Beam Simulation Hardware

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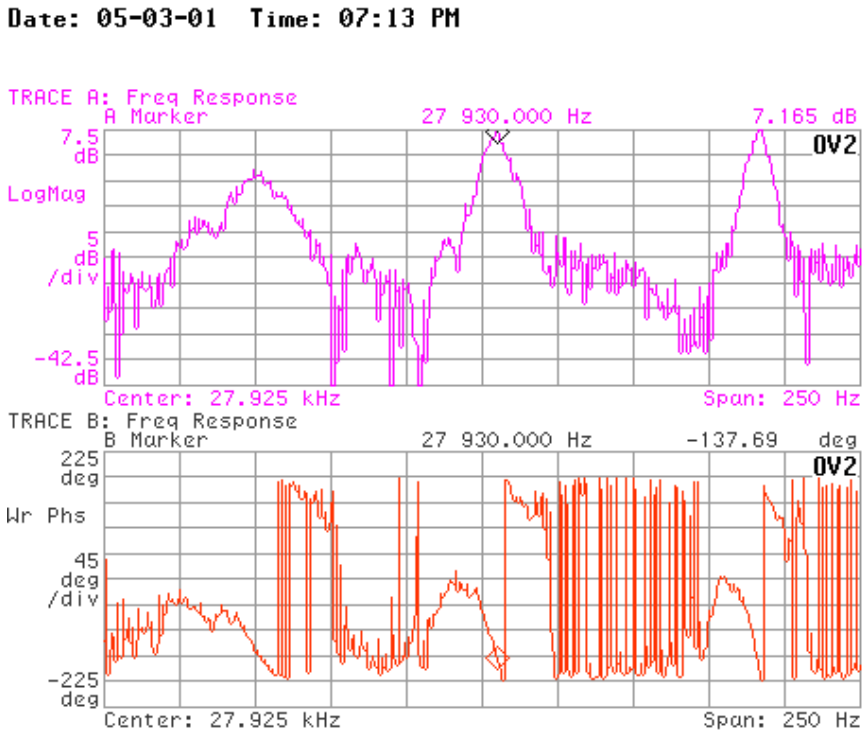
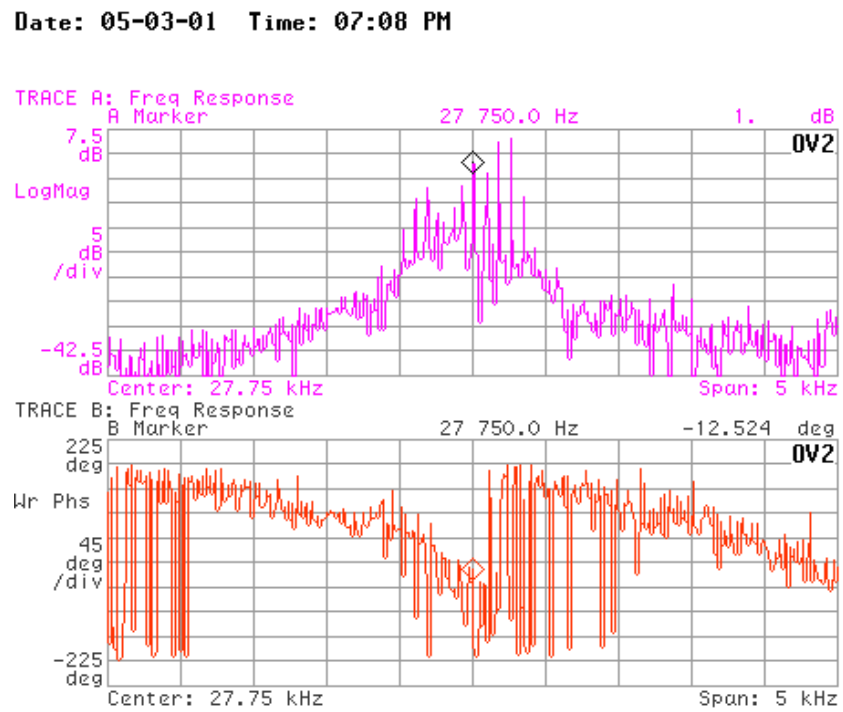
The goal of the beam simulation hardware

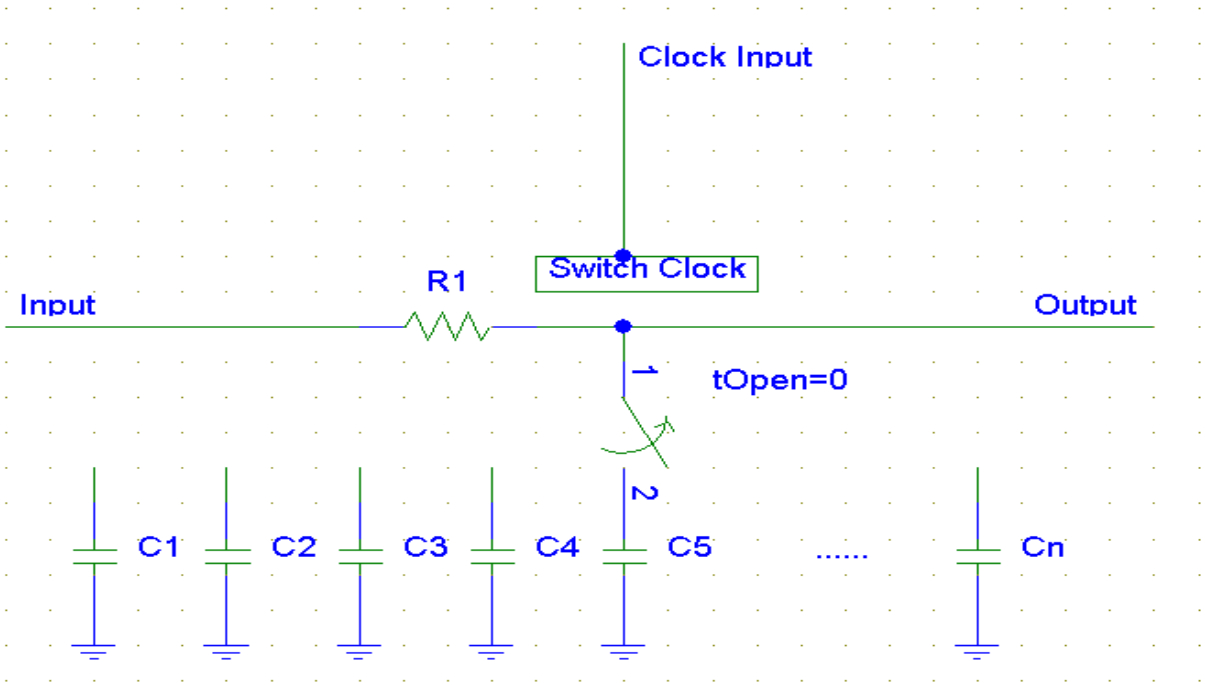




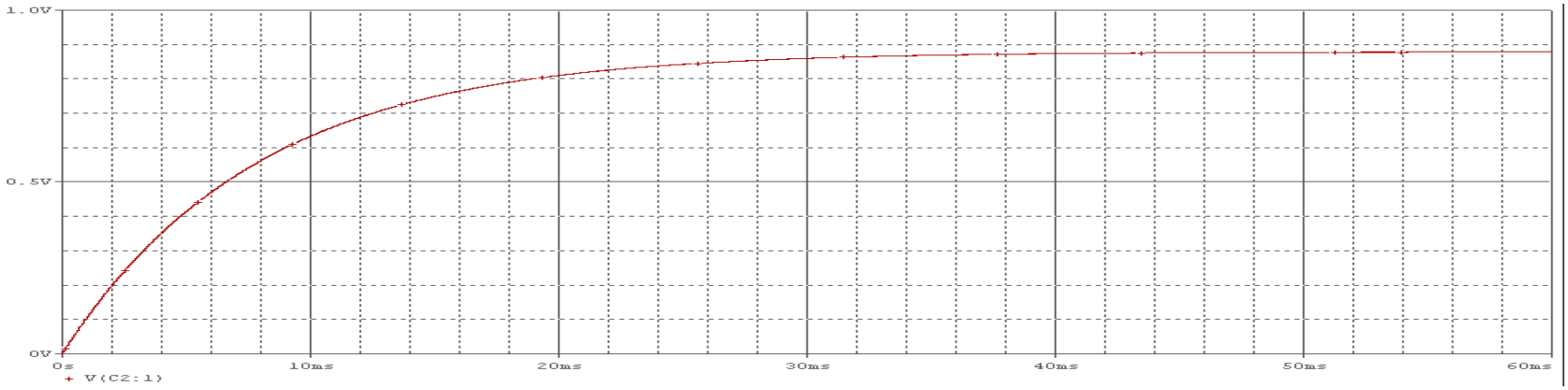
- Simulate the frequency response of the beam
- Test device before doing test on Tevatron, avoid wasting Tevatron time
- Modify central frequency, side band distance easily.

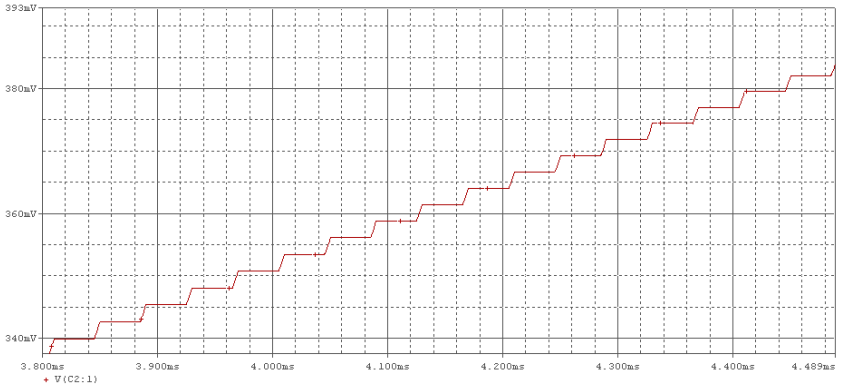
Circuit consideration: Commutating Filter and its frequency response

- A way to build a black box with required frequency response. (Idea from David Peterson)
- Use FM modulation signal as switch clock
- C1=C2=…=Cn
- Change the <u>center frequency</u>, <u>side band distance</u>, and <u>ratio between peaks</u> of I/O frequency response by changing FM modulation parameters, wc, wm and index.

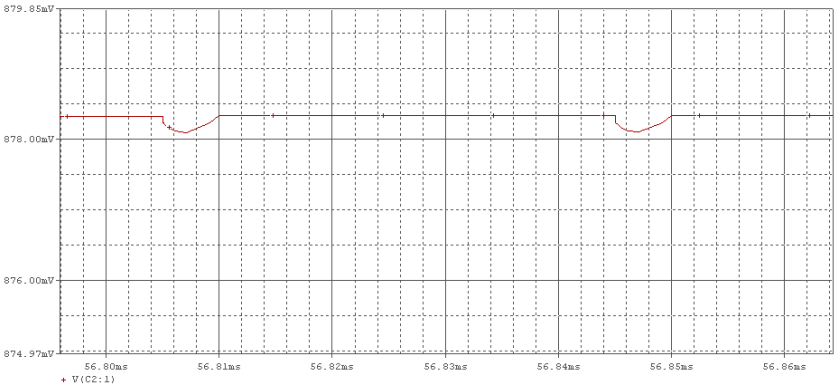


Voltage over singer capacitor(#2)
R=10K, C=0.1uF,N=8, fin=25kHz sinwave, switch clock=200kHz=N*fin

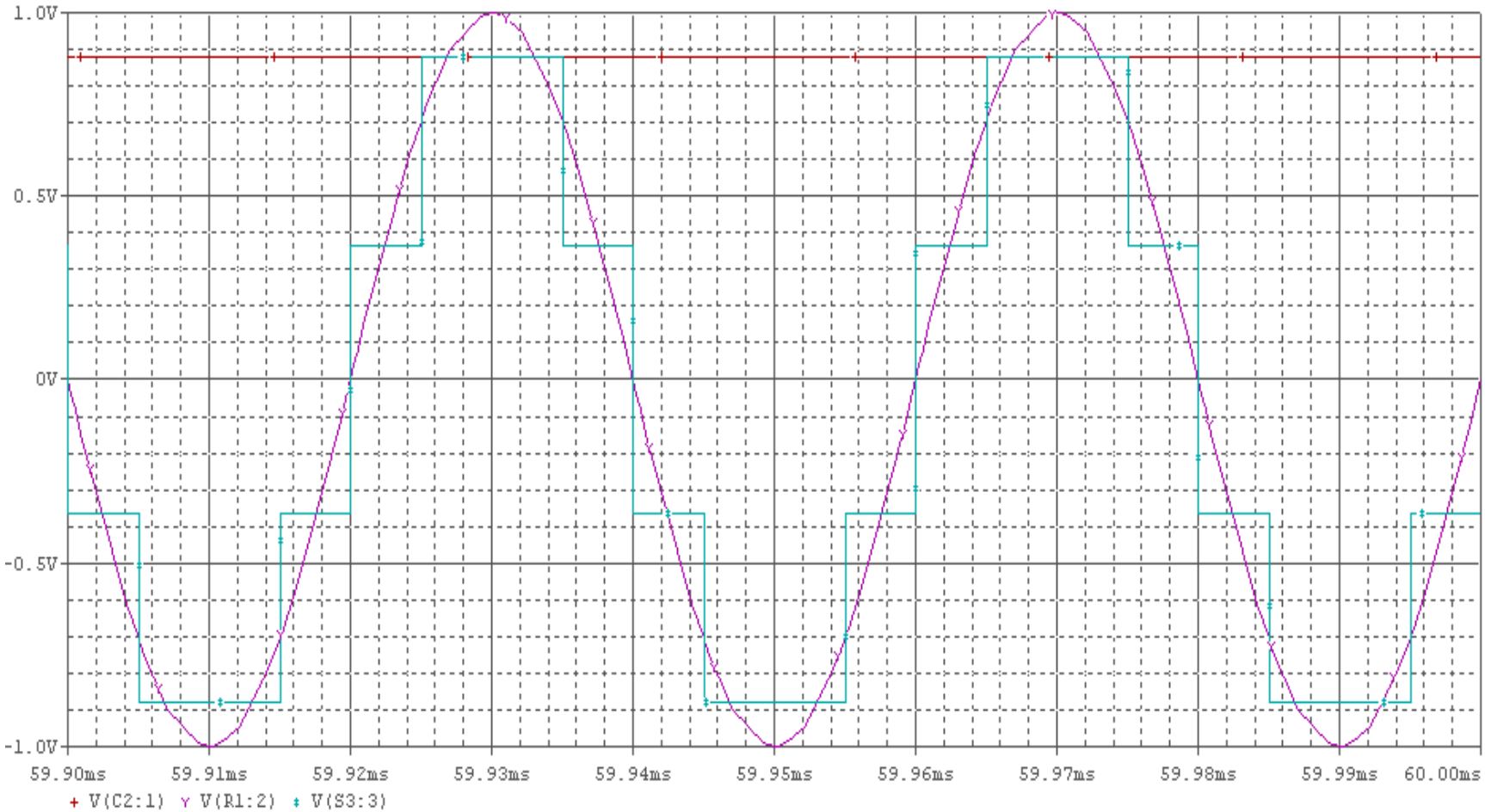




Capacitor voltage when the capacitor is being charged.



Capacitor voltage when it is saturated



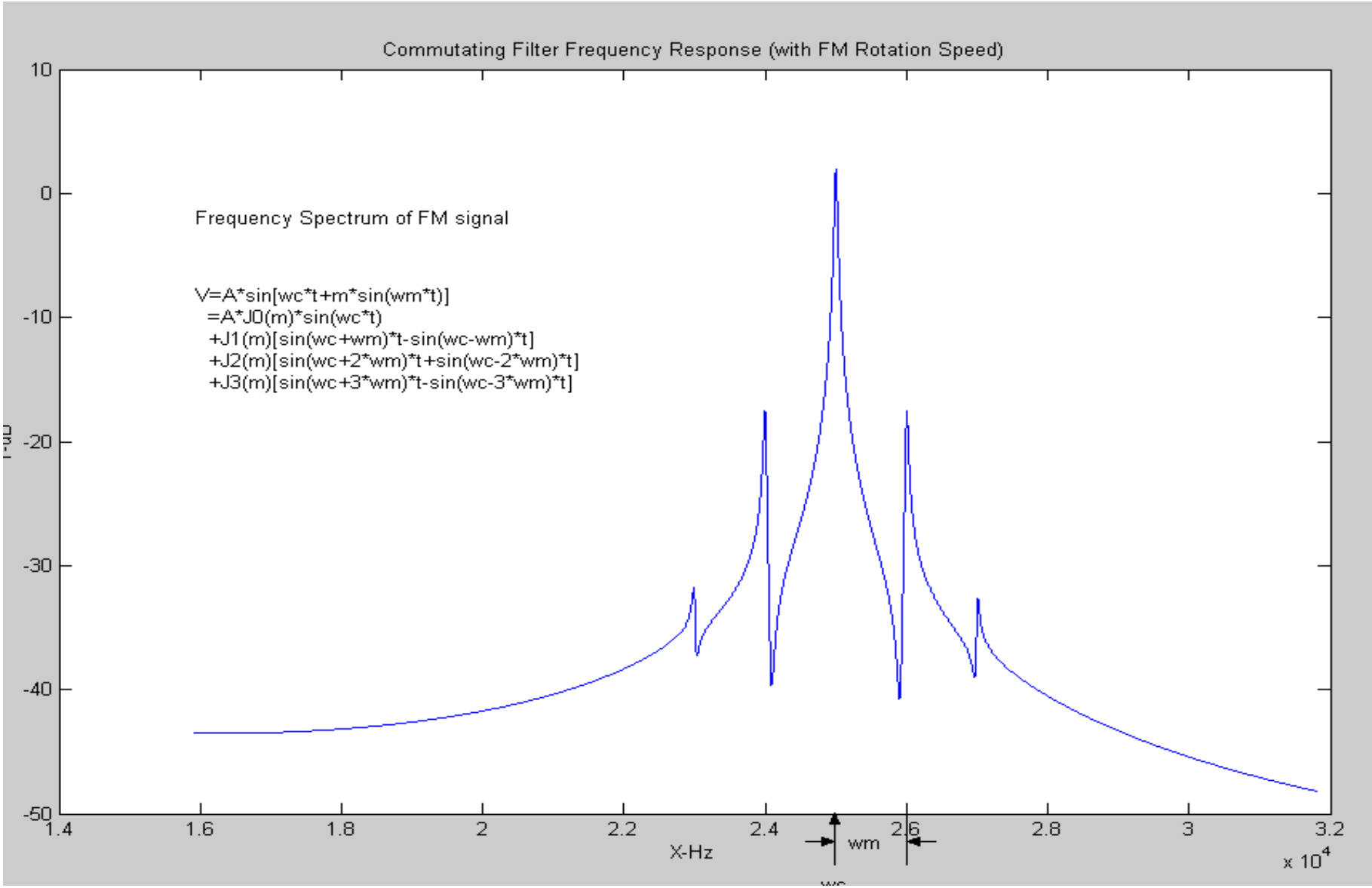
The input(25kHz)/output wave form

The switch is sampling from capacitor#1 to #8, periodically, gets a step waveform

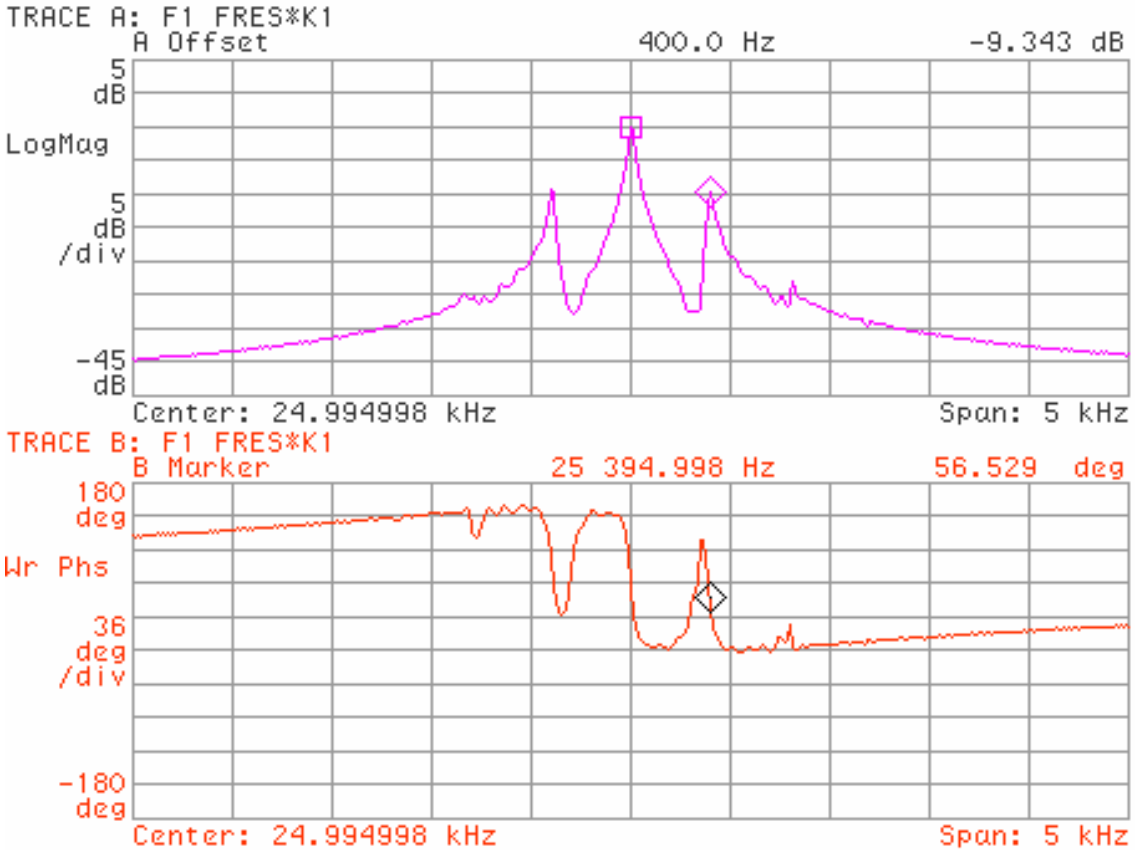
purple- 25kHz sinwave

blue- output waveform

red- voltage over #2 capacitor



Replace 25kHz sinwave by FM signal as switch clock, we expect the location of side bands can follow the spectrum of FM signal.



$$SwitchClock = \sin(w_c t + m\sin(w_m t))$$

$$w_c = 25kHz$$

$$w_m = 400Hz$$

$$R = 10k\Omega$$

$$C = 0.1\mu F$$

$$N = 8$$

$$Bandwidth = \frac{1}{N\pi RC} = 40Hz$$

When we apply an FM signal to switch clock, we get the frequency response by **Vector Signal Analyzer**.

The locations of the peaks are related to the FM modulation parameters. By changing the parameter of FM, we can observe the corresponding change of the frequency response.

Conclution

The design is an attempt to simulate the beam response. For the project is to build a black box with beam response, there will be many approaches to build it. We got some of the experimental result without the calculation. We hope the commutating filter can give us satisfied performance. If not, we will try other methods such as DSP, ect.

A brief schedule:

June. 2004: Complete the calculation of the design, confirm if the design will work.

July. 2004: Start building the equipment

Nov. 2004: Complete the first prototype of the beam response simulator