



4.7.3 Oxygen Sensor Heater Monitoring Description

For proper functioning of an oxygen sensor, its element must be heated. A non-functioning heater delays the oxygen sensor's readiness for closed loop control and influences emissions.

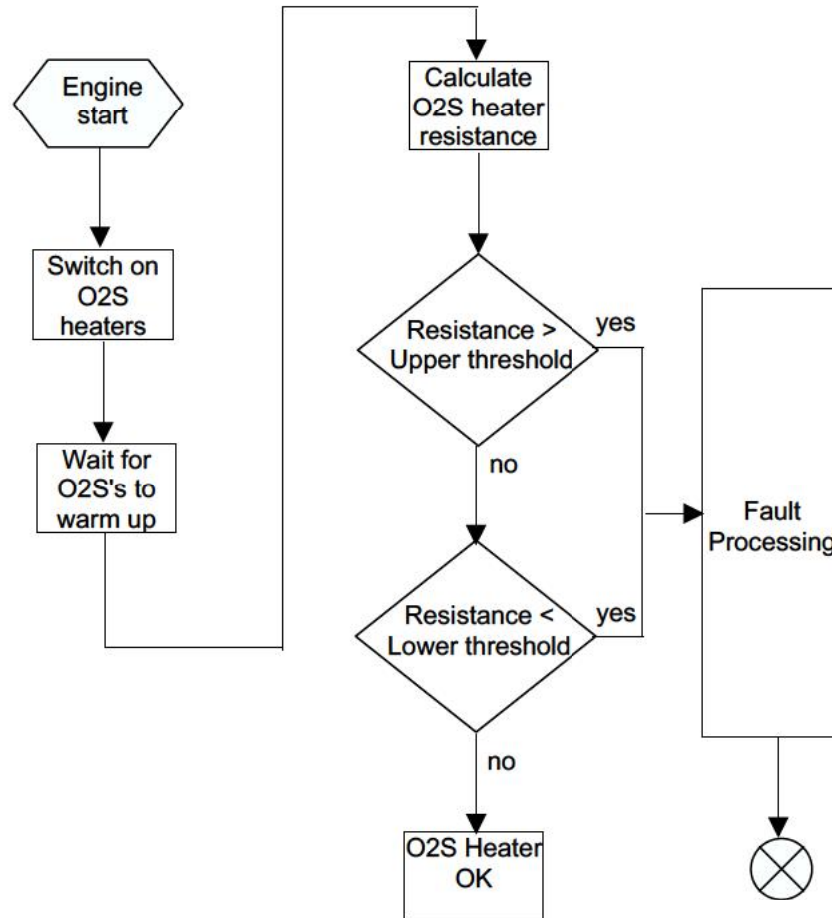
The monitoring function measures both oxygen sensor heater current (voltage drop over a shunt) and the heater voltage (heater supply voltage), so that the oxygen sensor heater resistance can be calculated. If the oxygen sensor heater resistance exceeds a minimum or maximum threshold an oxygen sensor heater fault is detected.

The monitoring function is activated once per drive cycle, as long as the heater has been switched on for a certain time period and the current has stabilized.

Characteristics:-

- ECM controlled switching of the oxygen sensor heater.
- One shunt for each pair of oxygen sensors upstream and downstream of the catalysts for current measurement.

4.7.4 Oxygen Sensor Heater Monitoring Structure





The oxygen sensor heater resistance is calculated from the following equation:-

$$\text{Resistance}_{\text{sensor heater}} = \frac{\text{Voltage}_{\text{battery}}}{\text{Voltage}_{\text{shunt}}} \cdot \text{Resistance}_{\text{shunt}}$$

Oxygen Sensor Circuit Monitoring

Monitoring for electrical faults in the oxygen sensors both upstream and downstream of the catalyst.

Implausible voltages:

- Analogue to Digital Converter (ADC) voltages exceeding the maximum threshold VMAX are caused by a short circuit to battery positive.
- ADC voltages falling below the minimum threshold VMIN are caused by a short circuit of the oxygen sensor signal or oxygen sensor ground to the ECM ground.
- An open circuit of the oxygen sensor can be detected if the ADC voltage remains within a specified range after the oxygen sensor has been heated for a certain time.



Oxygen Sensor Monitoring – Discovery Series II

Component/ System	Fault Codes	Monitoring Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameter	Enable Conditions	Time Required	MIL Illumination
Oxygen Sensor (front)	P0133/53	response rate	oxygen sensor signal period (over 50 periods)	> 2.2 sec	engine speed engine load catalyst temperature (model) IAT EVAP canister purge status transfer gears	1400< rpm <2600 2.0< TL msec <5.0 > 340 °C •65.25 °C Off <u>or</u> on > 20 sec high range	immediately/ once per driving cycle	two driving cycles
	P1170/73	sensor ageing	rich shift delay Time	< -1.0 or > 1.0 sec	O2S post catalyst control transfer gears	active high range	30 sec	
	P1129	exchanged oxygen sensors connector	fuel control factor or	bank 1 > 1.22 and bank 2 < 0.77 bank 1 < 0.77 and bank 2 > 1.22			8.0 sec	
					heater on transfer gears	> 90 sec high range		
	P0134/54	O2S circuit continuity	voltage or voltage (front & rear)	0.399V < voltage <0.598V voltage > 0.199V	over run fuel cut off	> 3.0 sec	15 sec/continuous 0.1 sec/continuous	
	P0132/52	range check (high)	voltage	voltage > 1.081V			5.1 sec/continuous	
	P0130/50	O2S short circuit	voltage	voltage < 0.0399V Or	O2S post catalyst voltage	•0.501V	20 sec/continuous	
					ECT battery voltage time after start ECT at power down	< 39.75 °C > 8.016V > 1.0 sec > 60 °C	0.1 sec/continuous	
			0.062V • voltage < 0.399V	O2S post catalyst voltage	•0.501V	20 sec/continuous		



Oxygen Sensor Monitoring – Discovery Series II

Component/ System	Fault Codes	Monitoring Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameter	Enable Conditions	Time Required	MIL Illumination
Heater				0.598V ••voltage ••1.081V	O2S post catalyst voltage	< 0.102V	10 sec/continuous	
	P0135/55	O2S heater current circuit continuity	calculated resistance voltage	resistance < 2.453 • • <u>or</u> resistance > 10.06 • •	after engine start up transfer gears	> 180 sec high range	10 sec/continuous	
Oxygen Sensor (rear)					O2S heater on transfer gears	> 90 sec high range		two driving cycles
	P0140/60	O2S circuit continuity	voltage	0.399V < voltage < 0.501V			500 sec/ continuous	
	P0138/58	range check (high)	voltage	voltage > 1.081V			5.1 sec/continuous	
	P0137/57	range check (low)	voltage	voltage < 0.501V	engine air flow O2S post catalyst control	> 16.67 g/sec Active	210 sec/ continuous	
	P0136/56	O2S short circuit	voltage	voltage < 0.0399	O2S post catalyst control	Active	200 sec/ continuous	
	P0139/59	oscillation capability check			O2S post catalyst control catalyst temperature (model) engine air flow rear O2S ready for at least rear O2S heater test rear O2S rich & lean flags not set	Active > 300 °C > 13.89 g/sec 30.0 sec completed successfully > 120 sec		
			if rear O2S voltage not •• 0.625V for	enrichment request still present after 25 sec	catalyst temperature (model)	> 300 °C	2.0 sec/continuous	



Oxygen Sensor Monitoring – Discovery Series II								
Component/ System	Fault Codes	Monitoring Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameter	Enable Conditions	Time Required	MIL Illumination
Heater	P0141/61	O2S heater current circuit continuity	0.52 sec request enrichment					
			if rear O2S voltage not • 0.625 V for 0.52 sec wait for over run fuel cut off (ORFCO)	rear O2S voltage > 0.200V	fuel system status integrated engine air flow whilst in ORFCO front O2S check	in over run fuel cut off (ORFCO) for > 4.0 sec > 35.0 g completed successfully	0.20 sec/continuous	
			calculated resistance voltage	resistance < 2.453 • • <u>or</u> resistance > 10.06 • •	after engine start up transfer gears	> 180 sec high range	10 sec/continuous	

If the above table does not include details of the following enabling conditions: - IAT, ECT, vehicle speed range, and time after engine start-up then the state of these parameters has no influence upon the execution of the monitor.

Oxygen Sensor Monitoring – Range Rover								
Component/ System	Fault Codes	Monitoring Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameter	Enable Conditions	Time Required	MIL Illumination
Oxygen Sensor (front)	P0133/53	response rate	O2S signal period (over 30 periods)	> 2.2 sec	engine speed engine load catalyst temperature (model) intake air temperature EVAP canister purge status	1400 < rpm < 2600 2.0 < TL msec < 5.0 > 340 °C • 69.75 °C off <u>or</u> on > 20 sec	Immediately/ once per driving cycle	two driving cycles