Design

* NMOS：, with W/L=3

1. For 🡪
2. For 🡪
3. For 🡪
4. For 🡪
5. Calculate ： 🡪
6. Calculate ： 🡪
7. Calculate 🡪 (Using 1.)

* PMOS：, with W/L=3

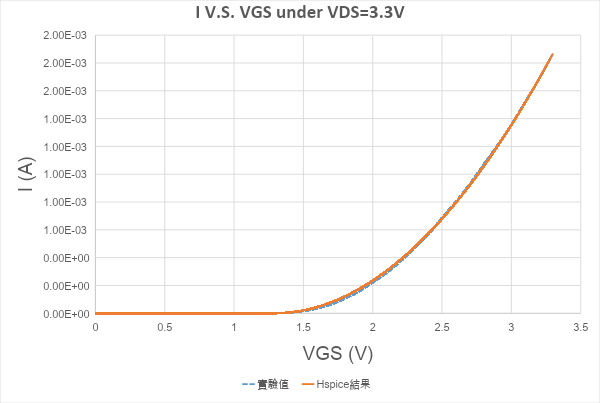
1. For 🡪
2. For 🡪
3. For 🡪
4. For 🡪
5. Calculate ： 🡪 的蛋糕
6. Calculate ： 🡪
7. Calculate 🡪 (Using. 1)

Table1

Comment:

當小的時候，實驗數據與hspice模擬結果相近。當變得越來越大的時候，實驗數據與模擬結果偏差越來越多。推測是計算等值時只用了一組數據去計算，但是在不同情況之下會有稍微不同數值，例如當上升時，也會稍微的上升，因此模擬的結果才會與實驗數據有誤差。

Table2



Comment:

實驗結果與hspice模擬的結果相近。根據Table1，當小的時候hspice模擬結果跟實驗結果會相當吻合。

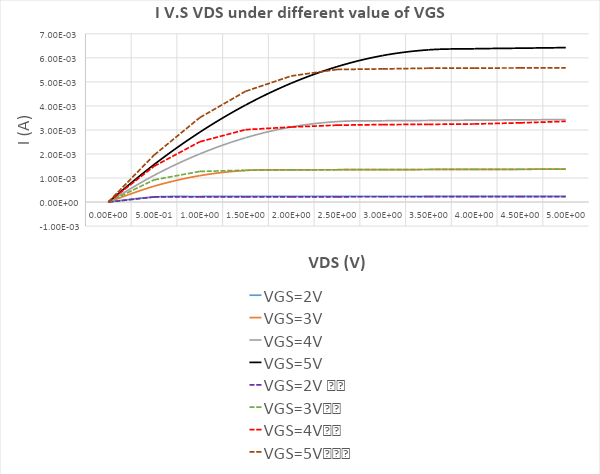
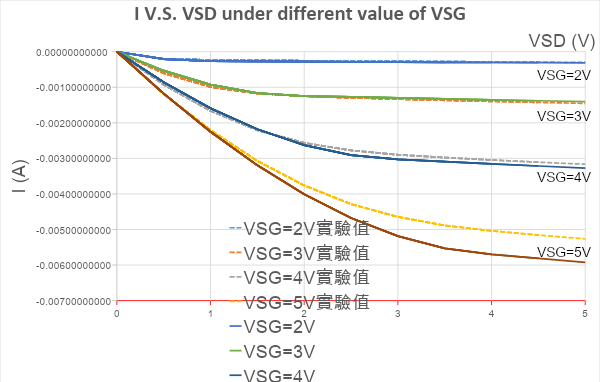


Table3

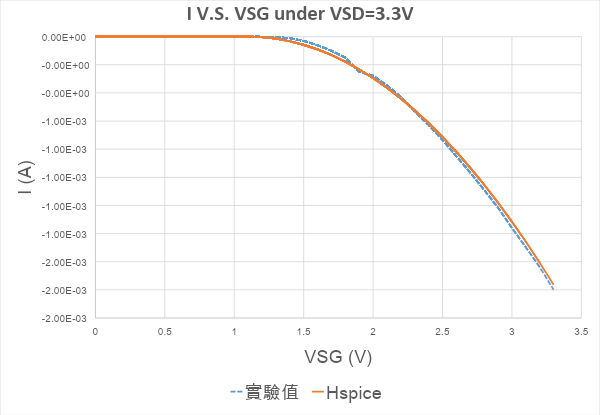


4

Comment:

PMOS與NMOS有類似的現象，變得越來越大的時候，實驗數據與模擬結果偏差越來越多。不過跟模擬結果的差距比NMOS還小。誤差仍可能來自於手算只取了一組數據來去算，因此產生誤差。

Table 4



Comment:

實驗結果與hspice模擬的結果相近。根據Table3，當小的時候hspice模擬結果跟實驗結果會相當吻合。

2.

Vary from 0.8V to 1.5 (0.2V/step)

Comment:

, with W/L=3. When is fixed, is higher, is lower, which means mosfets is more easily to enter saturation region ( > . The figure above is consistent what I analyzed. When is higher, it enters saturation early (when is smaller compared to smaller ). And according to the current formula, as long as mosfets stay in saturation region, the smaller is, the larger is, which is also consistent with the figure above.

Vary from 50u to 250u (50u/step)











Comment:

, with W/L=3. According to current formula, the larger is, the larger is when other parameters are fixed.

Vary from 0.02 to 0.06 (0.01/step)



Comment:

, with W/L=3. The different current curve caused by different value of will be seen after the mosfet enter saturation region. And according to the foumela, the larger is, the larger current is and slope of of curve () is larger as well when other parameters are fixed, which is consisten to the figure above.

Hspice code:

NMOS:

lab6 nmos

.param Vtn=0.8949

+ kn=217.44u

+ lam=0.0065562

+ toxn=100n

+ cbd0=2p

+ cgso=0.1p

.model N\_MOS nmos level=1 vto=vtn kp=kn

+ lambda=lam tox=toxn cgso=cgso

+ cgdo=cgso cbd=cbd0

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* $Table1

M1 d1 g1 gnd! gnd! N\_MOS W=30u L=10u

Vds1 d1 gnd! 3.3

Vgs1 g1 gnd! 3.3

.DC Vds1 0 5 0.5 sweep Vgs1 2 5 1

.probe dc I(M1)

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* $Table2

M2 d2 g2 gnd! gnd! N\_MOS W=30u L=10u

Vds2 d2 gnd! 3.3

Vgs2 g2 gnd! 3.3

.DC Vgs2 0 3.3 0.1

.probe dc I(M2)

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* $Vary the parameters

M3 d3 g3 gnd! gnd! N\_MOS W=30u L=10u

Vds3 d3 gnd! 3.3

Vgs3 g3 gnd! 2

.DC Vds3 0 5 0.5 sweep Vtn 0.8 1.6 0.2

.alter

.DC Vds3 0 5 0.5 sweep kn 50u 250u 50u

.alter

.DC Vds3 0 5 0.5 sweep lam 0.02 0.06 0.01

.probe dc I(M3)

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

.option post probe

.end

PMOS:

lab6 pmos

.param Vtn=-1.1012

+ kn=210.821u

+ lam=0.0563

+ toxn=100n

+ cbd0=2p

+ cgso=0.1p

.model P\_MOS pmos level=1 vto=vtn kp=kn

+ lambda=lam tox=toxn cgso=cgso

+ cgdo=cgso cbd=cbd0 cbs=cbd0

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* $Table1

M1 d1 g1 gnd! gnd! P\_MOS W=30u L=10u

Vds1 gnd! d1 3.3

Vgs1 gnd! g1 3.3

.DC Vds1 0 5 0.5 sweep Vgs1 2 5 1

.probe dc I(M1)

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* $Table2

M2 d2 g2 gnd! gnd! P\_MOS W=30u L=10u

Vds2 gnd! d2 3.3

Vgs2 gnd! g2 3.3

.DC Vgs2 0 3.3 0.1

.probe dc I(M2)

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

.option post probe

.end