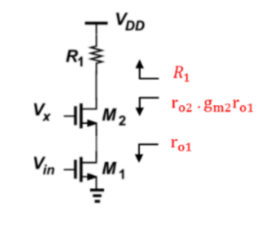
- For the circuit shown in Fig. Derive an expression for the output impedance

$$R_{out} = R_1 \,||\, r_{o2}\,.\,[1 + (g_{m2} + g_{mb2})r_{o1}] \approx R_1 \,||\, r_{o2}.g_{m2}r_{o1}$$

- Design the circuit to get

Spec.	
DC Gain	$\geq$ 23 dB
BW	$\geq$ 50 MHz
Power Consumption	$\leq$ 0.8 mW
Cap Load	1.25 pF



$$P_{cons} = V_{DD}\, I_D \leq 0.8 \text{ mW} \rightarrow \therefore I_{Dmax} \leq 666 \text{ uA}$$

$$GBW = A_V\,.\,BW = \frac{g_{m1}}{2\pi C_L} \geq 710 \text{ MHz} \rightarrow g_{m1} \geq 5.576 \text{ mS} \rightarrow g_{m1} = 8 \text{ mS}$$

$$A_V = g_{m1} R_{out} \geq 14.2 \rightarrow R_{out} = 1775 \rightarrow \text{Choose } R_1 = 1800\ \Omega$$

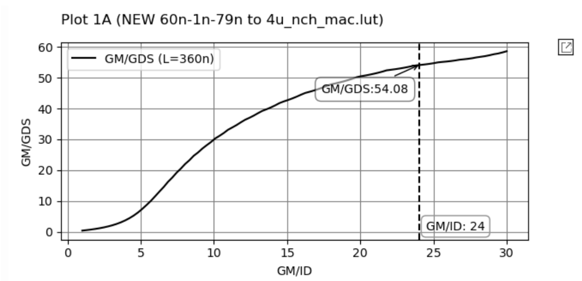
$$@\ V_{OUT} = \frac{V_{DD}}{2} \text{ for maximum output swing} \rightarrow I_D = \frac{0.6}{1800} = 333.33 \text{ uA} \rightarrow \left(\frac{g_m}{I_D}\right)_1 = 24$$

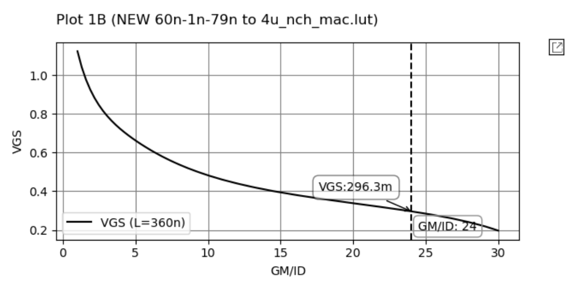
$$\text{Assume } M_2 \text{ operate in SI for large } r_{o2} \text{ and Assume } r_{o1} = r_{o2} = r_o$$

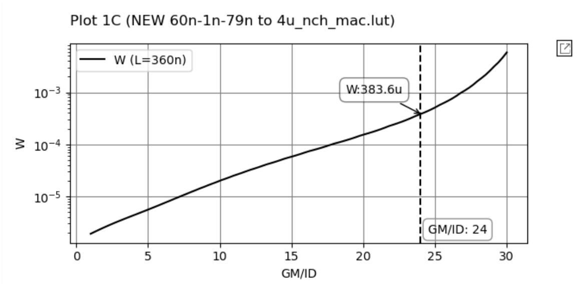
$$\therefore \text{set } \left(\frac{g_m}{I_D}\right)_2 = 10 \rightarrow g_{m2} = 3.33 \text{ mS} \rightarrow R_{out} = R_1 \,||\, r_o^2.g_{m2} \ \rightarrow r_o = 6195\ \Omega$$

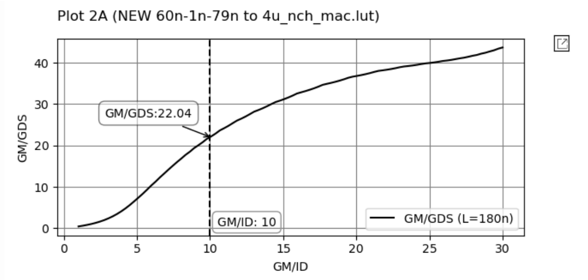
$$\therefore \left(\frac{g_m}{g_{ds}}\right)_1 = 49.56 \rightarrow \left(\frac{g_m}{g_{ds}}\right)_2 = 20.63$$

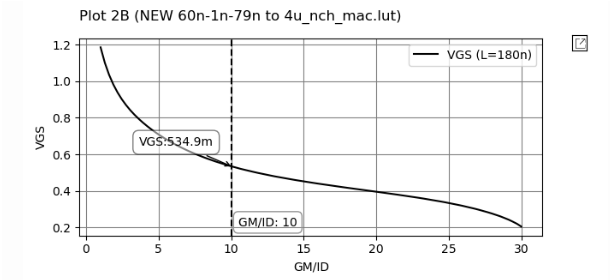
For M1

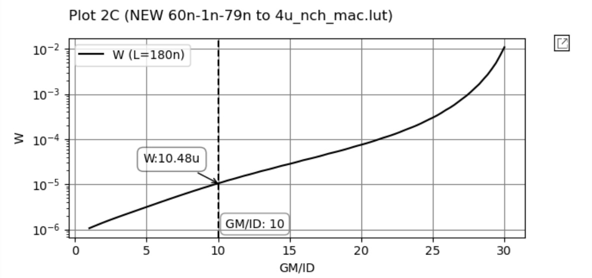








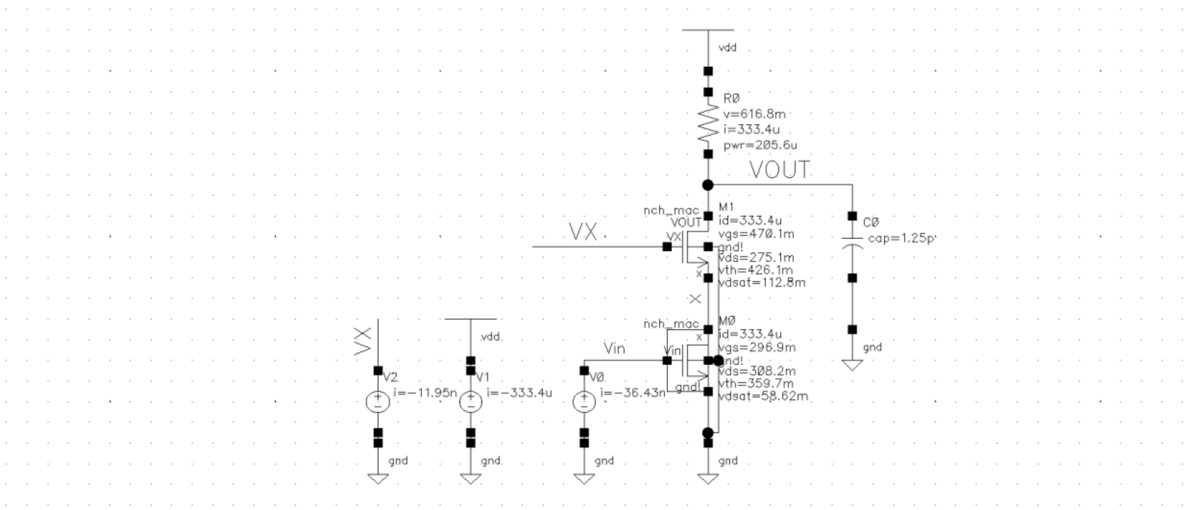




After Simulations, I need to increase the R1 to 1900

Simulations Results

- DC OP



- Vout AC Analysis