

Hw 4

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1. (1)

 $|A_{vo}|$ 要求與 Hw 3.1 同要 > 5

$$\Rightarrow \text{取 Hw 3.1 中的 } R_D = 60000 \Omega / V_{GS} = 0.8 \text{ V} / \frac{W}{L} = \frac{0.25 \mu}{0.18 \mu}$$

$$\Rightarrow V_{GS} = V_{DD} \times \frac{R_2}{R_1 + R_2} \Rightarrow R_1 : R_2 = 5 : 4$$

$$\text{取 } R_1 = 5000 \Omega, R_2 = 4000 \Omega$$

① ω_L 需介於 $950 \sim 1000 \text{ Hz}$ ($5969 \sim 6283 \text{ rad/s}$)

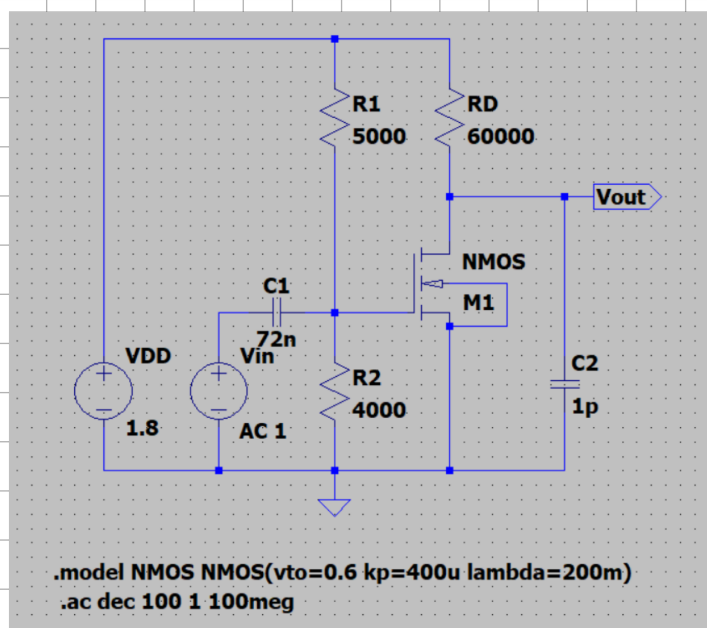
$$\Rightarrow C_1 = \frac{1}{\omega_L (R_1 // R_2)}, \text{ 取 } C_1 = 72 \text{ nF}$$

② ω_H 需大於 1 M Hz (6.28 M rad/s)

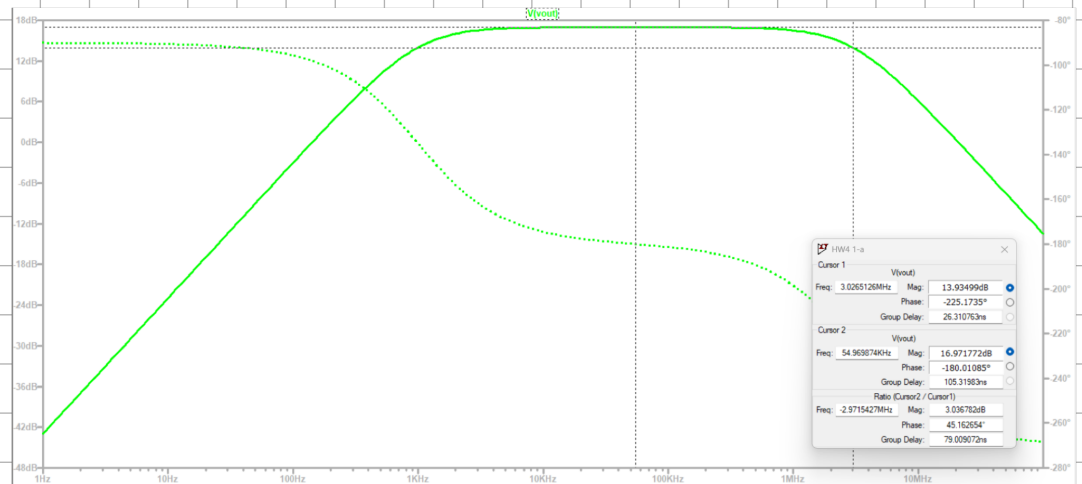
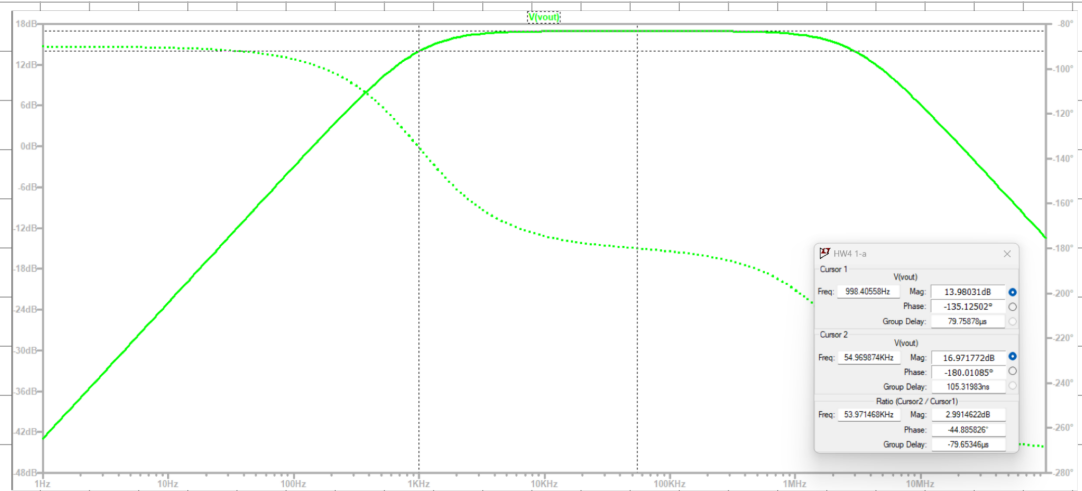
$$R_D = 60000 \Omega, r_o = \frac{1}{I_D \lambda} = 450045 \Omega \text{ 代入}$$

$$\Rightarrow \omega_H = \frac{1}{C_2 (R_D // r_o)} = 18.89 \text{ M} \text{ 有大於 } 6.28 \text{ M}$$

設計圖：



結果:



$W_L = 998 \text{ Hz}$ 有介在 $950 \sim 1000 \text{ Hz}$ (可行)

$W_H = 3 \text{ MHz}$ 有大於 1 MHz (可行)

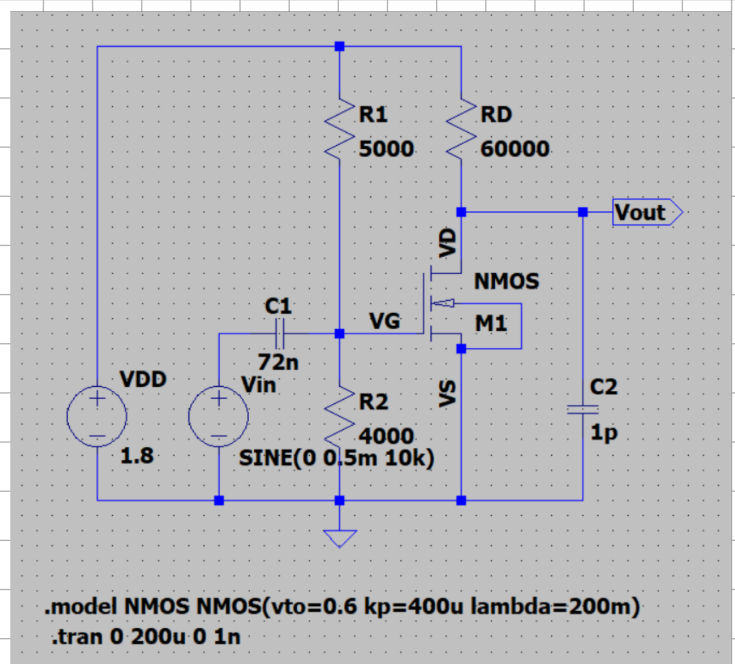
$\text{gain} = 16.97 \text{ dB} = 7.056$ 有大於 5 (可行)

(2)

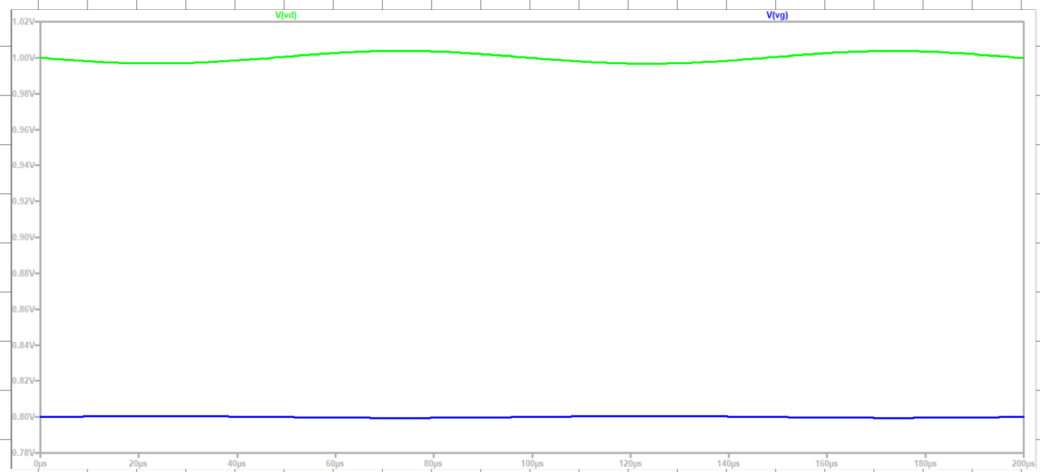
設計圖:

$R_1, R_2, R_D = C_1 \cdot \left(\frac{W}{L}\right)$,

與 (1) 同

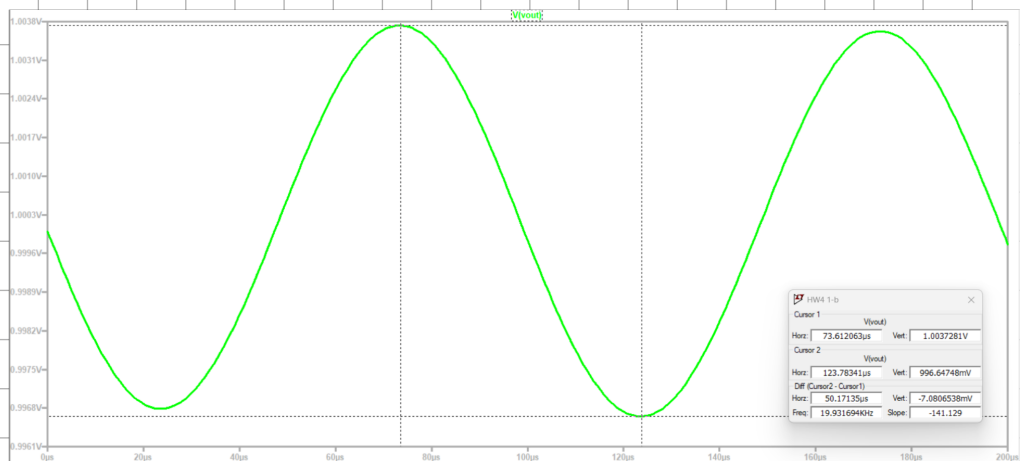


結果:



$$V_{DS} \approx 1V, V_{GS} \approx 0.8V$$

$$V_{DS} > V_{GS} - V_{TH} \approx 0.2V \text{ 有在 Sat. (可行)}$$



$$A_{vo} = \frac{-7.081}{1} = -7.081 \text{ 有大於5 (可行)}$$

(3)

Table I

Parameters		Please fill value with unit.
	R_1	5000 Ω
	R_2	4000 Ω
	C_1	72 nF
	R_D	60000 Ω
	Size of M_1 (W_1, L_1)	0.25 μm / 0.18 μm
	V_{GS} of M_1	約 0.8V
	V_{DS} of M_1	約 1V
AC analysis	Voltage gain	7.056
	Lower cutoff frequency	998 Hz
	Upper cutoff frequency	3 MHz
transient analysis	Voltage gain	7.081