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|------------|--------------|--|
| 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) |

HINT:

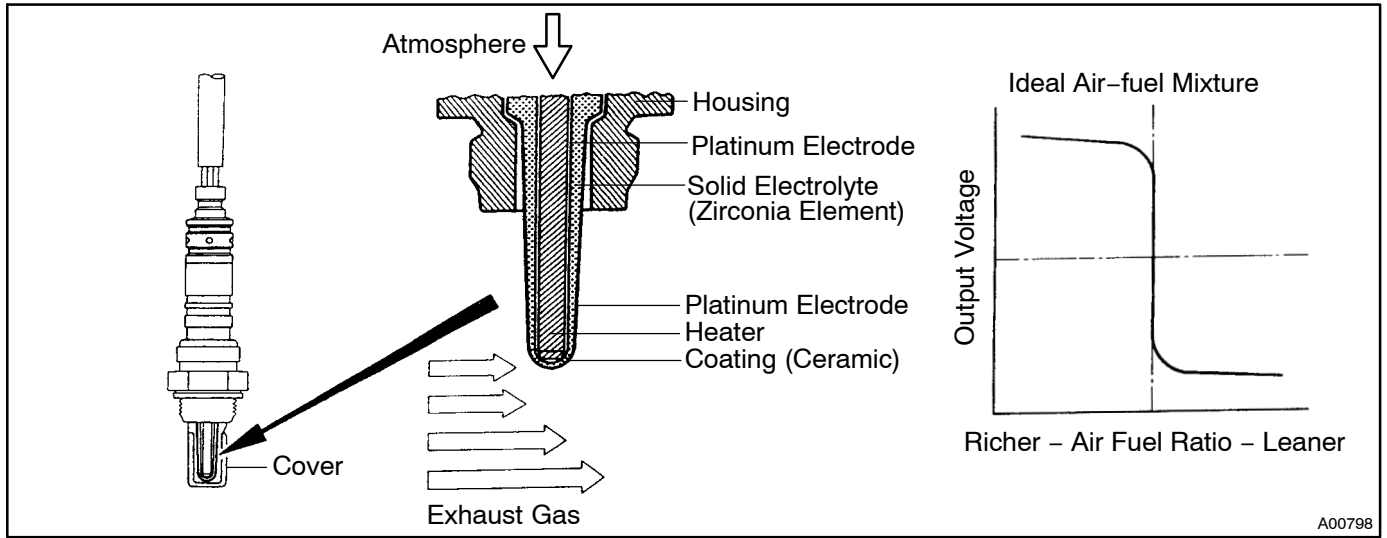
- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that does not include cylinder No. 1.
- Bank 1 includes cylinder No. 1, but bank 2 does not. Cylinder No. 1 is located in the front part of the engine, opposite the transmission.
- Sensor 1 refers to the sensor closest 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. The HO2S generates a voltage between 0.1 and 0.9 V in response to oxygen concentration in the exhaust gas.

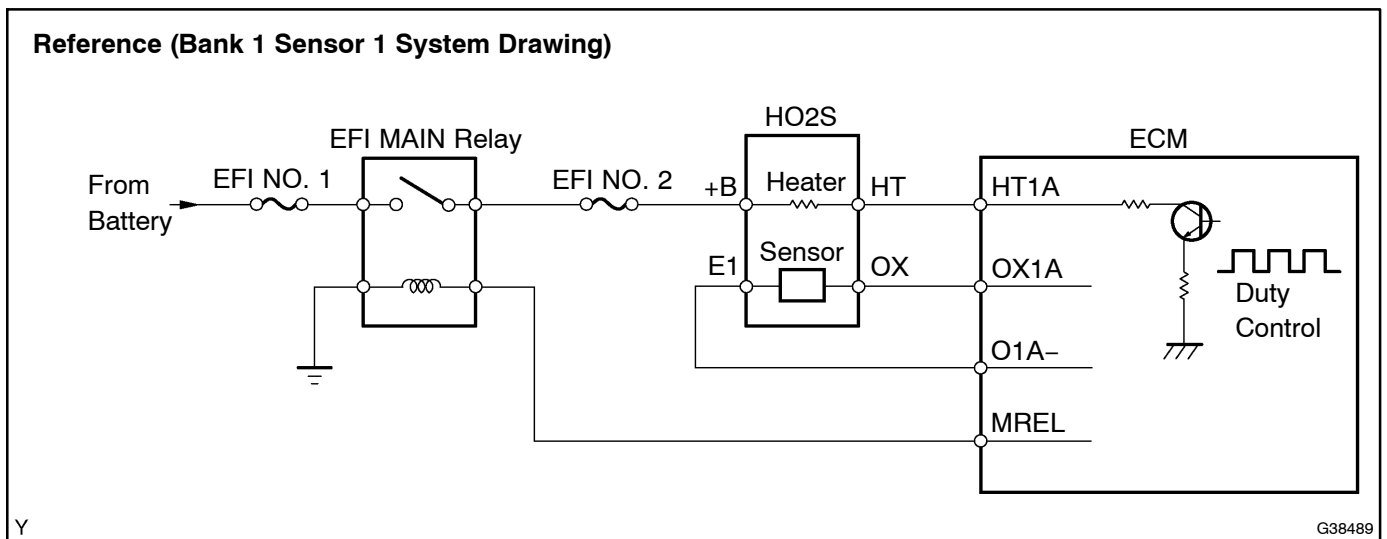
If the oxygen concentration in the exhaust gas increases, the air-fuel ratio is called LEAN. The HO2S voltage drops below 0.45 V and the HO2S, which informs the ECM of the LEAN condition.

If oxygen is not in the exhaust gas, the air-fuel ratio is called 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.



| DTC No. | DTC Detection Condition | Trouble Area |
|----------------------------------|---|--|
| P0031 P0037 P0051 P0057 | HO2S heater current is below 0.25 A when heater operates with +B greater than 11.5 V (1 trip detection logic) | <ul style="list-style-type: none"> • Open or short in HO2S heater circuit • HO2S heater • EFI MAIN relay • ECM |
| P0032 P0038 P0052 P0058 | Heated current exceeds 2 A when heater operates (1 trip detection logic) | <ul style="list-style-type: none"> • Open or short in HO2S heater circuit • HO2S heater • EFI MAIN relay • ECM |

MONITOR DESCRIPTION

The sensing portion of the HO2S has a zirconia element which is used to detect oxygen concentration in the exhaust. If the zirconia element is at the proper temperature and difference of the oxygen concentration between the inside and outside surface of the sensor is large, the zirconia element will generate voltage signals. In order to increase the oxygen concentration detecting capacity in the zirconia element, the ECM supplements the heat from the exhaust with heat from a heating element inside the sensor. When current in the HO2S heater is out of the standard operating range, the ECM interprets this as a fault in the HO2S heater. The ECM illuminates the MIL and sets a DTC.

Normally, the HO2S heater current is 0.4 to 1.0 A.

Example:

The ECM will set a high current DTC if the current in the sensor is more than 2 A. Similarly, the ECM will set a low current DTC if the current is less than 0.25 A.

The monitor runs if engine is started and run at idle for 9 minutes or more.

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) P0051: HO2S heater (bank 2 sensor 1) range check (low current) P0052: HO2S heater (bank 2 sensor 1) range check (high current) P0057: HO2S heater (bank 2 sensor 2) range check (low current) P0058: HO2S heater (bank 2 sensor 2) range check (high current) |
| Required Sensors/Components (Main) | HO2S heater |
| Required Sensors/Components (Related) | Vehicle speed sensor |
| Frequency of Operation | Once per driving cycles: P0031, P0037, P0051, P0057 Continuous: P0032, P0038, P0052, P0058 |
| Duration | 0.3 seconds |
| MIL Operation | Immediate |
| Sequence of Operation | None |

TYPICAL ENABLING CONDITIONS

P0031, P0037, P0051 and P0057

| | |
|--|-------------------------|
| Monitor will run whenever these DTCs are not present | None |
| Either of the following conditions A and B are met | |
| Condition A | |
| Time after engine start | 250 to 500 seconds |
| Vehicle speed | Within 90 km/h (56 mph) |
| Battery voltage | 10.5 V or more |
| Pass or Fail detection in this driving cycle | None |
| Condition B | |

DIAGNOSTICS - SFI SYSTEM

| | |
|--|--------------------------|
| Time after engine start | 500 seconds or more |
| Vehicle speed | 40 km/h (25 mph) or more |
| Battery voltage | 10.5 V or more |
| Pass or Fail detection in this driving cycle | None |

P0032, P0038, P0052 and P0058

None

TYPICAL MALFUNCTION THRESHOLDS**P0031, P0037, P0051 and P0057:**

| | |
|---|---|
| HO2S heater current when HO2S heater ON | Less than 0.25 A (when battery voltage is 11.5 V or more) |
|---|---|

P0032, P0038, P0052 and P0058:

| | |
|--|---------------|
| HO2S heater current when HO2S heater OFF | More than 2 A |
|--|---------------|

COMPONENT OPERATING RANGE

| | |
|---------------------|--|
| HO2S heater current | 0.4 to 1 A (when engine is idling after warming it up and battery voltage is 11 to 14 V) |
|---------------------|--|

MONITOR RESULTRefer to page [05-25](#) for detailed information.

The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (refer to "Confirmation Monitor").

- MID (Monitor Identification Data) is assigned to each emission-related component.
- TID (Test Identification Data) is assigned to each emissions-related component.
- Scaling is used to calculate the test value indicated on generic OBDII scan tools.

HO2S bank 1 sensor 1

| MID | TID | Scaling | Description of Test Value | Minimum Test Limit | Maximum Test Limit |
|------|------|-----------------------|-------------------------------|--------------------|--------------------|
| \$41 | \$90 | Multiply by 0.001 [A] | Maximum sensor heater current | Minimum test limit | Maximum test limit |

HO2S bank 1 sensor 2

| MID | TID | Scaling | Description of Test Value | Minimum Test Limit | Maximum Test Limit |
|------|------|-----------------------|-------------------------------|--------------------|--------------------|
| \$42 | \$90 | Multiply by 0.001 [A] | Maximum sensor heater current | Minimum test limit | Maximum test limit |

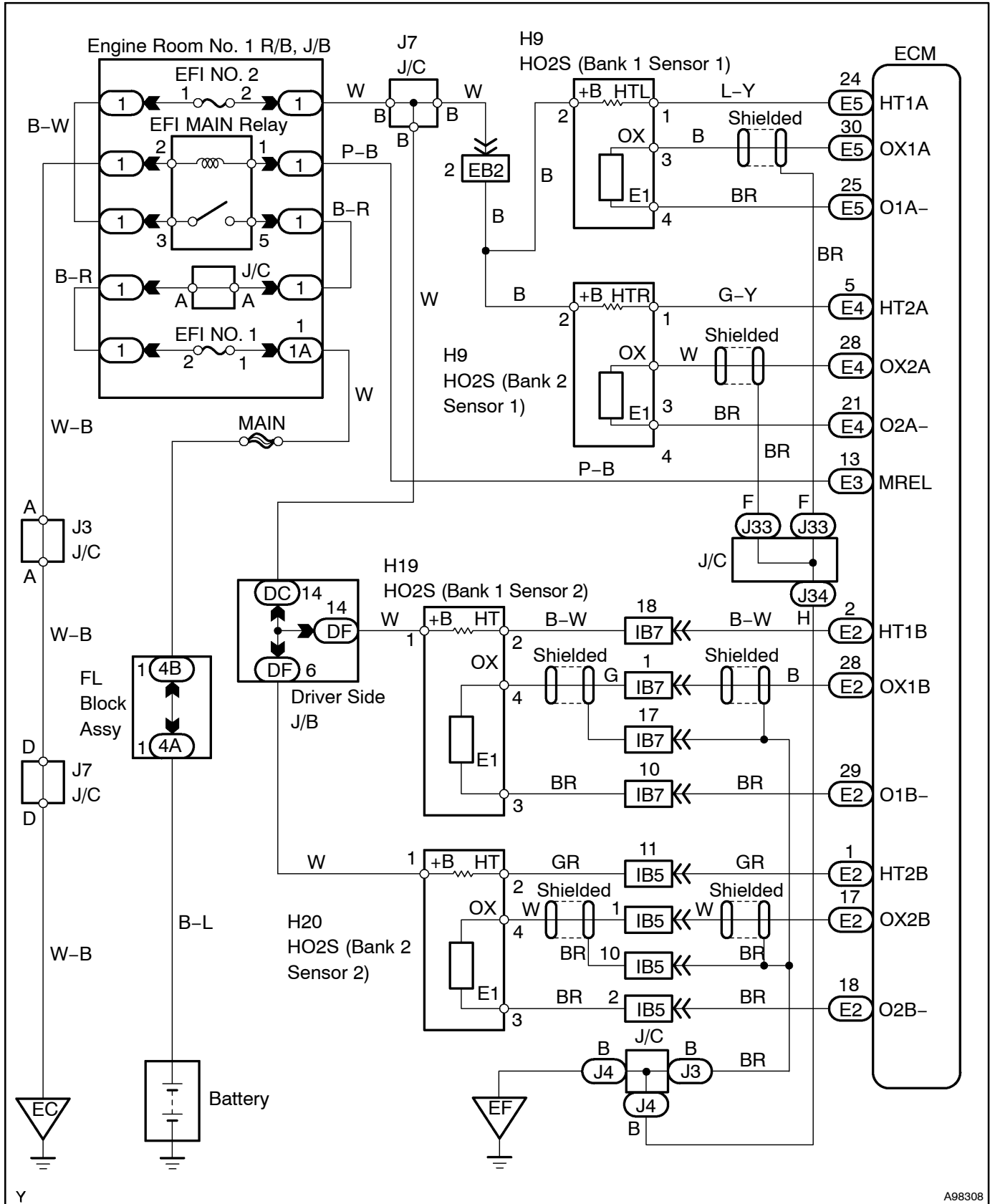
HO2S bank 2 sensor 1

| MID | TID | Scaling | Description of Test Value | Minimum Test Limit | Maximum Test Limit |
|------|------|-----------------------|-------------------------------|--------------------|--------------------|
| \$45 | \$90 | Multiply by 0.001 [A] | Maximum sensor heater current | Minimum test limit | Maximum test limit |

HO2S bank 2 sensor 2

| MID | TID | Scaling | Description of Test Value | Minimum Test Limit | Maximum Test Limit |
|------|------|-----------------------|-------------------------------|--------------------|--------------------|
| \$46 | \$90 | Multiply by 0.001 [A] | Maximum sensor heater current | Minimum test limit | Maximum test limit |

WIRING DIAGRAM



Y

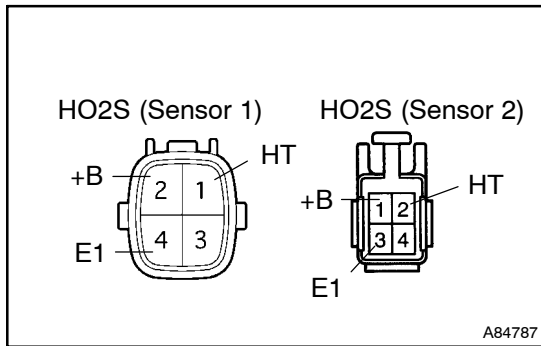
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INSPECTION PROCEDURE

HINT:

Read freeze frame data using the hand-held tester. 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)



- (a) Disconnect the H9, H10, H19 and H20 HO2S connectors.
- (b) Measure the resistance of the sensors.

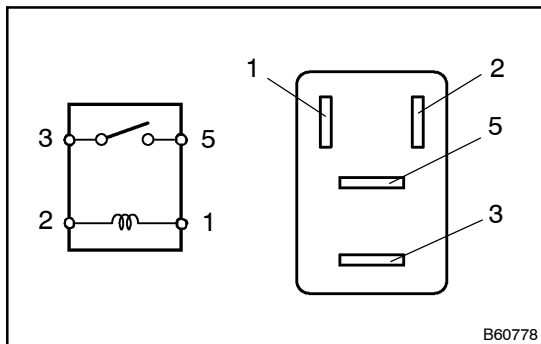
Standard:

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

NG → REPLACE HEATED OXYGEN SENSOR

OK

2 INSPECT RELAY (Marking: EFI MAIN)



- (a) Remove the EFI MAIN relay from the engine room No. 1 R/B.
- (b) Measure the resistance of the EFI MAIN relay.

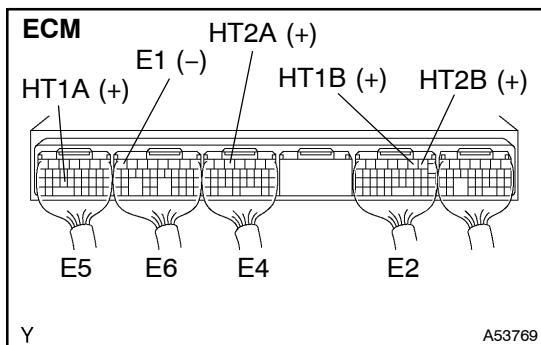
Standard:

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

NG → REPLACE RELAY

OK

3 CHECK ECM (HT1A, HT2A, HT1B, HT2B VOLTAGE)



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

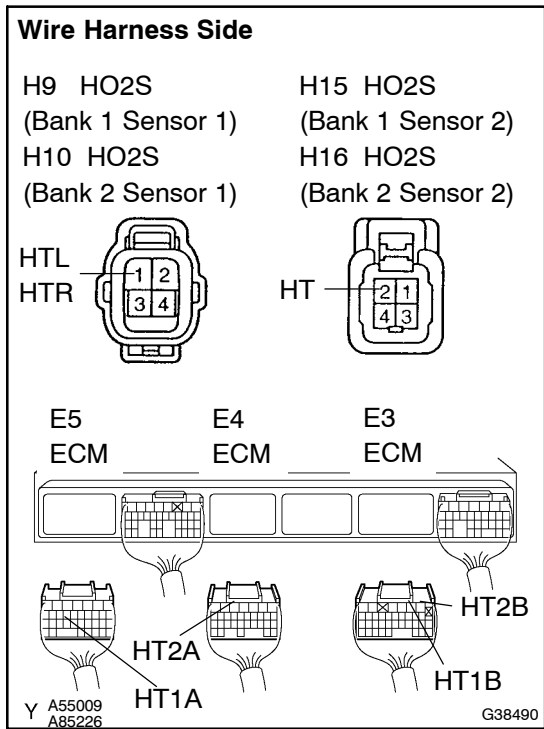
Standard:

| Tester Connection | Specified Condition |
|--------------------------|---------------------|
| E5-24 (HT1A) - E6-7 (E1) | 9 to 14 V |
| E4-5 (HT2A) - E6-7 (E1) | 9 to 14 V |
| E2-2 (HT1B) - E6-7 (E1) | 9 to 14 V |
| E2-1 (HT2B) - E6-7 (E1) | 9 to 14 V |

OK → REPLACE ECM (See page 10-20)

NG

4 CHECK WIRE HARNESS (HEATED OXYGEN SENSOR - ECM)



- (a) Disconnect the H9, H10, H19 and H20 HO2S connectors.
- (b) Disconnect the E2, E4 and E6 ECM connectors.
- (c) Measure the resistance of the wire harness side connectors.

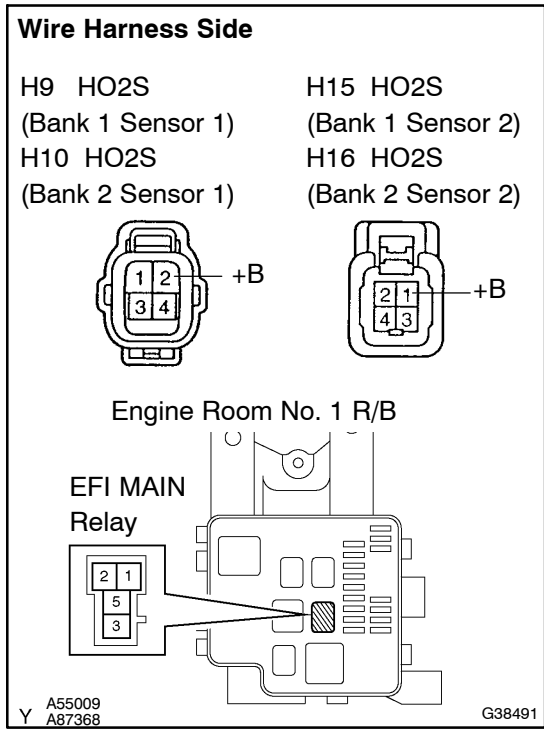
Standard:

| Tester Connection | Specified Condition |
|--|---------------------|
| H9-1 (HTL) - E5-24 (HT1A) | Below 1 Ω |
| H10-1 (HTR) - E4-5 (HT2A) | Below 1 Ω |
| H19-2 (HT) - E2-2 (HT1B) | Below 1 Ω |
| H20-2 (HT) - E2-1 (HT2B) | Below 1 Ω |
| H9-1 (HTL) or E5-24 (HT1A) - Body ground | 10 kΩ or higher |
| H10-1 (HTR) or E4-5 (HT2A) - Body ground | 10 kΩ or higher |
| H19-2 (HT) or E2-2 (HT1B) - Body ground | 10 kΩ or higher |
| H20-2 (HT) or E2-1 (HT1B) - Body ground | 10 kΩ or higher |

NG REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

5 CHECK WIRE HARNESS (HEATED OXYGEN SENSOR - EFI RELAY)



- (a) Disconnect the H9, H10, H19 and H20 HO2S connectors.
- (b) Remove the EFI MAIN relay from the engine room No. 1 R/B.
- (c) Measure the resistance of the wire harness side connectors.

Standard:

| Tester Connection | Specified Condition |
|--|---------------------|
| H9-2 (+B) - R/B EFI MAIN relay terminal 3 | Below 1 Ω |
| H10-2 (+B) - R/B EFI MAIN relay terminal 3 | Below 1 Ω |
| H19-1 (+B) - R/B EFI MAIN relay terminal 3 | Below 1 Ω |
| H20-1 (+B) - R/B EFI MAIN relay terminal 3 | Below 1 Ω |
| H9-2 (+B) - Body ground | 10 kΩ or higher |
| H10-2 (+B) - Body ground | 10 kΩ or higher |
| H19-2 (+B) - Body ground | 10 kΩ or higher |
| H20-2 (+B) - Body ground | 10 kΩ or higher |

NG REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

CHECK ECM POWER SOURCE CIRCUIT (See page 05-314)