

Power

To get a measure of how efficient our amplifier is, we simulated the current drawn by the amplifier when it was connected as a unity gain follower with the input in the middle of the rails. For $V_{dd}=5\text{ V}$, we measured a quiescent current of $113.3\text{ }\mu\text{A}$ ($V_1=2.5\text{ V}$). Note that for $V_{dd}=3.3\text{ V}$, the circuit draws only $48.8\text{ }\mu\text{A}$.

Demonstrations

Figure 1 shows the results when sweeping V_1 from 0 to +5 V, for many values of V_2 that span the entire rail-to-rail input range. Note the rail-to-rail output swing over the entire range. The response is also identical over the entire input range.

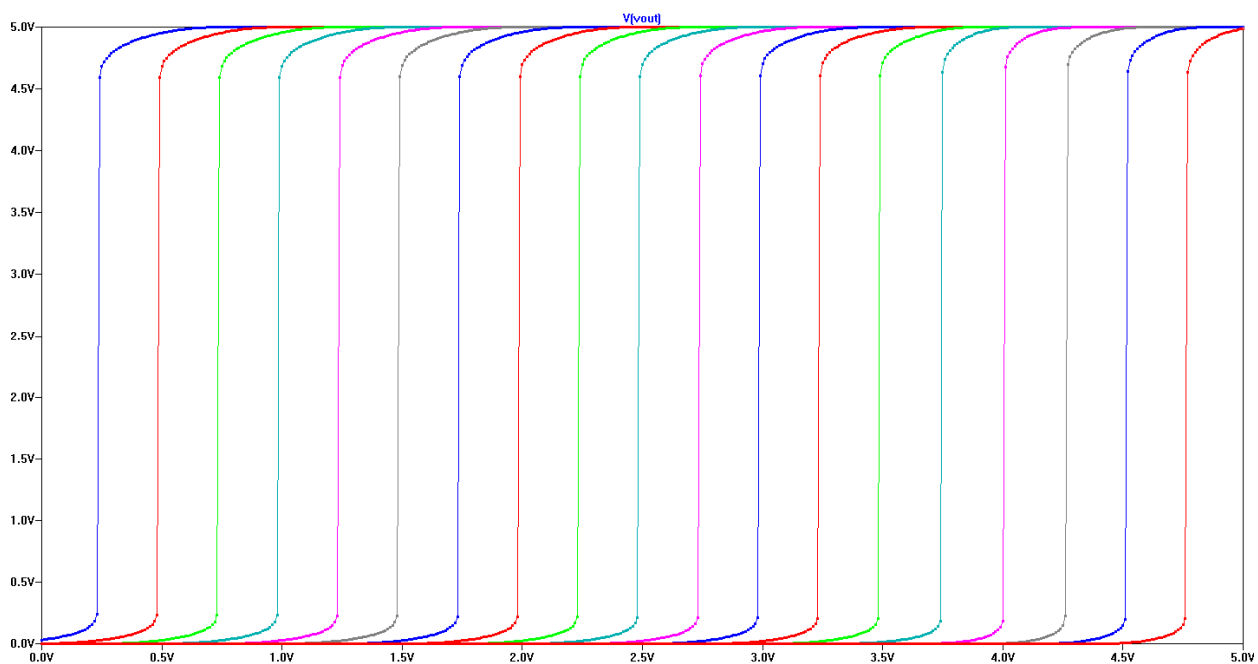


Figure 1: DC Sweep of Inputs

Figure 2 shows a sweep of V_1 around 0.5 V. From this we can find the DC gain by looking at the slope (derivative) of the line in the high-gain region. The red line in the plot is the derivative, showing a gain of several thousand in the high-gain region. Similarly, Figure 3 shows the DC gain around 4.5 V. Similar tests were done to show that the gain is above 60 dB (1000x) for all common mode input voltages within 0.5V of the rails.

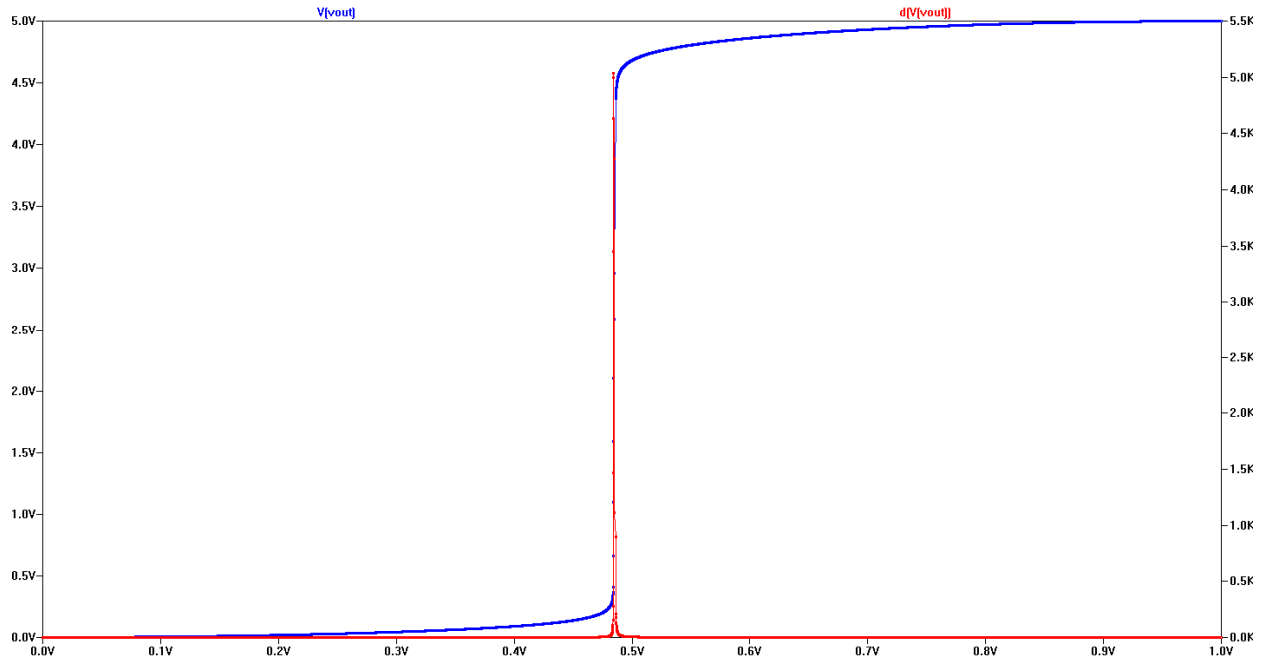


Figure 2: Amplifier Gain around 0.5 V

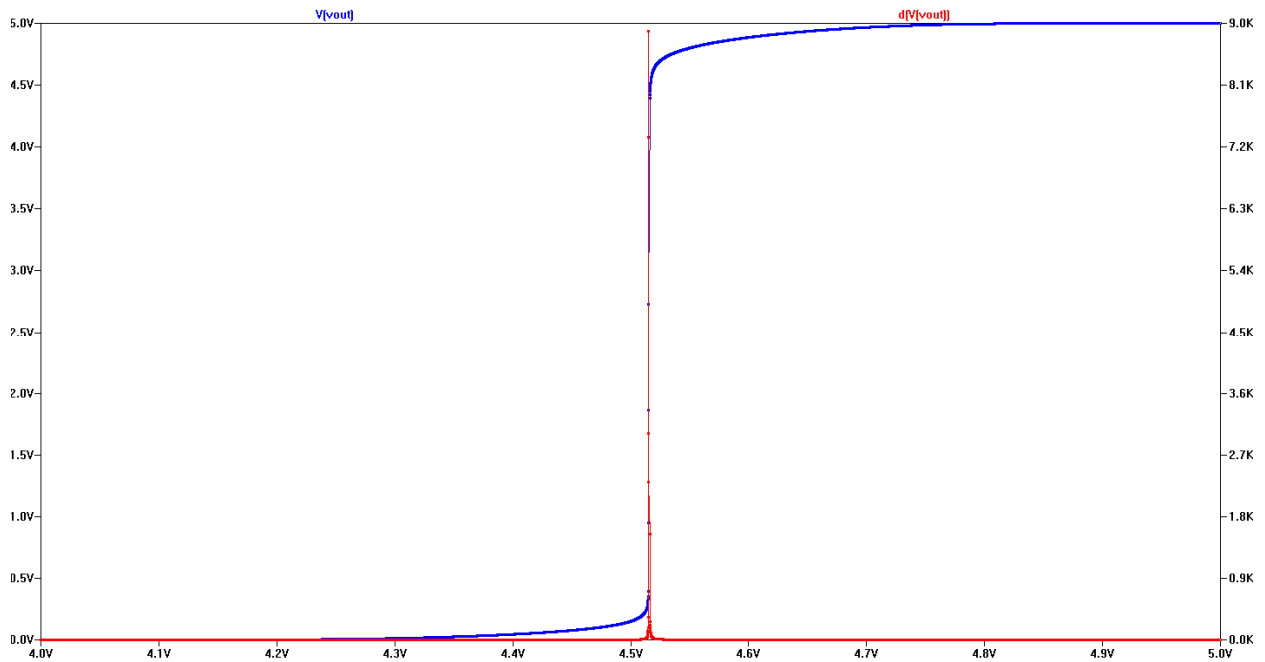


Figure 3: Amplifier Gain around 4.5 V

We then set up our simulated circuit as a unity gain follower driving a 100 pF capacitor. The voltage transfer characteristic of this follower is shown in Figure 4. Note the linear response over the entire range.

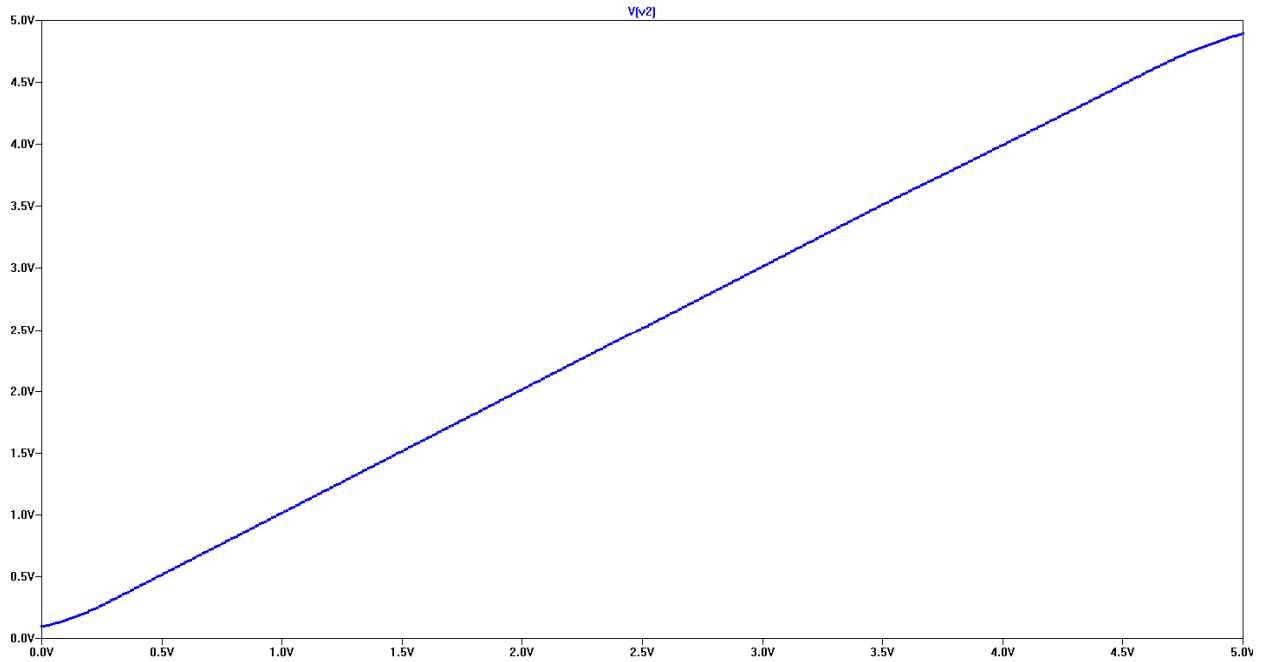


Figure 4: Unity Gain Response

Figure 4 shows the frequency response of the unity gain follower while driving a 100 pF capacitor. The circuit has a gain of 1 (0 dB) as expected over most of the range. The crossover frequency is clearly greater than 100 kHz as specified.

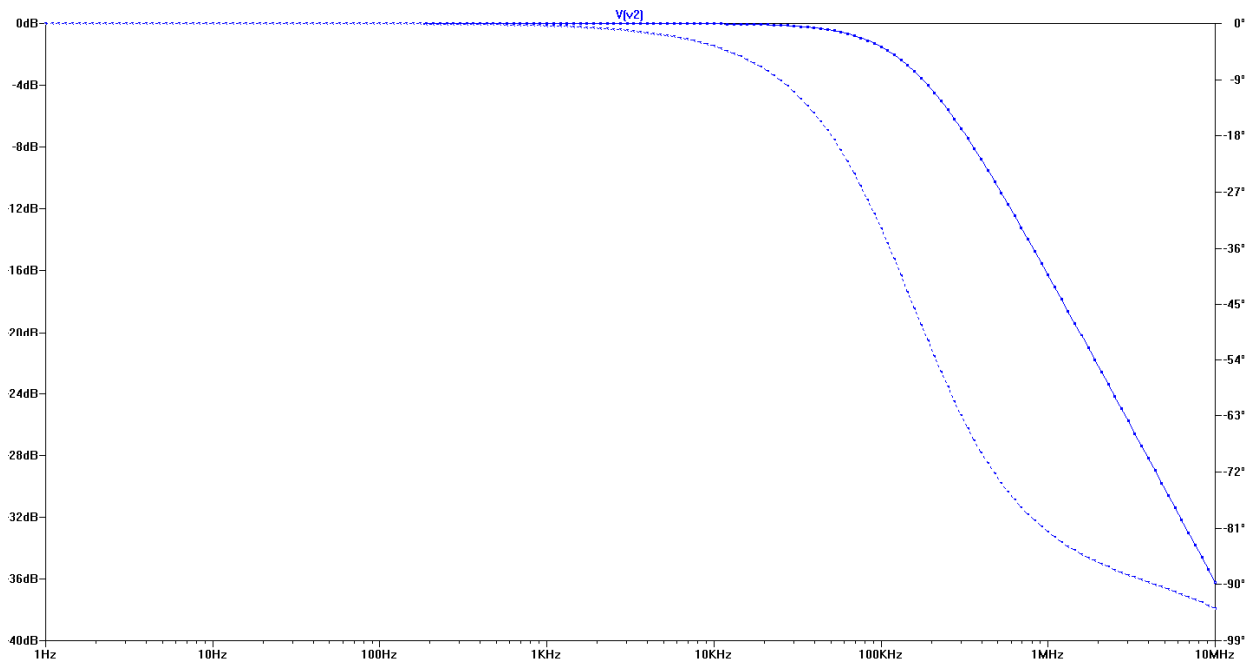


Figure 5: Frequency Response of Follower

Figures 5 and 6 show the follower's response to a small signal square wave. Note that the response is stable and does not overshoot or ring.

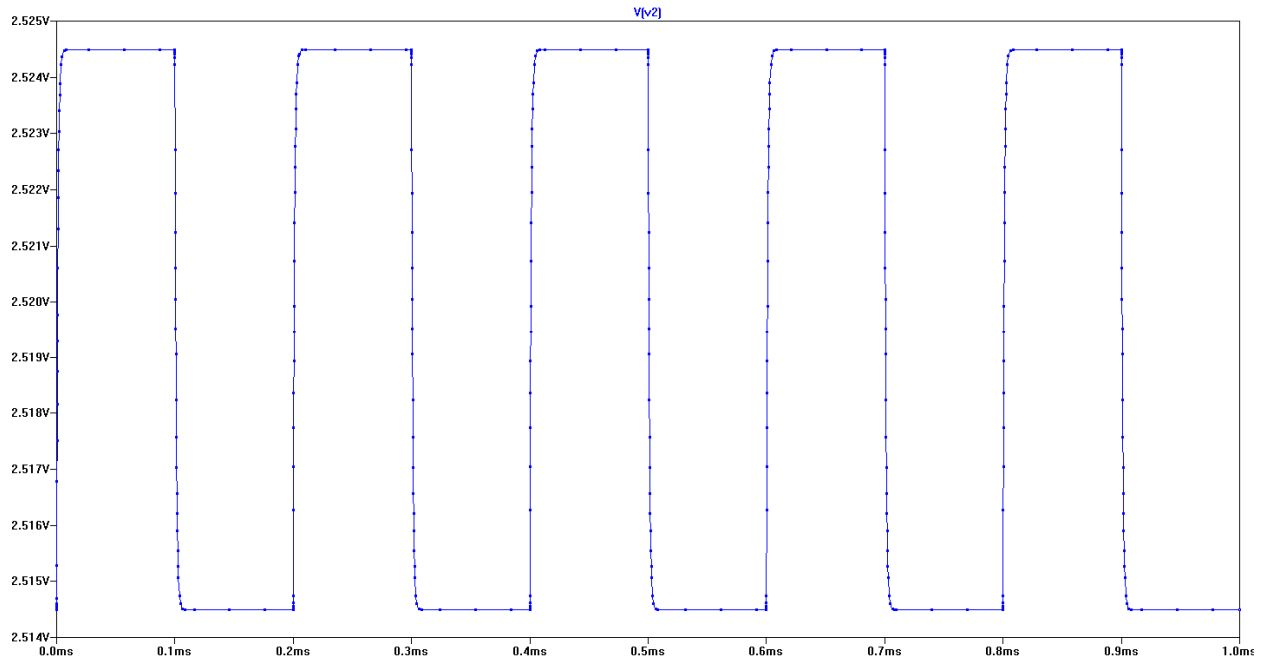


Figure 6: Square Wave Response of Follower

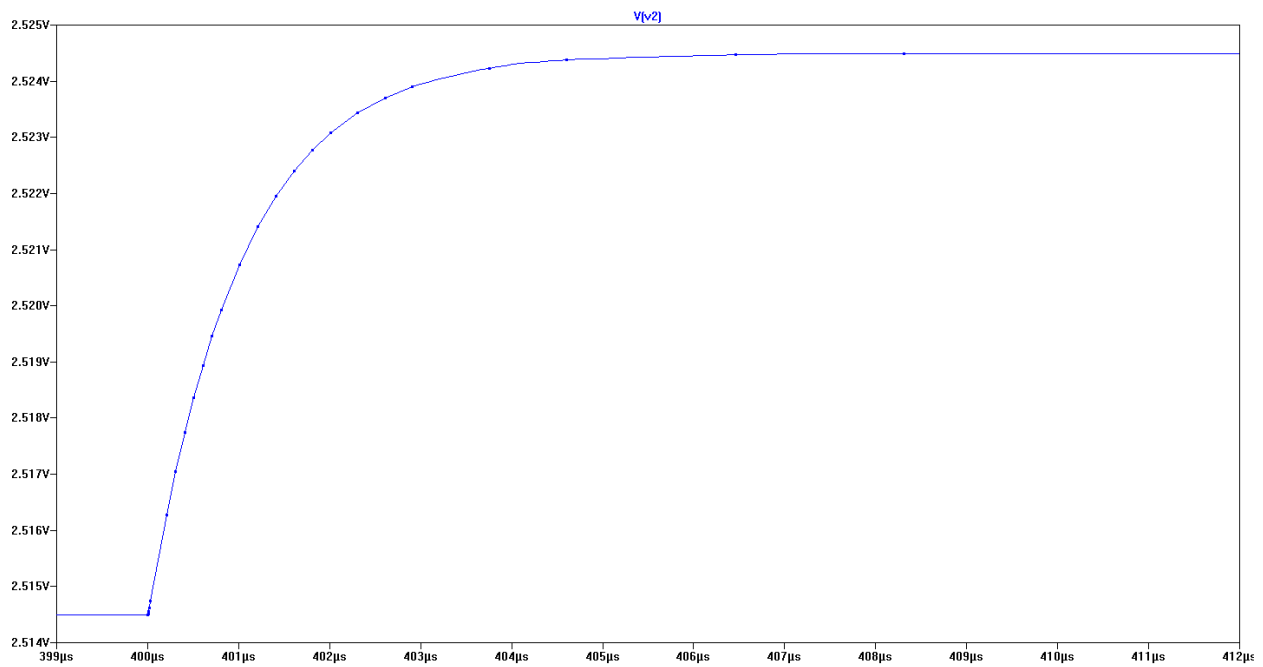


Figure 7: Smooth Step Response

These tests demonstrate that the differential amplifier meets all of the specifications outlined in the lab.

Appendix

The LTSpice files are attached. If there are any questions about this report or the contained material, please email me at raphael.cherney@students.olin.edu.