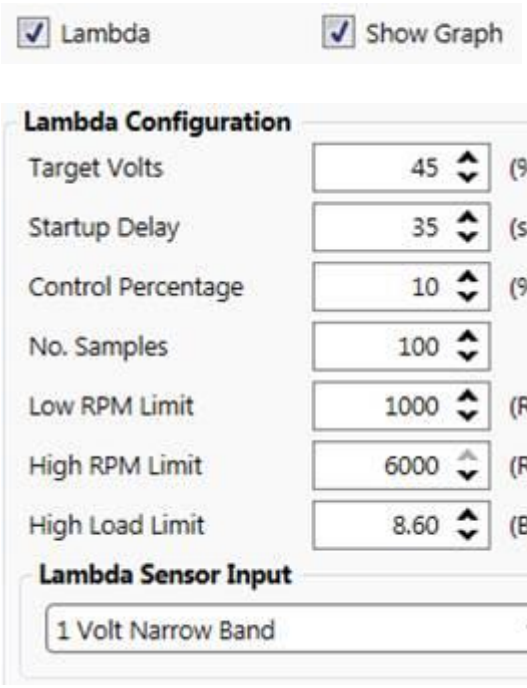
Lambda Sensor

All Spitronics ECU's have the capability to do AFR loop control with a lambda sensor connected. The tuner may set up parameters for lambda control and then the ECU will compensate the main air fuel ratio according to the lambda sensor in real time. This will result in the optimum mixture even if all the maps are not setup accurately or/and due to variations in environment which are difficult to tune in, such as moisture, air density etc. You need to tune the engine properly first and then activate this control afterwards.

Lambda Configuration

To setup this feature, click on the *Lambda* and *Show graph* check box. If you only check Lambda, then it will display the values but not control AFR. This is handy while you do the base tuning.



Target Volts

This is the desired Stoic area where the sensor determines the best mixture of 14.7 air to fuel ratio. These narrow band lambda sensors have a voltage output of 0.1 to 0.9 volt. A voltage of 0.45 volt = 14.7 A/F ratio = 45%. Spitronics work in % as this is easier to simplify between the 1 volt and 5 volt signal. This unit can receive a wide band signal of 0 to 5 volts but the electronics for driving the sensor is not built in the ECU. It will require a separate electronic board. The ECU does not convert this volt signal in A/F ratio or lambda values as it is not required for control. There is a difference in volts for different type wide band sensors. The tuner uses an accurate test instrument to tune the engine and set his AFR correctly in real time.

Startup Delay

This will give the sensors' element time to heat up so that it can measure accurately. A normal setting here is 30 to 45 seconds. If the temperature of the engine is below 30°C, then lambda control will be disabled. When you start the engine time the sensor with a stopwatch till you can see that it measures correctly.

Control Percentage

This is the value of injector compensation. It can be adjusted from 0 to 20%. This means that if on 10%, the ECU will lengthen or shorten the injector signal by 10% to achieve stoic. Always try and

tune the engine accurate in open loop and give the lambda just a little control to smooth it out. If you give it a large % and the sensor fails your engine may be out of AFR.

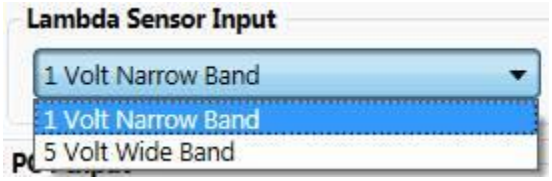
No. Samples

This Setting is the number of samples that is used as an average to prevent the control from becoming erratic. Because the sensor has a 0.6 seconds reaction time the ECU tends to over react. Increasing the number of samples will bring more stability to the control program.

The 3 limits

This will set the control range to where the narrowband sensor is accurate. A narrow band sensor cannot always control where a slightly richer or leaner mixture is required. The control will be active between the RPM limits and below the vacuum limit. Do not use this control at high RPM and high boost. It may be too slow to react when a mixture is lean. These settings are displayed on the graphs as short bars.

Sensor input



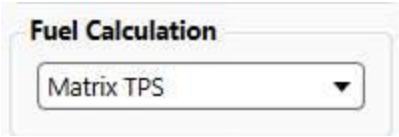
This input is used to select between a narrow band 1 volt signal and a wideband 5 volt signal. A wideband signal is linear and can cover a wider range of A/F measurements. It can be used for idling and high load readings. Notice that the rich and lean % change between the 2 sensors. Narrowband is inverted and wideband is linear.

Tuning

Now click on the Lambda Graph  button.

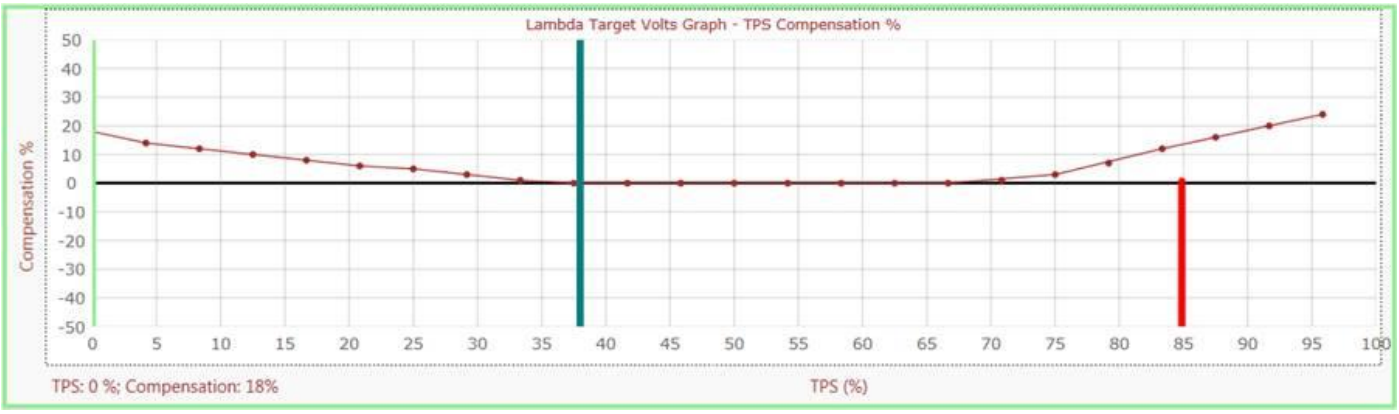
Lambda Target Volts Graph – Manifold Pressure Compensation

You can manipulate these two graphs to alter the target voltage of the lambda sensor for control of the ECU. This means if you have a 10% increase on the graph and the target volts is on 45%, then the ECU will use 49.5% as the new target volts. Now, remember on a narrow band sensor this makes a larger difference in fuel as on a wide band sensor. Normally a car idling or under load requires a richer mixture. The top graph compensates according to load and the bottom graph according to RPM. These graphs are interpolated. Note for a wideband sensor the richer mixtures will be below the line.



When TPS Matrix is selected the ECU will use the TPS as load signal since there may be no MAP sensor.

Lambda Target Volts Graph – TPS Compensation



Lambda Target Volts Graph – RPM Compensation

This graph will adjust compensation in the RPM range. Outside the 2 limits will be no control.

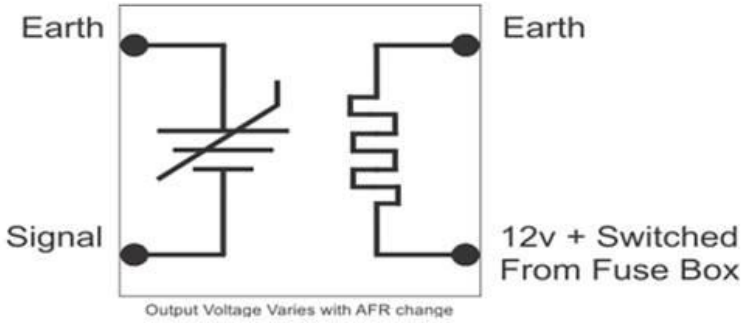
When you drive the car you can set different target controls to obtain different AFR ratios to cater for load. For racing vehicles wideband AFR gauges are recommended with the signal connected to the ECU.

Hardware

The Lambda Sensor or Oxygen Sensor is used by the ECU to display Air Fuel Ratios AFR and optimize the fuel economy after the vehicle has been tuned. **Note**: In the ECU software it shows a voltage signal and not the actual AFR value. The reason is that the ECU is not a tuning tool with calibration software. It is merely using the sensor for control purposes which is tuned to the correct mixture.

Different Lambda sensors

1 to 4 wire sensors are normally narrow band sensors. Their signal could be used directly in the ECU as it is a 0.1 volt to 0.9-volt signal. The 5 and 6 wire sensors require driving electronics and give a 0 to 5-volt signal out for the ECU. This wideband signal could be used by the ECU.



Testing a Lambda sensor for the correct Pin-outs

Test the resistance with an Ohm Meter between two pins at a time. The heater element normally has the same colors and has a resistance of 6 to 12 ohm. Connect the element wires to earth and 12 volts as above. The element does not have a specific polarity. The sensor output can only be measured while the engine is running. Connect the two remaining wires to the ECU signal input wires as indicated on the drawing. The sensor will only give an output when the engine has achieved some temperature. If the sensor is not working, swop the signal and earth wires and test again. The sensor will not be damaged if the earth and signal output has been swopped.

Life expectancy

The life expectancy of a lambda sensor varies due to fuel type and application. On unleaded fuel around 500 hours. Very rich mixtures will shorten sensor life. Lambda sensors can be damaged by gasket sealants, anti-seize and some fuel additives.

Position

The ideal position for mounting the lambda sensor is at least half a meter from the engine and after the exhaust collector or turbo down pipe. The lambda should be orientated on the top or side of the pipe. Never at the bottom!

Sample Sensor Pin outs

Bosch 4 Wire
White - Heater 12v +
White - Heater Earth
Grey - Sensor earth
Black - Signal to ecu

Denso 1 Wire
Black - Signal to ecu

Bosch 3 Wire
White - Heater 12v +
White - Heater Earth
Black - Signal to ecu