Master Thesis Presentation

Stripline Coil for Magnetic Resonance Tomograph

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Supervised by
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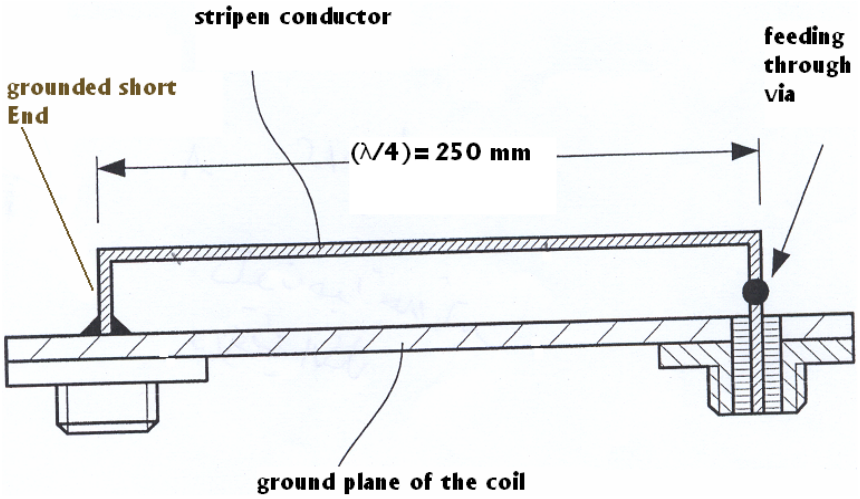
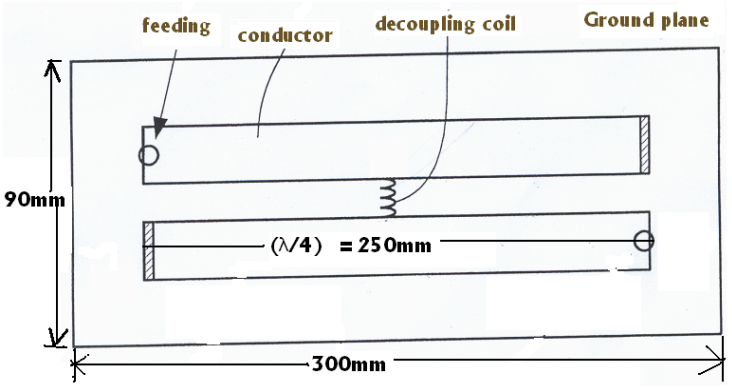
- **Introduction**
- **3-D Simulation**
- **90° hybrid**
- **Matching**
- **Experimental measurement**
- **Conclusion**
- **Futur work**

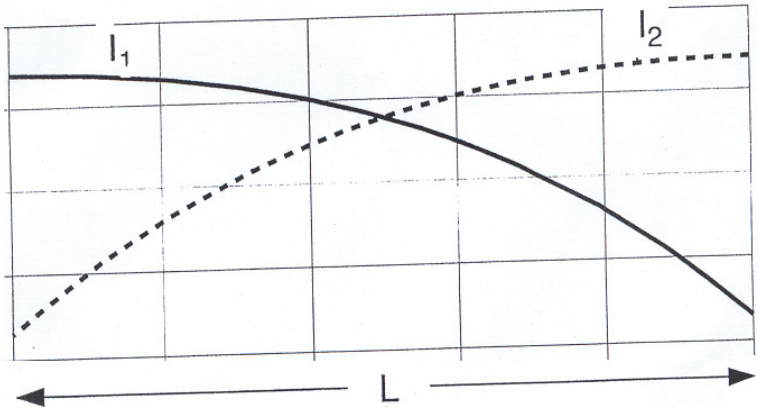
Introduction

- Two parallel strip conductors of length (λ/4).
- Both are shorted from one side to ground and connected to Ports to the other side, such that the short Ends are not on the same ends.
- Both Ports are excited instantaneously and and are 180° out of phase





- Superposition of both magnetic field of I1 & I2 leads to more homogeneous and less bending



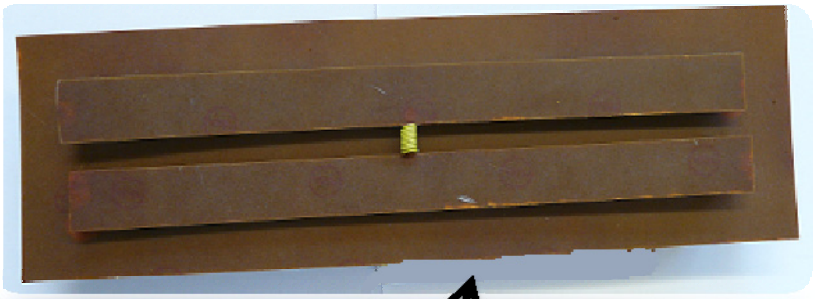
- Due to the vicinity of the strip conductors,Electromagnetic coupling occurs between them.

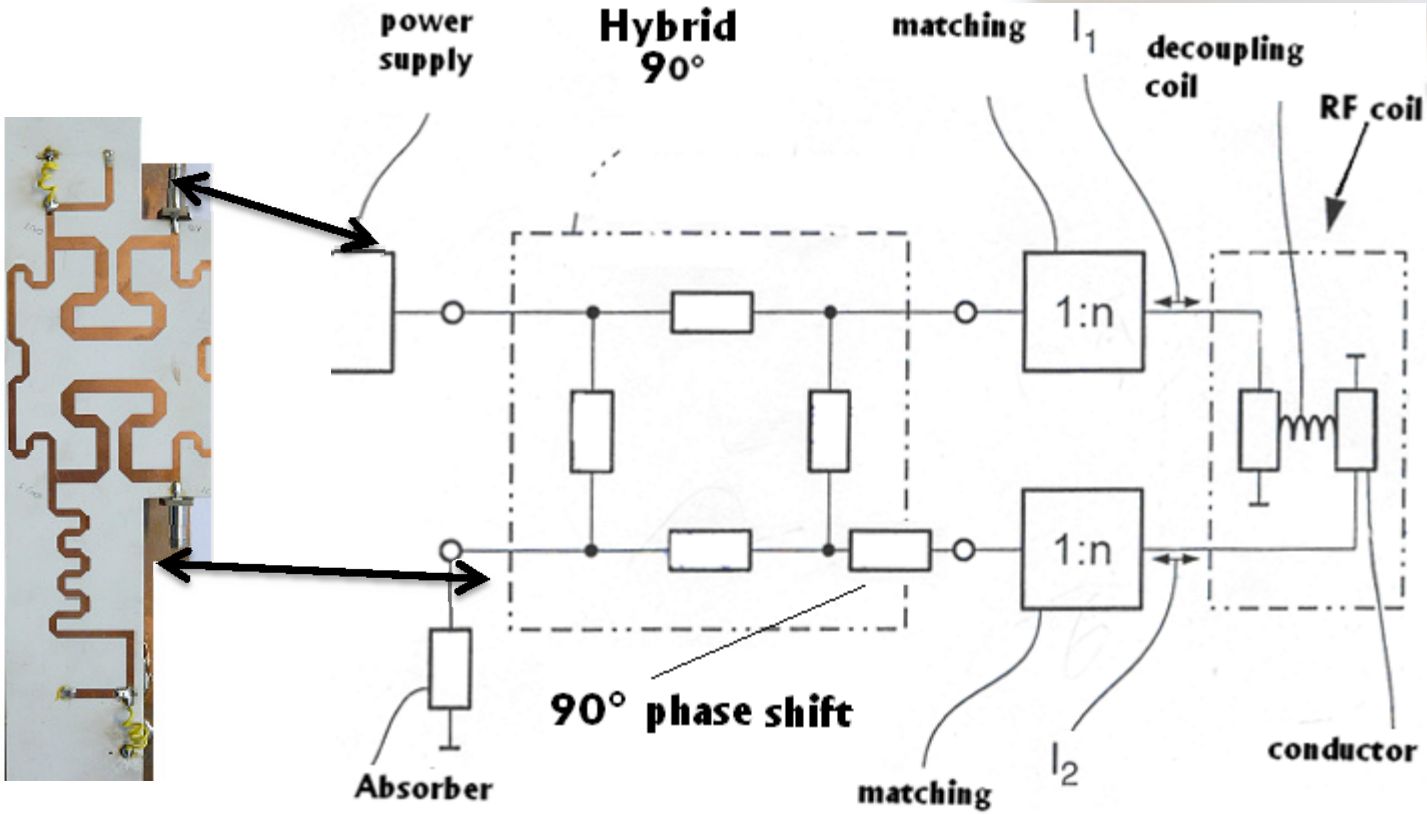
- Two modes of propagation appear even and Odd, and are different because of two different propagated medium

- $L=\lambda/4$ ⟶ Maximum Coupling
- This coupling causes to Power losses.
- Compensate the capacitive coupling using inductive coupling(Air inductor).
- The decoupling Inductor is mounted in a such way that its magnetic Field is perpendicular to the Field of the Coil

View of the overall System

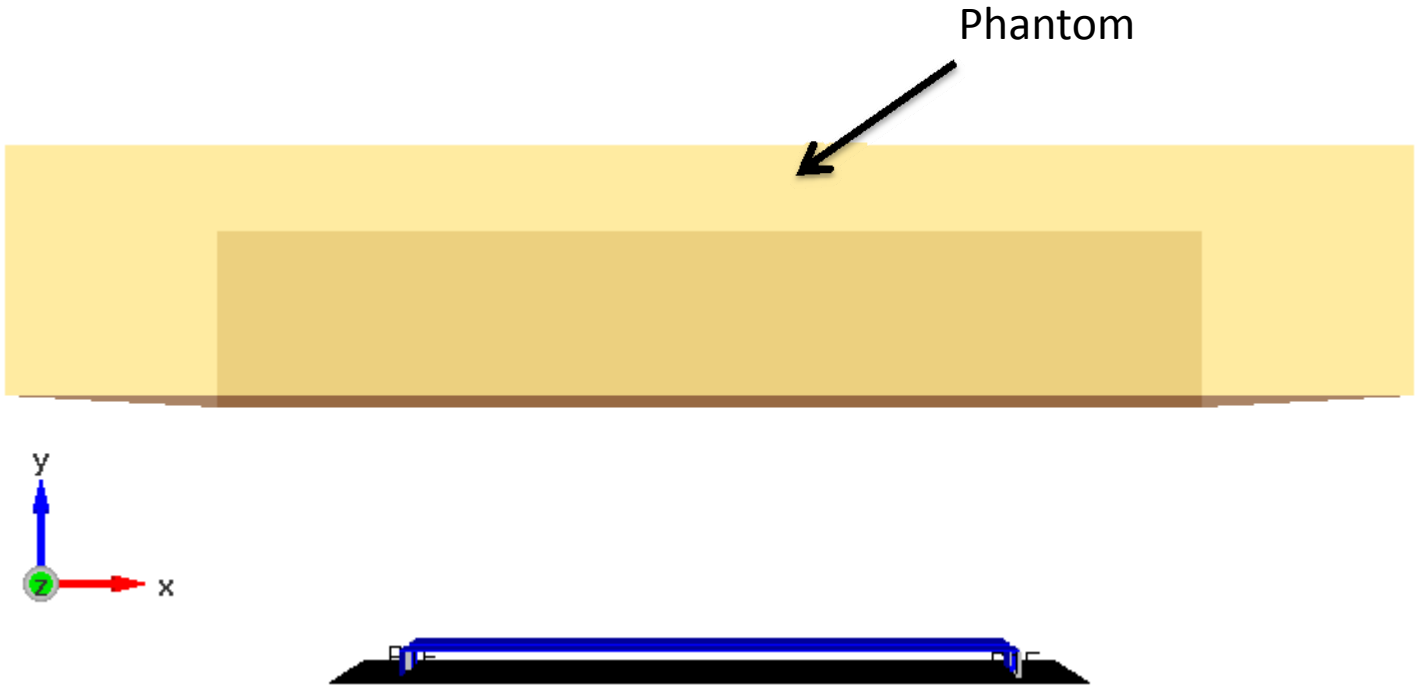
- Two modes
- Two different matching needed
- Coplings depends upon excitation
- Coupling upset the Input impedance





3-D Simulation

- Empire Simulator



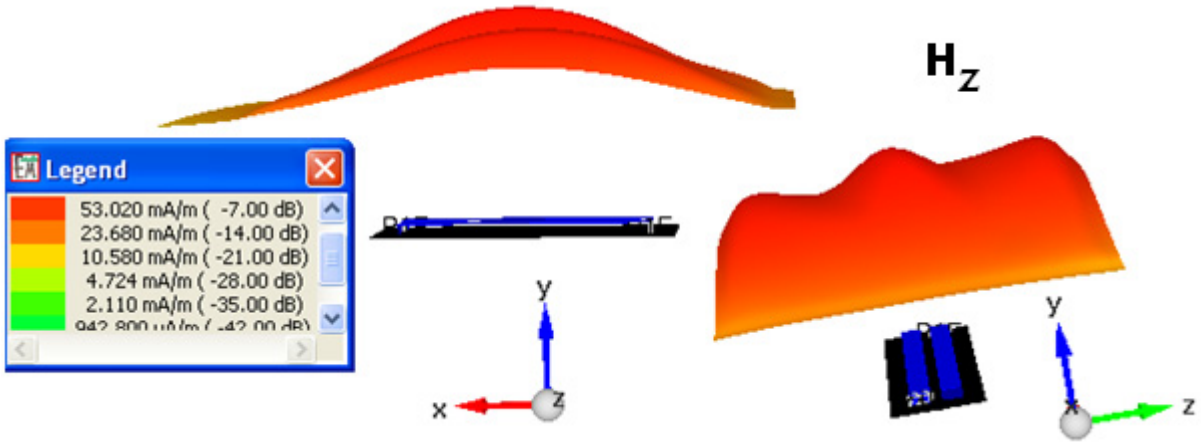
- **The main constant(7 Tesla) magnetic Field is in the direction of X-axis(direction of current distribution in the conductors of the coil),so that we are only interesting with the Field components that are perpendicular to the main Field to produce circulation magnetic Field.**

→ **Both Hy&Hz have to by investigated**

- **Otherwise we ignore half the power**

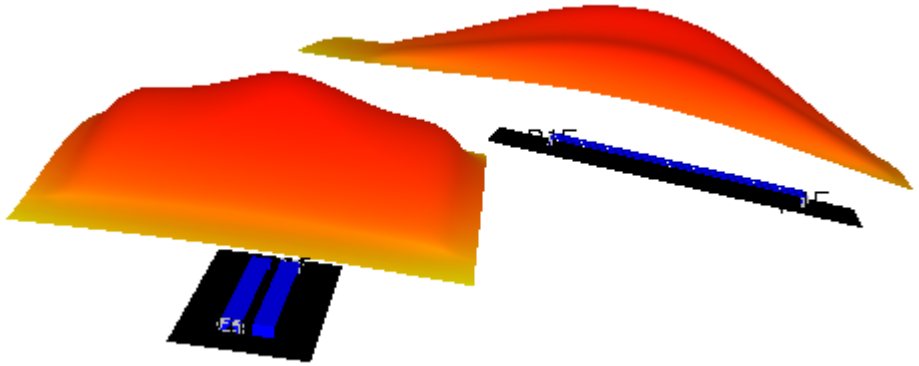
Magnetic Field investigation

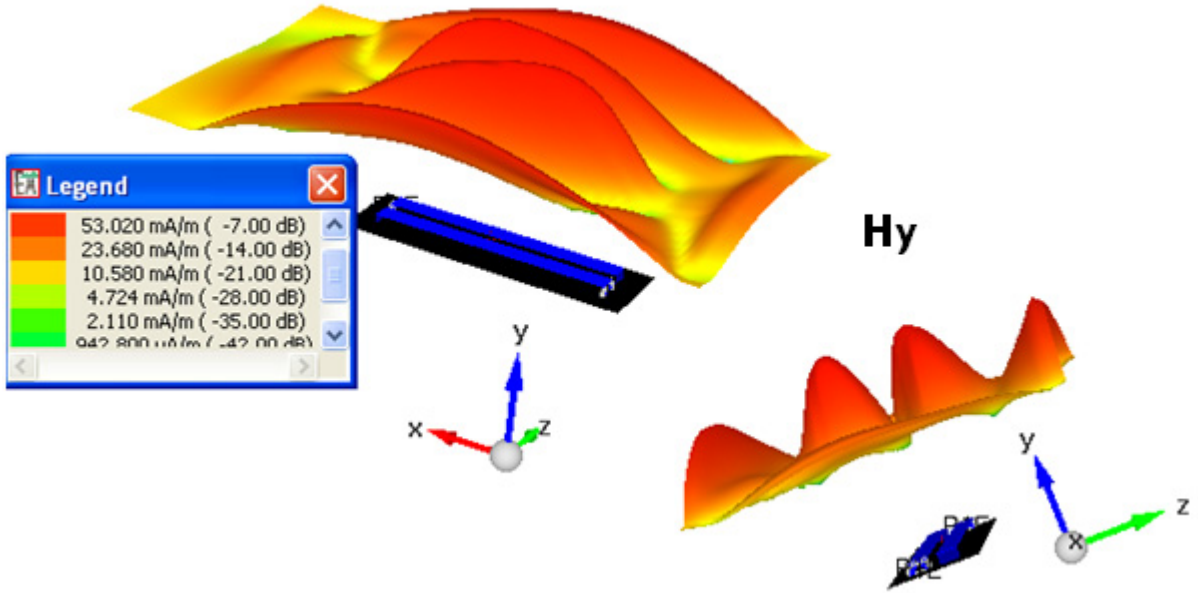
- Superposition of Fields



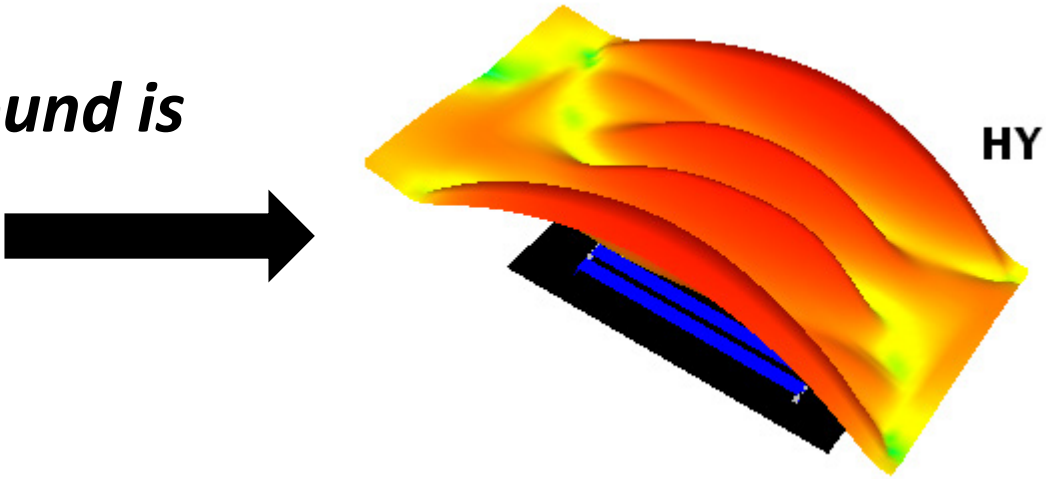
when the ground is bigger **:**

- surfaces are more flat
- Substrate collects the stray fields



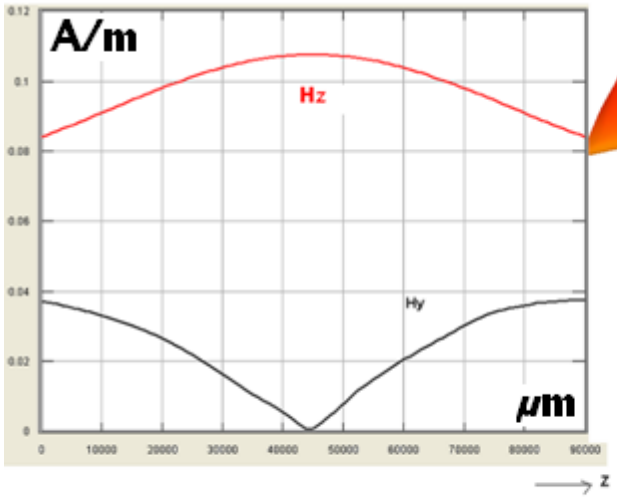


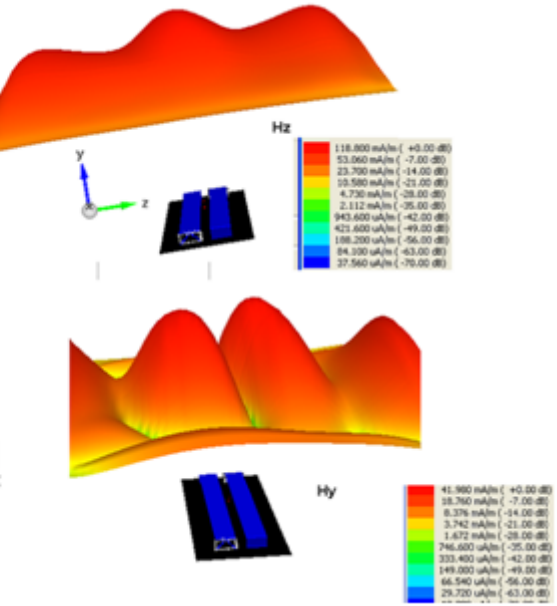
When the ground is bigger

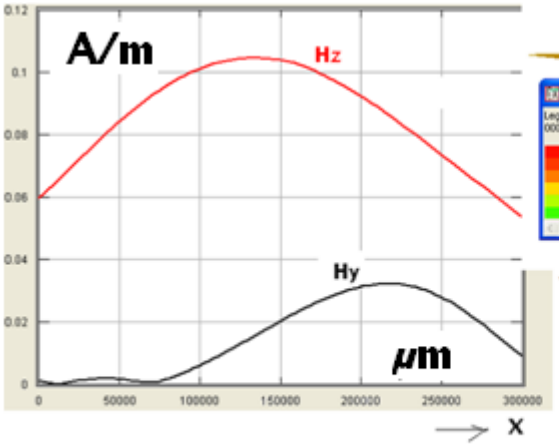


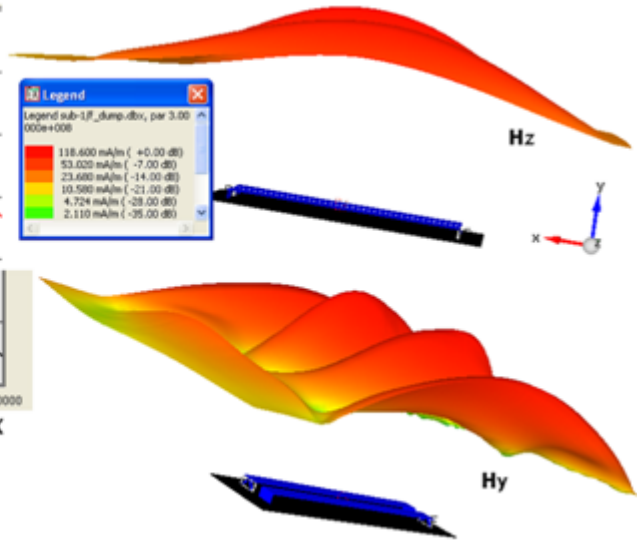
2-D representation of Fields gives more informations:

- Values and
- Locations



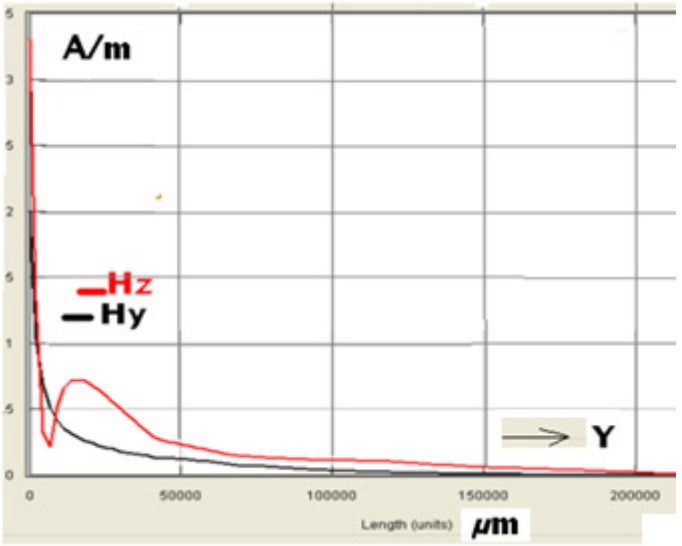




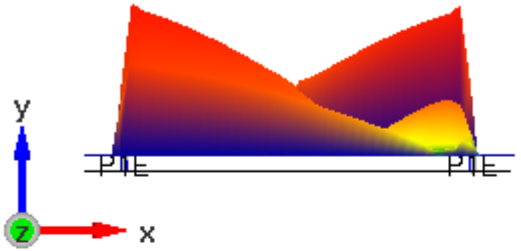


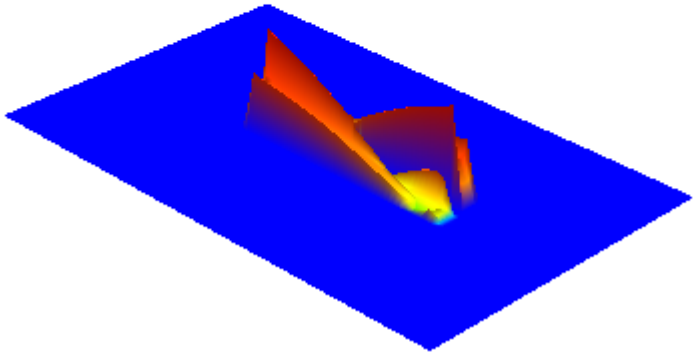
- decays with square of (1/r).

- Hz decays with the (1/r).



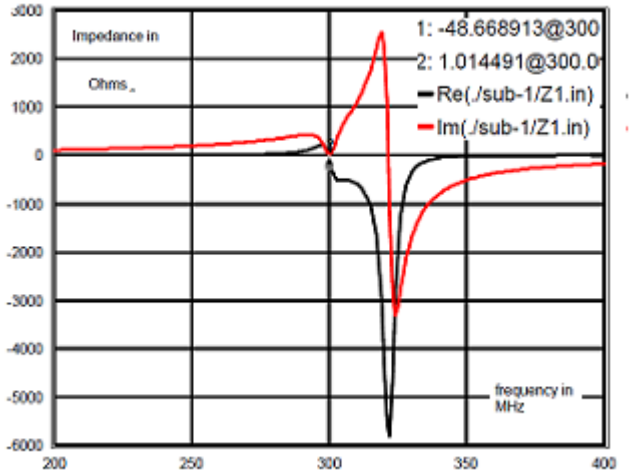
- Current density (Jx) distribution along the Coil.



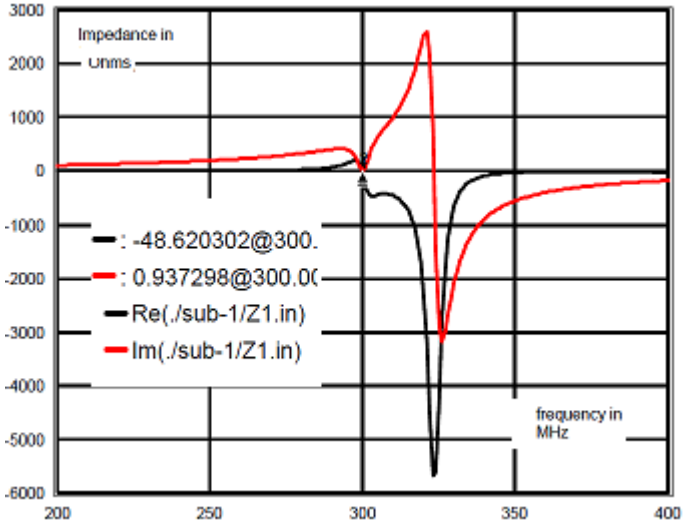


Investigation of the input Impedance of the coil

Phantom at 5cm from the coil



Phantom at 10cm from the coil

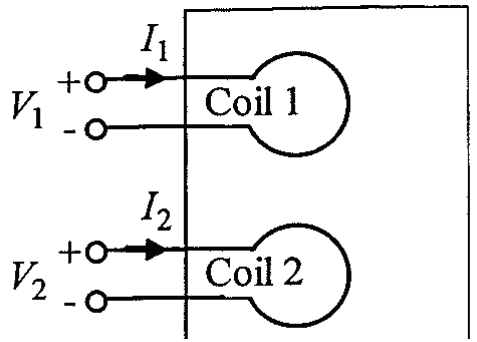


Same results!!(high coupling)

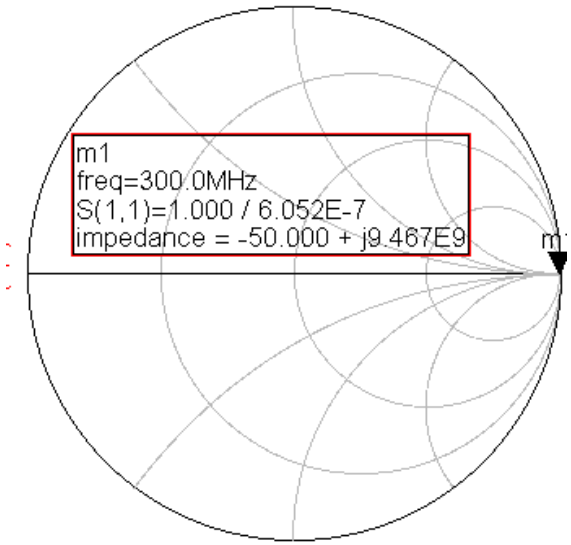
Real part is negative??

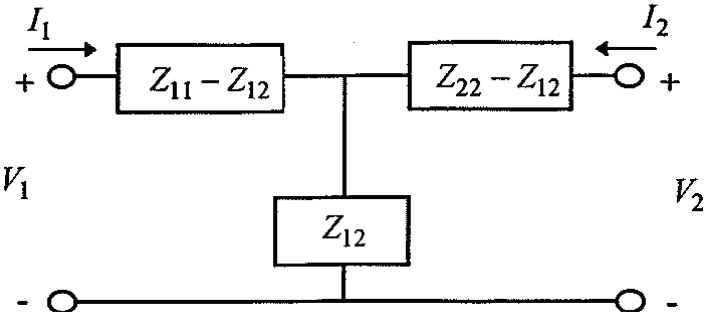
Assume two side by side Coil

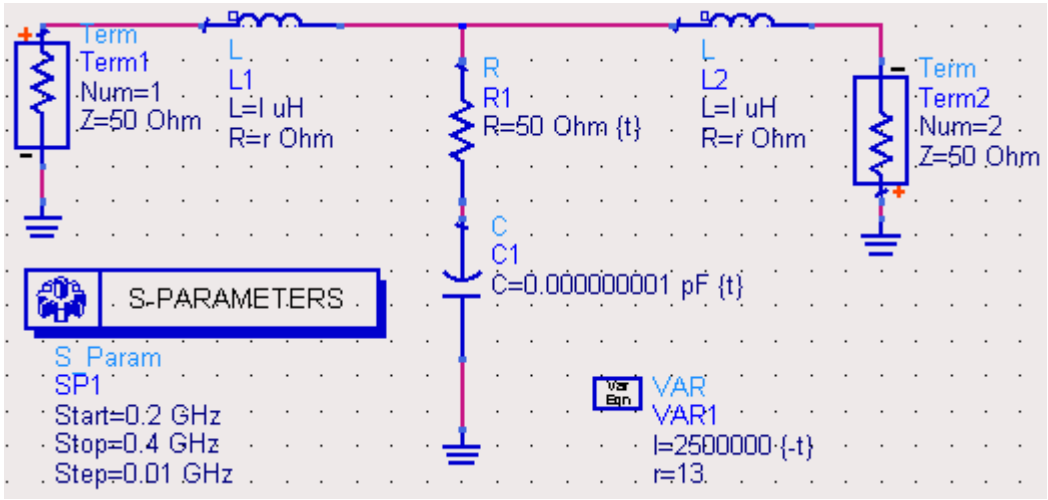
$Z_{12}=Z_{21}$
$Z_{22}=Z_{11}$ } Symmetry



Equivalent Circuit



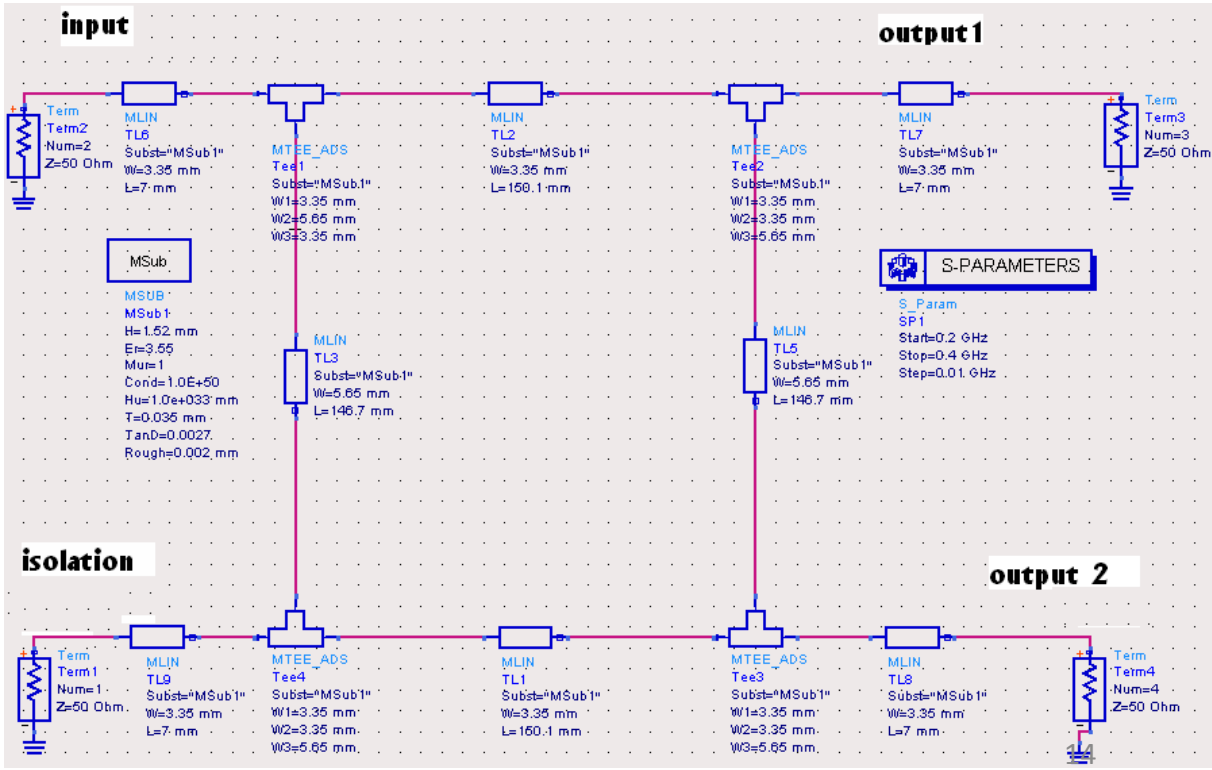




•90° Hybrid

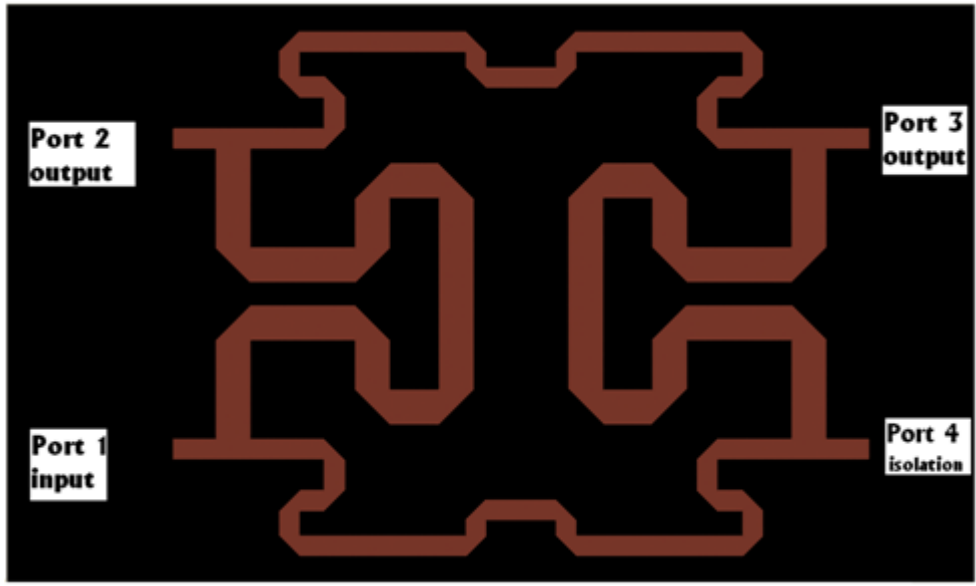
Substrate:Roger4003: ε_r =3.55, H=1.52 mm

- ***Sensitive to unbalanced loads.***
- ***Used as: Splitter/Combiner/ Phase shifter.***

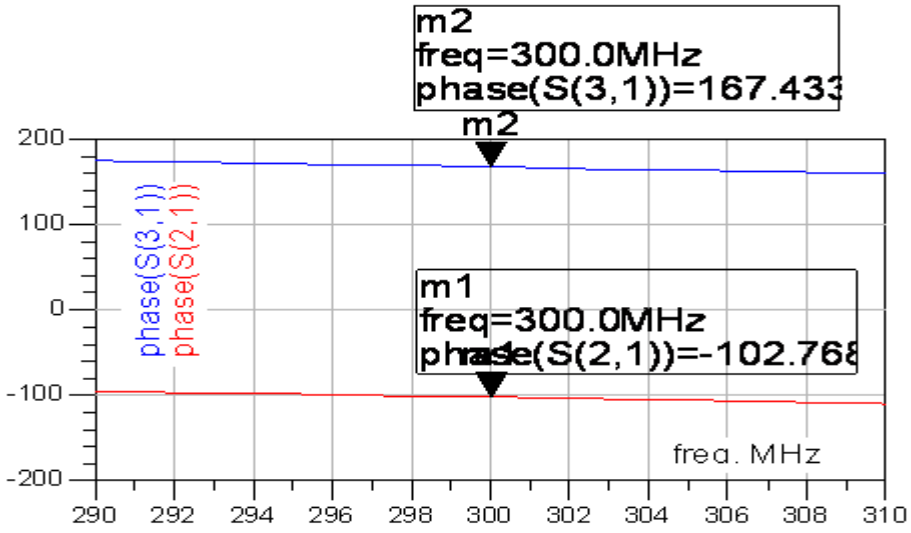


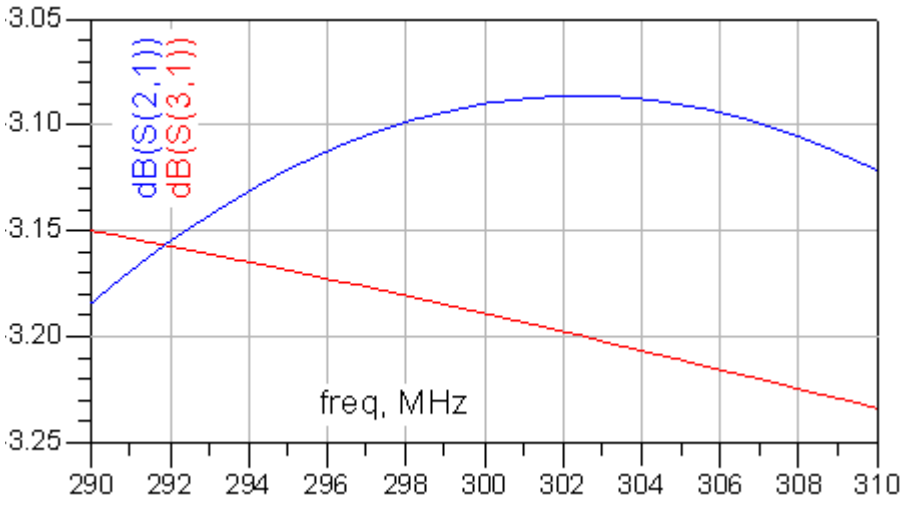
•90° Hybrid

Momentum Layout

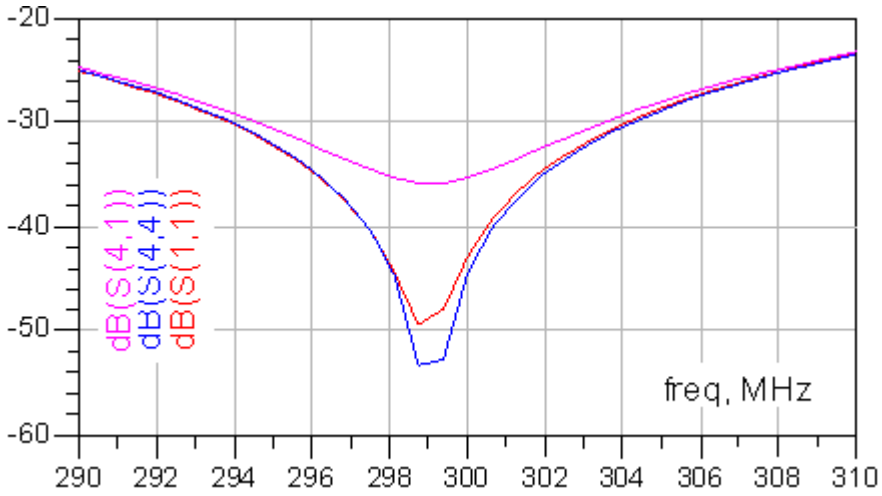


Main characteristics:

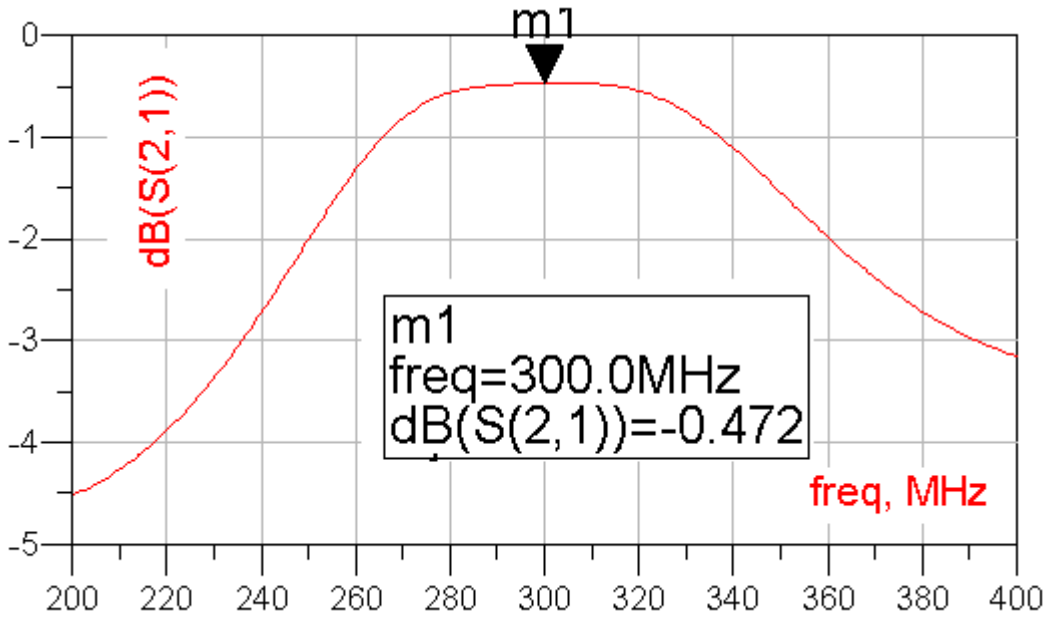




•90° Hybrid

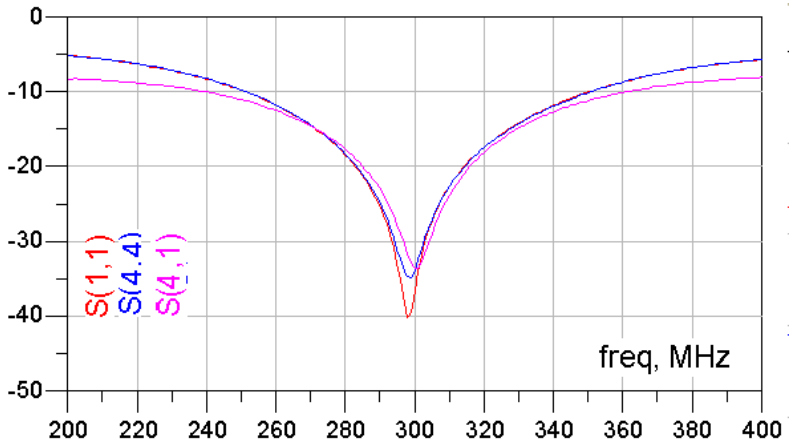


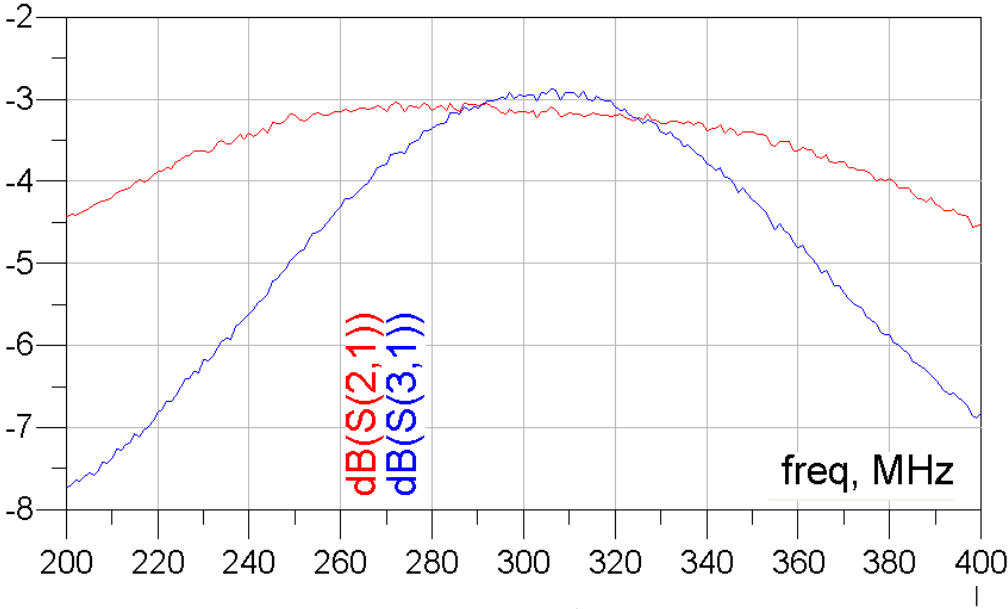
•Insertionloss=-0.472/2
=-0.236 dB

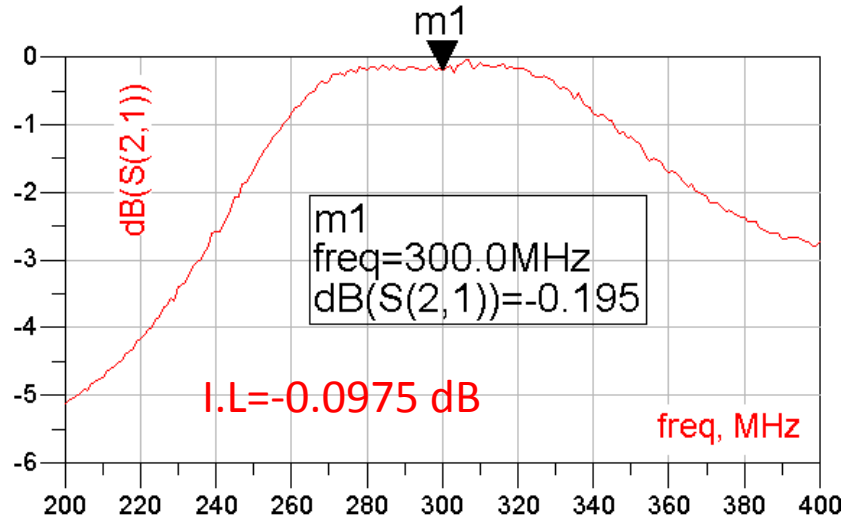


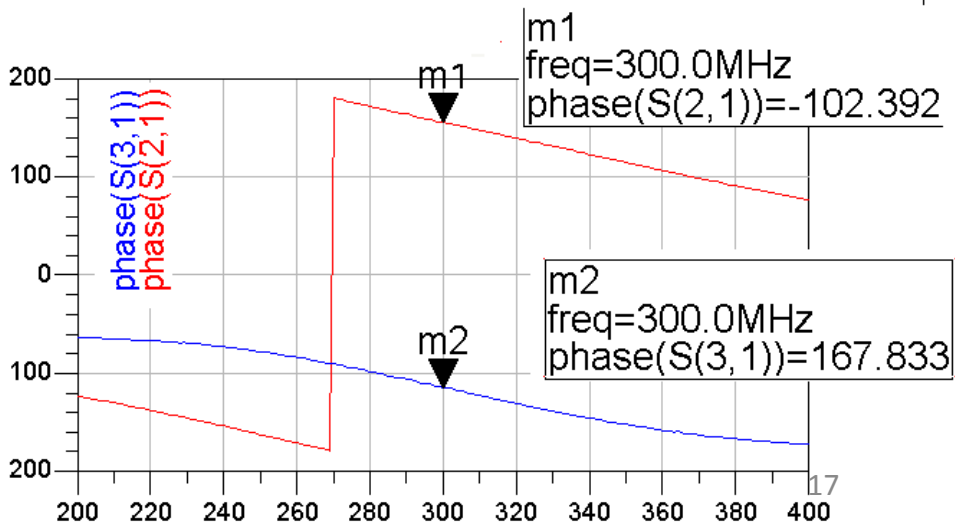
•90° Hybrid

Experimental Results





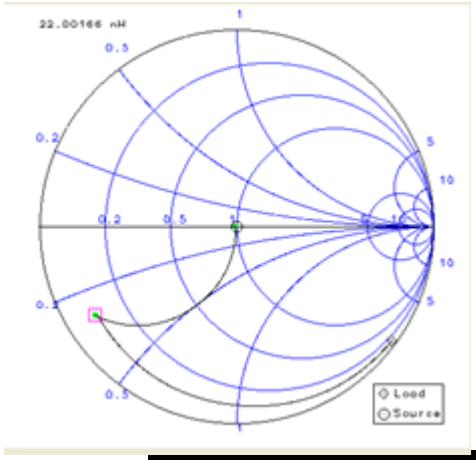


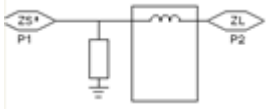


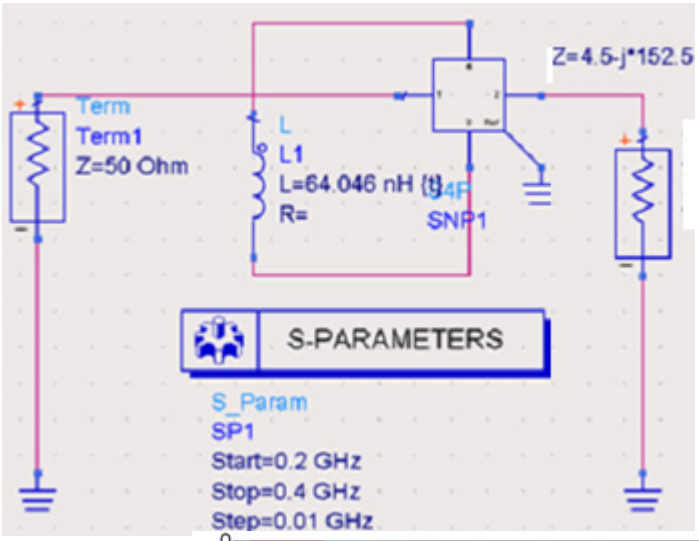
•*Matching*

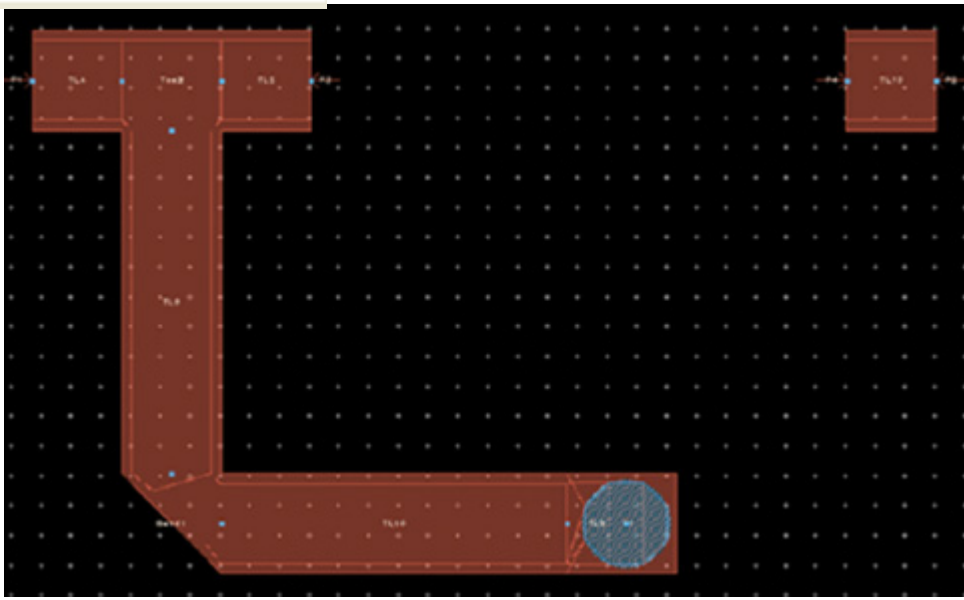
Z_1=4.5-152.5j Ω

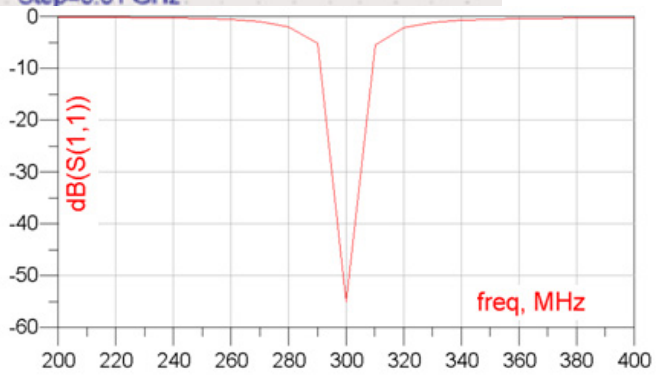
Z_2=10.5-125j Ω



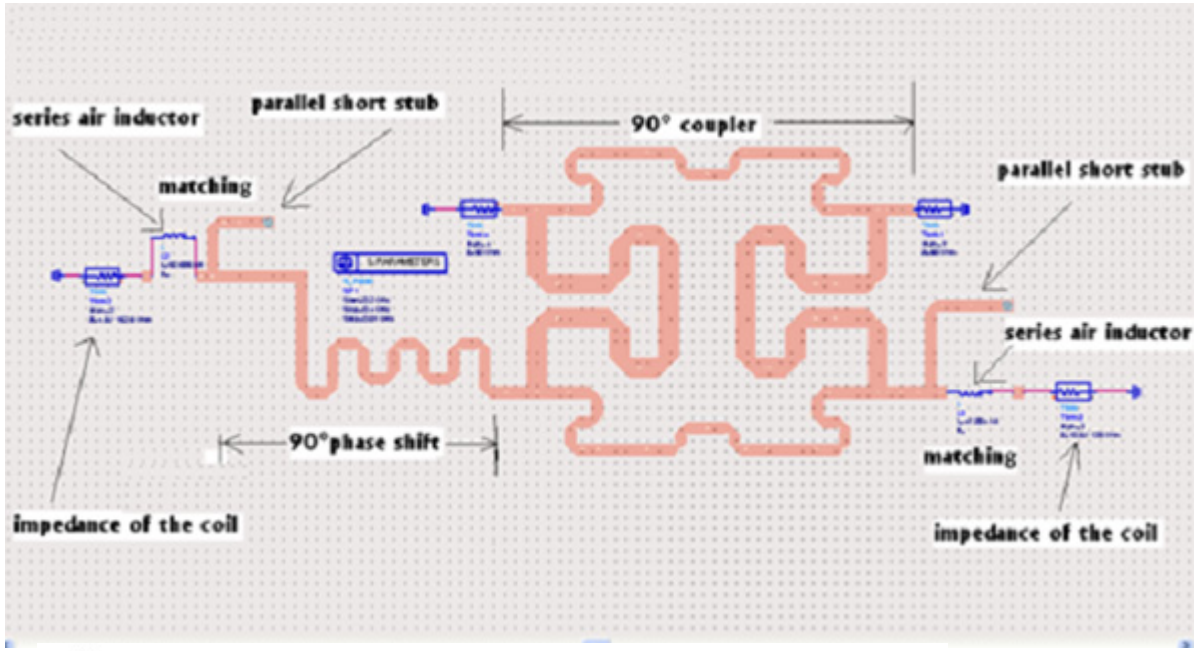


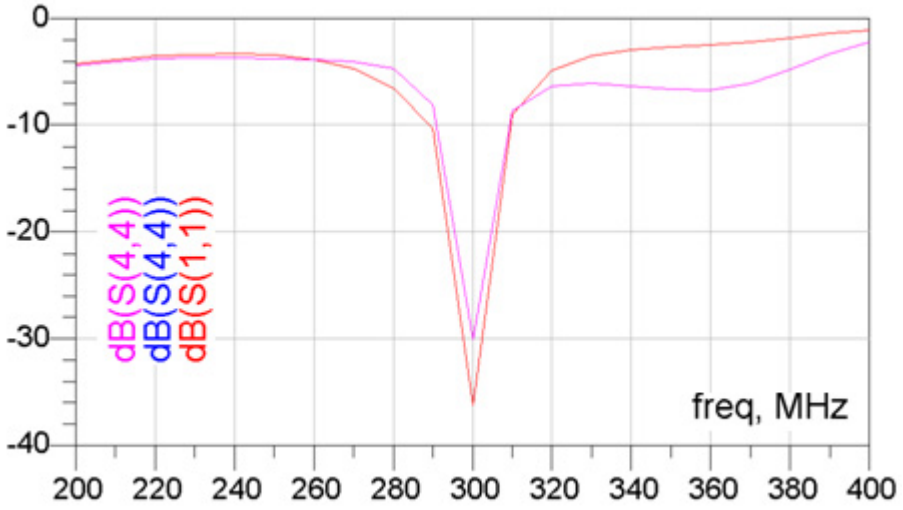






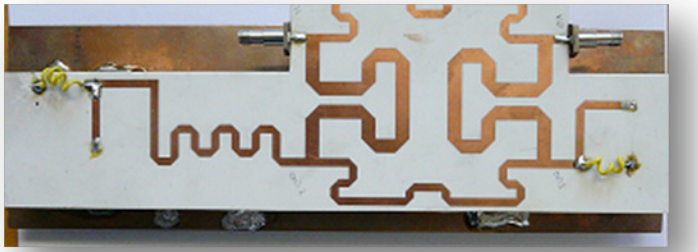
•*Matching*


series air inductor
parallel short stub
90° coupler
matching
parallel short stub
series air inductor
90°phase shift
matching
impedance of the coil
impedance of the coil

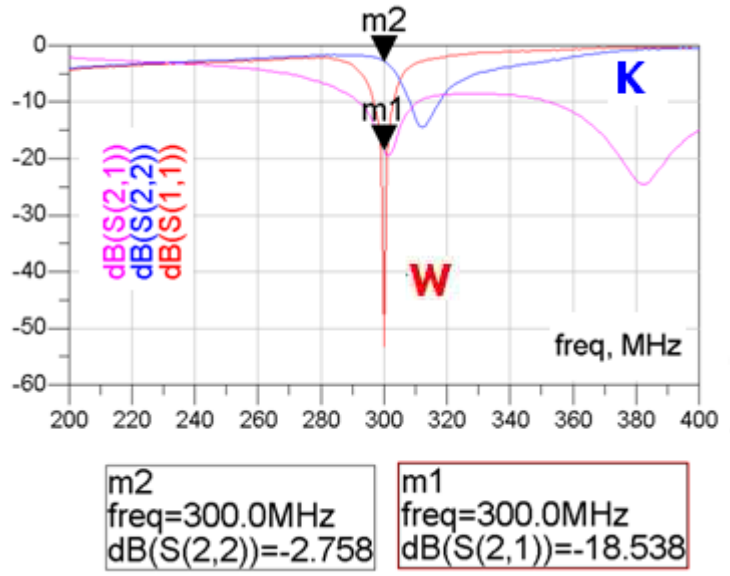

0
-10
-20
-30
-40
dB(S(4,4))
dB(S(4,4))
dB(S(1,1))
freq, MHz
200
220
240
260
280
300
320
340
360
380
400

•*Experimental measurement*

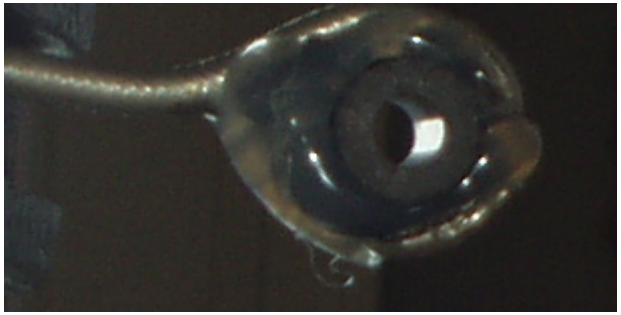
Phantom

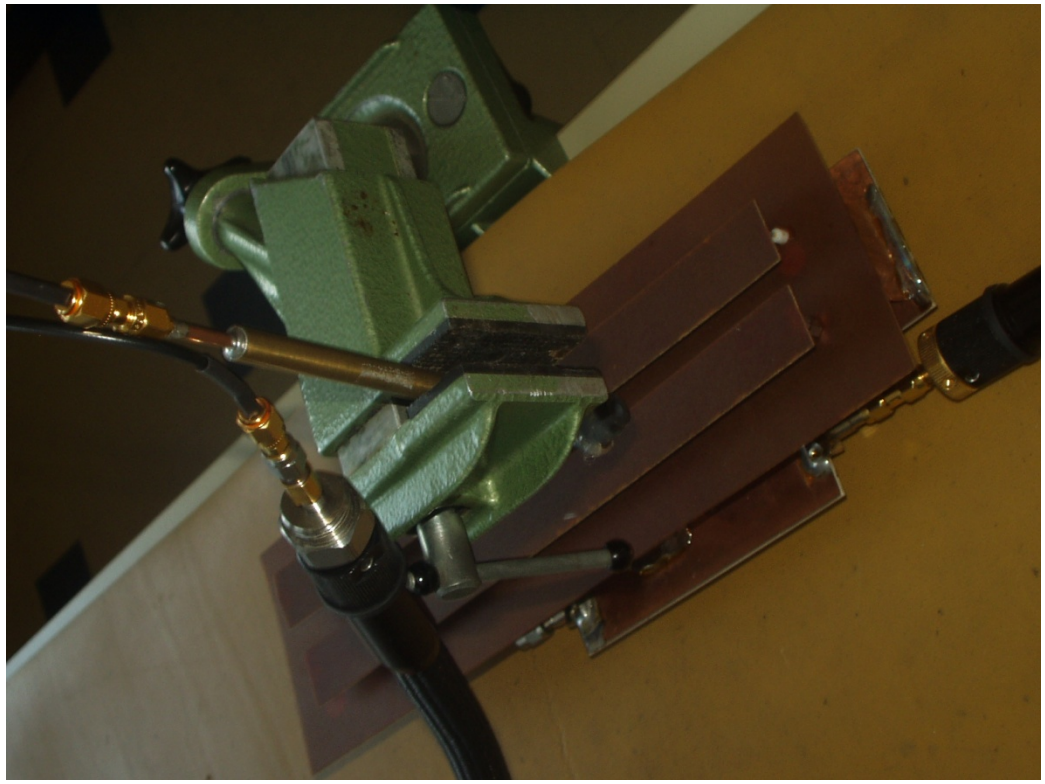


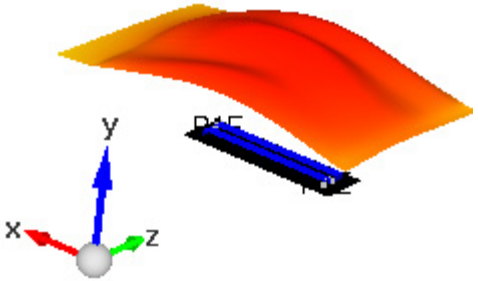
- *Mode W is matched*
- *Mode K is not matched*



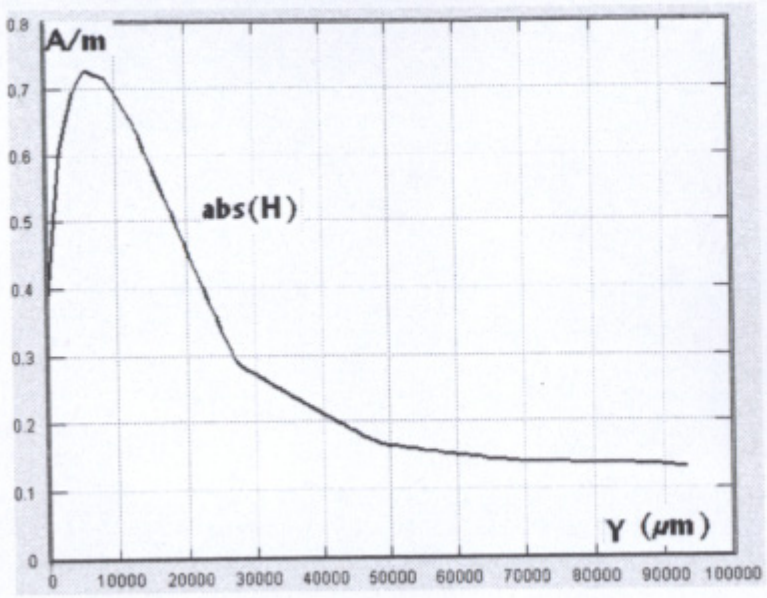
Magnetic Nearfield measurement





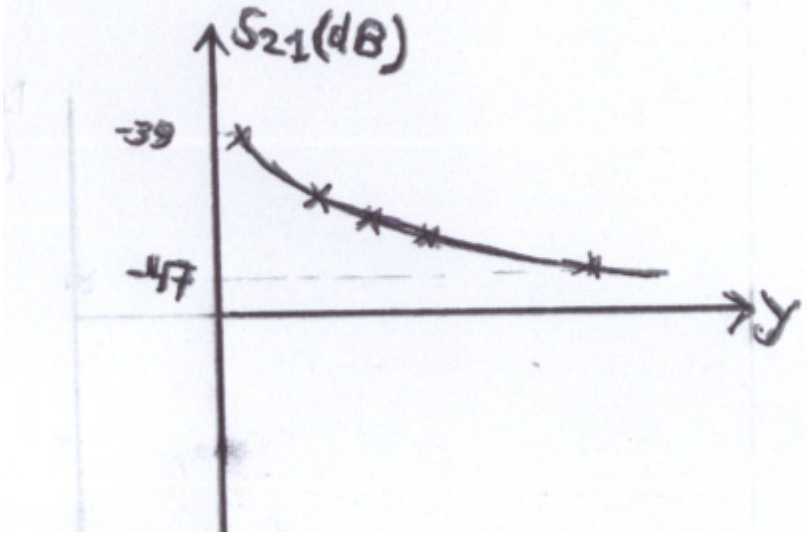


- **From Empire**



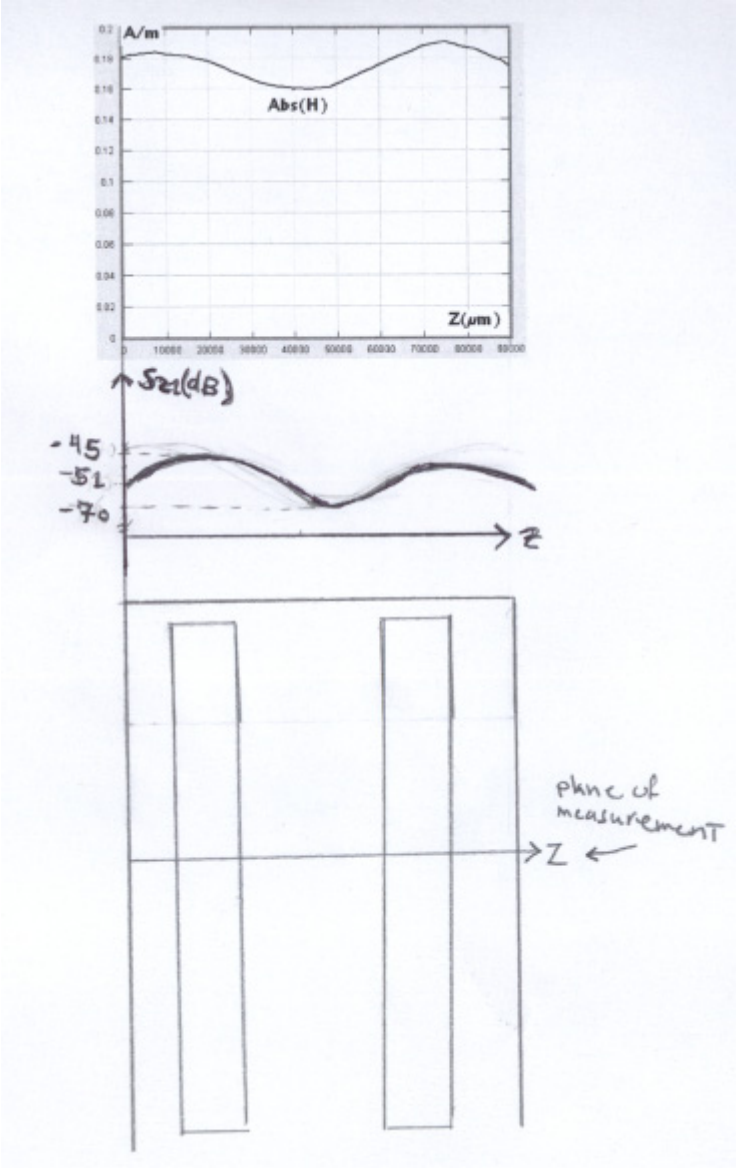
x = 160000
z = 44000
dy

- **From experiment**



- **From Empire**

- **From experiment**



Conclusion

- **Coupling&decoupling must be handeled carefully.**

- **Increasing the size of the ground and consequently the space between the conductor strips leads to smaller coupling and more homgenous magnetic fields**

- **Futur Work**

  - Using the concept of Inverted F antenna
  - No need for matching elements.
  - adjust the feed input point to get Zin=50ohm

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HFT

THANK YOU VERY MUCH

Odd/Even mode