
Heated Oxygen Sensor

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Oxygen Sensor Heater

Oxygen Sensor Heater

MONITOR DESCRIPTION

The ECM uses the 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 gases. 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 oxygen sensor has the characteristic whereby its output voltage change suddenly in the vicinity of the stoichiometric air-fuel ratio. When heated, the sensor becomes very efficient. If the temperature of the exhaust is low, the sensor will not generate useful voltage signals without supplemental heating. The ECM regulates the supplemental heating using a duty-cycle approach to regulate the average current in the heater element. If the heater current is out of the normal range, the sensor's output signals will be inaccurate and the ECM cannot regulate the air/fuel ratio properly. When the heater current is out of the normal operating range, the ECM interprets this as a malfunction and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0135 (Bank 1 sensor 1)	Heater current is low or high
	P0141 (Bank 1 sensor 2)	
Required sensors/Components	Main	Oxygen sensor heater
	Sub	Crankshaft position sensor and Vehicle speed sensor
Frequency of operation	Continuous	
Duration	12 sec. x 10 times	Heater current is low
	10 sec.	Heater current is high
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 page In-4	
Battery voltage	10.5 V	16 V
Time after engine start	250 sec.	-
Vehicle speed	40 km/h (25 mph)	90 km/h (56 mph)
Misfire	Not detected	

TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
Case 1: Heater current is low	
Heater current while heater ON	Less than 0.25 A (when battery voltage is 11.5 V or more)
Case 2: Heater current is high	
Heater current while heater OFF	<ul style="list-style-type: none"> • More than 3.5 A (2ZZ-GE, 2003 MY 1ZZ-FE [4WD]) • More than 2.0 A (Others)

COMPONENT OPERATING RANGE

Parameter	Standard Value
Heater current	Between 0.4 and 1.0 A (idling, engine warmed-up and battery voltage 11 to 14 V)

READINESS MONITOR DRIVING PATTERN

See page In-9

Oxygen Sensor

Front Heated Oxygen Sensor

MONITOR DESCRIPTION

The engine control module (ECM) uses the 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 gases. 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 oxygen sensor has the characteristic whereby its output voltage change suddenly in the vicinity of the stoichiometric air-fuel ratio. The heated oxygen sensor generates output voltages between 0 V and 1 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 0.40 V or less, the ECM judges that the air/fuel ratio is LEAN.

If the oxygen sensor cannot output enough voltage to reach the minimum specification, the ECM interprets this as a malfunction in the oxygen sensor and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0130 (Bank 1)	Front heated oxygen sensor voltage is constant
	P0150 (Bank 2)	
Required sensors/Components	Main	Front heated oxygen sensor
	Sub	Crankshaft position sensor and Vehicle speed sensor
Frequency of operation	Once per driving cycles	
Duration	18 to 36 sec. x 3	
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 page In-4	
Fuel system status	Closed Loop	
Engine RPM	Idle speed	
Time after engine start	120 sec.	-
Vehicle speed	-	0 km/h (0 mph)
Time after following conditions is met	20 sec.	-
Engine RPM	900 rpm	-
Vehicle speed	40 km/h (25 mph)	-

TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
Number of "Fail A*" event	3 times or more
Number of "Fail B*" event	2 times or more

* "Fail A": Sensor voltage is 0.55 V or less for 18 seconds or more

"Fail B": Sensor voltage is 0.40 V or more for 18 seconds or more

COMPONENT OPERATING RANGE

When normal, voltages output from the oxygen sensor produce a waveform alternating between 0 V and 1 V.

READINESS MONITOR DRIVING PATTERN

See page In-9

Front Heated Oxygen Sensor Slow Response

MONITOR DESCRIPTION

The engine control module (ECM) uses the 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 gases. 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 oxygen sensor has the characteristic whereby its output voltage change suddenly in the vicinity of the stoichiometric air–fuel ratio. The heated oxygen sensor generates waveforms of a voltage between 0 V and 1 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 0.40 V or less, the ECM judges that the air/fuel ratio is LEAN.

The ECM monitors the response feature of the oxygen sensor. If the response time of the oxygen sensor output status change from RICH to LEAN or vice versa becomes longer, the ECM interprets this as a malfunction in the oxygen sensor and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0133 (Bank 1)	Front oxygen sensor slow response
	P0153 (Bank 2)	
Required sensors/Components	Main	Front heated oxygen sensor
	Sub	Crankshaft position sensor and Vehicle speed sensor
Frequency of operation	Once per driving cycles	
Duration	Within 60 sec.	
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 page In-4	
Fuel system status	Closed Loop	
Time after engine start	120 sec.	–
Engine RPM	Idle speed	
Vehicle speed	–	3 km/h (2 mph)
Time after following conditions is met:	20 sec.	–
Engine RPM	900 rpm	–
Vehicle speed	40 km/h (25 mph)	–

TYPICAL MALFUNCTION THRESHOLDS**1996 – 2002 MY:**

Detection Criteria	Threshold
Time that output voltage of front heated oxygen sensor increase from 0.4 V to 0.55 V and that they decrease from 0.55 V to 0.4 V	20 sec. or more x 3 times

2003 MY:

Detection Criteria	Threshold
Time that output voltage of front heated oxygen sensor increase from 0.4 V to 0.55 V and that they decrease from 0.55 V to 0.4 V	1 sec. or more x 3 times

COMPONENT OPERATING RANGE

When normal, voltages output from the oxygen sensor produce a waveform alternating between 0 V and 1 V.

READINESS MONITOR DRIVING PATTERN

See page In-9

Rear Heated Oxygen Sensor

MONITOR DESCRIPTION

The engine control module (ECM) uses the 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 gases. 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 oxygen sensor has the characteristic whereby its output voltage change suddenly in the vicinity of the stoichiometric air–fuel ratio. The heated oxygen sensor generates waveforms of a voltage between 0 V and 1 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 0.40 V or less, the ECM judges that the air/fuel ratio is LEAN.

If the sensor output does not change between RICH and LEAN during “Stop and Go” driving, the ECM interprets this as a malfunction in the oxygen sensor and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0136 (Bank 1)	Rear oxygen sensor malfunction
	P0156 (Bank 2)	
Required sensors/Components	Main	Rear heated oxygen sensor
	Sub	Crankshaft position sensor, MAF sensor, Throttle position sensor and Vehicle speed sensor
Frequency of operation	Once per driving cycles	
Duration	Within 360 sec.	
MIL operation	2 driving cycles	
Sequence of operation	None	

TYPICAL ENABLING CONDITIONS

- “Stop and Go” is defined as follows:
 “Stop” indicates a vehicle speed of less than 3 km/h (2 mph). “Go” indicates a vehicle speed of 40 km/h (25 mph) or more
- A deceleration is counted up when the vehicle decelerates 5 km/h (3 mph) or more within 2 sec.

Item	Specification	
	Minimum	Maximum
The monitor will run whenever the following DTCs are not present	See page In-4	
Intake air amount	1 g/sec.	–
Cumulative time while rear oxygen sensor heater ON	22 sec.	–
Stop and Go (1996 to 2002 MY)	10 times	–
Deceleration count (2003 MY and beyond)	30 times	–
Fuel status	Closed Loop	
Sub feedback status	Executing	
Throttle valve	Open (idle OFF)	
Fuel cut	Not operating (for 5 sec. or more)	

TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
Number of change between LEAN and RICH	None

COMPONENT OPERATING RANGE

When normal, voltages output from the rear oxygen sensor produce a waveform alternating between 0 V and 1 V.

READINESS MONITOR DRIVING PATTERN

See page In-9