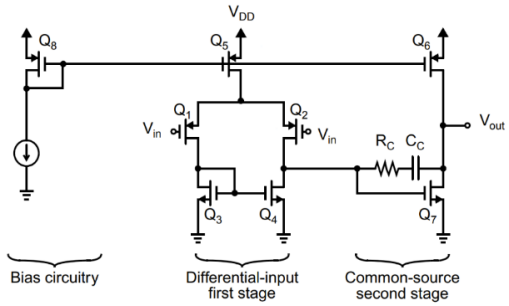
Design a Single Ended Two Stage Miller Compensated OTA meets the Specs (Use IREF = 10u)

Spec.	
DC Gain	$\geq$ 63 dB
Unity Gain Frequency	$\geq$ 10 MHz
Power Consumption	$\leq$ 0.8 mW
Cap Load	2 pF

- Assume $C_C = 0.5\ C_L = 1$ pF
- Assume CMIR from $0.2 \rightarrow 0.6$ V $\rightarrow$ use PMOS input transistors
- Assign higher gain for the first stage $A_V = A_{V1}.A_{V2} = 45 * 32$



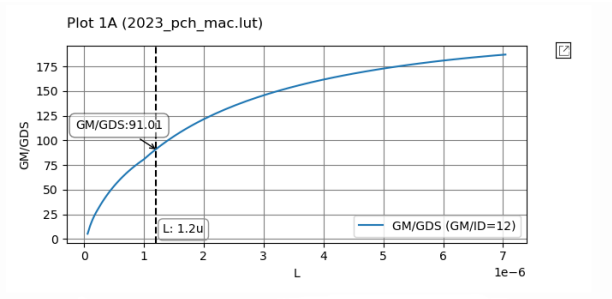
$$I_{Consmax} = \frac{P_{cons}}{V_{DD}} \rightarrow I_{Dmax} \leq 666\ uA$$

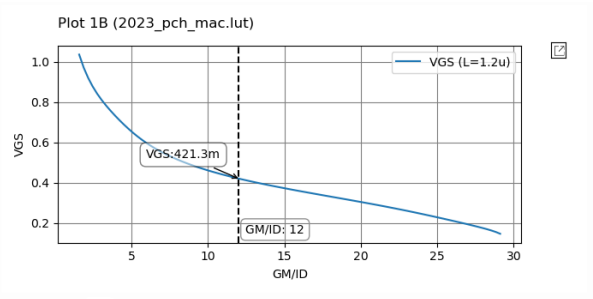
$$UGF = \frac{g_{m1,2}}{2\pi C_C} \geq 10\ MHz \rightarrow g_{m1,2} \geq 63\ uS \rightarrow g_{m1,2} = 90\ uS$$

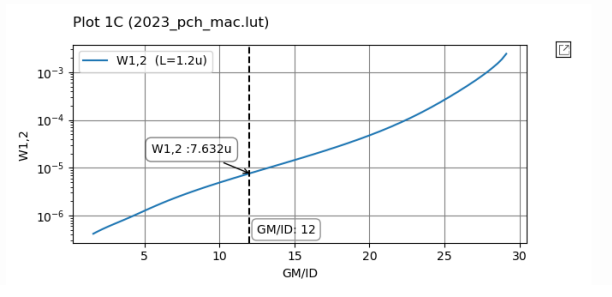
$$\text{Assume } M_{1,2} \text{ in MI } \left(\frac{g_{m1,2}}{I_D} = 12\right) \rightarrow I_{D1,2} = 7.5\ uA \rightarrow I_{B1} = 15\ uA$$

$$A_{V1} = \frac{g_{m1,2} r_{o2,4}}{2} (\text{Assume } r_{o2} = r_{o4}) \geq 45 \rightarrow r_{o2,4} = 1\ M\Omega \rightarrow (g_m r_o)_{1,2} = 90$$

$L_{1,2} = 1.2$ um , $V_{GS1,2} = 421.3$ mV, $W_{1,2} = 7.632$ um



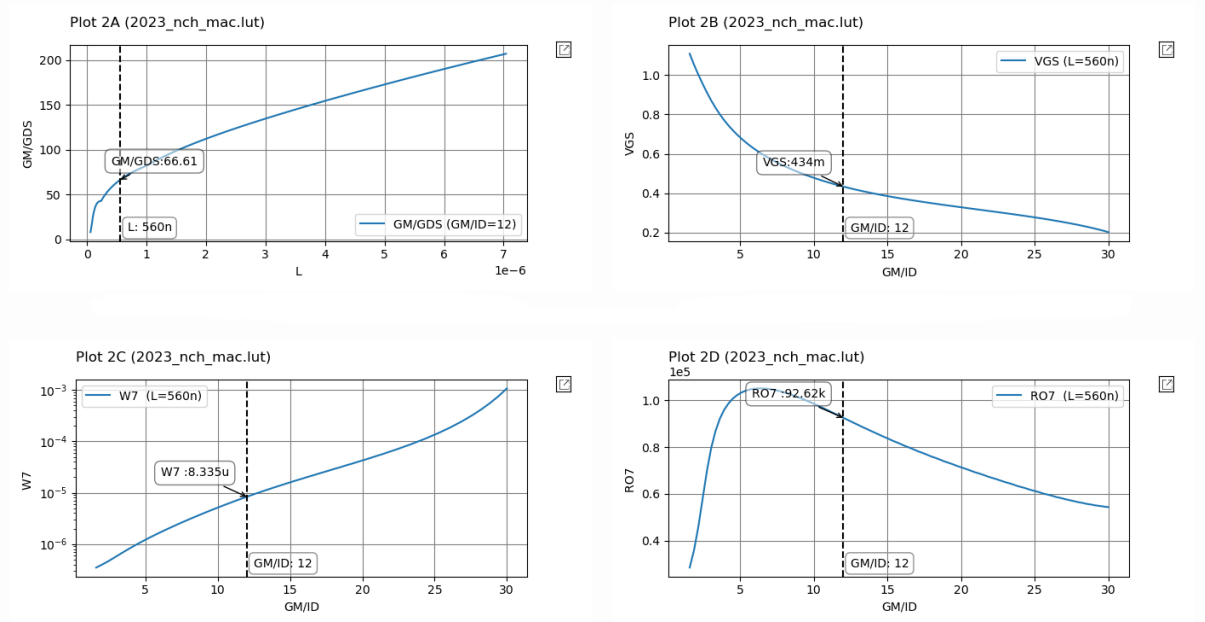




Choose $\omega_{p2} = 4\omega_u \rightarrow PM > 70^o \rightarrow g_{m7} = 8\, g_{m1,2} = 720\ uS \rightarrow I_{B2} = 4I_{B1} = 60\ uA$

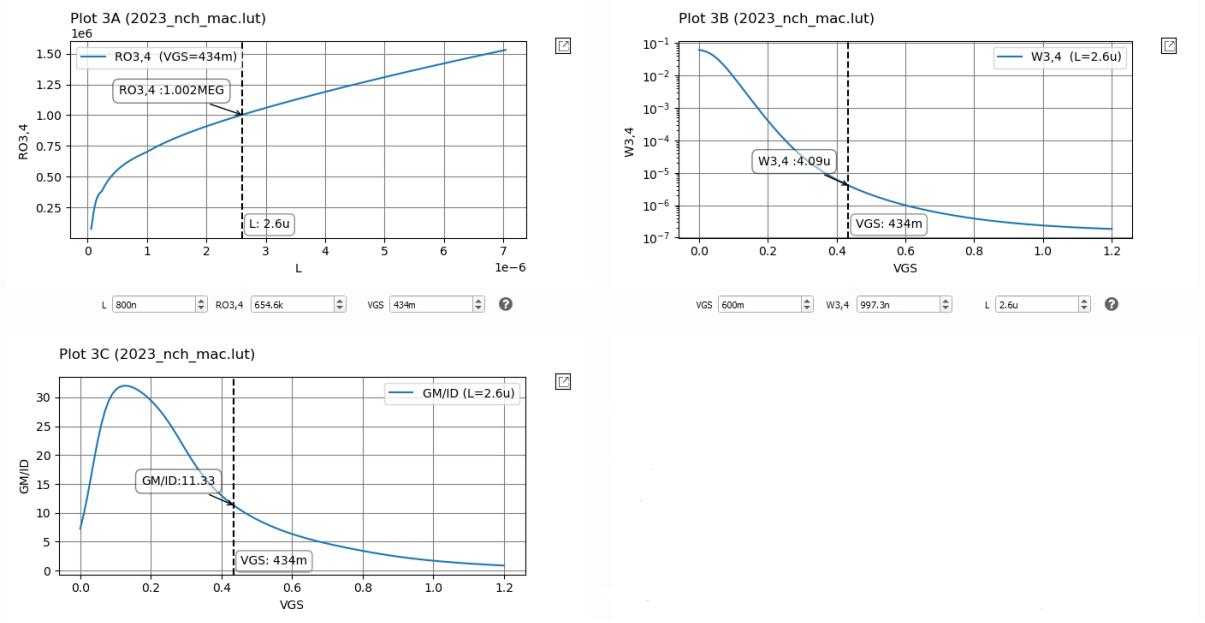
$$A_{V1} = \frac{g_{m7} r_{o6,7}}{2} (\text{Assume } r_{o6} = r_{o7}) \geq 32 \rightarrow r_{o2,4} = 89\ k\Omega \rightarrow (g_m r_o)_7 = 64$$

$$L_7 = 560\ nm\ , V_{GS7} = 434\ mV, W_7 = 8.335\ um$$



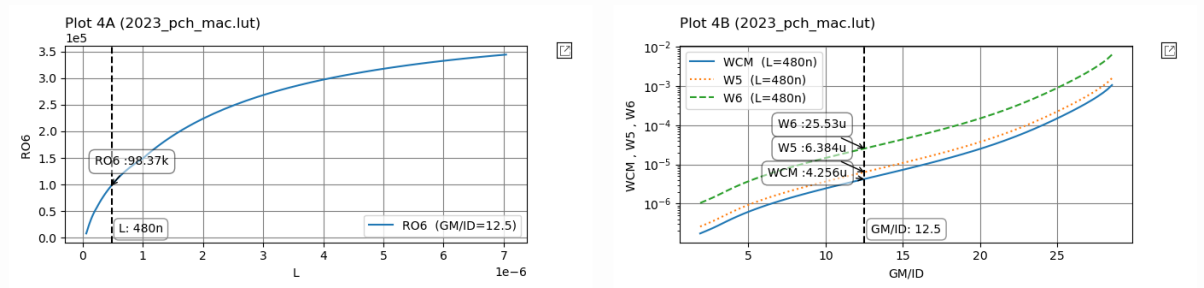
set $V_{GS3,4} = V_{GS7}$ (Cancels offset)

$$L_{3,4} = 2.6\ um\ , W_{3,4} = 4.09\ um, \left(\frac{g_{m3,4}}{I_D}\right) = 11.33$$



$$CMIR_H = -V_{SG1,2} - V_5^* + V_{DD} = 0.6 \rightarrow V_5^* \leq 0.1787\ V \rightarrow V_5^* = 0.16\, V \rightarrow \left(\frac{g_{m5}}{I_D}\right) = 12.5$$

$$L_{CM} = L_5 = L_6 = 480\ um, W_{CM} = 4.256\ um, W_5 = 6.384\ um, W6 = 25.53\ um$$



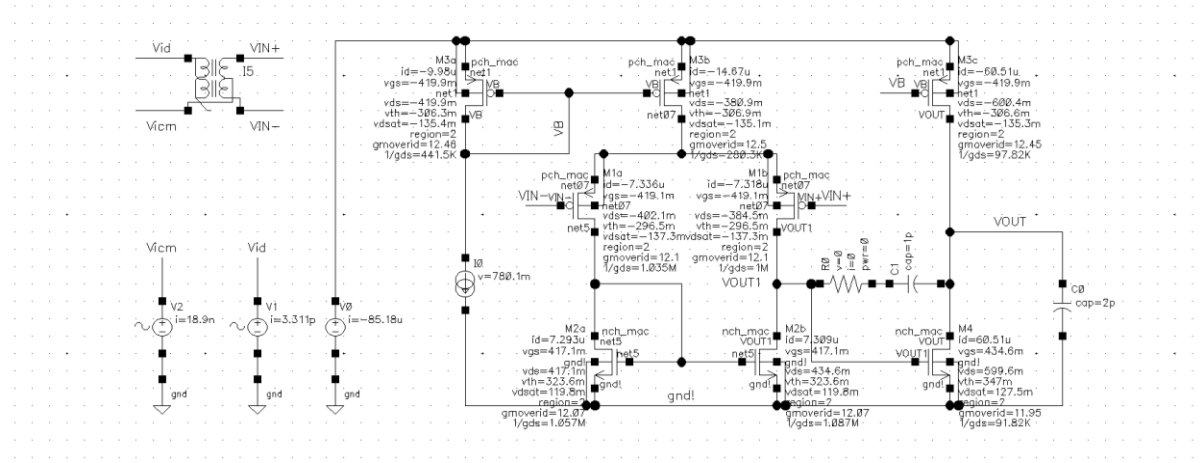
** After Running DC Analysis W3,4 needed to be increased to 4.82u **

Sizing Summary

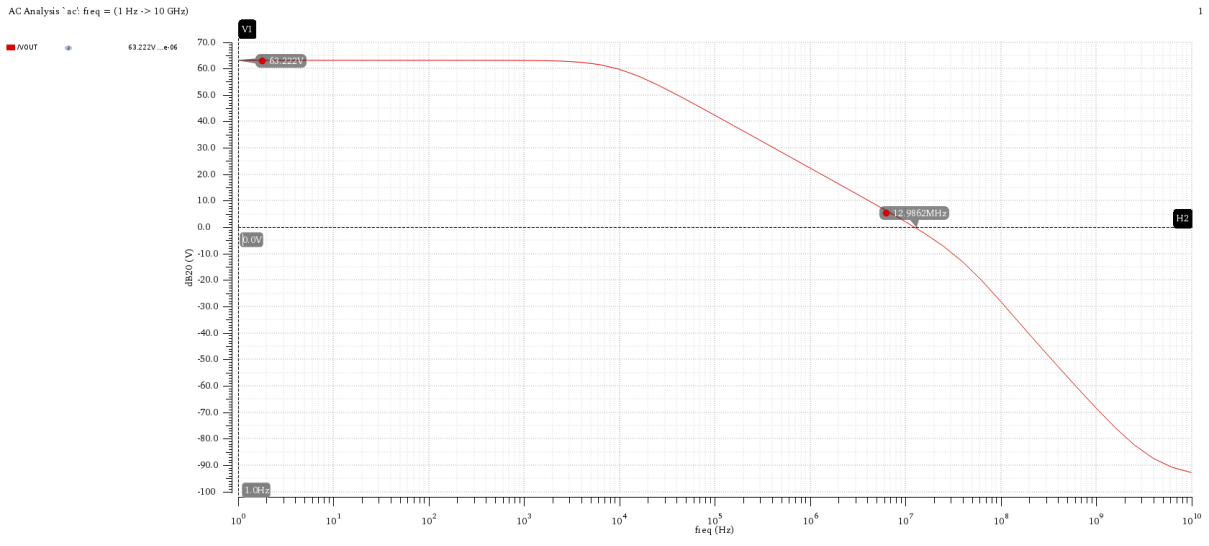
	M1	M2	M3	M4	M5	M6	M7	MCM
L	1.2u	1.2u	2.6u	2.6u	480n	480n	560n	480n
W	7.632u	7.632u	4.82u	4.82u	6.256u	25.53u	8.335u	4.256u

Simulations Results

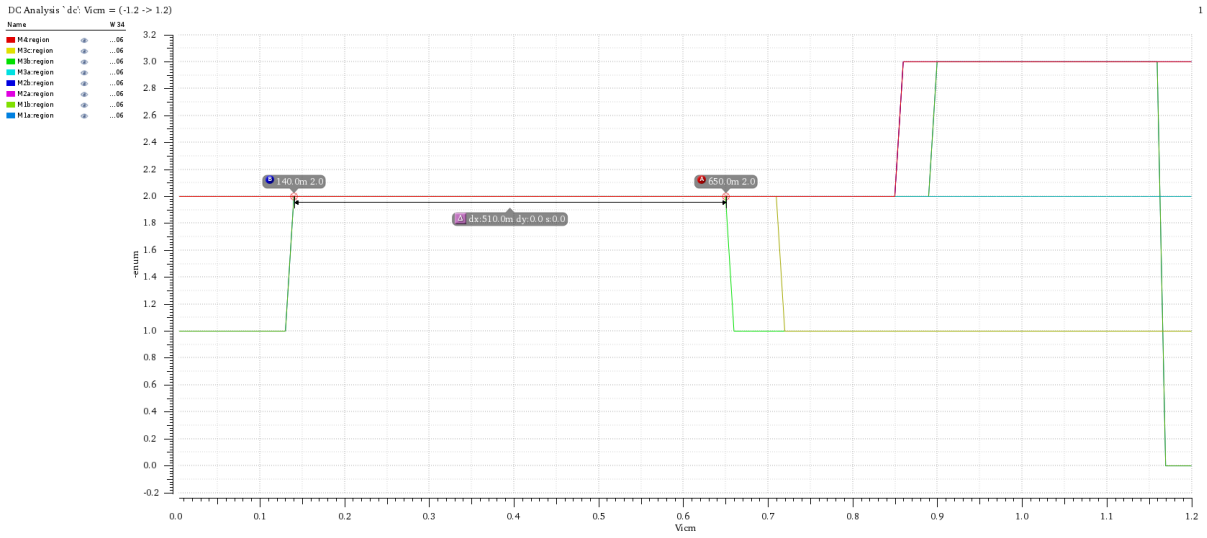
- DC Operating Points



- AC Analysis



- CMIR Results



- STB Analysis