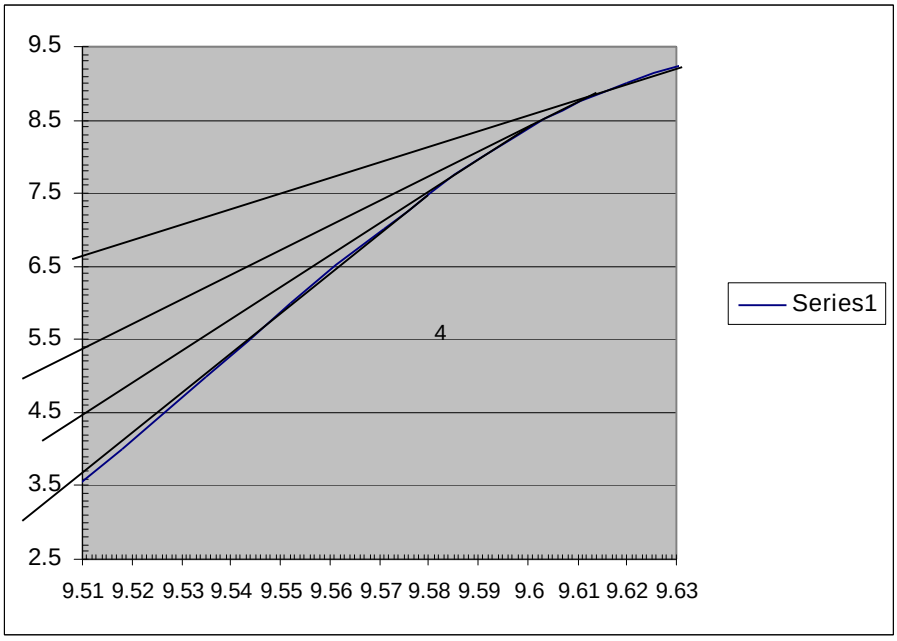
Linearizer Demo for #### VCO

This demo is based on VCO #### data that was supplied by ########. This document gives a quick overview of the proto, with a more detailed and calculation method, based on an Excel spreadsheet, to be provided later :

Frequency	Voltage
9.445	0
9.458	1
9.477	2
9.496	3
9.514	4
9.531	5
9.548	6
9.567	7
9.587	8
9.616	9
9.669	10
9.723	11
9.776	12

The goal was to linearize the VCO in the band of 9.566 +/-60MHz at 12MHz/Volt with a 0 to +10V tuning range. The supply voltage given for this requirement is +15V only, with no negative supply available.

The data in that frequency range is plotted below, interpolated and plotted as a function of VCO voltage versus frequency. Four construction lines are overlaid on the plot, which are the current contributions of the four breakpoints at each point in the band:



A positive 10V regulator will be used to power the linearizer and provide the reference voltage for the system. To offset the tuning input to allow "foot room" for the linearizer to operate, a 7.5K resistor is used as a pull-up from the linearizer compensation pin to the +10V reference. Within the linearizer, there is a 7.5K series resistor from the input pin to the compensation pin, and there is another internal 7.5K resistor between the compensation pin and ground. As a result of this three-resistor divider, the internally offset tune voltage is calculated as follows:

ext tune V	after divider
0	3.333
1	3.667
2	4.000
3	4.333
4	4.667
5	5.000
6	5.333
7	5.667
8	6.000
9	6.333
10	6.667

Based on the construction lines in the graphical portion of the analysis, the internal offset tuning range, and the planned output current range, the following four breakpoints were desired :

mA	Fdelta	Int TuneV delta	Rthev	Vthev	Nu
2.5	-120	-3.33	1.33	6.66	0.666
1.9	-103	-2.85825	1.50	6.19	0.618825
0.9	-90	-2.4975	2.78	5.83	0.58275
0.8	-70	-1.9425	2.43	5.27	0.52725

Using the 10V reference which sets Nu = (Vthev/10V), the thevenin dividers are converted to the breakpoint resistors shown below:

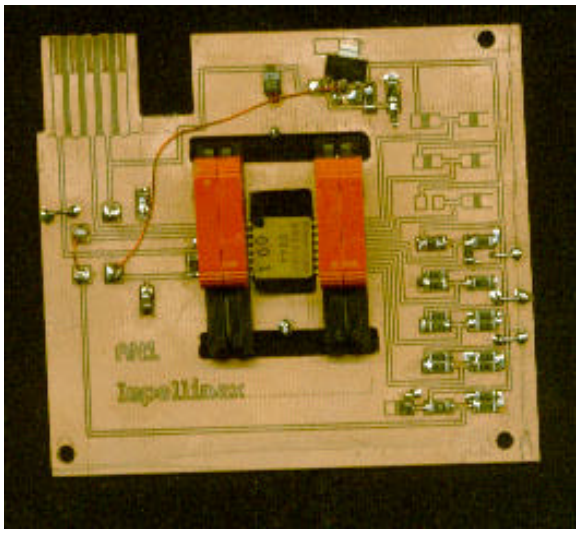
Rup	Rdown
R/Nu	R/(1-Nu)
2.000	3.988
2.431	3.947
4.762	6.651
4.605	5.136

The output of the linearizer is a current sink that is connected to a resistive divider which is set to Vthev = VCO tune voltage at the high end of the band, and an Rthev which will bring the divider midpoint to the VCO low end of the band when all of the

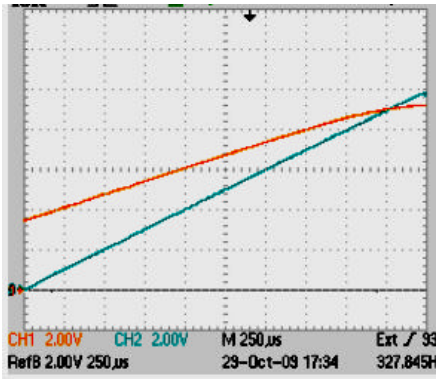
breakpoints are summed at 0V in. For this example, these values (in Kohms) calculated to be :

1.015681Rup
11.68033Rdown

A demo board was constructed as shown below :



The output transfer function was initially very close to the desired voltages, but to improve the fit, the last breakpoint was empirically adjusted slightly, resulting in the transfer function shown below :



The curvature of the output transfer function is more easily seen when the output is viewed at 1V/div and compared against the straight-line input: