UM-SJTU Joint Institute

ELECTRONIC CIRCUIT LABORATORY

(ECE3110J)

Laboratory Report

Lab 5

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1 Exercise 2.1.1

The obtained values are shown below, simulated by Proteus.

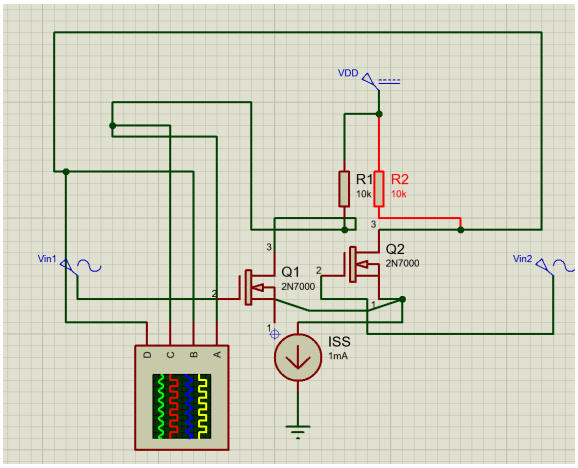

Figure 1: Vout1 vs. t

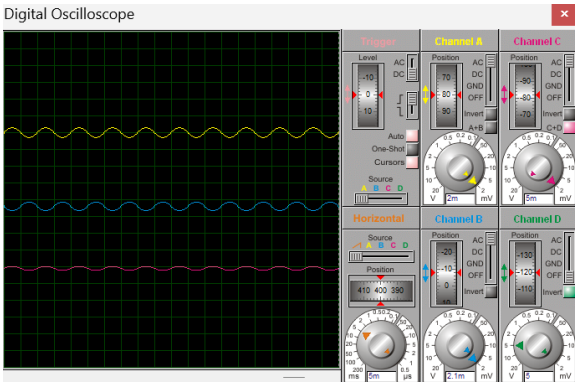

Figure 2: Vout2 vs. t

2 Exercise 2.1.2

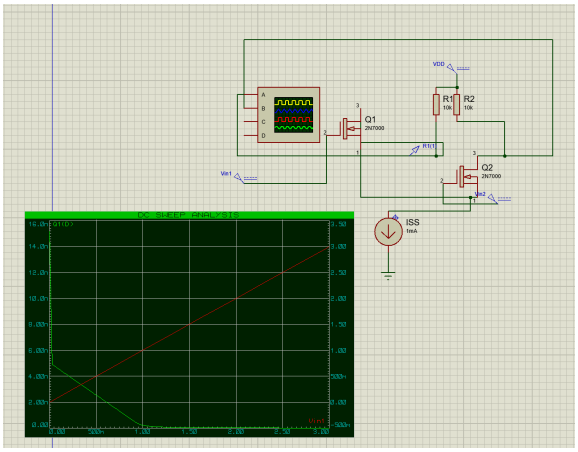

Figure 3: Vout(CM) vs. Vin(CM)

We can calculate the Acm = (for Vin(CM) = 2V)

3 Exercise 2.1.3

The experiment circuit is shown below:

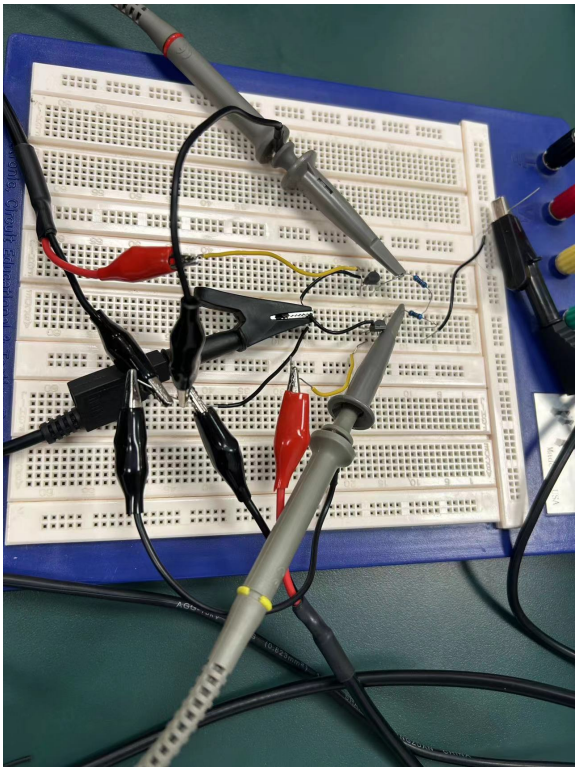

Figure 4: Circuit of 2.1.3

According to the experiment's results, $|A_{DM}| = 25$.

The experimental result is shown below:

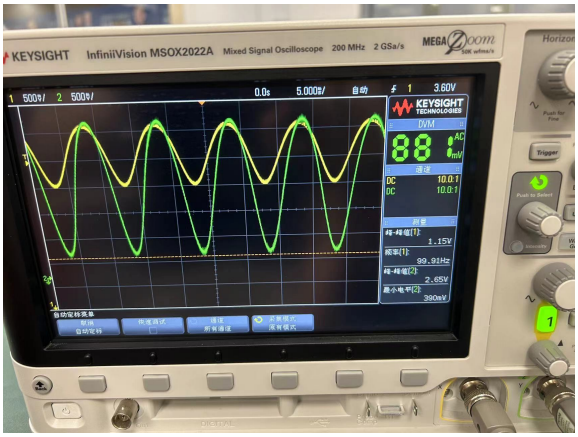

Figure 5: Lab result of 2.1.3

4 Exercise 2.1.4

The experiment circuit still like the above one, the only thing to do is to alternate the input into a identical DC value:

According to the experiment's results, $|A_{CM}| = 0.06$.

The experimental result is shown below:

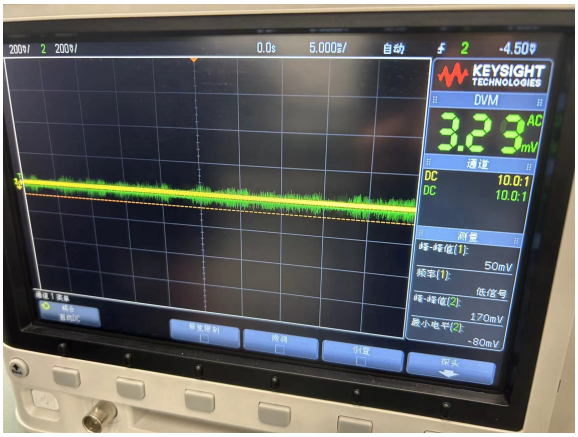

Figure 6: Lab result of 2.1.4

This result is appropriate, confirm to the therotical result as part (2)(close to zero).

5 Exercise 2.2.1

In this part, the gain is shown as below:

$$A = \frac{d_{Vout}}{dV_{in}} = k * (\frac{W}{L}) * (V_{in} - V_{Th}) * R_L;$$

6 Exercise 2.2.2

The simulation with Proteus is shown below:

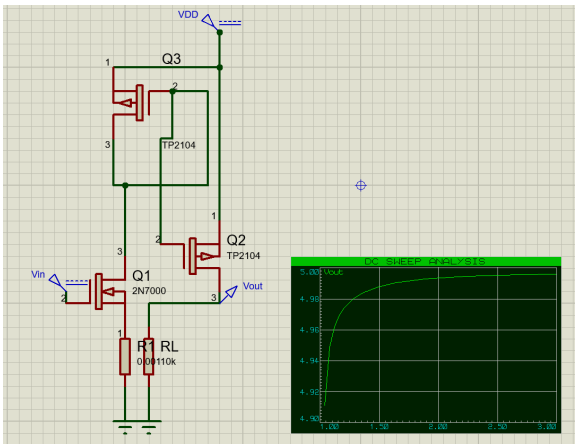

Figure 7: Vin vs. Vout

The voltage gain equals to

7 Exercise 2.2.3

The experiment circuit is shown below:

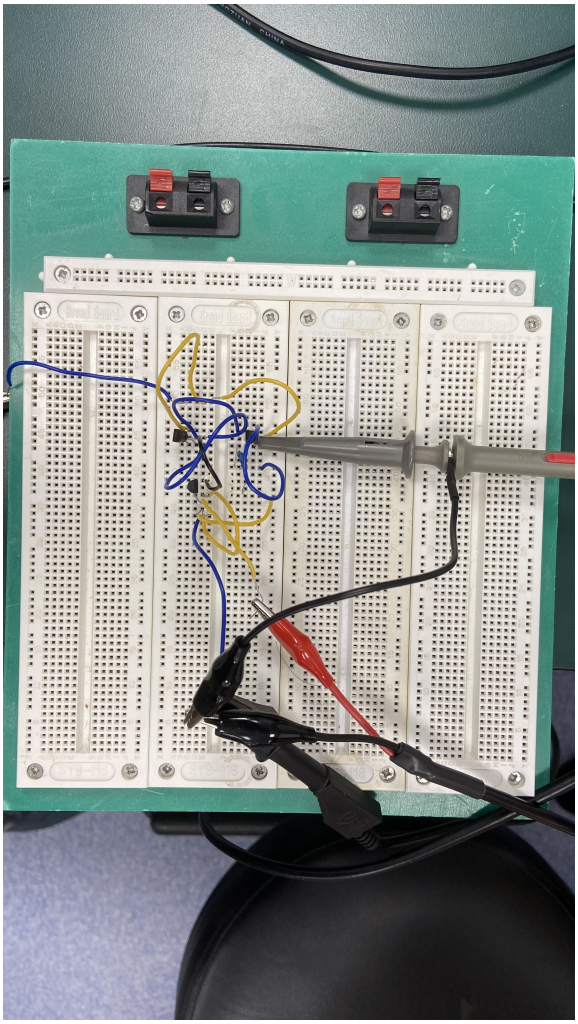

Figure 8: Circuit of 2.2.3

The experimental result is shown below:

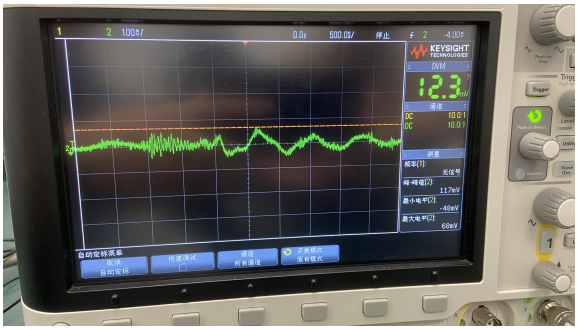

Figure 9: Lab result of 2.2.3(V=1)

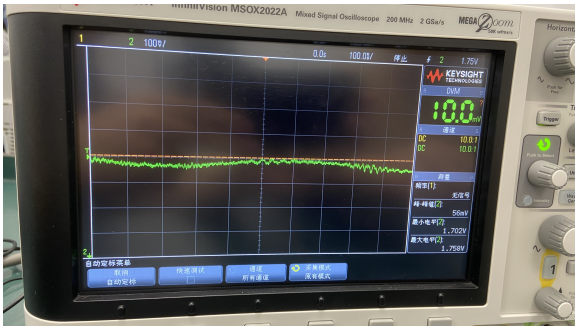

Figure 10: Lab result of 2.2.3(V=1.5)

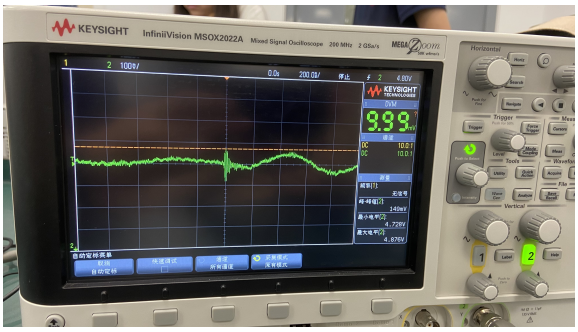

Figure 11: Lab result of 2.2.3(V=2.5)

So the plot for Vout vs. Vin is shown below:(actually when Vin = 1.6, Vout reaches its maximum)

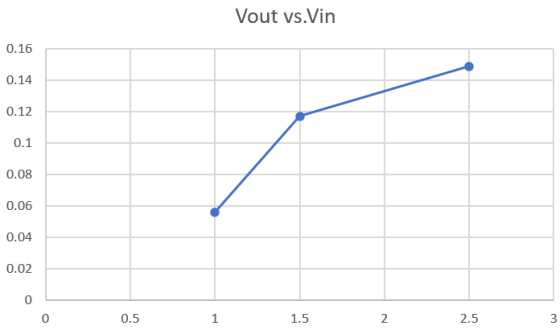

Figure 12: Vout vs. Vin

8 Error Analysis and Discussion

The resistors and transistors used in the circuits have manufacturing tolerances that lead to slight variations in their values, which can affect the balance and performance of the differential amplifier. Measurement inaccuracies arise from the precision limits of the oscilloscopes, multimeters, and other instruments, which can introduce errors when capturing small signal variations. Temperature changes also play a significant role, as they can alter the characteristics of semiconductor devices, especially NMOS transistors, affecting their threshold voltage and mobility.

9 Conclusion

In conclusion,the current mirror circuit showed a predictable voltage gain, confirming the expected small-signal performance. The error analysis underscored the significance of accounting for practical deviations in real-world applications. Overall, this lab exercise provided a comprehensive understanding of differential amplifiers and current mirrors, emphasizing the interplay between theoretical concepts and practical implementation.