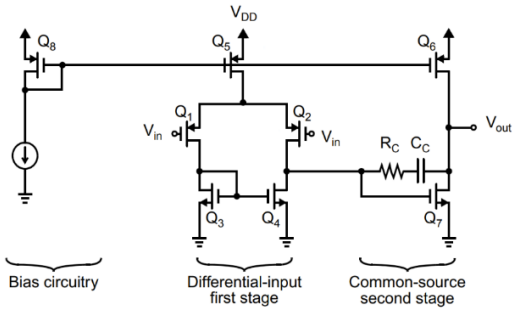
Design a Single Ended Two Stage Miller Compensated OTA meets the Specs (Use IREF = 10u)

Spec.	
DC Gain	$\geq$ 60 dB
Unity Gain Frequency	$\geq$ 50 MHz
Power Consumption	$\leq$ 1 mW
Cap Load	1 pF

- Assume $C_C = 0.5\ C_L = 0.5$ pF
- Assume CMIR from $0.2 \rightarrow 0.6$ V $\rightarrow$ use PMOS input transistors
- Assign higher gain for the first stage $A_V = A_{V1}.A_{V2} = 40 * 25$



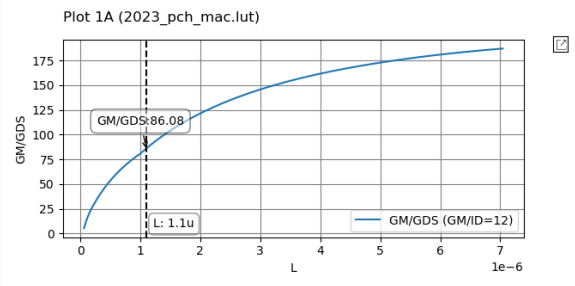
$$I_{Dmax} = \frac{P_{cons}}{V_{DD}} \rightarrow I_{Dmax} \leq 830\ uA$$

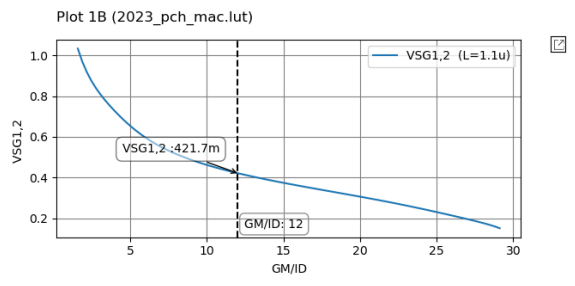
$$UGF = \frac{g_{m1,2}}{2\pi C_C} \geq 50\ MHz \rightarrow g_{m1,2} \geq 157\ uS \rightarrow g_{m1,2} = 200\ uS$$

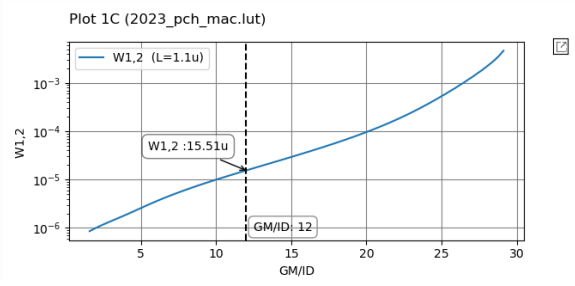
$$\text{Assume } M_{1,2} \text{ in MI } \left(\frac{g_{m1,2}}{I_D} = 12\right) \rightarrow I_{D1,2} = 16.7\ uA \rightarrow I_{B1} = 33.4\ uA$$

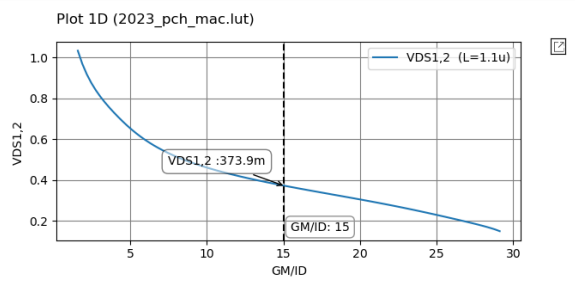
$$A_{V1} = \frac{g_{m1,2}r_{o2,4}}{2} (\text{Assume } r_{o2} = r_{o4}) \geq 40 \rightarrow r_{o2,4} = 400\ k\Omega \rightarrow (g_m r_o)_{1,2} = 80$$

$$L_{1,2} = 1.1\ um\ , V_{GS1,2} = 421.7\ mV, W_{1,2} = 15.51\ um$$







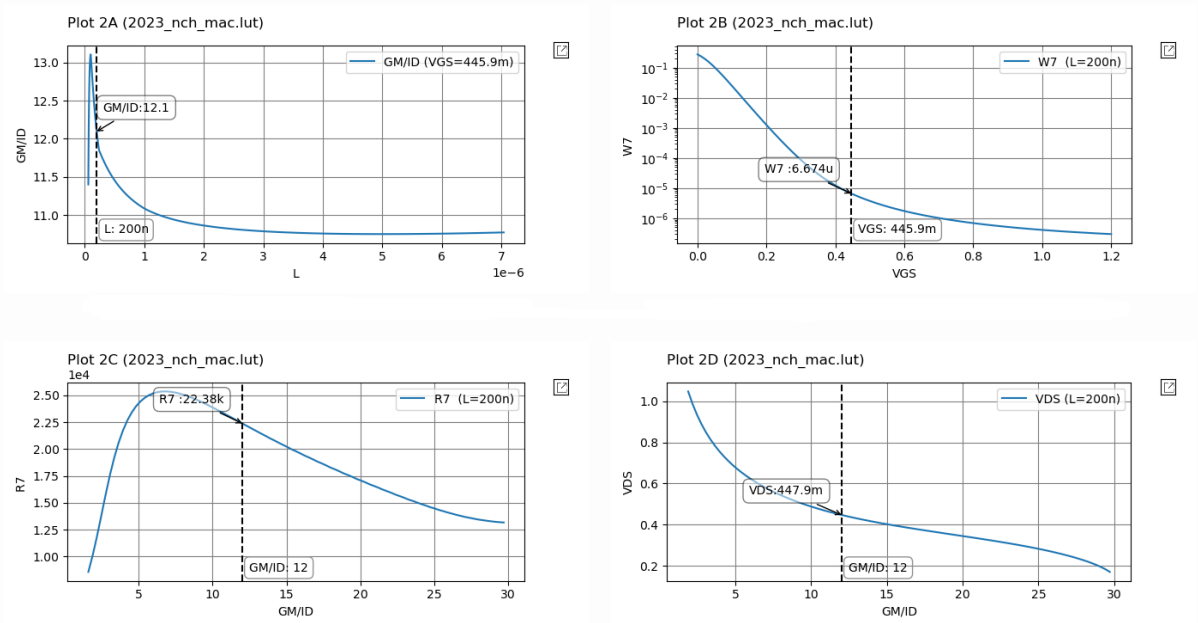


$$\text{CMIR}_L = -V_{SG1,2} + V_{1,2}^* + V_{GS3,4} \leq 0.2 \rightarrow V_{GS3,4} \leq 0.455\ \text{V}$$

$$\text{set } V_{iCM} = \frac{\text{CMIR}}{2} = 400\ \text{mV} \rightarrow V_{GS3,4} = 400\ \text{m} + 419.8\ \text{m} - 373.9\ \text{m} = 445.9\ \text{mV} = V_{GS7}$$

$$\text{Choose } \omega_{p2} = 4\omega_u \rightarrow \text{PM} > 70^o \rightarrow g_{m7} = 8\, g_{m1,2} = 1.6\ \text{mS} \rightarrow I_{B2} = 4I_{B1} = 133.6\ \text{uA}$$

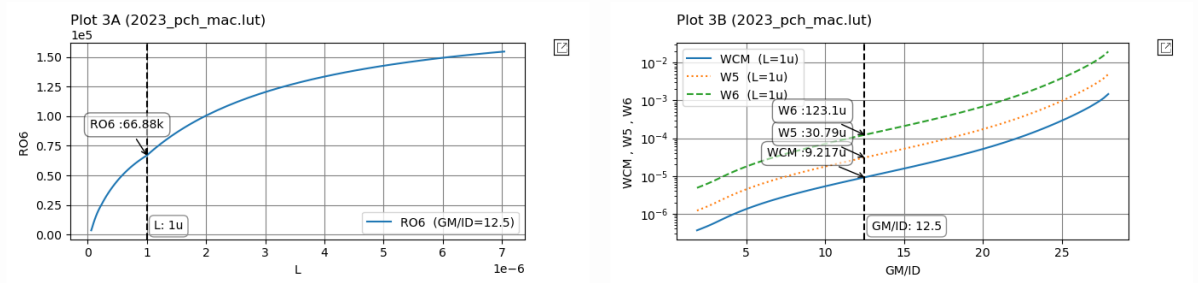
$$L_7 = 200\ \text{nm}\ , V_{DS7} = 447.7\ \text{mV}, W_7 = 6.674\ \text{um}$$



$$A_{V2} = g_{m7}\left(\frac{r_{o7} * r_{o6}}{r_{o7} + r_{o6}}\right) = 25 \rightarrow r_{o6} = 51.768\ \text{k}\Omega$$

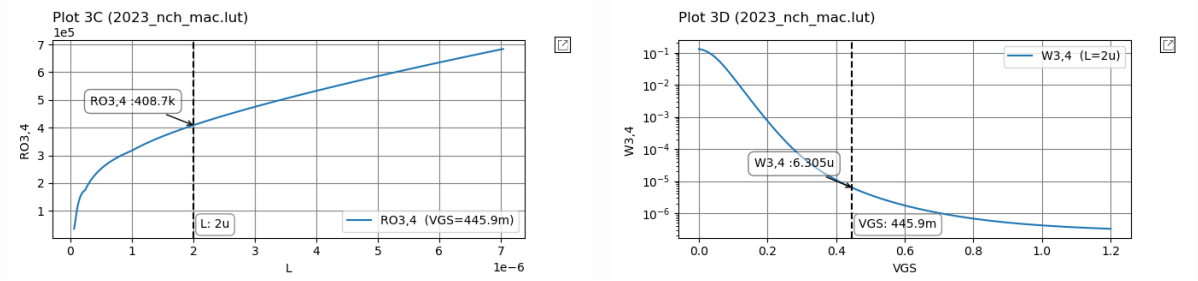
$$\text{CMIR}_H = -V_{SG1,2} - V_5^* + V_{DD} \leq 0.6 \rightarrow V_5^* \leq 0.1783\ \text{V} \rightarrow V_5^* = 0.16\ \text{V} \rightarrow \left(\frac{g_{m5,6}}{I_D}\right) = 12.5 \rightarrow g_{m5} = 117.5\ \text{uS}$$

$$L_{CM} = L_5 = L_6 = 1\ \text{um}, W_{CM} = 9.217\ \text{um}, W_5 = \ 30.79\ \text{um}, W6 = 123.1\ \text{um}$$



$$r_{o3,4} = r_{o1,2} = 400\ \text{k}\Omega \rightarrow I_{D3,4} = 16.7\ \text{uA}\ @\ V_{GS3,4} = 445.9\ \text{mV}$$

$$L_{3,4} = 2\ \text{um}\ , W_{3,4} = 6.305\ \text{um}$$



Sizing Summary

	M1	M2	M3	M4	M5	M6	M7	MCM
W	15.51u	15.51u	6.305u	6.305u	30.79u	123.1u	6.674u	9.217u
L	1.1u	1.1u	2u	2u	1u	1u	200n	1u

Simulations Results