DEVICES AND CIRCUITS LAB REPORT – 5

EXPERIMENT NAME: NMOS current mirror circuit and CMOS differential input to single ended output amplifier.

ROLL NUMBERS: 200020010, 200020051

Hardware Exercise:

Objectives: To characterize an NMOS current mirror circuit and a CMOS differential input to single ended output amplifier.

Equipment/Components Required:

1. MOSFET IC – CD 4007

2. Resistors of suitable values

3. Capacitors – 2.2 µF

4. Regulated power supply – 10V

5. Arbitrary Function Generator

6. Digital Storage Oscilloscope

Observations:

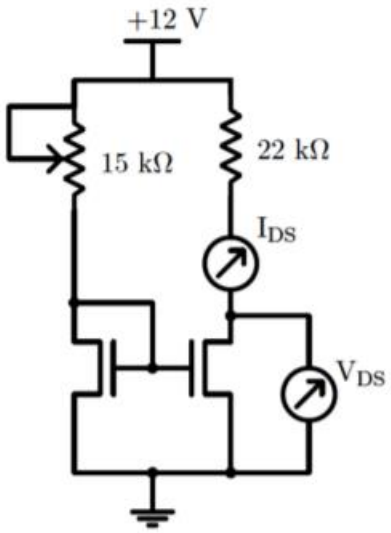
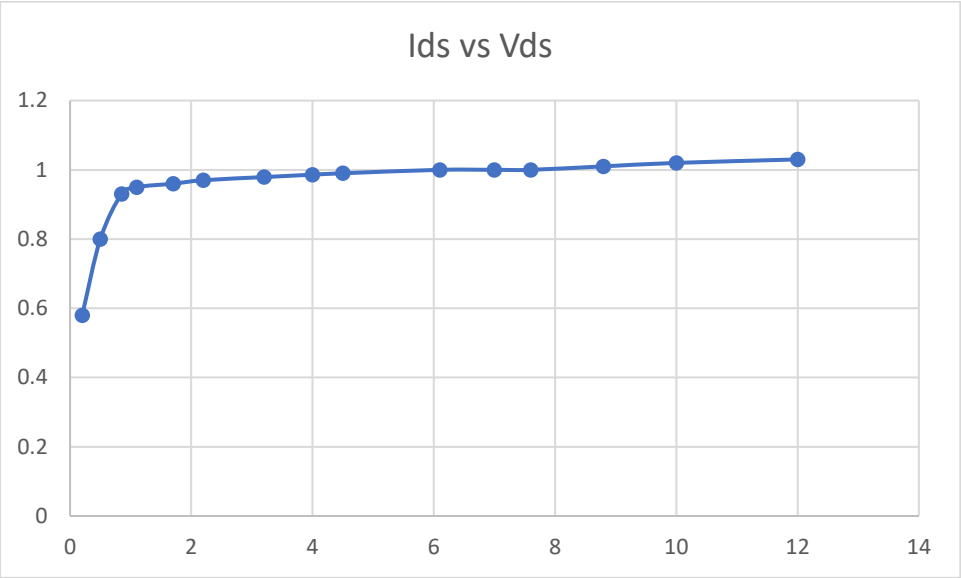


Figure 1: NMOS current mirror circuit

1. We have made the hardware setup as shown in the above figure
2. Here we adjusted 20 kΩ potentiometer instead of 15 kΩ till the output current IDS is 1 mA.
3. Now we removed the 22 kΩ resistor and replaced it with a 20 kΩ potentiometer.
4. By adjusting the 20 kΩ potentiometer we measured IDS for different values of VDS and tabulated our results.

Table:

Vds	Ids
0.2	0.58
0.5	0.8
0.85	0.93
1.1	0.95
1.7	0.96
2.2	0.97
3.2	0.979
4	0.986
4.5	0.99
6.1	1
7	1
7.6	1
8.8	1.01
10	1.02
12	1.03



For the values of Rds and channel length modulation parameter

Rds = vds/ids(near saturation)

Rds = 4.2k

CMOS differential amplifier:

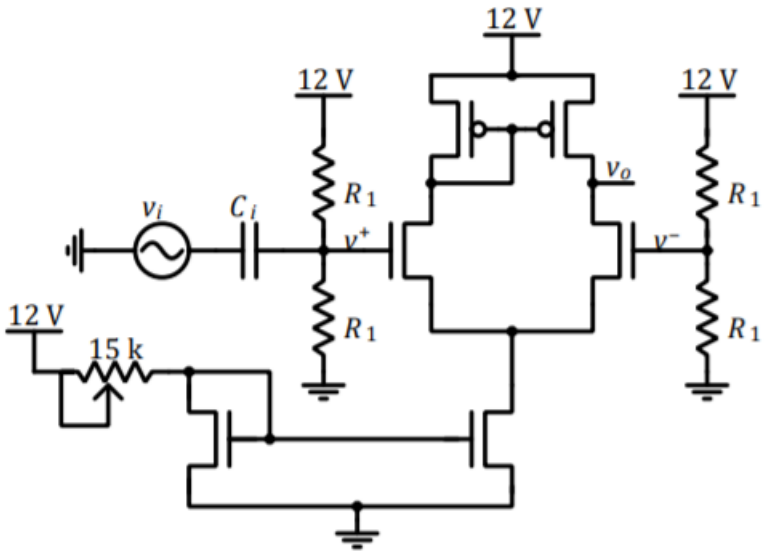


Figure 2: CMOS differential amplifier.

1.We Connected the circuit of a CMOS differential amplifier as Figure 2 on a breadboard using CD4007 IC for the MOSFETS. We used the current mirror set to provide 1 mA as in the previous sub experiment.

2. We took R1 =1kohm, Ci=2.2 micro Farady.

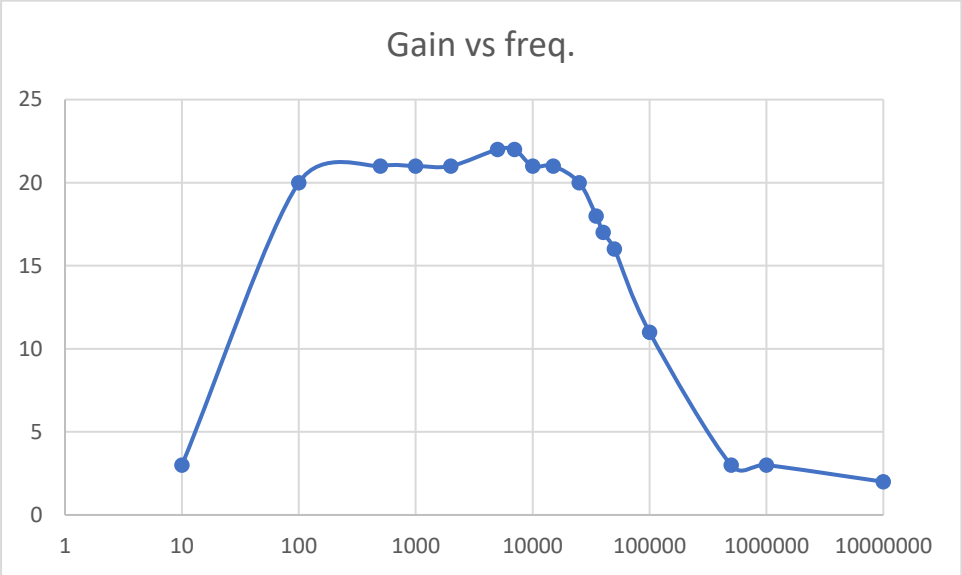
3. We used the function generator to provide an input of 100 mV at 1 kHz and using the oscilloscope, we measured the gain of the amplifier.

Table:

Vi	frequency	Vo	phase
100	10	0.3	134
100	100	2	50
100	500	2.1	16
100	1000	2.1	14
100	2000	2.1	10
100	5000	2.2	5
100	7000	2.2	2
100	10000	2.1	0
100	15000	2.1	-7
100	25000	2	-10
100	35000	1.8	-30
100	40000	1.7	-40
100	50000	1.6	-40
100	100000	1.1	-60

100	500000	0.3	-85
100	1000000	0.3	-102
100	10000000	0.2	-130

4. At 100mV and 1kHz we got gain of the amplifier as 21.



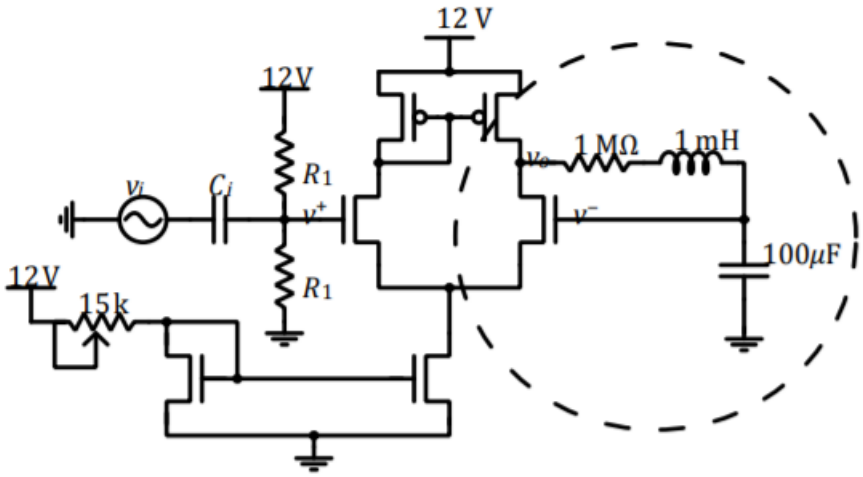


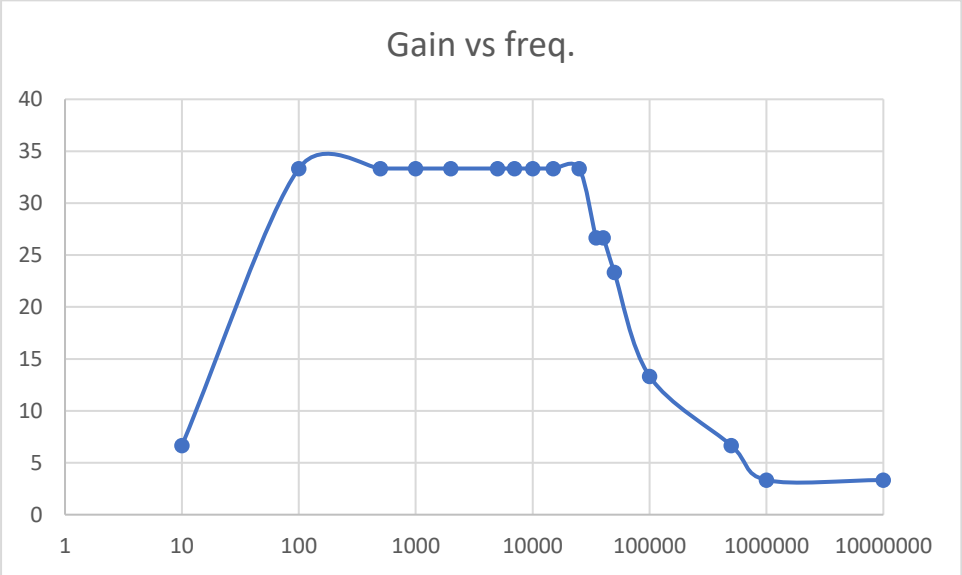
Figure 3: CMOS differential amplifier.

5. We modified the circuit as shown in figure 3 and by using the function generator to provide an input of 30 mV at 1 kHz and using the oscilloscope we measured the gain of the amplifier.

Table:

Vi	frequency	Vo	phase
30	10	0.2	
30	100	1	32
30	500	1	20
30	1000	1	0
30	2000	1	0
30	5000	1	-6
30	7000	1	-11
30	10000	1	-14
30	15000	1	-21
30	25000	1	-30
30	35000	0.8	-52
30	40000	0.8	-102
30	50000	0.7	
30	100000	0.4	
30	500000	0.2	
30	1000000	0.1	
30	10000000	0.1	

6. When we provided the input of 30mV at 1kHz we got gain of amplifier as 30.



Discussion :

200020051:

In lab 5 we did NMOS current mirror circuit and found out how it works and it frequency response to different frequencies and we saw how gain will change with frequencies and it gave us better idea to understand the characteristics of NMOS and we made a CMOS differential input to single ended output amplifier to see its gain at different frequencies

In this lab we did all well and nothing went wrong

200020010:

Today in lab 5 we have done hardware excercise of CMOS Differential

Amplifier and NMOS current mirror. We understood about its frequency response and gain of differential amplifier and also about I vs v characteristics of NMOS current mirror.

In hardware excercise we understood how to connect NMOS,CMOS with loads and power supply and with

the help of oscilloscope , DSO we could find the gain of amplifiers.