

Microstrip Antenna Size Reduction Using Slots

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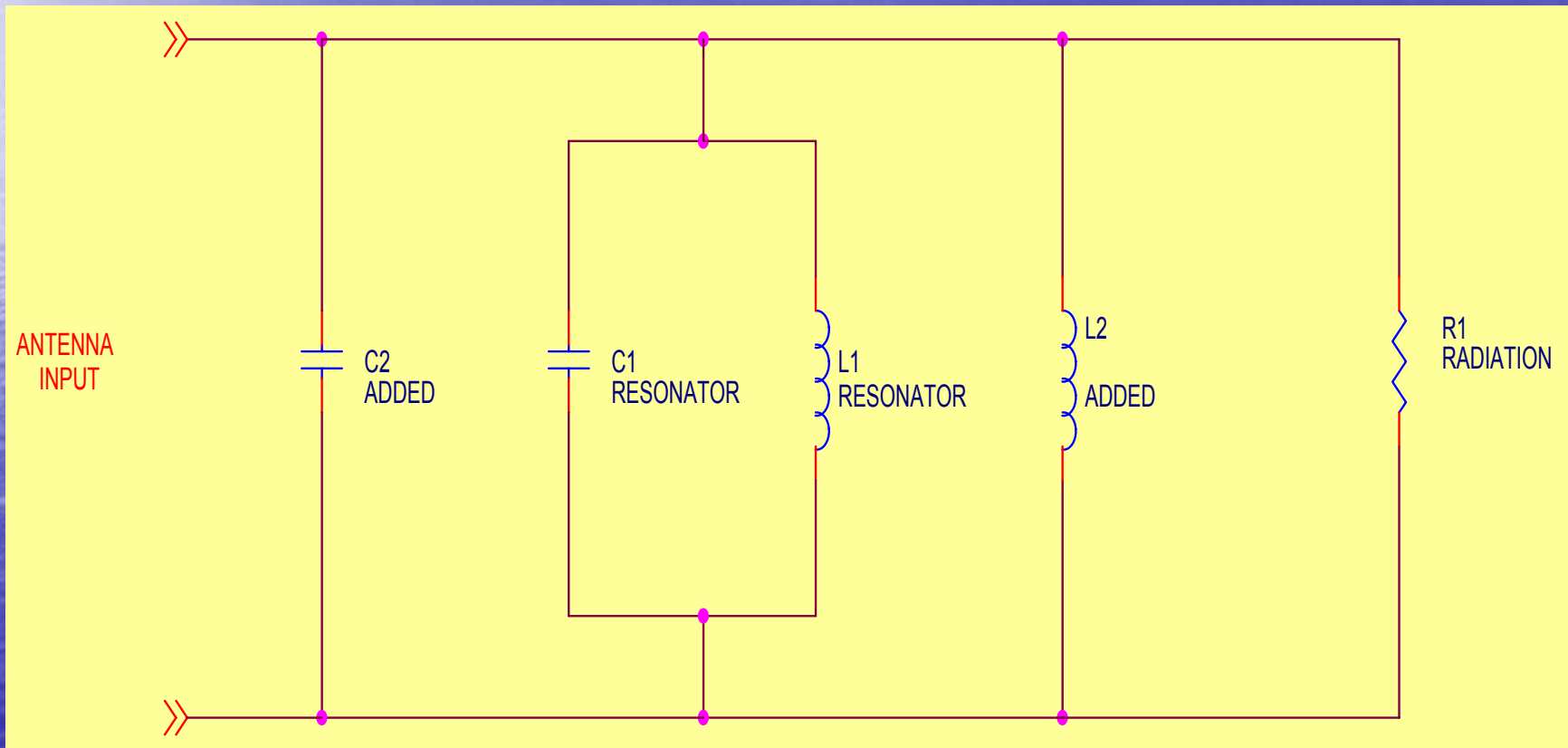
OUTLINE

- Design Conventional Microstrip Antenna
- Design Microstrip Antenna With Slot
- Compare Results & Performance

BACKGROUND

- Reduced Microstrip Antenna Size
 - Added Capacitance
 - Quarter-wave Length

OPTIONS



SPECIFICATIONS

- Frequency – 1.575 GHz
- Circularly Polarized, RHCP
- Input – 100 ohms with quarter-wave matching section
- Duroid 6002 dielectric, 0.050 thick
- Size – Minimize square antenna dimension

DEFINE MODEL

- Specify Units – inches
- Edit Layers – create
 - g1, Infinite Ground Plane
 - d1, Dielectric
 - gps1, Trace
- Edit Stack Up
 - Add Duroid6002 dielectric
 - Define d1: Duroid6002, 0.05 thickness
 - Define gps1: Available material - copper

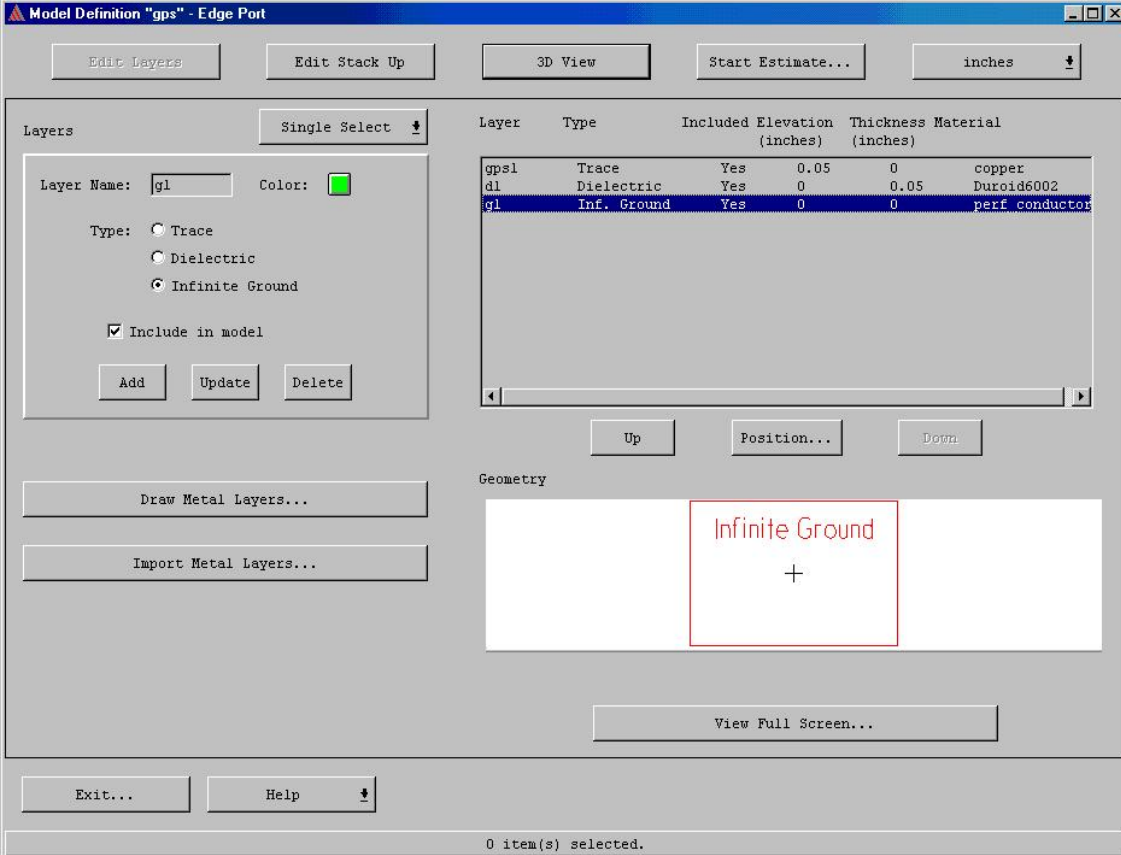
EDIT LAYERS

Create:

g1

d1

gps1



The screenshot shows the 'Model Definition "gps" - Edge Port' dialog box. The 'Layers' section on the left has 'Layer Name' set to 'g1' and 'Color' set to green. The 'Type' is 'Infinite Ground' (selected), and 'Include in model' is checked. The 'Layers' table on the right lists three layers: 'gps1' (Trace, 0.05 inches elevation, copper material), 'd1' (Dielectric, 0.05 inches thickness, Duroid6002 material), and 'g1' (Infinite Ground, 0 inches elevation, perf conductor material). The 'Geometry' section shows a preview of the 'Infinite Ground' layer with a red border and a plus sign. The status bar at the bottom indicates '0 item(s) selected.'

Layer	Type	Included	Elevation (inches)	Thickness (inches)	Material
gps1	Trace	Yes	0.05	0	copper
d1	Dielectric	Yes	0	0.05	Duroid6002
g1	Inf. Ground	Yes	0	0	perf conductor

Edit Stack Up

Add Duroid6002

Define d1

Duroid6002

0.05 thickness

Define gps1 Trace

Avail. material – Copper

Dielectric

Material name:

Relative Permittivity:

Dielectric Loss Tangent:

Bulk Conductivity:

Relative Permeability:

Magnetic Loss Tangent:

Model Definition "gps" - Edge Port

Edit Layers Edit Stack Up 3D View Start Estimate... inches

Edit Stack Up Single Select

Layer Name: gps1
Elevation: (inches)
Thickness: (inches)
Material:

Layer	Type	Included	Elevation	Thickness	Material
gps1	Trace	Yes	0.05	0	copper
d1	Dielectric	Yes	0	0.05	Duroid6002
g1	Inf. Ground	Yes	0	0	perf_conductor

Available Materials

beryllium	Dielectric
brass	Conductor
bronze	Conductor
cast_iron	Conductor
chromium	Conductor
cobalt	Conductor
copper	Conductor

Conductivity: 5.8E+007 mho/m
MuR: 1, Mag Loss Tan: 0

Stack Up

Exit... Help

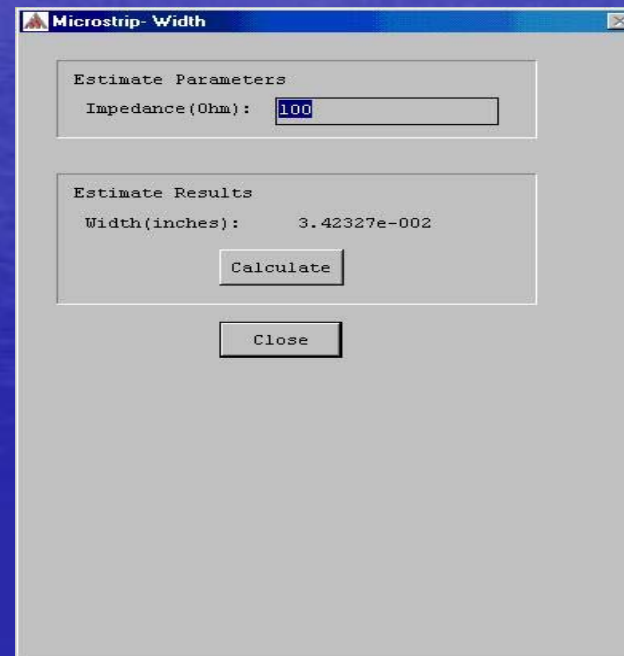
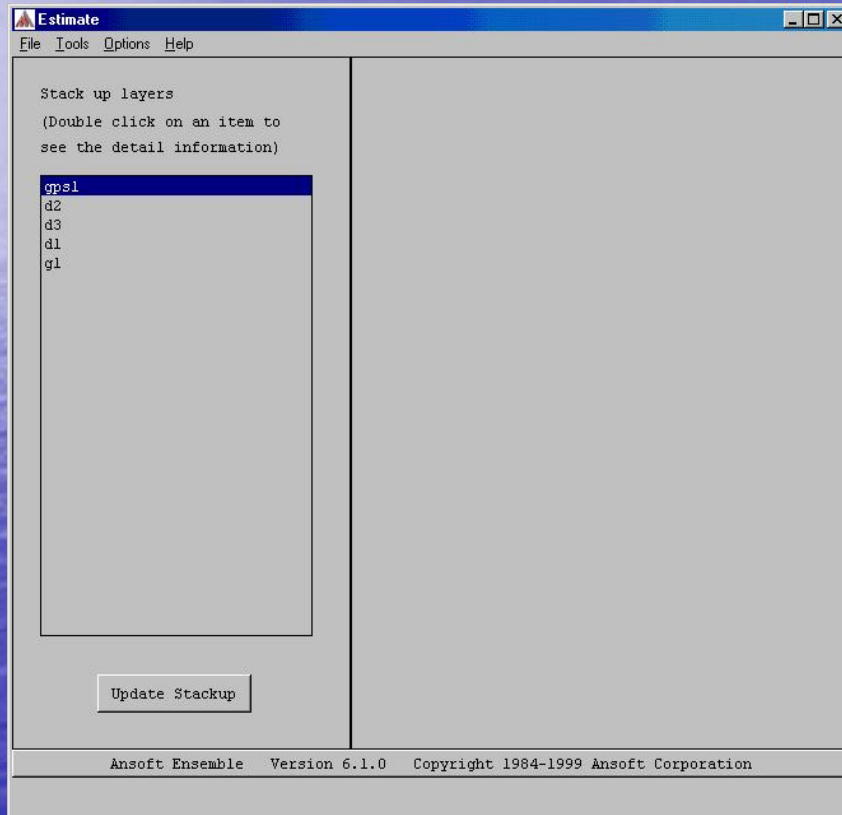
4 item(s) selected.

START ESTIMATE

Tools

T-line

Width



QUARTER WAVE TRANSFORMER

Estimate

Tools

Impedance Match

Quarter-Wave

The screenshot shows a software window titled "Quarter-Wave Transformer" with a blue title bar. The window is divided into two main sections: "Estimate Parameters" and "Estimate Results".

Estimate Parameters:

- Frequency(Ghz): 1.575
- Load Impedance: 200
- Input Impedance: 100

Estimate Results:

- Impedance(Ohm): 1.41421e+002
- Width(inches): 1.28215e-002
- Length(inches): 1.29072e+000

At the bottom of the results section is a "Calculate" button, and at the bottom of the window is a "Close" button.

Antenna Starting Point

Estimate

Tools

Printed Antennas

CP Corners Truncated

The screenshot shows a software window titled "Circularly Polarized Patch - Corners Truncated". It contains two main sections: "Estimate Parameters" and "Estimate Results".

Estimate Parameters:

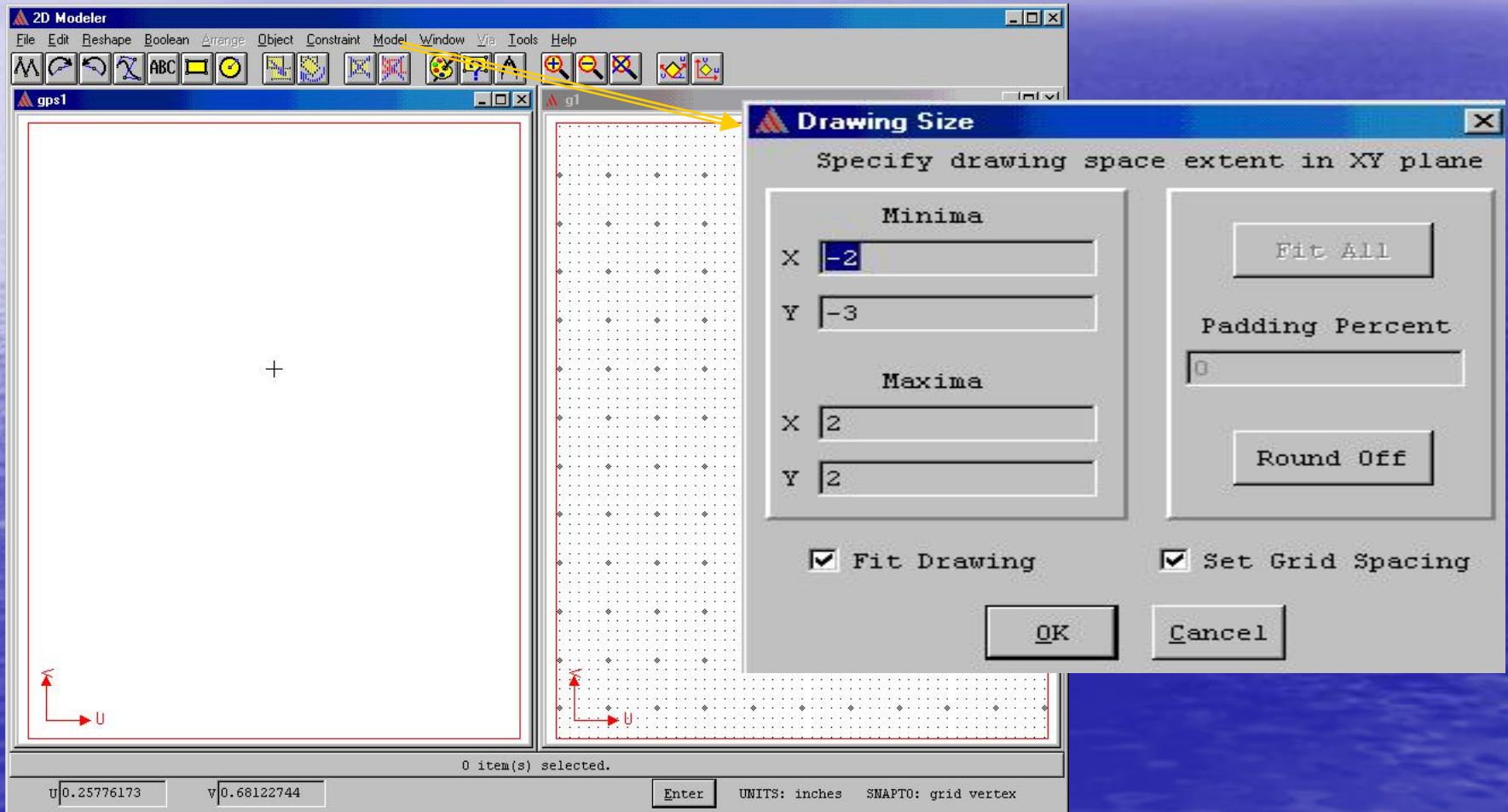
- Frequency(Ghz):

Estimate Results:

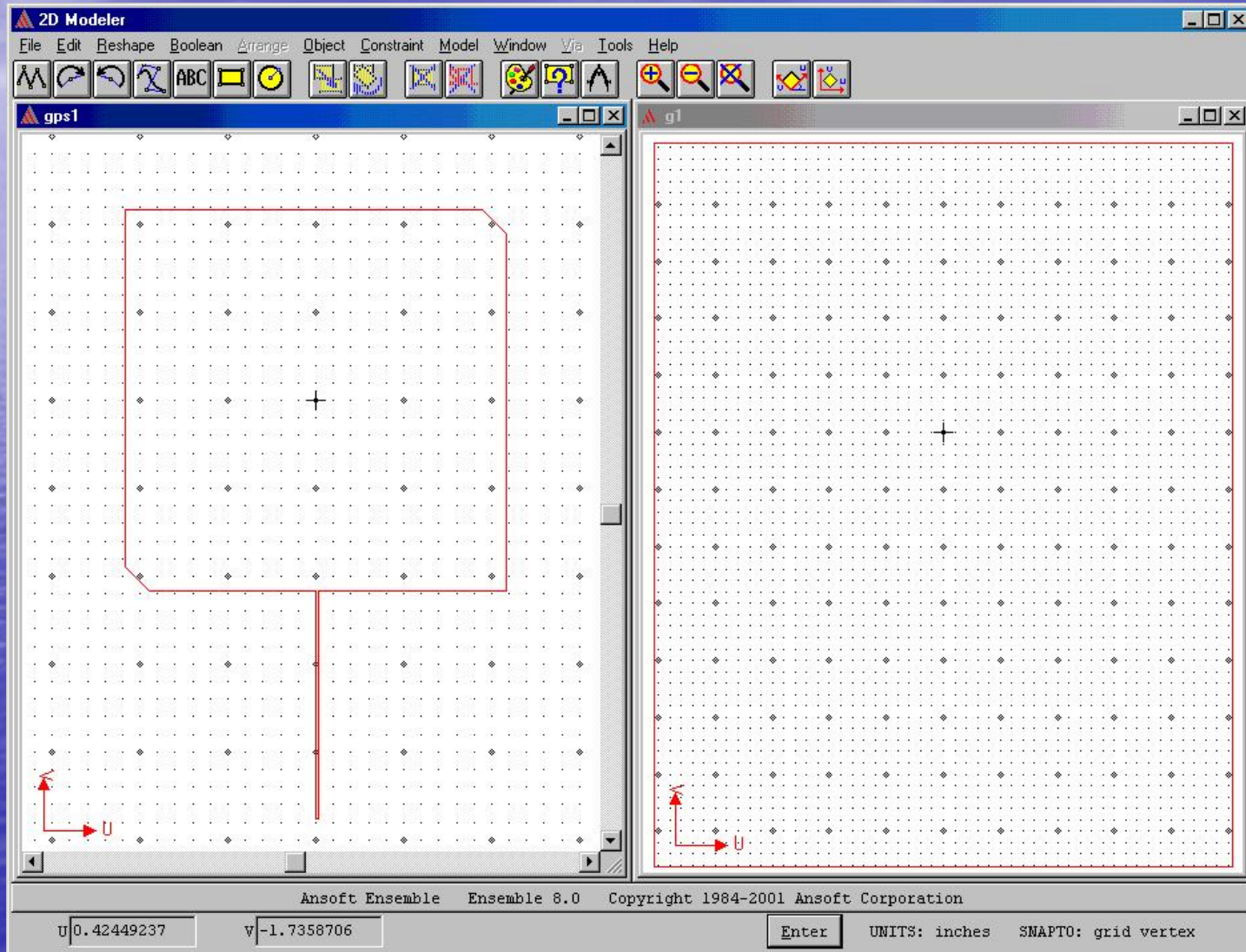
- Square Length(inches): 2.17235e+000
- Corner Length(inches): 1.40615e-001

Below the results, there is a "Calculate" button and a "Close" button.

DRAW METAL LAYERS

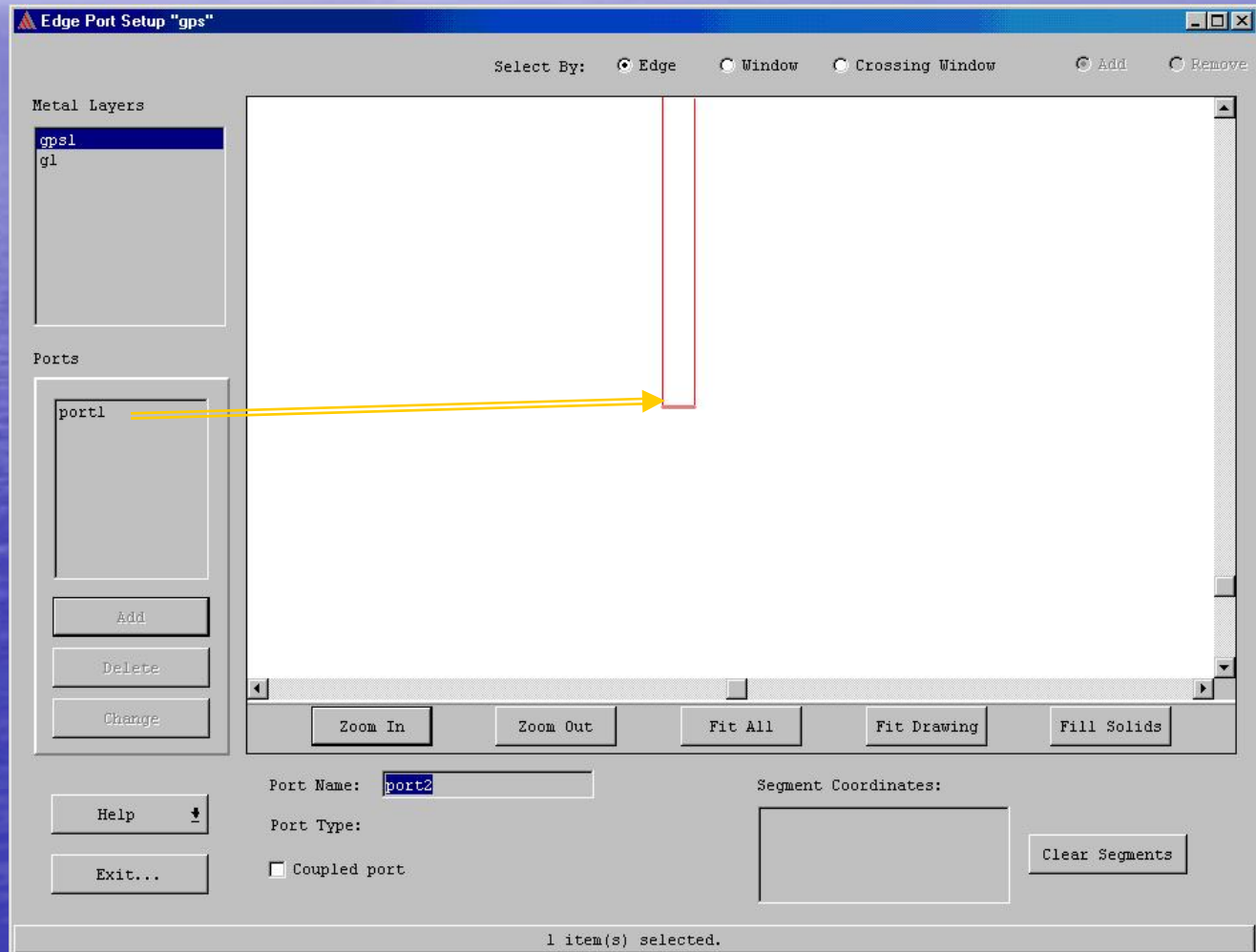


DRAW THE ANTENNA



SET-UP EXCITATION

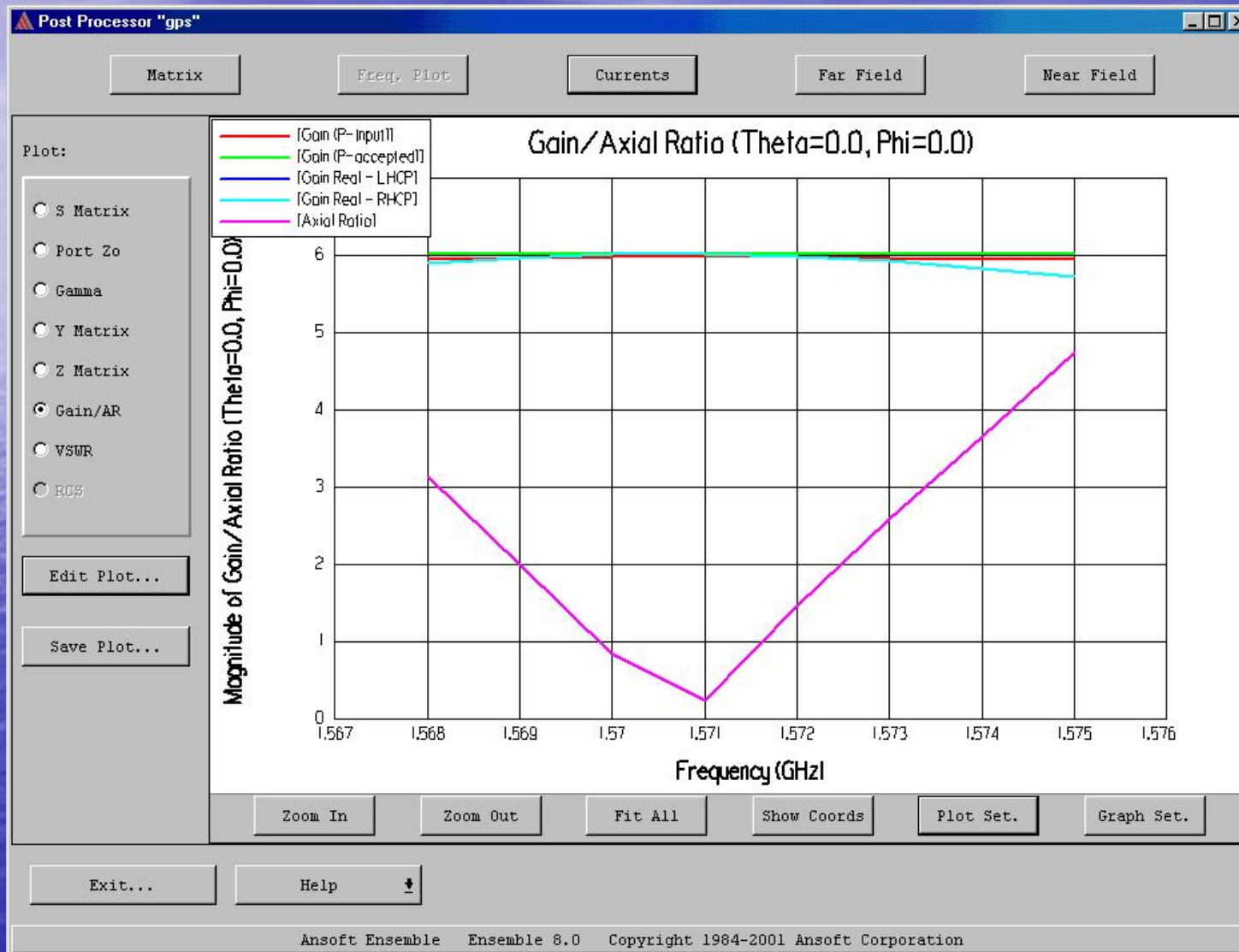
Add Port 1



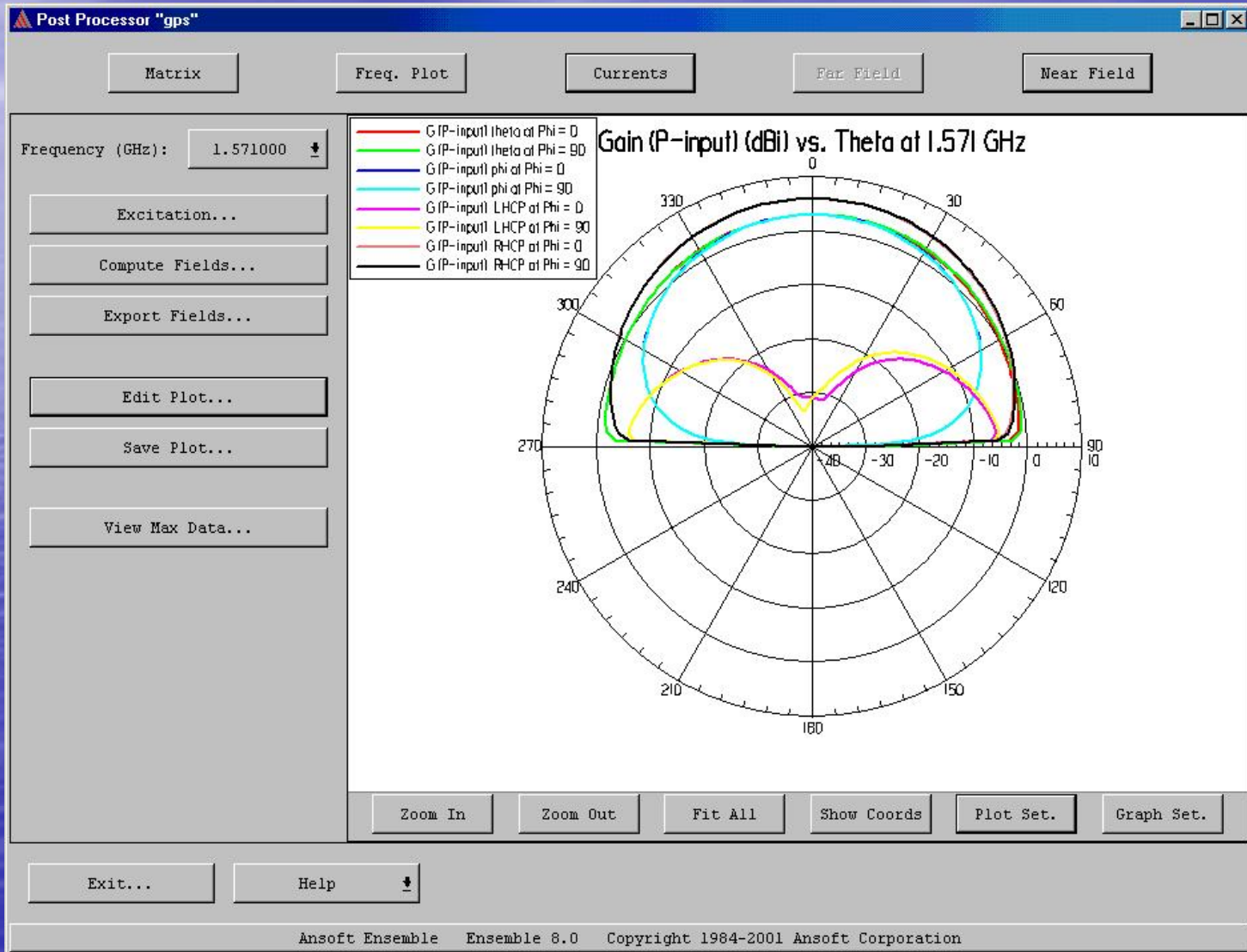
DETERMINE CORRECT SIZE

- Iterate square length – center frequency
2.172 to 2.162
Error = 0.5 %
- Iterate corner length – axial ratio
0.141 to 0.145
Error = 2.8 %

AXIAL RATIO



PATTERNS



ADD ANNULAR SLOT

- 0.375 inch in center of antenna
- Center Frequency – 1.538 GHz
- New Size – 2.112 inch square
- Size Reduction – 2.162 to 2.112
 - 0.050 inch Change
 - 2.4 % Change

SET HOLE TO AIR

Material Setup "gps01" [read-only]

Setup: Objects 2.5D Vias 3D Vias

Select By: Edge Window Crossing Window

Layer	Type	Default Material
gps1	2D	copper

Object Name	Material
object34	copper
object35	air

Assign Material

Available Materials	Type
Teflon	Dielectric
air	Dielectric
alumina_92pct	Dielectric
alumina_96pct	Dielectric
aluminum	Conductor
aluminum_EC	Conductor

EpsilonR: 1.0006, Diel Loss Tan: 0
Bulk Conductivity: 0 mho/m
MuR: 1, Mag Loss Tan: 0

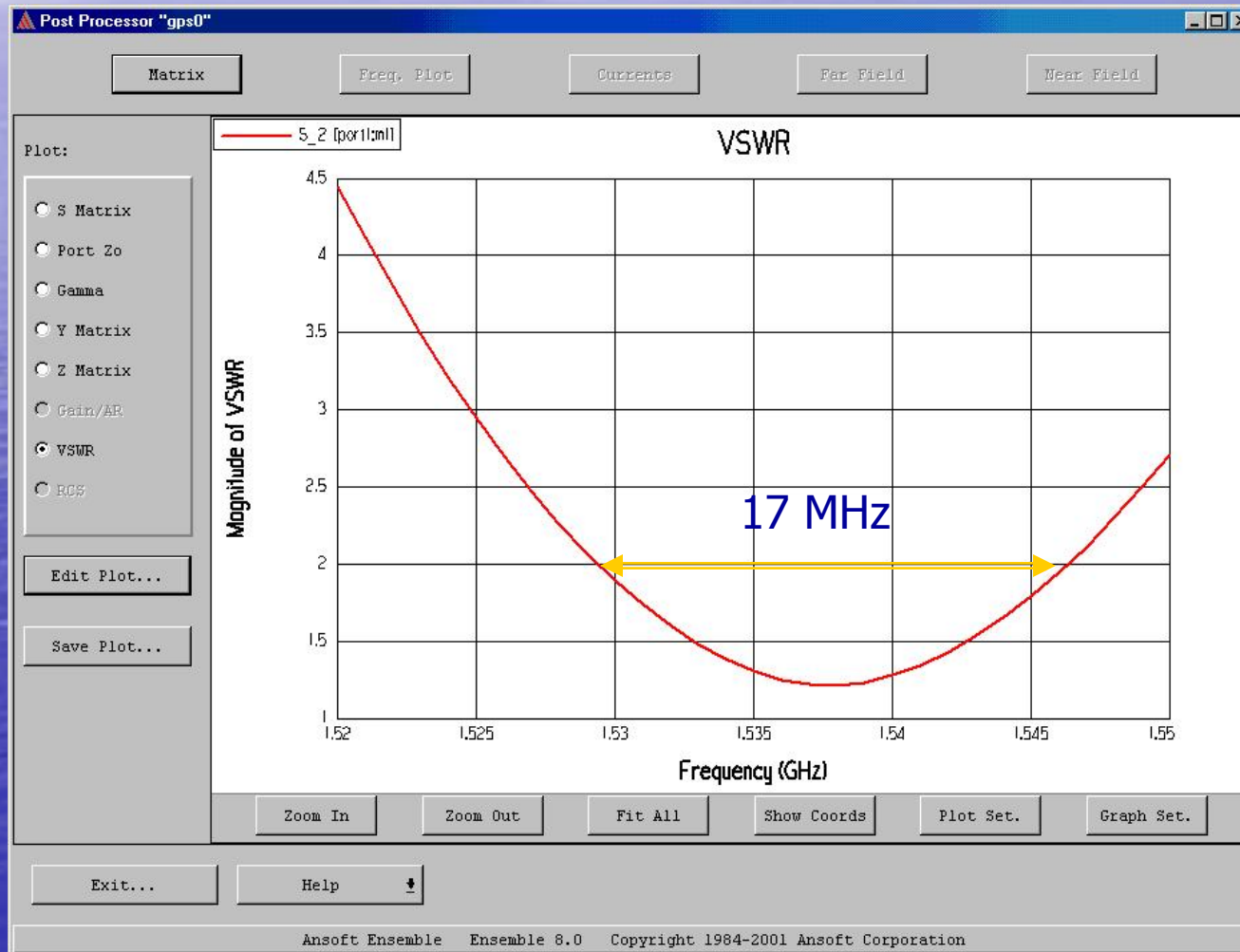
Add Change Delete

Zoom In Zoom Out Fit All Fit Drawing Fill Solids

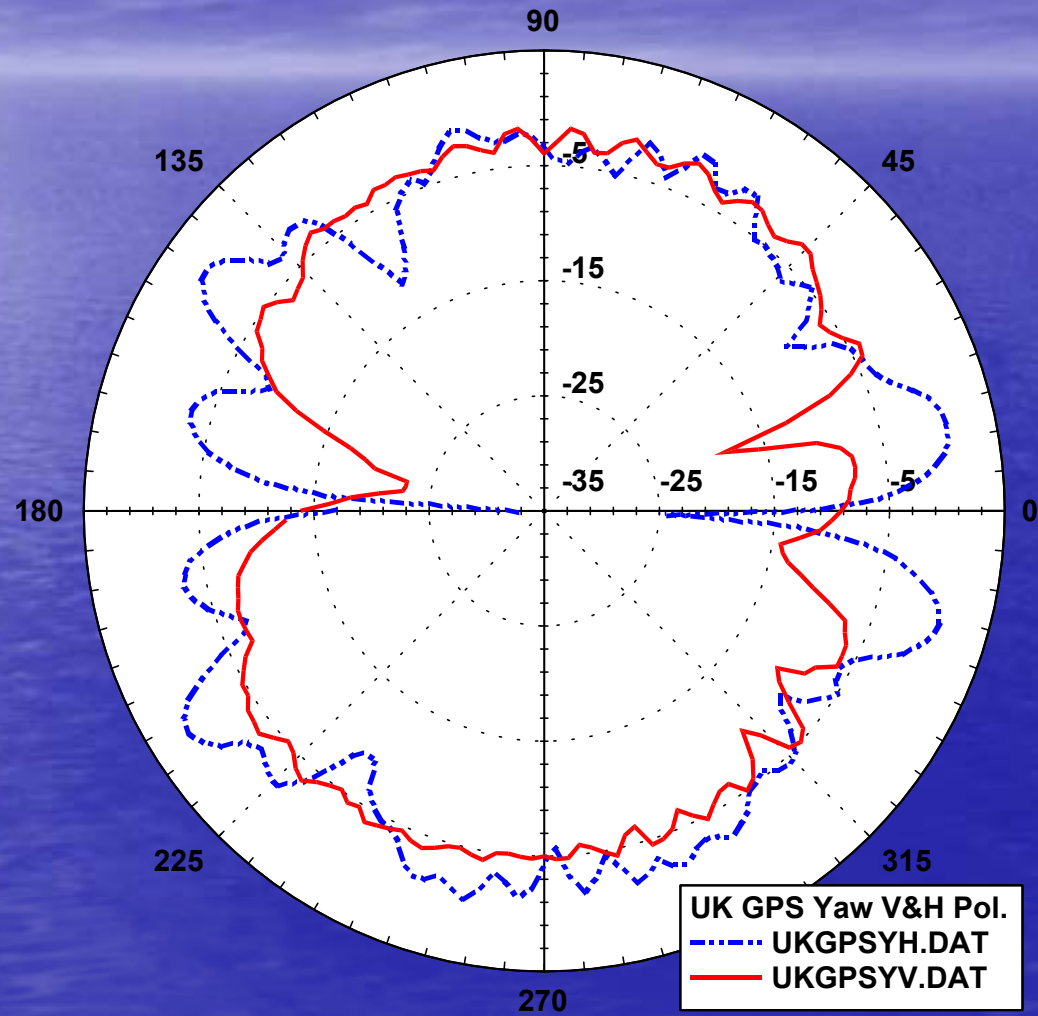
Help Exit...

1 item(s) selected.

2:1 VSWR BANDWIDTH



MEASURED PERFORMANCE



CONCLUSIONS

- Design easily done in Ensemble
- Design correlates with measured data
- Annular slot does reduce size of antenna