電子電路設計模擬與實習

實驗名稱：數位電路

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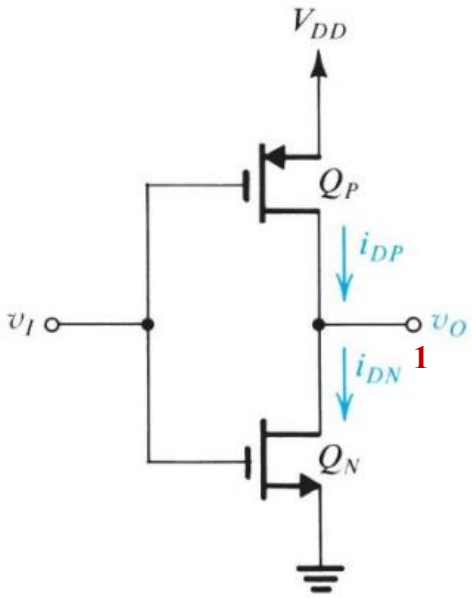
10. CMOS 主動負載差動放大器設計

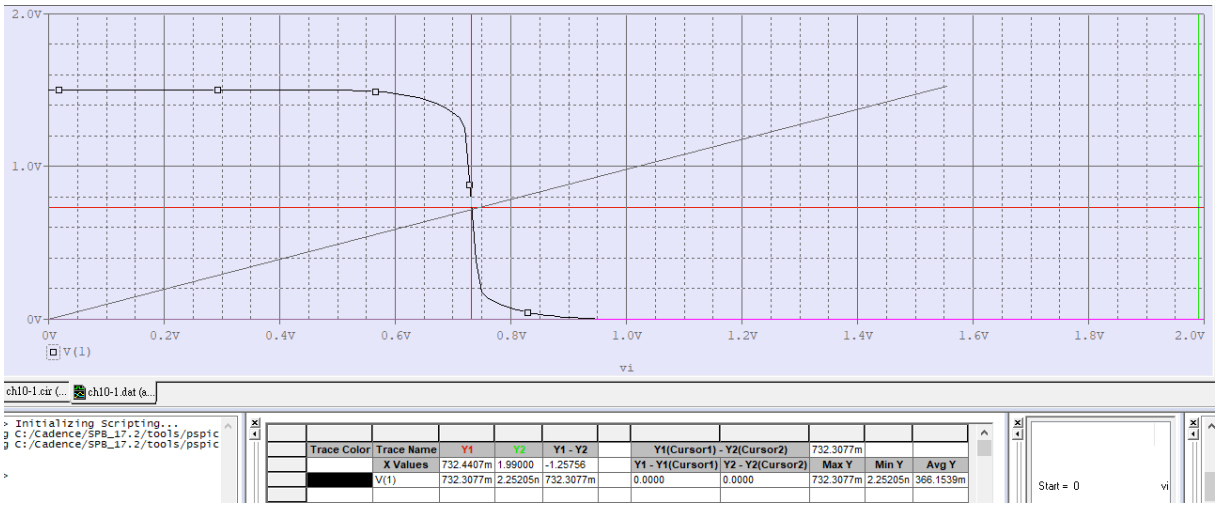
Lab 10-1. CMOS 反向器 VTC 曲線模擬及靜態參數萃取

實驗電路圖：

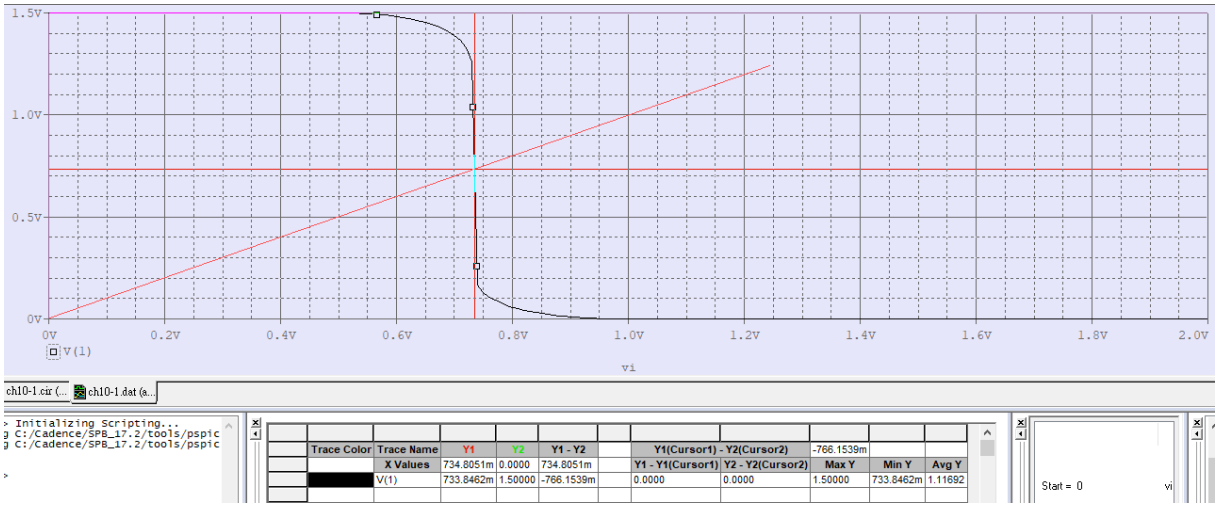


1. 模擬不同 λ(0.2、0.02、0.002)下之 VTC 曲線。

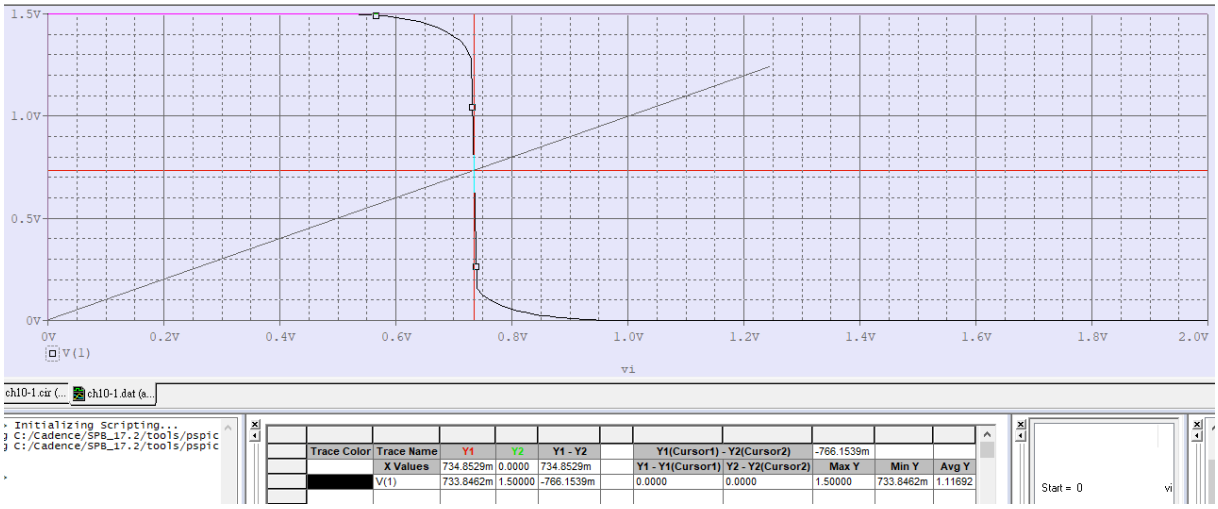
	λ		
	0.2	0.02	0.002
V_M	732.4407m	734.8051m	734.8529m
g	-46.1856	-11.1404	-8.00048



$\lambda = 0.2$



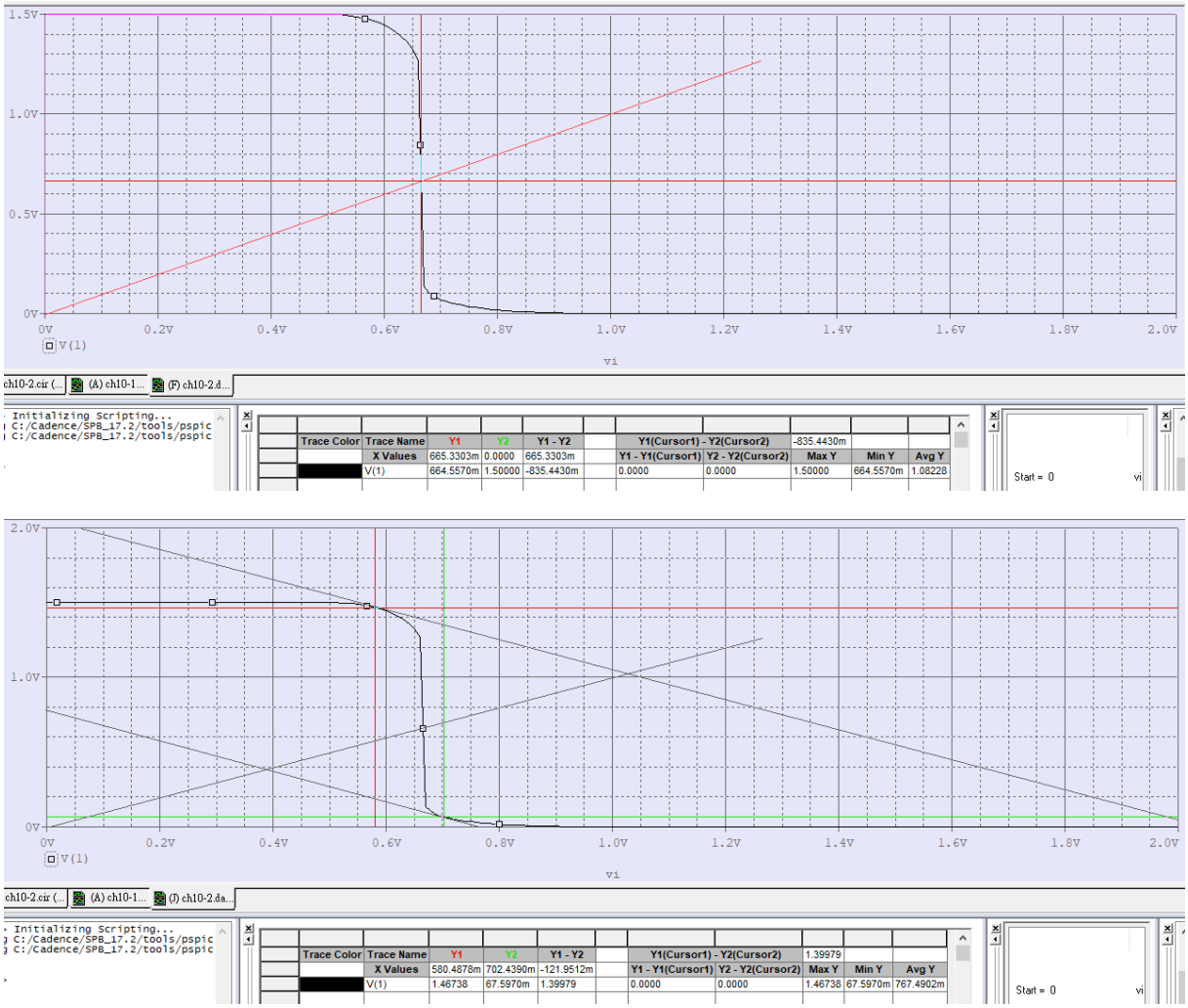
$\boldsymbol{\lambda = 0.02}$



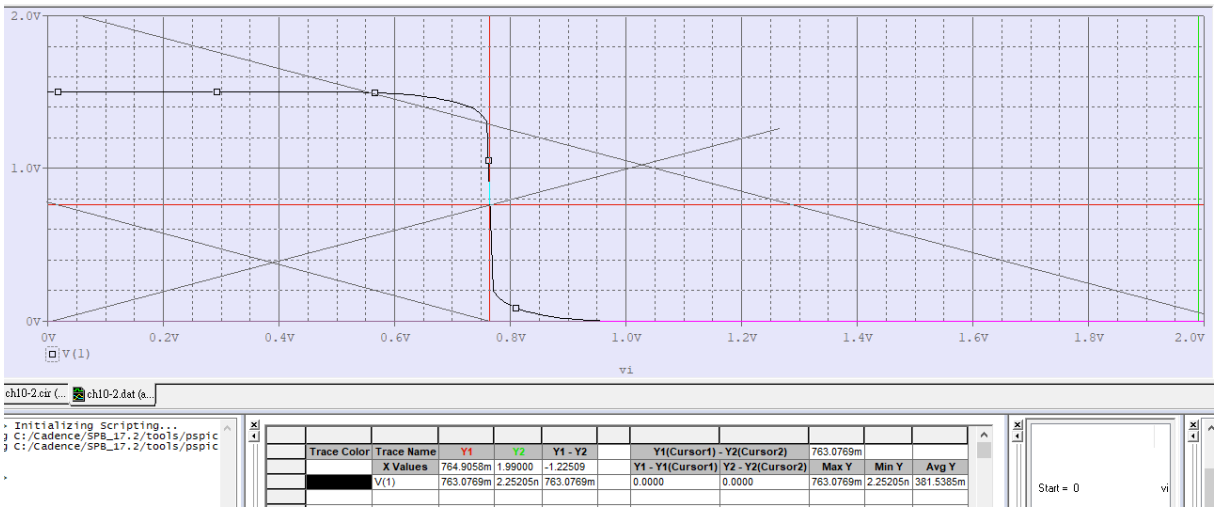
$\boldsymbol{\lambda = 0.002}$

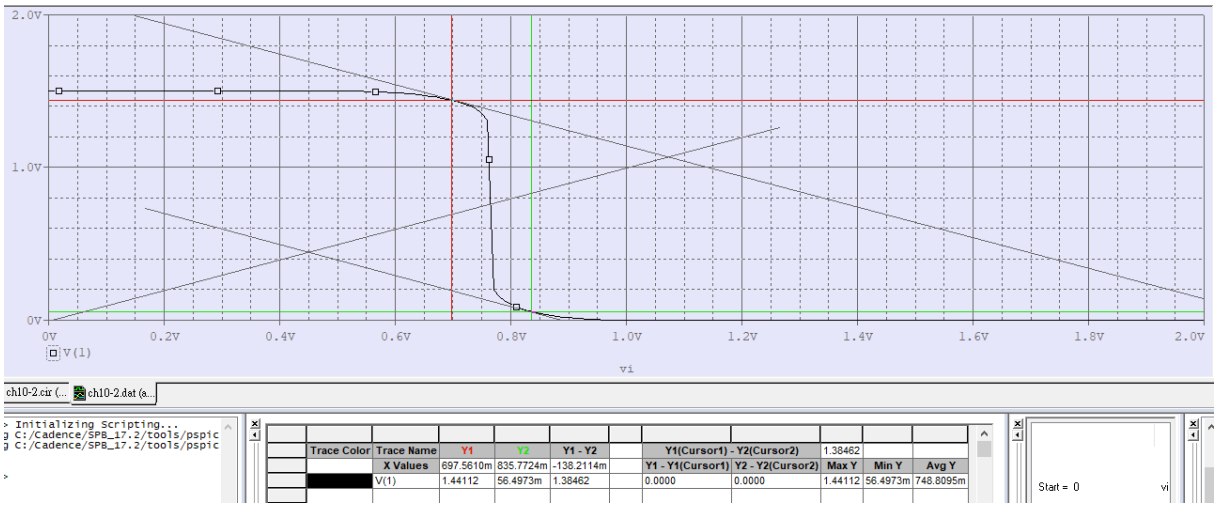
2. 模擬 PMOS、NMOS W/L 的尺寸比變動對反向器 VTC 曲線的影響。

靜態變數	PMOS-to-NMOS ration		
	1	5	11
V_M	665.3303m	764.9058m	814.6295m
g	-33.3033	-406.699	-14.613
V_{IL}	580.4878m	697.561m	773.9837m
V_{IH}	702.439m	835.7724m	881.3008m
V_{OL}	0	0	0
V_{OH}	1.5	1.5	1.5
NM_L	797.561m	664.2276m	618.6992m
NM_H	580.4878m	697.561m	773.9837m

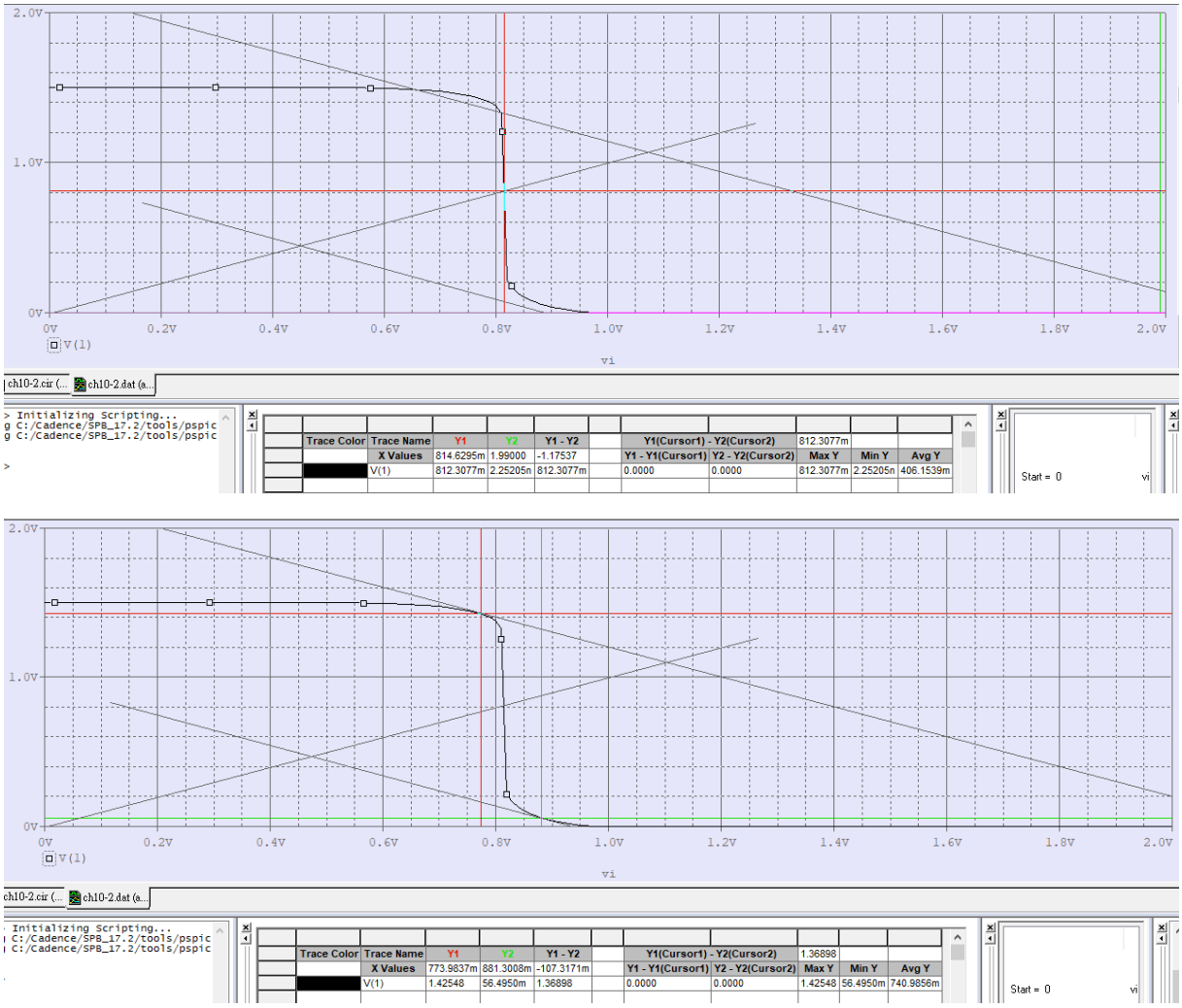


PMOS-to-NMOS ration = 1





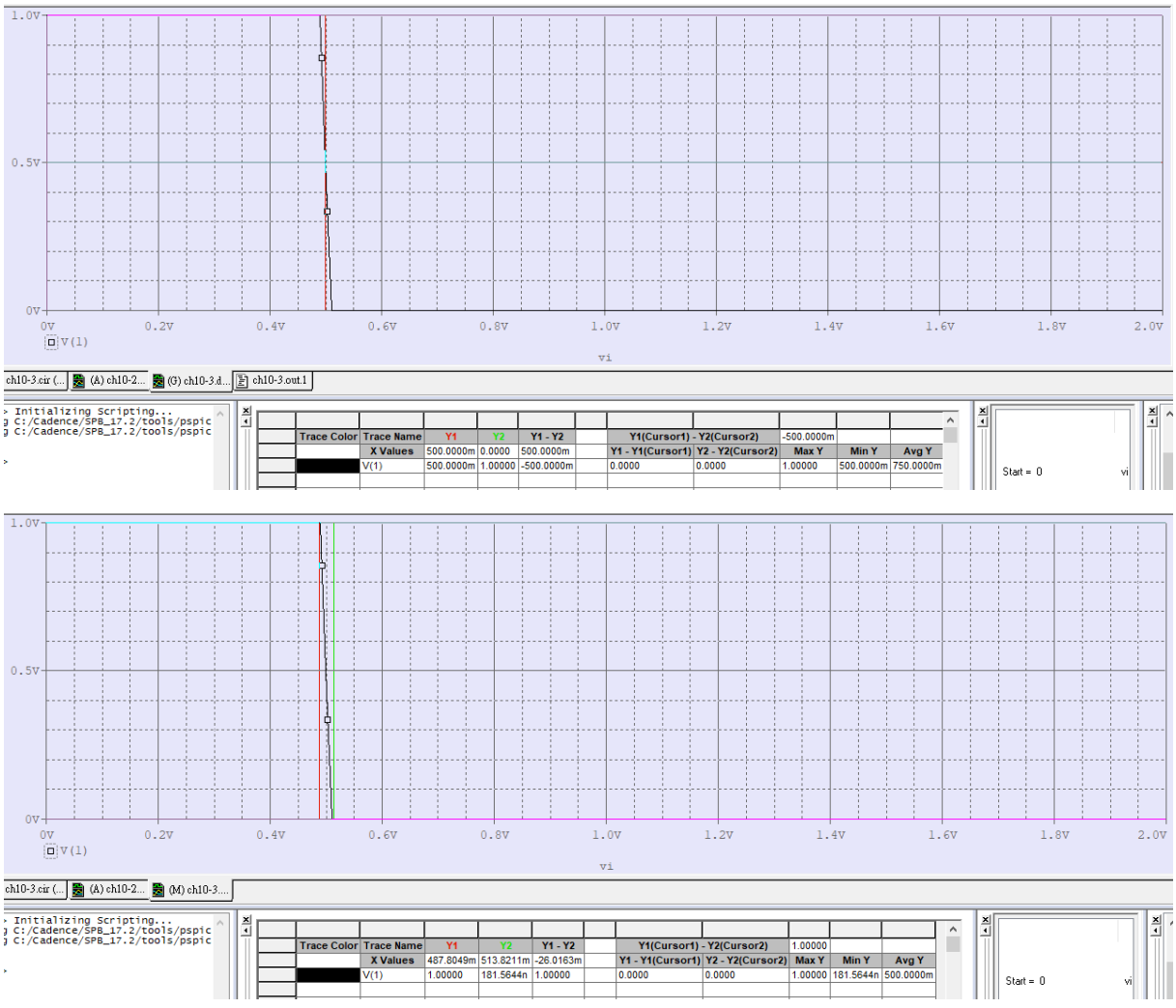
PMOS-to-NMOS ration = 5



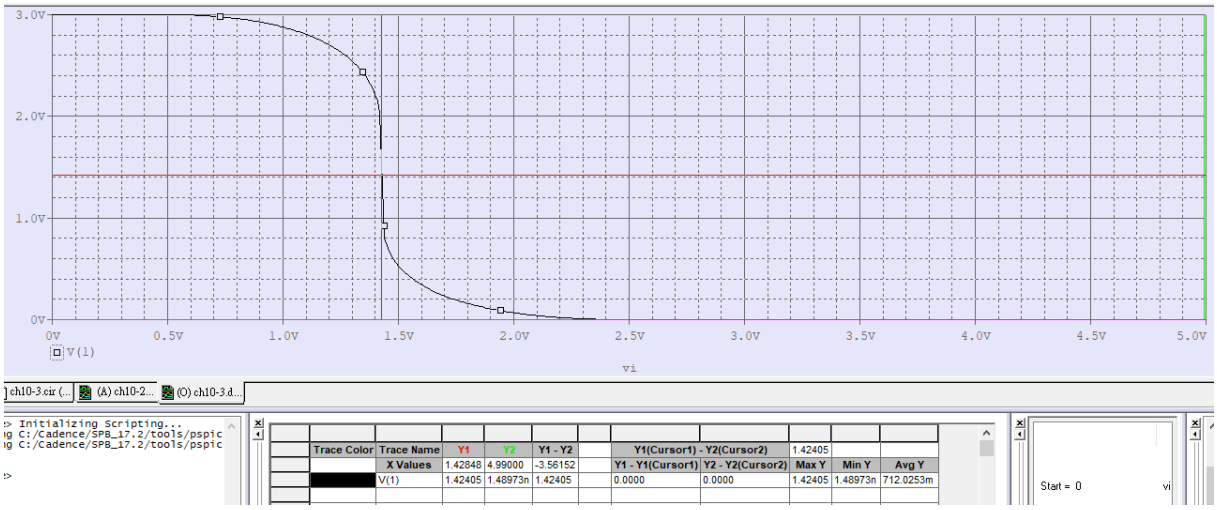
PMOS-to-NMOS ration = 11

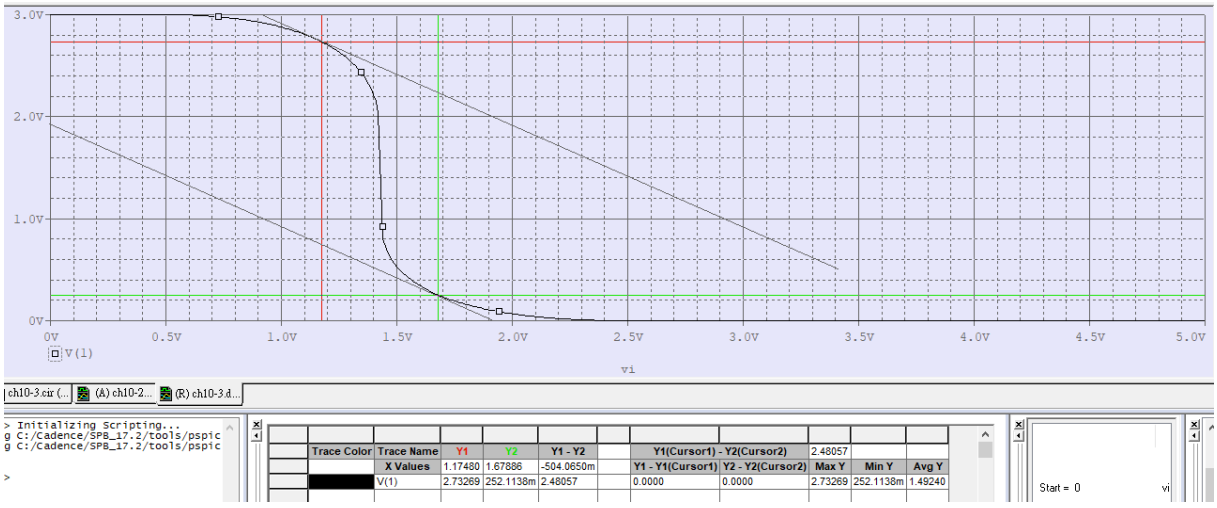
3. 模擬電源電壓 VDD 變動對反向器 VTC 曲線的影響。

靜態變數	V_{DD}		
	1	3	5
V_M	0.5	1.42848	2.35918
g	0	-103.479	-52.6367
V_{IL}	487.8049m	1.17480	1.83058
V_{IH}	513.8211m	1.67886	2.85950
V_{OL}	0	0	0
V_{OH}	1	3	5
NM_L	486.1789m	1.32114	2.14050
NM_H	487.8049m	1.17480	1.83058

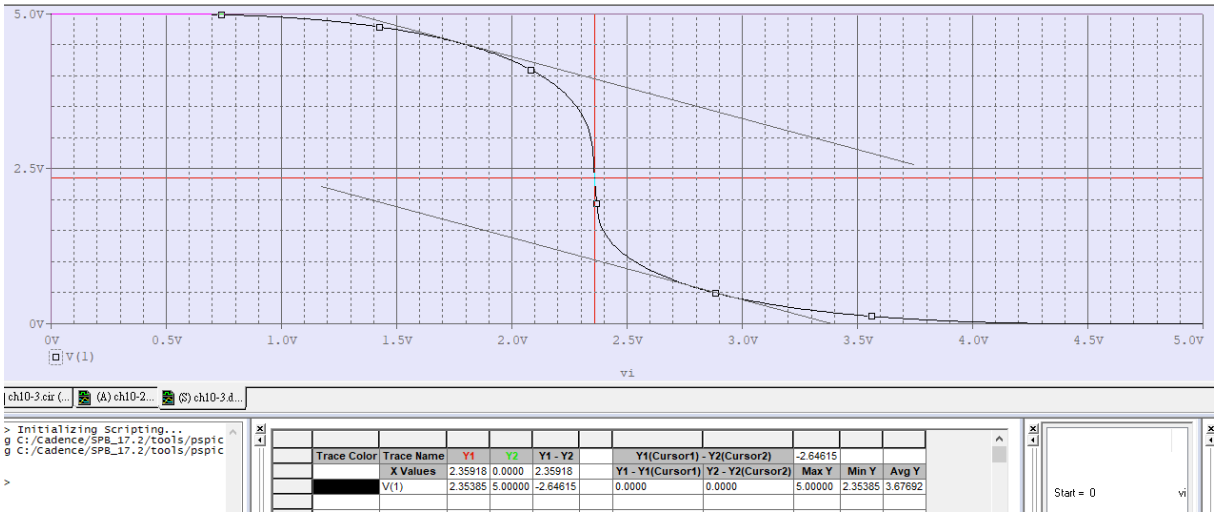


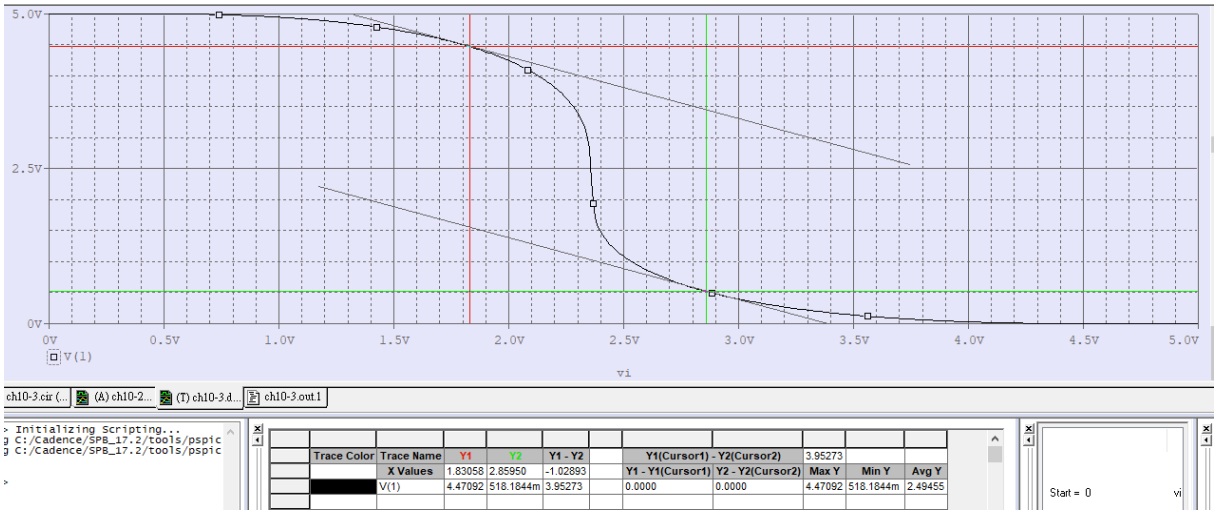
$V_{DD} = 1$


3.0V
2.0V
1.0V
0V
0V
0.5V
1.0V
1.5V
2.0V
2.5V
3.0V
3.5V
4.0V
4.5V
5.0V
V(1)
vi
ch10-3.cir (...
(A) ch10-2...
(O) ch10-3.d...
> Initializing Scripting...
g C:/Cadence/SPB_17.2/tools/pspic
g C:/Cadence/SPB_17.2/tools/pspic
Trace Color | Trace Name | Y1 | Y2 | Y1 - Y2 | Y1(Cursor1) - Y2(Cursor2) | 1.42405
X Values | 1.42848 | 4.99000 | -3.56152 | Y1 - Y1(Cursor1) | Y2 - Y2(Cursor2) | Max Y | Min Y | Avg Y
V(1) | 1.42405 | 1.48973n | 1.42405 | 0.0000 | 0.0000 | 1.42405 | 1.48973n | 712.0253m
Start = 0
vi


3.0V
2.0V
1.0V
0V
0V
0.5V
1.0V
1.5V
2.0V
2.5V
3.0V
3.5V
4.0V
4.5V
5.0V
V(1)
vi
ch10-3.cir (...
(A) ch10-2...
(R) ch10-3.d...
> Initializing Scripting...
g C:/Cadence/SPB_17.2/tools/pspic
g C:/Cadence/SPB_17.2/tools/pspic
Trace Color | Trace Name | Y1 | Y2 | Y1 - Y2 | Y1(Cursor1) - Y2(Cursor2) | 2.48057
X Values | 1.17480 | 1.67886 | -504.0650m | Y1 - Y1(Cursor1) | Y2 - Y2(Cursor2) | Max Y | Min Y | Avg Y
V(1) | 2.73269 | 252.1138m | 2.48057 | 0.0000 | 0.0000 | 2.73269 | 252.1138m | 1.49240
Start = 0
vi

$V_{DD} = 3$


5.0V
2.5V
0V
0V
0.5V
1.0V
1.5V
2.0V
2.5V
3.0V
3.5V
4.0V
4.5V
5.0V
V(1)
vi
ch10-3.cir (...
(A) ch10-2...
(S) ch10-3.d...
> Initializing Scripting...
g C:/Cadence/SPB_17.2/tools/pspic
g C:/Cadence/SPB_17.2/tools/pspic
Trace Color | Trace Name | Y1 | Y2 | Y1 - Y2 | Y1(Cursor1) - Y2(Cursor2) | -2.64615
X Values | 2.35918 | 0.0000 | 2.35918 | Y1 - Y1(Cursor1) | Y2 - Y2(Cursor2) | Max Y | Min Y | Avg Y
V(1) | 2.35385 | 5.00000 | -2.64615 | 0.0000 | 0.0000 | 5.00000 | 2.35385 | 3.67692
Start = 0
vi



Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		3.95273		
	X Values	1.83058	2.85950	-1.02893		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
	V(1)	4.47092	518.1844m	3.95273		0.0000	0.0000	4.47092	518.1844m	2.49455

$\boldsymbol{V_{DD} = 5}$