EECS120 - Fall 2003
Homework No. 7
Due: In the 120 Box On Oct 30

You are strongly urged to turn in a photocopy of your work so that you can check against the solutions.

Collaboration permitted and solutions to be written up by groups up to 3.
Be clear and precise in your answers
Questions can be asked in ucb.class.ee120 or in office hours

Problem 6.1 *BIG BONUS Continues:*

Go to www.scitoys.com or other similar sites to look up how to make simple crystal radios. Build one and report on how it works. Can you give an explanation in terms of the concepts taught in this class?

Can you simulate this radio in MATLAB using idealized circuit components and illustrate the operation?

This problem is good for the rest of the term.

For a further twist, see if you can pick up TEMPEST transmissions from a CRT monitor on your radio.

Problem 6.2 *Book Problems from Oppenheim, Willsky, and Nawab*

Problems 7.52, 8.36, 8.38, 8.42

Problem 6.3 *A COM system: from words to understanding*

Suppose that we have the digital communication system described in class. The transmitter takes a 3000 bits per second stream of binary data in, groups it into groups of 3 bits, translates those 3 bits into complex numbers corresponding to the eighth-roots of unity, and then uses this discrete-time complex signal to generate a continuous time complex signal $x(t)$ *by using the complex numbers to multiply appropriately spaced and time-scaled sinc functions. The transmitter then uses the Real and Imaginary parts of this continuous time signal to multiply a* $\cos(2\pi * 100000t)$ *and* $\sin(2\pi * 100000t)$ *carriers respectively, and then adds the two together to get a real continuous time signal* $y(t)$. $Y(\omega)$ *is restricted to be zero except in a band 2kHz wide centered at*

a. *Draw a block diagram of the communication system and label all intermediate signals described above. Give pictures in frequency domain where appropriate and pick suitable parameters for the sinc functions so that a receiver has a chance of decoding correctly. When in doubt, use your intuition or ask questions.*

b. *Now, construct a receiver that has perfect time and phase synchronization to the transmitter to recover the transmitted bits. Draw a block diagram and label everything as in part (a).*

c. *Suppose that the* cos *and* sin *generators at the receiver were out of phase slightly (by* ϕ*) from the transmitter. Show what happens. How big a* ϕ *can your receiver tolerate if there is no noise?*

d. *BONUS: Suppose that the sampler at the receiver was also out of timing syncronization and your samples were all being taken τ seconds too late where constant τ is a few tens of microseconds. If you knew τ, what could you do at the receiver to compensate for this problem? You are not allowed to add any new blocks before the sampler. Only things after sampling are permitted.*