

電子電路設計模擬與實習

實驗名稱：差動放大器

班級：電子三甲

組員：黃 琦 U0722006

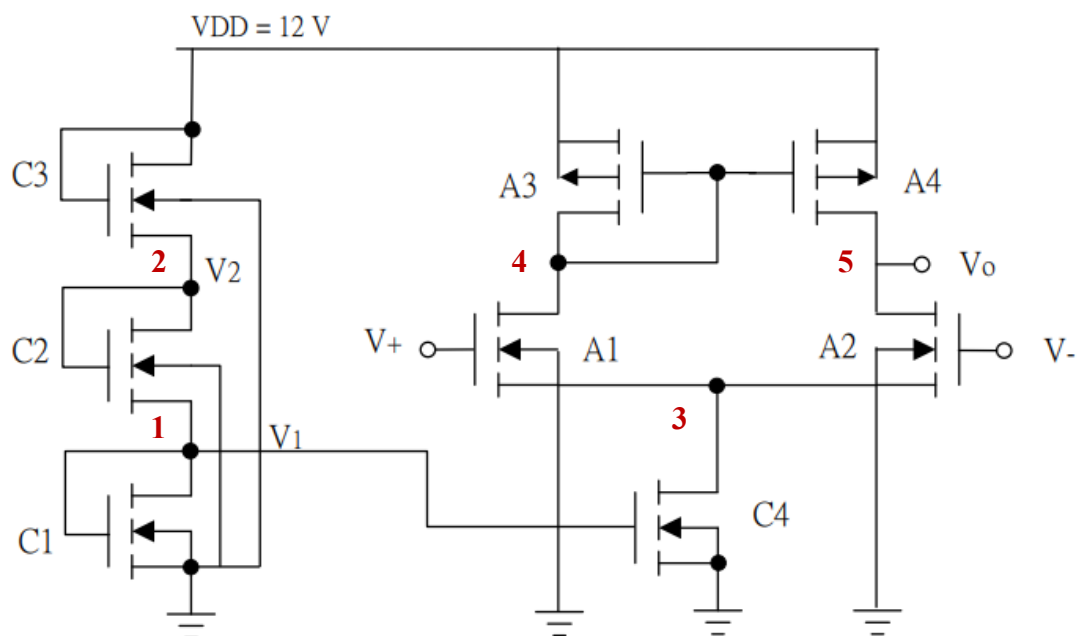
林雅晴 U0722045

日期：2021 年 5 月 27 日

7. CMOS 主動負載差動放大器設計

Lab 7-1. 試設計一主動負載 CMOS 差動放大器

實驗電路圖：



1. 電晶體參數值

k'_n	k'_p
1.073μ	10.43μ

V_{TH_C1}	V_{TH_C2}	V_{TH_C3}	V_{TH_C4}	V_{TH_A1}	V_{TH_A2}	V_{TH_A3}	V_{TH_A4}
1.73	1.73	1.73	1.73	1.73	1.73	-3.533	-3.533

2. CMOS 差動放大器各電晶體之尺寸

$(W/L)_{C1}$	$(W/L)_{C2}$	$(W/L)_{C3}$	$(W/L)_{C4}$	$(W/L)_{A1}$	$(W/L)_{A2}$	$(W/L)_{A3}$	$(W/L)_{A4}$
11.48748	11.48748	1.01017	11.48748	5.74374	5.74374	0.15567	0.15567

3. CMOS 差動放大器之直流工作點模擬值

	V_1	V_2	V_{D_C4}	V_{D_A1}	V_o	I_{DQ_C4}
理論值 (設計規格)	3	6	3	6	6	10μ
模擬值	3	6	3	6	6	10μ

NODE	VOLTAGE	NODE	VOLTAGE	NODE	VOLTAGE	NODE	VOLTAGE
(1)	V_1 3.0000	(2)	V_2 6.0000	(3)	$V_{D,C4}$ 3.0000	(4)	$V_{D,A1}$ 6.0000
(5)	V_o 6.0000	(v1)	6.0000	(v2)	6.0000	(vdd)	12.0000

NAME	M1	M2	M3	M4	$I_{DQ,C4}$	M5
MODEL	e_mos	e_mos	e_mos	e_mos		e_mos
ID	1.00E-05	1.00E-05	1.00E-05	1.00E-05		5.00E-06
VGS	3.00E+00	3.00E+00	6.00E+00	3.00E+00		3.00E+00
VDS	3.00E+00	3.00E+00	6.00E+00	3.00E+00		3.00E+00
VBS	0.00E+00	-3.00E+00	-6.00E+00	0.00E+00		-3.00E+00
VTH	1.73E+00	1.73E+00	1.73E+00	1.73E+00		1.73E+00
VDSAT	1.27E+00	1.27E+00	4.27E+00	1.27E+00		1.27E+00
Lin0/Sat1	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00		-1.00E+00
if	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00		-1.00E+00
ir	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00		-1.00E+00
TAU	-1.00E+00	-1.00E+00	-1.00E+00	-1.00E+00		-1.00E+00
GM	1.57E-05	1.57E-05	4.68E-06	1.57E-05		7.87E-06
GDS	1.99E-08	1.99E-08	1.98E-08	1.99E-08		9.94E-09
GMB	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
CBD	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
CBS	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
CGSOV	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
CGDOV	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
CGBOV	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
CGS	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
CGD	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00
CGB	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00

NAME	M6	M7	M8
MODEL	d_mos	e_mos	d_mos
ID	-5.00E-06	5.00E-06	-5.00E-06
VGS	-6.00E+00	3.00E+00	-6.00E+00
VDS	-6.00E+00	3.00E+00	-6.00E+00
VBS	0.00E+00	-3.00E+00	0.00E+00
VTH	-3.53E+00	1.73E+00	-3.53E+00
VDSAT	-2.47E+00	1.27E+00	-2.47E+00
Lin0/Sat1	-1.00E+00	-1.00E+00	-1.00E+00
if	-1.00E+00	-1.00E+00	-1.00E+00
ir	-1.00E+00	-1.00E+00	-1.00E+00
TAU	-1.00E+00	-1.00E+00	-1.00E+00
GM	4.05E-06	7.87E-06	4.05E-06
GDS	9.88E-09	9.94E-09	9.88E-09
GMB	0.00E+00	0.00E+00	0.00E+00
CBD	0.00E+00	0.00E+00	0.00E+00
CBS	0.00E+00	0.00E+00	0.00E+00
CGSOV	0.00E+00	0.00E+00	0.00E+00
CGDOV	0.00E+00	0.00E+00	0.00E+00
CGBOV	0.00E+00	0.00E+00	0.00E+00
CGS	0.00E+00	0.00E+00	0.00E+00
CGD	0.00E+00	0.00E+00	0.00E+00
CGB	0.00E+00	0.00E+00	0.00E+00

4. CMOS 差動放大器各參數之模擬值

	$A_d(1)$	$A_{CM}(1)$	CMRR(1)	$V_{CM}(max)$	$V_{CM}(min)$	最大輸出電壓 擺幅(swing)	R_{out}
理論值	-393.7	2.4508m	104.117	7.73	4.27	5.263	50.45M
模擬值	-397.1	2.3844m	104.43	7.73	4.27	5.31358	50.47M

