

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)

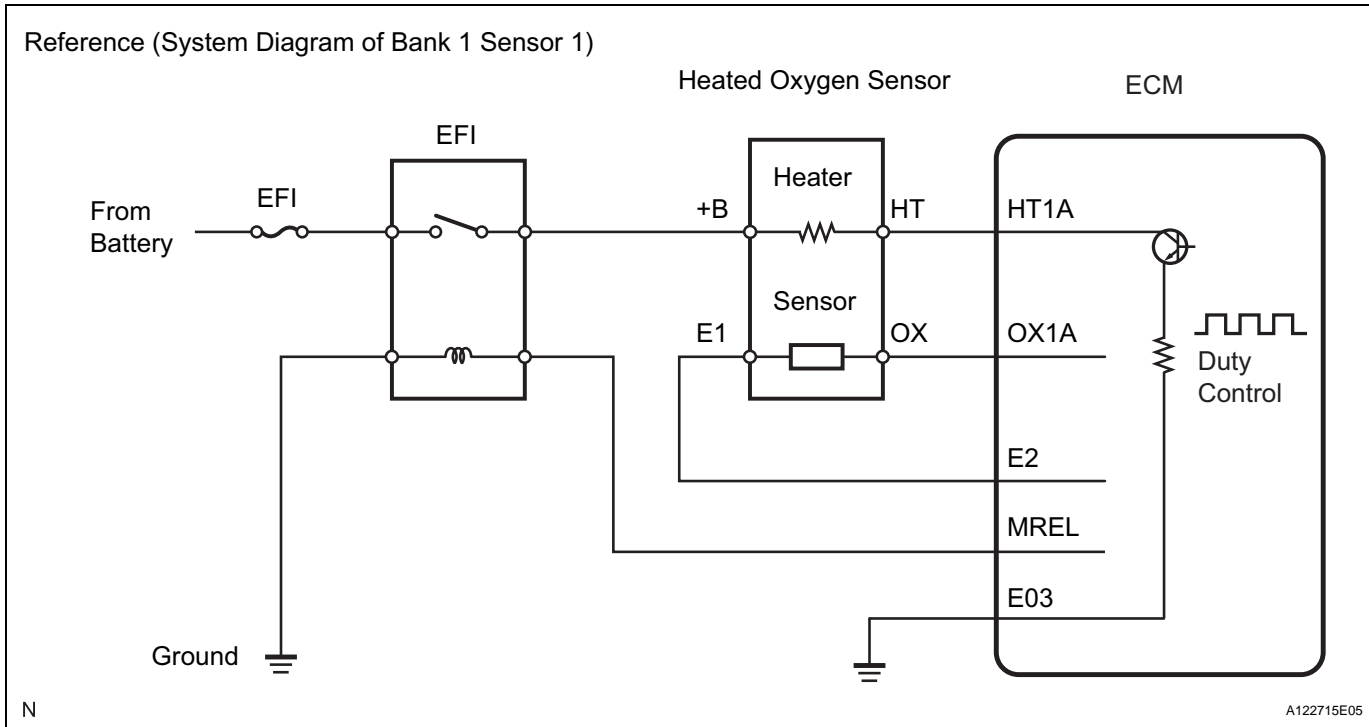
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DESCRIPTION

Refer to DTC P0130 (see page ES-110).

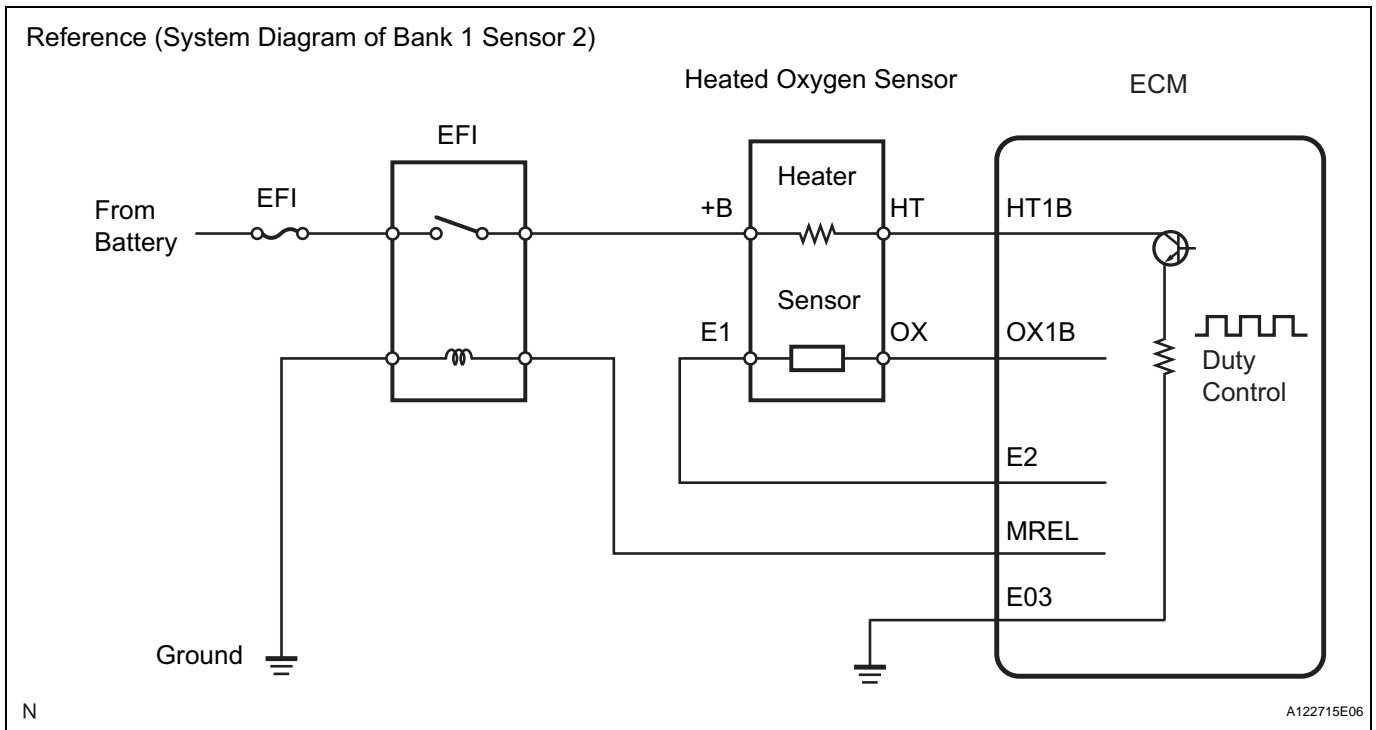
HINT:

- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC), and located near the engine assembly.
- Sensor 2 refers to the sensor mounted behind the TWC, and located far from the engine assembly.
- When any of these DTCs are set, the ECM enters fail-safe mode. During fail-safe mode, the ECM turns off the Heated Oxygen (HO2) sensor heater. Fail-safe mode continues until the ignition switch is turned OFF.
- The ECM provides a pulse width modulated control circuit to adjust current through the heater. The sensor heater circuit uses a relay on the +B side of the circuit.



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DTC No.	DTC Detection Condition	Trouble Area
P0031 P0037	Heated current 0.3 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 Heated Oxygen (HO2) sensor heater circuit • HO2 sensor heater • EFI relay • ECM
P0032 P0038	Heated current exceeds 2 A when heater operates (1 trip detection logic)	<ul style="list-style-type: none"> • Short in HO2 sensor • HO2 sensor heater • EFI relay • ECM

MONITOR DESCRIPTION

The ECM uses information from the Heated Oxygen (HO2) sensor to regulate the air-fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-Way Catalytic Converter (TWC) to purify the exhaust gases.

The HO2 sensor detects oxygen levels in the exhaust gas and transmits the information 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 the exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element.

The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies the voltage generation.

The HO2 sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the HO2 sensor will be inaccurate. As a result, the ECM will be unable to regulate air-fuel ratio properly.

When the current in the HO2 sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and sets a DTC.

Example:

The ECM sets either DTC P0032 or P0038 when the current in the HO2 sensor heater is more than 2 A despite the heater being OFF. Conversely, when the heater current is less than 0.3 A despite the heater being ON, DTC P0031 or P0037 is set.

MONITOR STRATEGY

Related DTCs	P0031: HO2S heater (bank 1 sensor 1) range check (low current) P0032: HO2S heater (bank 1 sensor 1) range check (high current) P0037: HO2S heater (bank 1 sensor 2) range check (low current) P0038: HO2S heater (bank 1 sensor 2) range check (high current)
Required sensors/components (Main)	HO2S heater
Required sensors/components (Related)	Vehicle Speed Sensor (VSS)
Frequency of operation	Continuous
Duration	0.3 seconds
MIL operation	Immediate
Sequence of operation	None

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TYPICAL ENABLING CONDITIONS

Battery voltage	10.5 V or more
Engine	Running
Starter	OFF
Intrusive heating	Not operating

P0031 and P0037:

Duration of following conditions	0.5 seconds or more
Learned heater current during heater OFF	Completed
Heater current	Less than 0.3 A
Intrusive heating for high current monitor	Not operating
Time after all heaters are OFF	1 second or more

P0032 and P0038:

Duration of following conditions	0.3 seconds or more
Learned heater current during heater OFF	Completed
Heater current	2 A or more
Time after all heaters are OFF	1 second or more

TYPICAL MALFUNCTION THRESHOLDS

P0031 and P0037:

HO2 sensor heater current when heated oxygen sensor heater ON	Less than 0.3 A
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P0032 and P0038:

HO2 sensor heater current when heated oxygen sensor heater OFF	More than 2 A
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COMPONENT OPERATING RANGE

HO2 sensor heater current	0.3 to 2 A (when idling with warm engine and battery voltage 11 to 14 V)
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MONITOR RESULT

Refer to CHECKING MONITOR STATUS (see page [ES-19](#)).

WIRING DIAGRAM

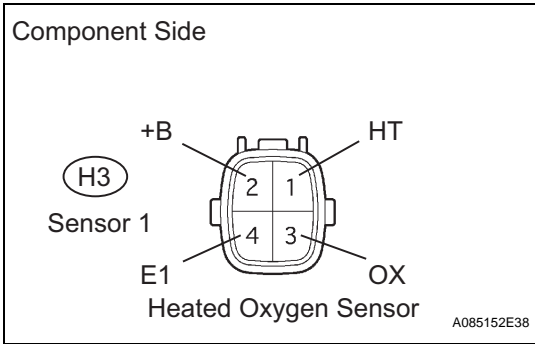
Refer to DTC P0130 (see page [ES-113](#)).

HINT:

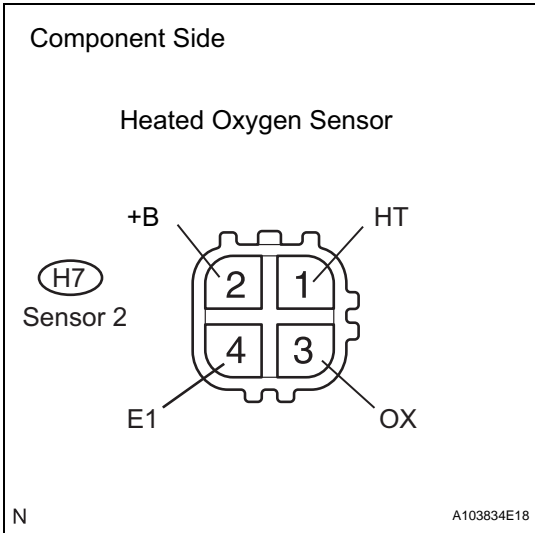
Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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1 INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)



(a) Disconnect the H3 or H7 Heated Oxygen (HO2) sensor connector.



(b) Measure the resistance of the HO2 sensor connector.

Standard resistance (Sensor 1)

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

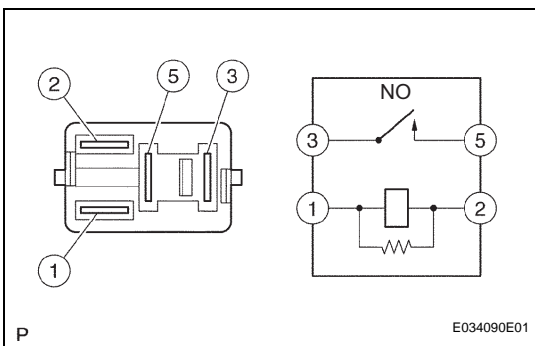
Standard resistance (Sensor 2)

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

NG → **REPLACE HEATED OXYGEN SENSOR**

OK

2 INSPECT EFI RELAY (Marking: EFI)



(a) Remove the EFI relay from the engine room relay block.

(b) Measure the resistance of the EFI relay.

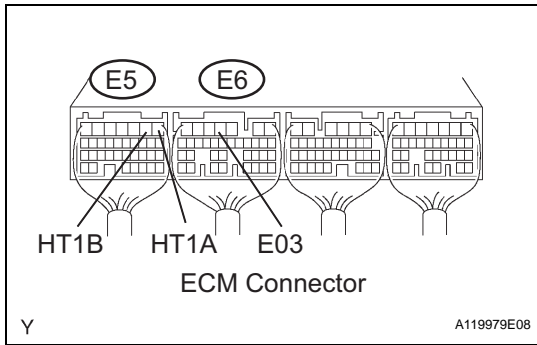
Standard resistance

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

NG → **REPLACE EFI RELAY**

OK

3 INSPECT ECM (HT1A, HT1B VOLTAGE)



- (a) Turn the ignition switch ON.
- (b) Measure the voltage of the ECM connectors.

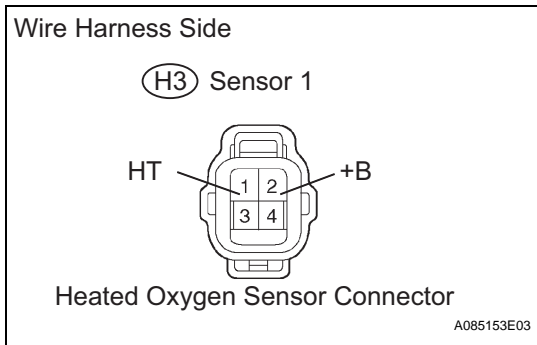
Standard voltage

Tester Connection	Specified Condition
HT1A (E5-1) - E03 (E6-4)	9 to 14 V
HT1B (E5-2) - E03 (E6-4)	9 to 14 V

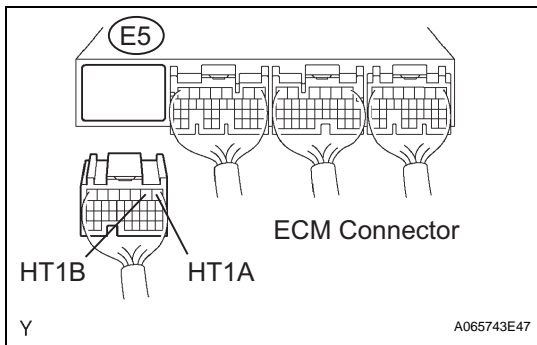
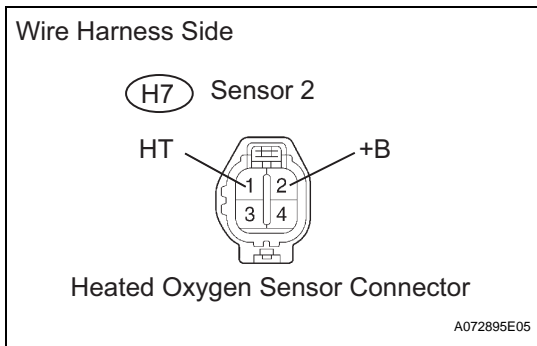
OK → **REPLACE ECM**

NG

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



- (a) Check the harness and connectors between the ECM and HO2 sensor.
 - (1) Disconnect the H3 or H7 HO2 sensor connector.



- (2) Disconnect the E5 ECM connector.
- (3) Measure the resistance of the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
HT (H3-1) - HT1A (E5-1)	Below 1 Ω
HT (H7-1) - HT1B (E5-2)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
HT (H3-1) or HT1A (E5-1) - Body ground	10 kΩ or higher

Tester Connection	Specified Condition
HT (H7-1) or HT1B (E5-2) - Body ground	10 kΩ or higher

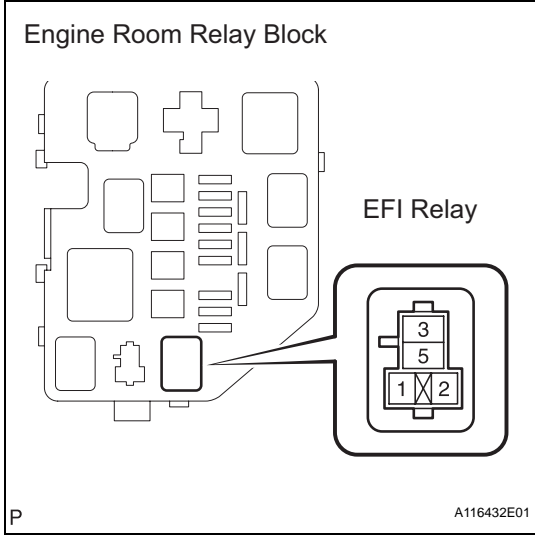
- (b) Check the harness and connectors between the HO2 sensor and EFI relay.
- (1) Disconnect the H3 or H7 HO2 sensor connector.
 - (2) Remove the EFI relay from the engine room relay block.
 - (3) Measure the resistance of the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
+B (H3-2) - Engine room relay block (EFI relay terminal 3)	Below 1 Ω
+B (H7-2) - Engine room relay block (EFI relay terminal 3)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
+B (H3-2) or Engine room relay block (EFI relay terminal 3) - Body ground	10 kΩ or higher
+B (H7-2) or Engine room relay block (EFI relay terminal 3) - Body ground	10 kΩ or higher



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

OK

REPLACE ECM

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