



Part II: The CMOS current- mode 60GHz mixer

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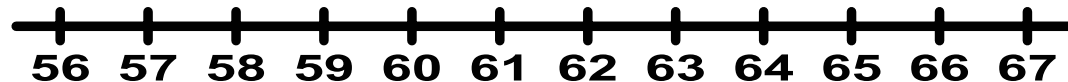
National Chiao-Tung University

Outline

- Introduction & Motivation
- Transmission-line Simulation & Modeling
- Architecture & Schematic
- Simulated Results
- Layout
- Specification Table
- Conclusion

Motivation

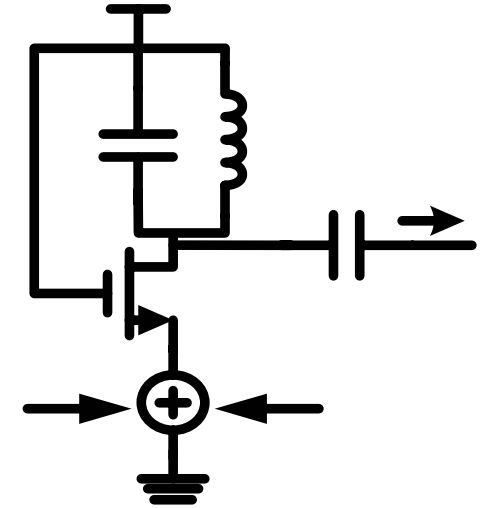
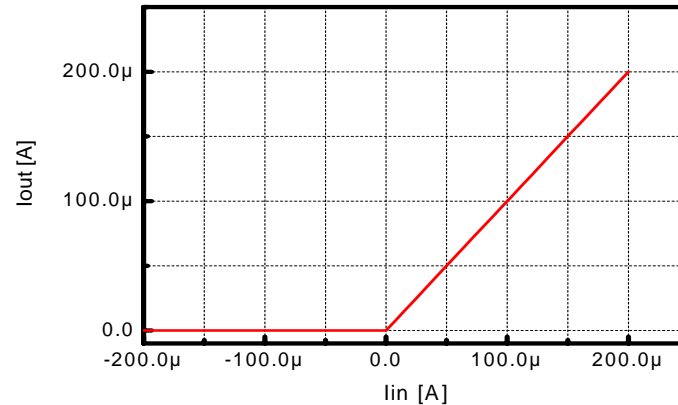
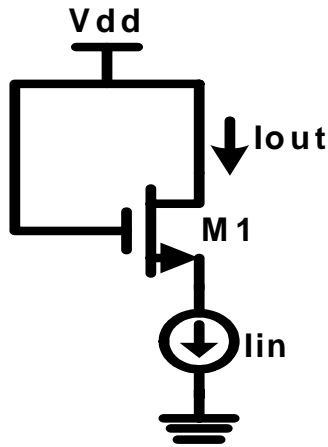
Japan		Unlicensed	
Europe		Unlicensed	
USA		Unlicensed	



■ Motivation

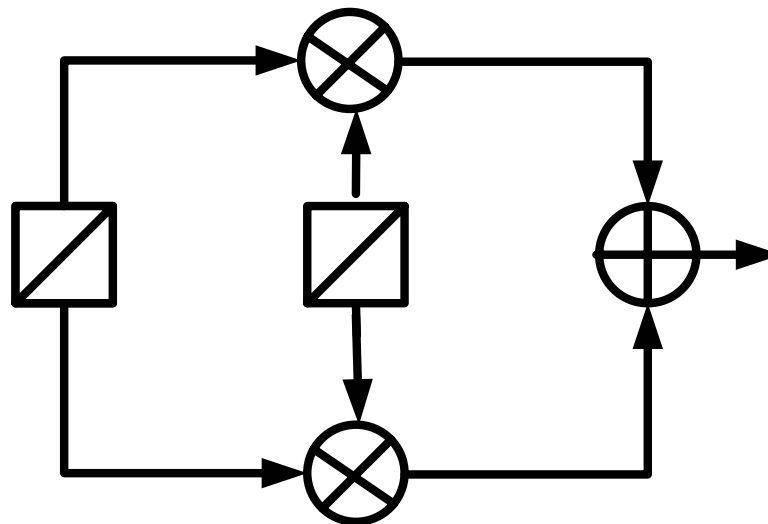
To fully exploit the 7-GHz of unlicensed around 60 GHz for consumer applications, a low cost solution is necessary. This presents a great motivation for using mainstream CMOS technology for 60GHz radios.

Introduction & Motivation



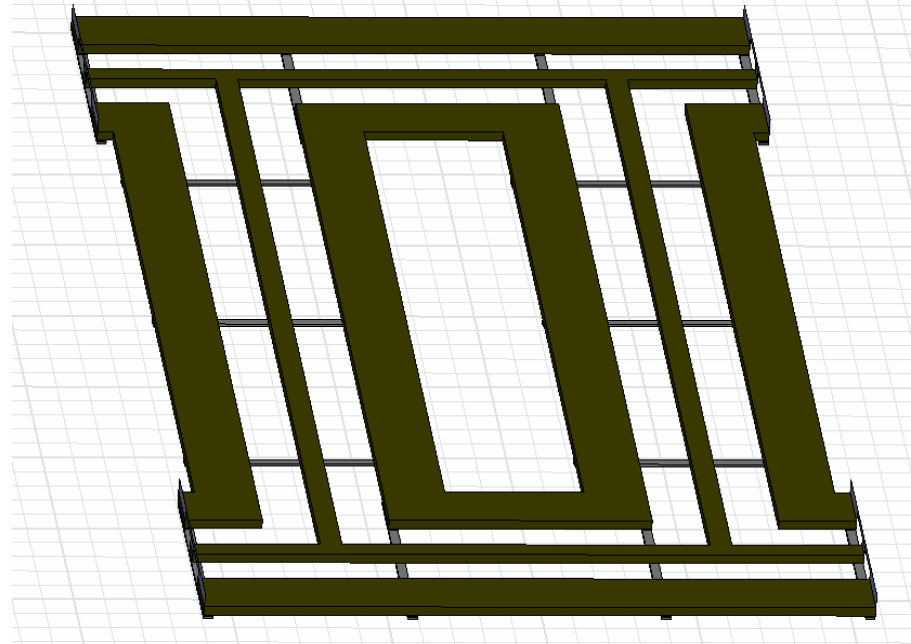
- The current switch device is used in this mixer to down convert the 60GHz RF input into 2GHz IF.
- **Issue** : RF-LO Isolation.

Introduction & Motivation



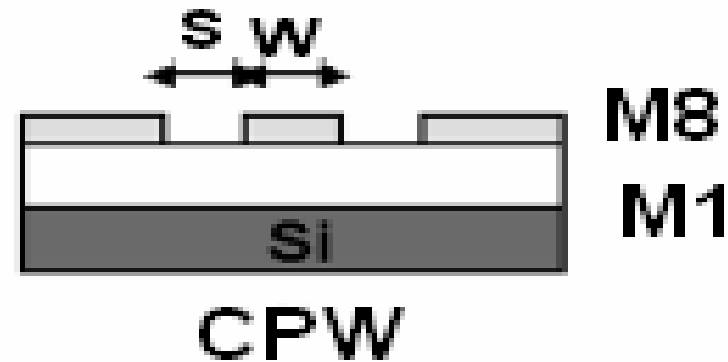
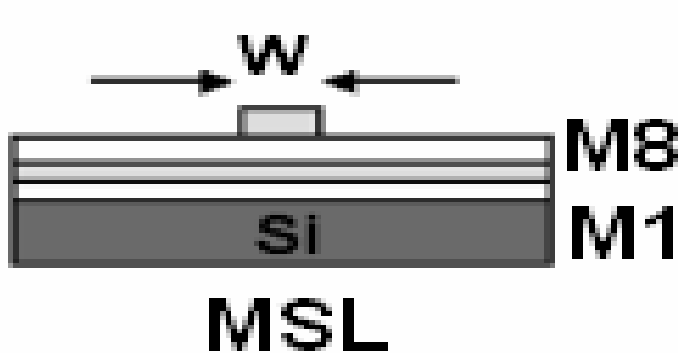
- Single mixer has one major practical implementation problem: they require a hybrid or elaborate power combining circuit to combine the LO and RF.

Introduction & Motivation



- In this design we use HFSS to design CPW and 90 phase shifter, after that all, the S-parameters for the designed CPW is used to simulate the Mixer performance by using Designer Ansoft V3

Transmission line



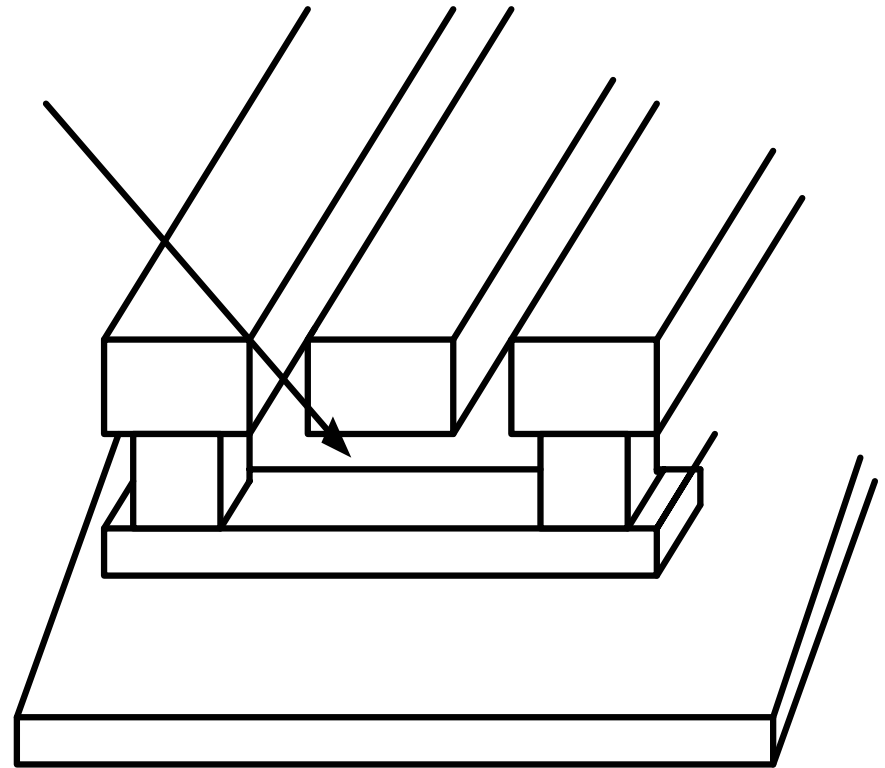
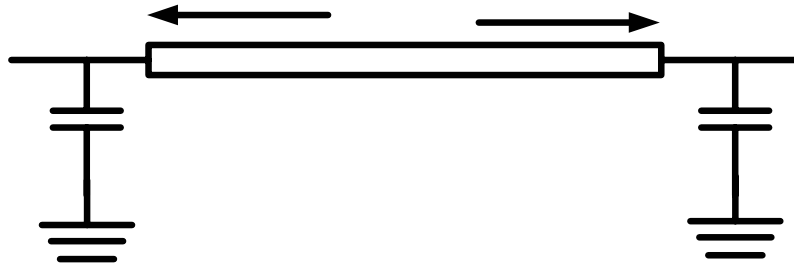
MSL

- dissAdv.: highly dependent on the technology
- Advantage: low substrate loss

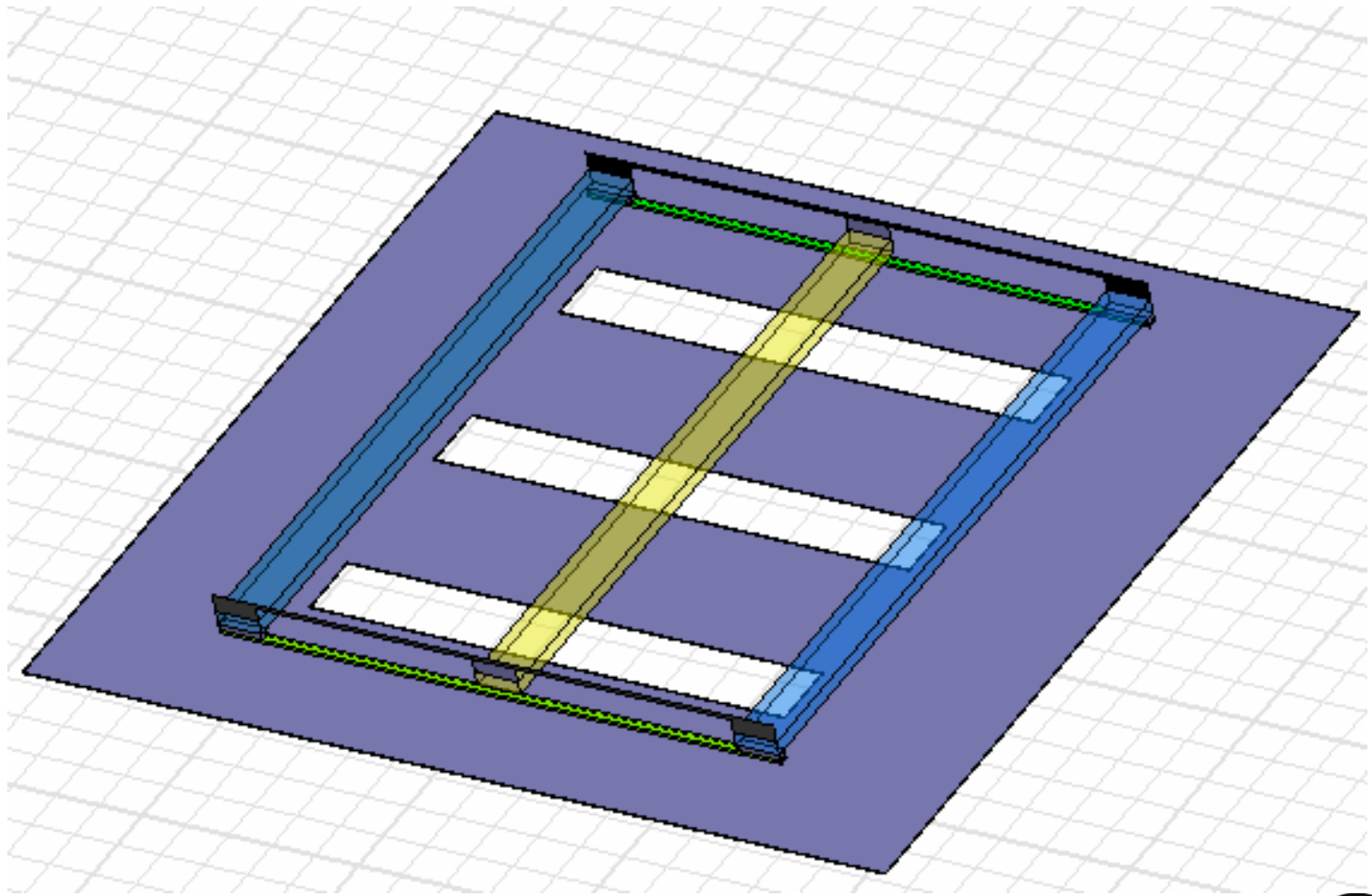
CPW

- Advantage: weak dependent on technology
- dissAdv.: high loss

CPW

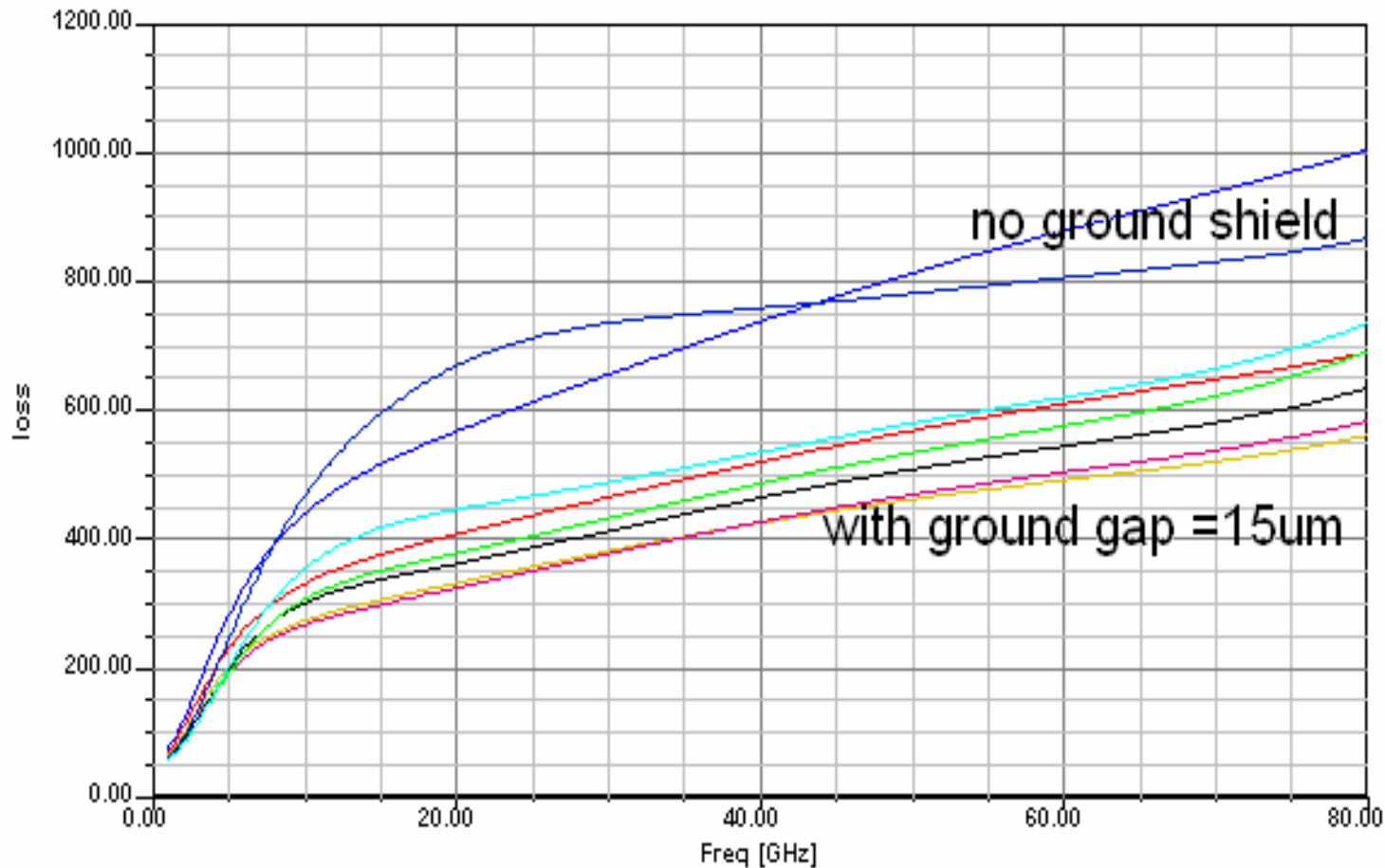


CPW



Loss in dB/meter

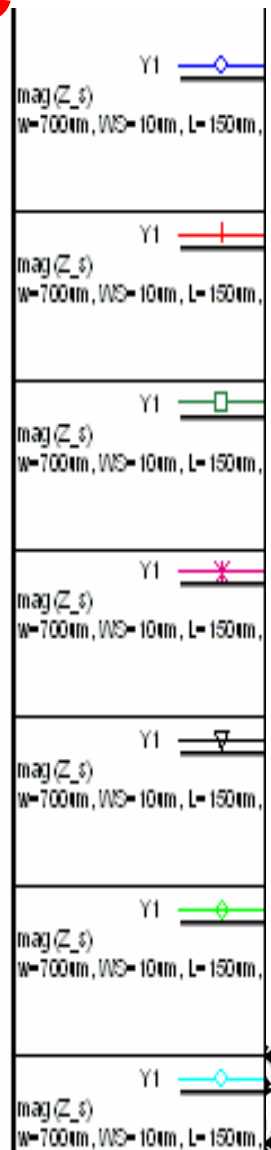
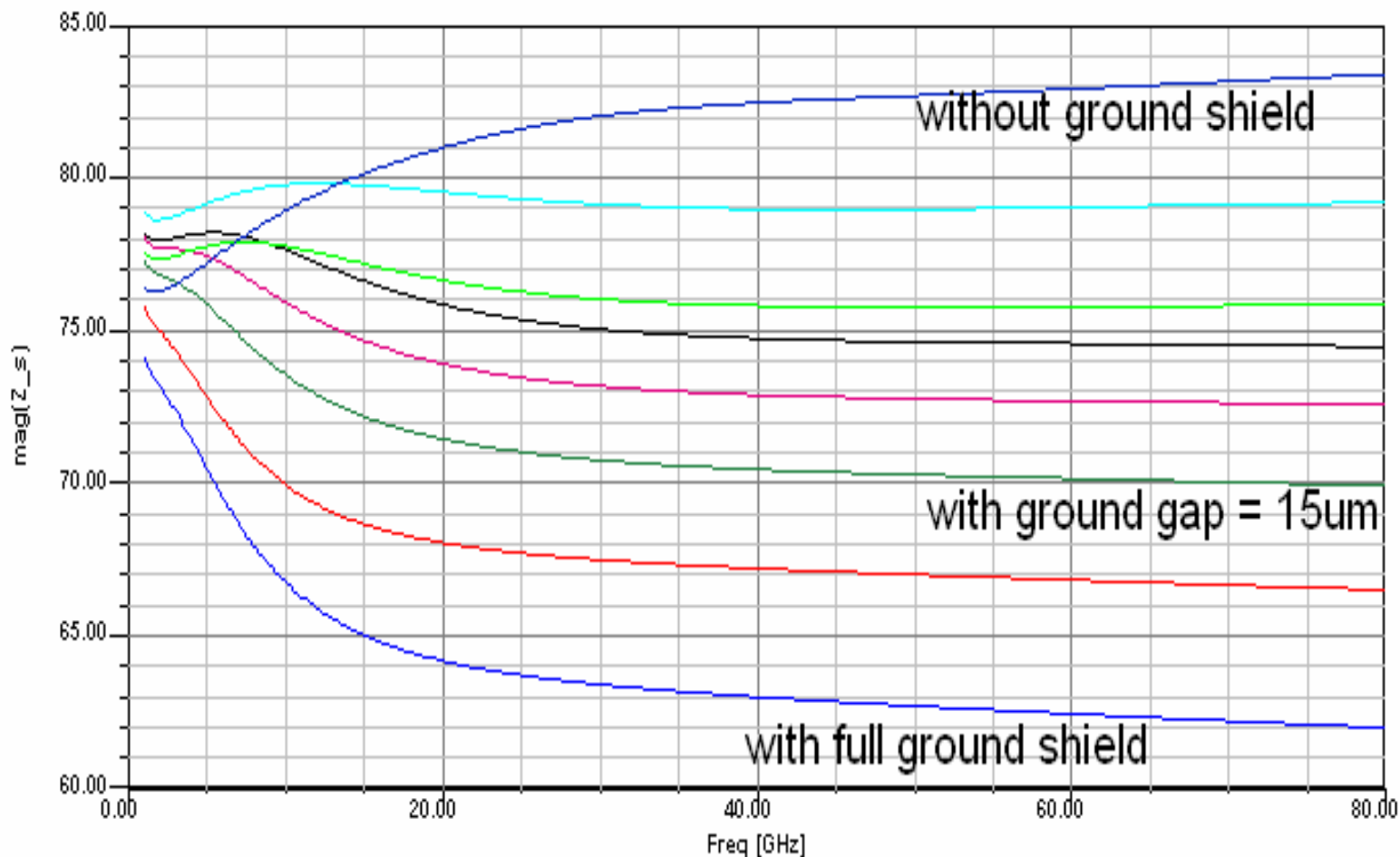
Ansoft Corporation
XY Plot 5
HFSSModel 1



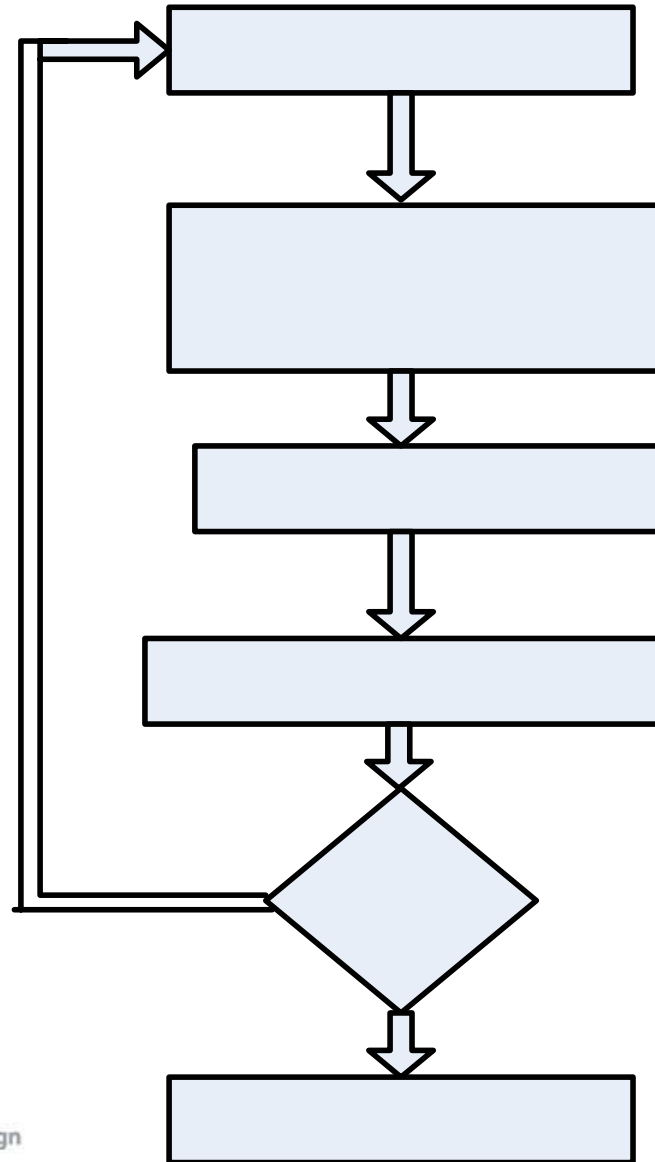
loss	Y1	Blue line with circle	W=700um, WS=10um, L=150um, t=3.3
loss	Y1	Red line with plus	W=700um, WS=10um, L=150um, t=3.3
loss	Y1	Yellow line with square	W=700um, WS=10um, L=150um, t=3.3
loss	Y1	Pink line with asterisk	W=700um, WS=10um, L=150um, t=3.3
loss	Y1	Black line with triangle	W=700um, WS=10um, L=150um, t=3.3
loss	Y1	Green line with diamond	W=700um, WS=10um, L=150um, t=3.3
loss	Y1	Cyan line with diamond	W=700um, WS=10um, L=150um, t=3.3

Characteristic impedance

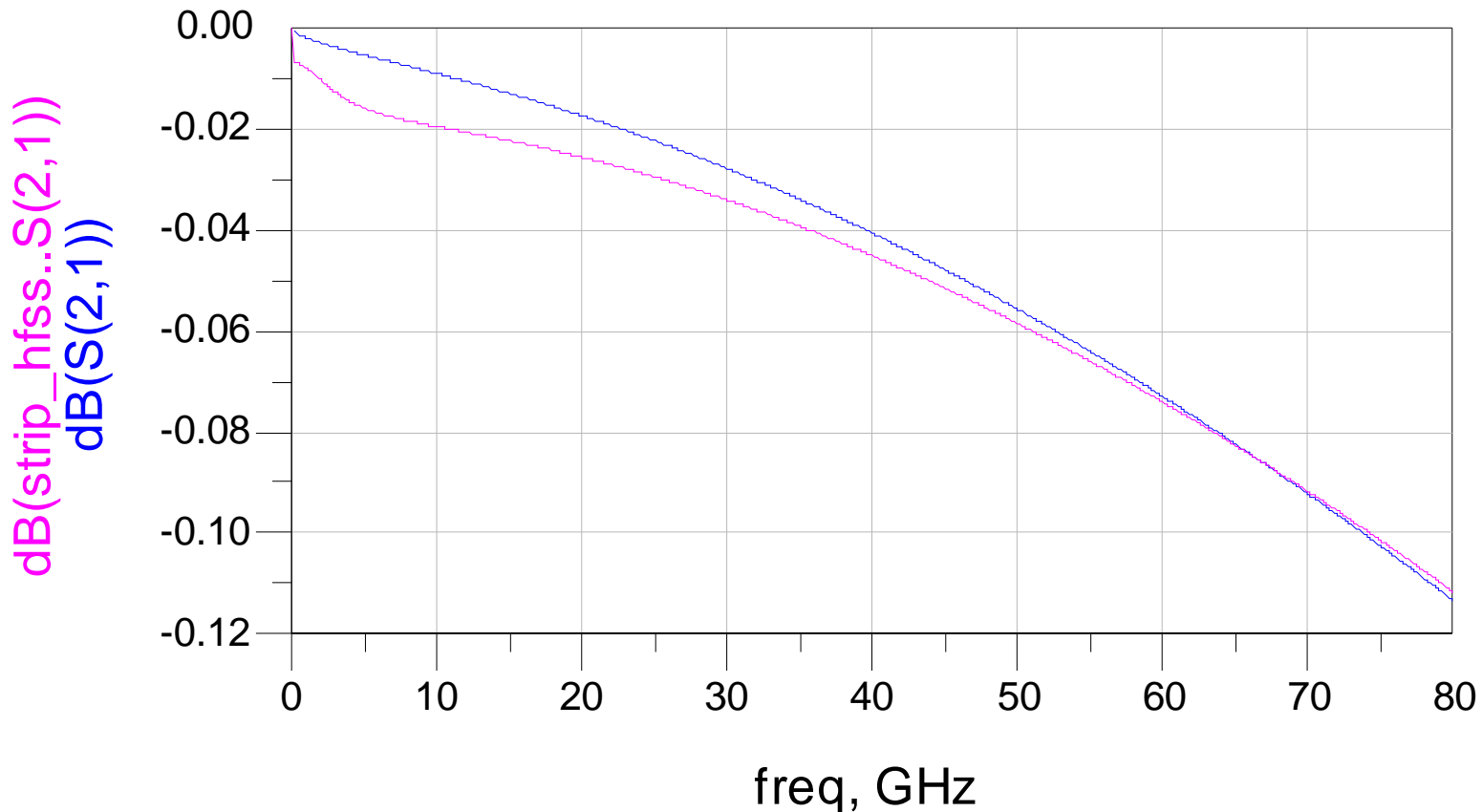
Ansoft Corporation
XY Plot 6
HFSSModel 1



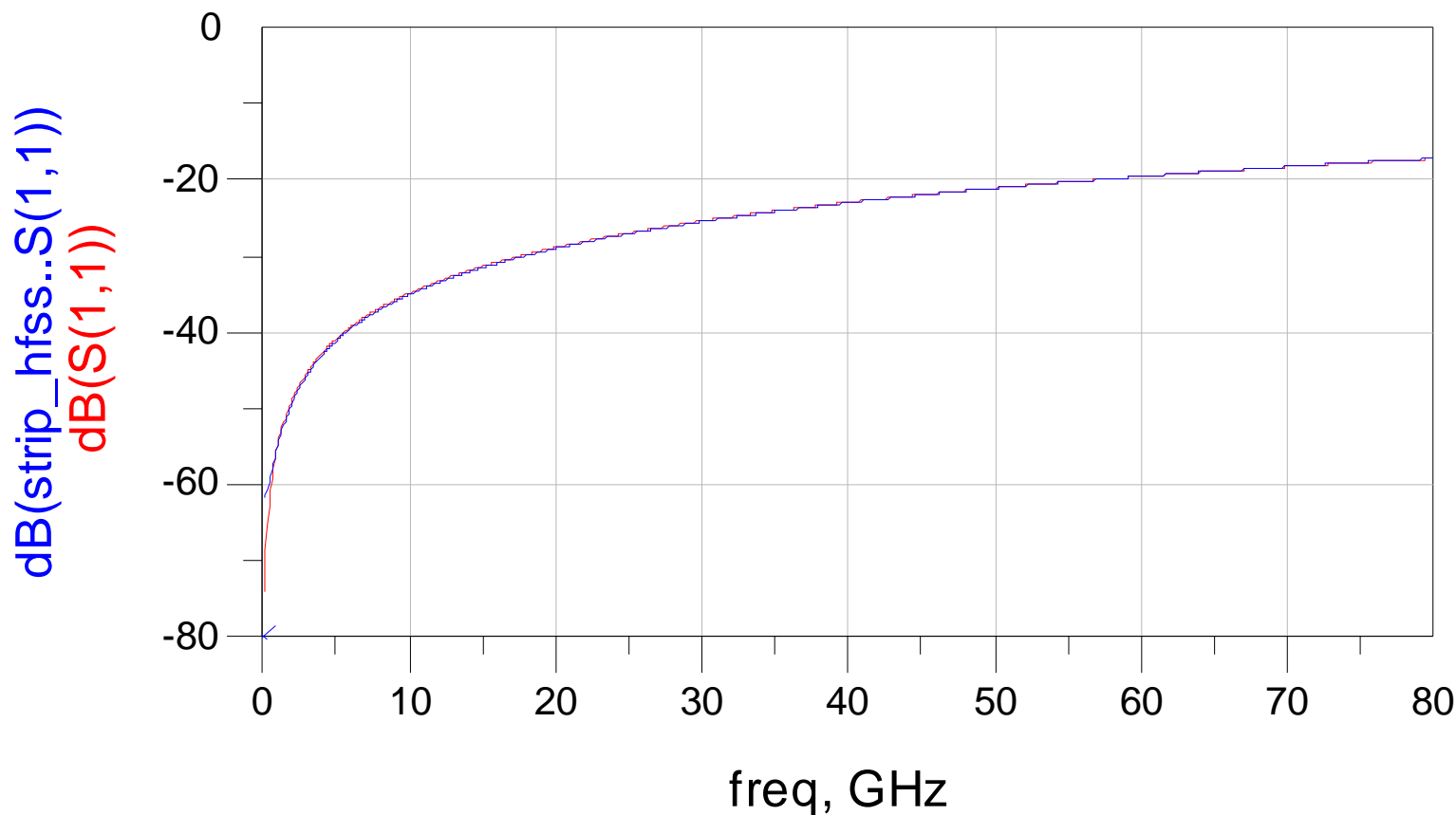
Design Methodology



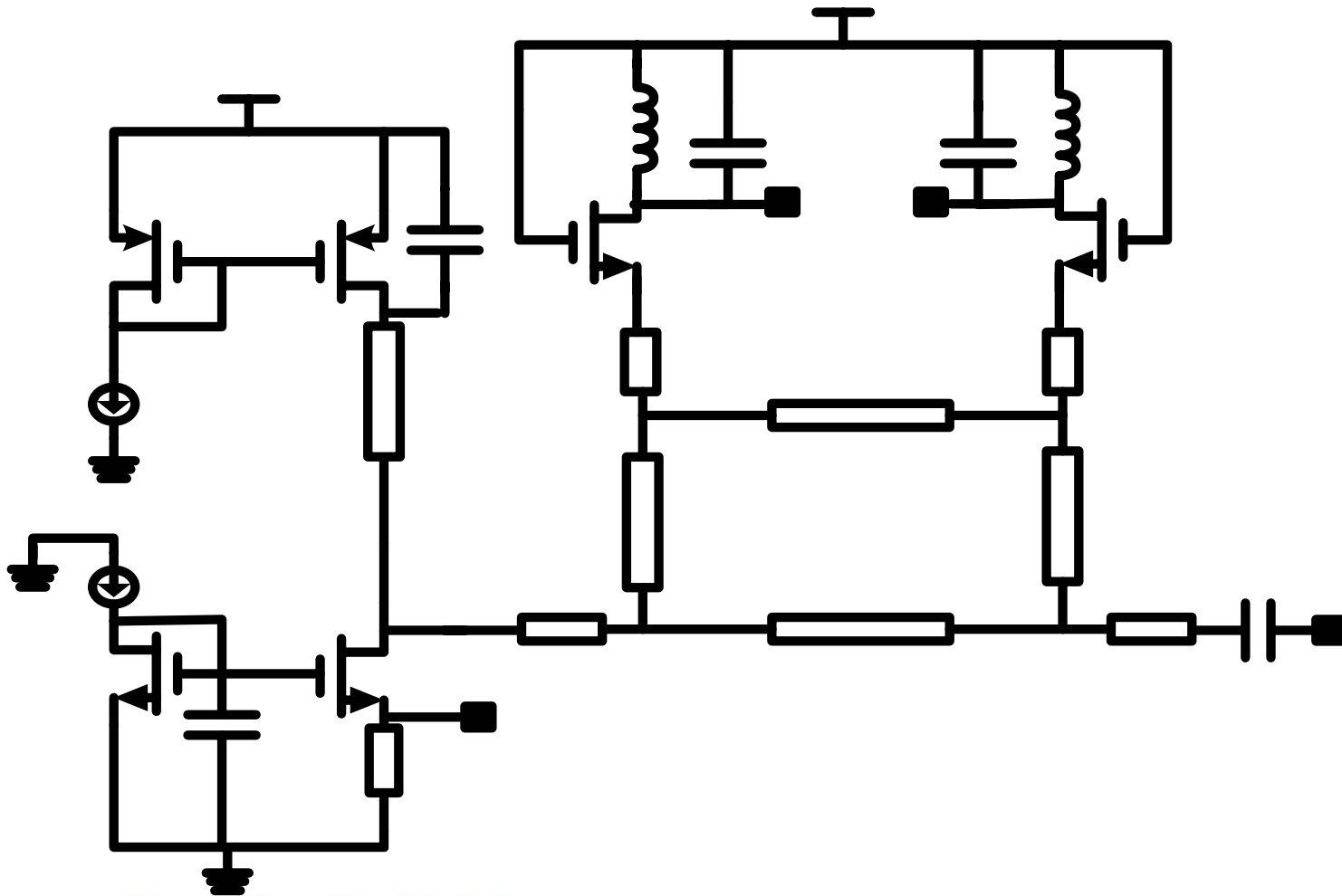
Wide –Band Modeling S21



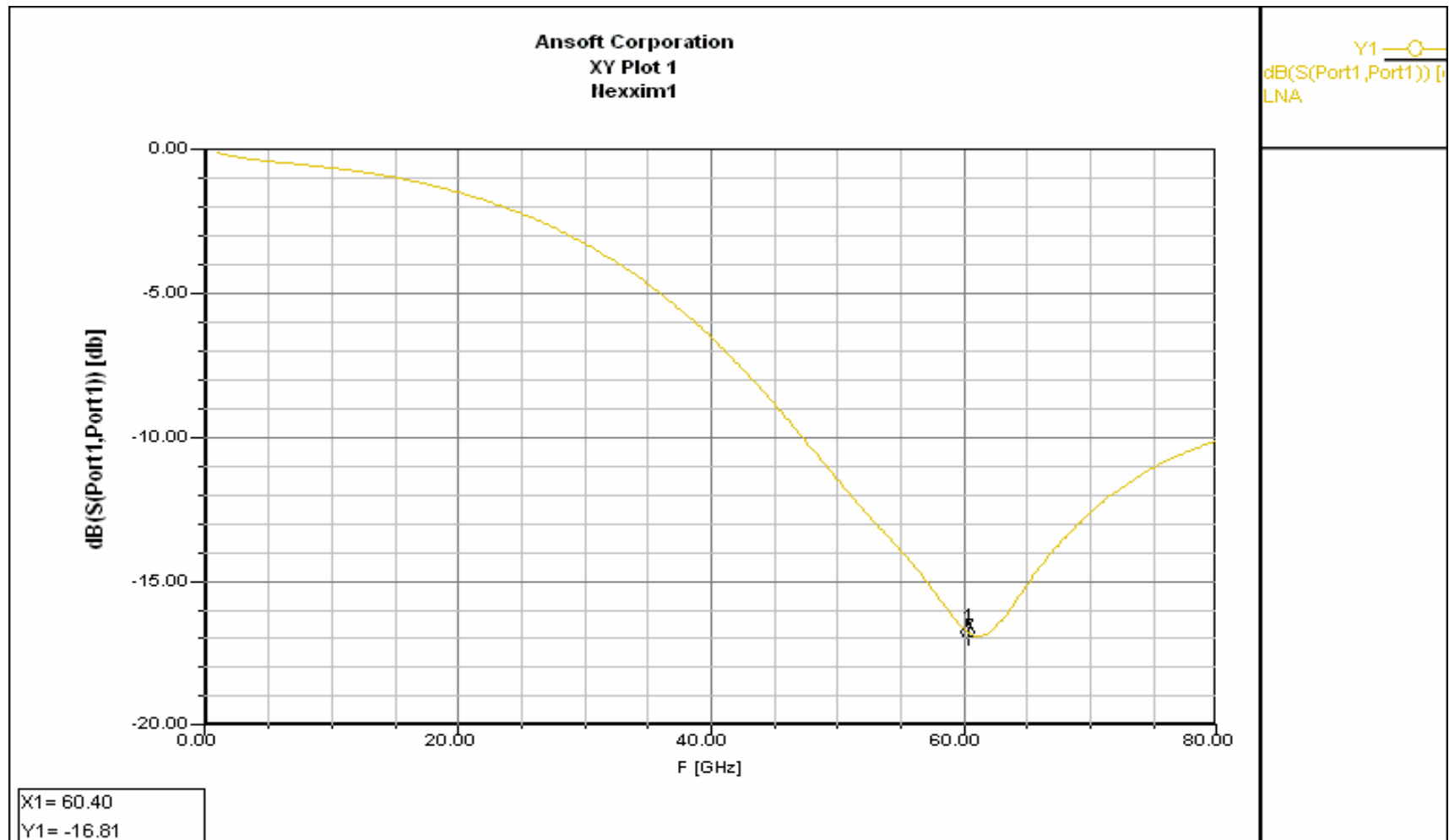
Wide -Band Modeling S11



Architecture & Schematic



Simulated Results



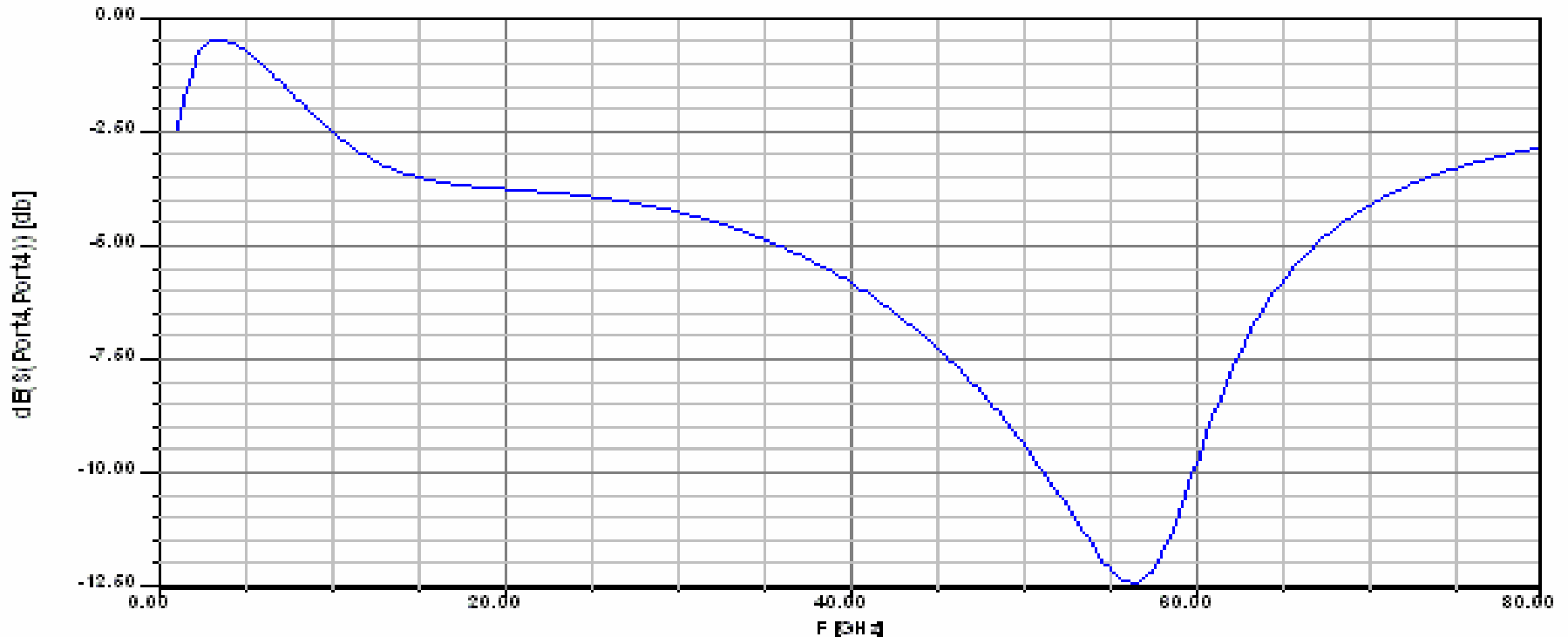
- RF input return loss frequency

LeadingInsight

Application Workshops for High-Performance Design

Simulated Results

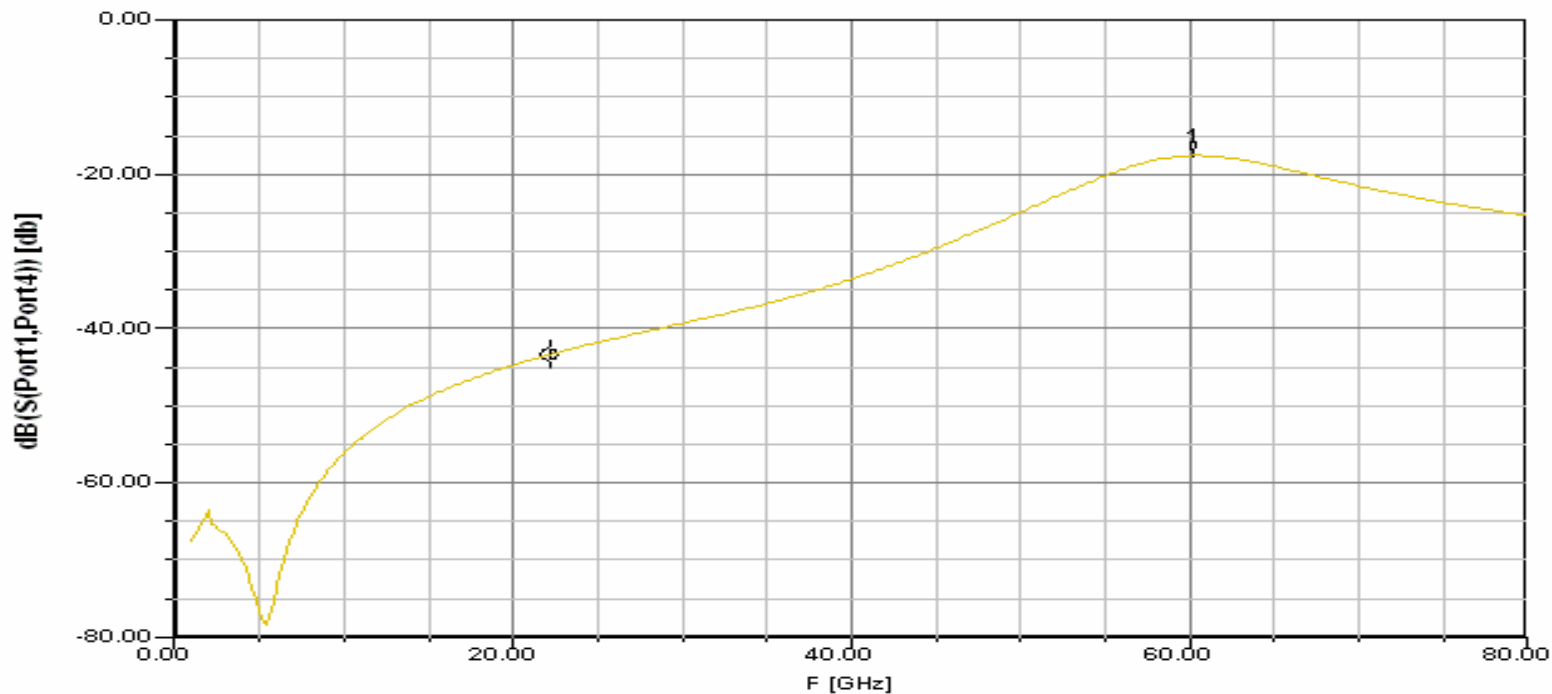
Ansoft Corporation
XY Plots
Meas1



- LO input return loss frequency

Simulated Results

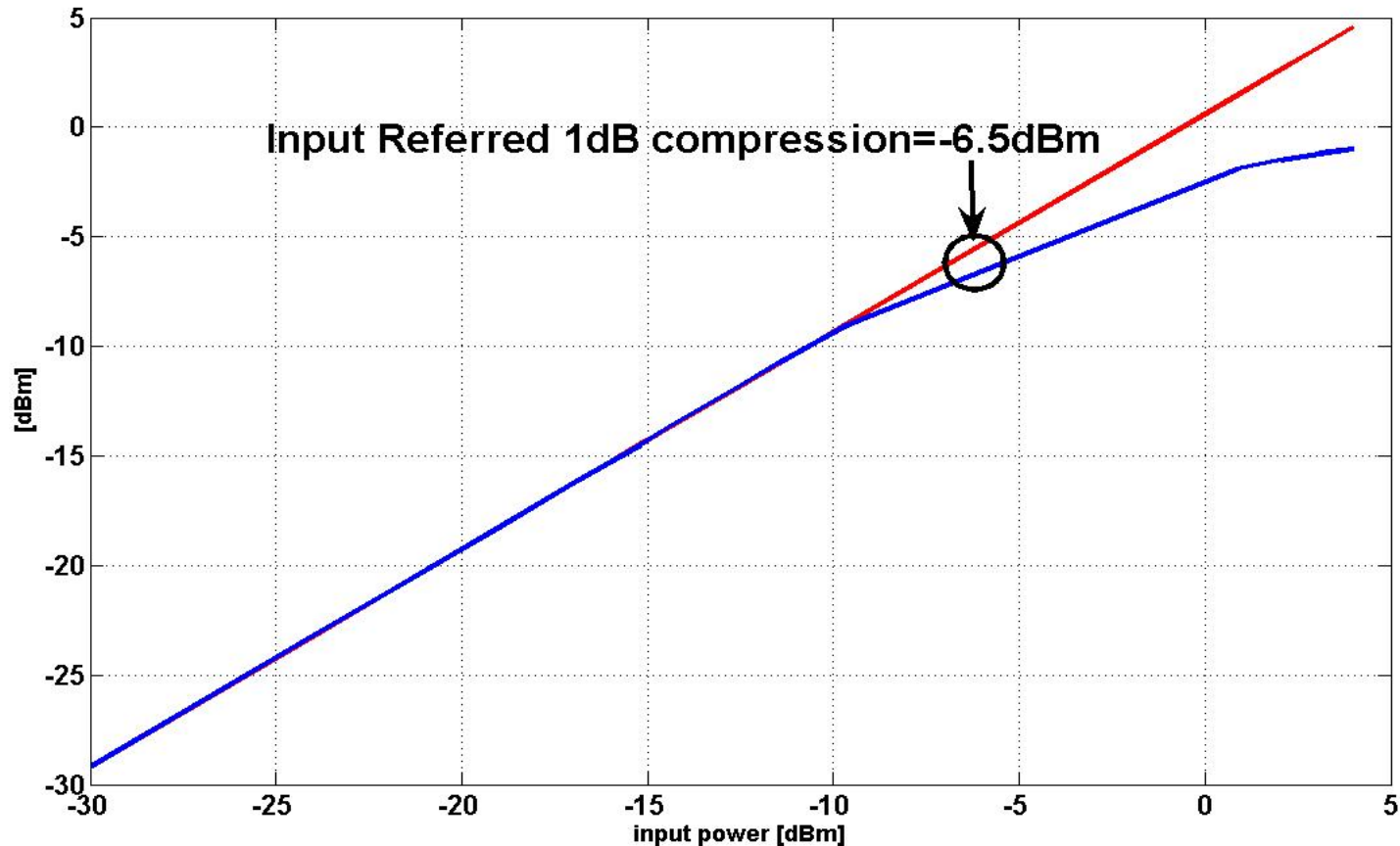
Ansoft Corporation
XY Plot 3
Hexxim1



X1 = 60.20
Y1 = -17.54

■ LO-RF isolation frequency characteristics

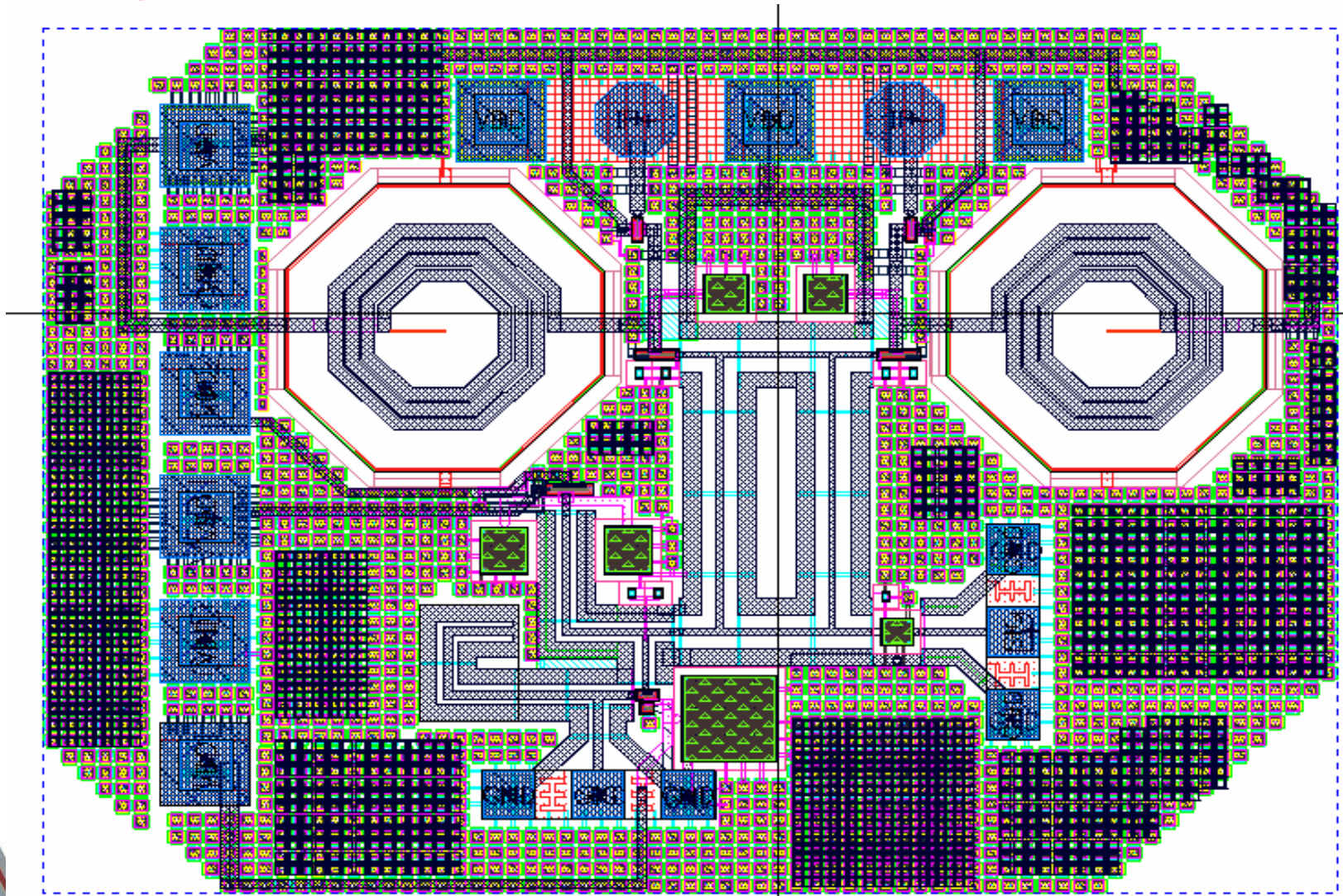
Simulated Results



- 1dB compression point

Layout

Chip size : 1444um x 1048um



Specication Table

Technology	0.13um 1P8M TSMC
Power Supply	1.2V
Current	4mA
RF Return loss	-16.81dB
LO Return loss	-12.6dB
RF_LO Isolation	-17.54dB
1dB compression point	-6.5 dBm
Conversion gain	2dB

Conclusion

- Transmission-line simulation and modeling by using HFSS has been shown.
- 60 GHz Mixer with 90 phase shift has been successfully designed by using Ansoft[®] simulation tools.