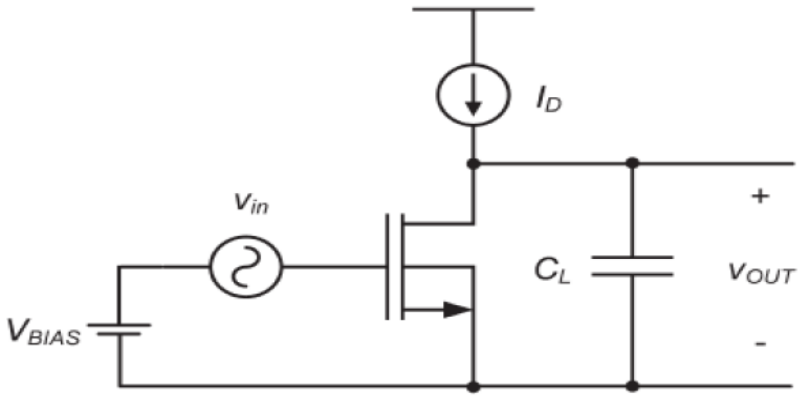
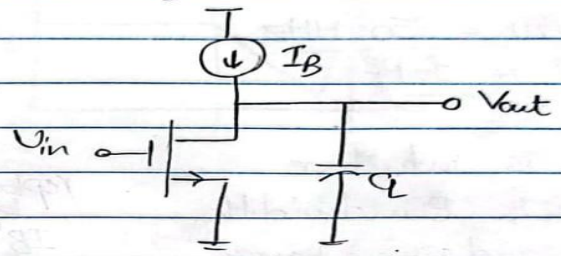
2. Design the following intrinsic gain stage using the 180nm PTM to have the following specs.



a. Av = 60
b. GBW = 250 MHz
c. CL = 1 pF

Degrees of freedom
DOF
g_m/I_D ?
L ?
I_B ?

Specs
DC Gain ⇒ 60
GBW ⇒ 250 MHz
CL ⇒ 1 PF



$GBW \simeq f_u$ (UGF)

$= Gain \times BW$

$= g_m f_{3dB} \times \frac{1}{2\pi f_{3dB} C_L} = \frac{g_m}{2\pi C_L}$

$\therefore g_m = GBW \cdot 2\pi C_L = 1.57$ ms

let $\frac{g_m}{I_D} = 5 \sim 25$ → limited range
strong inversion — weak inversion

$\therefore g_m = 1.57$ ms

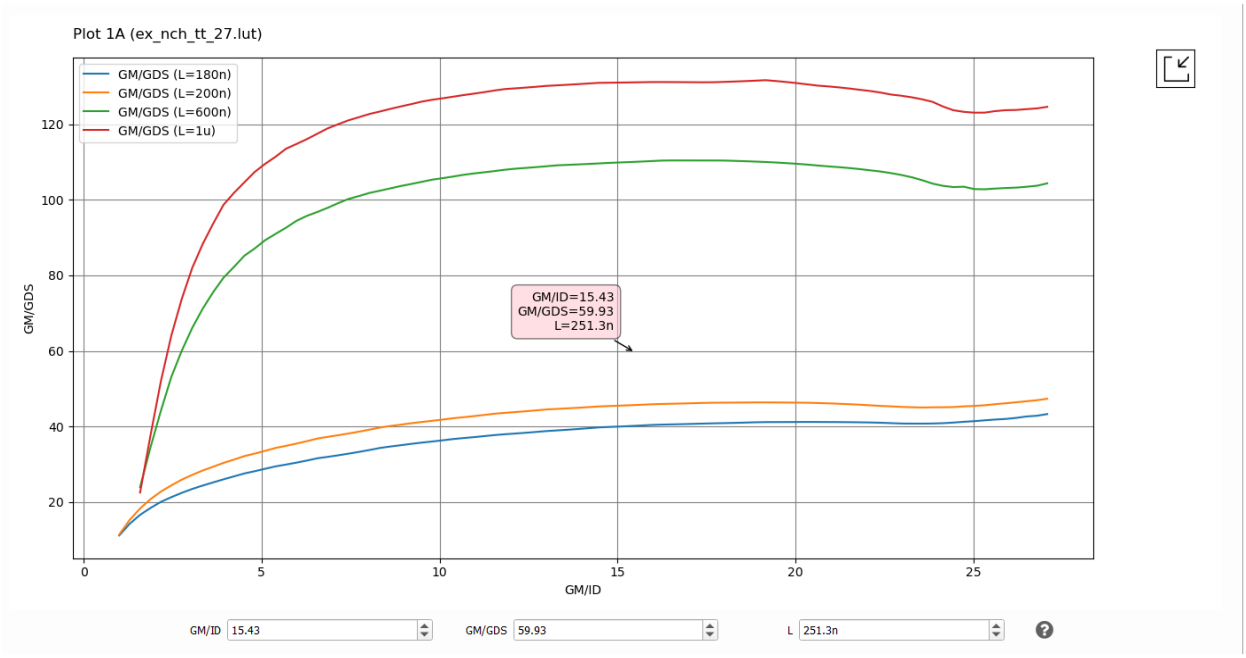
$\therefore I_D = 314\ \mu A \sim 62.8\ \mu A$
Strong Inv. — weak inversion

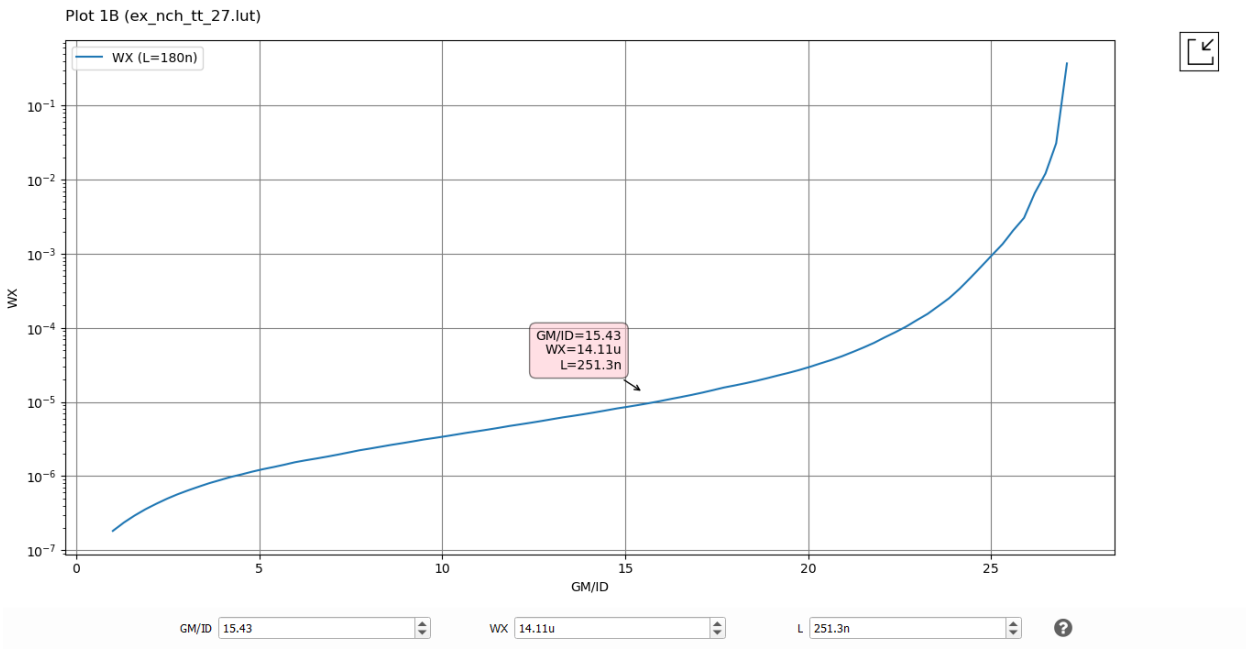
take $V_{DD} = 1.8$ V

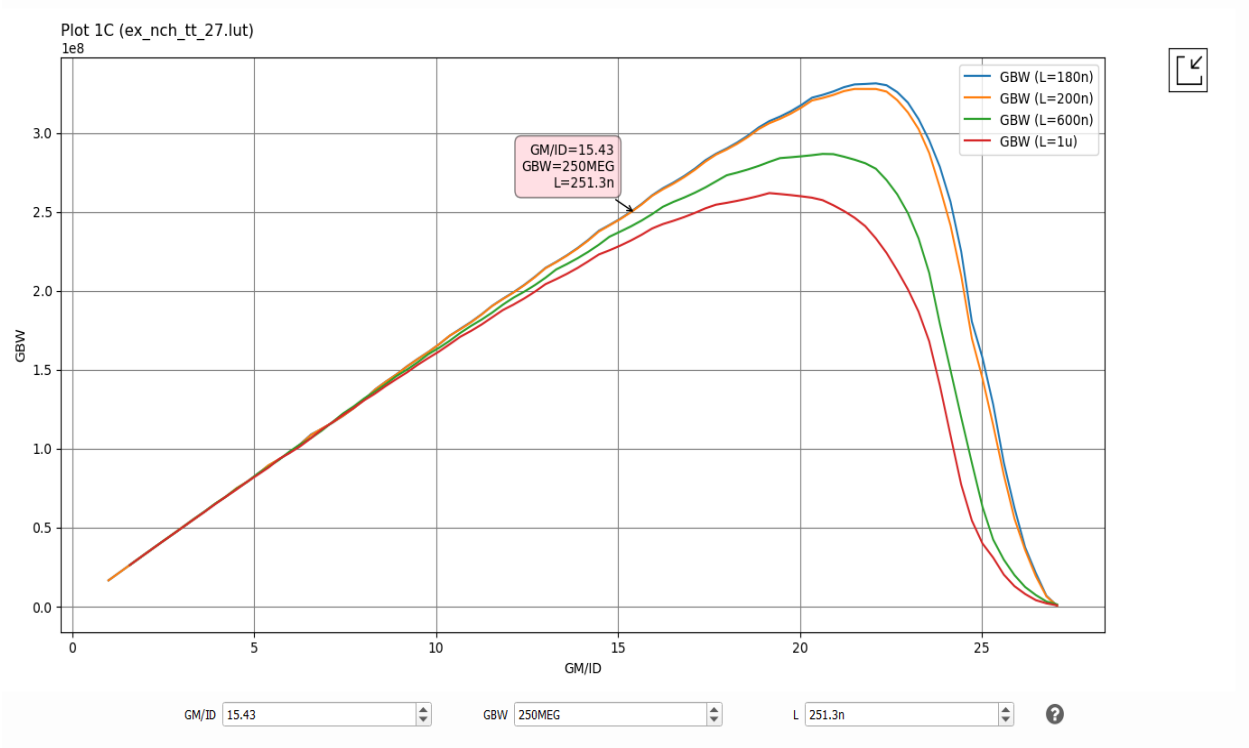
take $\frac{g_m}{I_D} = 15$ (MI) ∴ $I_D = 104.6$ µA

from the ADT $L \rightarrow 251.3$ n

$W \rightarrow 14.11$ µ






Plot 1C (ex_nch_tt_27.lut)
1e8
GBW (L=180n)
GBW (L=200n)
GBW (L=600n)
GBW (L=1u)
GM/ID=15.43
GBW=250MEG
L=251.3n
GBW
GM/ID
0.0
0.5
1.0
1.5
2.0
2.5
3.0
0
5
10
15
20
25
GM/ID 15.43
GBW 250MEG
L 251.3n