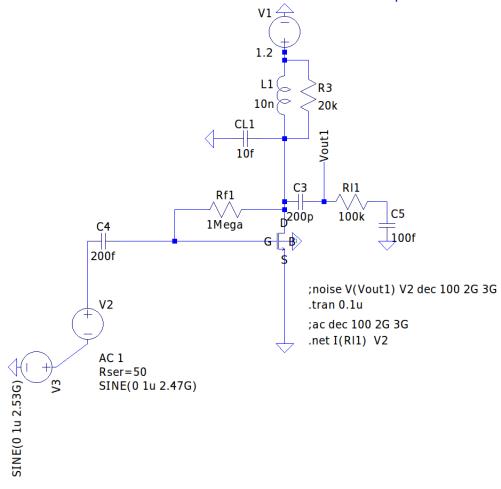
MINI PROJECT 2

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Justification

Drain-feedback CG Low Noise Amplifier



- This implementation is Drain-feedback Common Gain Noise Low Noise Amplifier with inductor degeneration.
- The drain feedback ensures DC biasing.
- \bullet Inductor ensures that low pass gain is pushed to bandpass in our desired frequency range of 2GHz-3GHz.

• $Nf = 1 + \frac{R_s}{R_f} + \frac{\gamma}{g_m R_s} + \frac{1}{R_s R_d g_m^2}$, High drain feedback and high transconductance ensure low Noise figures.

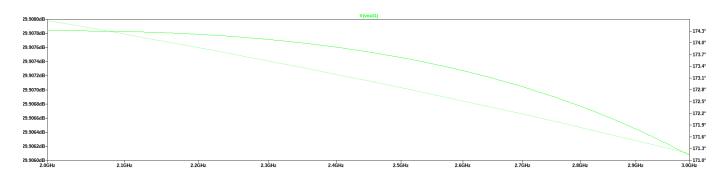
Design specifications

NMOS of L=65nm and W=100 μ m is used.

Netlist

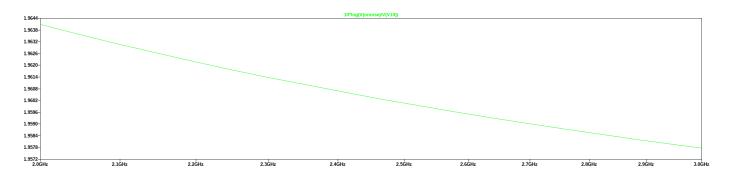
```
* Z:\home\solomon\ICWC\Mini_Projects\Mini_Project_2\final_lna.asc
XX1 N004 N002 0 0 nmos65 params: L=65nm, W=100um, M=10
V1 N001 0 1.2
C3 Vout1 N002 200p
Rl1 N003 Vout1 100k
C4 N004 N005 200 f
Rf1 N002 N004 1Mega
L1 N002 N001 10n Rser=1.57k
CL1 N002 0 10 f
C5 N003 0 100 f
V2 N005 N006 SINE(0 1u 2.47G) AC 1 Rser=50
R3 N001 N002 20k
V3 N006 0 SINE(0 1u 2.53G)
* block symbol definitions
.subckt nmos65 G D S B
M1 D G S B NMOS l=\{L\} w=\{W\} ad=2*65n*\{W\} as=2*65n*\{W\} pd=2*(2*65n+\{W\}) ps=2*(2*65n+\{W\})
.PARAM L=65n W=1u M=1
.ends nmos65
. model NMOS NMOS
. model PMOS PMOS
. lib C:\users\solomon\My Documents\LTspiceXVII\lib\cmp\standard.mos
; ac dec 100 2G 3G
.tran 0.1u
; noise V(Vout1) V2 dec 100 2G 3G
.net I(Rl1) V2
* Drain-feedback CG Low Noise Amplifier
. backanno
. end
```

Gain



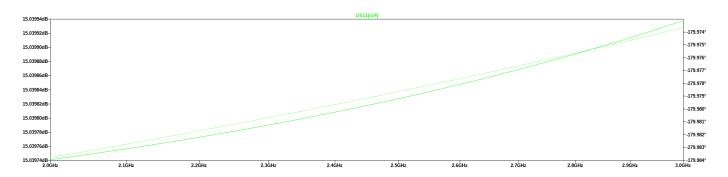
A gain of **29.9dB** was obtained.

Noise Figure



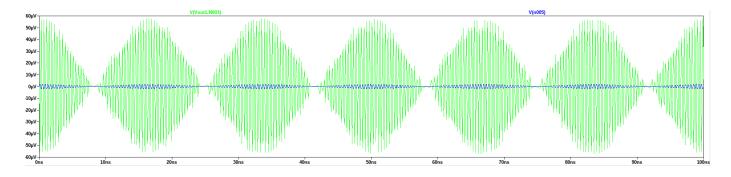
Noise figure is below ${\bf 1.96dBm}.$

Input Return Loss

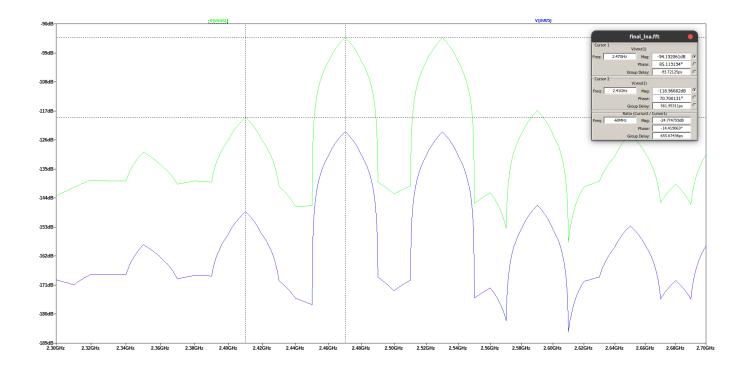


Input return loss is 15dB.

Dual-tone test



Input signal consists of two sinusoids at $2.47\mathrm{GHz}$ and $2.53\mathrm{GHz}.$



$$\begin{split} A_1 &= -94.2dB; A_2 = -118.97dB \\ IIP_3 &= \frac{\Delta P}{2} + P_{in} \\ IIP_3 &= -47.6 \text{dB} \end{split}$$

Obtained specifications

- Gain = 29.9dB
- Input return loss = 15dB
- Noise figure = 1.96dBm
- IIP3 = -47.6dB