EXPERIMENT 7
MOSFET Current Sources

A. Background

The short circuit connection between gate and drain in the NMOS circuit given in Fig. 7.1 guarantees the condition that NMOS is in SAT region as long as $V_{GS} \geq V_{TN}$.

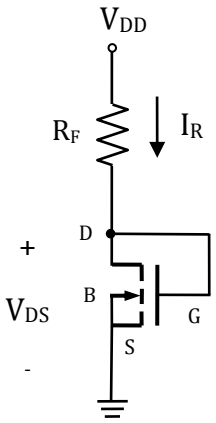

Fig. 7. 1. NMOS DC Circuit

A simple current source may be formed by connecting another NMOS transistor as shown in Fig. 7.2. If the transistors M_R and M_O are matched, then the current I_O through the transistor M_O is equal to I_R. So the change in R_D will not effect the current I_O. However due to Early effect at output characteristics, I_O may be slightly changed as a result of the large changes in R_D.

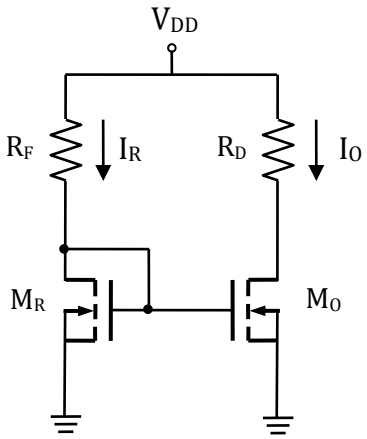

Fig. 7.2. Simple Current Mirror

B. Preliminary Work

a) Consider the NMOS circuit given in Fig. 7.3. Assume V_{DD} = 12 V. Determine the value of R_F to set the current I_R = 1 mA, using the transistor parameters obtained in Experiment 2.

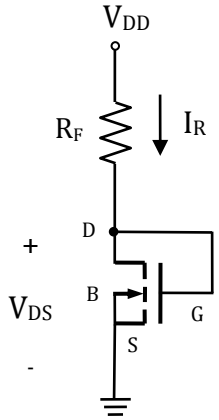

Fig. 7. 3. NMOS Circuit

b) Add M_O and R_O to the circuit as given in Fig. 7.3 as shown in Fig. 7.4; to form a simple current mirror to be used as a current source. Assume M_R and M_O are matched with the same parameters. With V_{DD} = 12 V, and the value of R_F as obtained in part (a), and R_D = 5 kΩ, determine I_O and V_{DSO}.

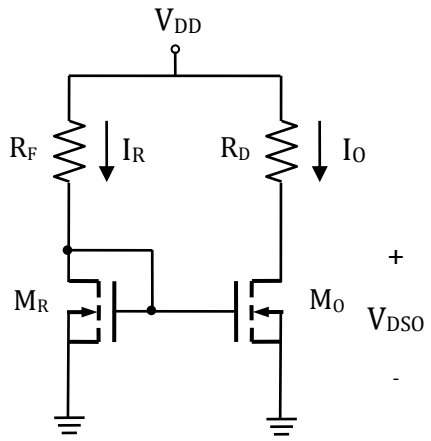

Fig. 7.4. Simple Current Mirror

C. Experimental Work

C.1. NMOS Biasing

1. Set up the circuit given in Fig. 7.5. with V_{DD}= 15 V, R_{F1}= 5.6 kΩ, R_{F2} as a potentiometer of value 50 kΩ.

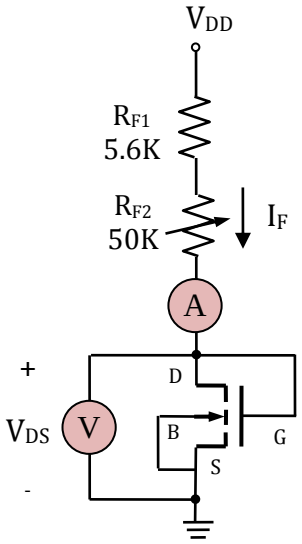

Fig. 7. 5. NMOS Biasing

2. Adjust I_R = 1 mA and measure $V_{GS} = V_{DS}$= …… V.
3. Calculate $R_{F1} + R_{F2}$. $R_{F1} + R_{F2}$ = …… kΩ.

C.2. NMOS Simple Current Mirror

4. Set up the circuit given in Fig. 7.6. by modifying Fig. 7.5.

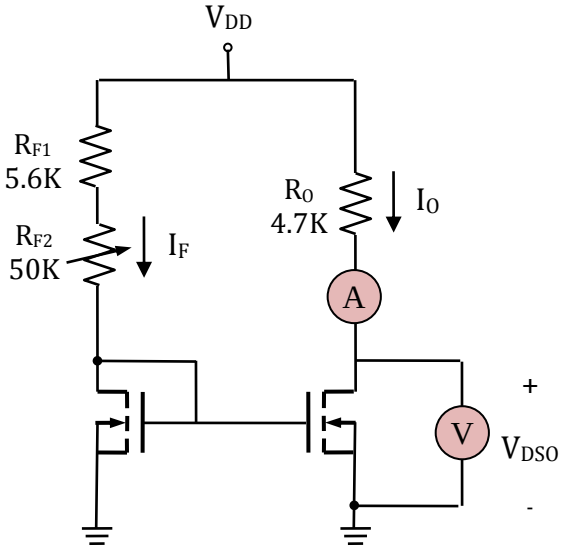

Fig. 7. 6. NMOS Biasing

5. Measure I_O and V_{DSO}. I_O = …….. mA and V_{DSO} = ……V.
6. Repeat Part 5, for R_O = 10 K. I_O = …….. mA and V_{DSO} = ……V.
7. Comment on the differences between I_O and I_R.