ATV Pre Emphasis Filter

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Abstract

The ATV system used on LV2 uses a preemphasis filter to compensate between transmitter and receiver frequency response. The preemphasis filter design was provided by PC Electronics, however it seems to impair the video signal rather than help it. I will look at the frequency response using the Saber simulator, and discuss its appropriateness.

Introduction

The ATV system used in the LV2 is expected to have a video preemphasis filter between the camera and the transmitter (or exciter). This provides the correct frequency response matching between the ATV transmitter on the rocket, and a commercial off the shelf satellite receiver like the one used in the LV2 ground system. We have decided to use the filter provided by PC Electronics, Tom O'Hara. However when we switch in this filter, the video seems to be impaired. The video seems to be better without the filter. I will look at the frequency response of this filter by simulating it using Saber, a Spice variant circuit simulator.

The circuit is a bridged tee filter providing a high pass function. The characteristic impedance of both the signal source, and the load is 50 ohms resistive.

0 dBV = 1 volt at 1004 Hz, into 50 ohms (or 600 ohms if used in telecom)

If a 1 volt signal were applied to the circuit, the output magnitude plot would be referenced to standard dBV levels. This is useful because both absolute levels referenced to 0 dBV can be observed, and relative dB of attenuation can be obtained directly. This signal level is also appropriate since the nominal voltage level used with line level video signals is 1 volt peak to peak.

Procedure

Enter the circuit using the Saber Sketch tool. Figure 1 shows the circuit provided by Tom as entered into Saber. Then perform an ac analysis between 10 Hz, and 8 MHz, and look at the bode plot of output magnitude.

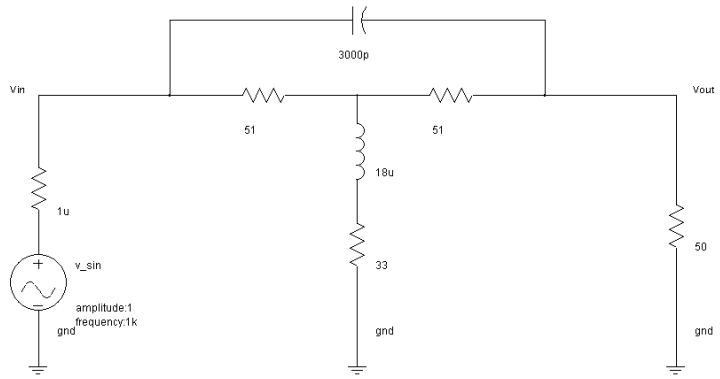

Figure 1 – Bridged Tee Passive Filter

Results

The output magnitude bode plot is shown in Figure 2. This magnitude response seems correct for a high pass filter. I have placed markers at the -3 dB, and -6dB attenuation points. Also I placed a marker at the 4.8 MHz point, which is well after where video ends, and the FM modulated audio is placed on the baseband video signal.

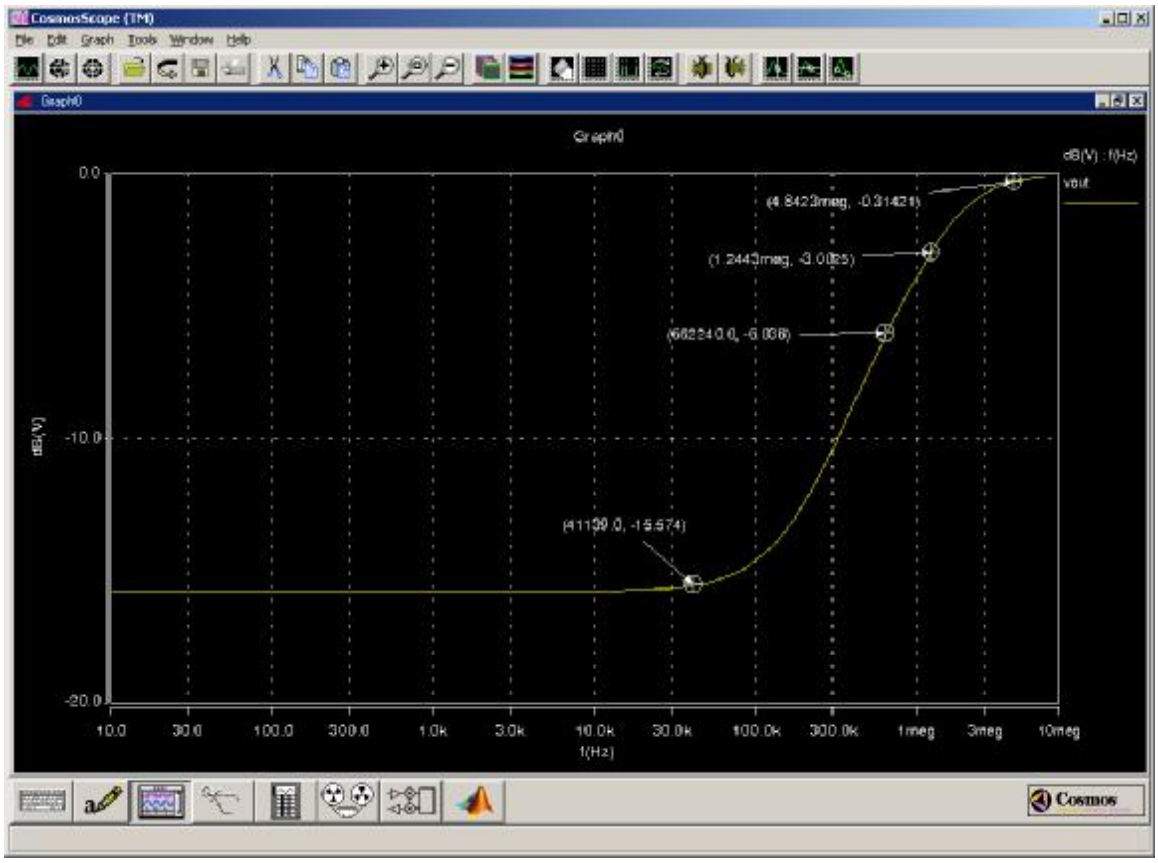

Figure 2 – Bode Plot of Filter Output

Figure 3 shows the magnitude response of the same filter except it considers the nominal output impedance of the source, which is 50 ohms. Here markers have been placed in the same locations as before. The filter has a 6 dB voltage attenuation on the passband.

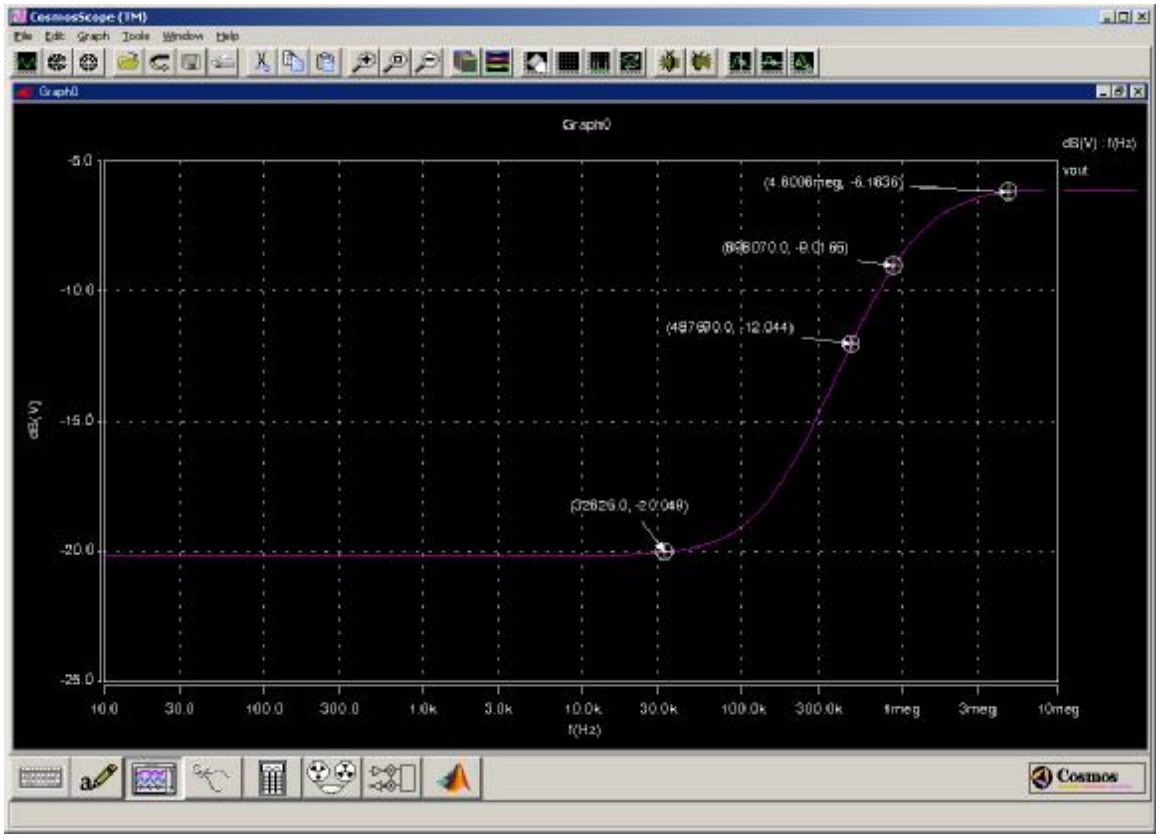

Figure 3 - Bode plot of filter output with 50 ohm source

Conclusions

This is a high pass filter. Great! The question is, what should it really be like?

This filter introduces a 6 dB attenuation in video signal level. When applied to an FM exciter it will have the effect of reducing the maximum deviation by 50 % (6dB in volts is a half power level, deviation is directly proportional).

It is possible this filter is appropriate, however the video signal level should be amplified by two before the filter, or exciter, or alternately the IF gain of the satellite receiver should be increased. I did discuss satellite receivers used for FM ATV with Tom O'Hara, and he said since ATV signals have less deviation than ordinary C band satellite signals, the IF gain in satellite receivers needs to be increased. These findings are consistent with what he said. However they may be more appropriate as a result of this filters attenuation.

There is something to be gained be having a smaller signal going into the exciter, and subsequently a smaller deviation. This would reduce the bandwidth of the FM ATV signal. This is a benefit should the ATV transmitter antenna have an insufficient bandwidth.