UNIVERSITY OF CALIFORNIA
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	Homework 7	EECS 247
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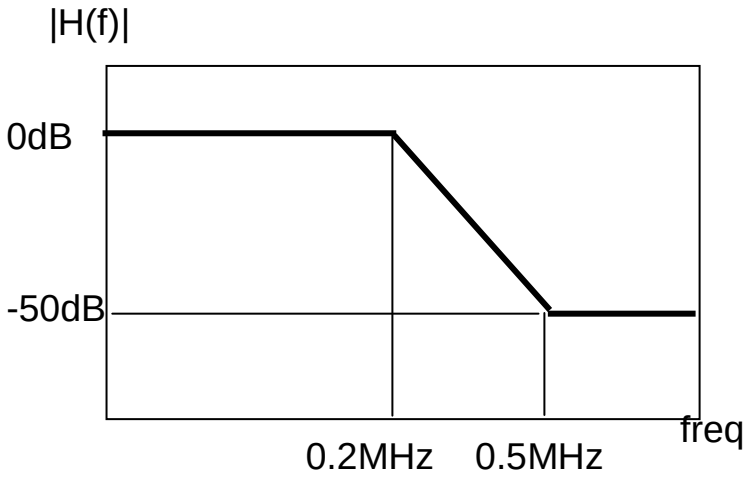
Problem 1.

The specifications for a switched-capacitor sigma-delta modulator are given as follows:

a) Signal bandwidth of interest 80kHz. Input signal however, has the following spectrum:



b) Required minimum SNR 90dB- Input signal range (Δ) is 2V

c) The settling of the opamp designed is slew limited (ignore settling time) and the slew rate is defined by Iy/Cintg

d) The first integrator power consumption is estimated as 2VDDXIy where VDD=2.5V

e) The following integrators consume half the power compared to the 1^{st} integrators and the power dissipation for the comparator and the rest of the associated circuitry is about 10% of the power dissipated in the 1^{st} integrator

f) An anti-aliasing filter is required in front of the converter. The out-of-band aliased signal should be kept <-95dB with respect to inband signal.

The goal is a preliminary study to choose between a 2^{nd} order sigma-delta modulator architecture and a cascaded (2-1) configuration. The choice is based on minimum total power dissipated by the converter and the required prefilter. Assume that a first order filter can be built with a simple passive RC with no power dissipation and the power dissipation of filters with order larger than one is give by P= (n-1)(2Iy) VDD where n is the filter order.

In your over-sampling ratio computations, for ease of the decimator filter design, choose M, the oversampling ratio, to be 2^m with m an integer number. Ignore noise contributed

by the opamp and make sure that all other noise sources added to the quantization noise are -90dB lower compared to the converter full-scale signal. Also, note that it is desirable to have the in-band thermal noise exceed in-band quantization noise for dithering purposes.

Submit your computations and the estimated power dissipation for the two architectures. Use the table bellow to show the final results:

	2^{nd} Order ΣΔ Modulator	Cascaded (2-1) ΣΔ Modulator
Oversampling ratio (M)		
In-band quantization noise power		
In-band thermal noise power		
1^{st} integrator Cintg value		
1^{st} integrator power dissipation		
Total integrator + comparator power		
Anti-aliasing filter order		
Anti-aliasing filter power		
Total Power Dissipation		

Problem 2.

Compute the required sampling frequency for an oversampled ADC converter built to handle in-band signal ranging from DC to 20kHz with 18-bit resolution (HiFi audio applications). Consider these three cases:

a) No noise-shaping, just pure oversampling, 1-bit quantization

b) 1^{st} order noise shaping ΣΔ (1-bit quantizer)

c) 2^{nd} order noise shaping ΣΔ (1-bit quantizer)

What are the reasons you would choose option c) for the implementation?