DTC	P0130	OXYGEN SENSOR CIRCUIT (BANK 1 SENSOR 1)

DTC	P0150	OXYGEN SENSOR CIRCUIT (BANK 2 SENSOR 1)

DTC	P2195	OXYGEN SENSOR SIGNAL STUCK LEAN (BANK 1 SENSOR 1)

DTC	P2196	OXYGEN SENSOR SIGNAL STUCK RICH (BANK 1 SENSOR 1)

DTC	P2197	OXYGEN SENSOR SIGNAL STUCK LEAN (BANK 2 SENSOR 1)

DTC	P2198	OXYGEN SENSOR SIGNAL STUCK RICH (BANK 2 SENSOR 1)

HINT:

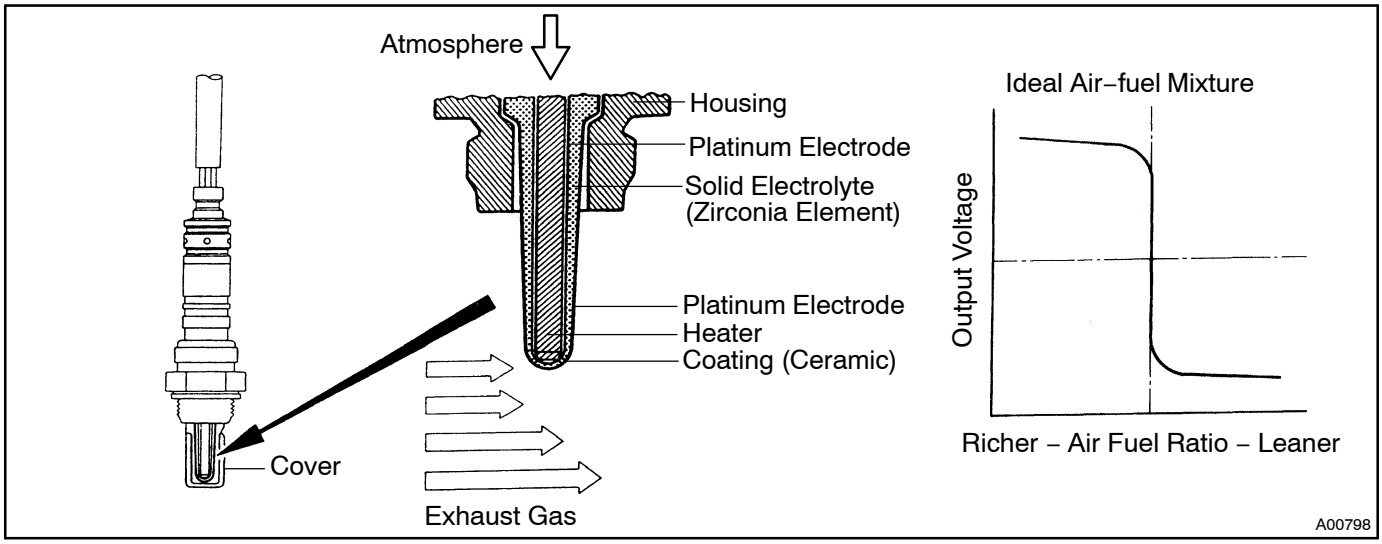
- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that does not include cylinder No. 1.
- Cylinder No. 1 is located in the front part of the engine, opposite the transmission.
- Sensor 1 refers to the sensor closest to the engine body.
- Sensor 2 refers to the sensor farthest away from the engine body.

CIRCUIT DESCRIPTION

The Heated Oxygen Sensor (HO2S) is used to monitor oxygen concentration in the exhaust gas. For optimum catalytic converter operation, the air–fuel mixture must be maintained near the ideal stoichiometric ratio. The HO2S output voltage changes suddenly in the vicinity of the stoichiometric ratio. The ECM adjusts the fuel injection time so that the air–fuel ratio is nearly stoichiometric.

If the oxygen concentration in the exhaust gas increases, the air–fuel ratio is LEAN. The HO2S voltage drops below 0.45 V and the HO2S informs the ECM of the LEAN condition.

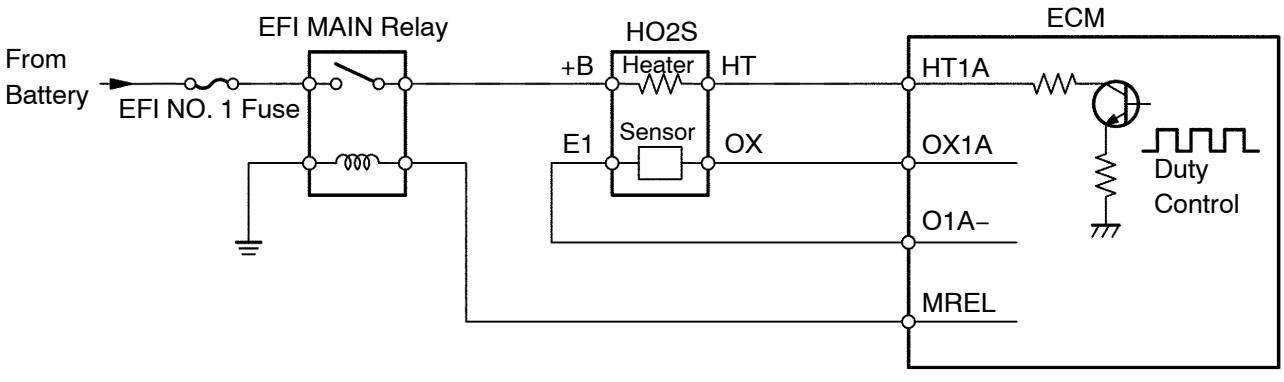
If oxygen is not in the exhaust gas, the air–fuel ratio is RICH. The HO2S voltage increases above 0.45 V and the HO2S informs the ECM of the RICH condition.



HINT:

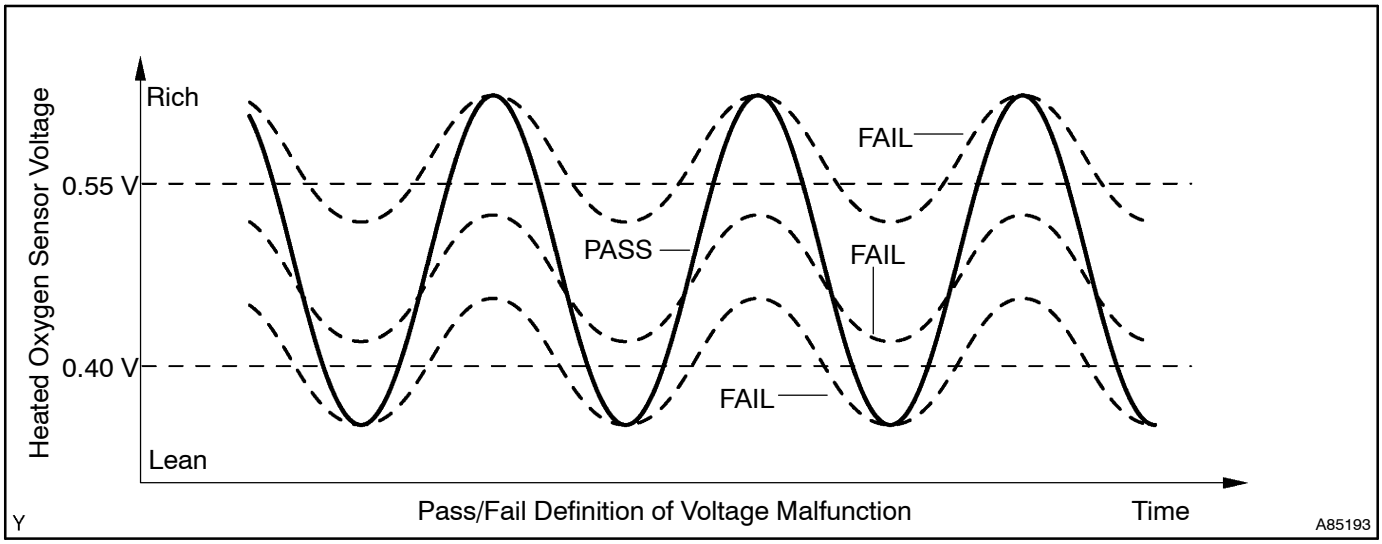
The ECM provides a pulse width modulated control circuit to adjust current through the heater. The HO2S heater circuit uses a relay on the +B side of the circuit.

Reference (Bank 1 Sensor 1 System Drawing):



DTC No.	DTC Detection Condition	Trouble Area
P0130 P0150	The following conditions are met (2 trip detection logic): • HO2S (sensor 1) voltage remains at 0.4 V or more (stuck in RICH condition) • HO2S (sensor 1) voltage remains at below 0.55 V (stuck in LEAN condition) • Engine is idling after engine warm–up	• Open or short in HO2S (sensor 1) circuit • HO2S (sensor 1) • EFI MAIN relay • Air induction system • Fuel pressure • Injector • ECM
P2195 P2197	The following conditions are met (2 trip detection logic): • HO2S (sensor 1) voltage remains at below 0.55 V (stuck in LEAN condition) • Engine is idling after engine warm–up	• Open or short in HO2S (sensor 1) circuit • HO2S (sensor 1) • EFI MAIN relay • Air induction system • Fuel pressure • Injector • ECM
P2196 P2198	The following conditions are met (2 trip detection logic): • HO2S (sensor 1) voltage remains at 0.4 V or more (stuck in RICH condition) • Engine is idling after engine warm–up	• Open or short in HO2S (sensor 1) circuit • HO2S (sensor 1) • EFI MAIN relay • Air induction system • Fuel pressure • Injector • ECM

MONITOR DESCRIPTION



The ECM uses the HO2S information to regulate the air–fuel ratio close to the stoichiometric ratio. This maximizes the catalytic converter's ability to purify the exhaust gases. The HO2S detects oxygen levels in the exhaust gas and sends a signal to the ECM.

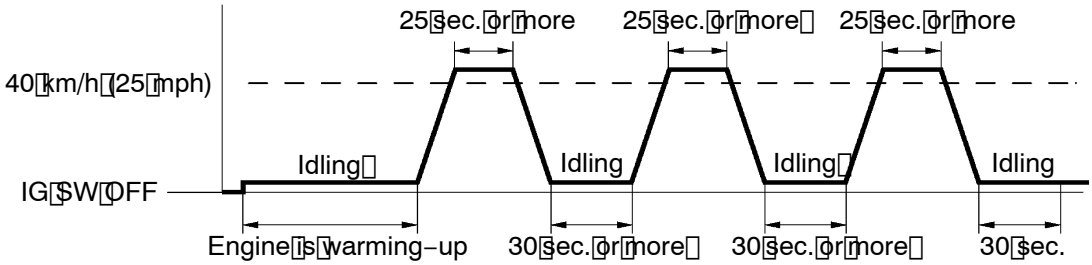
The inner surface of the sensor element is exposed to outside air. The outer surface of the sensor element is exposed to the exhaust gases. The sensor element is made of platinum coated zirconia and includes an integrated heating element. The HO2S's output voltage changes suddenly in the vicinity of the stoichiometric air–fuel ratio. The HO2S generates output voltage between 0.1 V and 0.9 V in response to the oxygen concentration in exhaust gas. When the front HO2S voltage is 0.45 V or more, the ECM judges that the air–fuel ratio is RICH. When it is 0.45 V or less, the ECM judges that the air–fuel ratio is LEAN.

The HO2S should indicate RICH and LEAN alternately at a regular cycle under the air–fuel ratio feedback control. If the HO2S voltage remains at RICH or LEAN for about 20 seconds on 3 different occasions, the ECM interprets this as malfunction of the HO2S. The ECM illuminates the MIL (2 trip detection logic) and sets a DTC.

WIRING DIAGRAM

Refer to DTC P0031 on page 05–54.

CONFIRMATION DRIVING PATTERN



(a) Connect the Intelligent Tester II to the DLC3.
(b) Switch from normal mode to check mode (see page 05–27).
(c) Allow the engine to idle until the Engine Coolant Temperature (ECT) reaches 75°C (167°F).
(d) Allow the vehicle to run at 40 km/h (25 mph) or more for 25 seconds or more.
(e) Allow the engine to idle for 30 seconds or more. Perform steps (d) and (e) at least 3 times.
(f) Allow the engine to idle for 30 seconds.

HINT:

If a malfunction exists, the MIL will be illuminated on the multi–information display during step (f).

NOTICE:

If the conditions in this test are not strictly followed, you should perform steps (d) and (e).

If you do not have the Intelligent Tester II, turn the ignition switch OFF after performing steps from (c) to (f), then perform steps from (c) to (f) again.

INSPECTION PROCEDURE

HINT:

It is possible the malfunctioning area can be found using the active test ”Control the injection volume A/F sensor” operation. The active test can determine if the HO2S or othe potential trouble areas are malfunctioning or not.

The injection volume can be switched to –12.5 % (decrease) or +25 % (increase) by the active test.

The active test procedure enables a technician to check and graph the voltage outputs of the HO2Ss.

Procedure:

(a) Connect the Intelligent Tester II to the DLC3 on the vehicle.
(b) Turn the ignition switch ON.
(c) Warm up the engine by running the engine at 2,500 rpm for approximately 90 seconds.
(d) Enter the following menus: Active Test/ Control the injection volume A/F sensor.
(e) Perform the active test at the engine idling.

Standard:

The HO2S reacts in accordance with increase and decrease of injection volume +25 % → Rich output: more than 0.55 V

–12.5 % → Lean output: Less than 0.4 V

NOTICE:
The HO2S (sensor 1) output has a few seconds of delay and the HO2S (sensor 2) output has a maximum of 20 seconds of delay.
If the vehicle is short of fuel, the air–fuel ratio becomes LEAN and the DTCs will be recorded.

Case	HO2S Voltage (Sensor 1)	HO2S Voltage (Sensor 2)	Main Suspected Trouble Area
1	Injection Volume +25% –12.5% HO2S Voltage 0.55 V or more Below 0.4 V OK	Injection Volume +25% –12.5% HO2S Voltage 0.5 V or more Below 0.4 V OK	–
2	Injection Volume +25% –12.5% HO2S Voltage Almost no reaction NG	Injection Volume +25% –12.5% HO2S Voltage 0.5 V or more Below 0.4 V OK	HO2S (sensor 1) HO2S heater (sensor 1)
3	Injection Volume +25% –12.5% HO2S Voltage 0.55 V or more Below 0.4 V OK	Injection Volume +25% –12.5% HO2S Voltage Almost no reaction NG	HO2S (sensor 2) HO2S heater (sensor 2)
4	Injection Volume +25% –12.5% HO2S Voltage Almost no reaction NG	Injection Volume +25% –12.5% HO2S Voltage Almost no reaction NG	Injector Fuel Pressure Exhaust Gas Leak etc. (Air–Fuel ratio is extremely Lean or Rich)

HINT:
Read freeze frame data using the Intelligent Tester II. 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	CHECK OTHER DTC OUTPUT

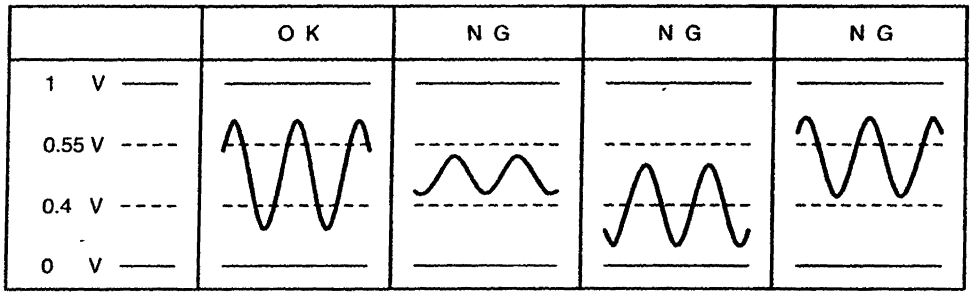
Display (DTC output)	Proceed to
P0130, P0150, P2195, P2196, P2197 or P2198	A
P0130, P0150, P2195, P2196, P2197 or P2198 and other DTCs	B

B → **GO TO RELEVANT DTC CHART (See page 05–36)**

A

2 READ VALUE OF INTELLIGENT TESTER II (HO2S VOLTAGE)

(a) Connect the Intelligent Tester II to the DLC3.
(b) Enter the following menus: Enter/ Diagnosis/ OBD·MOBD/ Power train/ Engine and ECT/ Data List/ All Data/ O2S B1S1 (O2S B2 S1).
(c) Allow the engine to run for 90 seconds at 2,500 rpm.
(d) Read the HO2S voltage at the engine idling.
OK :
The front HO2S voltage alternates between below 0.4 V and more than 0.55 V.

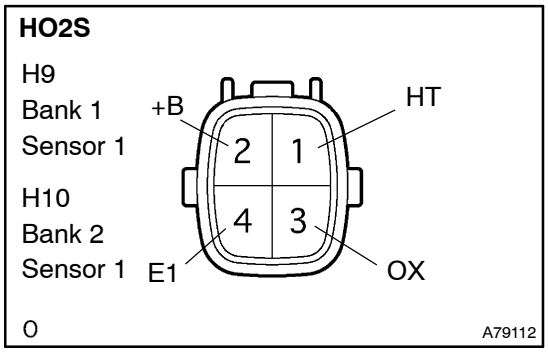


P18349

OK → **Go to step 9**

NG

3 INSPECT HEATED OXYGEN SENSOR



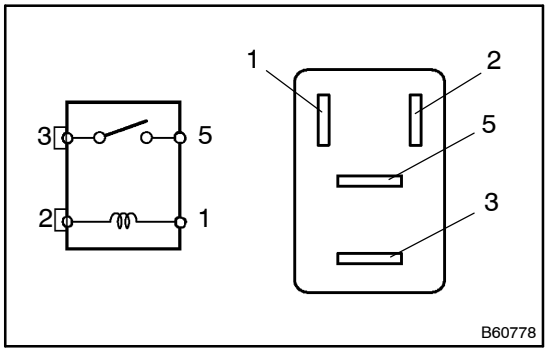
(a) Disconnect the H9 or H10 HO2S connector.
(b) Measure the resistance between the terminals of the HO2S sensor.
Standard:

Tester Connection	Specified Condition
H9–1 (HT) – H9–2 (+B)	5 to 10 Ω at 20 °C (68 °F)
H9–1 (HT) – H9–4 (E1)	10 kΩ or higher
H10–1 (HT) – H10–2 (+B)	5 to 10 Ω at 20 °C (68 °F)
H10–1 (HT) – H10–4 (E1)	10 kΩ or higher

NG → **REPLACE HEATED OXYGEN SENSOR**

OK

4 INSPECT EFI MAIN RELAY



(a) Remove the EFI MAIN relay from the engine room R/B.
(b) Measure the resistance of the EFI MAIN relay.

Standard:

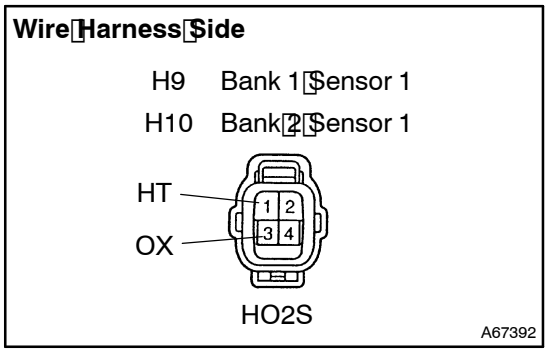
Tester Connection	Specified Condition
3 – 5	10 kΩ or higher
3 – 5	Below 1 Ω (apply battery voltage to terminals 1 and 2)

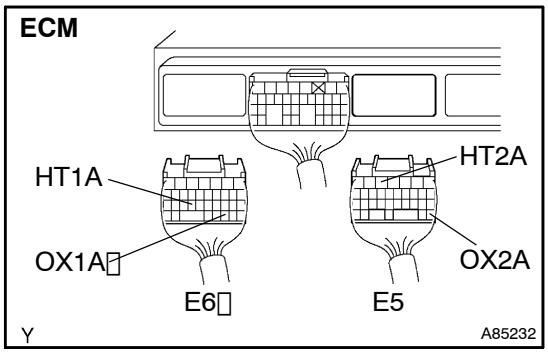
(c) Reinstall the EFI MAIN relay.

NG → REPLACE EFI MAIN RELAY

OK

5 CHECK WIRE HARNESS (HO2S – ECM)





(a) Disconnect the H9 and H10 HO2S connectors.
(b) Disconnect the E5 and E6 ECM connectors.
(c) Measure the resistance between the wire harness side connectors.

Standard:

Tester Connection	Specified Condition
H9–1 (HT) – E6–24 (HT1A)	Below 1 Ω
H9–3 (OX) – E6–30 (OX1A)	Below 1 Ω
H10–1 (HT) – E5–5 (HT2A)	Below 1 Ω
H10–3 (OX) – E5–28 (OX2A)	Below 1 Ω
H9–1 (HT) or E6–24 (HT1A) – Body ground	10 kΩ or higher
H9–3 (OX) or E6–30 (OX1A) – Body ground	10 kΩ or higher
H10–1 (HT) or E5–5 (HT1A) – Body ground	10 kΩ or higher
H10–3 (OX) or E5–28 (OX1A) – Body ground	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

6 CHECK AIR INDUCTION SYSTEM (INJECTION AND VOLUME) (See page 13–3)

Check the air induction system for vacuum leaks.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

7	CHECK FUEL PRESSURE (See page 11–9)

NG → REPAIR OR REPLACE FUEL SYSTEM

OK

8	INSPECT FUEL INJECTOR ASSY (See page 11–11)

NG → REPLACE FUEL INJECTOR ASSY (See page 11–15)

OK

REPLACE HEATED OXYGEN SENSOR

9	PERFORM CONFIRMATION DRIVING PATTERN

HINT:
Clear all DTCs prior to performing the confirmation driving pattern.

NEXT

10	READ OUTPUT DTC

Display (DTC output)	Proceed to
P0130, P0150, P2195, P2196, P2197 or P2198	A
P0130, P0150, P2195, P2196, P2197 or P2198 and other DTCs	B

B → CHECK FOR INTERMITTENT PROBLEMS (See page 05–11)

A

REPLACE HEATED OXYGEN SENSOR