DIC22–03

CIRCUIT INSPECTION

DTC	P0031	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 1)

DTC	P0032	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 1)

DTC	P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC	P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DTC	P0051	Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 1)

DTC	P0052	Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 1)

DTC	P0057	Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)

DTC	P0058	Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

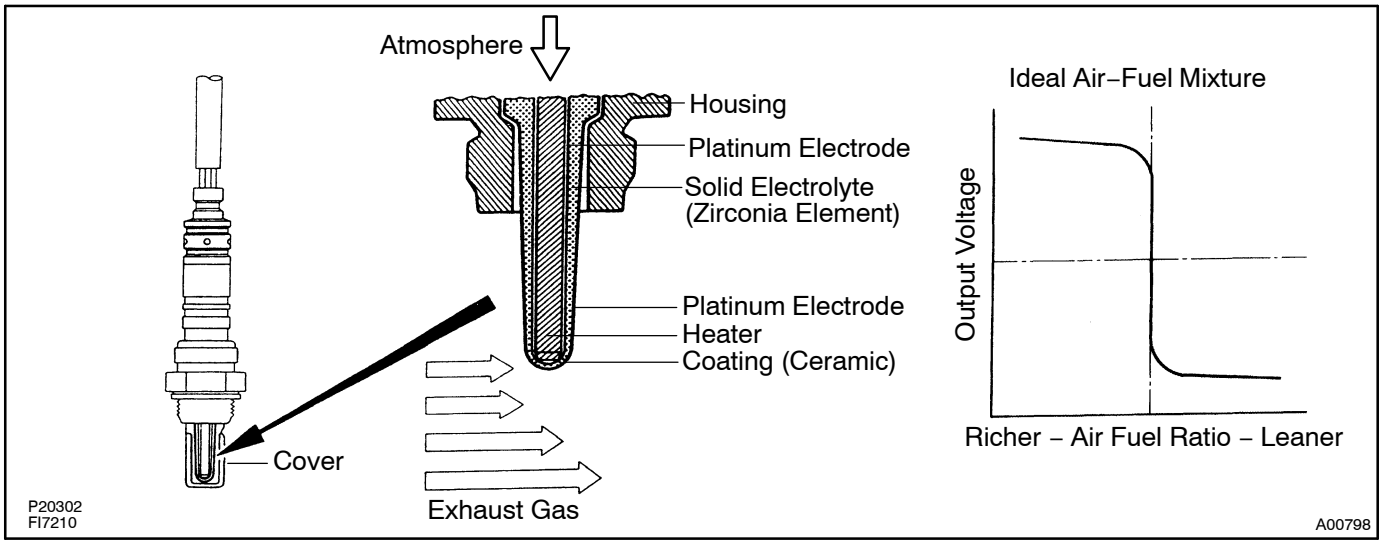
CIRCUIT DESCRIPTION

To obtain a high purification rate for the CO, HC and NOx components of the exhaust gas, a three–way catalytic converter is used, but 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 heated oxygen sensor has the characteristic which its output voltage changes suddenly in the vicinity of the stoichiometric air–fuel ratio. This characteristic is used to detect the oxygen concentration in the exhaust gas and provide the engine control ECU with feedback to control the air–fuel ratio.

When the air–fuel ratio becomes LEAN, the oxygen concentration in the exhaust increases and the heated oxygen sensor informs the engine control ECU of the LEAN condition (low voltage, i.e. less than 0.45 V).

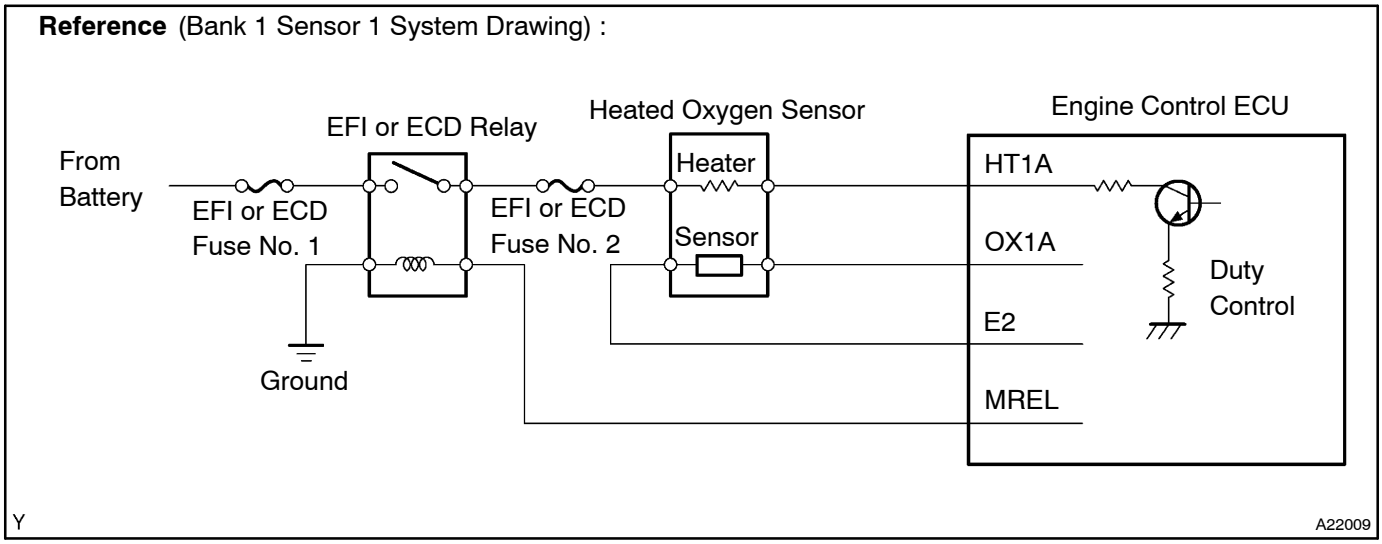
When the air–fuel ratio is RICHER than the stoichiometric air–fuel ratio, the oxygen concentration in the exhaust gas is reduced and the heated oxygen sensor informs the engine control ECU of the RICH condition (high voltage, i.e. more than 0.45 V). The engine control ECU judges by the voltage output from the heated oxygen sensor whether the air–fuel ratio is RICH or LEAN and controls the injection time accordingly. However, if malfunction of the heated oxygen sensor causes output of abnormal voltage, this disables the engine control ECU for performing an accurate air–fuel ratio control. The heated oxygen sensors include a heater which heats the zirconia element. The heater is controlled by the engine control ECU. When the intake air volume is low (the temperature of the exhaust gas is low) current flows to the heater to heat the sensor for accurate oxygen concentration detection.



HINT:

The engine control ECU provides a pulse width modulated control circuit to adjust current through the heater. The heated oxygen sensor heater circuit uses a relay on the B+ side of the circuit.

Reference (Bank 1 Sensor 1 System Drawing) :



DTC No.	DTC Detecting Condition	Trouble Area
P0031 P0037 P0051 P0057	Heater current is 0.25 A or less when the heater operates with more than 10.5 V positive battery voltage (1 trip detection logic)	• Open in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Engine control ECU
P0032 P0038 P0052 P0058	When heater does not operates, heater current exceeds 2.0 A (1 trip detection logic)	• Short in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • Engine control ECU

HINT:

- Bank 1 refers to bank the includes cylinder No. 1.
- Bank 2 refers to bank that does not includes cylinder No. 1.
- Sensor 1 refers to the sensor closer to the engine assembly.
- Sensor 2 refers to the sensor farther away from the engine assembly.

MONITOR DESCRIPTION

The sensing portion of the heated oxygen sensor has a zirconia element which is used to detect oxygen concentration in the exhaust. If the zirconia element is at the proper temperature and difference of the oxygen concentration between the inside and outside surface of sensor is large, the zirconia element will generate voltage signals. In order to increase the oxygen concentration detecting capacity in the zirconia element, the engine control ECU supplements the heat from the exhaust with heat from a heating element inside the sensor. When heater current in the sensor is out of the standard operating range, the engine control ECU interprets this as a fault in the heated oxygen sensor and sets a DTC.

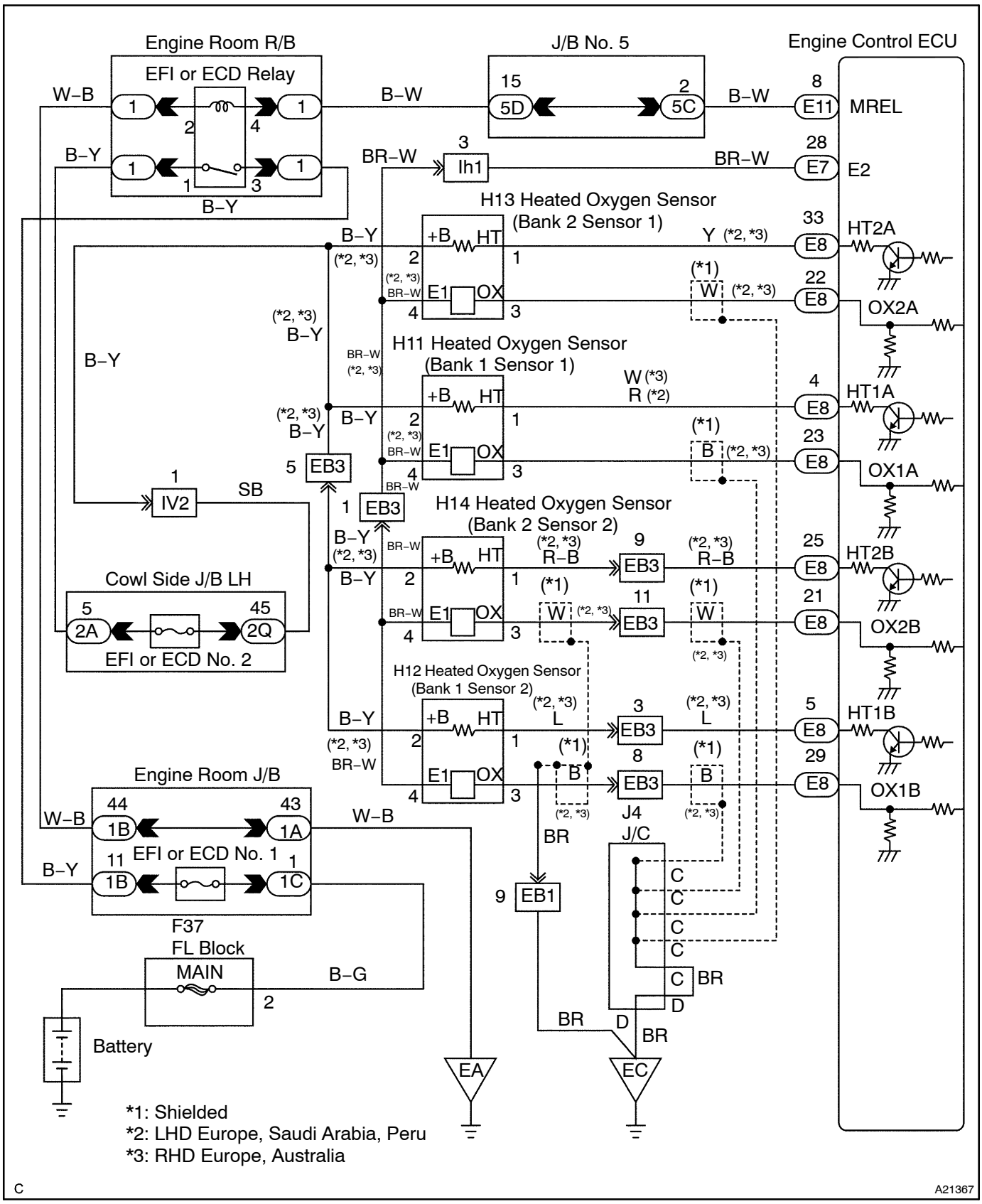
Example:

The engine control ECU will set a high current DTC if the current in the sensor is more than 2.0 A. Similarly, the engine control ECU will set a low current DTC if the current is less than 0.25 A when the heater is ON.

The monitor runs if conditions below is met:

Engine is started and run at idle for 9 minutes or more.

WIRING DIAGRAM



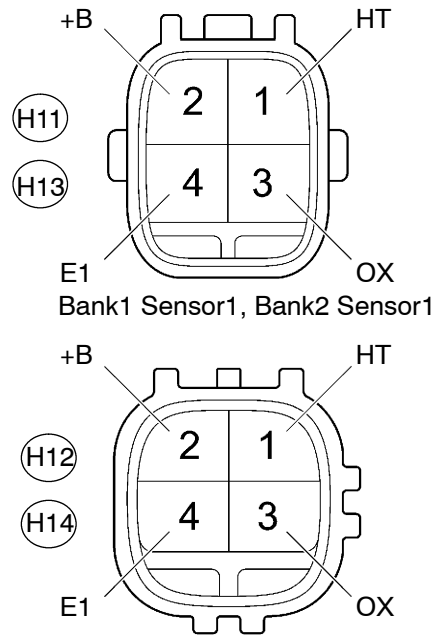
INSPECTION PROCEDURE

HINT:

Read freeze frame data using hand–held tester. Because freeze frame records the engine conditions when the malfunction is detected. When troubleshooting, it is useful to determine whether the vehicle was running or stopped, the engine was warmed up or not, the air–fuel ratio was lean or rich, etc. at the time of the malfunction.

1	**Check resistance of heated oxygen sensor heater.**

Components Side:



PREPARATION:

Disconnect the H11, H12, H13 or H14 heated oxygen sensor connector.

CHECK:

Measure resistance between terminals of the heated oxygen sensor.

OK:

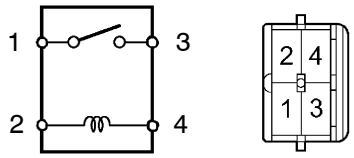
Tester Connection	Specified Condition
HT (H11–1) – +B (H11–2)	11.7 to 14.3 Ω (20°C)
HT (H12–1) – +B (H12–2)	11.7 to 14.3 Ω (20°C)
HT (H13–1) – +B (H13–2)	11.7 to 14.3 Ω (20°C)
HT (H14–1) – +B (H14–2)	11.7 to 14.3 Ω (20°C)

NG → **Replace heated oxygen sensor.**

OK

2	Check EFI or ECD relay.

EFI or ECD Relay



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PREPARATION:

Remove the EFI or ECD relay from the engine room R/B.

CHECK:

Inspect the EFI or ECD relay.

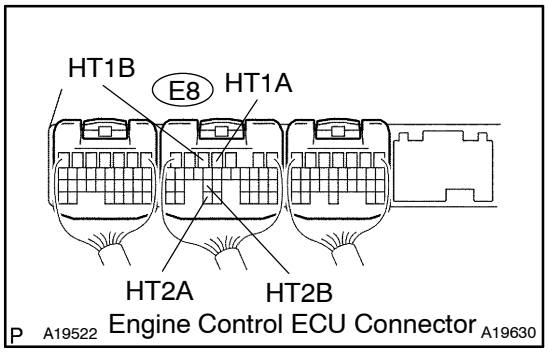
OK:

Terminal No.	Condition	Specified Condition
2 – 4	Constant	Continuity
1 – 3	Usually	No Continuity
	Apply B+ between terminals 2 and 4	Continuity

NG → **Replace EFI or ECD relay.**

OK

3	Check voltage between terminals HT1A, HT2A, HT1B, HT2B of engine control ECU connectors and body ground.



PREPARATION:

Turn the ignition switch ON.

CHECK:

Measure the voltage between terminals of the engine control ECU connectors and body ground.

HINT:

- Connect terminal HT1A to the bank 1 sensor 1.
- Connect terminal HT1B to the bank 1 sensor 2.
- Connect terminal HT2A to the bank 2 sensor 1.
- Connect terminal HT2B to the bank 2 sensor 2.

OK:

Tester Connection	Specified Condition
HT1A (E8–4) – Body ground	9 to 14 V
HT1B (E8–5) – Body ground	9 to 14 V
HT2A (E8–33) – Body ground	9 to 14 V
HT2B (E8–25) – Body ground	9 to 14 V

OK → **Replace engine control ECU (See Pub. No. RM630E, page FI–74).**

NG

Check and repair harness or connector between EFI or ECD relay and heated oxygen sensor, and heated oxygen sensor and engine control ECU (See page IN–20).