EEE411/511 TERM PROJECT

(assigned at 5 Dec 2008)

DUE DATES:

1. **7 January 2009 (Wednesday), 17.30: amplifiers designed and constructed.**
2. **20 Jan, 2009 (Tuesday), 10.00: complete receiver designed and constructed.**

PROJECT:

- Construction of a Radio Receiver,
- Measurements of the frequency responses of the extra amplifiers.
- Measurement of the output S/N and finding the input sensitivity which gives and output S/N equal to 10 dB.
- Measurement of the noise figure of the receiver.
- Measurement of the output IP3

Specifications of the receiver:

- Sensitivity: 0.7 μVrms -110 dBm which produces an output level equal to or greated than 0 dBm at 10 dB or greater SINAD.
- Noise figure: 5 dB
- Input frequency range: 55-58MHz
- Output frequency: 10.7MHz
- Output signal level: 0dBm on 50Ω
- 3dB bandwidth: 180+/-40kHz
- Output IP3: 10dBm

Hint: SINAD = (Signal + Noise + Distorsion Power)/(Noise + Distorsion Power)

Steps of the Project:

1. Design your extra amplifiers in order to obtain a receiver to satisfy the specifications stated above and construct the amplifiers. Measure the frequency response of the IF amplifier by using LABVIEW. Measure the frequency response of the RF amplifier section by network analyzer (first demo). Design your receiver by integrating the circuits you have built during the experiments as shown below. The overall gain of the combined LNA+MIXER must at least be 10 dB (power) from the input of the LNA to the o/p of the MIXER including the IF filter. Hint: You need to place an extra amplifier between the LNA and the MIXER. You also may need to place a 10.7 MHz IF filter at the output of the amplifier of exp3.

2. To measure the Frequency Response of the IF amplifier, prepare a program based on Labview, which is available at the microprocessors lab, and use the signal generator and the oscilloscope which are available at the same lab, too, and control them through their serial ports. The program must measure the gain of the receiver over the IF frequency band and plot it on in dB's against linear frequency scale. The plot should reflect the overall BW of the receiver clearly. Measure the gain of the LNA + amplifier you designed using network analyzer.
3. Construct your receiver as shown at the block diagram (Fig.1). The receiver subcircuits-frontend amplifier, mixer, IF amplifier and the frequency synthesizer-must be placed in separate faraday's cages in order to minimize the interference and cross-coupling between the subcircuits. The power supply connection (only the positive) must be filtered while entering each box (as shown in Fig.2). The negative DC connection can be coupled via the chassis. The thickness of the walls of the boxes must be chosen with skin depth in mind.
4. After the circuit becomes operational, adjust the LNA for maximum gain at the operating frequency range. Adjust the L.O. by loading the right frequency to your PLL frequency synthesizer. Always adjust the PLL frequency synthesizer frequency to f_{in}-10.7 MHz in order that the center frequency of the input signal falls onto the center frequency of the IF filter.

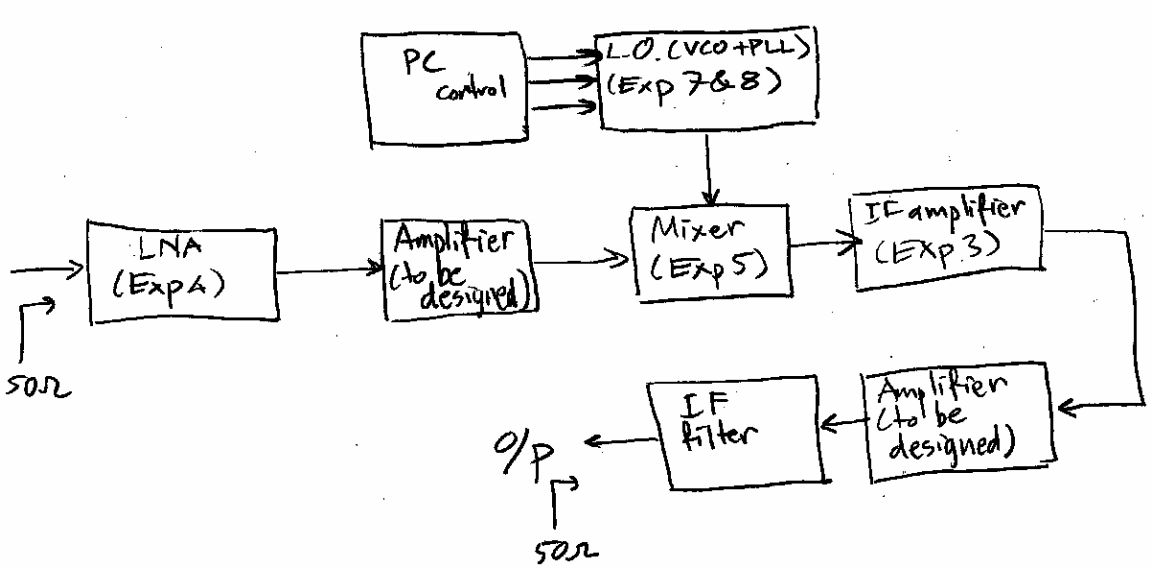

Fig 1: Block diagram of the project circuit.

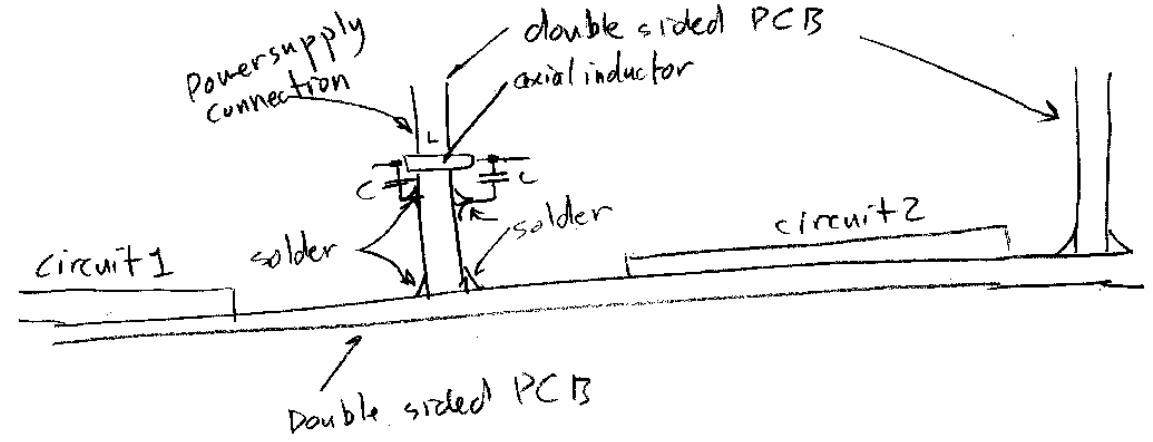

Fig 2: Construction of the faraday's cage

Deadlines for the project:

I. (7 January, Wednesday), after exp8 at the microprocessors lab (BB-10); the additional amplifiers to be designed must be working to the specifications written by you (You have to justify your specification). You should also present the circuit diagrams during the presentation. The specification must be based on the receiver specification given above (Steps 1 and 2).

II. (20 January 2008, Tuesday, 10.00am), at the microprocessors lab (BB-10), demonstrations start at 10.00 o'clock sharp. The lab will be opened at 9.00 the same day to allow for preparations. Every student must be present there at 10.00 o'clock sharp with his/her project (receiver working) and the project report ready. No one will be allowed to work on their project once the demonstration starts in order to let every student have equal chance (Steps 3 and 4).

III. The project is an important component of the course and all of the steps of the project must be presented before the project is graded.