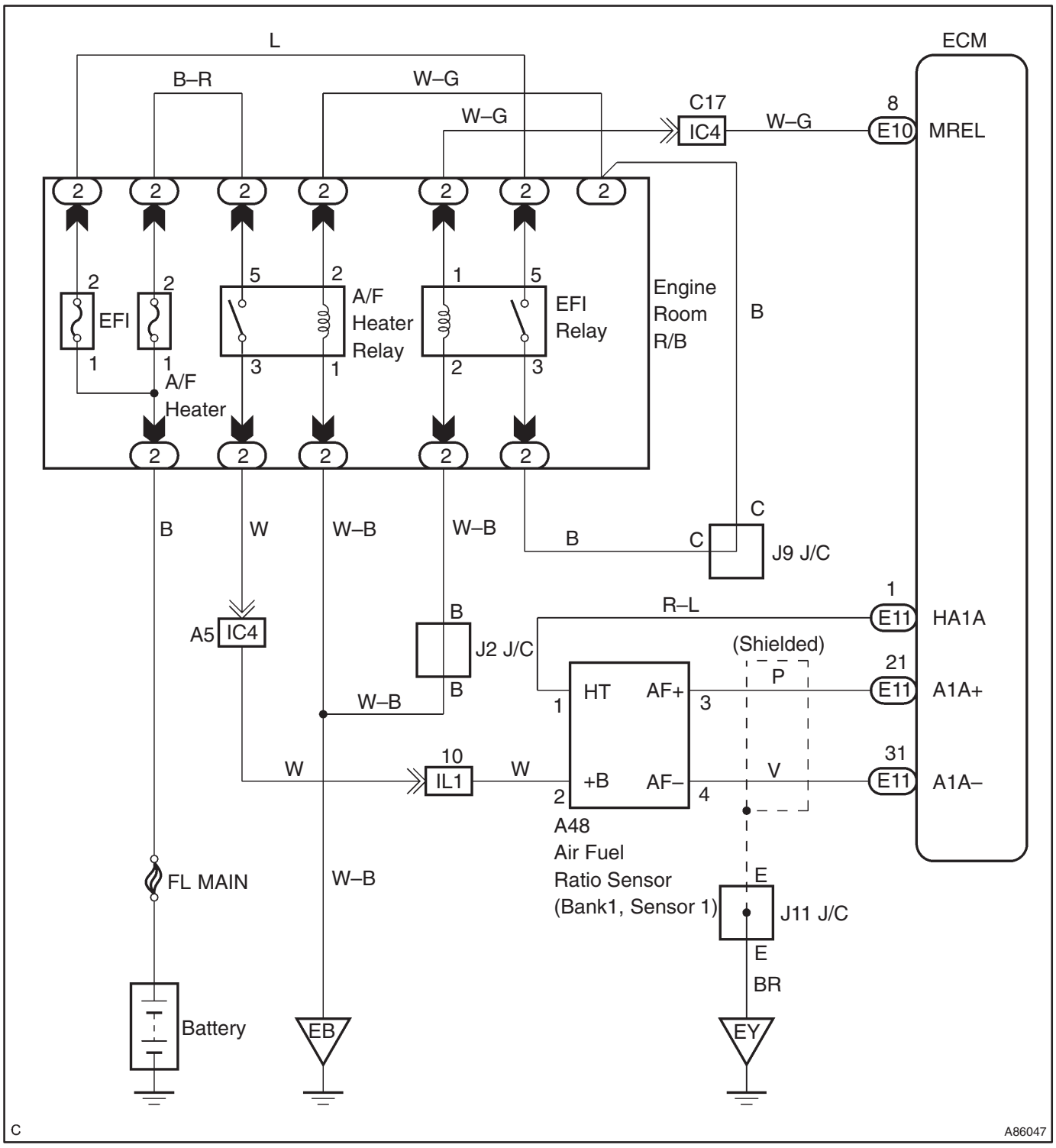
- When any of these DTCs are set, the ECM enters fail–safe mode. The ECM turns off the A/F sensor heater in fail–safe mode. Fail–safe mode continues until the ignition switch is turned to OFF.
- The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.

Reference (Sensor 1 System Diagram):



DTC No.	DTC Detection Condition	Trouble Area
P0031	A/F sensor heater current is 0.8 A or less when heater operates (1 trip detection logic)	• Open or short in heater circuit of heated oxygen sensor • A/F sensor heater (sensor 1) • A/F heater relay • ECM
P0032	A/F sensor heater current exceeds 10 A when the heater operates (1 trip detection logic)	• Open or short in heater circuit of heated oxygen sensor • A/F sensor heater (sensor 1) • A/F heater relay • ECM

WIRING DIAGRAM

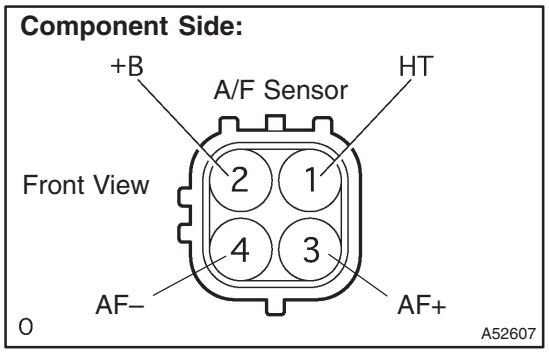


INSPECTION PROCEDURE

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.

1	INSPECT AIR FUEL RATIO SENSOR(HEATER RESISTANCE)



(a) Disconnect the A48 Air–Fuel Ratio (A/F) sensor connector.

(b) Measure the resistance according to the value(s) in the table below.

Standard:

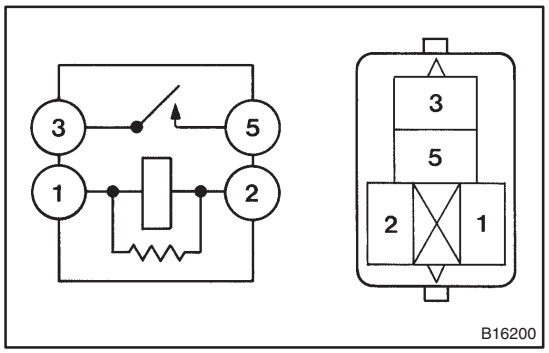
Tester Connection	Specified Conditions
HT (1) – +B (2)	Between 1.8 Ω and 3.4 Ω at 20°C (68°F)
HT (1) – AF– (4)	10 kΩ or higher

(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

2	INSPECT AIR FUEL RATIO SENSOR HEATER RELAY



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

(b) Check the A/F sensor heater relay resistance.

Standard:

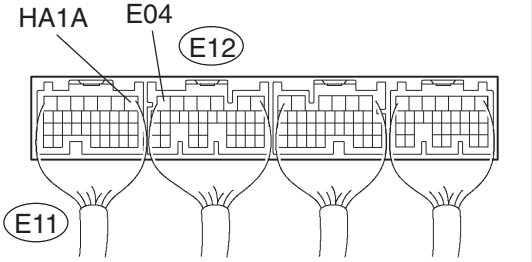
Tester Connection	Specified Condition
3 – 5	10 kΩ or higher
3 – 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

(c) Reinstall the A/F sensor heater relay.

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

OK

3 INSPECT ECM(HA1A VOLTAGE)



ECM Connector A18294

(a) Turn the ignition switch to ON.
(b) Measure the voltage according to the value(s) in the table below.

Standard:

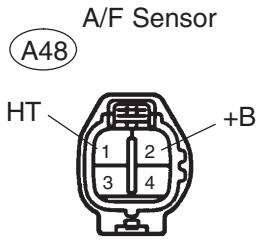
Tester Connection	Specified Condition
HA1A (E11–1) – E04 (E12–7)	9 to 14 V

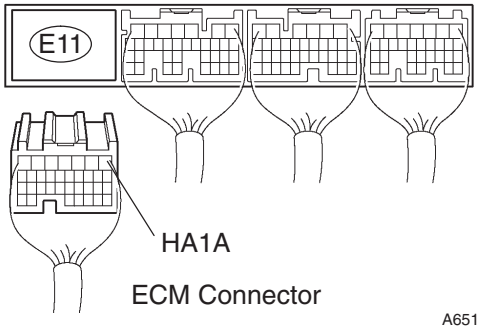
OK → **REPLACE ECM (See page 10–12)**

NG

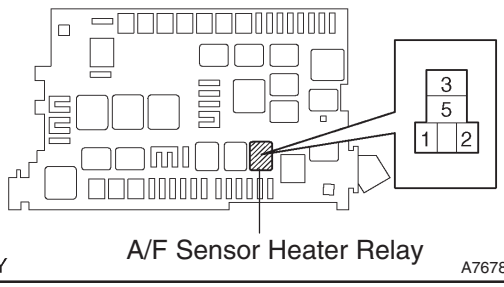
4	CHECK HARNESS AND CONNECTOR(AIR FUEL RATIO SENSOR – ECM, AIR FUEL RATIO SENSOR – AIR FUEL RATIO SENSOR HEATER RELAY)

Wire Harness Side:





Engine Room R/B



(a) Check the harness and the connectors between the ECM and the A/F sensor.
  (1) Disconnect the A48 A/F sensor connector.
  (2) Disconnect the E11 ECM connector.
  (3) Measure the resistance according to the value(s) in the table below.

Standard (Check for open):

Tester Connection	Specified Condition
HT (A48–1) – HA1A (E11–1)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
HT (A48–1) or HA1A (E11–1) – Body ground	10 kΩ or higher

  (4) Reconnect the A/F sensor connector.
  (5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the A/F sensor and A/F sensor heater relay.
  (1) Disconnect the A48 A/F sensor connector.
  (2) Remove the A/F sensor heater relay from the engine room R/B.
  (3) Measure the resistance according to the value(s) in the table below.

Standard (Check for open):

Tester Connection	Specified Condition
+B (A48–2) – A/F heater relay (3)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
+B (A48–2) or A/F heater relay (3) – Body ground	10 kΩ or higher

  (4) Reconnect the A/F sensor connector.
  (5) Reinstall the A/F sensor heater relay.

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

OK

REPLACE ECM (See page 10–12)