ECE720 CAD Design Report

Work on at least part of both topics described on the following pages, or you can include another topic if you obtain pre-approval. The topic needs to involve mixed signal circuit simulation, analysis, and discussion. The Report can be a team effort (2 students) and is due by the end of Finals Week.

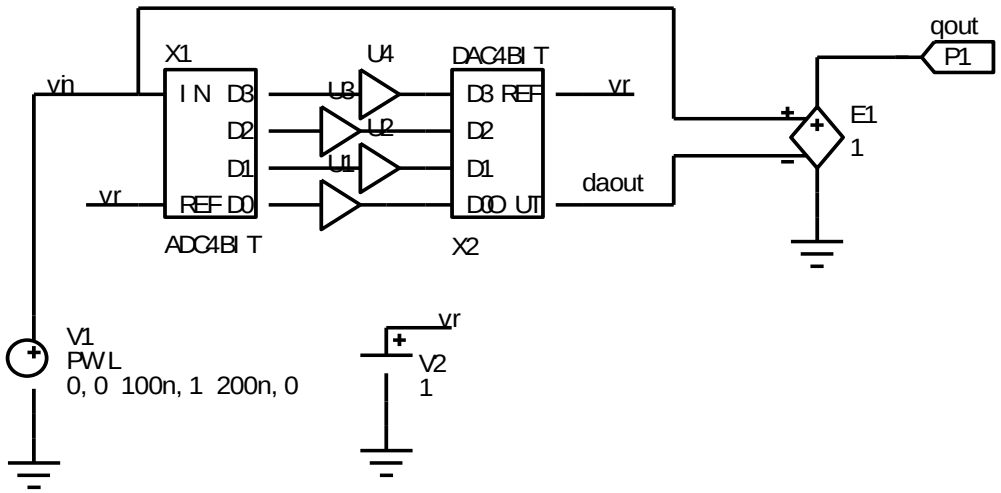
The first topic involves modeling and simulation of N bit ADC and DAC converters. The second topic involves modeling and simulation of feedback amplifiers using different amplifier topologies. If one of the topics is more problematic for you, fell free to increase the content of the other topic. Also, keep in mind it is very useful to put your spice topic files in separate folders, especially when using netlists, such as in the DAC/ADC topic.

Topic 1

Extend the 4 bit DAC model with the 4 bit ADC model as shown in the schematic below, using a circuit file (netlist) approach. Design models for a 5 bit, 6 bit system, and N bit system. Discuss physical limitations of your models. Simulating more than 6 bits is good if your simulator will allow it.

Simulate for various types of input waveforms at V1 and discuss the resulting quantization error signal qout.

Discuss the internal models of the ADC, explaining the structure and behavior of the various circuit statements, such as the E source behavioral modeling. Also discuss the internal model of the DAC.



Topic 2

Simulate the following circuit for various values of Cin and show the transition from a differentiator behavior to an open loop amplifier with a unity gain frequency. Use a several different kinds of circuits for the inverting amplifier:

1. common source,
2. differential pair with current mirror load
3. wide swing differential pair with push-pull load (3 current mirror op amp)

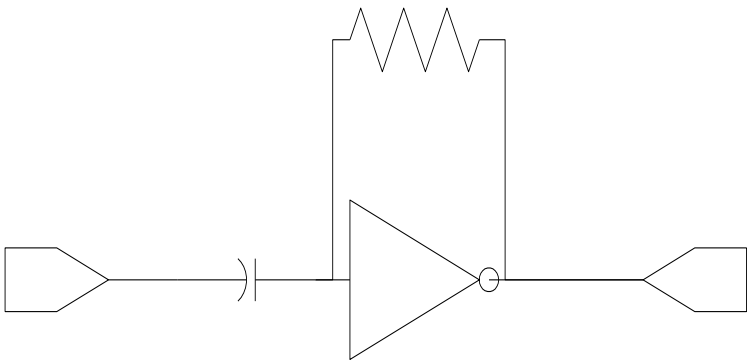
Generate the following simulations.
1. DC transfer curve of the open loop amplifier for several values of the V+ voltage (parametric step). Since the common source doesn't have a V+ terminal, explain how you found your bias point for the common source circuit.

2. AC frequency response for the closed loop amplifier at large and small Cin.

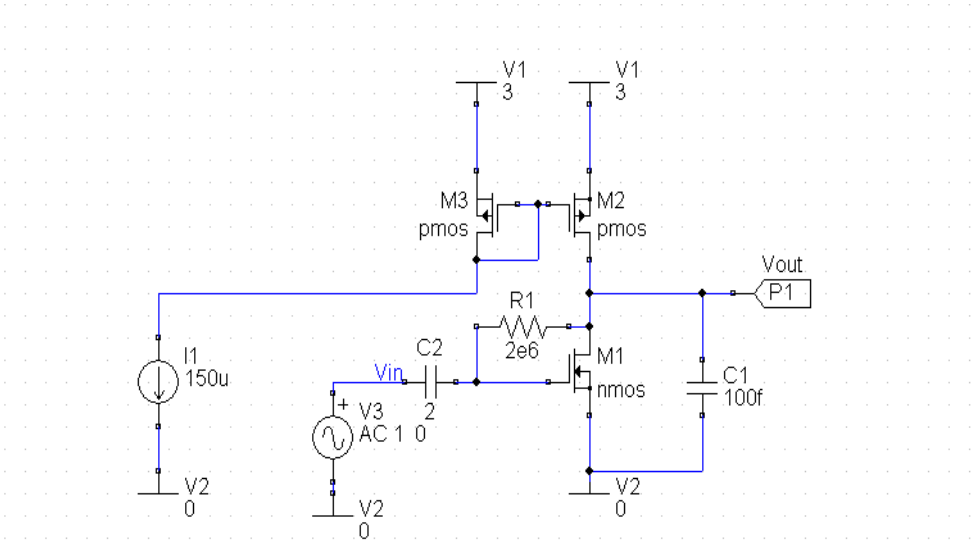
3. The transient response of the closed loop amplifier at small Cin.

R is large, eg. 2 Meg

Figure 2



An example of a common source amplifier in the inverter is shown in the figure below.



Examples of the schematics for the differential pair with current mirror load are in the textbook, as is the schematic for the wideswing output version. The wideswing version is also shown in the notes from the Carver Mead textbook on analog systems.