

MINI PROJECT 1

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Calculations

We need a step-down matching network to match $250\ \Omega$ to $50\ \Omega$.

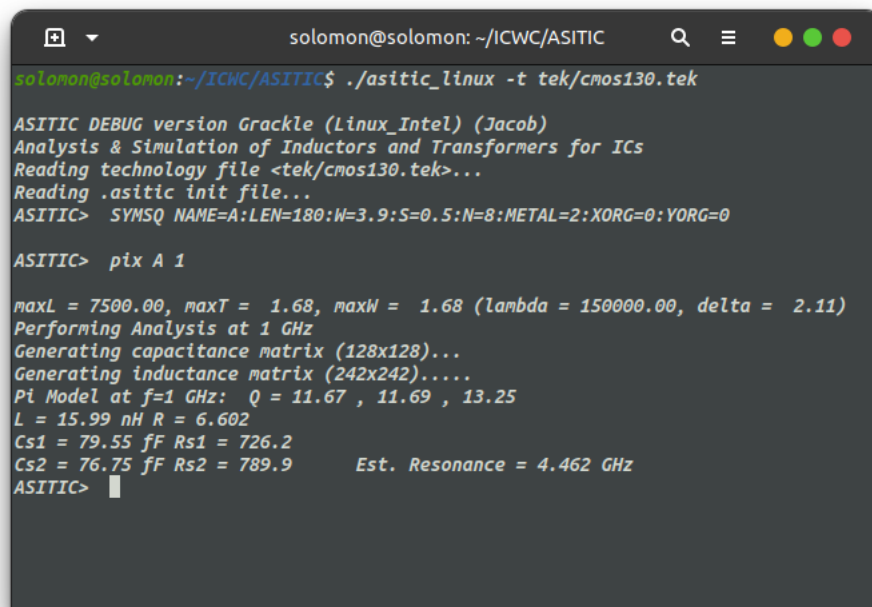
$$Q = \sqrt{\frac{250}{50} - 1} \Rightarrow Q = 2$$

$$Q = \frac{\omega L}{50} \Rightarrow L = 15.9\text{ nH}$$

$$Q = \omega C 250 \Rightarrow C = 1.2\text{ pF}$$

On chip inductor design

Inductor design is done on ASITIC CAD tool. Using **Square Symmetric Spiral** with the below specifications.



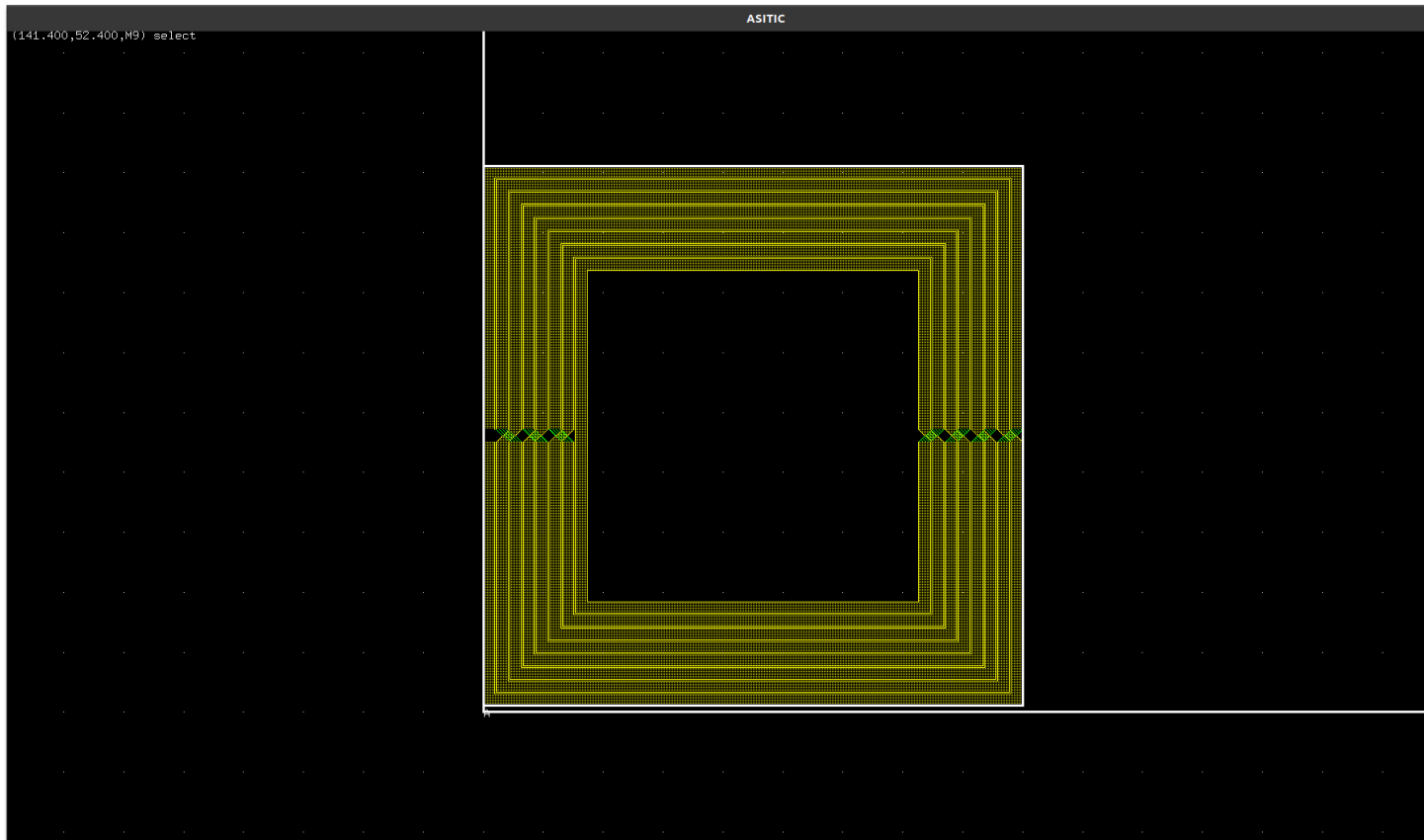
```
solomon@solomon: ~/ICWC/ASITIC
solomon@solomon:~/ICWC/ASITIC$ ./asitic_linux -t tek/cmos130.tek

ASITIC DEBUG version Grackle (Linux_Intel) (Jacob)
Analysis & Simulation of Inductors and Transformers for ICs
Reading technology file <tek/cmos130.tek>...
Reading .asitic init file...
ASITIC> SYMSQ NAME=A:LEN=180:W=3.9:S=0.5:N=8:METAL=2:XORG=0:YORG=0

ASITIC> pix A 1

maxL = 7500.00, maxT = 1.68, maxW = 1.68 (lambda = 150000.00, delta = 2.11)
Performing Analysis at 1 GHz
Generating capacitance matrix (128x128)...
Generating inductance matrix (242x242)....
Pi Model at f=1 GHz: Q = 11.67 , 11.69 , 13.25
L = 15.99 nH R = 6.602
Cs1 = 79.55 fF Rs1 = 726.2
Cs2 = 76.75 fF Rs2 = 789.9      Est. Resonance = 4.462 GHz
ASITIC> 
```

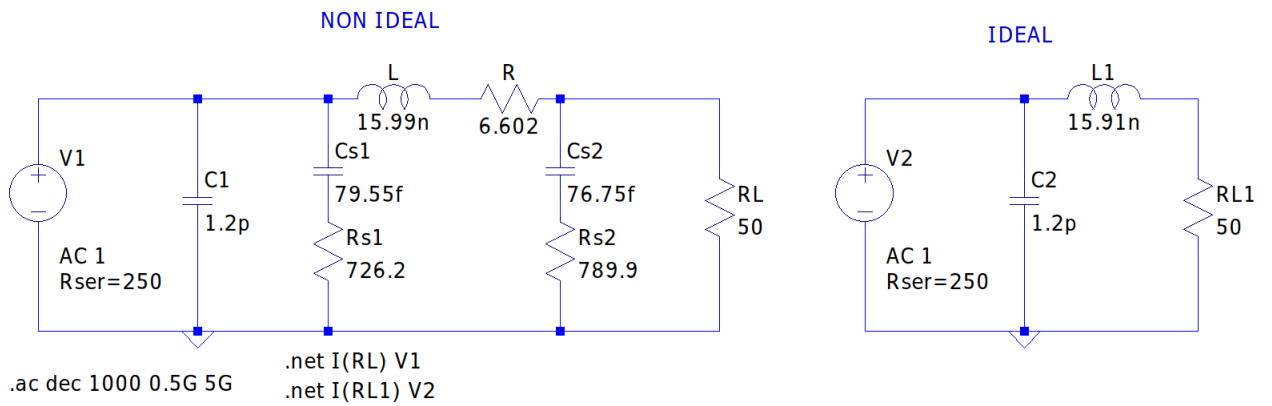
The Pi Model parameters are ,
 $L = 15.99\text{nF}$, $R = 6.602\Omega$, $Cs1 = 79.55\text{fF}$, $Rs1 = 726.2\Omega$, $Cs2 = 76.75\text{fF}$, $Rs2 = 789.9\Omega$.



Schematic

Both ideal and non-ideal networks are simulated and compared.

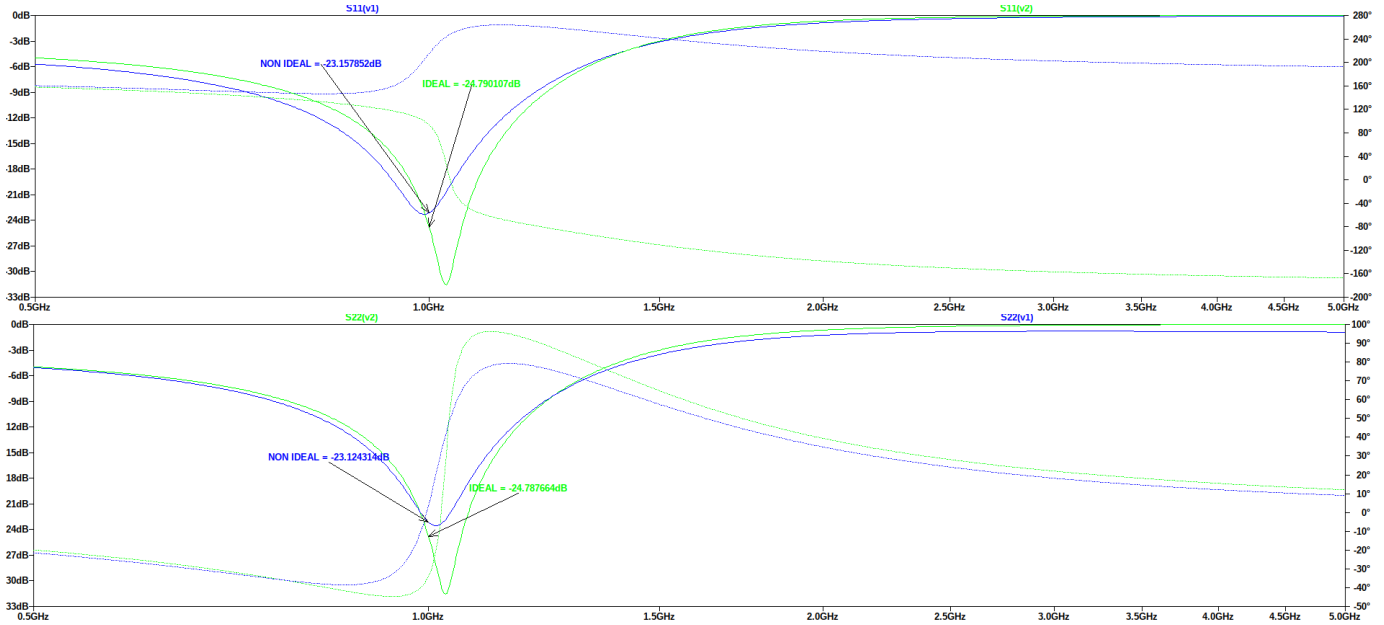
MATCHING NETWORK



S-parameters

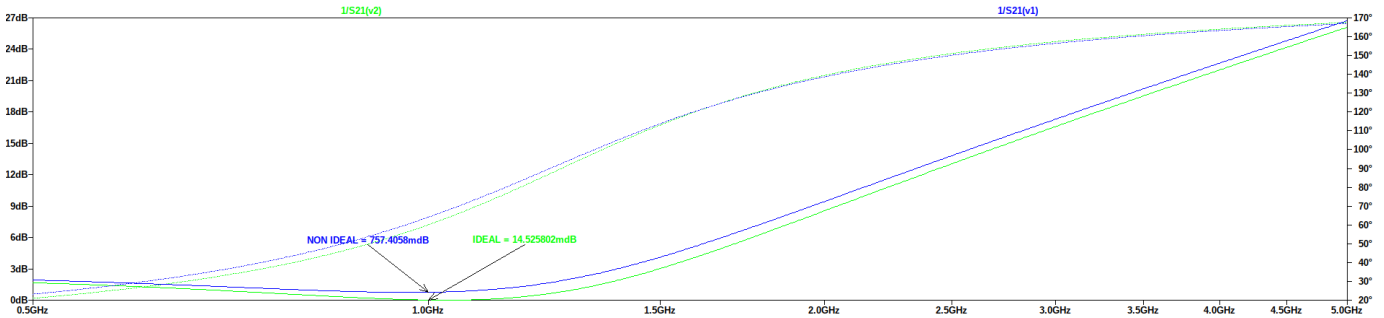
S11, S22 Return Loss

Port 1 side is **-23.15dB** and Port 2 side is **-23.12dB** which also satisfies given constraints.

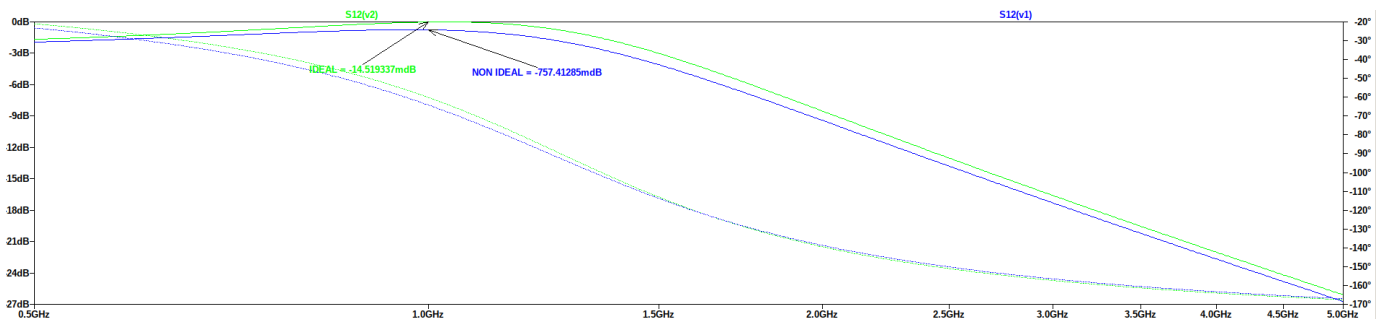


Insertion Loss

Insertion loss here is $-20\log|S_{21}|$ and the same is plotted. After many iterations of inductor design, insertion loss of **757.4mdB** is obtained.



S12



IDEAL vs NON IDEAL

S-parameters	IDEAL	NON IDEAL	Metric
S11	-24.79dB	-23.157dB	<i>Lower is better.</i>
S12	-14.52mdB	-757.4mdB	<i>Lower is better.</i>
S21	-14.52mdB	-757.4mdB	<i>Higher is better.</i>
S22	-24.79dB	-23.12dB	<i>Lower is better.</i>