Using Optimetrics to Design a Self-Matched Waveguide Junction

Perry M. Malouf, Ph. D.

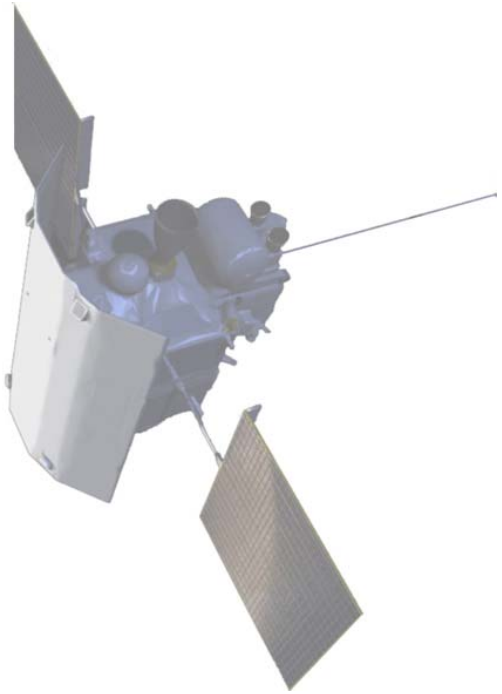
RF Engineering Group (SER),

Space Department

The Johns Hopkins University
Applied Physics Laboratory

Laurel, MD 20723

perry.malouf@jhuapl.edu

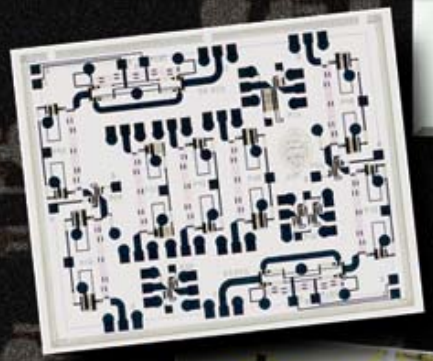


Diverse Examples of Technology Produced by the RF Engineering Group at the Applied Physics Laboratory

HFSS Users Workshop - Boston, MA - February 24, 2004

A.

B.



C.

D.

E.

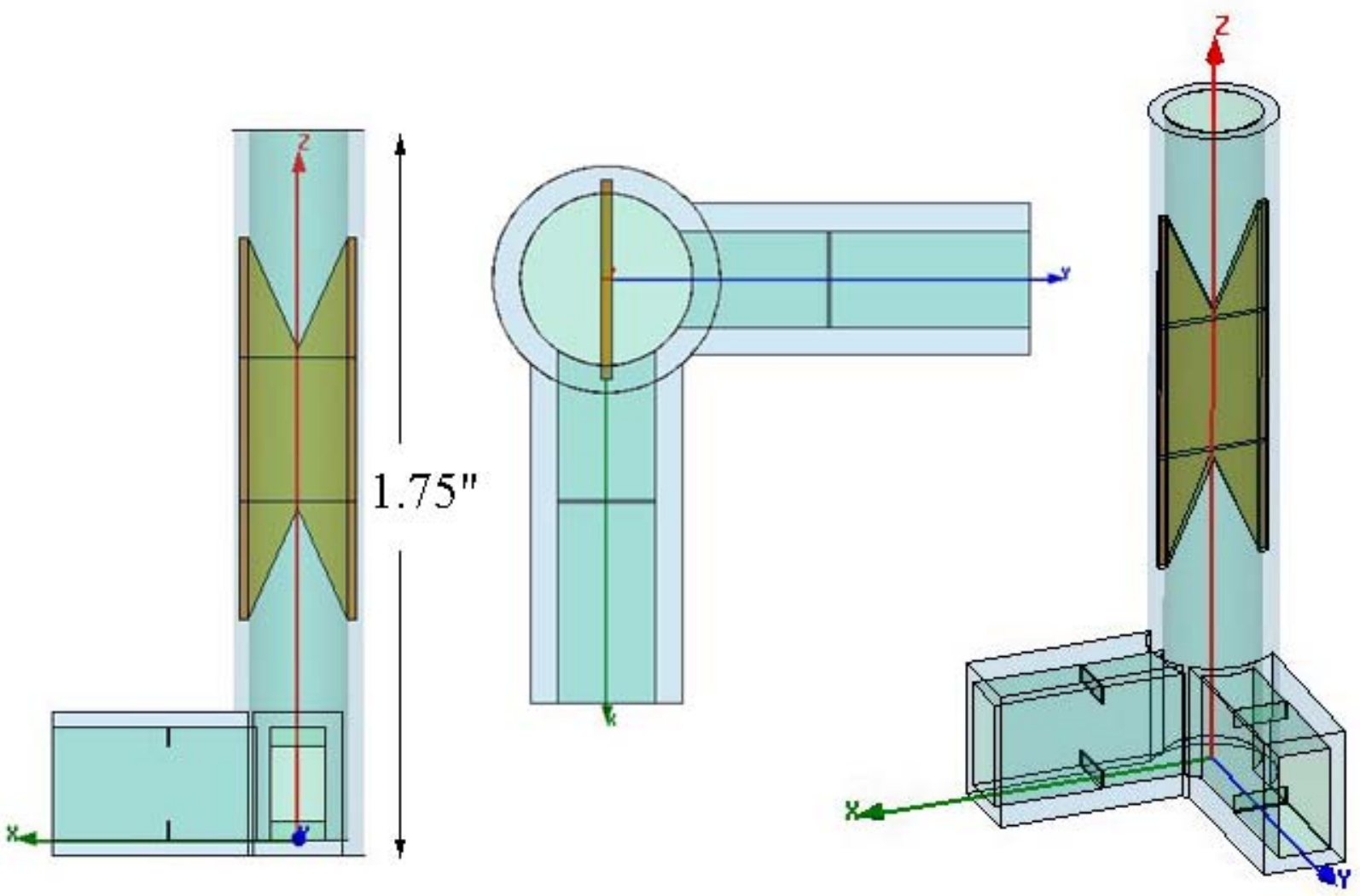
A. X-Band Solid State Power Amplifier (MESSENGER)

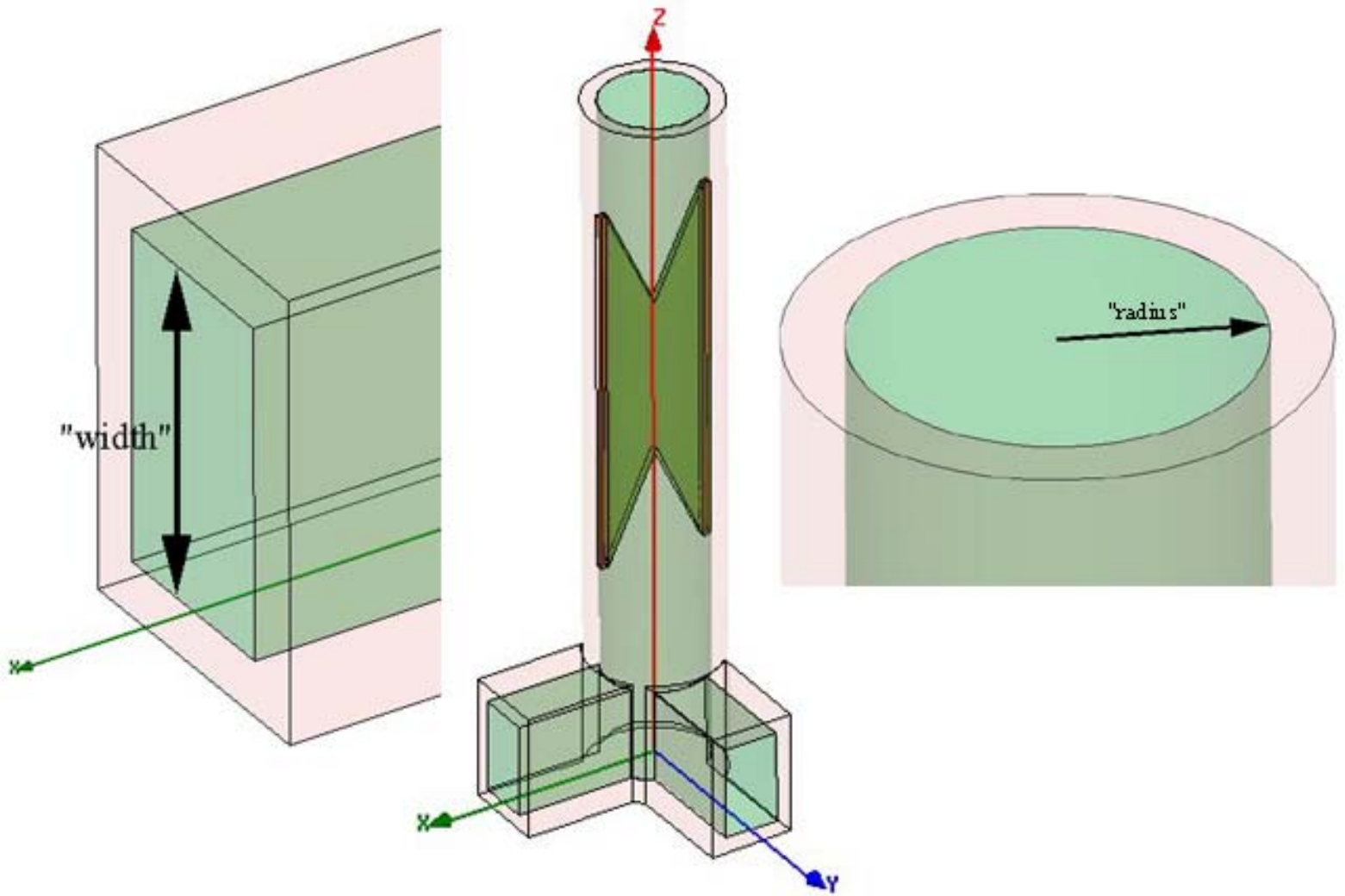
B. Ultra-Stable Oscillator (Cassini)

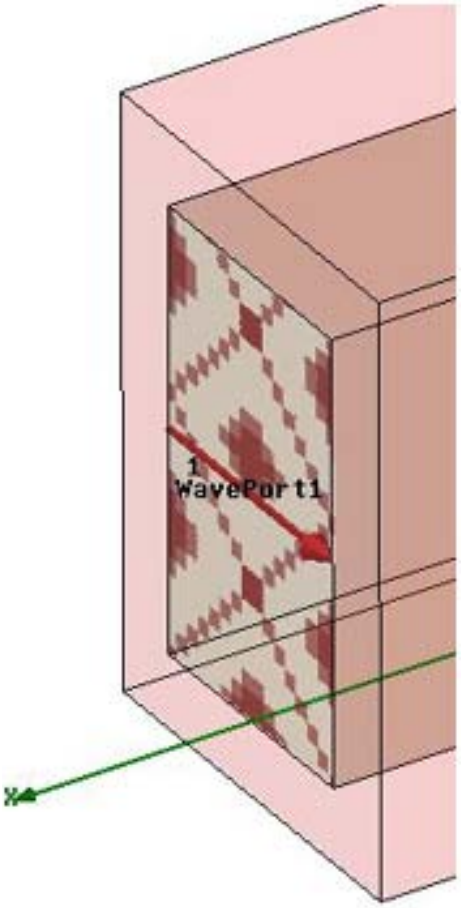
C. Circuit Layout Drawing, Ka-Band MMIC Phase Shifter

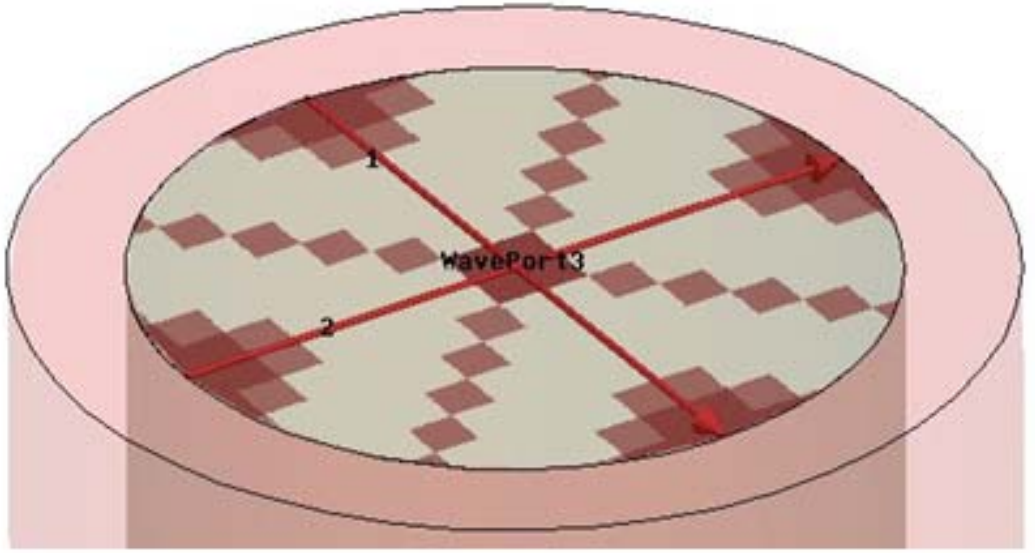
D. X-Band Antenna Assembly (MESSENGER)

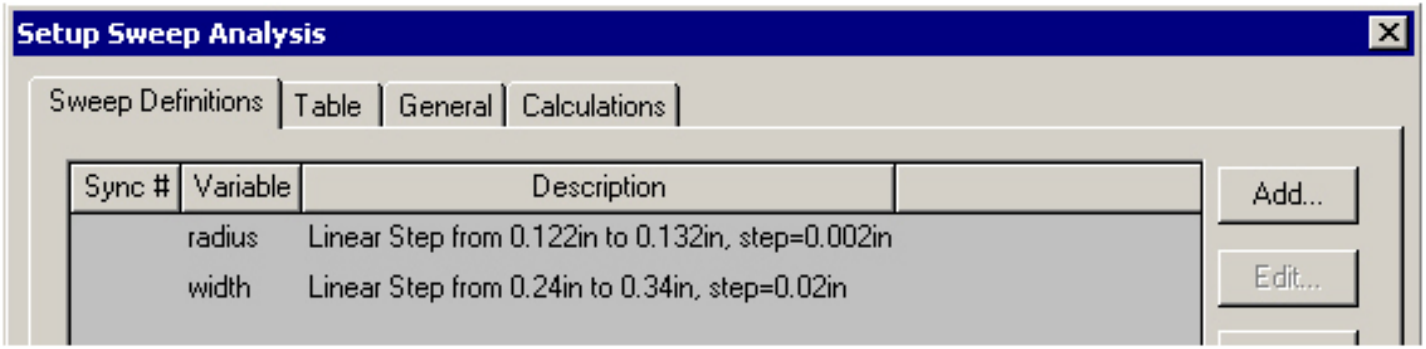
E. X-Band Patch Antenna Array (NEAR)

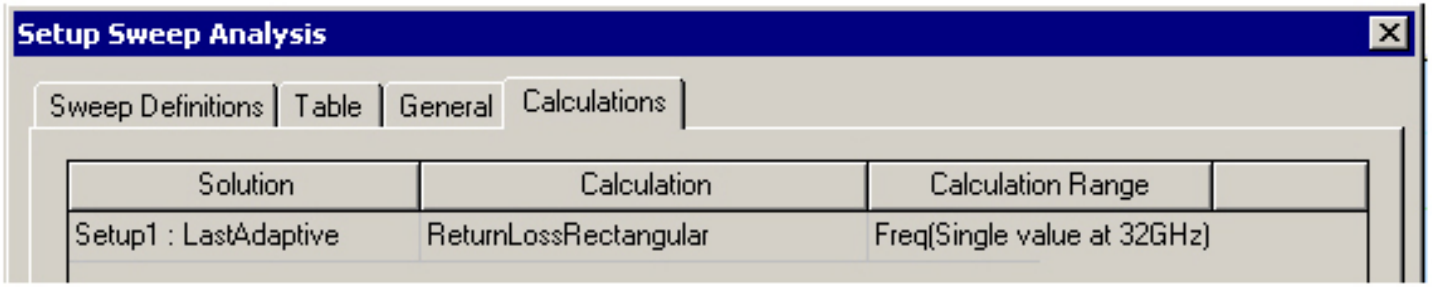

1.75"
Z
Y
X
Z
Y
X
Y

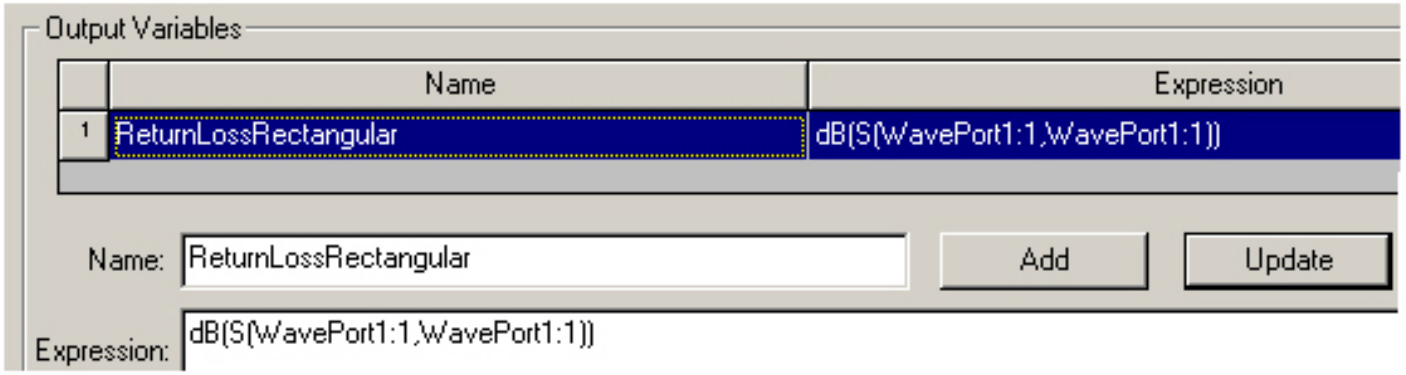

"width"
Z
X
Y
"radius"

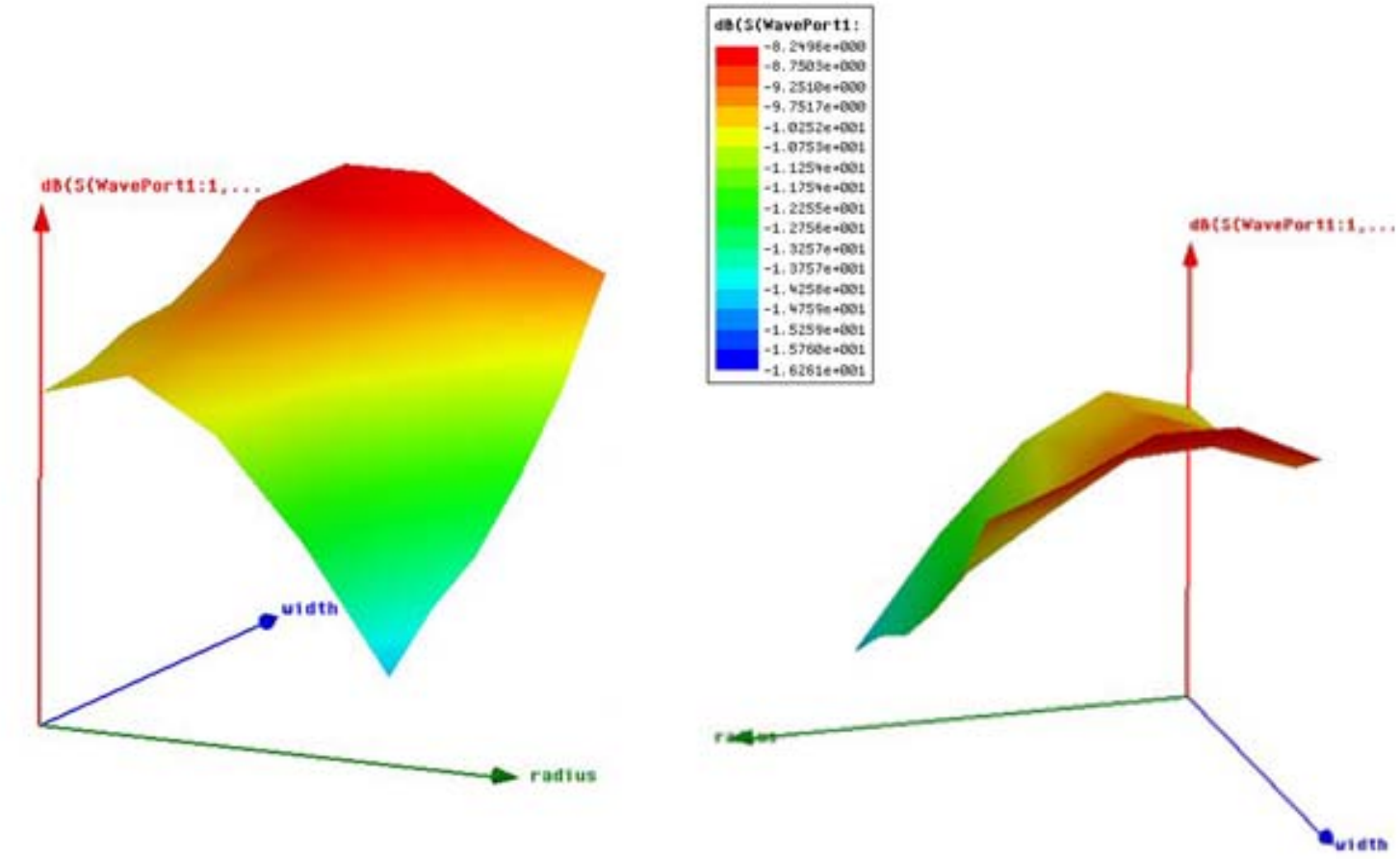

1
WavePort1
X

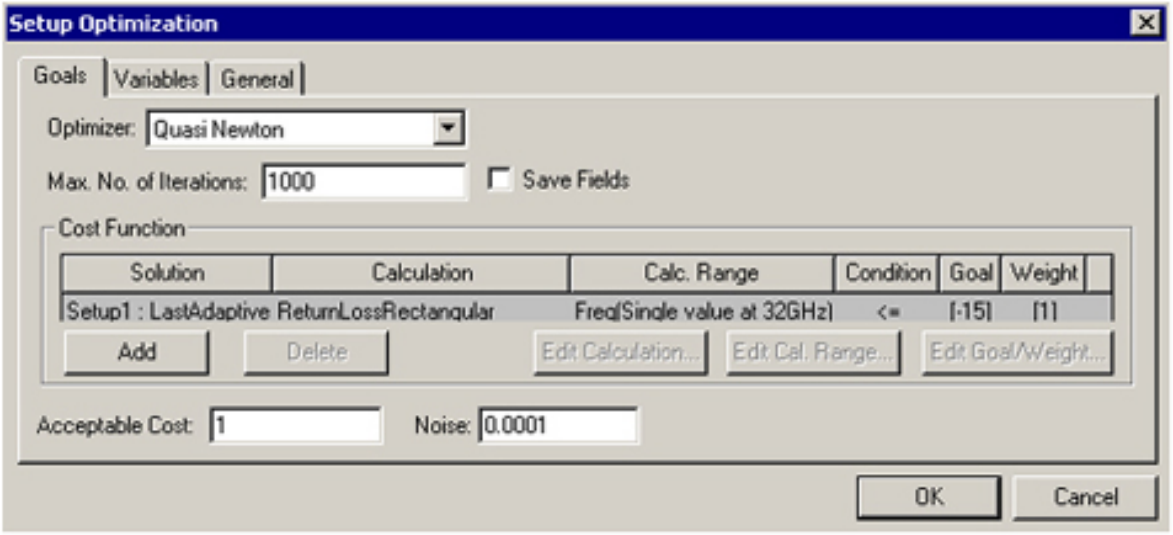

1
WavePort3
2


Setup Sweep Analysis
Sweep Definitions
Table
General
Calculations
Sync #
Variable
Description
radius
Linear Step from 0.122in to 0.132in, step=0.002in
width
Linear Step from 0.24in to 0.34in, step=0.02in
Add...
Edit...

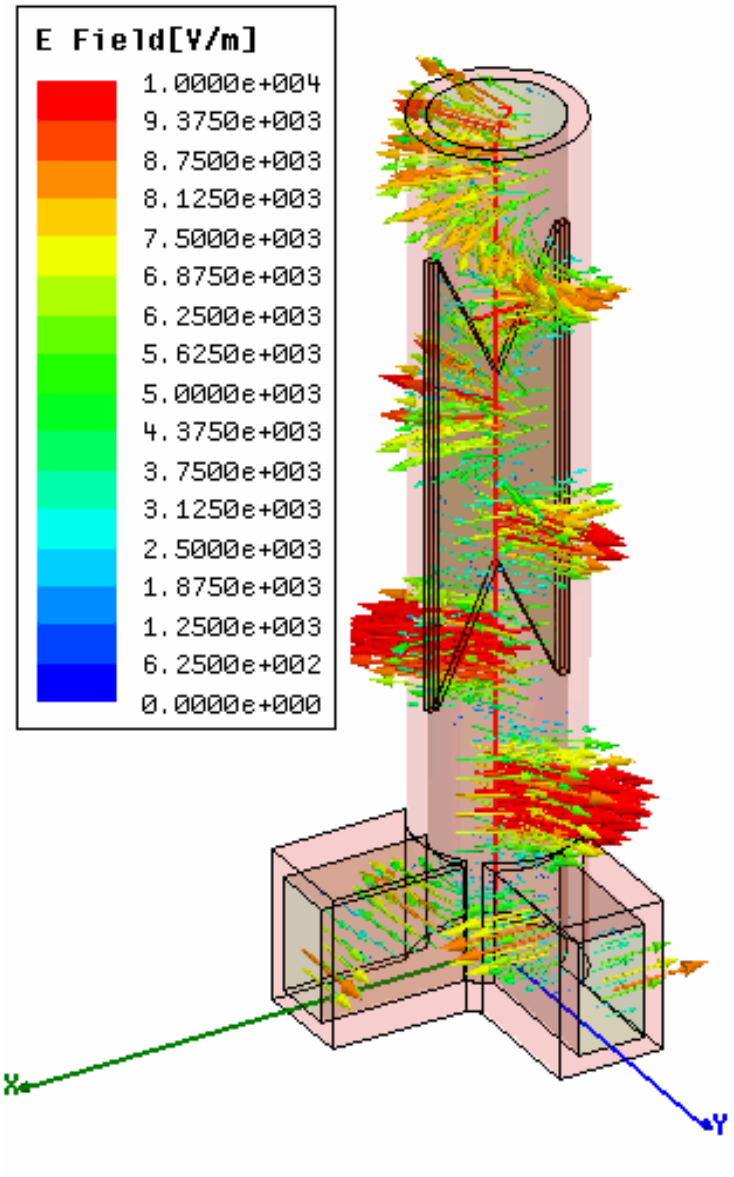

Setup Sweep Analysis
Sweep Definitions
Table
General
Calculations
Solution
Calculation
Calculation Range
Setup1 : LastAdaptive
ReturnLossRectangular
Freq(Single value at 32GHz)

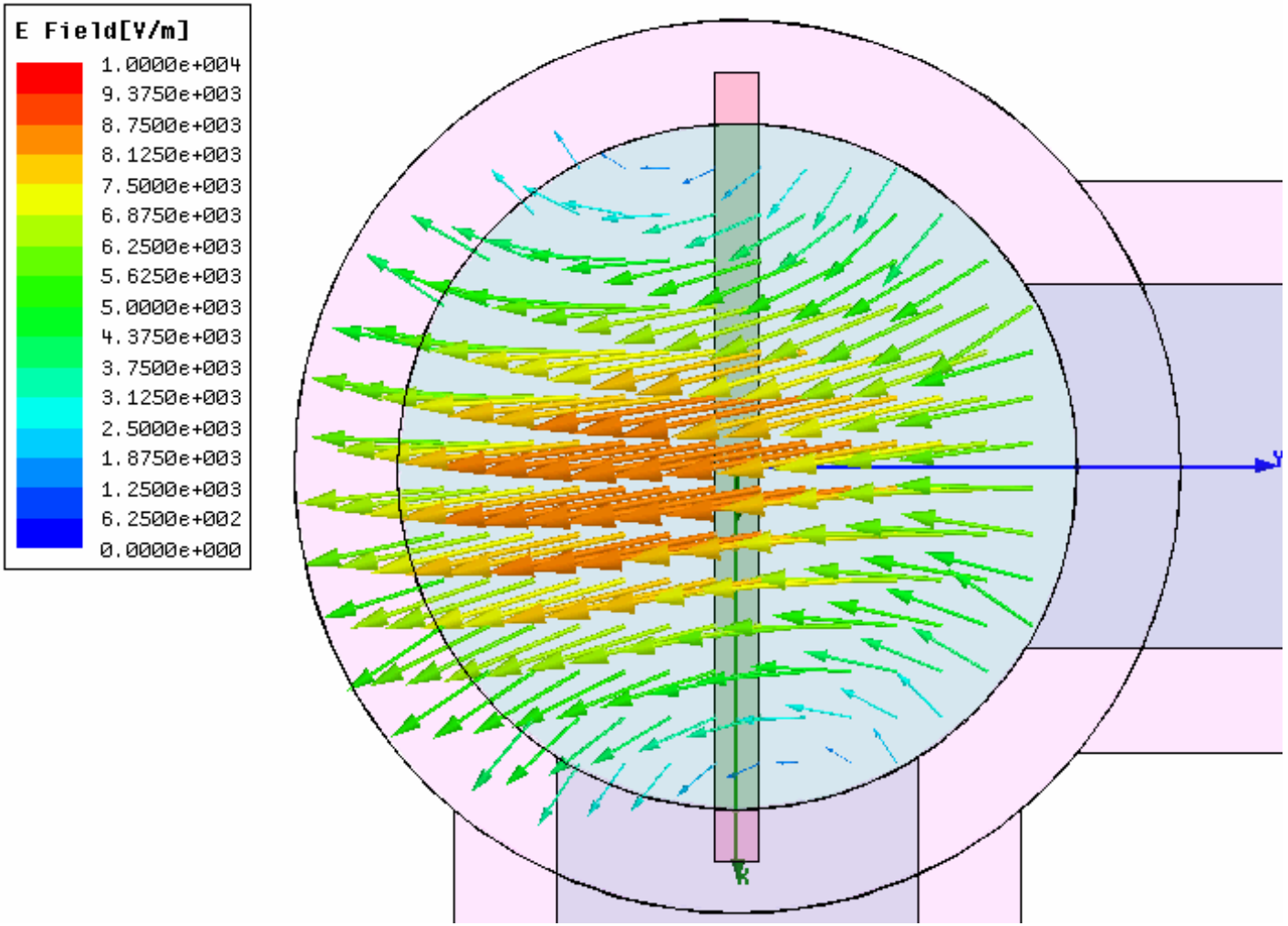

Output Variables
Name
Expression
1
ReturnLossRectangular
dB(S(WavePort1:1,WavePort1:1))
Name:
ReturnLossRectangular
Add
Update
Expression:
dB(S(WavePort1:1,WavePort1:1))


dB(S(WavePort1:
-8.2496e+000
-8.7503e+000
-9.2510e+000
-9.7517e+000
-1.0252e+001
-1.0753e+001
-1.1254e+001
-1.1754e+001
-1.2255e+001
-1.2756e+001
-1.3257e+001
-1.3757e+001
-1.4258e+001
-1.4759e+001
-1.5260e+001
-1.5760e+001
-1.6261e+001
dB(S(WavePort1:1,...
width
radius
dB(S(WavePort1:1,...
width



radius	width	Cost
0.13in	0.28in	1.5834
0.13in	0.3in	2.5574
0.13in	0.32in	3.7463
0.13in	0.34in	5.3858
0.132in	0.24in	0
0.132in	0.26in	0
0.132in	0.28in	0.13675
0.132in	0.3in	1.4621


E Field[V/m]
1.0000e+004
9.3750e+003
8.7500e+003
8.1250e+003
7.5000e+003
6.8750e+003
6.2500e+003
5.6250e+003
5.0000e+003
4.3750e+003
3.7500e+003
3.1250e+003
2.5000e+003
1.8750e+003
1.2500e+003
6.2500e+002
0.0000e+000
X
Y


E Field[V/m]
1.0000e+004
9.3750e+003
8.7500e+003
8.1250e+003
7.5000e+003
6.8750e+003
6.2500e+003
5.6250e+003
5.0000e+003
4.3750e+003
3.7500e+003
3.1250e+003
2.5000e+003
1.8750e+003
1.2500e+003
6.2500e+002
0.0000e+000

Summary

- The return loss into the rectangular ports may be improved by using non-standard waveguide sizes for the junction.
  - If a 16 dB return loss satisfies requirements, then no further matching elements are required.
  - If a better return loss is required, then this junction provides a better starting point for the use of a matching element.