DIDT7−01

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

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

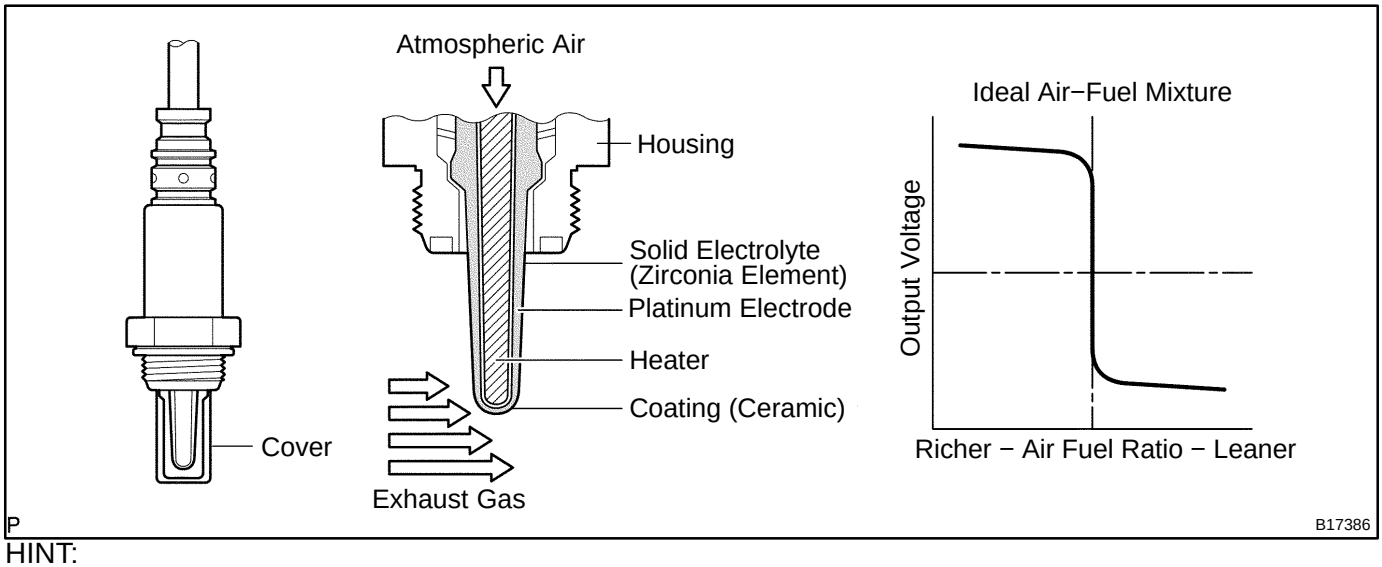
CIRCUIT DESCRIPTION

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).

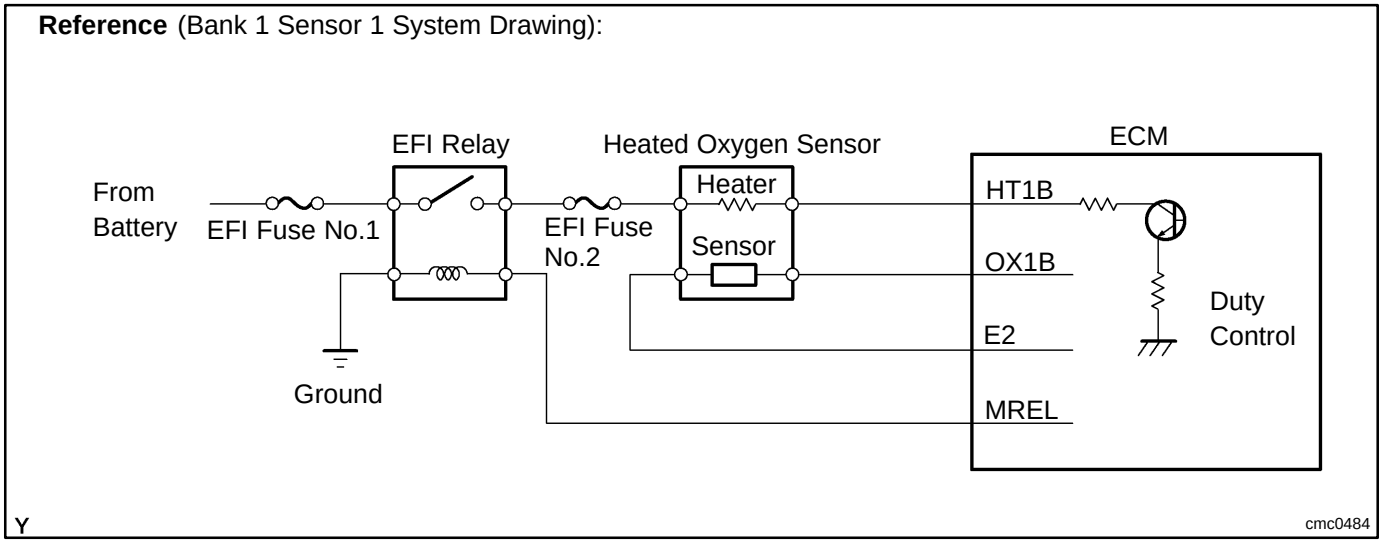
When the air−fuel ratio is RICHER than the stoichiometric air−fuel ratio, the oxygen concentration in the exhaust gas is reduced and the heated oxygen sensor informs the ECM of the RICH condition (high voltage, i.e. more than 0.45 V). The ECM judges by the voltage output from the heated oxygen sensor 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
P0037 P0057	Heater current is less than 0.3 A 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 relay • ECM
P0038 P0058	When heater operates, heater current exceeds 2.0 A	• Short in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI relay • ECM

HINT:

- Bank 1 refers to bank that 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 0.3 A when the heater is ON.

MONITOR STRATEGY

Related DTCs	P0037	Rear HO2S heater (Bank 1) range check (Low Current)
	P0038	Rear HO2S heater (Bank 1) range check (High Current)
	P0057	Rear HO2S heater (Bank 2) range check (Low Current)
	P0058	Rear HO2S heater (Bank 2) range check (High Current)
Required sensors/components	Main sensors/components	HO2S heater
	Related sensors/components	Vehicle speed sensor (VSS)
Frequency of operation	Continuous	
Duration	0.3 sec.	
MIL operation	Immediate	
Sequence of operation	None	

TYPICAL ENABLING CONDITIONS

Item	Specification	
	Minimum	Maximum
The monitor will run whenever these DTCs are not present	See page DI−18	
P0037, P0057 (Low current):		
Battery voltage	10.5 V	−
Engine	Running	
Starter	OFF	
Intrusive heating	Not operating	
All heater is turned OFF and intrusive heating is operated when the following conditions are met	Condition (a) and (b)	
(a) Heater	ON	
(b) Heater current	−	0.3 A
P0038, P0058 (High current):		
Case 1:		
Battery voltage	10.5 V	−
Engine	Running	
Starter	OFF	
Intrusive heating	Not operating	
Case 2:		
Battery voltage	10.5 V	−
All heater is turned OFF and intrusive heating is operated when the following conditions are met	Condition (a) and (b)	
(a) Heater	ON	
(b) Heater current	2 A	−

TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
P0037, P0057 (Low current):	
HO2S heater current during intrusive heating	Less than 0.3 A (when battery voltage is 10.5 V or more)
P0038, P0058 (High current):	
Case 1:	
HO2S heater current	2 A or more
Case 2:	
HO2S heater current during intrusive heating	More than 2 A

COMPONENT OPERATING RANGE

Parameter	Standard Value
HO2S heater current	0.4 to 1 A (at idle, warmed−up engine and +B: 11 to 14 V)

MONITOR RESULT

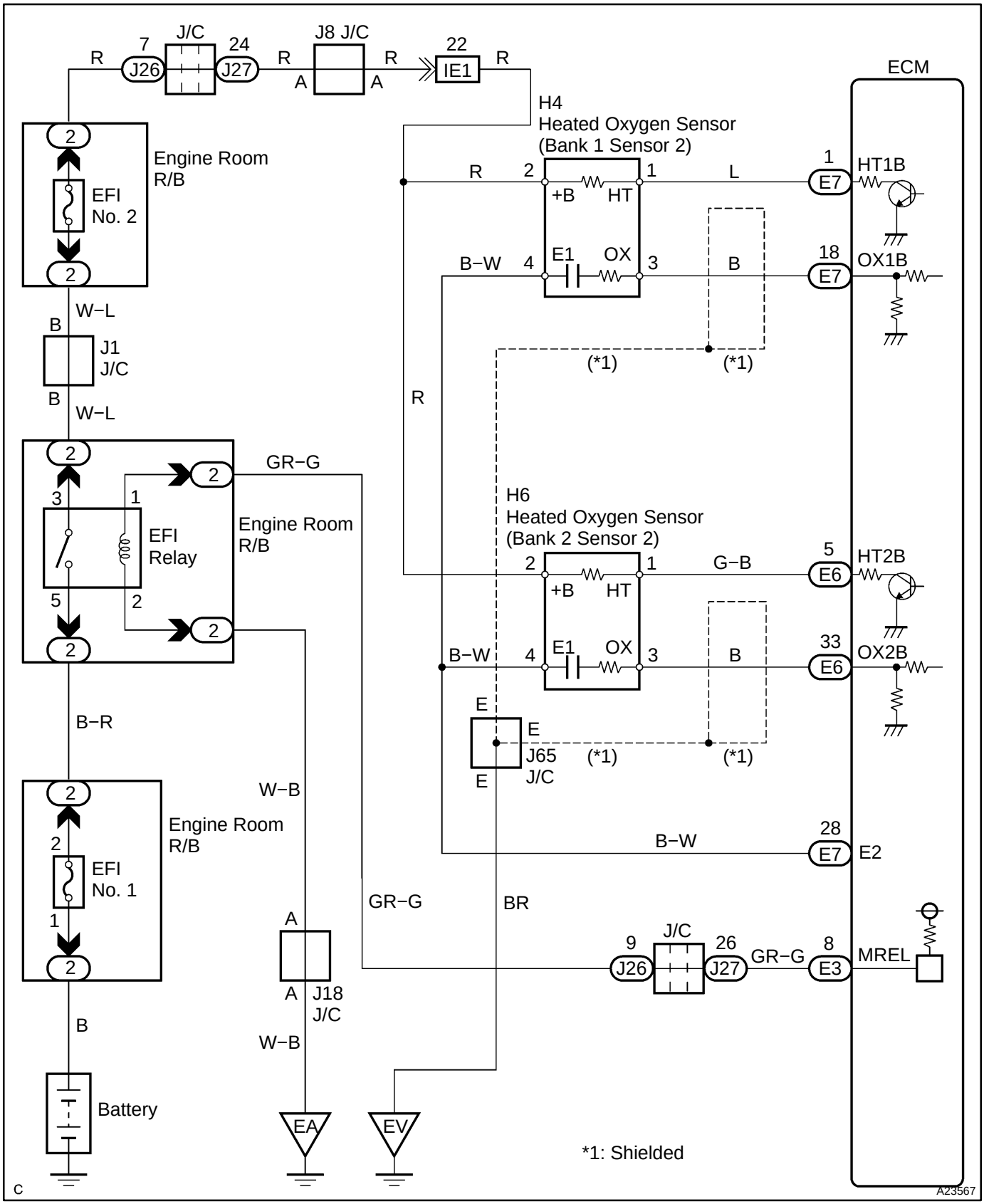
The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (see page DI−27).

- TID (Test Identification Data) is assigned to each emissions−related component.
- TLT (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.

TID $04: HO2S heater

TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
1	$02	Multiply by 0.000076 (A)	Maximum HO2S heater current (Bank 1 Sensor 2)	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



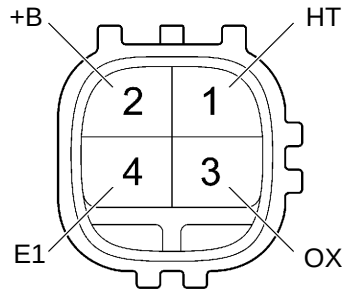
INSPECTION PROCEDURE

HINT:

Read freeze frame data using hand−held tester. 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. when a malfunction occurred.

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

Components Side:



PREPARATION:

Disconnect the H4 or H6 heated oxygen sensor connector.

CHECK:

Measure resistance between terminals of the heated oxygen sensor.

OK:

Standard:

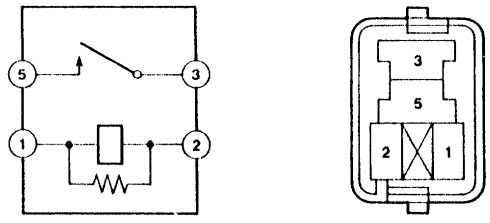
Tester Connection	Specified Condition
HT (H4−1) − +B (H4−2)	11 to 16 Ω at 20°C (68°F)
HT (H6−1) − +B (H6−2)	11 to 16 Ω at 20°C (68°F)

NG	**Replace heated oxygen sensor.**

OK

2	**Check EFI relay.**

EFI Relay



PREPARATION:

Remove the EFI relay from the engine room J/B.

CHECK:

Inspect the EFI relay.

OK:

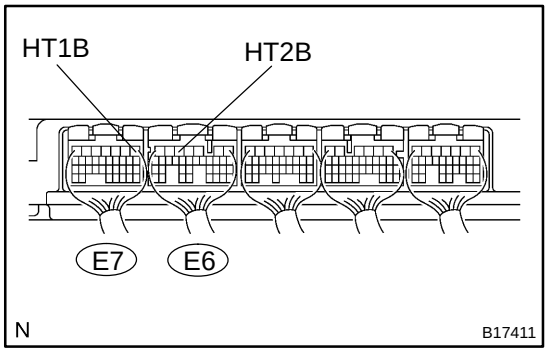
Standard:

Terminal No.	Condition	Specified Condition
3 − 5	Usually	10 KΩ or higher
3 − 5	Apply B+ between terminals 1 and 2	Below 1 Ω

NG	**Replace EFI relay.**

OK

3	**Check voltage between terminals HT1B, HT2B of ECM connectors and body ground.**



PREPARATION:

Turn the ignition switch ON.

CHECK:

Measure the voltage between terminals of the ECM connectors and body ground.

OK:

Standard:

Tester Connection	Specified Condition
HT1B (E7−1) − Body ground	9 to 14 V
HT2B (E6−5) − Body ground	9 to 14 V

HINT:

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

NG → **Replace ECM (See page SF−66).**

NG

Check and repair harness or connector between EFI relay and heated oxygen sensor, and heated oxygen sensor and ECM (See page SF−66).