

DTC	P0130/21	OXYGEN SENSOR CIRCUIT MALFUNCTION (BANK 1 SENSOR 1)
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CIRCUIT DESCRIPTION

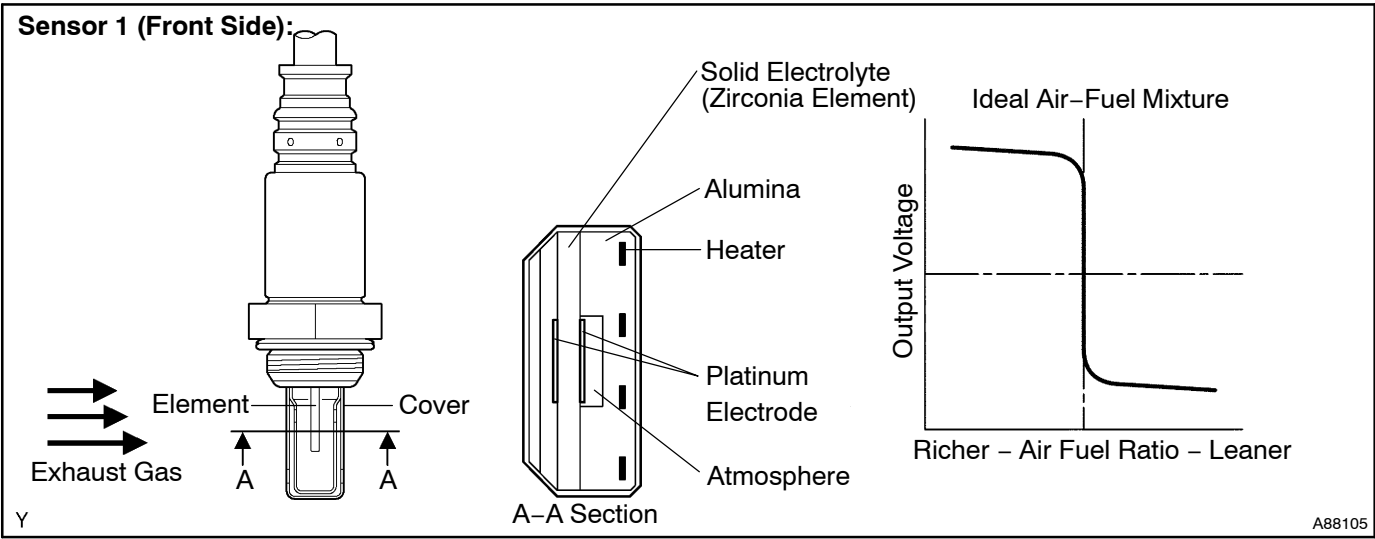
In order to obtain a high purification rate for the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxides (NOx) components of the exhaust gas, a three-way catalytic converter is used. For the most efficient use of the three-way catalytic converter, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric air-fuel ratio.

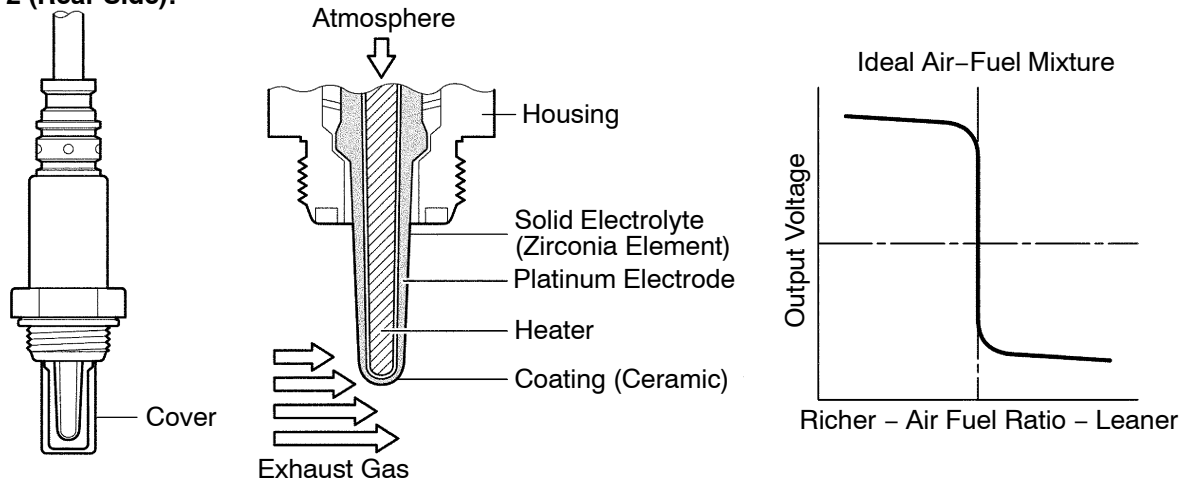
The heated oxygen sensor has the characteristic whereby its output voltage changes suddenly in the vicinity of the stoichiometric air-fuel ratio. This is used to detect the oxygen concentration in the exhaust gas and provide the ECM with feedback to control the air-fuel ratio.

When the air-fuel ratio becomes lean, the oxygen concentration in the exhaust gas increases. 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 of the heated oxygen sensor whether the air-fuel ratio is rich or lean and controls the injection time accordingly. If a malfunction of the heated oxygen sensor causes an output of abnormal voltage, the ECM will be unable to perform accurate air-fuel ratio control.

The heated oxygen sensor includes 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), a current flows to the heater in order to heat the sensor for accurate oxygen concentration detection.



**Sensor 2 (Rear Side):**

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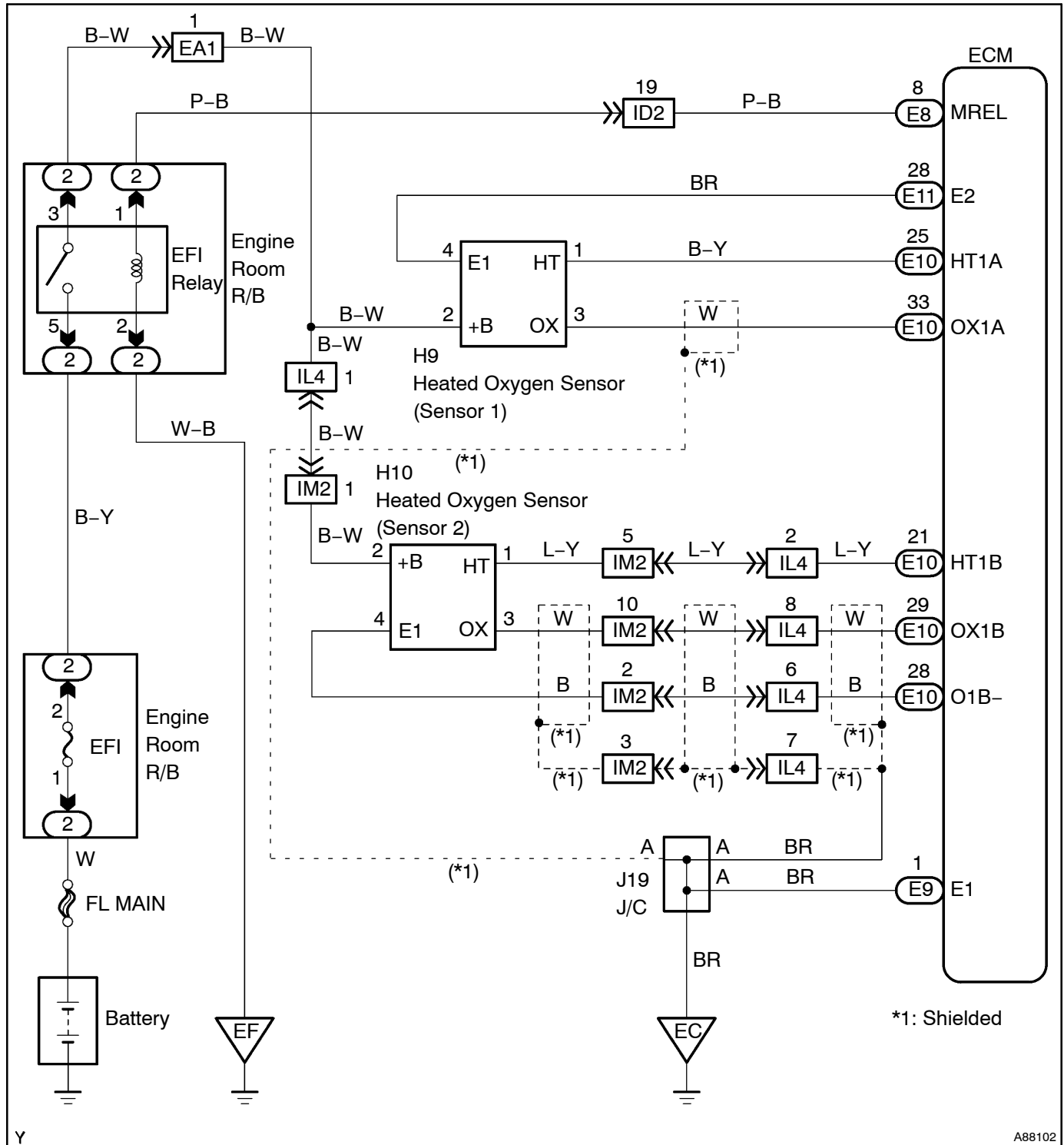
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DTC No.	DTC Detection Condition	Trouble Area
P0130/21	After engine is warmed up, output voltage of heated oxygen sensor remains at 0.4 V or more, or 0.55 V or less, during engine idling (1 trip detection logic)	<ul style="list-style-type: none"> <li>• Open or short in heated oxygen sensor circuit</li> <li>• Heated oxygen sensor (Sensor 1)</li> <li>• Heated oxygen sensor heater (Sensor 1)</li> <li>• EFI relay</li> <li>• Air induction system</li> <li>• Fuel pressure</li> <li>• Injector</li> <li>• ECM</li> </ul>

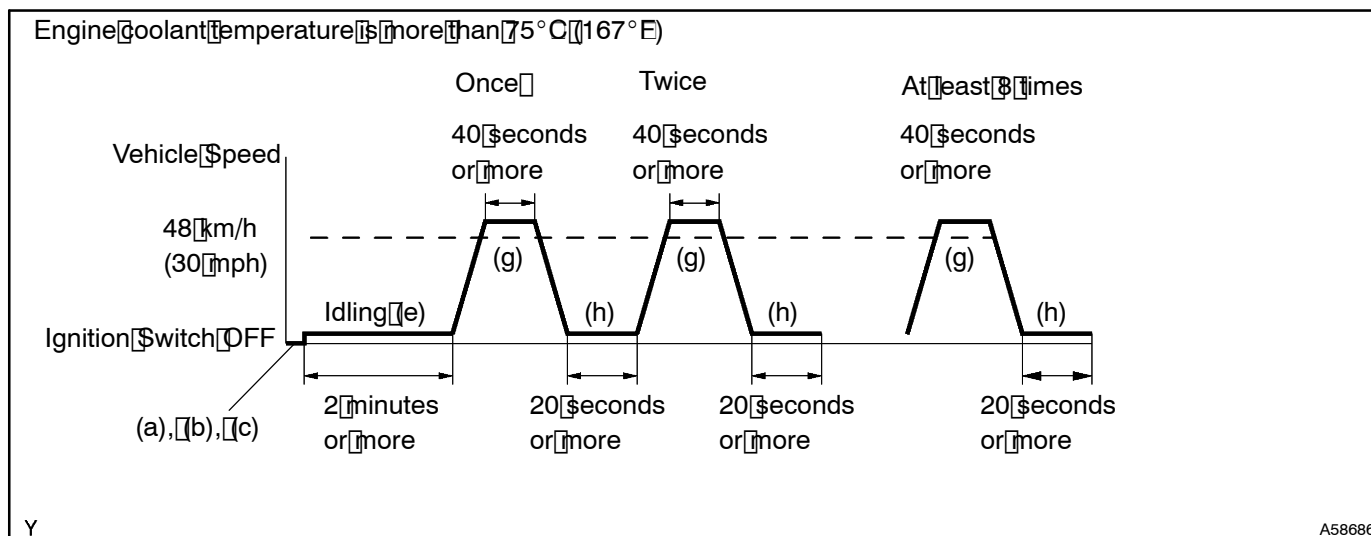
**HINT:**

- Sensor 1 refers to the sensor closest to the engine assembly.
- The output voltage of the heated oxygen sensor and the short-term fuel trim value can be read using the intelligent tester II.

## WIRING DIAGRAM



## CONFIRMATION DRIVING PATTERN



- (a) Connect the intelligent tester II to the DLC3.
- (b) Turn the ignition switch to ON and turn the intelligent tester II ON.
- (c) Switch the ECM from normal mode to check mode using the intelligent tester II (see page 05-270).
- (d) Start the engine.
- (e) Allow the engine to idle for 2 minutes.
- (f) Warm up the engine until the engine coolant temperature reaches more than 75°C (167°F).
- (g) Drive the vehicle at 48 km/h (30 mph) or more for 40 seconds or more.
- (h) Stop the vehicle and allow the engine to idle for 20 seconds or more.
- (i) Repeat the steps (g) and (h) at least 8 times in one driving cycle.

### HINT:

If a malfunction exists, the MIL will be illuminated during step (i).

### NOTICE:

**If the conditions in this test are not strictly followed, no malfunction will be detected. If you do not have the intelligent tester II, turn the ignition switch to OFF after performing steps from (e) to (i), then perform steps (e) to (i) again.**

## INSPECTION PROCEDURE

### HINT:

intelligent tester II only:

Malfunctioning areas can be found using the Active Test / A/F Control operation. The A/F Control operation can determine if the heated oxygen sensor or other potential trouble areas are malfunctioning or not.

(a) Perform the Active Test using the intelligent tester II.

### HINT:

The A/F CONTROL operation lowers the injection volume by 12.5 % or increases the injection volume by 25 %.

- (1) Connect the intelligent tester II to the DLC3.
- (2) Start the engine and turn the intelligent tester II ON.
- (3) Warm up the engine by running the engine at 2,500 rpm for approximately 3 minutes.
- (4) On the intelligent tester II, select the following menu items: Powertrain / Engine and ECT / Active Test / A/F Control.
- (5) Select the following monitor items: O2S B1 S1 and O2S B1 S2.
- (6) Perform the A/F Control operation with the engine in an idling condition (press the right or left button).

### Result:


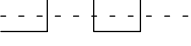


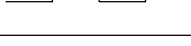

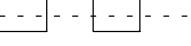

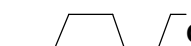
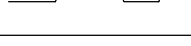








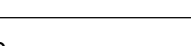




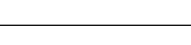



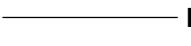



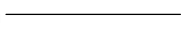



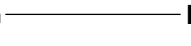
**The heated oxygen sensor reacts in accordance with increase and decrease of the injection volume:**

**+25 % → Rich output: More than 0.5 V**

**-12.5 % → Lean output: Less than 0.4 V**

### NOTICE:

**There is a delay of few seconds in the sensor 1 (front sensor) output, and there is a delay of about 20 seconds at maximum in the sensor 2 (rear sensor).**

	Output Voltage of Heated Oxygen Sensor (sensor 1: front sensor)	Output Voltage of Heated Oxygen Sensor (sensor 2: rear sensor)	Main Suspect Trouble Area
Case 1	Injection volume +25 %   -12.5 %  Output voltage More than 0.5 V  <b>OK</b> Less than 0.4V 	Injection volume +25 %   -12.5 %  Output voltage More than 0.5 V  <b>OK</b> Less than 0.4V 	—
Case 2	Injection volume +25 %   -12.5 %  Output voltage Almost no reaction  <b>NG</b>	Injection volume +25 %   -12.5 %  Output voltage More than 0.5 V  <b>OK</b> Less than 0.4V 	Sensor 1: front sensor (Sensor 1, heater, sensor 1 circuit)
Case 3	Injection volume +25 %   -12.5 %  Output voltage More than 0.5 V  <b>OK</b> Less than 0.4V 	Injection volume +25 %   -12.5 %  Output voltage Almost no reaction  <b>NG</b>	Sensor 2: rear sensor (Sensor 2, heater, sensor 2 circuit)
Case 4	Injection volume +25 %   -12.5 %  Output voltage Almost no reaction  <b>NG</b>	Injection volume +25 %   -12.5 %  Output voltage Almost no reaction  <b>NG</b>	Extremely rich or lean actual air-fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

The following A/F Control procedure enables the technician to check and graph the voltage output of both the heated oxygen sensors.

To display the graph, select the following menu items on the tester: View / Line Graph.

**NOTICE:**

**If the vehicle is short of fuel, the air-fuel ratio becomes LEAN and the heated oxygen sensor DTCs will be recorded, and the MIL then illuminates.**

**HINT:**

- If different DTCs related to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the intelligent tester II. Freeze frame data record the engine condition 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.
- A high heated oxygen sensor (sensor 1) voltage (0.5 V or more) could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.
- A low heated oxygen sensor (sensor 1) voltage (0.4 V or less) could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.

**1 CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0130/21)**

- (a) Connect the intelligent tester II to the DLC3.
- (b) Turn the ignition switch to ON and turn the intelligent tester II ON.
- (c) Select the following menu items: Powertrain / Engine and ECT / DTC.
- (d) Read DTCs.

**Result:**

Display (DTC Output)	Proceed To
P0130/21	A
P0130/21 and other DTCs	B

**HINT:**

If any other DTCs besides P0130/21 are output, perform troubleshooting for those DTCs first.

**B**

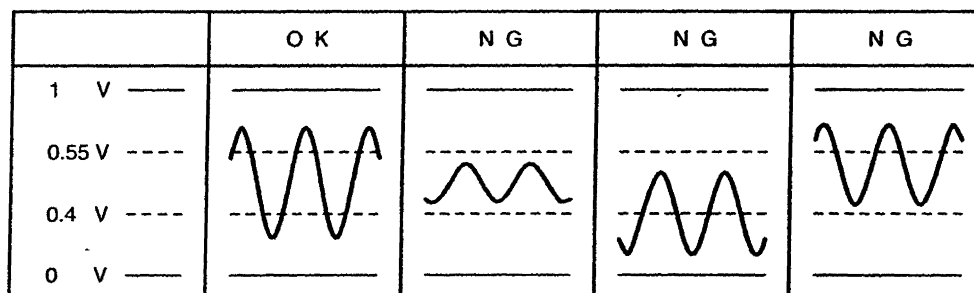
**GO TO RELEVANT DTC CHART**  
(See page 05-277)

**A****2 READ VALUE OF INTELLIGENT TESTER II (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)**

- (a) Connect the intelligent tester II to the DLC3.
- (b) Start the engine and turn the intelligent tester II ON.
- (c) Select the following menu items: Powertrain / Engine and ECT / Data List / O2s B1 S1.
- (d) Warm up the heated oxygen sensor at the engine speed of 2,500 rpm for approximately 90 seconds.
- (e) Read the output voltage of the heated oxygen sensor during engine idling.

**Standard:**

**Fluctuates between less than 0.4 V and more than 0.55 V (see the following figure).**

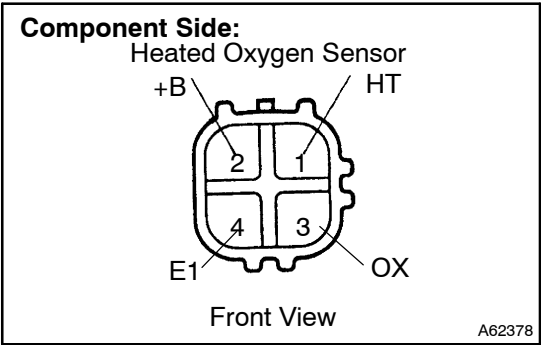


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**OK****Go to step 9****NG**

3

INSPECT HEATED OXYGEN SENSOR(HEATER RESISTANCE)



- (a) Disconnect the H9 heated oxygen sensor connector.  
(b) Measure the resistance between the terminals of the heated oxygen sensor connector.
- Standard (Sensor 1):**

Tester Connection	Specified Condition
1 (HT) - 2 (+B)	5 to 10 $\Omega$ at 20°C (68°F)
1 (HT) - 4 (E1)	10 k $\Omega$ or higher

- (c) Reconnect the heated oxygen sensor connector.

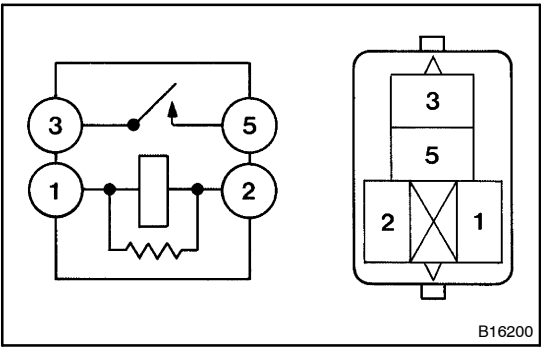
NG

REPLACE HEATED OXYGEN SENSOR

OK

4

INSPECT EFI RELAY



- (a) Remove the EFI relay from the engine room R/B.  
(b) Check the EFI relay resistance.
- Standard:**

Tester Connection	Specified Condition
3 - 5	10 k $\Omega$ or higher
3 - 5	Below 1 $\Omega$ (Apply battery voltage to terminals 1 and 2)

- (c) Reinstall the EFI relay.

NG

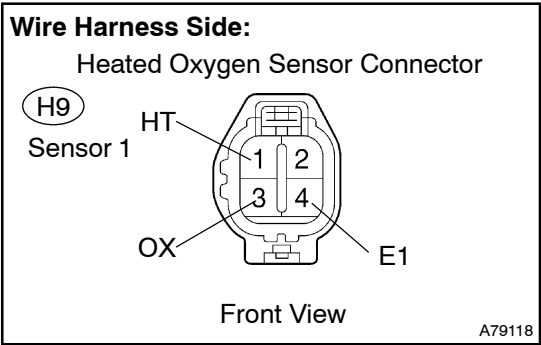
REPLACE EFI RELAY

OK



5

CHECK HARNESS AND CONNECTOR(HEATED OXYGEN SENSOR - ECM)



- (a) Disconnect the H9 heated oxygen sensor connector.
- (b) Disconnect the E10 and E11 ECM connectors.
- (c) Check the resistance.

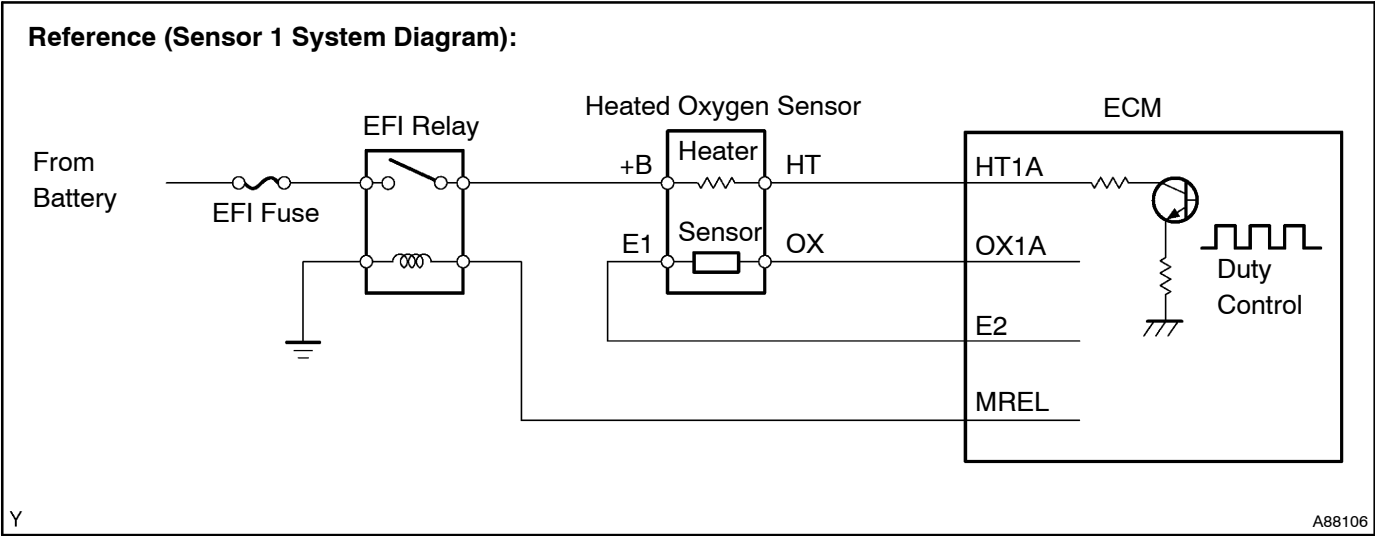
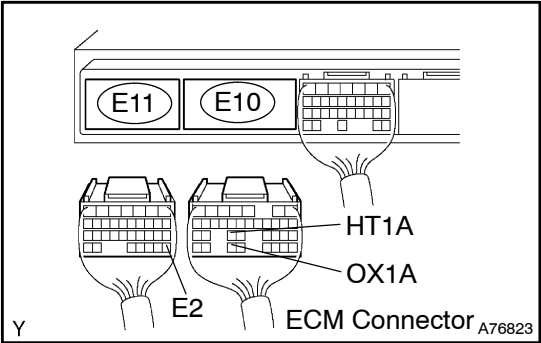
Standard (Check for open):

Tester Connection	Specified Condition
OX (H9-3) - OX1A (E10-33)	Below 1 $\Omega$
HT (H9-1) - HT1A (E10-25)	Below 1 $\Omega$
E1 (H9-4) - E2 (E11-28)	Below 1 $\Omega$

Standard (Check for short):

Tester Connection	Specified Condition
OX (H9-3) or OX1A (E10-33) - Body ground	10 k $\Omega$ or higher
HT (H9-1) or HT1A (E10-25) - Body ground	10 k $\Omega$ or higher

- (d) Reconnect the heated oxygen sensor connector.
- (e) Reconnect the ECM connector.



NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

**6 CHECK AIR INDUCTION SYSTEM**

(a) Check for vacuum leaks in the air induction system.

**NG****REPAIR OR REPLACE AIR INDUCTION SYSTEM****OK****7 CHECK FUEL PRESSURE (See page 1-5)****NG****REPAIR OR REPLACE FUEL SYSTEM****OK****8 INSPECT FUEL INJECTOR ASSY (INJECTION AND VOLUME) (See page 1-8)****NG****REPLACE FUEL INJECTOR ASSY  
(See page 1-11)****OK****REPLACE HEATED OXYGEN SENSOR****9 PERFORM CONFIRMATION DRIVING PATTERN****HINT:**

Clear all DTCs prior to performing the confirmation driving pattern.

**GO****10 CHECK IF DTC OUTPUT RECURS (DTC P0130/21)**

(a) Connect the intelligent tester to the DLC3.

(b) Turn the ignition switch to ON and turn the intelligent tester ON.

(c) Select the following menu items: Powertrain / Engine and ECT / DTC.

(d) Read DTCs.

**Result:**

Display (DTC Output)	Proceed To
P0130/21	A
No output	B

**B****CHECK FOR INTERMITTENT PROBLEMS  
(See page 05-259)****A****REPLACE HEATED OXYGEN SENSOR**