

|            |              |                                                          |
|------------|--------------|----------------------------------------------------------|
| <b>DTC</b> | <b>P0130</b> | <b>Oxygen Sensor Circuit (Bank 1 Sensor 1)</b>           |
| <b>DTC</b> | <b>P0150</b> | <b>Oxygen Sensor Circuit (Bank 2 Sensor 1)</b>           |
| <b>DTC</b> | <b>P2195</b> | <b>Oxygen Sensor Signal Stuck Lean (Bank 1 Sensor 1)</b> |
| <b>DTC</b> | <b>P2196</b> | <b>Oxygen Sensor Signal Stuck Rich (Bank 1 Sensor 1)</b> |
| <b>DTC</b> | <b>P2197</b> | <b>Oxygen Sensor Signal Stuck Lean (Bank 2 Sensor 1)</b> |
| <b>DTC</b> | <b>P2198</b> | <b>Oxygen Sensor Signal Stuck Rich (Bank 2 Sensor 1)</b> |

## CIRCUIT DESCRIPTION

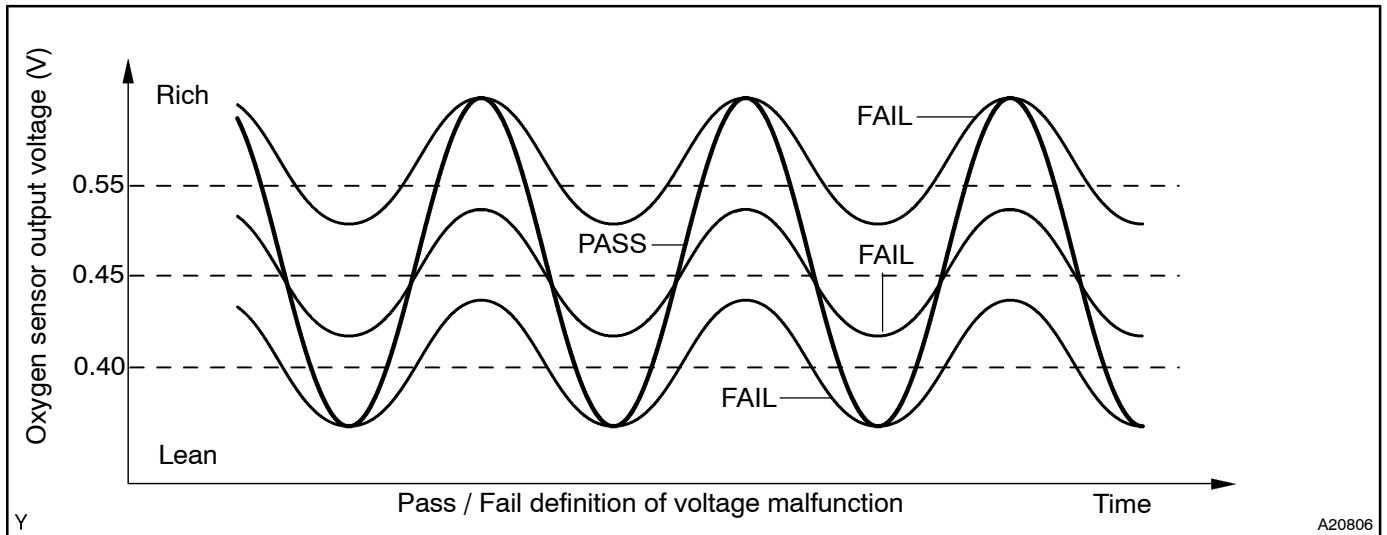
Refer to DTC P0031 on page [DI-53](#).

| DTC No.        | Detection Item                                                                                                                                          | Trouble Area                                                                                                                                                                                                                                                                                     |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P0130<br>P0150 | Output voltage of heated oxygen sensor remains at 0.4 V or more, or 0.55 V or less, during idling after engine is warmed up<br>(2 trip detection logic) | <ul style="list-style-type: none"> <li>• Open or short in heated oxygen sensor circuit</li> <li>• Heated oxygen sensor</li> <li>• Heated oxygen sensor heater</li> <li>• EFI or ECD relay</li> <li>• Air induction system</li> <li>• Fuel pressure</li> <li>• Injector</li> <li>• ECM</li> </ul> |
| P2195<br>P2197 | Output voltage of heated oxygen sensor remains at 0.55 V or less, during idling after engine is warmed up<br>(2 trip detection logic)                   |                                                                                                                                                                                                                                                                                                  |
| P2196<br>P2198 | Output voltage of heated oxygen sensor remains at 0.4 V or more, during idling after engine is warmed up<br>(2 trip detection logic)                    |                                                                                                                                                                                                                                                                                                  |

### HINT:

- Bank 1 refers to bank that includes cylinder No. 1.
- Bank 2 refers to bank that does not includes cylinder No. 2.
- Sensor 1 refers to the sensor closer to the engine assembly.
- The heated oxygen sensor's output voltage and the short-term fuel trim value can be read using the OBD II scan tool or hand-held tester.

## 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 gas. 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 heated oxygen sensor has the characteristic whereby its output voltage changes suddenly in the vicinity of the stoichiometric air-fuel ratio. The heated oxygen sensor generates output voltage between 0 V and 1.0 V in response to the oxygen concentration in exhaust gas. When the output voltage of the heated oxygen sensor is 0.55 V or more, the ECM judges that the air-fuel ratio is RICH. When it is 0.4 V or less, the ECM judges that the air-fuel ratio is LEAN.

Under normal condition, the output voltage from the heated oxygen sensor alternates RICH and LEAN sides periodically. If the heated oxygen sensor outputs RICH signal (or LEAN signal) constantly, or if the heated oxygen sensor cannot output enough voltage to reach the minimum specification, the ECM interprets this as a malfunction in the heated oxygen sensor and sets a DTC.

## MONITOR STRATEGY

|                             |                            |                                                                                   |
|-----------------------------|----------------------------|-----------------------------------------------------------------------------------|
| Related DTCs                | P0130                      | Front heated oxygen sensor voltage is constant at lean side or rich side (Bank 1) |
|                             | P0150                      | Front heated oxygen sensor voltage is constant at lean side or rich side (Bank 2) |
|                             | P2195                      | Front heated oxygen sensor voltage is constant at lean side (Bank 1)              |
|                             | P2196                      | Front heated oxygen sensor voltage is constant at rich side (Bank 1)              |
|                             | P2197                      | Front heated oxygen sensor voltage is constant at lean side (Bank 2)              |
|                             | P2198                      | Front heated oxygen sensor voltage is constant at rich side (Bank 2)              |
| Required sensors/components | Main sensors/components    | Front heated oxygen sensor                                                        |
|                             | Related sensors/components | Crank position sensor, Vehicle speed sensor                                       |
| Frequency of operation      | Once per drive cycle       |                                                                                   |
| Duration                    | 20 to 36 sec. x (3 times)  |                                                                                   |
| MIL operation               | 2 driving cycles           |                                                                                   |
| Sequence of operation       | None                       |                                                                                   |

## TYPICAL ENABLING CONDITIONS

| Item                                                             | Specification                                                   |         |
|------------------------------------------------------------------|-----------------------------------------------------------------|---------|
|                                                                  | Minimum                                                         | Maximum |
| The monitor will run whenever the following DTCs are not present | See "List of disable a monitor" (on page <a href="#">DI-3</a> ) |         |
| There is history that the following conditions A and B were met: | 20 sec. (Continuously)                                          | –       |
| A. Vehicle speed                                                 | 40 km/h (25 mph)                                                | –       |
| B. Engine speed                                                  | 900 rpm                                                         | –       |
| Time after engine start                                          | 120 sec.                                                        | –       |
| Idle                                                             | ON                                                              |         |
| Fuel system status                                               | Closed loop                                                     |         |

## TYPICAL MALFUNCTION THRESHOLDS

| Detection Criteria                                | Threshold               |
|---------------------------------------------------|-------------------------|
| <b>P0130, P0150:</b>                              |                         |
| Either of the following conditions A or B is met: | 3 times or more         |
| A. Front oxygen sensor voltage is 0.55 V or less  | For 18 sec. or more     |
| B. Front oxygen sensor voltage is 0.4 V or more   | For 18 sec. or more     |
| <b>P2195, P2197:</b>                              |                         |
| Front heated oxygen sensor voltage                | Constant 0.55 V or less |
| <b>P2196, P2198:</b>                              |                         |
| Front heated oxygen sensor voltage                | Constant 0.4 V or more  |

## COMPONENT OPERATING RANGE

| Parameter                                                 | Standard value |
|-----------------------------------------------------------|----------------|
| In the normal condition, the heated oxygen sensor voltage | 0 to 1 V       |

## O2S TEST RESULT

Refer to page [DI-3](#) for detailed information.

### Front HO2S voltage monitor

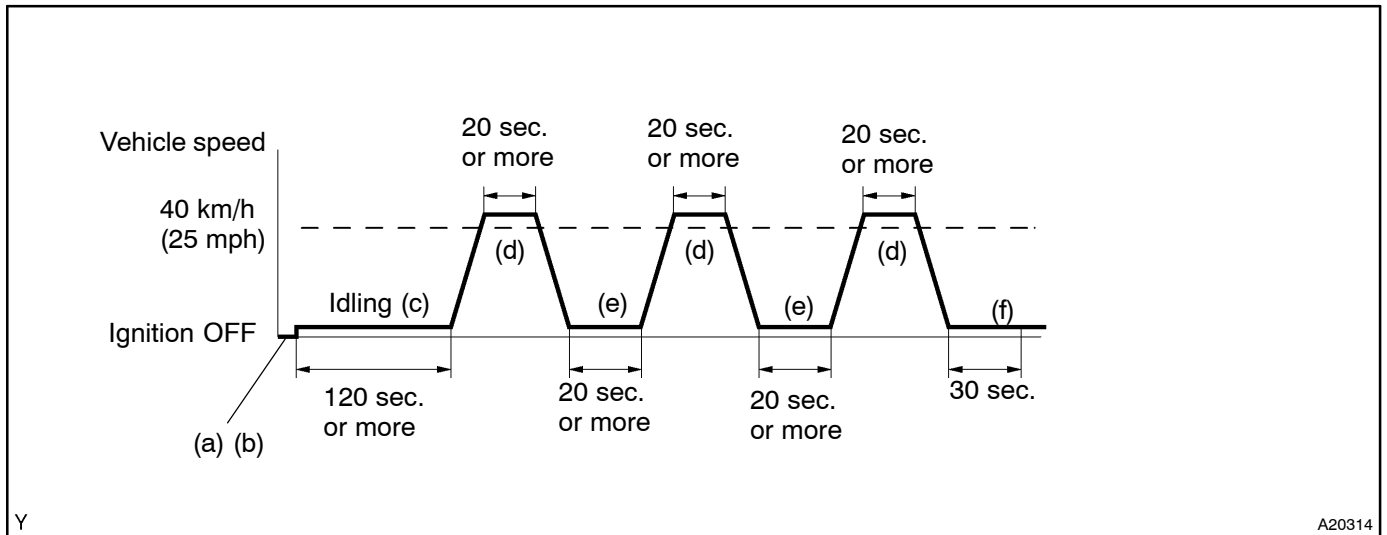
If the HO2S voltage is out of the standard value, the ECM interprets this as a malfunction.

| TEST ID | Description of TEST DATA   | Conversion Factor | Unit |
|---------|----------------------------|-------------------|------|
| \$07    | Minimum front HO2S voltage | N/A               | V    |
| \$08    | Maximum front HO2S voltage | N/A               | V    |

## WIRING DIAGRAM

Refer to DTC P0031 on page [DI-53](#).

## CONFIRMATION DRIVING PATTERN



- (a) Connect the hand-held tester to the DLC3.
- (b) Switch the hand-held tester from the "normal mode" to the "check mode" (See page [DI-3](#)).
- (c) Start the engine and let the engine idle for 120 seconds or more.
- (d) Drive the vehicle at 25 mph (40 km/h) or more for 20 seconds or more.
- (e) Let the engine idle for 20 seconds or more. Perform steps (d) and (e) at 3 times.
- (f) Let the engine idle for 30 seconds.

### HINT:

If a malfunction exists, the MIL will light up during step (f).

### NOTICE:

**If the conditions in this test are not strictly followed, detection of the malfunction will not be possible. If you do not have a hand-held tester, turn the ignition switch OFF after performing steps (c) to (f), then perform steps (c) to (f) again.**

## INSPECTION PROCEDURE

### HINT:

Hand-held tester only:

The narrowing down the trouble area is possible by performing ACTIVE TEST of the following "A/F CONTROL" (Heated oxygen sensor or another can be distinguished).

- (a) Perform ACTIVE TEST by hand-held tester (A/F CONTROL).

### HINT:

"A/F CONTROL" is an ACTIVE TEST which changes the injection volume to -12.5 % or +25 %.

- (1) Connect the hand-held tester to the DLC3 on the vehicle.
- (2) Turn the ignition switch ON.
- (3) Warm up the engine with the engine speed at 2,500 rpm for approximately 90 seconds.
- (4) Select the item "DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL".
- (5) Perform "A/F CONTROL" with the engine in an idle condition (press the right or left button).

### RESULT:

**Heated oxygen sensor reacts in accordance with increase and decrease of injection volume**

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

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

**NOTICE:**

However, there is a few seconds delay in the sensor 1 (front sensor) output. And there is about 20 seconds delay 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)                                         | Mainly suspect trouble area                                                                                           |
|--------|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| Case 1 | Injection volume<br>+25 %<br>-12.5 %<br>Output voltage<br>More than 0.5 V <b>OK</b><br>Less than 0.4 V | Injection volume<br>+25 %<br>-12.5 %<br>Output voltage<br>More than 0.5 V <b>OK</b><br>Less than 0.4 V | —                                                                                                                     |
| Case 2 | Injection volume<br>+25 %<br>-12.5 %<br>Output voltage<br>Almost no reaction <b>NG</b>                 | Injection volume<br>+25 %<br>-12.5 %<br>Output voltage<br>More than 0.5 V <b>OK</b><br>Less than 0.4 V | Sensor 1: front sensor<br>(sensor 1, heater, sensor 1 circuit)                                                        |
| Case 3 | Injection volume<br>+25 %<br>-12.5 %<br>Output voltage<br>More than 0.5 V <b>OK</b><br>Less than 0.4 V | Injection volume<br>+25 %<br>-12.5 %<br>Output voltage<br>Almost no reaction <b>NG</b>                 | Sensor 2: rear sensor<br>(sensor 2, heater, sensor 2 circuit)                                                         |
| Case 4 | Injection volume<br>+25 %<br>-12.5 %<br>Output voltage<br>Almost no reaction <b>NG</b>                 | Injection volume<br>+25 %<br>-12.5 %<br>Output voltage<br>Almost no reaction <b>NG</b>                 | Extremely rich or lean of the actual air-fuel ratio<br>(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 the heated oxygen sensors (sensor 1 and 2).

For displaying the graph indication, enter "ACTIVE TEST / A/F CONTROL / USER DATA" then select "O2S B1S1 and O2S B1S2" by pressing "YES" button and push "ENTER" button before pressing "F4" button.

**NOTICE:**

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

**HINT:**

- If different DTCs related to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may be open.
- 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, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air-fuel ratio was lean or rich, etc. at the time of the malfunction.
- 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.

|          |                                                                                                         |
|----------|---------------------------------------------------------------------------------------------------------|
| <b>1</b> | <b>Are there any other codes (besides DTC P0130, P0150, P2195, P2197, P2196 or P2198) being output?</b> |
|----------|---------------------------------------------------------------------------------------------------------|

**PREPARATION:**

- (a) Connect the hand-held tester or the OBD II scan tool to the DLC3.
- (b) Turn the ignition switch ON and push the hand-held tester or OBD II scan tool main switch ON.
- (c) When using hand-held tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.

**CHECK:**

Read the DTC using the hand-held tester or the OBD II scan tool.

**RESULT:**

| Display (DTC Output)                                       | Proceed to |
|------------------------------------------------------------|------------|
| "P0130, P0150, P2195, P2196, P2197 and/or P2198"           | A          |
| "P0130, P0150 P2195, P2196, P2197 or P2198" and other DTCs | B          |

**HINT:**

If any other codes besides "P0130, P0150, P2195, P2196, P2197 and/or P2198" are output, perform the troubleshooting for those DTCs first.

**B**

**Go to relevant DTC chart (See page [DI-43](#)).**

**A**

|   |                                                             |
|---|-------------------------------------------------------------|
| 2 | Check output voltage of heated oxygen sensor during idling. |
|---|-------------------------------------------------------------|

**PREPARATION:**

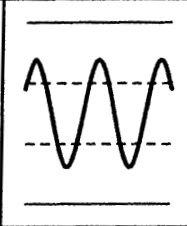
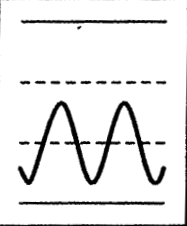
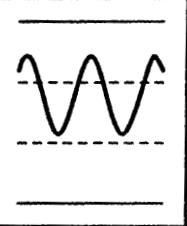
- (a) Warm up the heated oxygen sensor with the engine speed at 2,500 rpm for approximately 90 seconds.
- (b) Connect the hand-held tester or OBD II scan tool to the DLC3.
- (c) When using hand-held tester, enter the following menu: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / O2S B1 S1 or B2 S1.

**CHECK:**

Check the output voltage of the heated oxygen sensor during idling the OBD II scan tool or hand-held tester.

**OK:**

Heated oxygen sensor output voltage:  
Alternates repeatedly between less than 0.4 V and more than 0.5 V (See the following table).

|             | O K                                                                                | N G                                                                                | N G                                                                                 | N G                                                                                  |
|-------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 1 V —       |  |  |  |  |
| 0.5 V - - - |                                                                                    |                                                                                    |                                                                                     |                                                                                      |
| 0.4 V - - - |                                                                                    |                                                                                    |                                                                                     |                                                                                      |
| 0 V —       |                                                                                    |                                                                                    |                                                                                     |                                                                                      |

Q30018

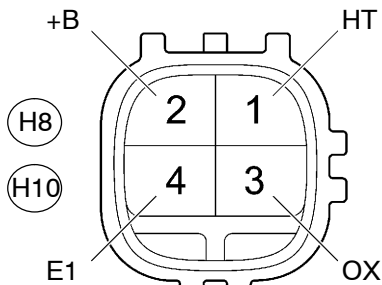
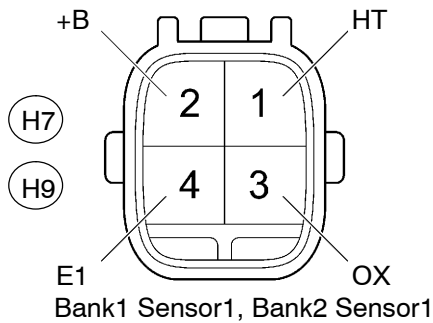
OK

Go to step 9.

NG

### 3 Check resistance of heated oxygen sensor heater.

#### Components Side:



C

A20870

#### PREPARATION:

Disconnect the H7, H8, H9 or H10 heated oxygen sensor connector.

#### CHECK:

Measure resistance between terminals of the heated oxygen sensor.

#### OK:

| Tester Connection       | Specified Condition      |
|-------------------------|--------------------------|
| HT (H7-1) - +B (H7-2)   | 11 to 16 $\Omega$ (20°C) |
| HT (H8-1) - +B (H8-2)   | 11 to 16 $\Omega$ (20°C) |
| HT (H9-1) - +B (H9-2)   | 11 to 16 $\Omega$ (20°C) |
| HT (H10-1) - +B (H10-2) | 11 to 16 $\Omega$ (20°C) |

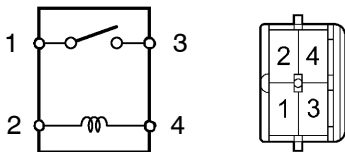
NG

Replace heated oxygen sensor.

OK

### 4 Check EFI or ECD relay.

#### EFI or ECD Relay



A21543

#### PREPARATION:

Remove the EFI or ECD relay from the engine room R/B.

#### CHECK:

Inspect the EFI or ECD relay.

#### OK:

| Terminal No. | Condition                          | Specified Condition |
|--------------|------------------------------------|---------------------|
| 2 - 4        | Constant                           | Continuity          |
| 1 - 3        | Usually                            | No Continuity       |
|              | Apply B+ between terminals 2 and 4 | Continuity          |

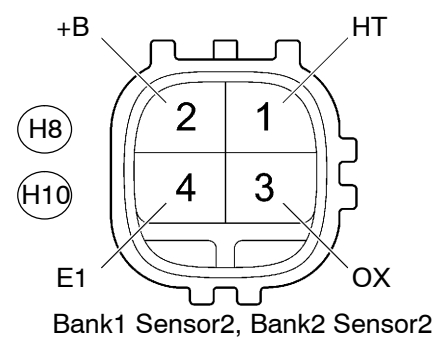
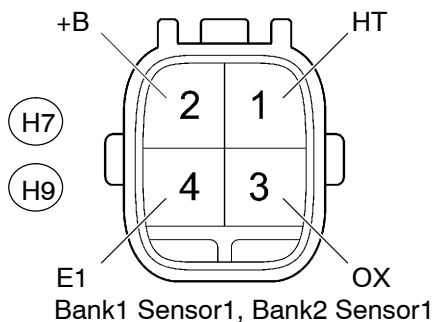
NG

Replace EFI or ECD relay.

OK

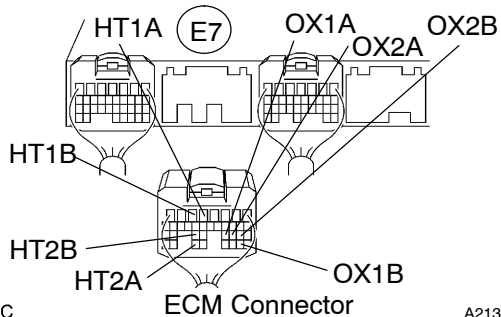
# 5 Check for open and short in harness and connector between ECM and heated oxygen sensor.

## Components Side:



C

A20870



C

A21340

## PREPARATION:

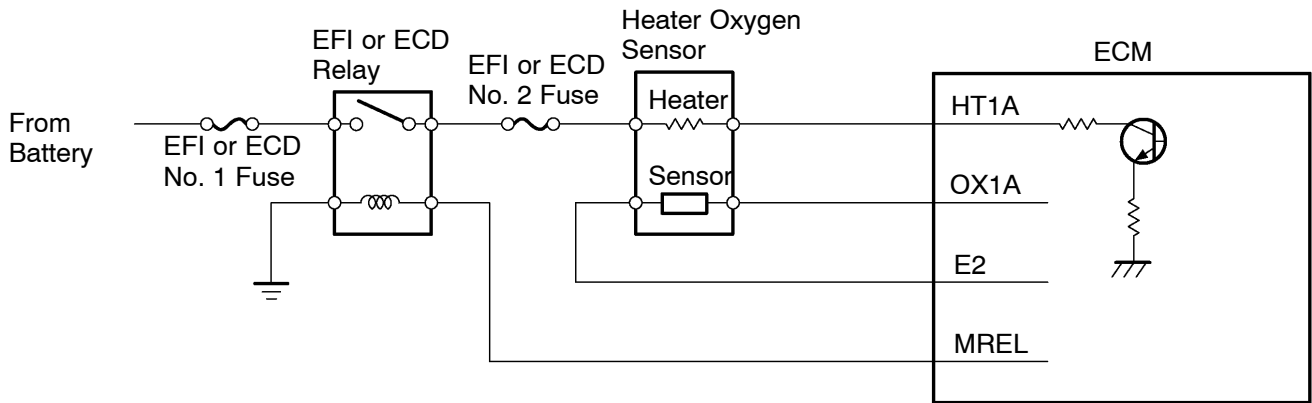
- Disconnect the H7, H8, H9 or H10 heated oxygen sensor connector.
- Disconnect the E7 ECM connector.

## CHECK:

Measure the resistance between the wire harness side connectors.

## OK:

| Tester Connection                        | Specified Condition     |
|------------------------------------------|-------------------------|
| OX (H7-3) - OX1A (E7-23)                 | Below 1 $\Omega$        |
| HT (H7-1) - HT1A (E7-4)                  | Below 1 $\Omega$        |
| OX (H8-3) - OX1B (E7-29)                 | Below 1 $\Omega$        |
| HT (H8-1) - HT1B (E7-5)                  | Below 1 $\Omega$        |
| OX (H9-3) - OX2A (E7-22)                 | Below 1 $\Omega$        |
| HT (H9-1) - HT2A (E7-33)                 | Below 1 $\Omega$        |
| OX (H10-3) - OX2B (E7-21)                | Below 1 $\Omega$        |
| HT (H10-1) - HT2B (E7-25)                | Below 1 $\Omega$        |
| OX (H7-3) or OX1A (E7-23) - Body ground  | 10 k $\Omega$ or higher |
| HT (H7-1) or HT1A (E7-4) - Body ground   | 10 k $\Omega$ or higher |
| OX (H8-3) or OX1B (E7-29) - Body ground  | 10 k $\Omega$ or higher |
| HT (H8-1) or HT1B (E7-5) - Body ground   | 10 k $\Omega$ or higher |
| OX (H9-3) or OX2A (E7-22) - Body ground  | 10 k $\Omega$ or higher |
| HT (H9-1) or HT2A (E7-33) - Body ground  | 10 k $\Omega$ or higher |
| OX (H10-3) or OX2B (E7-21) - Body ground | 10 k $\Omega$ or higher |
| HT (H10-1) or HT2B (E7-25) - Body ground | 10 k $\Omega$ or higher |

**Reference (Bank 1 Sensor 1 System Drawing)**

Y

A21040

**NG****Repair or replace harness or connector.****OK****6****Check air induction system (See page [SF-1](#)).****CHECK:**

Check the air induction system for vacuum leaks.

**NG****Repair or replace air induction system.****OK****7****Check fuel pressure (See page [SF-7](#)).****CHECK:**

Check the fuel pressure (high or low pressure).

**NG****Check and repair fuel pump, pressure regulator, fuel pipe line and filter (See page [SF-1](#)).****OK**

|   |                                                             |
|---|-------------------------------------------------------------|
| 8 | Check injector injection (See page <a href="#">SF-24</a> ). |
|---|-------------------------------------------------------------|

NG

Replace injector.

OK

Replace heated oxygen sensor.

|   |                                       |
|---|---------------------------------------|
| 9 | Perform confirmation driving pattern. |
|---|---------------------------------------|

HINT:

Clear all DTCs prior to performing the confirmation driving pattern.

Go

|    |                                                                             |
|----|-----------------------------------------------------------------------------|
| 10 | Is there DTC P0130, P0150, P2195, P2196, P2197 or P2198 being output again? |
|----|-----------------------------------------------------------------------------|

NO

Check for intermittent problems  
(See page [DI-3](#)).

YES

Replace ECM (See page [SF-60](#)).