DTC	P0136/29	OXYGEN SENSOR CIRCUIT MALFUNCTION (BANK 1 SENSOR 2)

DTC	P0156/27	OXYGEN SENSOR CIRCUIT MALFUNCTION (BANK 2 SENSOR 2)

CIRCUIT DESCRIPTION

The heated oxygen sensor is the planar type. Compared to the conventional type, the sensor and heater portions are narrower overall. Because the heat of the heater is conducted through the alumina to zirconia (of the sensor portion) it accelerates the activation of the sensor.

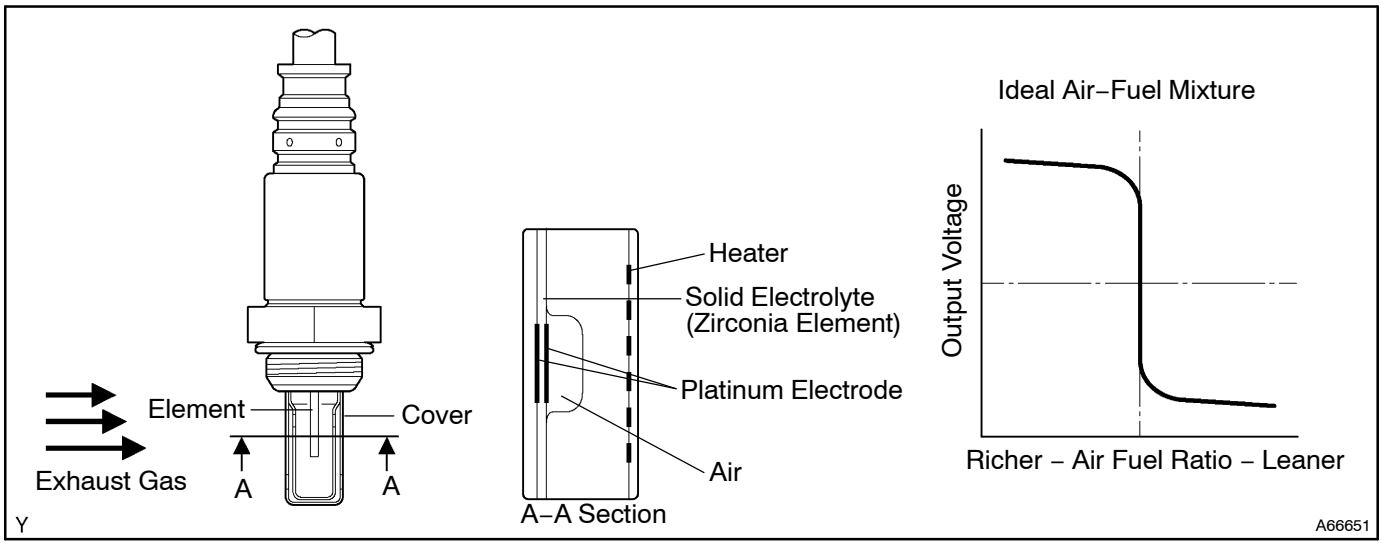
To obtain a high purification rate for the CO, HC and NOx components of the exhaust gas, a three–way catalytic converter is used. For the most efficient use of the three–way catalytic converter, the air–fuel ratio must be precisely controlled so that it is always close to the stoichiometric air–fuel 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 control the air–fuel ratio.

When the air–fuel ratio becomes LEAN, the oxygen concentration in the exhaust gas increases. And the heated oxygen sensor informs the ECM of the LEAN condition (small electromotive force: < 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 (large electromotive force: > 0.45 V). The ECM judges by the electromotive force from the heated oxygen sensor whether the air–fuel ratio is RICH or LEAN and controls the injection time accordingly. If the malfunction of the heated oxygen sensor causes an output of abnormal electromotive force, the ECM becomes unable to perform the accurate air–fuel ratio control.

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

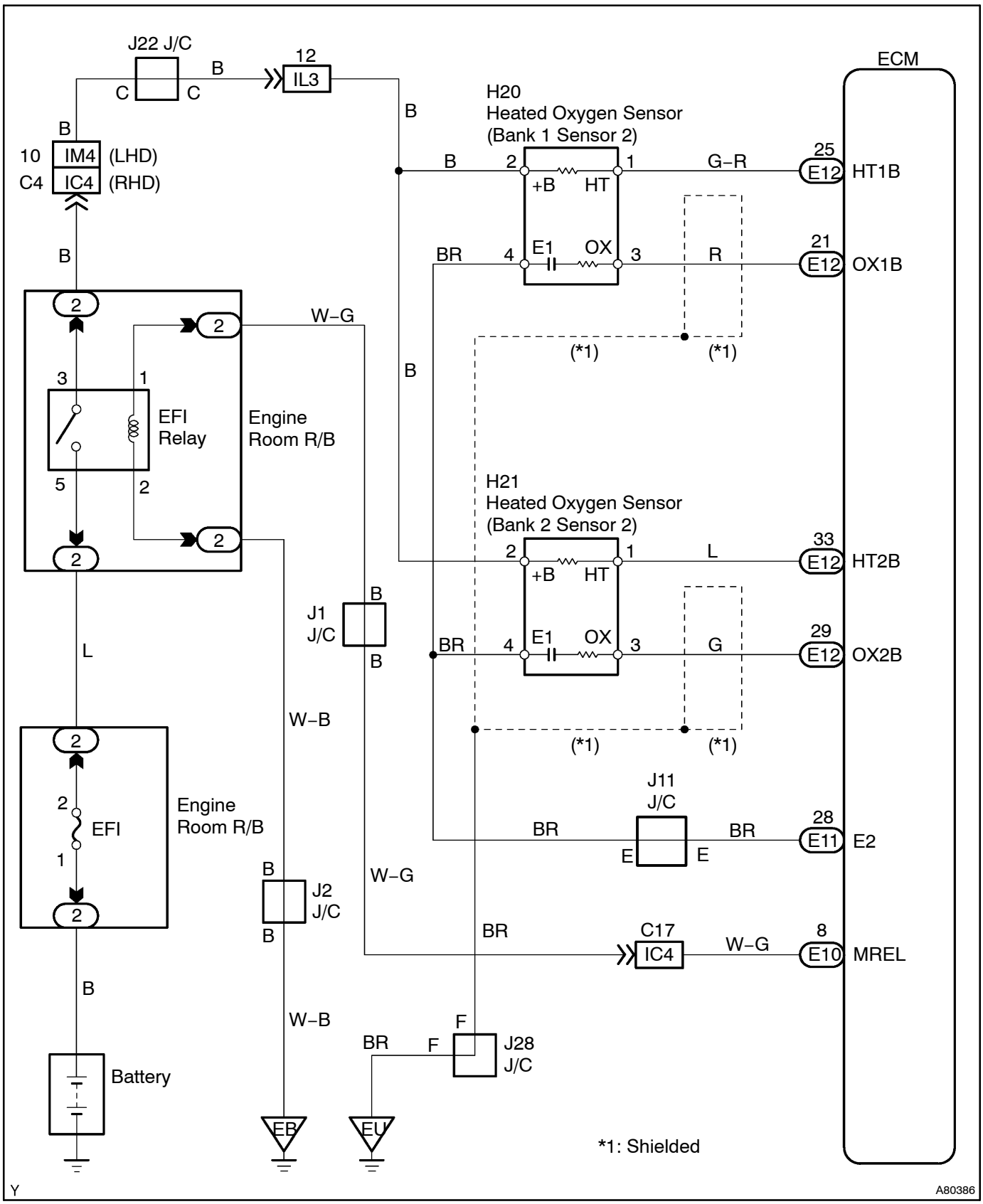


DTC No	DTC Detection Condition	Trouble Area
P0136/29 P0156/27	The following condition continues 480 sec. or more: • During driving with the engine warmed up, voltage output of the heated oxygen sensor remains at 0.45 V or more, or at 0.60 V or less.	• Open or short in heated oxygen sensor (bank 1, 2 sensor 2) circuit • Heated oxygen sensor (bank 1, 2 sensor 2) • Heated oxygen sensor heater (bank 1, 2 sensor 2) • EFI relay

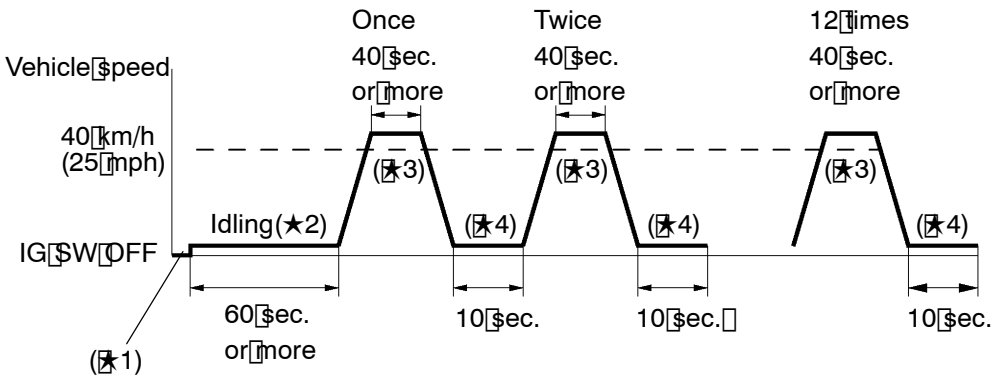
HINT:

- Bank 1 refers to the bank that includes cylinder No.1.
- Bank 2 refers to the bank that does not include cylinder No.1.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



1. **Connect the hand–held tester to the DLC3. (★1)**
2. **Switch the hand–held tester from the normal mode to the check (test) mode (See page 05–7). (★1)**
3. **Start the engine and let the engine idle for 60 seconds or more. (★2)**
4. **Drive the vehicle at 40 km/h (25 mph) or more for 40 seconds or more. (★3)**
5. **Let the engine idle for 10 seconds or more. (★4)**
6. **Perform steps (★3) to (★4) 12 times. (★5)**

HINT:

If a malfunction exists, the CHK ENG will illuminate on the multi–information display during step (★5).

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 from (★2) to (★5), then perform steps from (★2) to (★5) again.

INSPECTION PROCEDURE

HINT:

Hand–held tester only:

Narrowing down the trouble area is possible by performing ACTIVE TEST of the following ”A/F CONTROL” (A/F sensor, heated oxygen sensor or other trouble areas can be distinguished).

(a) Perform ACTIVE TEST by the 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 approx. 90 sec.
(4) Select the item ”DIAGNOSIS / OBD/MOBD / ACTIVE TEST / A/F CONTROL”.
(5) Perform ”A/F CONTROL” when idle condition (press the right or left button).

Result:

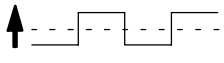
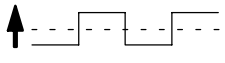
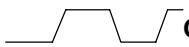
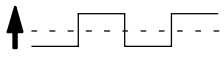
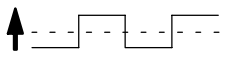
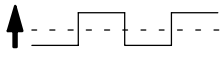
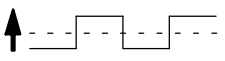
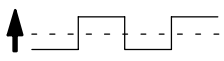
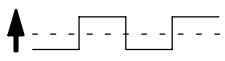
A/F sensor reacts in accordance with increase and decrease of injection volume:

+25 % → rich output: Less than 3.0 V

–12.5 % → lean output: More than 3.35 V

Heated oxygen sensor 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:
There is a few second delay in the A/F sensor output and there is about 20 seconds delay in the heated oxygen sensor output.

	Output voltage of A/F sensor (sensor 1)	Output voltage of heated oxygen sensor (sensor 2)	Mainly suspect trouble area
Case 1	Injection volume +25 % –12.5 %  Output voltage More than 3.35 V Less than 3.0 V  **OK**	Injection volume +25 % –12.5 %  Output voltage More than 0.55 V Less than 0.4V  **OK**	—
Case 2	Injection volume +25 % –12.5 %  Output voltage No reaction **NG**	Injection volume +25 % –12.5 %  Output voltage More than 0.55 V Less than 0.4V  **OK**	A/F sensor (A/F sensor, heater, A/F sensor circuit)
Case 3	Injection volume +25 % –12.5 %  Output voltage More than 3.35 V Less than 3.0V  **OK**	Injection volume +25 % –12.5 %  Output voltage No reaction **NG**	Heated oxygen sensor (heated oxygen sensor, heater, heated oxygen sensor circuit)
Case 4	Injection volume +25 % –12.5 %  Output voltage No reaction **NG**	Injection volume +25 % –12.5 %  Output voltage No reaction **NG**	Extremely rich or lean of the actual air–fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

The following procedure of A/F CONTROL enables the user to check its output (show its graph indication) of A/F sensor and heated oxygen sensor.
For displaying the graph indication, enter ”ACTIVE TEST/ A/F CONTROL/USER DATA”, then select ”AFS B1S1 and O2S B1S2” or ”AFS B2S1 and O2S B2S2” by pressing ”YES” button and push ”ENTER” button before pressing ”F4” button.
HINT:

- If different DTCs that are related to a different system are output simultaneously while terminal E2 is used as a ground terminal, terminal E2 may be open.
- Read freeze frame data using the hand–held tester, as 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.

1	CHECK OTHER DTC OUTPUT(BESIDES DTC P0136/29 AND/OR P0156/27)

(a) Read the DTC.

Result:

Display (DTC output)	Proceed to
Only "P0136/29 and/or P0156/27" are output	A
"P0136/29 or P0156/27" and other DTCs are output	B

HINT:

If any other codes besides "P0136/29 and/or P0156/27" are output, perform the troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–7)**

A

2	READ VALUE OF HAND–HELD TESTER(OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

(a) After warming up the engine, race the engine at 2,500 rpm for 3 minutes.

(b) Read the output voltage of the heated oxygen sensor when the engine is suddenly raced.

HINT:

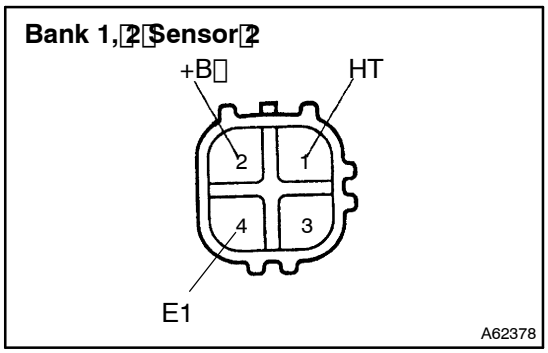
Perform a quick racing to 4,000 rpm 3 times by using the accelerator pedal.

Heated oxygen sensor output voltage: Alternates 0.4 V or less and 0.5 V or more.

OK → **Go to step 6**

NG

3	INSPECT HEATED OXYGEN SENSOR(HEATER RESISTANCE)



(a) Measure the resistance between the terminals of the heated oxygen sensor connector.

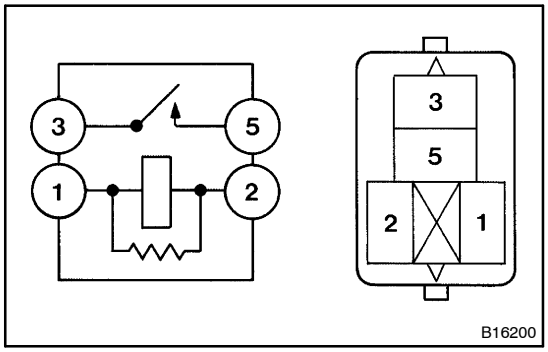
Standard (Bank 1, 2 sensor 2):

Terminal No.	Resistance
1 (HT) – 2 (+B)	5 to 10 Ω at 20 °C (68 °F)
1 (HT) – 4 (E1)	No Continuity

NG → **REPLACE HEATED OXYGEN SENSOR**

OK

4 INSPECT EFI RELAY



(a) Remove the EFI relay from the engine room R/B.
(b) Inspect the EFI relay.

Standard:

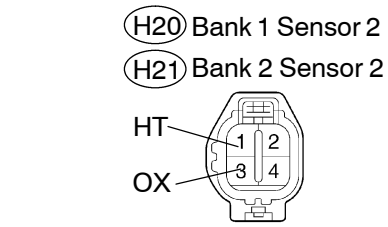
Terminal No.	Specified condition
1 – 2	Continuity
3 – 5	No Continuity
	Continuity (Apply battery voltage terminals 1 and 2)

NG → **REPLACE EFI RELAY**

OK

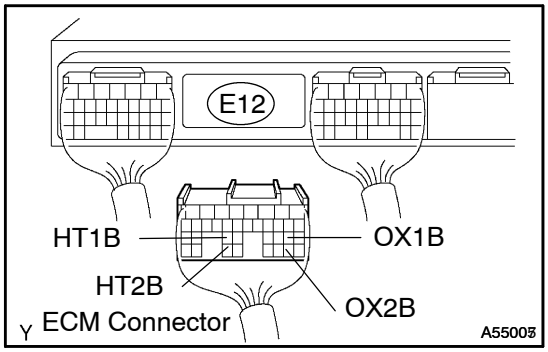
5 CHECK HARNESS AND CONNECTOR(HEATED OXYGEN SENSOR – ECM)

Wire Harness Side



Heated Oxygen Sensor Connector

A72895



(a) Disconnect the H20 or H21 heated oxygen sensor connector.
(b) Disconnect the E12 ECM connector.
(c) Check for continuity between the wire harness side connectors.

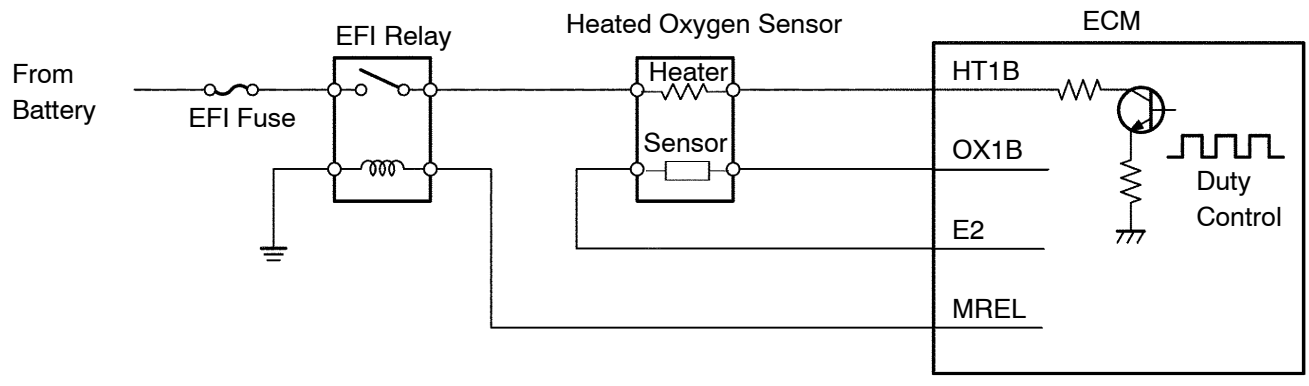
Standard (Check for open):

Symbols (Terminal No.)	Specified condition
OX (H20–3) – OX1B (E12–21)	Continuity
HT (H20–1) – HT1B (E12–25)	
OX (H21–3) – OX2B (E12–29)	
HT (H21–1) – HT2B (E12–33)	

Standard (Check for short):

Symbols (Terminal No.)	Specified condition
OX (H20–3) or OX1B (E12–21) – Body ground	No continuity
HT (H20–1) or HT1B (E12–25) – Body ground	
OX (H21–3) or OX2B (E12–29) – Body ground	
HT (H21–1) or HT2B (E12–33) – Body ground	

Reference (Bank 1 Sensor 2 System Drawing)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE HEATED OXYGEN SENSOR

6	PERFORM CONFIRMATION DRIVING PATTERN

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

GO

7	READ OUTPUT DTC (DTC P0136/29 AND/OR P0156/27 ARE OUTPUT AGAIN)

(a) Read the DTC using the hand–held tester.
Result:

Display (DTC output)	Proceed to
"P0136/29 and/or P0156/27" are not output again	A
"P0136/29 and/or P0156/27" are output again	B

B → REPLACE HEATED OXYGEN SENSOR

A

CHECK FOR INTERMITTENT PROBLEMS (See page 05–7)