> **You are required to design a single ended amplifier (choose the common source with resistive load amplifier) to achieve the following specs**

Spec.	
DC Gain	$6\ dB$
BW	$\geq 10\ GHz$
Power Consumption	$\leq 1.2\ mW$
Cap Load	$50\ fF$

1. Design

$$P_{cons} = V_{DD}\ I_D \leq 1.2\ mW \rightarrow I_D \leq 1\ mA$$

$$GBW = \frac{g_m}{2\pi C_{out}} \geq 2 * 10\ GHz \rightarrow g_m \geq 6.3\ mS$$
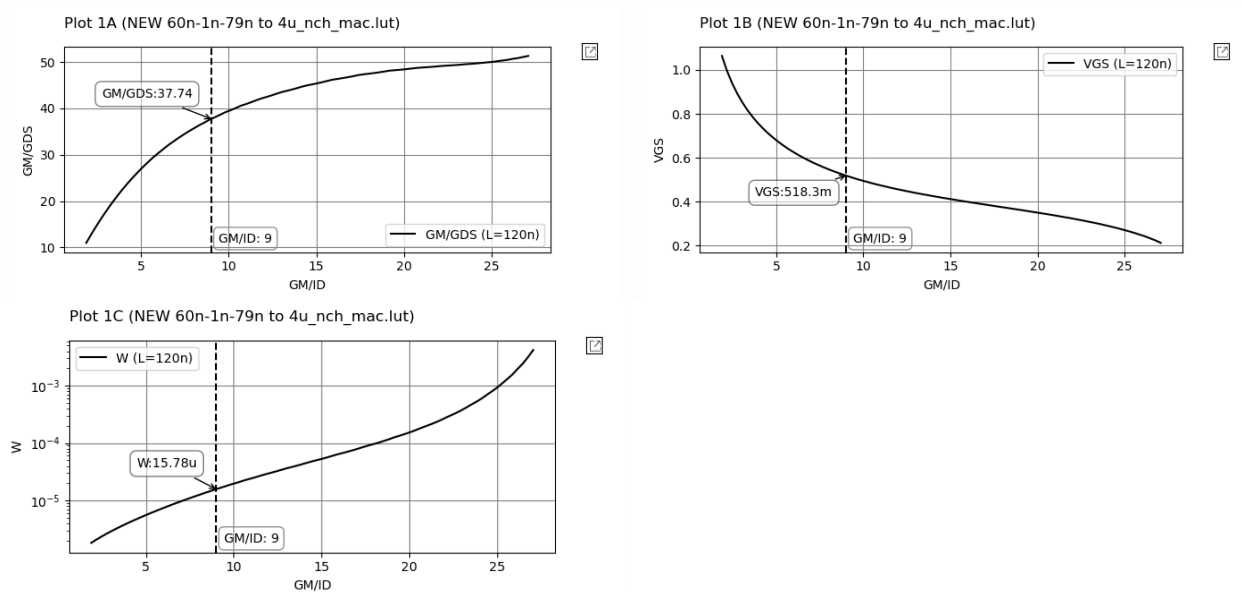
$$let\ g_m = 9\ mS \rightarrow \frac{g_m}{I_D} = 9$$

$$A_v = g_m R_{out} = 2 \rightarrow R_{out} = 225\ \Omega$$

$$R_D = 270\ \Omega \rightarrow R_{out} = \frac{R_D . r_o}{R_D + r_o} = 225 \rightarrow r_o \geq 1350\ \Omega \rightarrow \frac{g_m}{g_{ds}} \geq 12.15$$

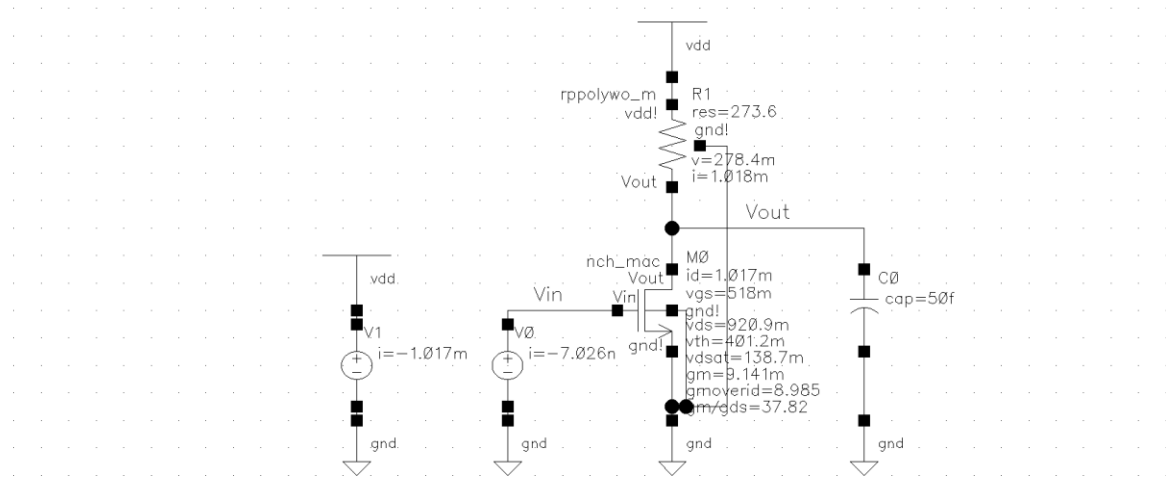$$V_{DS} = V_{out} = V_{DD} - I_D * R_D = 1.2 - 1m . 270 = 930\ mV$$

$$V_{SB} = 0$$

From gm/ID Charts

2. Simulations

- *DC OP*

vdd

rppolywo_m
vdd!
gnd!
v=278.4m
i=1.018m

R1
res=273.6

Vout

Vout

nch_mac
Vout
Vin
gnd!
gnd!

M0
id=1.017m
vgs=518m
vds=920.9
vth=401.2m
vdsat=138.7m
gm=9.141m
gmoverid=8.985
gm/gds=37.82

C0
cap=50f

vdd.

Vin

Vin

V1
i=-1.017m

V0.
i=-7.026n

gnd.

gnd

gnd

gnd

- *AC Analysis*

AC Analysis `ac': freq = (1 Hz -> 1 THz)   1

Av

/Vout   6.4026V / 7.8e-06

8.0
6.4026V   6.0   11.2286GHz   BW
4.0
3.4026V   2.0   20.6912GHz   UGF
0.0
0.0V   -2.0
-4.0
-6.0
-8.0
-10.0
-12.0
-14.0
-16.0
-18.0
-20.0
-22.0
-24.0
1.0Hz   -26.0

dB20 (V)

10^0 10^1 10^2 10^3 10^4 10^5 10^6 10^7 10^8 10^9 10^{10} 10^{11} 10^{12}

freq (Hz)