

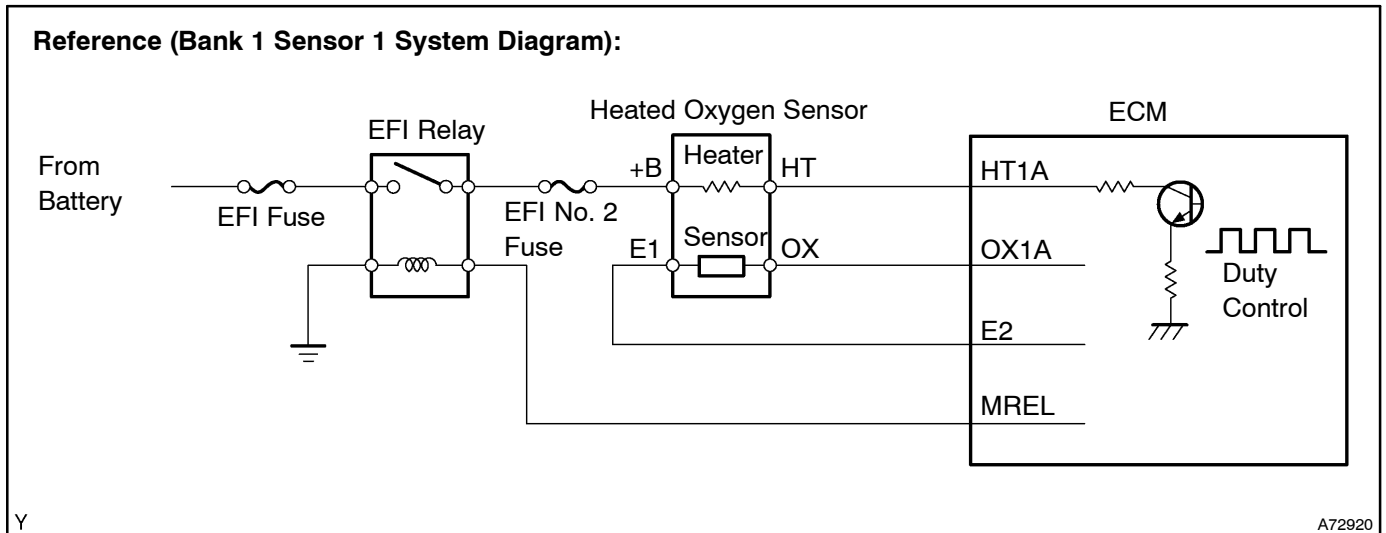
DTC	P0031	OXYGEN SENSOR HEATER CONTROL CIRCUIT LOW (BANK 1 SENSOR 1)
DTC	P0032	OXYGEN SENSOR HEATER CONTROL CIRCUIT HIGH (BANK 1 SENSOR 1)
DTC	P0037	OXYGEN SENSOR HEATER CONTROL CIRCUIT LOW (BANK 1 SENSOR 2)
DTC	P0038	OXYGEN SENSOR HEATER CONTROL CIRCUIT HIGH (BANK 1 SENSOR 2)
DTC	P0051	OXYGEN SENSOR 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

Refer to DTC P0130 on page 05-102.

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.



DTC No.	DTC Detection Condition	Trouble Area
P0031 P0037 P0051 P0057	(1) Heated current is 0.2 A or less when heater operates with +B voltage between 10.5 V and 11.5 V (1 trip detection logic) (2) Heated current is 0.25 A or less when heater operates with +B greater than 11.5 V (1 trip detection logic)	<ul style="list-style-type: none"> • Open or short in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI relay • EFI No. 2 fuse • ECM
P0032 P0038 P0052 P0058	When heater operates, heater current exceeds 2 A (1 trip detection logic)	<ul style="list-style-type: none"> • Short in heater circuit of heated oxygen sensor • Heated oxygen sensor heater • EFI 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 body.
- Sensor 2 refers to the sensor farthest away from the engine body.

MONITOR DESCRIPTION

The ECM uses the heated oxygen sensor information to regulate the air-fuel ratio close to a stoichiometric ratio. This maximizes the catalytic converter's ability to purify the exhaust gases. The sensor detects oxygen levels in the exhaust gas and sends this signal to the ECM.

The inner surface of the sensor element is exposed to outside air. The outer surface of the sensor element is exposed to exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element. The oxygen sensor has the characteristic whereby its output voltage change suddenly in the vicinity of the stoichiometric air-fuel ratio. When heated, the sensor becomes very efficient. If the temperature of the exhaust is low, the sensor will not generate useful voltage signals without supplemental heating. The ECM regulates the supplemental heating using a duty-cycle approach to regulate the average current in the heater element. If the heater current is out of the normal range, the sensor's output signals will be inaccurate and the ECM cannot regulate the air-fuel ratio properly. When the heater current is out of the normal operating range, the ECM interprets this as a malfunction and sets a DTC.

Example:

The ECM will set a high current DTC if the current in the sensor is more than 2 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)	Heated oxygen sensor
Required sensors/ components (Related)	Vehicle speed sensor
Frequency of operation	Continuous
Duration	0.3 second
MIL operation	1 driving cycle
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	See page 05-13
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P0031, P0037, P0051 and P0057 (Low current):

Either of the following conditions A and B is met	
Condition A	
Time after engine start	250 to 500 seconds
Battery voltage	10.5 V or more
Vehicle speed	Within 56 mph (90 km/h)
Misfire	None
Pass or Fail detection in this driving cycle	None
Condition B	
Time after engine start	500 seconds or more
Battery voltage	10.5 V or more
Vehicle speed	25 mph (40 km/h) or more
Misfire	None
Pass or Fail detection in this driving cycle	None

P0032, P0038, P0052 and P0058 (High current):

Intrusive heating	OFF
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TYPICAL MALFUNCTION THRESHOLDS

P0031, P0037, P0051 and P0057 (Low current):

Heated oxygen sensor heater current	Less than 0.25 A (at 0.3 sec. after heater "ON")
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P0032, P0038, P0052 and P0058 (High current):

Heated oxygen sensor heater current	More than 2A (while intrusive heating is OFF)
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COMPONENT OPERATING RANGE

Heated oxygen sensor heater current	0.4 to 1 A (at idle, warmed-up engine and +B: 11 to 14 V)
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MONITOR STATUS

The Monitor Status (mode 6) allows the OBD scan tool to display the monitor result, test value and test limit (malfunction criterion). A problem in this component can be found by comparing the test value and test limit. This procedure is described in "CHECKING MONITOR STATUS" (see page 05-21).

- TID (Test Identification) is assigned to each emission-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) is assigned to each test value.
- Unit Conversion is used to calculate the test value indicated on generic OBD 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 criterion
1	\$02	Multiply by 0.000076 (A)	Maximum HO2S heater current (bank 1 sensor 2)	Malfunction criterion
1	\$10	Multiply by 0.000076 (A)	Maximum HO2S heater current (bank 2 sensor 1)	Malfunction criterion
1	\$20	Multiply by 0.000076 (A)	Maximum HO2S heater current (bank 2 sensor 2)	Malfunction criterion

WIRING DIAGRAM

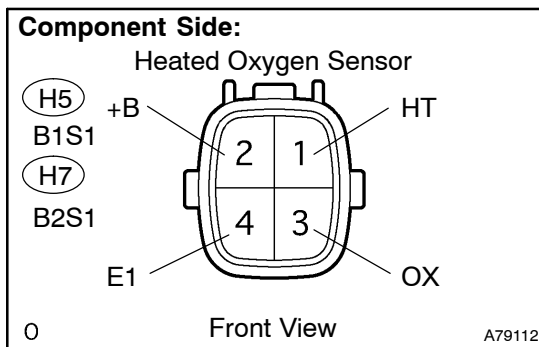
Refer to DTC P0130 on page 05-102.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand-held tester or the OBD II scan tool. 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 HEATED OXYGEN SENSOR(HEATER RESISTANCE)



- Disconnect the H5, H6, H7 or H8 heated oxygen sensor connector.
- Measure the resistance between the terminals of the heated oxygen sensor connector.

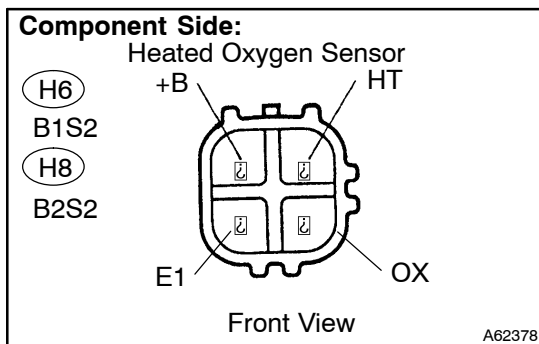
Standard (Bank 1, 2 sensor 1):

Tester Connection	Specified Condition
1 (HT) - 2 (+B)	11 to 16 Ω at 20 °C (68 °F)
1 (HT) - 4 (E1)	10 kΩ or higher

Standard (Bank 1, 2 sensor 2):

Tester Connection	Specified Condition
1 (HT) - 2 (+B)	11 to 16 Ω at 20 °C (68 °F)
1 (HT) - 4 (E1)	10 kΩ or higher

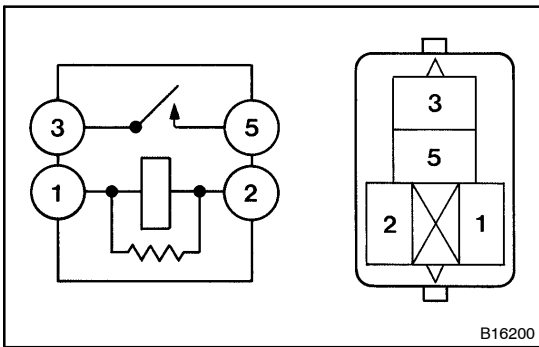
- Reconnect the heated oxygen sensor connector.



NG → REPLACE HEATED OXYGEN SENSOR

OK

2 INSPECT EFI RELAY



- (a) Remove the EFI relay from the engine room R/B.
- (b) Check for continuity in the EFI relay.

Standard:

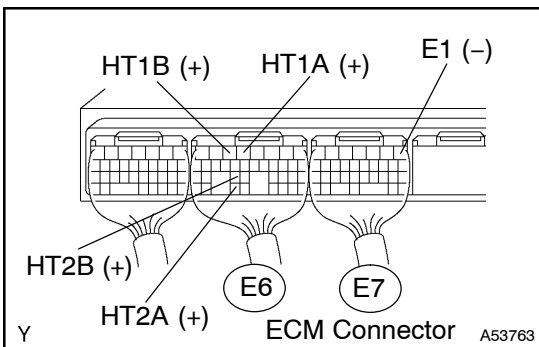
Tester Connection	Specified Condition
1 - 2	Continuity
3 - 5	No continuity
3 - 5	Continuity (Apply battery voltage to terminals 1 and 2)

- (c) Reinstall the EFI relay.

NG → **REPLACE EFI RELAY**

OK

3 INSPECT ECM(HT1A, HT1B, HT2A OR HT2B VOLTAGE)



- (a) Turn the ignition switch to ON.
- (b) Measure the voltage between the applicable terminals of the E6 and E7 ECM connectors.

Standard:

Tester Connection	Specified Condition
HT1A (E6-4) - E1 (E7-1)	9 to 14 V
HT1B (E6-5) - E1 (E7-1)	9 to 14 V
HT2A (E6-33) - E1 (E7-1)	9 to 14 V
HT2B (E6-25) - E1 (E7-1)	9 to 14 V

HINT:

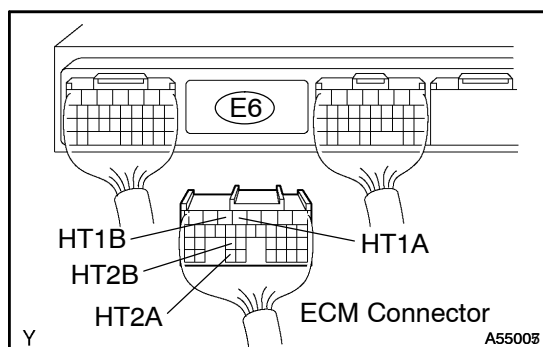
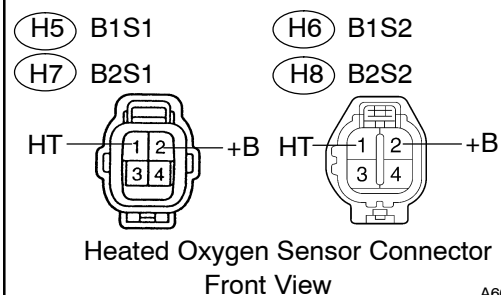
- The HT1A means the heated oxygen sensor bank 1 sensor 1.
- The HT1B means the heated oxygen sensor bank 1 sensor 2.
- The HT2A means the heated oxygen sensor bank 2 sensor 1.
- The HT2B means the heated oxygen sensor bank 2 sensor 2.

OK → **REPLACE ECM (See page 10-7)**

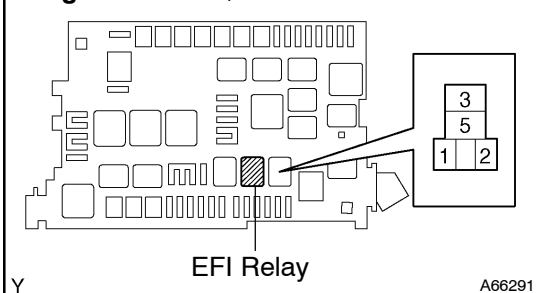
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4 CHECK HARNESS AND CONNECTOR(HEATED OXYGEN SENSOR - ECM, HEATED OXYGEN SENSOR - EFI RELAY)

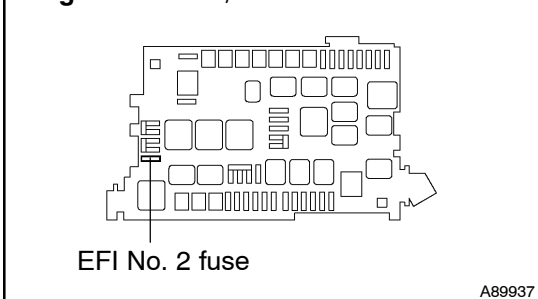
Wire Harness Side:



Engine Room R/B:



Engine Room R/B:



(a) Check the harness and connector between the ECM and heated oxygen sensor connectors.

- (1) Disconnect the H5, H6, H7 or H8 heated oxygen sensor connector.
- (2) Disconnect the E6 ECM connector.
- (3) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
HT (H5-1) - HT1A (E6-4)	Below 1 Ω
HT (H6-1) - HT1B (E6-5)	Below 1 Ω
HT (H7-1) - HT2A (E6-33)	Below 1 Ω
HT (H8-1) - HT2B (E6-25)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
HT (H5-1) or HT1A (E6-4) - Body ground	10 k Ω or higher
HT (H6-1) or HT1B (E6-5) - Body ground	10 k Ω or higher
HT (H7-1) or HT2A (E6-33) - Body ground	10 k Ω or higher
HT (H8-1) or HT2B (E6-25) - Body ground	10 k Ω or higher

- (4) Reconnect the heated oxygen sensor connector.
- (5) Reconnect the ECM connector.

(b) Check the harness and connector between the heated oxygen sensor and EFI relay.

- (1) Inspect the EFI No.2 fuse.
 - Remove the EFI No.2 fuse from the engine room R/B.
 - Check for continuity in the EFI No.2 fuse.

Standard: Continuity

- Reinstall the EFI No. 2 fuse.
- (2) Disconnect the H5, H6, H7 or H8 heated oxygen sensor connector.
 - (3) Remove the EFI relay from the engine room R/B.
 - (4) Check the resistance between the wire harness side connectors.

Standard (Check for open):

Tester Connection	Specified Condition
+B (H5-2) - Engine room R/B (EFI relay terminal 3)	Below 1 Ω
+B (H6-2) - Engine room R/B (EFI relay terminal 3)	Below 1 Ω
+B (H7-2) - Engine room R/B (EFI relay terminal 3)	Below 1 Ω
+B (H8-2) - Engine room R/B (EFI relay terminal 3)	Below 1 Ω

Standard (Check for short):

Tester Connection	Specified Condition
+B (H5-2) or Engine room R/B (EFI relay terminal 3) - Body ground	10 kΩ or higher
+B (H6-2) or Engine room R/B (EFI relay terminal 3) - Body ground	10 kΩ or higher
+B (H7-2) or Engine room R/B (EFI relay terminal 3) - Body ground	10 kΩ or higher
+B (H8-2) or Engine room R/B (EFI relay terminal 3) - Body ground	10 kΩ or higher

- (5) Reconnect the heated oxygen sensor connector.
 (6) Reinstall the EFI relay.

NG	REPAIR OR REPLACE HARNESS OR CONNECTOR
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OK

REPLACE ECM (See page 10-7)
