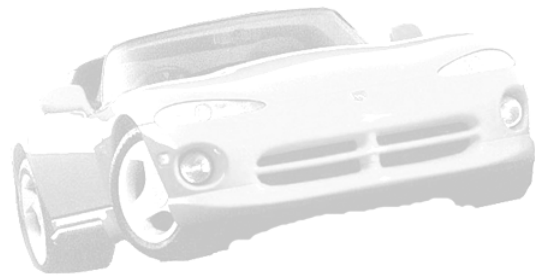


# Application Note:

## D-AN\_1.1



## CLOSED LOOP LAMBDA OPERATION

### INTRODUCTION

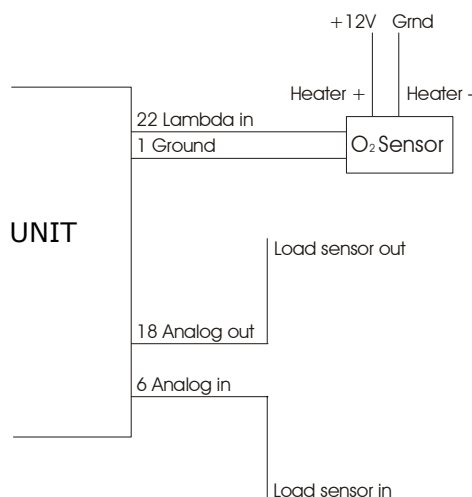
This type of installation is applicable on an engine that does not have an oxygen sensor. If you install an oxygen sensor, you can run closed loop on the engine.

### REQUIREMENTS

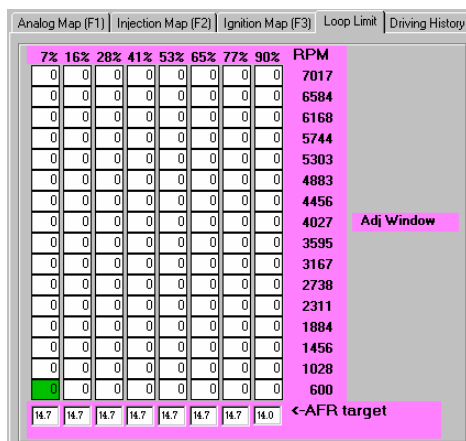
For this installation you will need to do the following:

- Interrupt the ECU's load sensor. This is normally a MAP, AMP or AFM.
- Install an oxygen sensor. It is recommended to use a 4-wire type sensor with a heater built into it.
- Wire the oxygen sensor to your personalised unit's lambda input on Pin 22 (Black/Brown wire).

### WIRING



### OPERATION



Using your personalised Windows Tuning Software, load the "Loop Limit" map by clicking on the tab on the Main Screen.

The values on the "Loop Limit" map are known as oxygen loop limits. They restrict the up or down loop adjustment made by closed loop mode.

When adjusting in closed loop mode, the Analog out value is determined as follows.

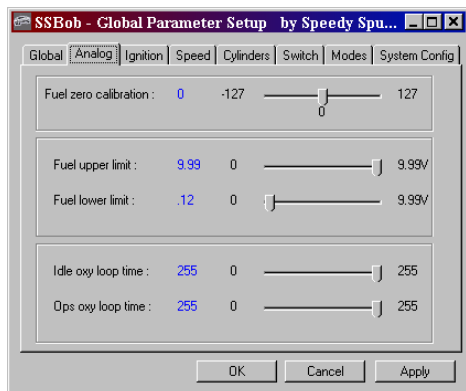
$$\text{Analog Out} = \text{Analog In} - + (\text{AFR\_mod}) - + (\text{Analog\_map} \times \text{A\_Eng\_temp})$$

The "Analog" map still has a role to play in this formula.

A value on the "Loop Limit" map represents both a positive and negative adjustment. In other words if you had a value of 10 in the cell, the cell could take a value of 10 away or add 10 to the above formula. A value of zero on the map will disable AFR adjustments in that cell.

In "Global Settings", click on the "Analog" tab.

The time between AFR adjustments can be updated according to the loop time settings:



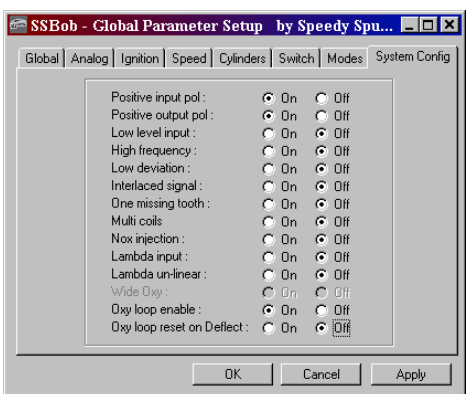
- Idle oxy loop time Adjusts loop time when the cursor is in the first column of the oxy loop map.
- Ops oxy loop time Adjusts the loop time for all columns on the oxy loop map other than the first.

The adjustment speed of the above settings is fastest for small numbers. Idle adjustments are slow to prevent hunting; typical values from 1 to 50 are seen here. "Ops oxy loop time" values are kept fast, to get the benefit of lambda adjustments for fast throttle movements. You may need to play around with the values to get a "perfect" setting. It is possible that if a car has an idle motor installed, this could affect the closed loop lambda operation.

It is recommended to first tune your engine using the "Analog" map and lambda as a reference only. Then switch on lambda, enter small values into your "Loop Limit" map. The software will show how much lambda correction the unit is doing. This is displayed in the "Adj Window" section.

Depending on the correct values in the "Analog" map two other options can be exercised by selecting "Oxy loop reset on Deflect" in "System Config" under "Global Settings".

Analog Map (F1)								Injection Map (F2)		Ignition Map (F3)		Loop Limit		Driving History	
0	0	0	0	0	0	0	0	7017	1.00	120					
0	0	0	0	0	0	0	0	6584	1.00	112					
0	0	0	0	0	0	0	0	6168	1.00	104					
0	0	0	0	0	0	0	0	5744	1.00	96					
0	0	0	0	0	0	0	0	5303	1.00	88					
0	0	0	0	0	0	0	0	4883	1.00	80					
0	0	0	0	0	0	0	0	4456	1.00	72					
0	0	0	0	0	0	0	0	4027	1.00	64					
0	0	0	0	0	0	0	0	3595	1.00	56					
0	0	0	0	0	0	0	0	3167	1.00	48					
0	0	0	0	0	0	0	0	2738	1.00	40					
0	0	0	0	0	0	0	0	2311	1.00	32					
0	0	0	0	0	0	0	0	1884	1.00	24					
0	0	0	0	0	0	0	0	1456	1.00	16					
0	0	0	0	0	0	0	0	1028	1.00	8					
0	0	0	0	0	0	0	0	600	1.00	0					
7% 16% 28% 41% 53% 65% 77% 90%								Deflection		RPM		0			
Load Deflection:								99 %							



- If you enable it (set it to "On"), it will reset the loop adjustment value for every change in throttle position.
- If you disable it (set it to "Off"), it will retain (carry over) the last loop adjustment value with throttle changes.

The goal is to get to the target AFR as quick as possible with throttle change conditions, without just changing the loop time speed. If you only changed the loop time speed, it could lead to instability and poor lap performance.

## CONCLUSION

Best results are achieved with a perfect "Analog" map and then using the loop to adjust for temperature and other engine variations. Indications of perfect loop conditions are when the adjustments are very small, and an equal swing from positive to negative is observed on the AFR adjustment bar graph.