Cairo University **Faculty of Engineering**

Advanced Topics in Electronics-1

Under supervision of:

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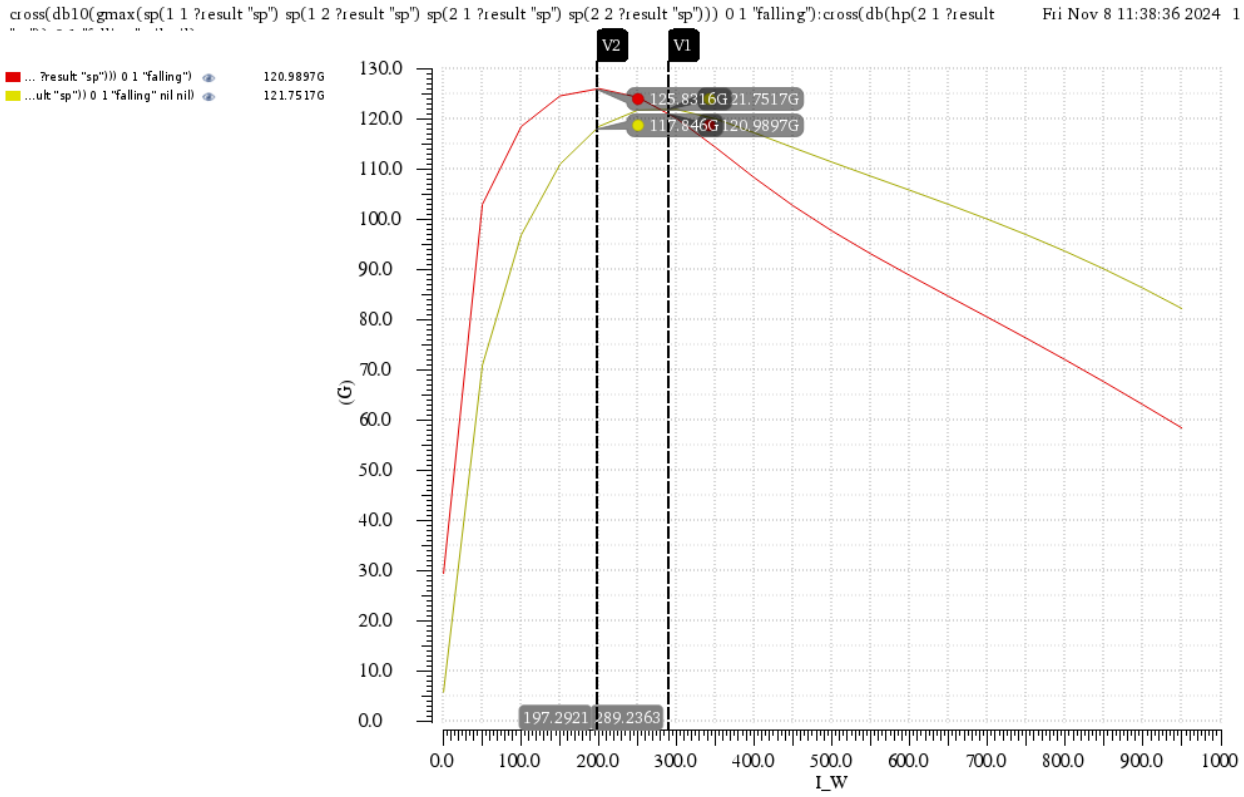
1. F_t & F_{MAX} versus current density for $|V_{DS}| = 0.5V, 0.8V, 1.0V$ & $1.2V$. Find J_{pFT} and J_{pFMAX}

NMOS:

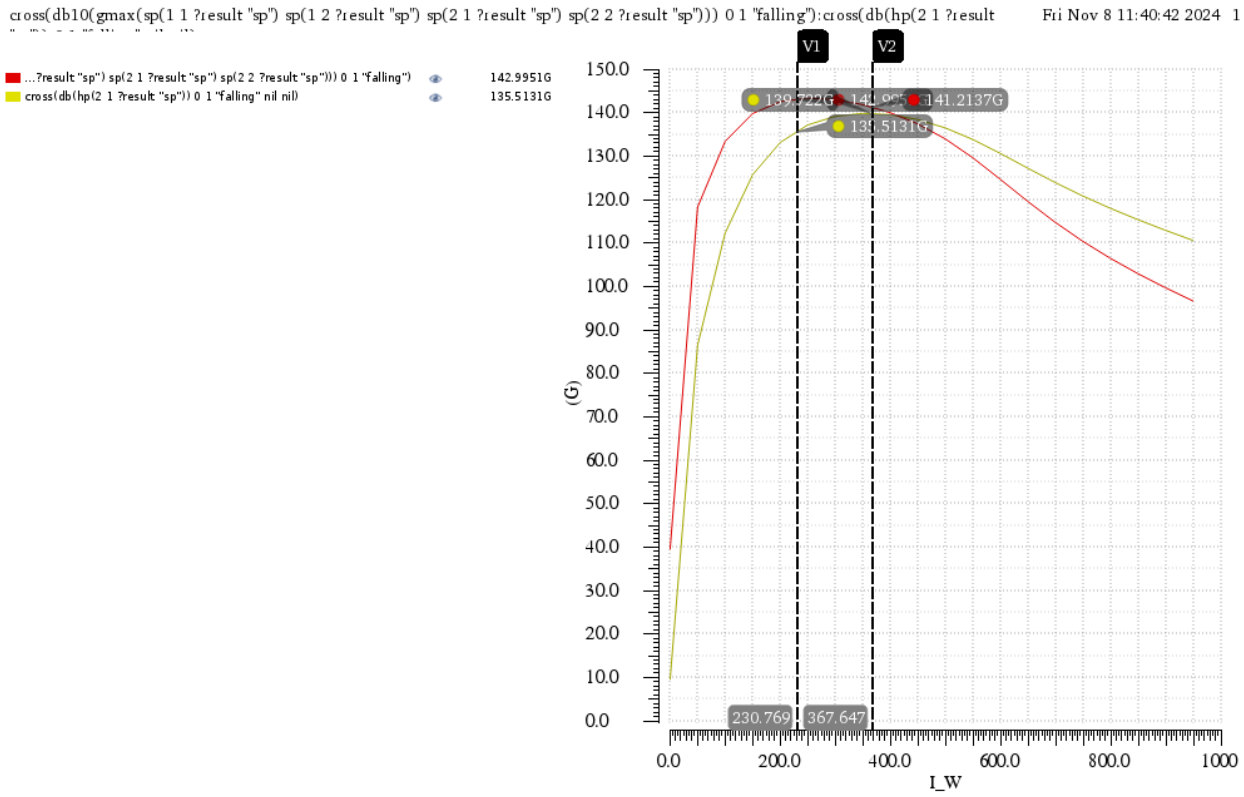
At $V_{DS} = 0.5V$



$J_{pFT} = 289.236\ \mu A/\mu m$ with highest $F_T = 121.7517$ GHz.

$J_{pFMAX} = 197.2921\ \mu A/\mu m$ with highest $F_{MAX} = 125.8316$ GHz.

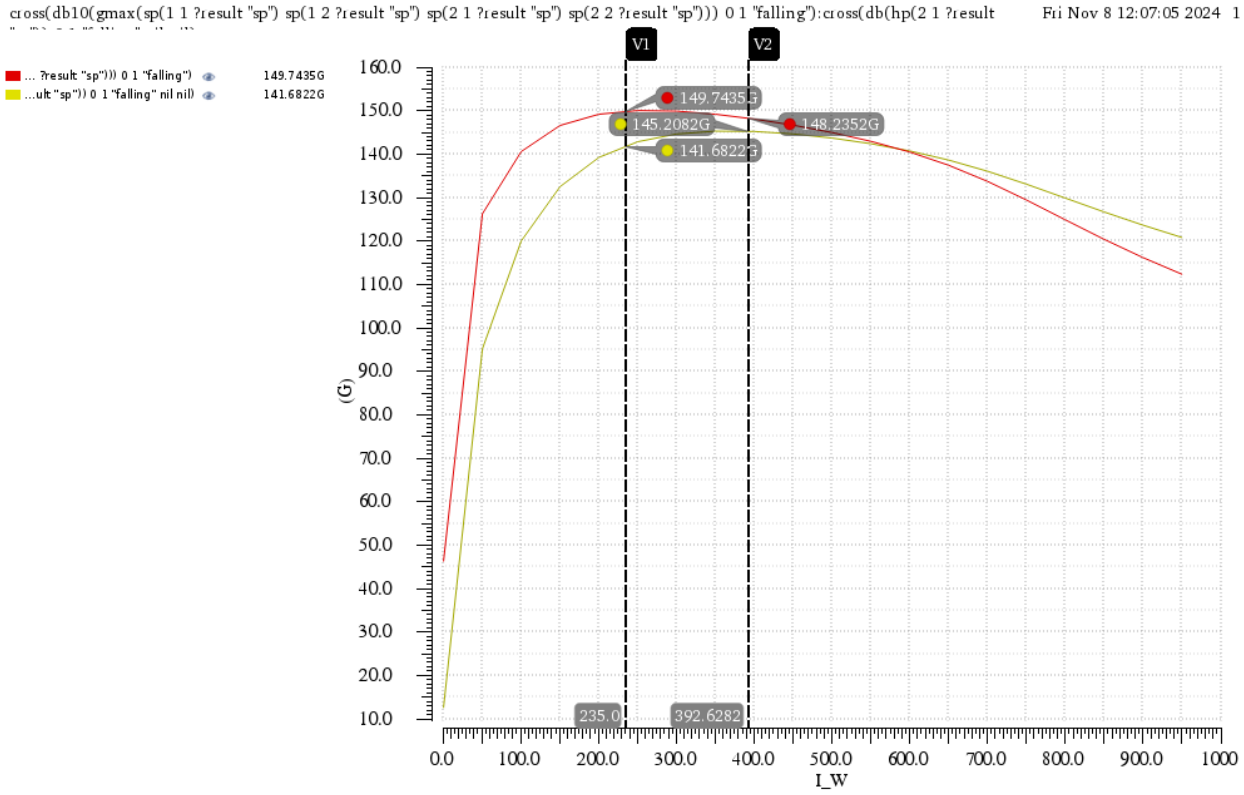
At $V_{DS} = 0.8V$:



$J_{pFT} = 367.647\ \mu A/\mu m$ with highest $F_T = 139.722$ GHz.

$J_{pFMAX} = 230.769\ \mu A/\mu m$ with highest $F_{MAX} = 142.995$ GHz.

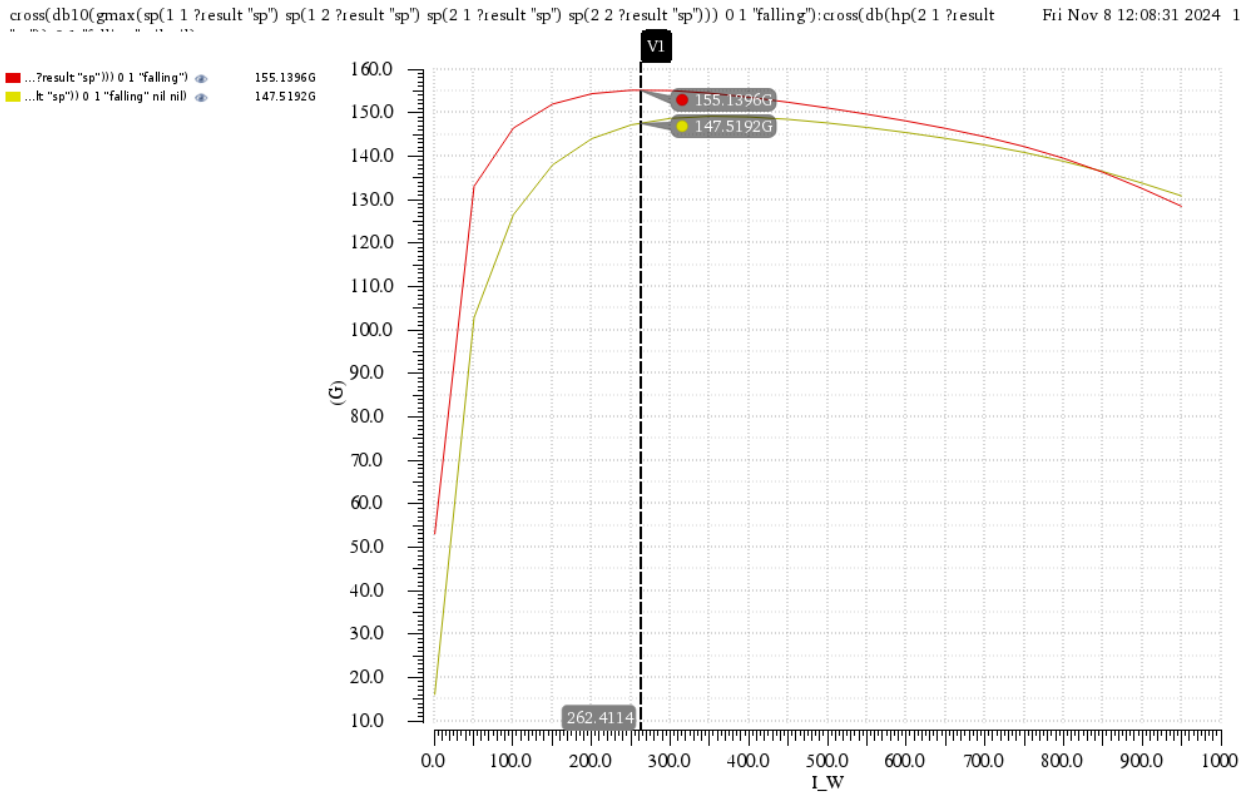
At $V_{DS} = 1.0V$:



$J_{pFT} = 392.6282\ \mu A/\mu m$ with highest $F_T = 145.2082$ GHz.

$J_{pFMAX} = 235\ \mu A/\mu m$ with highest $F_{MAX} = 149.7453$ GHz.

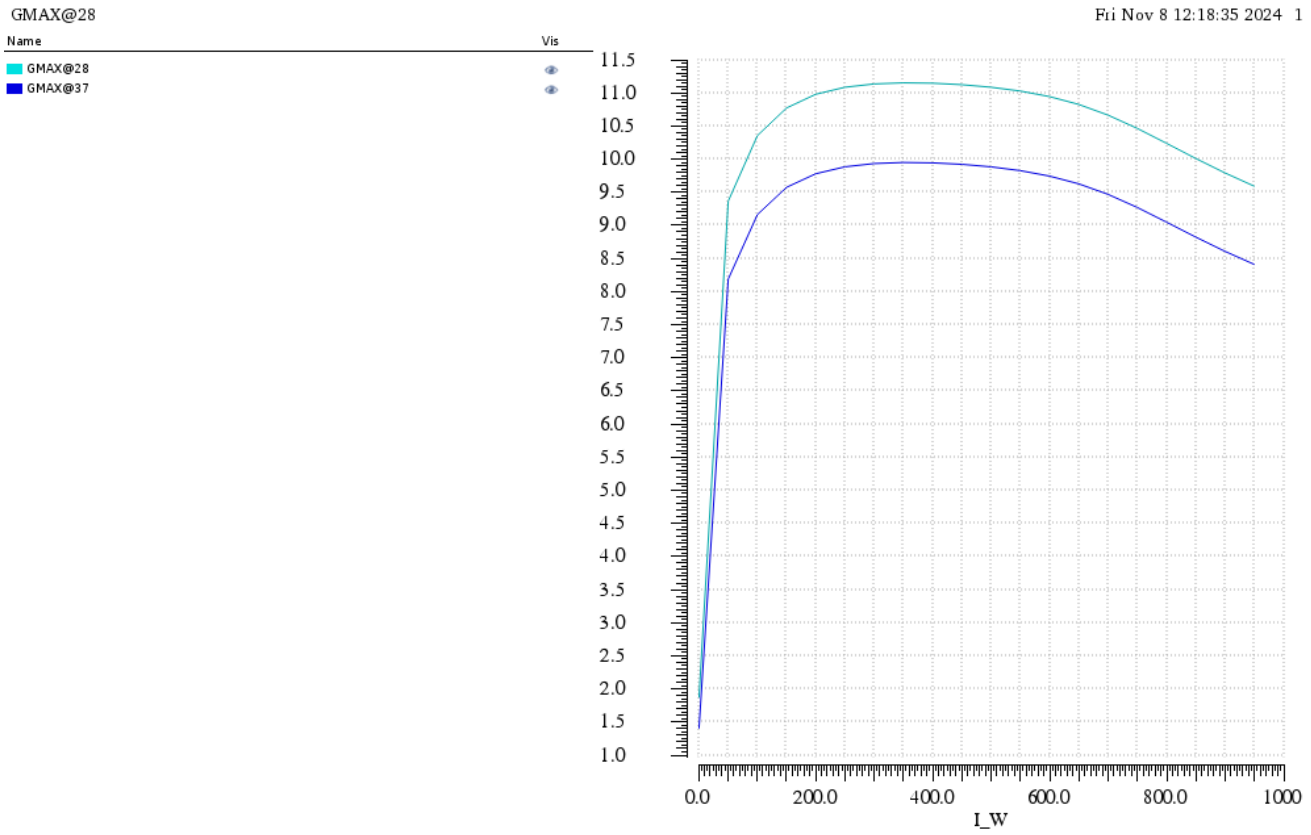
At $V_{DS} = 1.2V$:



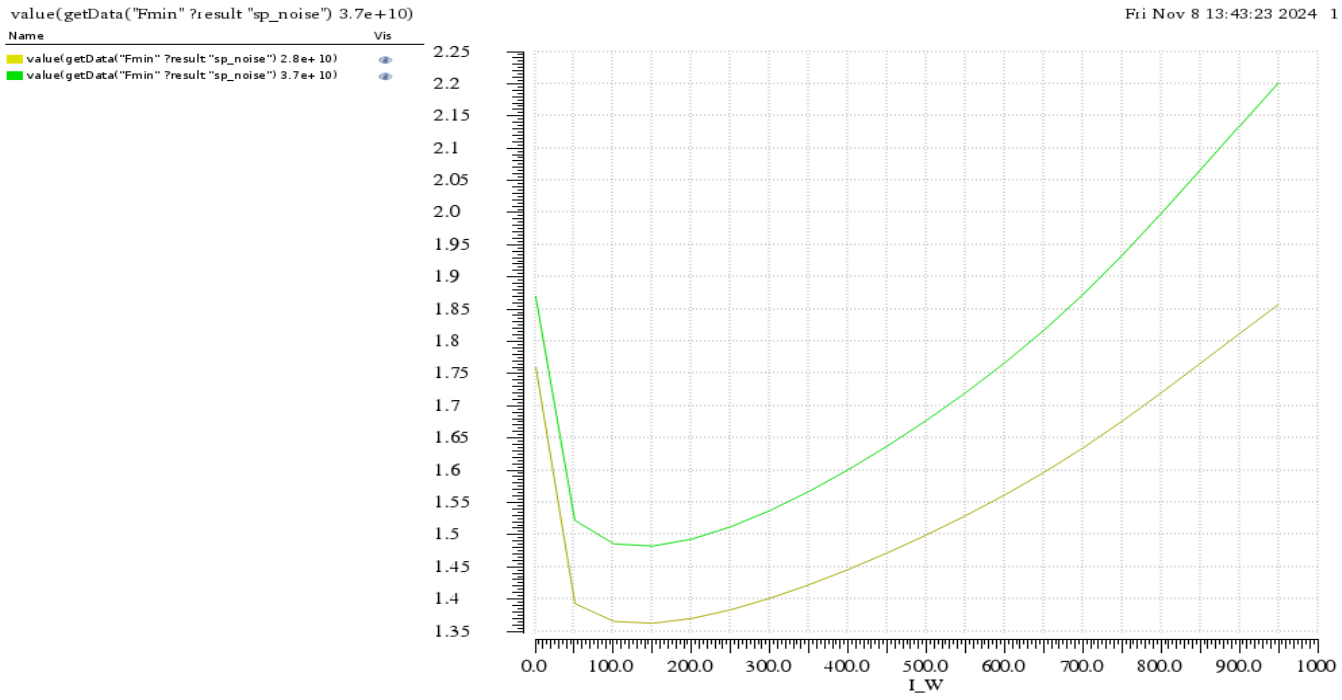
$J_{pFT} = 262.4114\ \mu A/\mu m$ with highest $F_T = 147.5192$ GHz.

$J_{pFMAX} = 262.4114\ \mu A/\mu m$ with highest $F_{MAX} = 155.1396$ GHz.

2. G_{MAX} @ 28Ghz & 37Ghz

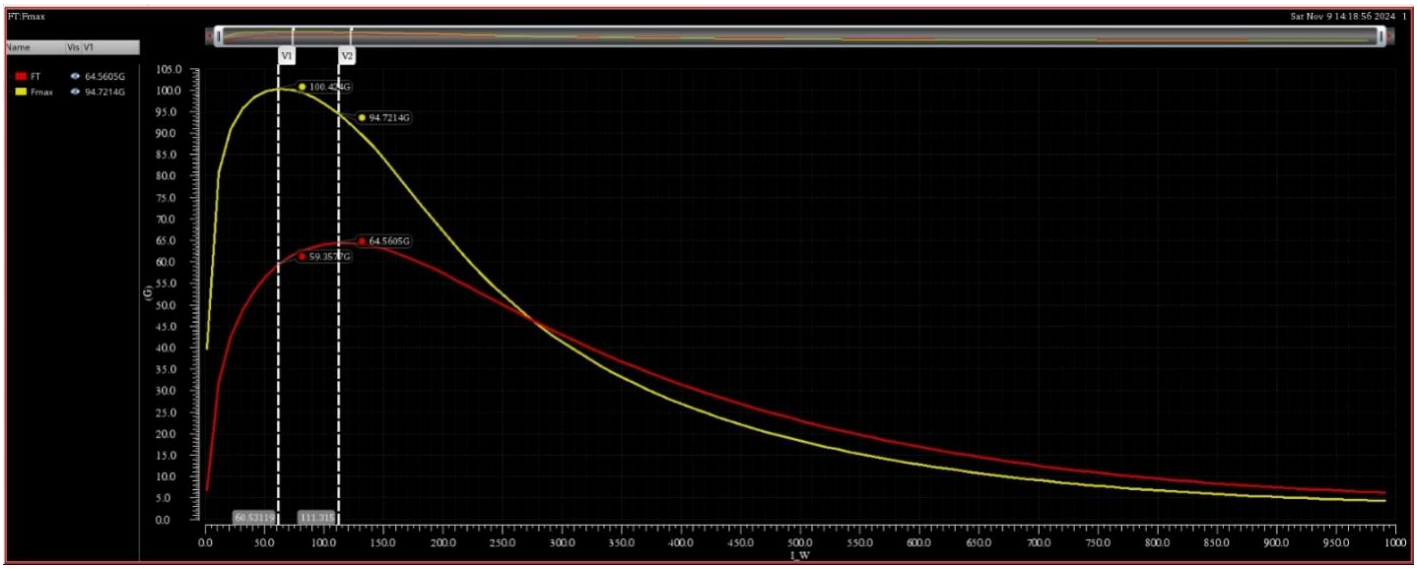


3. NF_{min} @ 28Ghz & 37Ghz



PMOS:

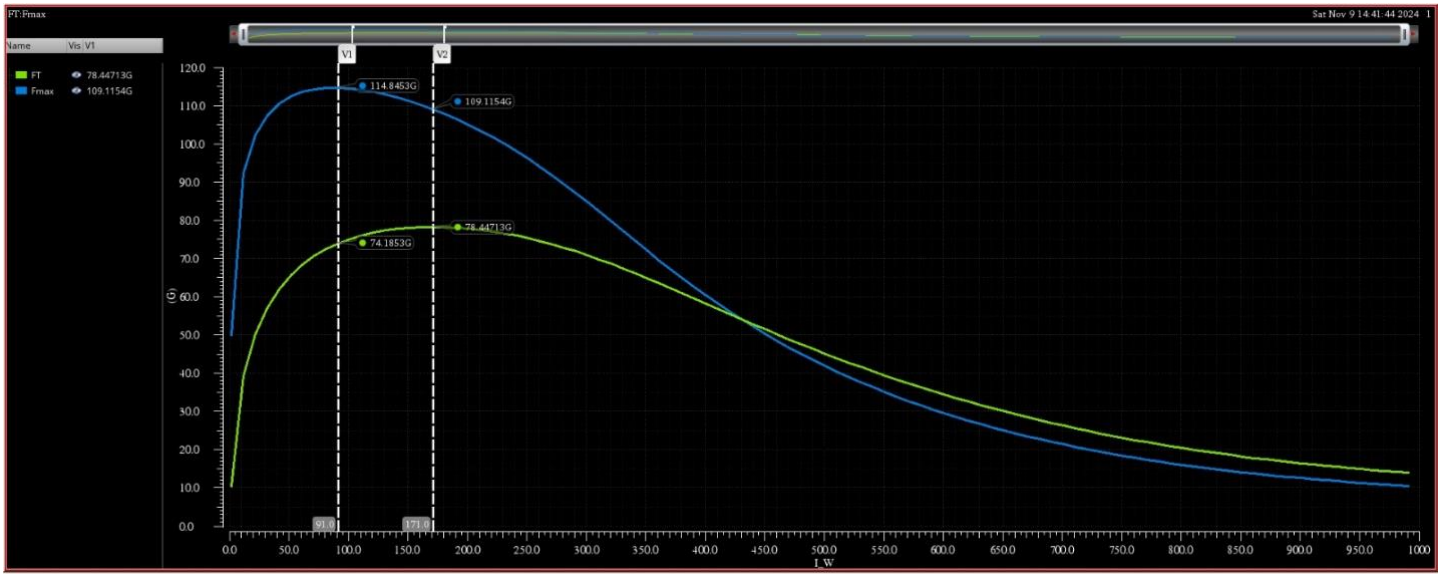
At $V_{DS} = 0.5V$



$J_{pFT} = 111.315\ \mu A/\mu m$ with highest $F_T = 64.56$ GHz.

$J_{pFMAX} = 60.53119\ \mu A/\mu m$ with highest $F_{MAX} = 100.42$ GHz.

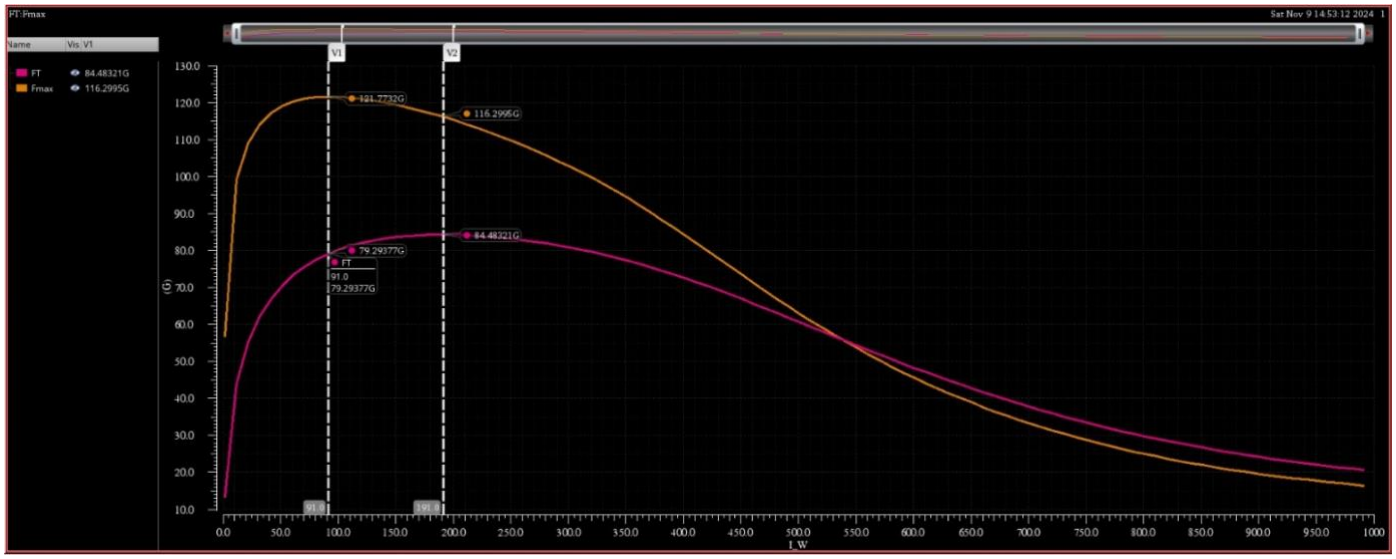
At $V_{DS} = 0.8V$



$J_{pFT} = 171\ \ \mu A/\mu m$ with highest $F_T = 78.447$ GHz.

$J_{pFMAX} = 91\ \mu A/\mu m$ with highest $F_{MAX} = 114.8453$ GHz

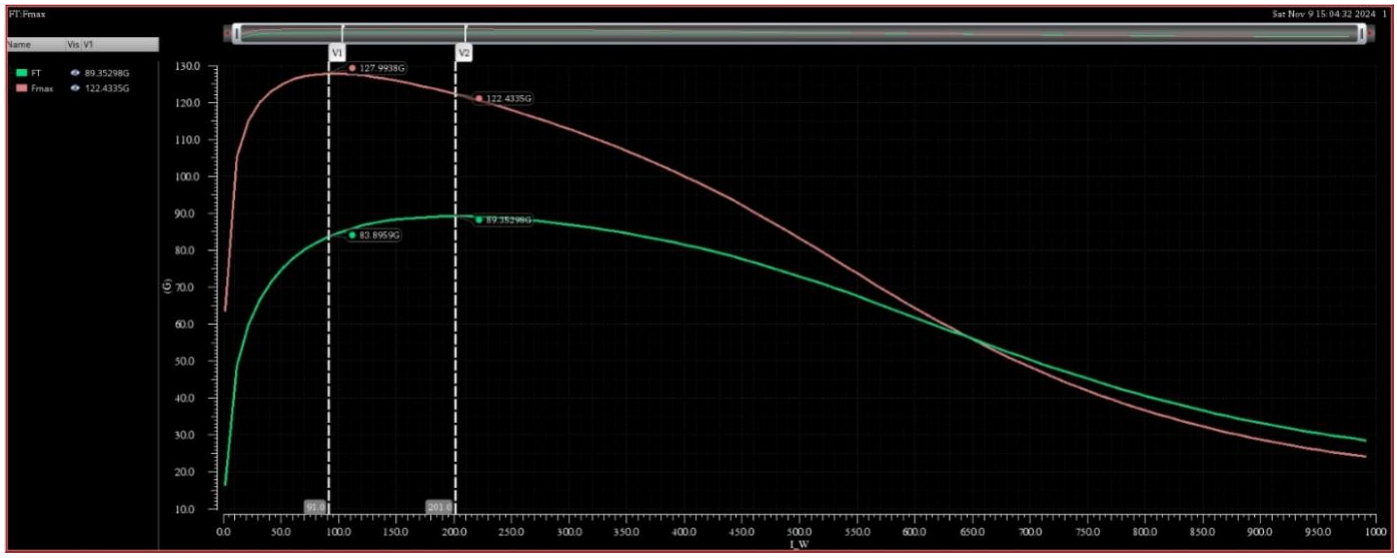
At $V_{DS} = 1.0V$



$J_{pFT} = 191\ \mu A/\mu m$ with highest $F_T = 84.4322$ GHz.

$J_{pFMAX} = 91\ \mu A/\mu m$ with highest $F_{MAX} = 121.7732$ GHz.

At $V_{DS} = 1.2V$

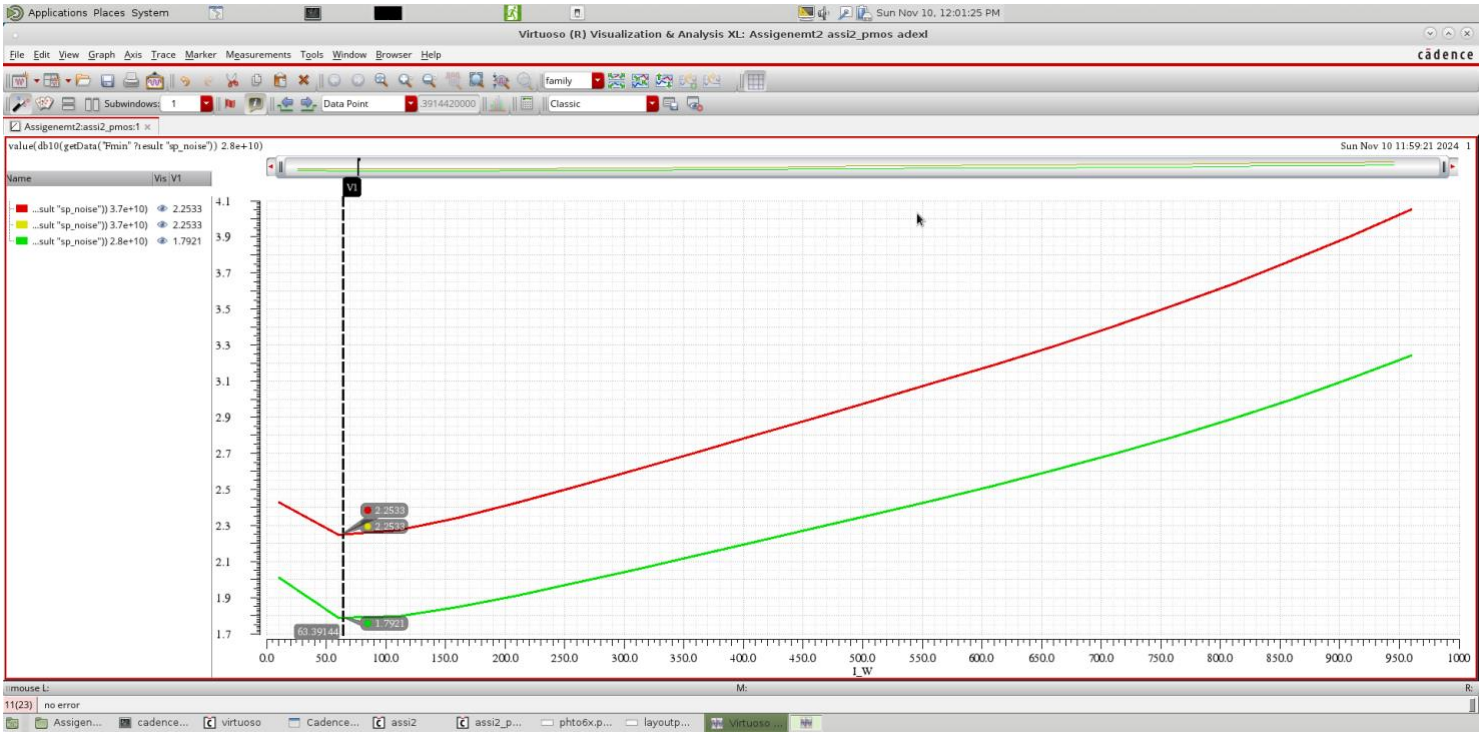


$J_{pFT} = 201\ \mu A/\mu m$ with highest $F_T = 89.35298$ GHz.

$J_{pFMAX} = 91\ \mu A/\mu m$ with highest $F_{MAX} = 127.9938$ GHz.

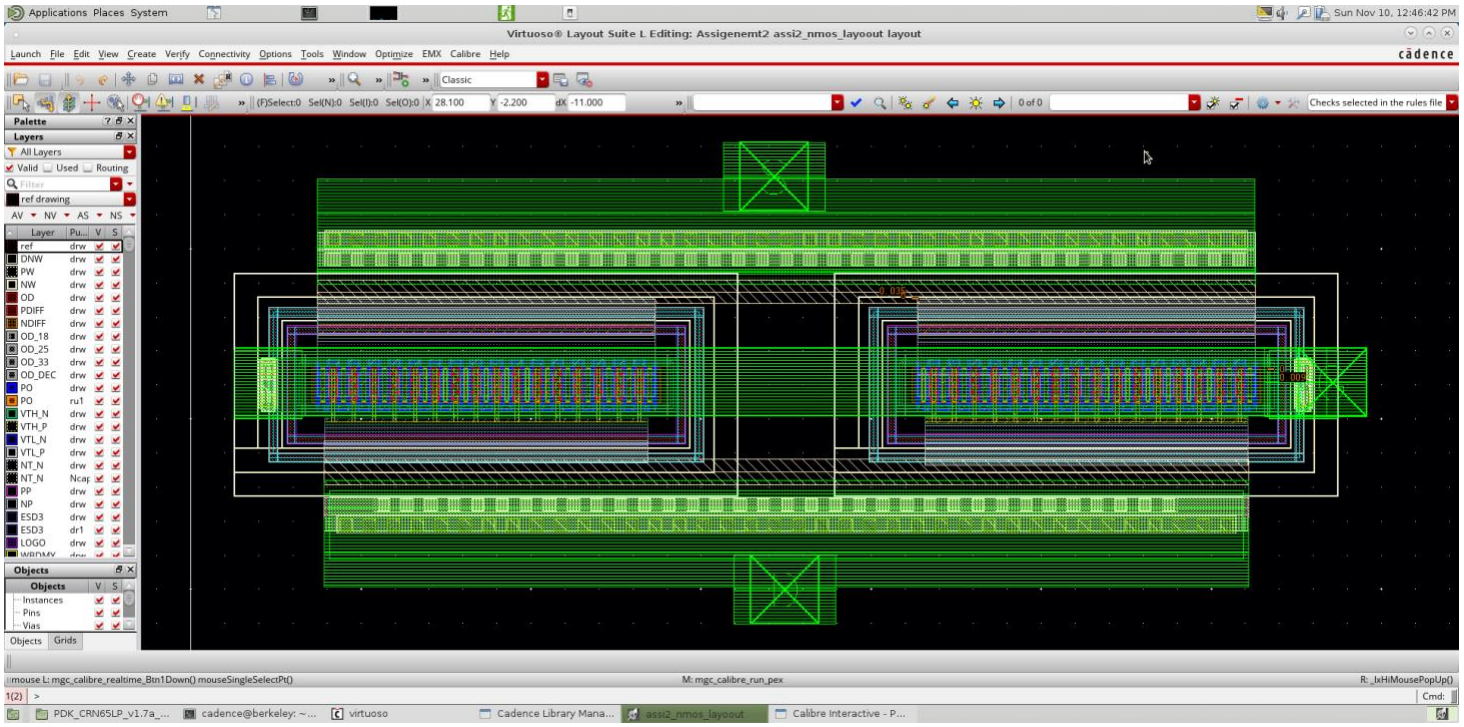
2. G_{MAX} @ 28Ghz & 37Ghz

2. NF_{min} @ 28Ghz & 37Ghz

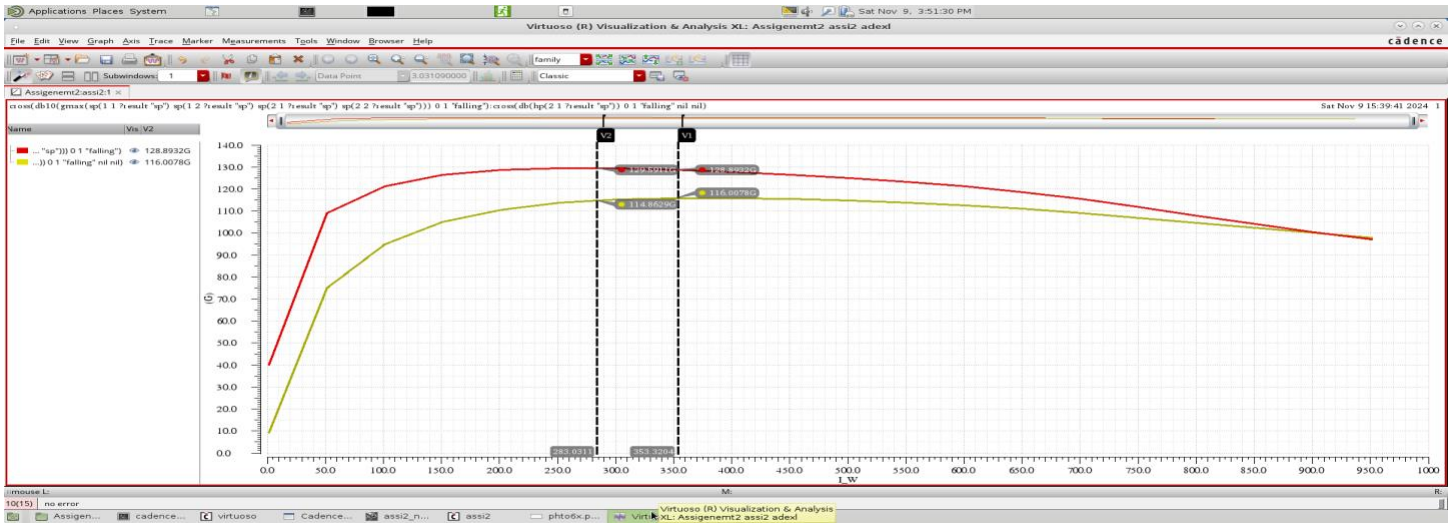


4. Repeat 1 to 3 after running RC extraction for the devices (make sure all the parasitics up to the top metallization with the routing of the 2 multipliers are included) and replot on the same graphs only for $V_{DS} = 1.0V$

NMOS layout



F_T & F_{MAX} at $V_{DS} = 1.0V$



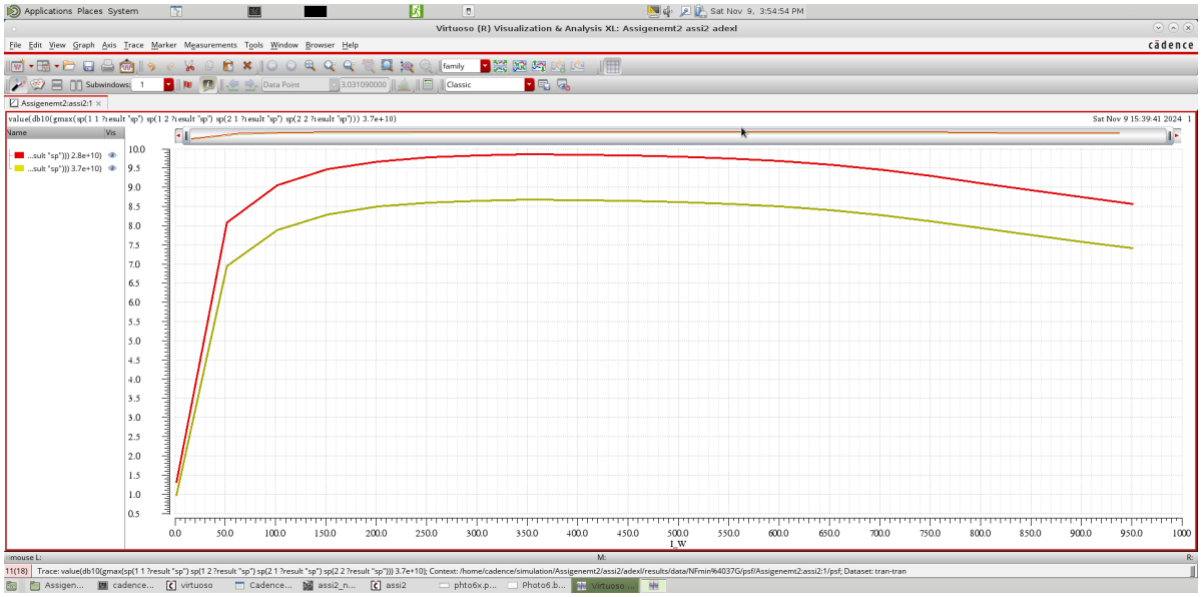
$J_{pFT} = 353.32\ \mu A/\mu m$ with highest $F_T = 116$ GHz.

$J_{pFMAX} = 283.0311\ \mu A/\mu m$ with highest $F_{MAX} = 129.59$ GHz.

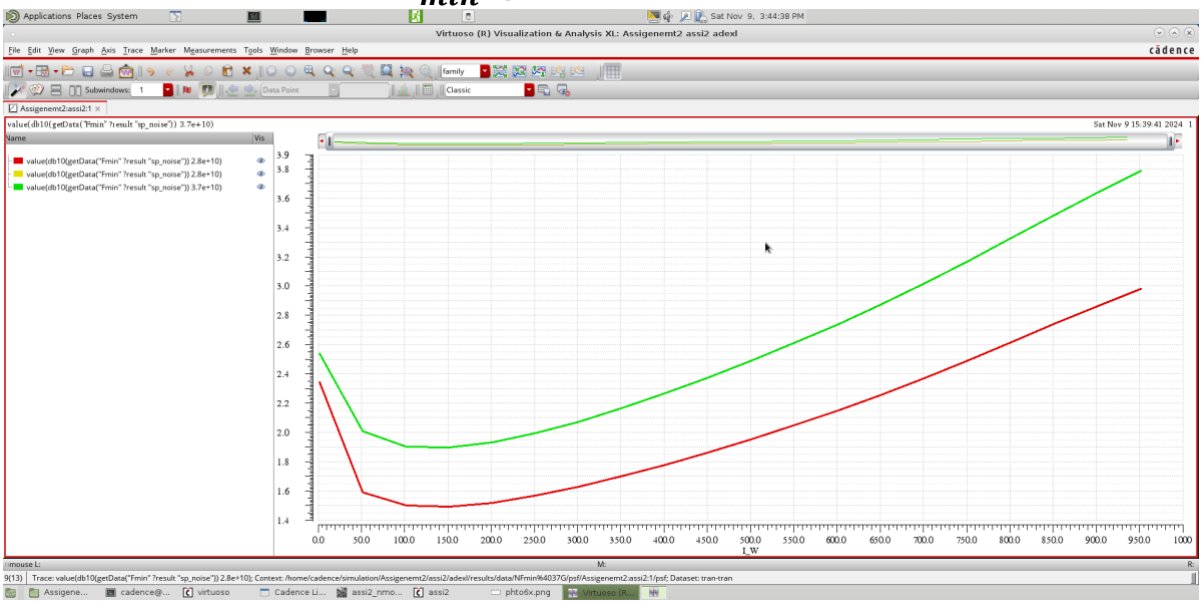
The value of F_{MAX} and F_T degrade because of parasitic generated by layout.

Before layout at $V_{DS} = 1.0V$. F_{MAX} was equal to $149.7453\ GHz$ & $F_T = 145.2082$ GHz

G_{MAX} @ 28Ghz & 37Ghz

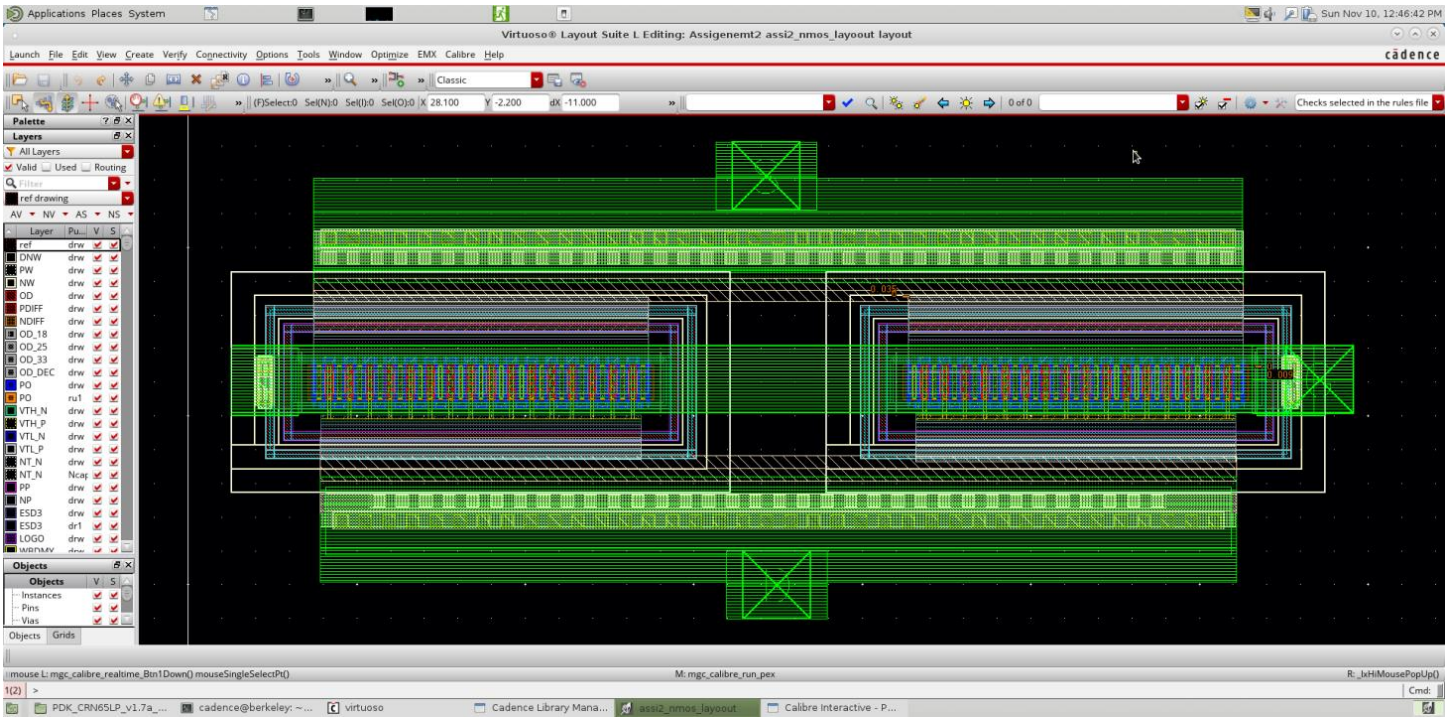


NF_{min} @ 28Ghz & 37Ghz

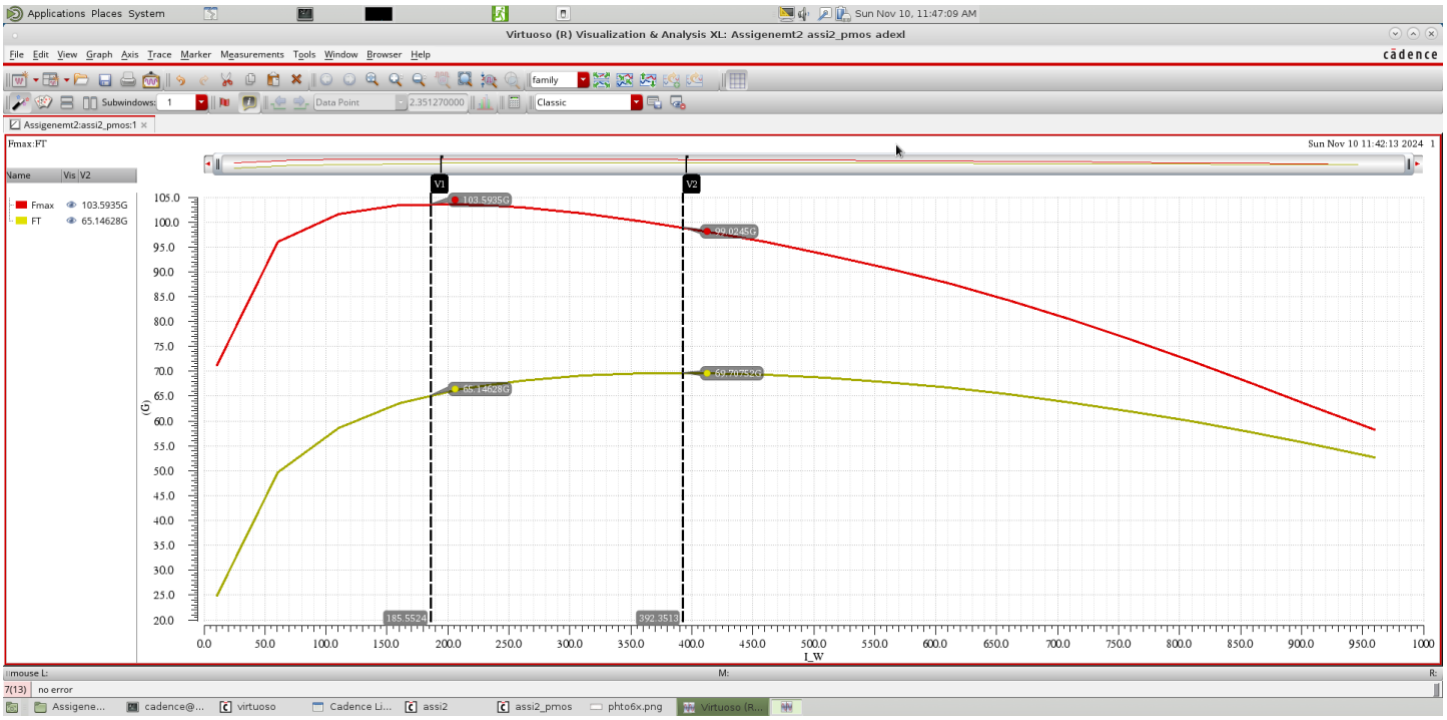


We can also see that the noise figure increased due to parasetics.

PMOS layout



F_T & F_{MAX} at $V_{DS} = 1.0V$



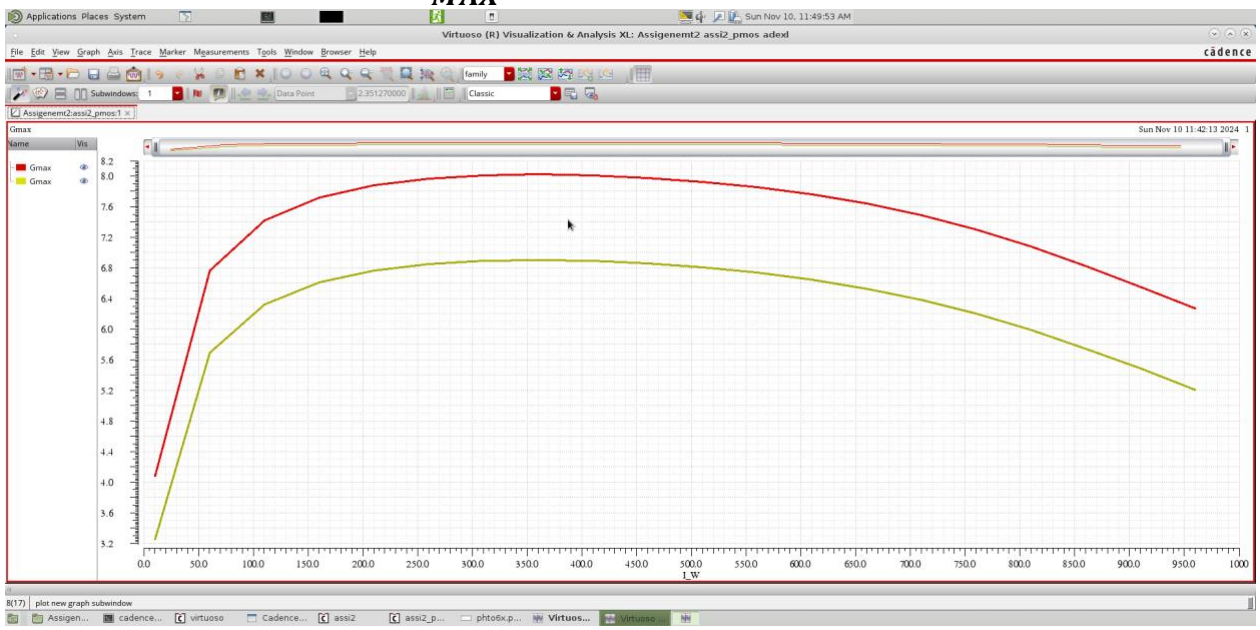
$J_{pFT} = 392.3513\ \mu A/\mu m$ with highest $F_T = 69.7$ GHz.

$J_{pFMAX} = 185.5524\ \mu A/\mu m$ with highest $F_{MAX} = 103.59$ GHz.

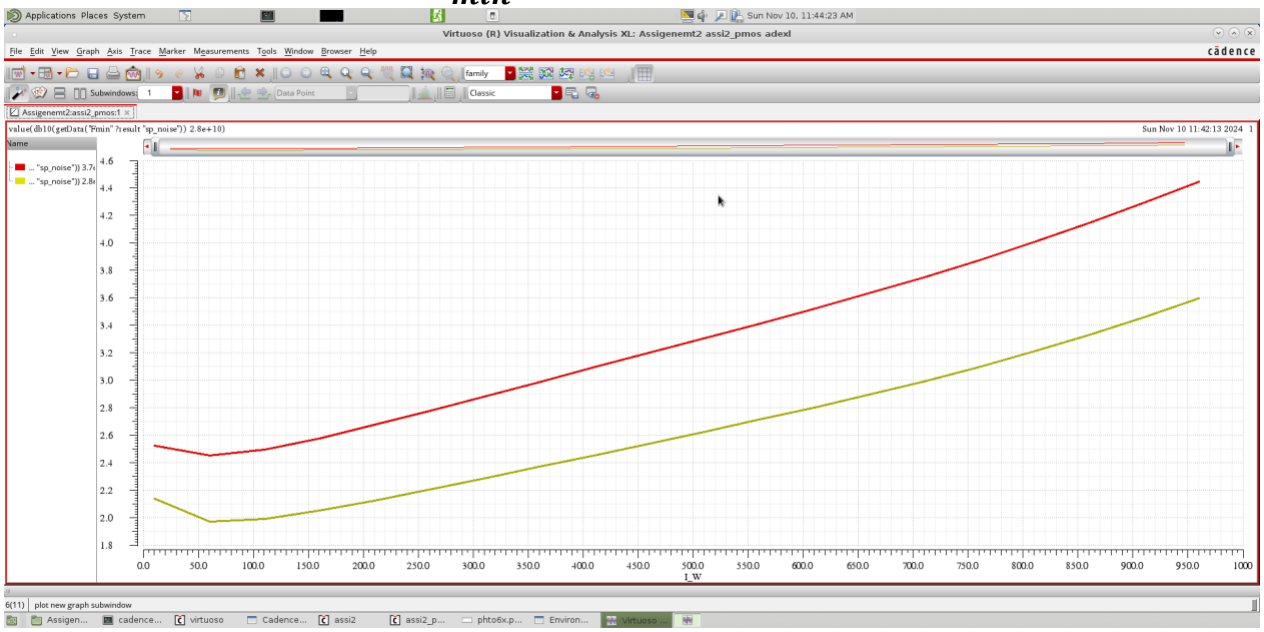
The value of F_{MAX} and F_T degrade because of parasitic generated by layout.

Before layout at $V_{DS} = 1.0V$. $F_T = 84.4322\ GHz$ & $F_{MAX} = 121.7732$ GHz

G_{MAX} @ 28Ghz & 37Ghz



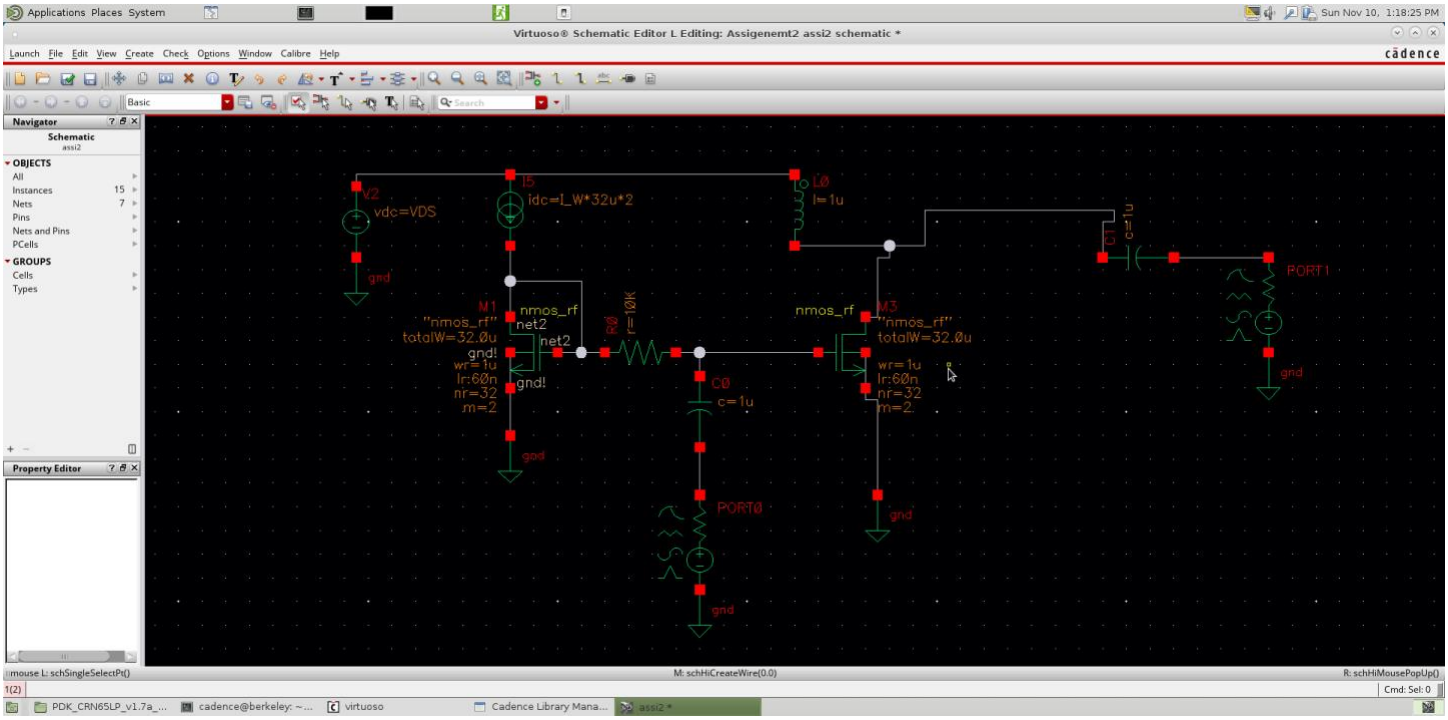
NF_{min} @ 28Ghz & 37Ghz

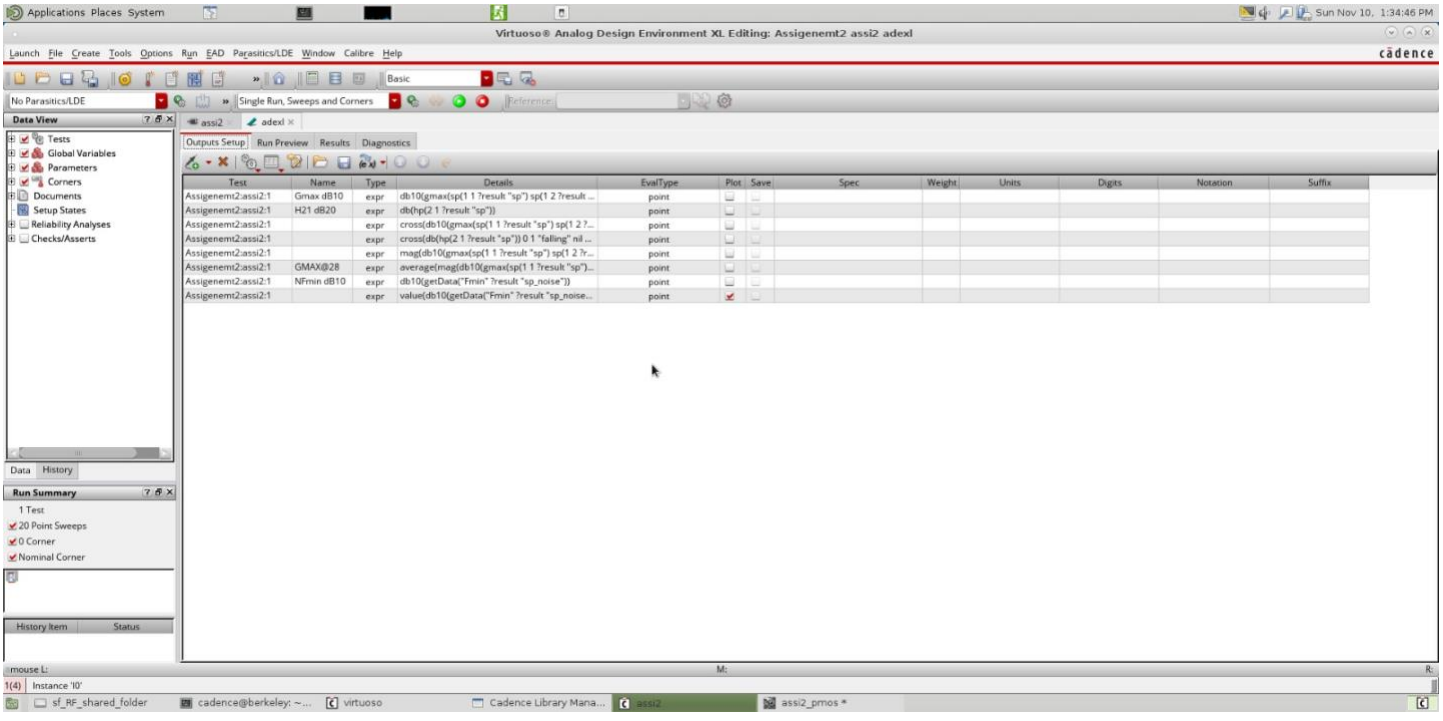


We can also see that the noise figure increased due to parasetics.

5. Show the testbench used to generate the results

NMOS testbench:





PMOS testbench: