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)

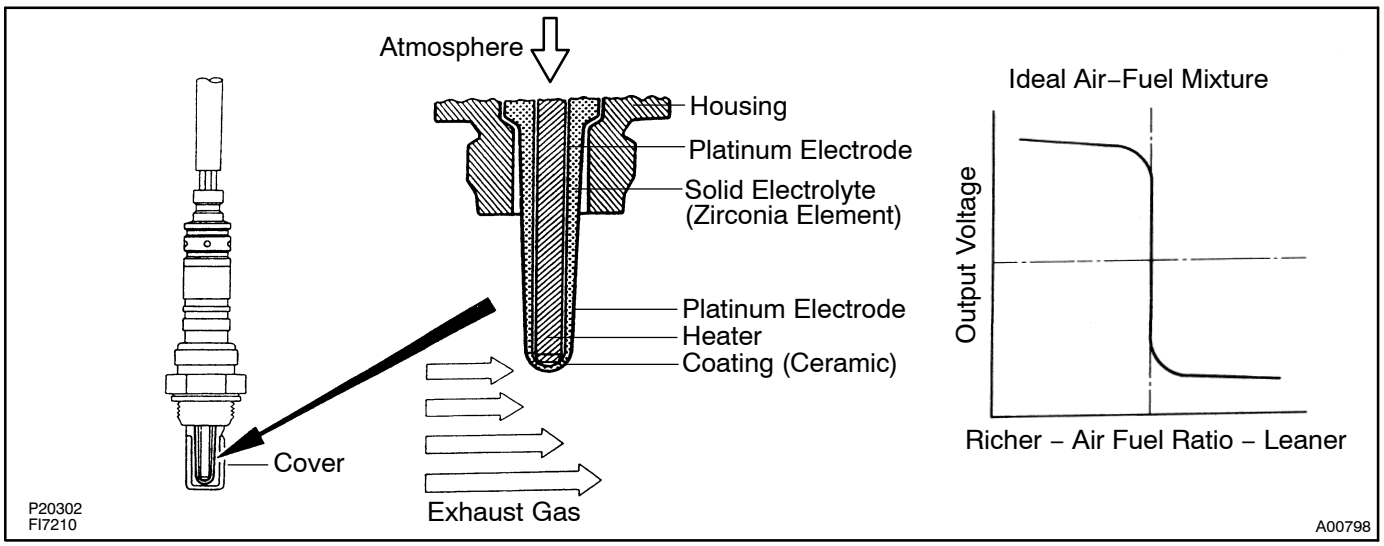
CIRCUIT DESCRIPTION

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 ECM 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 ECM of the LEAN condition (low voltage, i.e. less than 0.45 V).

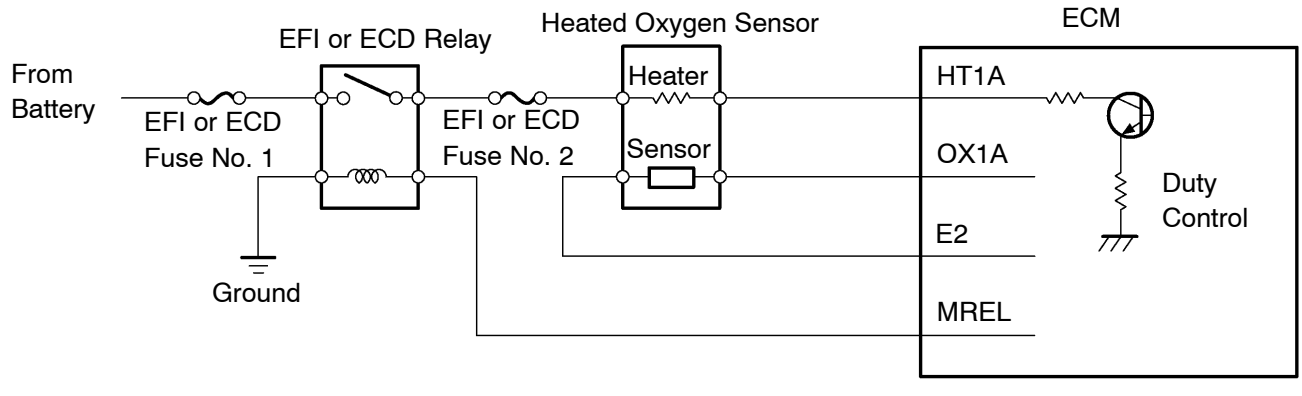
When the air–fuel ratio is RICHER than the stoichiometric air–fuel ratio, the oxygen concentration in the exhaust gas is reduced and the heated oxygen sensor informs the ECM of the RICH condition (high voltage, i.e. more than 0.45 V). The ECM judges by the voltage output from the heated oxygen sensor 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 ECM 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 ECM. 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 ECM 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	• Open in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • ECM
P0032 P0038 P0052 P0058	When heater operates, heater current exceeds 2.0 A	• Short in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI or ECD relay • ECM

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 ECM supplements the heat from the exhaust with heat from a heating element inside the sensor. When current in the sensor is out of the standard operating range, the ECM interprets this as a fault in the heated oxygen sensor and sets a DTC.

Example:

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

MONITOR STRATEGY

Related DTCs	P0031	Heated oxygen sensor heater current bank 1 sensor 1 (Low current)
	P0032	Heated oxygen sensor heater current bank 1 sensor 1 (High current)
	P0037	Heated oxygen sensor heater current bank 1 sensor 2 (Low current)
	P0038	Heated oxygen sensor heater current bank 1 sensor 2 (High current)
	P0051	Heated oxygen sensor heater current bank 2 sensor 1 (Low current)
	P0052	Heated oxygen sensor heater current bank 2 sensor 1 (High current)
	P0057	Heated oxygen sensor heater current bank 2 sensor 2 (Low current)
	P0058	Heated oxygen sensor heater current bank 2 sensor 2 (High current)
Required sensors/components	Main sensors/components	Heated oxygen sensor
	Related sensors/components	Vehicle speed sensor
Frequency of operation	Continuous	
Duration	0.3 sec.	
MIL operation	P0031, P0037, P0051, P0057: 1 driving cycle	
	P0032, P0038, P0052, P0058: Immediate	
Sequence of operation	None	

TYPICAL ENABLING CONDITIONS

Item	Specification	
	Minimum	Maximum
The monitor will run whenever the following DTCs are not present	See "List of disable a monitor" (on page DI–3)	
P0031, P0037, P0051, P0057 (Low current):		
Either of the following conditions is met:	A or B	
A. Following conditions are met:	1, 2, 3, 4 and 5	
1. Time after engine start	250 sec.	500 sec.
2. Battery voltage	10.5 V	–
3. Vehicle speed	–	90 km/h (56 mph)
4. Misfire	Not detected	
5. Pass/Fail detection in this driving cycle	Not detected	
B. Following conditions are met:	1, 2, 3, 4 and 5	
1. Time after engine start	500 sec.	–
2. Battery voltage	10.5 V	–
3. Vehicle speed	40 km/h (25 mph)	–
4. Misfire	Not detected	
5. Pass/Fail detection in this driving cycle	Not detected	
P0032, P0038, P0052, P0058 (High current):		
Intrusive heating is OFF		

TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
P0031, P0037, P0051, P0057 (Low current):	
Heated oxygen sensor heater current	Less than 0.25 A (at 0.3 sec. after heater "ON")
P0032, P0038, P0052, P0058 (High current):	
Heated oxygen sensor heater current	More than 2.0 A (while intrusive heating is OFF)

COMPONENT OPERATING RANGE

Parameter	Standard Value
Heated oxygen sensor heater current under the following conditions: (a) Engine has been warmed up (b) Engine is idling (c) Battery voltage is 11 to 14 V	0.4 to 1.0 A

MONITOR RESULT (MODE 06 DATA)

Refer to page DI–3 for detailed information.

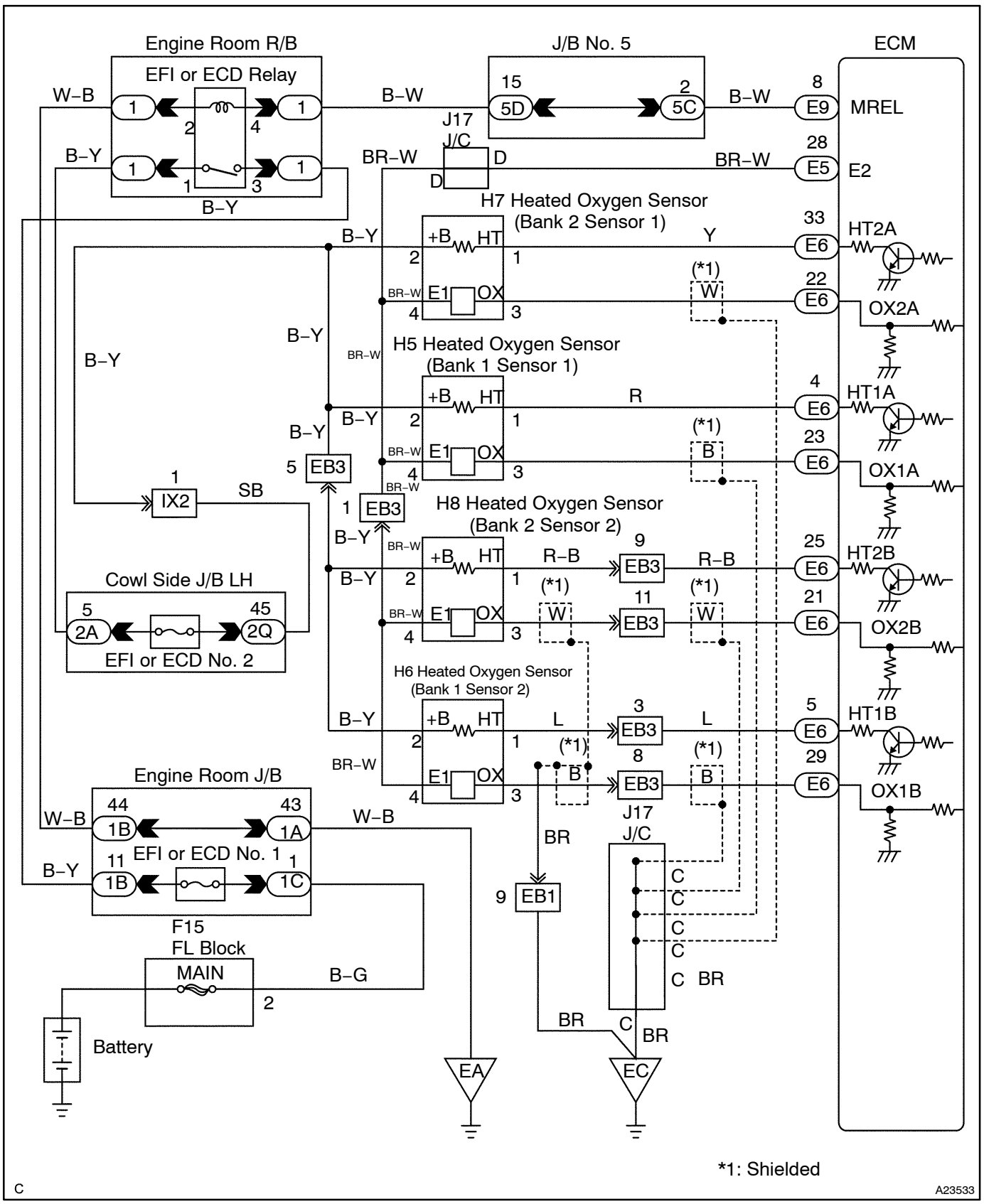
The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (see page DI–34)

- TID (Test Identification Data) is assigned to each emissions–related component.
- TID (Test Limit Type):
  If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
  If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component Identification Data) is assigned to each test value.
- Unit Conversion is used to calculate the test value indicated on generic OBDII scan tools.

TID $04: HO2S heater

TLT	CID	Unit Conversion	Description of Test Value	Description of Test Limit
1	$01	Multiply by 0.000076 [A]	Maximum HO2S heater current (Bank 1 Sensor 1)	Malfunction threshold for HO2S heater
1	$02	Multiply by 0.000076 [A]	Maximum HO2S heater current (Bank 1 Sensor 2)	Malfunction threshold for HO2S heater
1	$10	Multiply by 0.000076 [A]	Maximum HO2S heater current (Bank 2 Sensor 1)	Malfunction threshold for HO2S heater
1	$20	Multiply by 0.000076 [A]	Maximum HO2S heater current (Bank 2 Sensor 2)	Malfunction threshold for HO2S heater

WIRING DIAGRAM



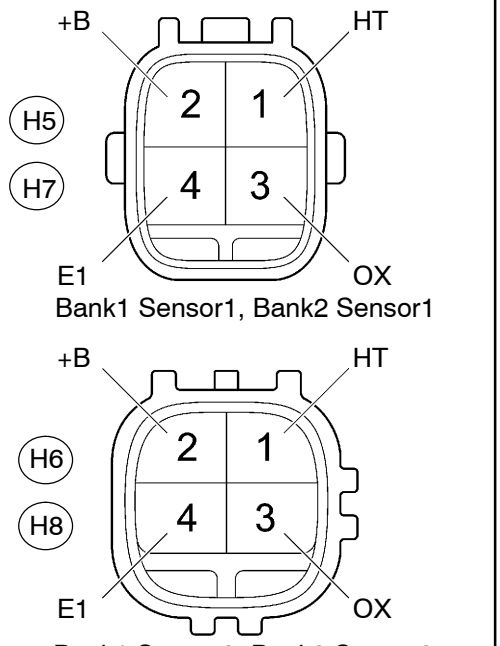
INSPECTION PROCEDURE

HINT:

Read freeze frame data using hand–held tester or OBD II scan tool. 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 H5, H6, H7 or H8 heated oxygen sensor connector.

CHECK:

Measure resistance between terminals of the heated oxygen sensor.

OK:

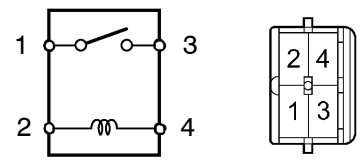
Tester Connection	Specified Condition
HT (H5–1) – +B (H5–2)	11 to 16 Ω (20°C)
HT (H6–1) – +B (H6–2)	11 to 16 Ω (20°C)
HT (H7–1) – +B (H7–2)	11 to 16 Ω (20°C)
HT (H8–1) – +B (H8–2)	11 to 16 Ω (20°C)

NG	**Replace heated oxygen sensor.**

OK

2	Check EFI or ECD relay.

EFI or ECD Relay



A21543

PREPARATION:

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

CHECK:

Inspect the EFI or ECD relay.

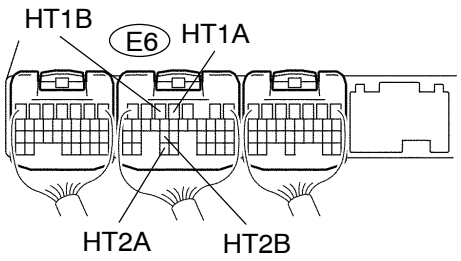
OK:

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 ECM connectors and body ground.



P A19522 ECM Connector A19630

PREPARATION:

Turn the ignition switch ON.

CHECK:

Measure the voltage between terminals of the ECM 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 (E6–4) – Body ground	9 to 14 V
HT1B (E6–5) – Body ground	9 to 14 V
HT2A (E6–33) – Body ground	9 to 14 V
HT2B (E6–25) – Body ground	9 to 14 V

OK → **Replace ECM (See page SF–60).**

NG

Check and repair harness or connector between EFI or ECD relay and heated oxygen sensor, and heated oxygen sensor and ECM (See page IN–36).