

1. Use composer and HSPICE to simulate the circuits in Fig. 1 (ideal current source) with  $V_{DD}=1.8V$  and do the calculation. (40%)
  - (a) Design a common source stage with gain  $A_1 > 100$  and **output DC voltage=0.9 (static current=5uA)** as shown at Fig. 1(a). (5%)
  - (b) Base on the simulation parameter of .lis file to calculate gain of (a) and comment. (5%)
  - (c) Design a common gate stage with gain  $A_2 > 8$  and **input DC voltage=0.9 (static current=60uA)** as shown at Fig. 1(b). (5%)
  - (d) Base on the simulation parameter of .lis file to calculate gain of (c) and comment. (5%)
  - (e) Connect two stage and add additional 60uA current source as shown in Fig. 1(c). Does the DC bias stay the same? The overall gain equals to  $A_1 \times A_2$  or not? If not, why? (20%)

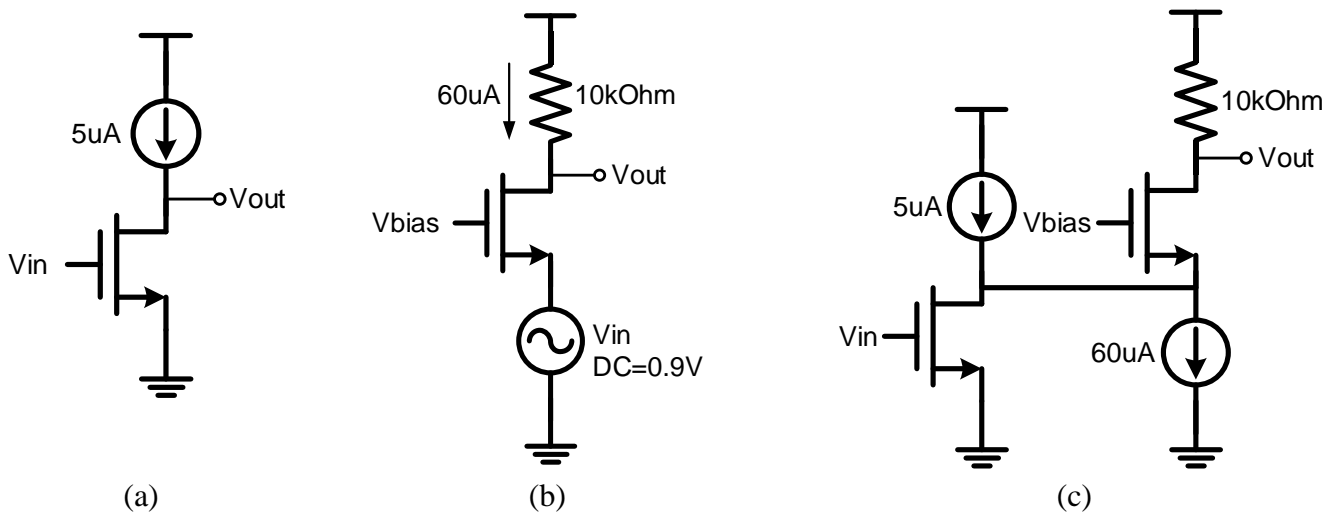


Fig. 1.

2. Design a common-source amplifier with cascaded loading as shown in Fig. 2. (30%)
  - (a) With  $V_{DD}=1.8V$  and  $I_{bias}=15uA$ , design the W/L sizes of M1~M4, the DC bias to get voltage gain  $A_v=V_{out}/V_{in} > 45dB$  and  $V_{out-swing} > 1V$ . (20%)
  - (b) Keep W/L as the same and double all of m (finger) in (a), check the differences of bias current, voltage gain and output swing and make a comment. (10%)

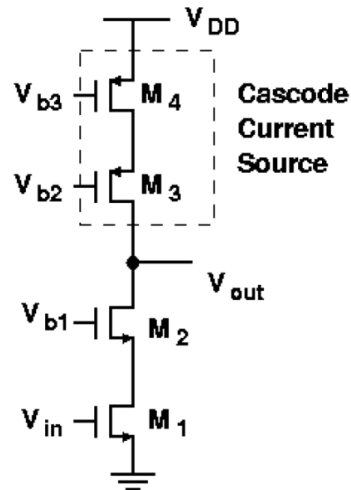


Fig. 2.

3. Design a source-follower amplifier with  $V_{DD}=1.8V$  as shown in Fig. 3. (30%)
- Design the W/L sizes and Vb (body-source M1 CANNOT be connected together) to get voltage gain  $A_v=V_{out}/V_{in}>0.8$  for  $V_{in}$  DC voltage from 0.5V to 1.8V. (10%)
  - Assume that the deep-N-well is available (body-source M1 can be connected together.) Design the W/L sizes and Vb to get voltage gain  $A_v=V_{out}/V_{in}>0.96$  for  $V_{in}$  DC voltage from 0.5V to 1.8V. (10%)
  - Comment on the differences between (a) and (b). (10%)

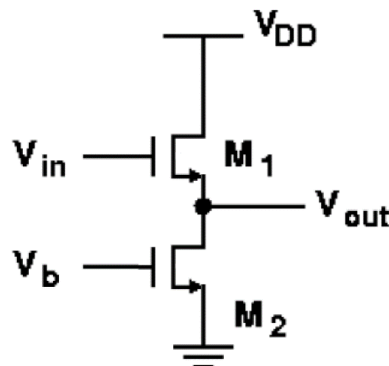


Fig. 3

- ✧ *The following should be included in your report (a) schematic (b) HSPICE netlist & simulation file (c) waveform with cursor values (d) comments.*

by CCHsieh

3. source-follower amplifier的gain<1, 所以這題是要調控Vb和W/L使得Vin在0.5V~1.8V時都能產生>0.96的gain。方法：由於Vin在低壓時易使M2進入triode region, 所以要使M2的over-drive voltage調小-->Vb壓低, 使Vov變小, 調整W/L(size)