

Digital Integrated Circuits

Hspice Example

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ICSSL

Basic(1/2)

- Hspice範例code請至以下路徑複製：
/RAID2/COURSE/dic/dicTA01/dic_2024_spring/Tutorial_Example

```
*****  
**.....Simulator setting.....**  
*****
```

```
.option accurate
```

較精準的模擬

```
.option post
```

輸出波型檔

```
.op
```

輸出元件工作點於.lis檔

```
.TEMP 25.0
```

設定環境溫度

```
*****  
**.....Library setting.....**  
*****
```

```
.protect
```

包含在裡頭的檔案資訊
不會秀在.lis檔

```
.lib './bulk_32nm.l' TT
```

引入模擬所需的library檔
(路徑與製程檔放置位置要一致)

```
.unprotect
```

Basic(2/2)

```
*****
** . . . . Parameter setting . . . . **
*****
.param xvdd = 0.9
.param xvss = 0
.param wp = 64n
.param wn = 64n
.param cycle = 1n
.param simtime = 5n
```

設定參數

```
*****
** . . . . Circuit description . . . . **
*****
.subckt inv in out vdd vss
m1 out in vdd vdd pmos w=wp l=32n
m2 out in vss vss nmos w=wn l=32n
.ends
```

建立子電路

(呼叫mos的方式: m?? D G S B pmos/nmos w=? l=?)

```
xinv_1 input output vdd vss inv
cload output vss 5f
```

建立主電路(呼叫子電路用x開頭; 呼叫電容用c開頭)

```
*****
** . . . . Power declaration . . . . **
*****
vdd . . . . . vdd . . . . . 0 . . . xvdd
vvss . . . . . vss . . . . . 0 . . . xvss
```

DC電壓源

呼叫電壓源用v開頭

```
*****
** . . . . Input declaration . . . . **
*****
vin . . . . . input . . . . 0 . . . pulse(xvdd 0 1n 0.1n 0.1n 'cycle*0.45' cycle)
```

pulse電壓源

DC Analysis

```
1 *****
2 **... Simulator setting ...**
3 *****
4 .option accurate
5 .option post
6 .op
7 .TEMP 25.0
8
9
10 *****
11 **... Library setting ...**
12 *****
13 .protect
14 .lib './bulk_32nm.1' TT
15 .unprotect
16
17
18 *****
19 **... Parameter setting ...**
20 *****
21 .param xvdd = 0.9
22 .param xvss = 0
23 .param wp = 64n
24 .param wn = 64n
25 .param cycle = 1n
26 .param simtime = 5n
27
28
29 *****
30 **... Circuit description ...**
31 *****
32 .subckt inv in out vdd vss
33 m1 out in vdd vdd pmos w=wp l=32n
34 m2 out in vss vss nmos w=wn l=32n
35 .ends
36
37 xinv_1 input output vdd vss inv
38 cload output vss 5f
39
```

```
*****
**... Power declaration ...**
*****
vvdv ..... vdd ..... 0 ..... xvdd
vvs ..... vss ..... 0 ..... xvss

*****
**... Input declaration ...**
*****
vin ..... input ..... 0 ..... pulse(xvdd 0 1n 0.1n 0.1n 'cycle*0.45' cycle)
```

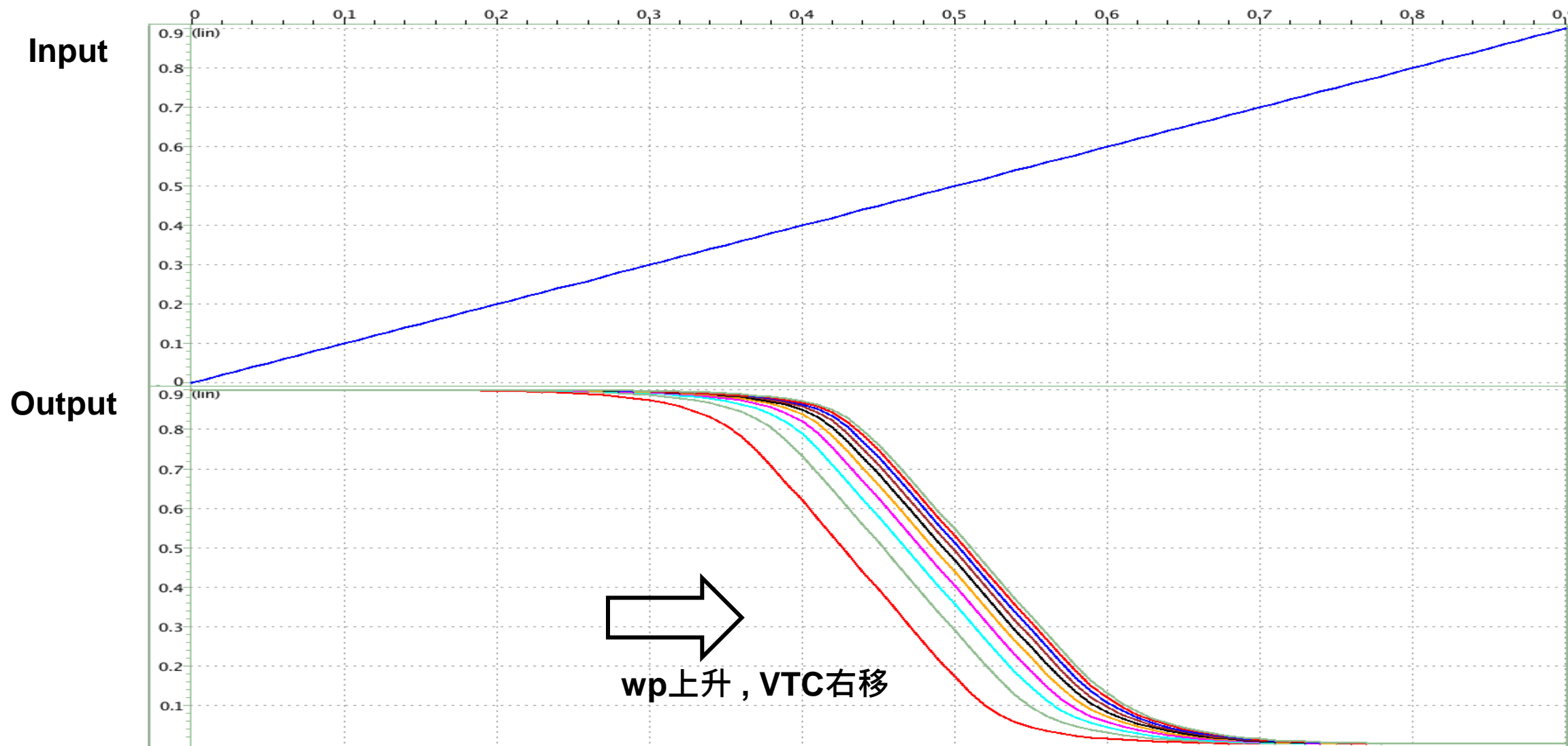
```
*****
**... Analysis setting ...**
*****

.dc vin 0 0.9 0.01 sweep wp 100n 1000n 100n

.end
```

對vin電壓源從0v到0.9v以step=0.01v做DC分析
(sweep wp變數，從wp=100n開始，每step=100n
重複模擬一次到wp=1000n)

尋找輸出：.sw0檔案 (for DC analysis)



Transient Analysis

```
1 *****
2 ** . . . . Simulator setting . . . . **
3 *****
4 .option accurate
5 .option post . . . . .
6 .op
7 .TEMP 25.0
8
9
10 *****
11 ** . . . . Library setting . . . . **
12 *****
13 .protect
14 .lib './bulk_32nm.1' TT
15 .unprotect
16
17
18 *****
19 ** . . . . Parameter setting . . . . **
20 *****
21 .param xvdd = 0.9
22 .param xvss = 0
23 .param wp = 64n
24 .param wn = 64n
25 .param cycle = 1n
26 .param simtime = 5n
27
28
29 *****
30 ** . . . . Circuit description . . . **
31 *****
32 .subckt inv in out vdd vss
33 m1 out in vdd vdd pmos w=wp l=32n
34 m2 out in vss vss nmos w=wn l=32n
35 .ends
36
37 xinv_1 input output vdd vss inv
38 cload output vss 5f
39
```

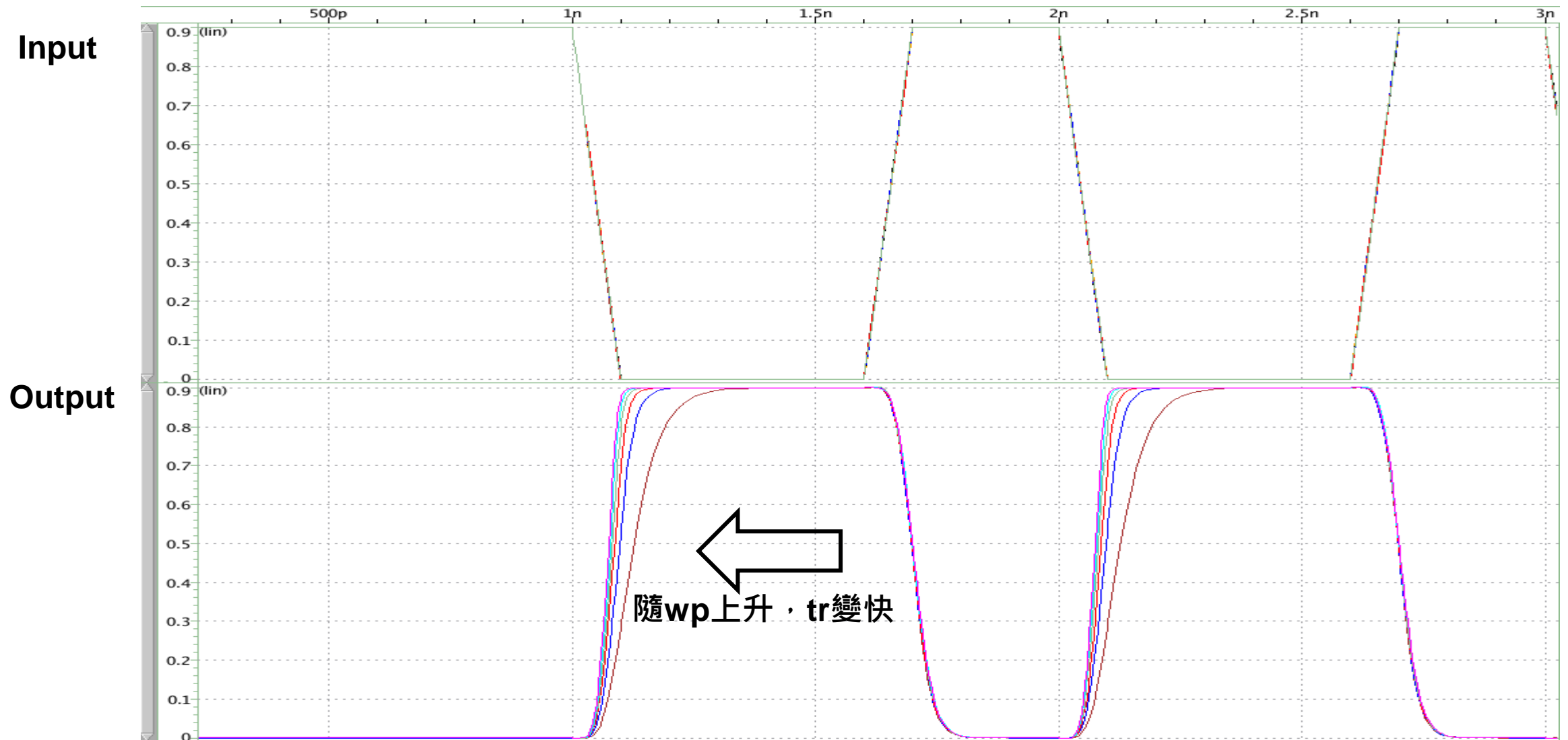
```
*****
** . . . . Power declaration . . . . **
*****
vvdv . . . . . vdd . . . . . 0 . . . xvdd
vvss . . . . . vss . . . . . 0 . . . xvss
.
.
*****
** . . . . Input declaration . . . . **
*****
vin . . . . . input . . . . 0 . . . pulse(xvdd 0 1n 0.1n 0.1n 'cycle*0.45' cycle)
```

```
*****
** . . . . Analysis setting . . . . **
*****
.tran 1p simtime sweep wp 64n 384n 64n
.
.end . . .
```



以1ps的間隔模擬總共simtime的時間做暫態分析
(sweep wp變數，從wp=64n開始每step=64n重
複做一次模擬到wp=384n)

尋找輸出：.tr0檔案 (for Transient analysis)



執行模擬指令以及開啟波形軟體

```
ee05 [dicta01/example_1]%  
ee05 [dicta01/example_1]%  
ee05 [dicta01/example_1]%  
ee05 [dicta01/example_1]%  
ee05 [dicta01/example_1]%  
ee05 [dicta01/example_1]%  
ee05 [dicta01/example_1]%  
ee05 [dicta01/example_1]%  
ee05 [dicta01/example_1]% hspice -i example_dc.sp
```

or

```
ee05 [dicta01/example_1]%  
ee05 [dicta01/example_1]%  
ee05 [dicta01/example_1]%  
ee05 [dicta01/example_1]%  
ee05 [dicta01/example_1]%  
ee05 [dicta01/example_1]%  
ee05 [dicta01/example_1]%  
ee05 [dicta01/example_1]%  
ee05 [dicta01/example_1]% hspice -i example_dc.sp -o
```

不會輸出.lis檔案(但會顯示在螢幕上)

- example_dc.ic0
- example_dc.sw0
- example_dc.pa0
- example_dc.st0
- example_tran.tr0
- example_tran.ic0@0
- example_tran.ic0
- example_tran.pa0
- example_tran.st0
- example_tran.sp
- example_dc.sp

```
linux15 [dicta02/example]%  
linux15 [dicta02/example]%  
linux15 [dicta02/example]%  
linux15 [dicta02/example]% wv &
```

開啟波形軟體