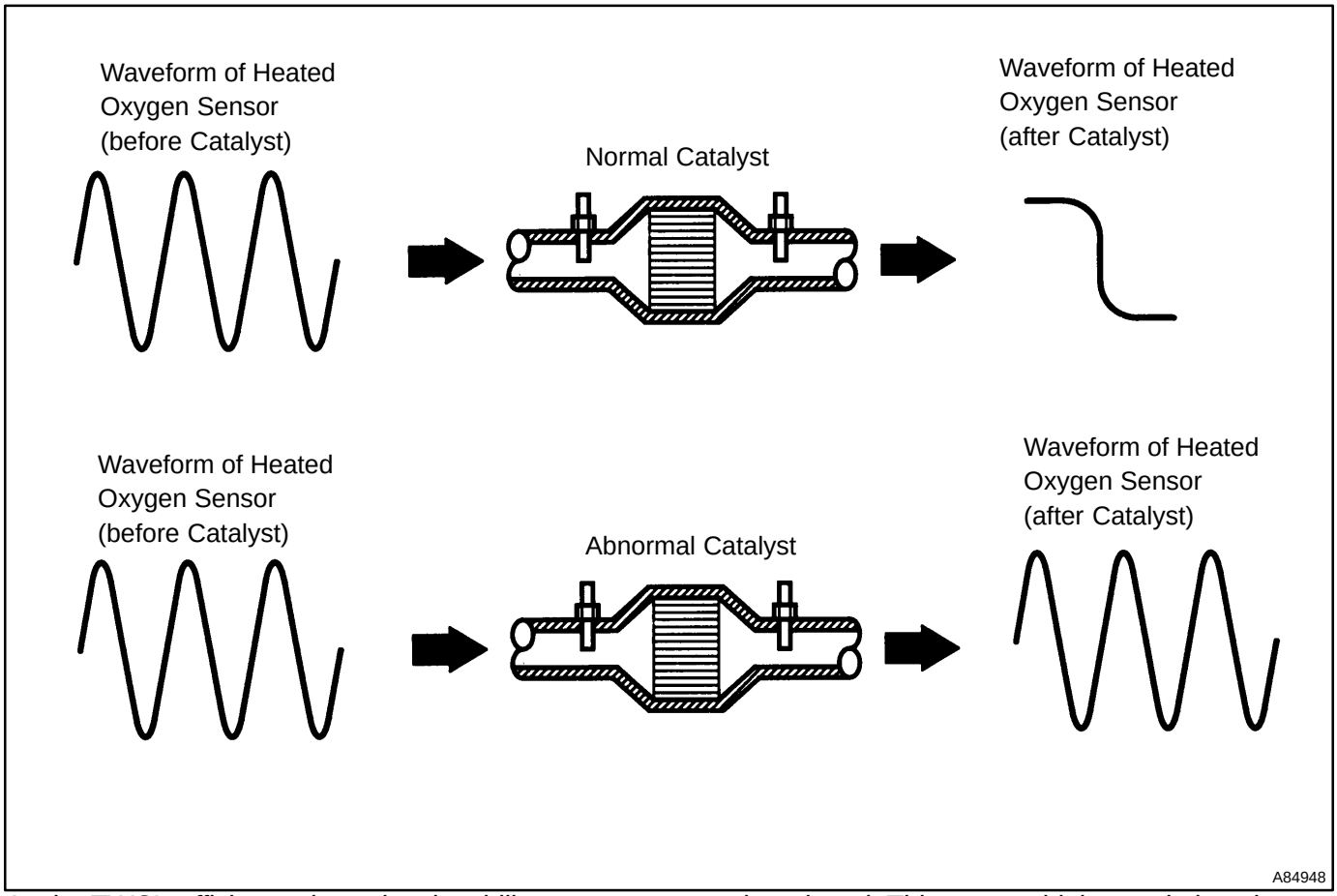
DTC	P0420	CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD (BANK 1)

CIRCUIT DESCRIPTION

The ECM compares the two waveforms of the heated oxygen sensors located before and after the catalyst to determine whether or not the catalyst performance has deteriorated.
Air–fuel ratio feedback compensation keeps the waveform of the heated oxygen sensor in front of the catalyst alternates between back and forth, from rich to lean.
If the catalyst is functioning normally, the waveform of the heated oxygen sensor behind the catalyst switches back and forth between rich and lean much more slowly than the waveform of the heated oxygen sensor in front of the catalyst.
When both waveforms change at a similar rate, it indicates that the catalyst performance has deteriorated.

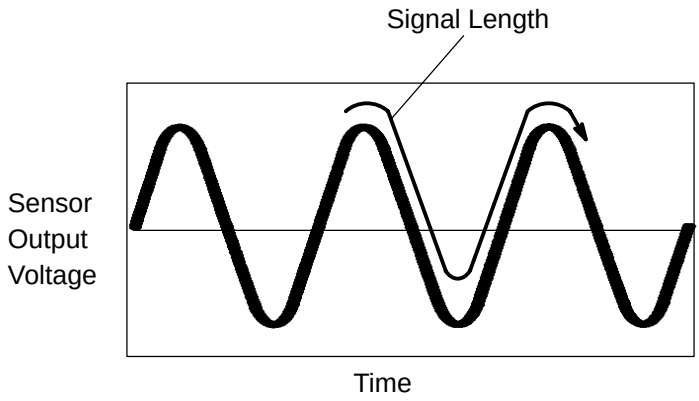
MONITOR DESCRIPTION

The vehicle is equipped with the two oxygen sensors (O2S). One is mounted upstream from the three–way catalytic (TWC) converter (front heated oxygen sensor ”sensor 1”), the second is mounted downstream (heated oxygen sensor ”sensor 2”). The catalyst efficiency monitor compares the sensor 1 and 2 signals in order to calculate TWC ability to store oxygen.
During normal operation, the TWC stores and releases oxygen as needed. This results in low oxygen variations in the post TWC exhaust stream as shown.



As the TWC’s efficiency degrades, its ability to store oxygen is reduced. This causes higher variations in post TWC exhaust stream oxygen content and results in increased sensor 2 signal activity as shown.
When running the monitor, the ECM compares sensor1 and sensor 2 signals over a specific time to determine the TWC efficiency. The ECM begins by calculating the signal length for both sensors.

Heated Oxygen Sensor Signal Length:



A82718

DTC No.	DTC Detection Condition	Trouble Area
P0420	After engine and catalyst are warmed up, and while vehicle is driven within set vehicle and engine speed range, waveforms of heated oxygen sensors have same amplitude (2 trip detection logic)	• Gas leakage in exhaust system • Heated oxygen sensor (bank 1 sensor 1, 2) • Three–way catalytic converter

MONITOR STRATEGY

Related DTCs	P0420	Bank 1 catalyst is deterioration
Required sensors/components	Main sensors	Front and rear heated oxygen sensor
	Related sensors	Mass air flow sensor, engine coolant temperature sensor, engine speed sensor, intake air temperature sensor
Frequency of operation	Once per driving cycle	
Duration	90 seconds	
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 05–25)	
Battery voltage	11 V	–
Intake air temperature	–10°C (14°F)	–
Idle	OFF	
Intake air amount	8.5 g/sec	25 g/sec
Engine speed	–	4,000 rpm
Engine coolant temperature	75°C (167°F)	–
Estimated catalyst temperature conditions are met:	1 and 2	
1. Upstream catalyst	500°C (932°F)	900°C (1,472°F)
2. Downstream catalyst	350°C (932°F)	900°C (1,472°F)
Fuel system status	Closed loop	

TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
Catalyst deterioration level	0.6 or more
Number of times detection	3 times

COMPONENT OPERATING RANGE

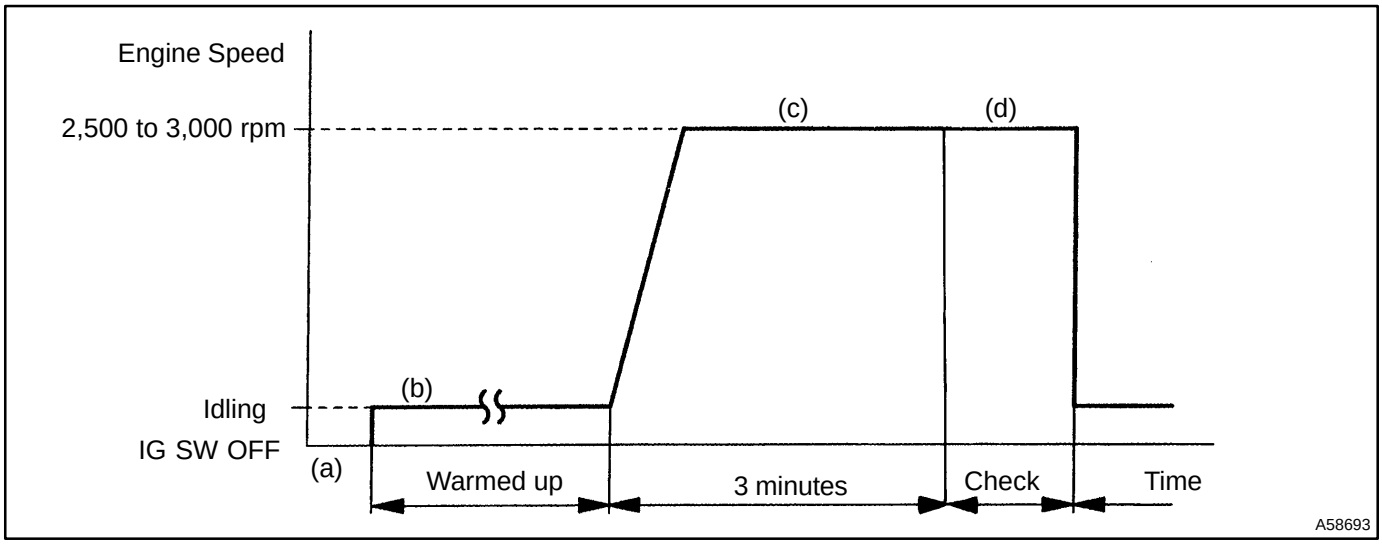
Parameter	Standard Value
Catalyst deterioration level (heated oxygen sensor signal length)	0 to 0.1

MONITOR RESULT (MODE 06 DATA)

Test ID	Comp ID	Description of Test Data	Description of Test Limit	Unit	Conversion Factor
$01	$01	Catalyst deterioration (bank 1) level determined by waveforms of the heated oxygen sensor.	Malfunction criteria for catalyst deterioration	–	Multiply by 0.007812 (no dimension)

Refer to page 05–27 for detailed information on Checking Monitor Status.

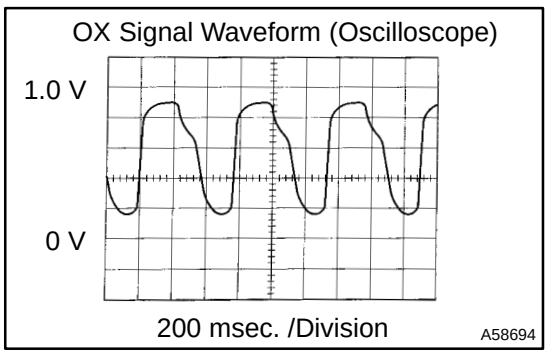
CONFIRMATION DRIVING PATTERN



(a) Connect the hand–held tester to the DLC3, or connect the probe of the oscilloscope between terminals OX1A, OX1B and E1 of the ECM connector.
(b) Start the engine and warm it up with all the accessories switched OFF until the engine coolant temperature becomes stable.
(c) Run the engine at 2,500 to 3,000 rpm for about 3 minutes.
(d) After confirming that the waveform of the bank 1 sensor 1 (OX) which oscillates between 0 V and 1 V under a feedback to the ECM, check the waveform of the bank 1 sensor 2 (OX).

HINT:

If there is malfunction in the system, the waveform of ”sensor 2” (OXL2) may become a similar to the one of ”sensor1” (OXL1) shown in the diagram on the left.



INSPECTION PROCEDURE

HINT:

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.

1	CHECK OTHER DTC OUTPUT(IN ADDITION TO DTC P0420)

(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 the OBD II scan tool main switch ON.
(c) Select the item ”DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES”.
(d) Read the DTCs.

Result:

Display (DTC output)	Proceed to
P0420	A
P0420 and other DTCs	B

HINT:

If any other codes besides P0420 are output, perform the troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART (See page 05–35)**

A

2	CHECK FOR EXHAUST GAS LEAKAGE

NG → **REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT (See page 15–2)**

OK

3	INSPECT HEATED OXYGEN SENSOR(BANK 1 SENSOR 1) (See page 05–101)

Refer to the hint below.

NG → **REPLACE HEATED OXYGEN SENSOR**

OK

4	INSPECT HEATED OXYGEN SENSOR(BANK 1 SENSOR 2) (See page 05–128)

Refer to the hint below.

NG → **REPLACE HEATED OXYGEN SENSOR**

OK

REPLACE THREE–WAY CATALYTIC CONVERTER(EXHAUST MANIFOLD)

HINT:

Hand–held tester only:

- The following procedure enables the technician to identify a trouble area if malfunction in both front and rear heated oxygen sensors other than the catalyst converter, or the malfunction that indicates the actual air–fuel ratio extremely RICH or LEAN.
- Narrowing down the trouble area is possible by performing ”A/F CONTROL” ACTIVE TEST (heated oxygen sensor or other trouble areas can be distinguished).

(a) Perform ACTIVE TEST using hand–held tester (A/F CONTROL).

HINT:

”A/F CONTROL” is ACTIVE TEST which changes the injection volume –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 by running 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:

There is a delay of few seconds in the sensor 1 (front sensor) output, and there is about 20 seconds delay 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)	Mainly suspect trouble area
Case 1	Injection volume +25 % –12.5 % Output voltage More than 0.5 V Less than 0.4 V **OK**	Injection volume +25 % –12.5 % Output voltage More than 0.5 V Less than 0.4 V **OK**	—
Case 2	Injection volume +25 % –12.5 % Output voltage No reaction **NG**	Injection volume +25 % –12.5 % Output voltage More than 0.5 V Less than 0.4 V **OK**	Sensor 1: front sensor (sensor 1, heater, sensor 1 circuit)
Case 3	Injection volume +25 % –12.5 % Output voltage More than 0.5 V Less than 0.4 V **OK**	Injection volume +25 % –12.5 % Output voltage No reaction **NG**	Sensor 2: rear sensor (sensor 2, heater, sensor 2 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 actual air–fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

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