1 Lab Introduction

In this lab you will build and characterize a common-source amplifier(loaded resistively and actively) and a current mirror using MOSFETs. The learning goals are listed below:

- Get some practice with MOSFET equations and amplifiers.
- Observe the difference between actively and passively loaded amplifiers

2 Resistively Loaded Common Source Amplifier

Build the common source amplifier picture in Figure 1 using the TN2106 N-channel MOSFET. Use the small signal input and XY mode on your scope (find it in the "horiz" menu) to vary V_G and plot the large-signal transfer characteristic (V_O vs. V_B) for this amplifier. Use the transfer characteristic to pick a value of V_B that will maximize your gain and swing. Measure a_v and V_{SW} in XY mode and save your transfer characteristic. After that, switch back to time domain measurements to measure I_D, r_{in}, r_{out}, a_v, and V_{SW} for this design with your V_B value. Use your results to extract g_m and V_T for this device, and compare your V_T value to the datasheet. Compare your XY a_v and your time-domain a_v

Required Data: Transfer characteristic. Descriptions of how to measure I_D, r_{in}, r_{out}, g_m, a_v in XY, a_v in time domain, V_{SW} in XY, V_{SW} in time domain and V_T. Equation relating some large signal parameters to g_m and comparison between equation and measurement. Values for all of these parameters.

3 Current Mirror

Build the current mirror pictured in Figure 2 using ttwo 2P2104 MOSFETs. Verify that the current in the source and load branches match as you vary the bias current and the load resistance.

Required Data: Plot of I_{LOAD} vs. I_{SRC}. Plot of I_{LOAD} vs. R_{LOAD}

4 Current Mirror Loaded Common Source Amplifier

Build the common source amplifier picture in Figure 3 by combining your circuits from the first two sections. Biasing this amplifier is going to be a little bit tricky, but XY mode can help. Use the small signal input and the XY mode on your oscilloscope to trace out the transfer characteristic by varying V_G, then tune your mirror potentiometer until you maximize your gain and swing. Measure a_v and V_{SW} in XY mode and save your transfer characteristic. After that, switch back to time domain measurements to measure I_D, r_{in}, r_{out}, a_v, and V_{SW} for this design. As before, extract g_m and V_T and compare them to your datasheet. Comment on differences in your results as compared to the resistively loaded common source amplifier. Compare your transfer function a_v to your time-domain a_v.

Required Data: Transfer characteristic. Descriptions of how to measure I_D, r_{in}, r_{out}, a_v in XY, a_v in time domain, V_{SW} in XY, V_{SW} in time domain and V_T. Equation relating some large signal parameters to g_m and comparison between equation and measurement. Values for all of these parameters. Commentary on differences between active load and resistive load.

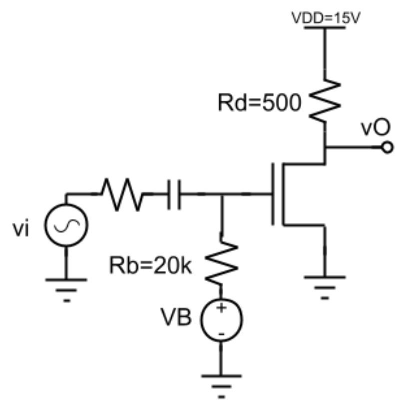

Figure 1: A sample design for a resistively loaded common source amplifier.

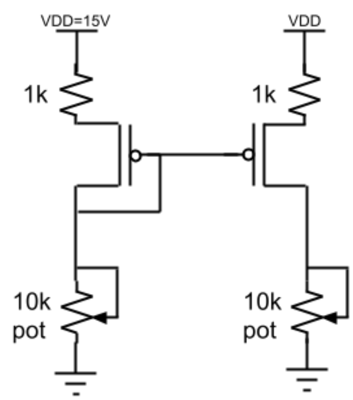

Figure 2: A sample design for a PMOS current mirror.

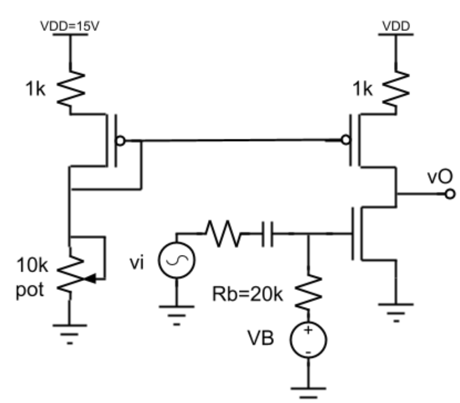

Figure 3: A sample design for an actively loaded common source amplifier.