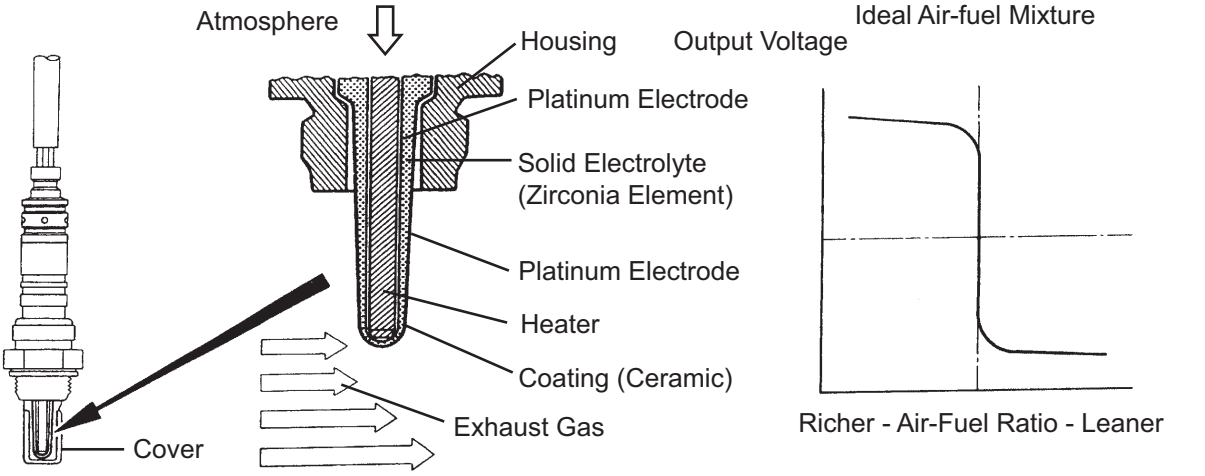
DTC	P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)
DTC	P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)
DTC	P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)
DTC	P0139	Oxygen Sensor Circuit Slow Response (Bank 1 Sensor 2)
DTC	P0156	Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)
DTC	P0157	Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)
DTC	P0158	Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)
DTC	P0159	Oxygen Sensor Circuit Slow Response (Bank 2 Sensor 2)

DESCRIPTION

The heated oxygen sensor (HO2S) is used to monitor oxygen in the exhaust gas. For optimum catalyst operation, the air fuel mixture (air-fuel ratio) 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 volts in response to oxygen in the exhaust gas. If the oxygen in the exhaust gas increases, the air-fuel ratio becomes "Lean". The ECM interprets Lean when the HO2S voltage is below 0.45 volts. If the oxygen in the exhaust gas decreases, the air-fuel ratio becomes "Rich". The ECM interprets Rich when the HO2S voltage is above 0.45 volts.



ES

DTC No.	DTC Detection Condition	Trouble Area
P0136 P0156	• Either of the following conditions is met (2 trip detection logic): (a) Heated Oxygen (HO2) sensor voltage was lower than 0.05 V for a certain period (b) HO2 sensor did not switch for a certain period	• Open or short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2) • Air-Fuel Ratio (A/F) sensor (bank 1, 2 sensor 1)
P0137 P0157	HO2 sensor voltage was lower than 0.03 V for 90 seconds	• Short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2)
P0138 P0158	HO2 sensor voltage was 1.2 V or higher for 10 seconds	• Short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2)
P0139 P0159	HO2 sensor voltage did not drop during fuel-cut	• Short in HO2 sensor (bank 1, 2 sensor 2) circuit • HO2 sensor (bank 1, 2 sensor 2) • HO2 sensor heater (bank 1, 2 sensor 2)

MONITOR DESCRIPTION

The ECM monitors the rear Heated Oxygen (HO2) sensor to check for the following malfunctions. If any of the malfunctions are detected, the ECM illuminates the MIL and sets a DTC.

- The HO2 sensor output voltage remains above 0.45 V (rich) or below 0.45 V (lean) while the vehicle is accelerated and decelerated for 8 minutes.
- The HO2 sensor output voltage remains at below 0.05 V, for a long period of time while the vehicle is driven.
- The HO2 sensor output voltage does not decrease below 0.2 V (extremely lean condition) within 7 seconds after fuel-cut is performed while the vehicle is decelerated. The ECM interprets this as the sensor response having deteriorated.

MONITOR STRATEGY

Voltage:

Related DTCs	P0136 (bank 1 sensor 2), P0156 (bank 2 sensor 2)
Required Sensors/Components (Main)	HO2S
Required Sensors/Components (Related)	ECT sensor, MAF meter, VSS, CKP sensor, Throttle position sensor
Frequency of Operation	Once per driving cycle
Duration	160 seconds
MIL Operation	2 driving cycle
Sequence of Operation	None

Switching:

Related DTCs	P0136 (bank 1 sensor 2), P0156 (bank 2 sensor 2)
Required Sensors/Components (Main)	HO2S
Required Sensors/Components (Related)	CKP sensor
Frequency of Operation	Once per driving cycle
Duration	480 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

Low voltage:

Related DTCs	P0137(bank 1 sensor 2), P0157 (bank 2 sensor 2)
Required Sensors/Components (Main)	HO2S
Required Sensors/Components (Related)	MAF meter, HO2 sensor heater
Frequency of Operation	Continuous
Duration	90 seconds
MIL Operation	Immediate
Sequence of Operation	None

High voltage:

Related DTCs	P0138(bank 1 sensor 2), P0158 (bank 2 sensor 2)
Required Sensors/Components (Main)	HO2S
Required Sensors/Components (Related)	None
Frequency of Operation	Continuous
Duration	10 seconds
MIL Operation	Immediate
Sequence of Operation	None

Voltage during fuel-cut:

Related DTCs	P0139(bank 1 sensor 2), P0159 (bank 2 sensor 2)
Required Sensors/Components (Main)	HO2S
Required Sensors/Components (Related)	ECT sensor, MAF meter, HO2 sensor heater
Frequency of Operation	Once per driving cycle
Duration	6 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs not present	P0031, P0032, P0051, P0052 (O2 sensor heater sensor 1), P0031, P0032, P0051, P0052 (A/F sensor heater sensor 1), P0037, P0038, P0057, P0058 (O2 sensor heater sensor 2), P0100, P0101, P0102, P0103 (MAF sensor), P0110, P0112, P0103 (IAT sensor), P0115, P0116, P0117, P0118 (ECT sensor), P0120, P0122, P0123, P0220, P0222, P0223, P2135, (TP sensor) P0125 (Insufficient ECT for closed loop), P0136, P0137, P0138 (O2 sensor 1), P0171, P0172, P0174, P0175 (Fuel system), P0300, P0301, P0302, P0303, P0304, P0305, P0306 (Misfire), P0335 (CKP sensor), P0340, P0341 (CMP sensor), P0402 (EGR system (Open)), P0442, P0455, P0456 (EVAP system), P0500 (VSS), P2196, P2198 (A/F sensor (Rationality))

Voltage:

Engine	Running
Vehicle speed	1.875 mph (3 km/h) or more
Idle	OFF
Fuel cut	OFF

Intake air amount	6g/sec or more

Switching:

All of the following condition are met	Condition 1, 2 and 3
1. Engine	Running
2. Cumulative time when oxygen sensor heater is operating	22 seconds or more
3. Time after engine start	0 second or more

Low voltage:

Battery voltage	11 V or more
Estimated heated oxygen sensor temperature	450°C (842°F) or more

High voltage:

Engine	Running
Battery voltage	11 V or more

Voltage during fuel-cut:

Engine coolant temperature	70°C (158°F) or more
Estimated catalyst temperature	500°C (932°F) or more
Fuel-cut	ON

TYPICAL MALFUNCTION THRESHOLDS

Voltage:

All of the following conditions are met	Conditions 1, 2, 3, 4 and 5
1. Cumulative sensor monitoring time	160 seconds or more
2. Cumulative time while rear HO2S voltage is less than 0.05 V	96 seconds or more
3. Cumulative time while rear HO2S voltage is more than 0.7 V	Less then 32 seconds
4. Cumulative time while rear HO2S voltage is more than 0.45 V	Less than 48 seconds
5. Maximum time while rear HO2S voltage is more than 0.45 V	Less than 20 seconds

Switching:

All of the following conditions are met:	Conditions 1 and 2
1. Frequency of switch time either less than 0.45 V or 0.6 V or more	0 times
2. Cumulative monitor time* of rear HO2S	480 seconds or more
*: Monitor time is counted when the following conditions are met	Conditions (a) and (b)
(a) Fuel system status	Closed-loop
(b) Idle	OFF

Low voltage:

Duration that rear oxygen sensor is less than 0.03 V	90 seconds or more

High voltage:

Duration that rear oxygen sensor is 1.2 V or more	10 seconds or more

Voltage during fuel-cut:

One of the following conditions is met:	Conditions 1 or 2
1. Duration until rear HO2S voltage drops to 0.2 V during fuel-cut start	6 seconds or more
2. Duration that rear HO2S voltage drops from 0.35 to 0.2 V during fuel-cut	1 second or more

COMPONENT OPERATING RANGE

Heated Oxygen sensor voltage	Varies between 0.1 and 0.9 V

MONITOR RESULT

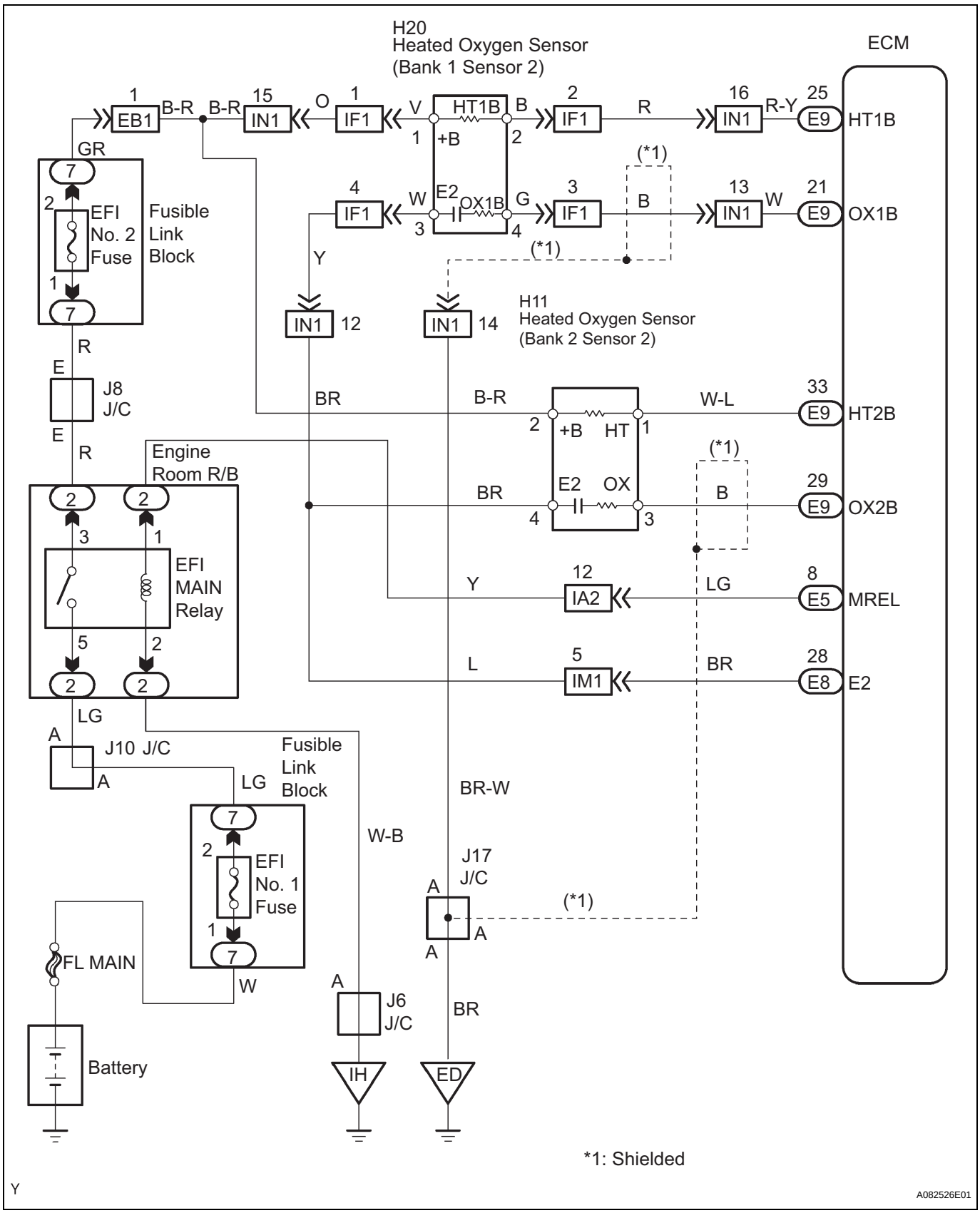
Refer to CHECKING MONITOR STATUS (See page ES-14).

HO2S bank 1 sensor 2

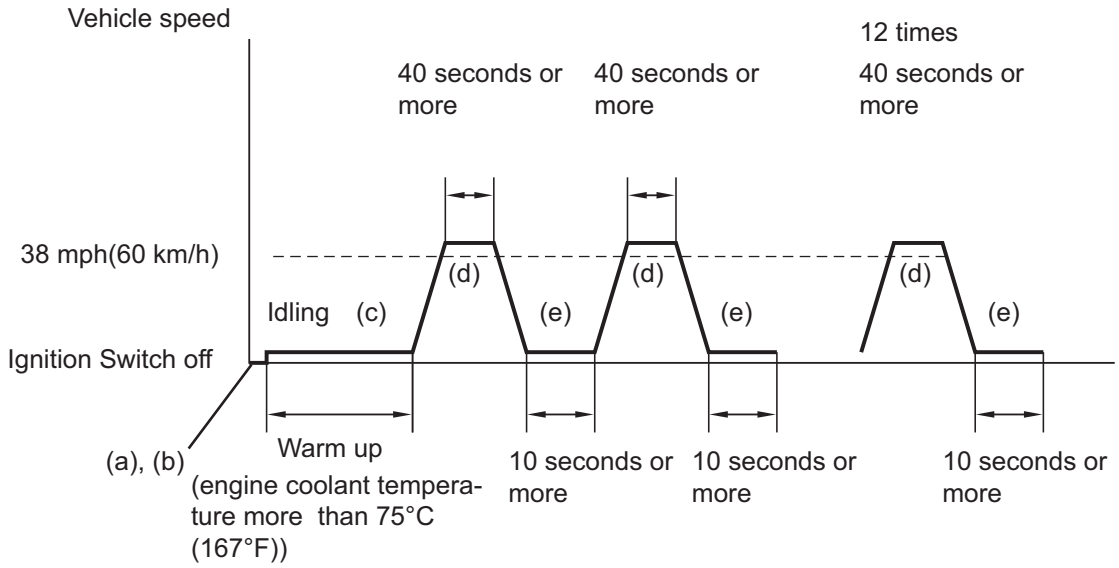
Test ID	Test Item	Description	Unit Conversion	Unit	Standard Value
$07	MIN HO2S V	Minimum HO2 voltage	Multiply by 0.005	V	Less than malfunction threshold
$08	MAX HO2S V	Maximum HO2 voltage	Multiply by 0.005	V	More than malfunction threshold
$31	Time $31	HO2S switch time form Lean to Rich	Multiply by 0.04096	Second	Less than malfunction threshold
$32	Time $32	HO2S switch time form Rich to Lean	Multiply by 0.04096	Second	Less than malfunction threshold
$37	Time $37	Time that HO2S voltage drops to 0.2 V after fuel-cut begins	Multiply by 0.04096	Second	Less than malfunction threshold
$81	Time $81	Percentage in monitor time when HO2S voltage is lower than 0.05 V	Multiply by 0.04096	%	Less than malfunction threshold
$84	Time $84	Percentage in monitor time when HO2S voltage is 0.7 V or higher	Multiply by 0.04096	%	More than malfunction threshold
$85	Time $85	Maximum time while HO2S voltage exceeded 0.45 V continuously	Multiply by 0.04096	Second	More than malfunction threshold
$87	Time $87	Maximum time while HO2S voltage exceeded 0.45 V or higher	Multiply by 0.04096	%	More than malfunction threshold

If the sensor voltage is outside the standard values, the ECM interprets this as a malfunction and sets a DTC.

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



(a) Connect the intelligent tester to the DLC3.
(b) Switch the ECM From normal mode to check mode using the tester (See page ES-29).
(c) Start the engine and warm it up until the engine coolant temperature reaches more than 75°C (167°F).
(d) Drive the vehicle at 38 mph (60 km/h) or more for 40 seconds or more.
(e) Let the engine idle for 10 seconds or more.
(f) Perform steps (d) and (e) 12 times.
HINT:
If a malfunction exists, the MIL illuminates during step (f).
NOTICE:
If the conditions in this test are not strictly followed, malfunctions may not be detected. If you do not have the intelligent tester, turn the engine switch off after performing steps from (c) to (f), then perform steps (c) to (f) again.

CONFIRMATION DRIVING PATTERN

Warm up the engine and run the engine at 38 mph (60 km/h) for 7 minutes.

CONFIRMATION DRIVING PATTERN

Warm up the engine and run the engine at idle for 30 seconds.

HINT:
Intelligent tester only:
Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.
The following instructions describe how to conduct the A/F CONTROL operation using an intelligent tester.
1. Connect the intelligent tester to the DLC3.
2. Start the engine and turn the tester ON.
3. Warm up the engine at engine speed of 2,500 rpm for approximately 90 seconds.
4. On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.

5. Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
6. Monitor the voltage outputs of the A/F and HO2 sensors (AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.

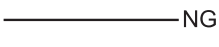
HINT:

- The A/F CONTROL operation lowers the fuel injection volume by 12.5 % or increases the injection volume by 25 %.
- Each sensor reacts in accordance with increases in the fuel injection volume.

Standard

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1S1 or AFS B2S1 (A/F)	+25 %	Rich	Less than 3.0
AFS B1S1 or AFS B2S1 (A/F)	-12.5 %	Lean	More than 3.35
O2S B1S2 or O2S B2S2 (HO2)	+25 %	Rich	More than 0.55
O2S B1S2 or O2S B2S2 (HO2)	-12.5 %	Lean	Less than 0.4

NOTICE:
The Air-Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.55 V Less than 0.4 V		
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• A/F sensor • A/F sensor heater A/F sensor circuit
	Output Voltage Almost no reaction		Output Voltage More than 0.55 V Less than 0.4 V		
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage Almost no reaction		
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction		Output Voltage Almost no reaction		

- Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.

- To display the graph, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2, and press the YES button and then the ENTER button followed by the F4 button.

HINT:

- If other DTCs relating 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. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. 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.
- If the OX1B wire from the ECM connector is short-circuited to the +B wire, DTC P0136 will be set.
- If the OX2B wire from the ECM connector is short-circuited to the +B wire, DTC P0156 will be set.

ES

1	CHECK OTHER DTC OUTPUT

(a) Read the DTC using the intelligent tester or the OBD II scan tool.

Result

Display (DTC Output)	Proceed to
P0138 and/or P0158 are output	A
P0137 and/or P0157 are output	B
P0136 and/or P0156 are output	C

HINT:
If any other codes besides P0136, P0137, P0138, P0156, P0157 and/or P0158 are output, perform the troubleshooting for those codes first.

B → **Go to step 9**

C → **Go to step 6**

A

2	READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

(a) Connect the intelligent tester or the OBD II scan tool to the DLC3.
(b) Turn the ignition switch ON. Push the intelligent tester or the OBD II scan tool main switch ON.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / O2S B1S2.
(d) Run the engine at idle.
(e) Read the output voltage of the heated oxygen sensor during idling.

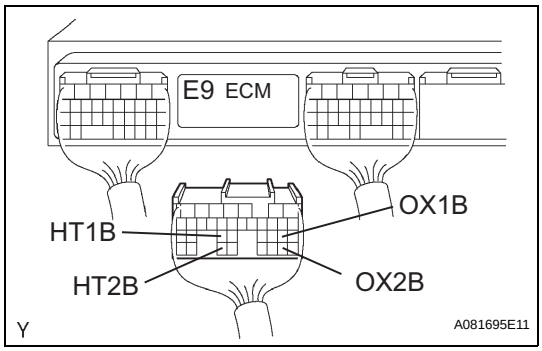
Result

Heated oxygen sensor output voltage	Proceed to
More than 1.2 V	A
Less than 1.0 V	B

B → **Go to step 5**

A

3 CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)



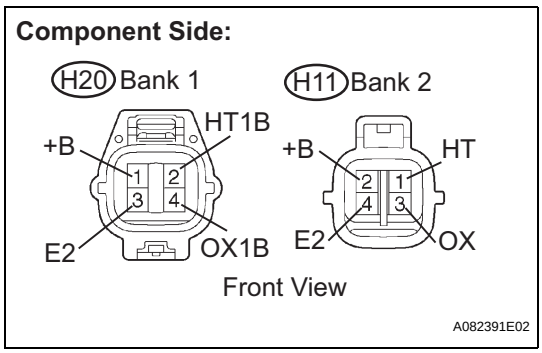
(a) Turn the ignition switch OFF and wait for 5 minutes.
(b) Disconnect the E9 ECM connector.
(c) Measure the resistance of the wire harness side connectors.
Standard resistance

Tester Connection	Specified Condition
E9-25 (HT1B) - E9-21 (OX1B)	10 kΩ or higher
E9-33 (HT2B) - E9-29 (OX2B)	10 kΩor higher
E9-25 (HT1B) - Body ground	10 kΩ or higher
E9-33 (HT2B) - Body ground	10 kΩor higher

OK → REPLACE ECM

NG

4 INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)



(a) Disconnect the H20 or H11 heated oxygen sensor connector.
(b) Measure the resistance of the sensor side connectors.
Standard resistance

Tester Connection	Specified Condition
H20-1 (+B) - H20-3 (E2)	10 kΩ or higher
H20-1 (+B) - H20-4 (OX1B)	10 kΩ or higher
H11-2 (+B) - H11-4 (E2)	10 kΩ or higher
H11-2 (+B) - H11-3 (OX)	10 kΩor higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

NG

REPLACE HEATED OXYGEN SENSOR

5 READ OUTPUT DTC (CHECK MODE)

(a) Change the ECM to check mode with the intelligent tester.
Enter the following menus: DIAGNOSIS / ENHANCED OBD II / CHECK MODE.
(b) Warm up the engine and drive the vehicle at over 25 mph (40 km/h) for 10 minutes.

HINT:
Driving should be continued for 10 minutes consecutively, but it is not necessary to maintain a speed of 25 mph (40 km/h) during this time.

(c) Read the DTC.

Result

Display (DTC output)	Proceed to
P0138 and/or P0158 are output	A
No DTC	B

B → **CHECK FOR INTERMITTENT PROBLEMS**

A

ES

REPLACE HEATED OXYGEN SENSOR

6 READ VALUE OF INTELLIGENT TESTER OR ODB II SCAN TOOL (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

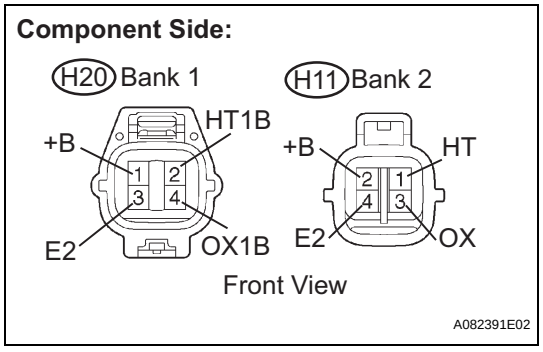
(a) After warming up the engine, run the engine at 2,500 rpm for 3 minutes.

(b) Read the output voltage of the heated oxygen sensor when the engine rpm is suddenly increased.
HINT:
Quickly accelerate the engine 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 10**

NG

7 INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)



(a) Disconnect the H20 or H11 heated oxygen sensor connector.

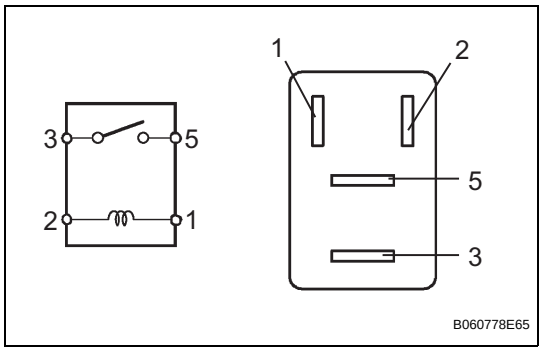
(b) Measure the resistance of the heated oxygen sensor terminals.
Standard resistance

Tester Connection	Condition	Specified Condition
H20-2 (HT1B) - H20-1 (+B)	20°C (68°F)	11 to 16 Ω
H11-1 (HT) - H11-2 (+B)	20°C (68°F)	11 to 16 Ω
H20-2 (HT1B) - H20-1 (+B)	800°C (1,472°F)	23 to 32 Ω
H11-1 (HT) - H11-2 (+B)	800°C (1,472°F)	23 to 32 Ω

NG → **REPLACE HEATED OXYGEN SENSOR**

OK

8 INSPECT EFI MAIN RELAY



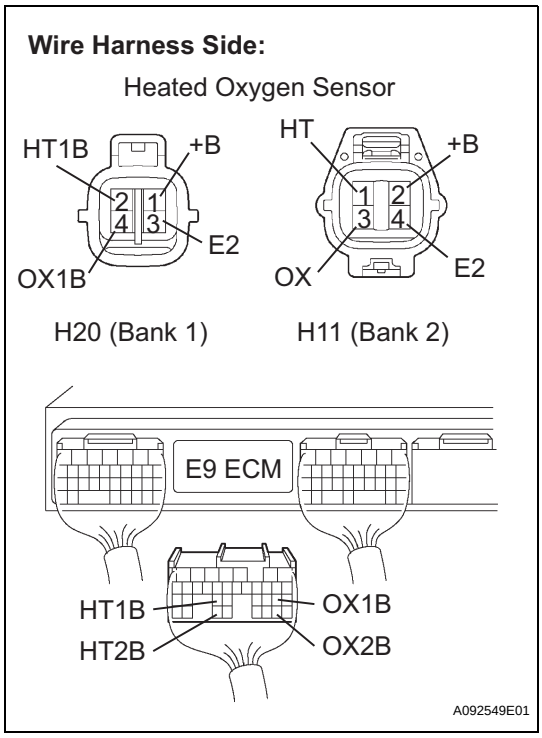
(a) Remove the EFI MAIN relay from the engine room R/B.
(b) Measure the resistance of the EFI MAIN relay.
Standard resistance

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 EFI MAIN RELAY

OK

9 CHECK HARNESS AND CONNECTOR

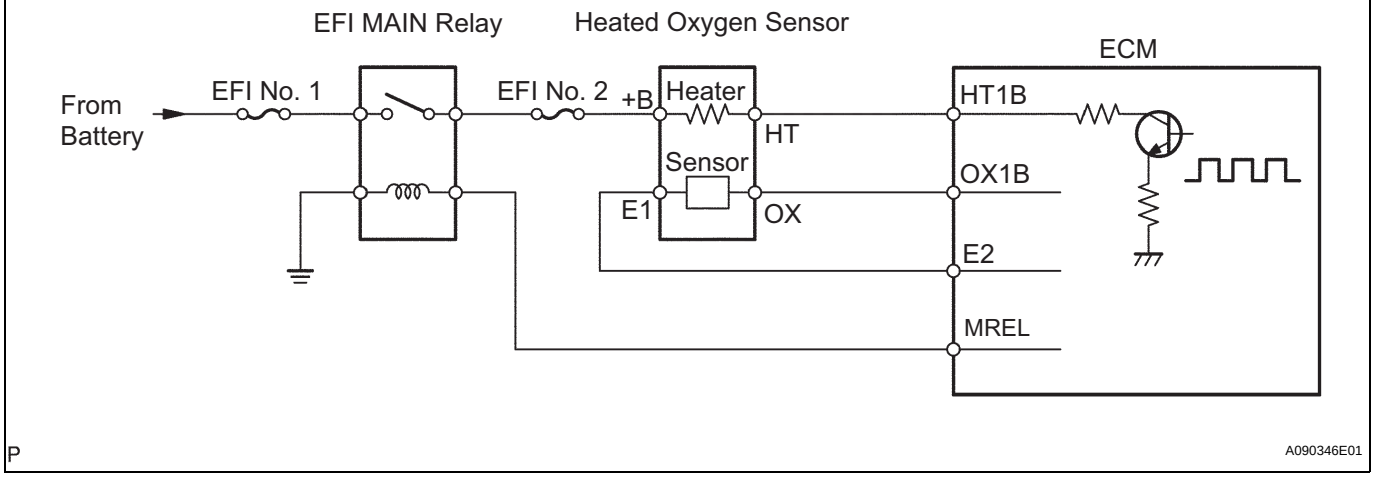


(a) Check the wire harness between the ECM and heated oxygen sensor.
(1) Disconnect the H20 or H11 heated oxygen sensor connector.
(2) Disconnect the E9 ECM connector.
(3) Measure the resistance of the wire harness side connectors.
Standard resistance

Tester Connection	Specified Condition
H20-4 (OX1B) - E9-21 (OX1B)	Below 1 Ω
H20-2 (HT1B) - E9-25 (HT1B)	Below 1 Ω
H11-3 (OX) - E9-29 (OX2B)	Below 1 Ω
H11-1 (HT) - E9-33 (HT2B)	Below 1 Ω
H20-4 (OX1B) or E9-21 (OX1B) - Body ground	10 kΩ higher
H20-2 (HT1B) or E9-25 (HT1B) - Body ground	10 kΩ higher
H11-3 (OX) or E9-29 (OX2B) - Body ground	10 kΩ higher
H11-1 (HT) or E9-33 (HT2B) - Body ground	10 kΩ higher

(4) Reconnect the H20 or H11 heated oxygen sensor connector.
(5) Reconnect the E9 ECM connector.

Reference (Bank 1 Sensor 2 System Drawing)



ES

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

REPLACE HEATED OXYGEN SENSOR

10	PERFORM CONFIRMATION DRIVING PATTERN

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

NEXT

11	READ OUTPUT DTC (DTC P0136 AND/OR P0156 ARE OUTPUT AGAIN)

(a) Read the DTC using the intelligent tester or the OBD II scan tool.
Result

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

A → **CHECK FOR INTERMITTENT PROBLEMS**

B

12	REPLACE HEATED OXYGEN SENSOR

NEXT

13	PERFORM CONFIRMATION DRIVING PATTERN

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

NEXT

14	READ OUTPUT DTC (DTC P0136 AND/OR P0156 ARE OUTPUT AGAIN)

ES

(a) Read the DTC using the intelligent tester or the OBD II scan tool.
Result

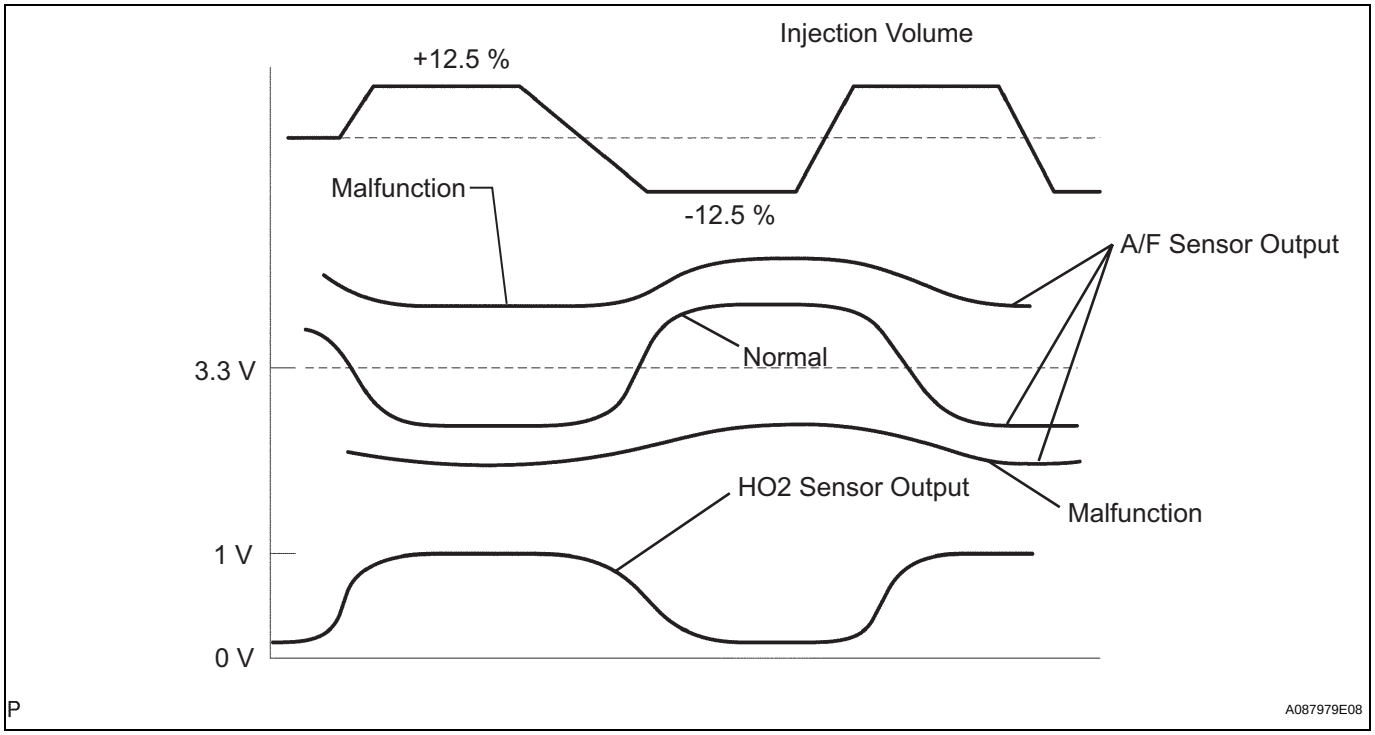
Display (DTC Output)	Proceed to
P0136 and/or P0156 are not output again	A
P0136 and/or P0156 are output again	B

A → REPAIR COMPLETED

B

15	PERFORM ACTIVE TEST BY INTELLIGENT TESTER

(a) Start the engine and warm it up.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch ON. Push the intelligent tester main switch ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / INJ VOL.
(e) Using the intelligent tester, change the injection volume to check the A/F sensor output and heated oxygen sensor output values below.



HINT:
Change the injection volume from -12.5 % to +12.5 %.

Result:

A/F sensor output remains more than 3.3 V or A/F sensor output remains less than 3.3 V (Heated oxygen sensor reacts in accordance with increase and decrease of injection volume)

OK → **REPLACE AIR FUEL RATIO SENSOR**

NG

CHECK AND REPAIR EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO (INJECTOR, FUEL PRESSURE, GAS LEAKAGE FROM EXHAUST SYSTEM, ETC.)

ES