ECE 121 Final Project Spring 2011
Design of a Multistage Amplifier

1 Project overview and specifications

You have been assigned a task of designing a multi-stage bipolar amplifier.

Power supply	V_{cc}=15V, V_{ee}=-15V
Overall transimpedance Gain	16000 V/A
AC current input	.1mA p-p
Experimental Cut-off frequency	200kHz
DC output voltage	0V
Output impedance	Of the order of ohms

Remember that your goal for this project is not just to meet the above mentioned specifications but to beat them as far as possible. You could come up with a better design by designing your circuit which gives more gain, lower DC power consumption, greater bandwidth or allows a larger AC signal as input. You can try to accomplish any one of these still trying to keep other parameters as good as possible.

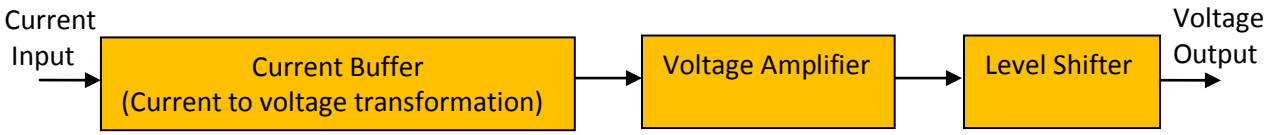

Fig. 1: Block diagram of the Transimpedance amplifier

- Stage 1: Current buffer (Common Base)- Converts current input into a linear voltage output
- Stage 2: Voltage gain (Common Emitter)- Major gain generating stage of the circuit
- Stage 3: Level Shifter (Common Collector)- Removes output DC offset

2 Work flow

As a part of this project you are expected to do the following:

1. Do hand calculations to compute the values of various resistors and DC biasing voltages and currents.
2. Verify your hand calculations using Spice.
3. Do some minor tweaking of values in Spice if needed.
4. Simulate a transient response and frequency response for your circuit in Spice.

5. Experimentally verify your hand calculations and simulations.

6. Get the frequency response of your circuit experimentally.

7. Find the bandwidth of your amplifier from simulations and experiment (if possible also hand calculations) and compare them.

3 Project Report

An individual project report is due at the end of the project deadline. The project report should follow the flow sequence as listed below:

1. Objective- Page 1
2. Specifications – Page 1
3. Parts list- Page 1
4. Write briefly your design approach, what is unique to your design, what steps did you follow to achieve you design- Page 1
5. Circuit diagram with all your resister values written on it and the current and the voltages clearly marked in each branch and at each node respectively- Page 2
6. Calculations- Page 3 (Take extra pages if you need)
    a. Resistor values, bias voltages and currents (You may assume a voltage gain you want to attain and calculate the rest or work backwards)
    b. DC power consumption
7. Transient waveform from Spice showing both input and output - Page 4
8. Frequency response from Spice showing the 3db frequency- Page 5
9. DC power consumption using the marker on the circuit from ORCAD- Page 6
10. Experimental transient response - Page 7
11. Experimental frequency response (Table and plot)- Page 8
12. Calculations for 3 dB frequency and bandwidth from table and plot on page 8- Page 9
13. Results- Comparison table- Page 10

	Calculation	Simulation	Experiment
Gain			
Cut-off frequency			
Bandwidth			
DC power consumption			

14. Conclusion: Write about your experience working with the project. What was the most difficult part, what was simple? What did you learn from it and what you think the project failed to teach you. Your comments and suggestions about the project are most welcome. Please be genuine while writing this section and do not write redundant stuff.

Notes:

- Make sure all your waveforms have legends and scales clearly visible.
- Figures and table are properly marked and numbered.
- All mathematical manipulations should be shown in the calculations.

4 Grading

4.1 *Project Presentation*

Project presentation is 25% of your final project grade. You will be graded based on

- Quality of your presentation (Well made, organized and complete PowerPoint presentation- **15 points**)
- Your understanding of the project and the material that you present (**10 points**)

4.2 *Final Quiz*

There will be a quiz on the day of the final project presentation. Quiz will be 25% of your final project grade. It will be based on the final project circuit design and the related lab experiments. 25 multiple choice questions, each question worth 1 point. Allotted time will be 30 minutes.

4.3 *Project Report*

Project report is 50% of your final project grade. All 14 report sections listed in previous section will carry 3 points each except section 6 (5 points), and section 12-13 (4 points each). 4 points are assigned for bonus which will be rewarded based on how efficient your circuit is compared to what is designed by others.