You are required to design a fully differential broadband amplifier (simple differential amplifier with resistive load) with the following specs

Spec.			
DC Gain	9 dB	Linear Range	300 mVpp
BW	≥ 7.5 GHz	CMRR	≥ 10 dB
Power Consumption	≤ 1.7 mW	Cap Load	40 fF
Reference Current	30 uA		

<u>Design of the input pair</u>

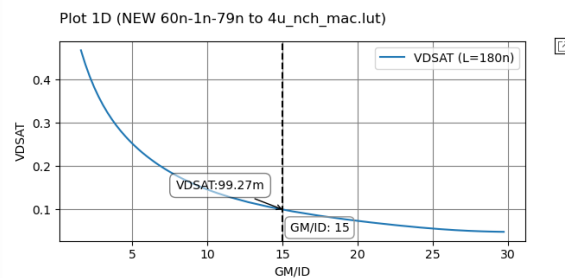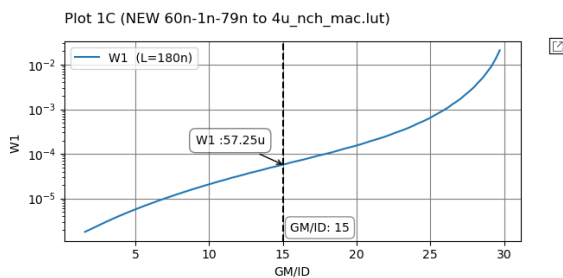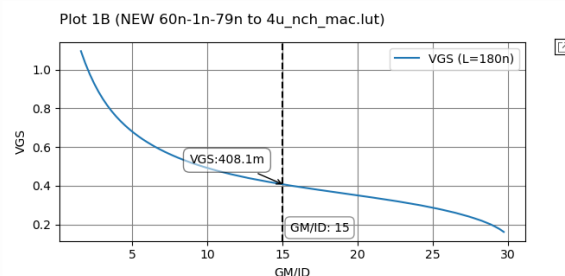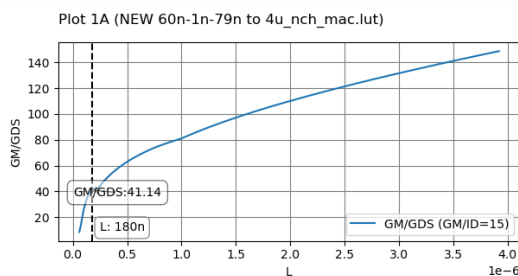$$P_{cons} = V_{DD}\, I_{ss} \leq 1.7 \text{ mW} \rightarrow I_{ss} \leq 1.4 \text{ mA}$$

$$GBW = \frac{g_{m1}}{2\pi C_L} \geq 2.9 * 7.5 \text{ GHz} \rightarrow g_{m1} \geq 3.77 \text{ mS} \rightarrow \frac{g_{m1}}{I_D} \geq 5.4$$

$$\frac{g_{m1}}{I_D} = 15 \rightarrow g_{m1} = 10.5 \text{ mS}$$

$$A_v = g_{m1} R_{out} = 2.9 \rightarrow R_{out} = 277\ \Omega \rightarrow R_D = 305\ \Omega \rightarrow r_{o1} \geq 3018\ \Omega \rightarrow \frac{g_{m1}}{g_{ds}} \geq 31.7$$

$$V_{out} = V_{DD} - I_{D1} * R_D = 1 \text{ V}$$

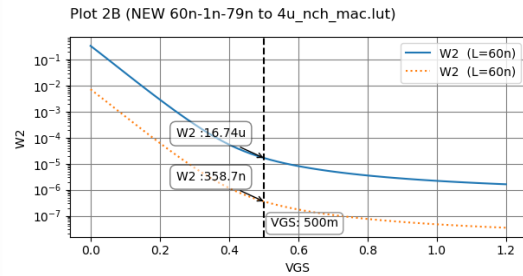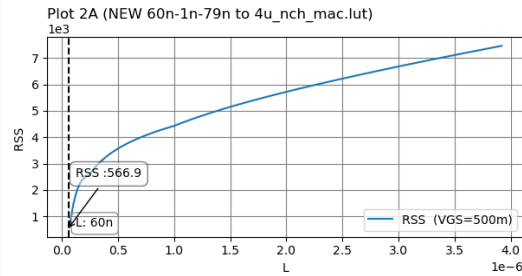$$L_1 = 180 \text{ nm}, V_{GS1} = 408.1\ mV, W_1 = 57.25\ um$$

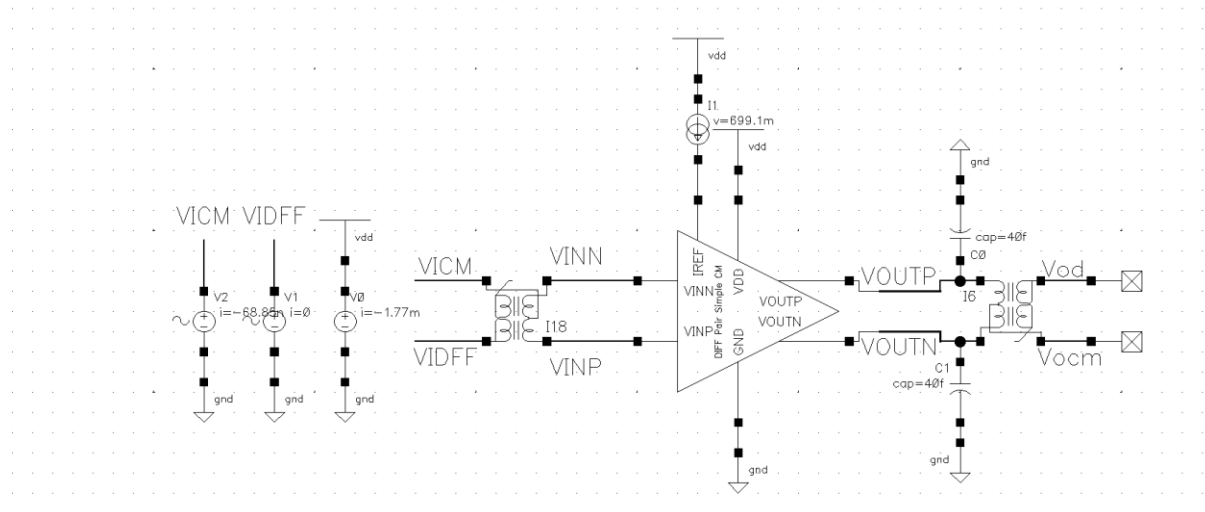# Designing the Current Mirror circuit

$$CMRR = 2g_m * R_{SS} = 10 \rightarrow R_{SS} \geq 477 \, \Omega \rightarrow \text{Assume } V_{GS2} = V_{DS2} = 500 \text{ mV}$$

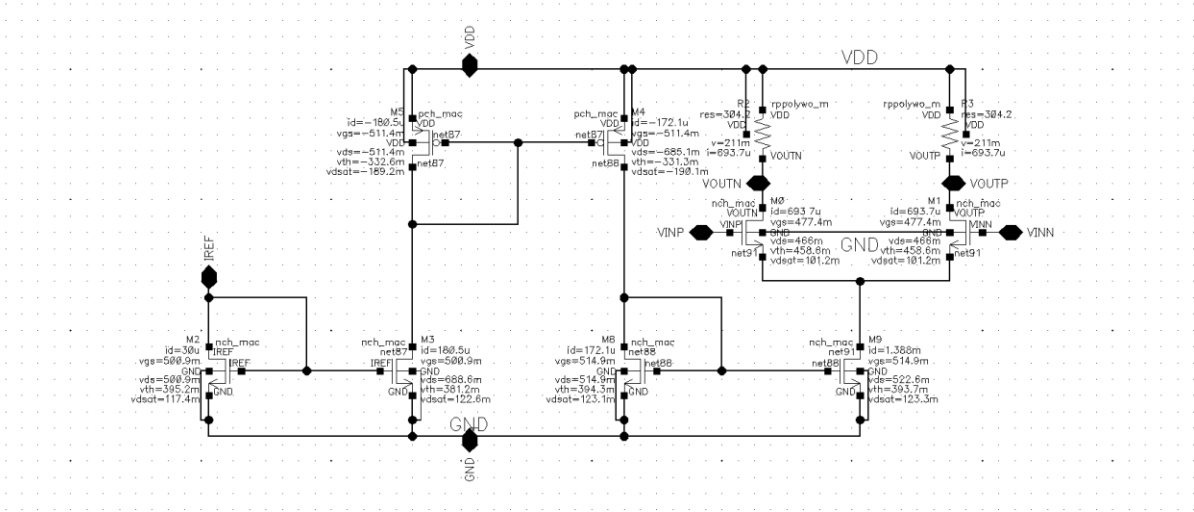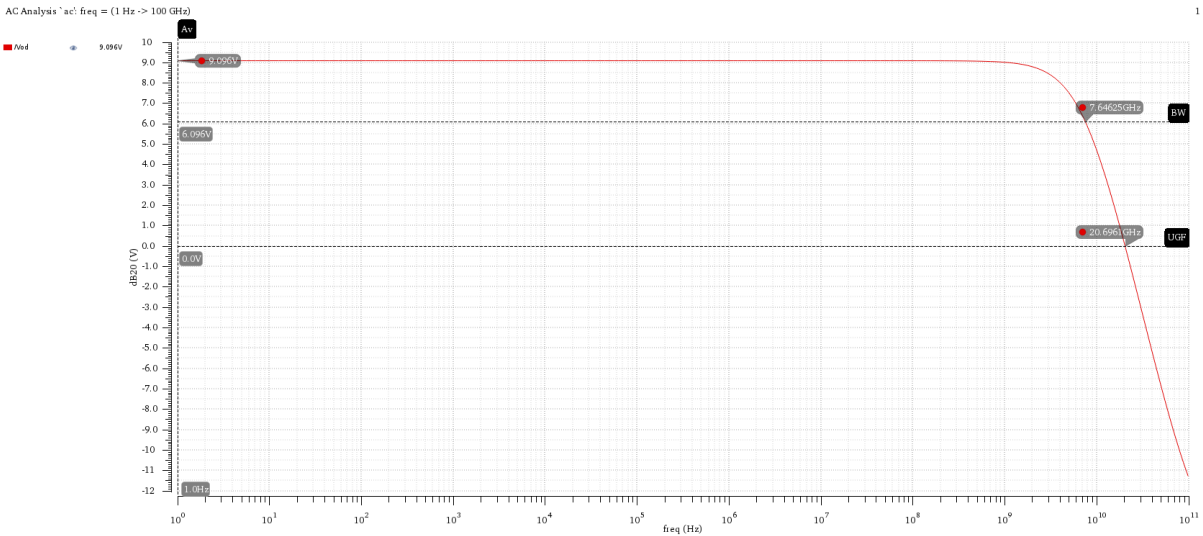$$L_2 = 60 \text{ nm}, W_2 = 358.7 \text{ n @ } I_D = 30 \text{ uA}$$
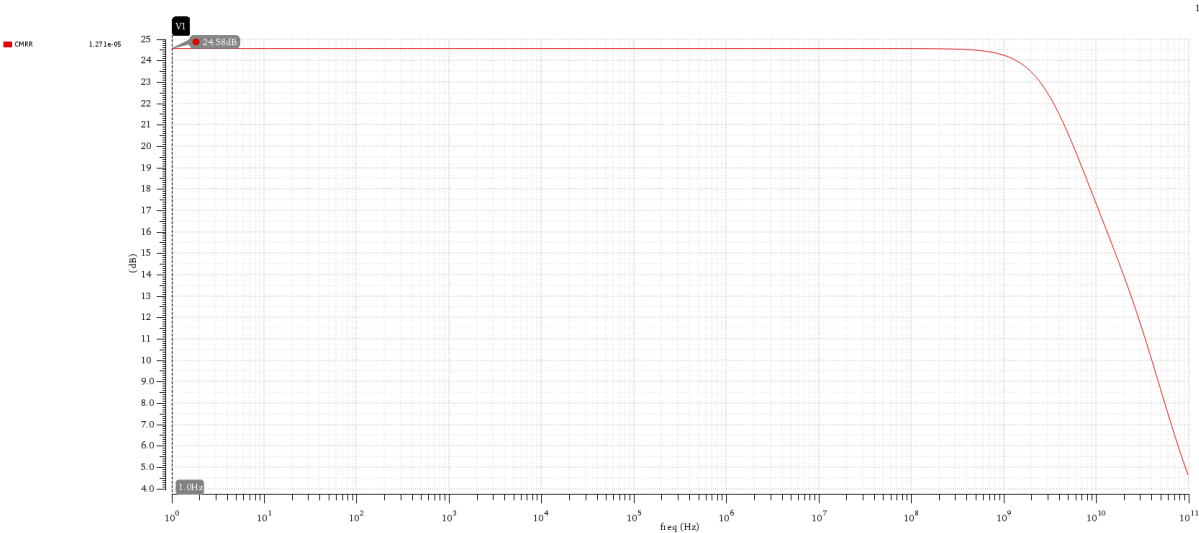

Simulations

Using the following TB

DC Operating Point

Differential Small Signal

CM Small Signal

CM Large Signal