# Antenna and Radio Propagation

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## Experiment: 7

**Design & Analysis of a Horn Antenna**


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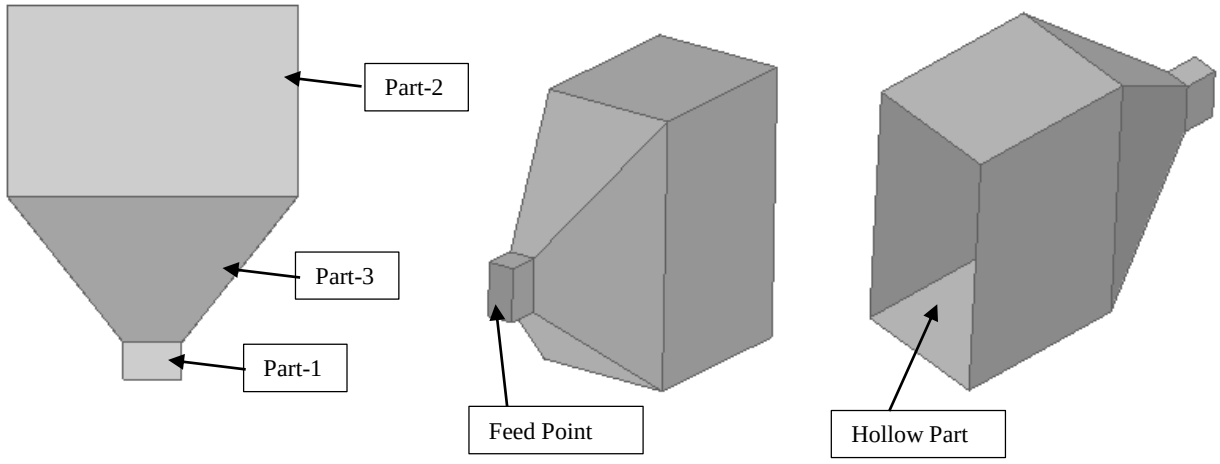
## 1 (a) Design & Analysis of a Horn Antenna

This guide leads you step-by-step through creating, solving, and analysing the results of a horn antenna

By following the steps in this guide, you will learn how to perform the following tasks in HFSS:

- Draw a geometric model.
- Modify a model's design parameters.
- Assign variables to a model's design parameters.
- Specify solution settings for a design.
- Validate a design's setup.
- Run an HFSS simulation.
- Create a 2D x-y plot of S-parameter results.
- Create a 2D x-y plot of gain, efficiency results.
- Create a 2D Polar/Rectangular plot of radiation pattern.
- Create a 3D plot of radiation pattern.
- Create a field overlay plot of results.

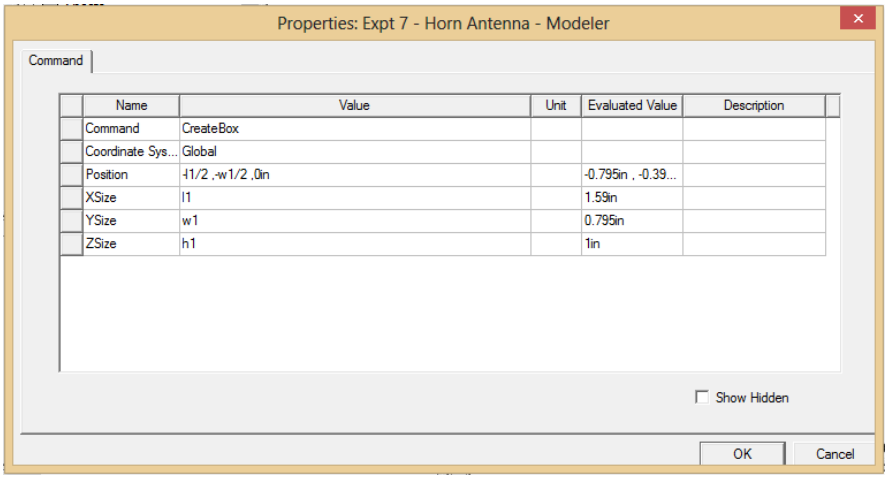
## 1 (b) Project overview



## 2 Create the Model (All parameters are in 'inch')

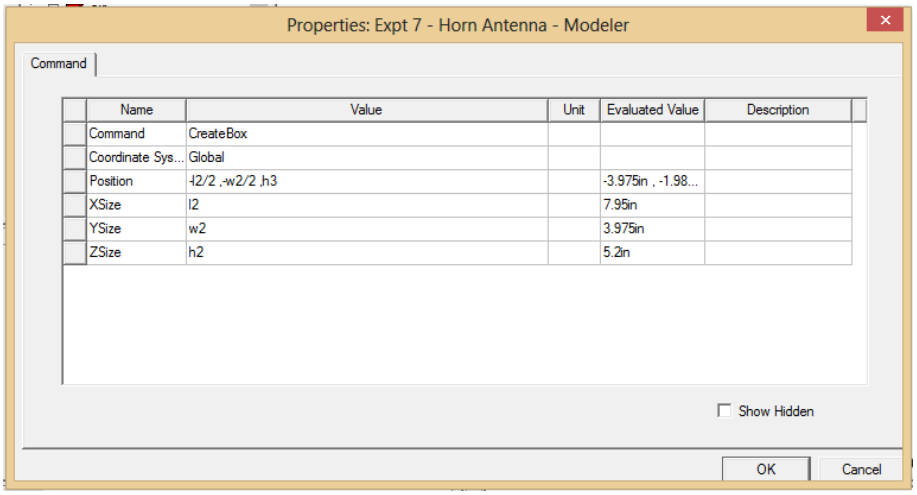
### Part-1

1. Create a Rectangular Box1. Centre (-l1/2 ,-w1/2 ,0in), X size = l1, Y size= wl, Z size = h1 Where; l1 = 1.59 in, w1 = 0.795 in, h1 = 1 in



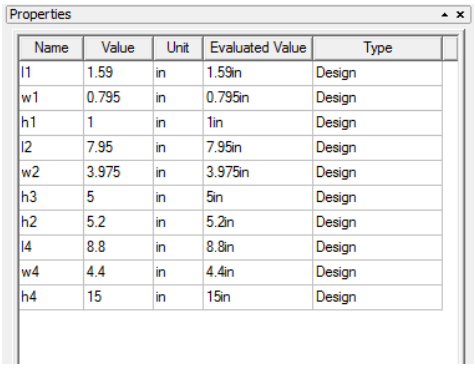

### Part-2

2. Create Rectangular Box2. Centre (-l2/2, -w2/2, h3), X size = l2, Y size= w2, Z size = h2. Where, l2 = 7.95 in, w2 = 3.975 in, h2 = 5.2 in, h3 = 5 in.




### Part-3

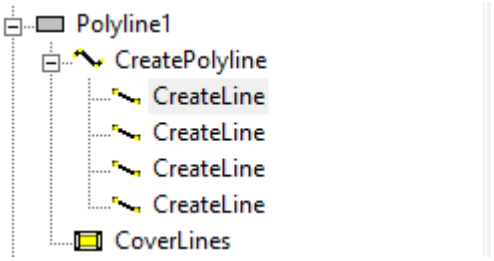
Use the following parameters




| Name | Value | Unit | Evaluated Value | Type |
|---|---|---|---|---|
| l1 | 1.59 | in | 1.59in | Design |
| w1 | 0.795 | in | 0.795in | Design |
| h1 | 1 | in | 1in | Design |
| l2 | 7.95 | in | 7.95in | Design |
| w2 | 3.975 | in | 3.975in | Design |
| h3 | 5 | in | 5in | Design |
| h2 | 5.2 | in | 5.2in | Design |
| l4 | 8.8 | in | 8.8in | Design |
| w4 | 4.4 | in | 4.4in | Design |
| h4 | 15 | in | 15in | Design |

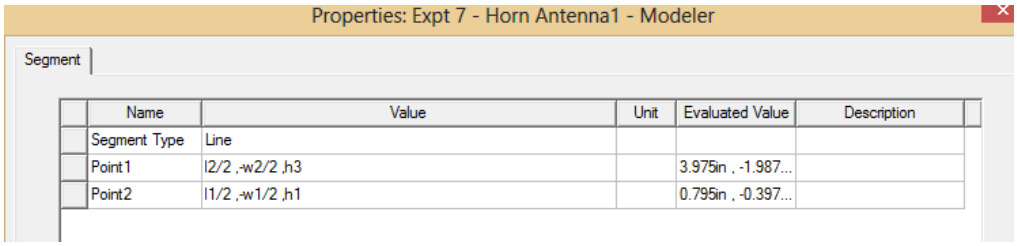
3. Create Polylines

a) Create Polyline 1



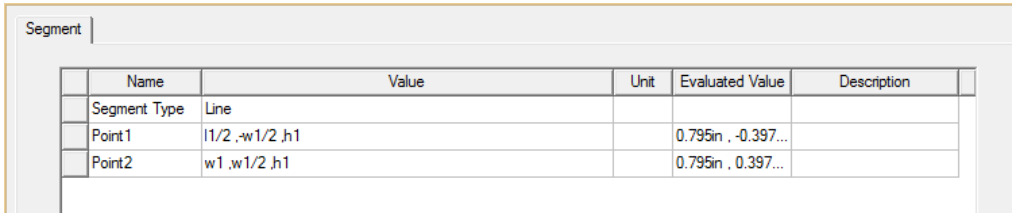

4 lines will be drawn

Line 1



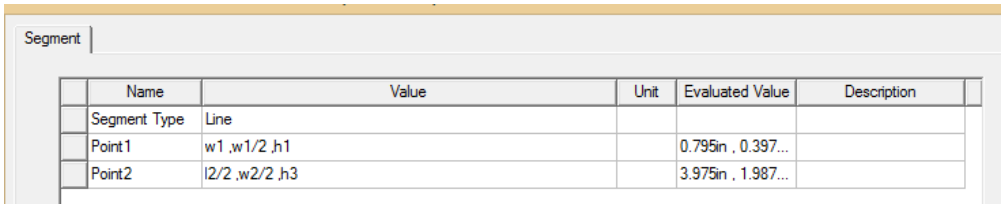

| Name | Value | Unit | Evaluated Value | Description |
|---|---|---|---|---|
| Segment Type | Line | | | |
| Point1 | l2/2 ,-w2/2 ,h3 | | 3.975in , -1.987... | |
| Point2 | l1/2 ,-w1/2 ,h1 | | 0.795in , -0.397... | |

Line 2



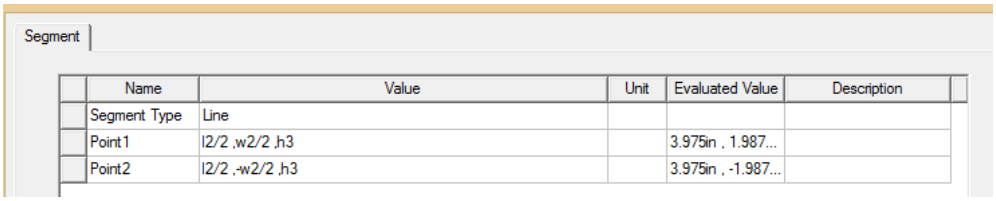

| Name | Value | Unit | Evaluated Value | Description |
|---|---|---|---|---|
| Segment Type | Line | | | |
| Point1 | l1/2 ,-w1/2 ,h1 | | 0.795in , -0.397... | |
| Point2 | w1 ,w1/2 ,h1 | | 0.795in , 0.397... | |

Line 3




| Name | Value | Unit | Evaluated Value | Description |
|---|---|---|---|---|
| Segment Type | Line | | | |
| Point1 | w1 ,w1/2 ,h1 | | 0.795in , 0.397... | |
| Point2 | l2/2 ,w2/2 ,h3 | | 3.975in , 1.987... | |

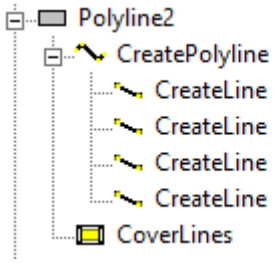
Line 4




| Name | Value | Unit | Evaluated Value | Description |
|---|---|---|---|---|
| Segment Type | Line | | | |
| Point1 | l2/2 ,w2/2 ,h3 | | 3.975in , 1.987... | |
| Point2 | l2/2 ,-w2/2 ,h3 | | 3.975in , -1.987... | |

For any doubt please check this video:[Link: https://www.youtube.com/watch?v=pUYQRftD-AU] Go to time: 3.24 min.

b) Create Polyline 2




4 lines will be drawn

Line 1

| Name | Value | Unit | Evaluated Value | Description |
|---|---|---|---|---|
| Segment Type | Line | | | |
| Point1 | l2/2 ,w2/2 ,h3 | | 3.975in , 1.987... | |
| Point2 | l1/2 ,w1/2 ,h1 | | 0.795in , 0.397... | |

Line 2

| Name | Value | Unit | Evaluated Value | Description |
|---|---|---|---|---|
| Segment Type | Line | | | |
| Point1 | l1/2 ,w1/2 ,h1 | | 0.795in , 0.397... | |
| Point2 | -l1/2 ,w1/2 ,h1 | | -0.795in , 0.397... | |

Line 3

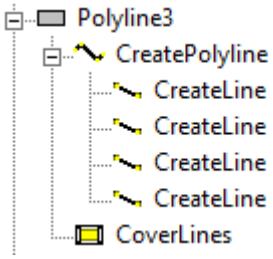
| Name | Value | Unit | Evaluated Value | Description |
|---|---|---|---|---|
| Segment Type | Line | | | |
| Point1 | -l1/2 ,w1/2 ,h1 | | -0.795in , 0.397... | |
| Point2 | -l2/2 ,w2/2 ,h3 | | -3.975in , 1.987... | |

Line 4

| Name | Value | Unit | Evaluated Value | Description |
|---|---|---|---|---|
| Segment Type | Line | | | |
| Point1 | -l2/2 ,w2/2 ,h3 | | -3.975in , 1.987... | |
| Point2 | l2/2 ,w2/2 ,h3 | | 3.975in , 1.987... | |

For any doubt please check this video:[Link: https://www.youtube.com/watch?v=pUYQRftD-AU] Go to time: 3.24 min.

c) Create Polyline 3




4 lines will be drawn

Line 1

| | Name | Value | Unit | Evaluated Value | Description |
|---|---|---|---|---|---|
| | Segment Type | Line | | | |
| | Point1 | l2/2 ,-w2/2 ,h3 | | 3.975in , -1.987... | |
| | Point2 | l1/2 ,-w1/2 ,h1 | | 0.795in , -0.397... | |

Line 2

| | Name | Value | Unit | Evaluated Value | Description |
|---|---|---|---|---|---|
| | Segment Type | Line | | | |
| | Point1 | l1/2 ,-w1/2 ,h1 | | 0.795in , -0.397... | |
| | Point2 | -l1/2 ,-w1/2 ,h1 | | -0.795in , -0.39... | |

Line 3

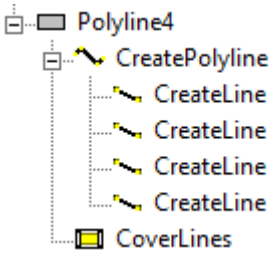
| | Name | Value | Unit | Evaluated Value | Description |
|---|---|---|---|---|---|
| | Segment Type | Line | | | |
| | Point1 | -l1/2 ,-w1/2 ,h1 | | -0.795in , -0.39... | |
| | Point2 | -l2/2 ,-w2/2 ,h3 | | -3.975in , -1.98... | |

Line 4

| | Name | Value | Unit | Evaluated Value | Description |
|---|---|---|---|---|---|
| | Segment Type | Line | | | |
| | Point1 | -l2/2 ,-w2/2 ,h3 | | -3.975in , -1.98... | |
| | Point2 | l2/2 ,-w2/2 ,h3 | | 3.975in , -1.987... | |

For any doubt please check this video:[Link: https://www.youtube.com/watch?v=pUYQRftD-AU] Go to time: 3.24 min.

d) Create Polyline 4




4 lines will be drawn

Line 1

| | Name | Value | Unit | Evaluated Value | Description |
|---|---|---|---|---|---|
| | Segment Type | Line | | | |
| | Point1 | -l2/2 ,-w2/2 ,h3 | | -3.975in , -1.98... | |
| | Point2 | -l1/2 ,-w1/2 ,h1 | | -0.795in , -0.39... | |

Line 2

| | Name | Value | Unit | Evaluated Value | Description |
|---|---|---|---|---|---|
| | Segment Type | Line | | | |
| | Point1 | -l1/2 ,-w1/2 ,h1 | | -0.795in , -0.39... | |
| | Point2 | -w1 ,w1/2 ,h1 | | -0.795in , 0.397... | |

Line 3

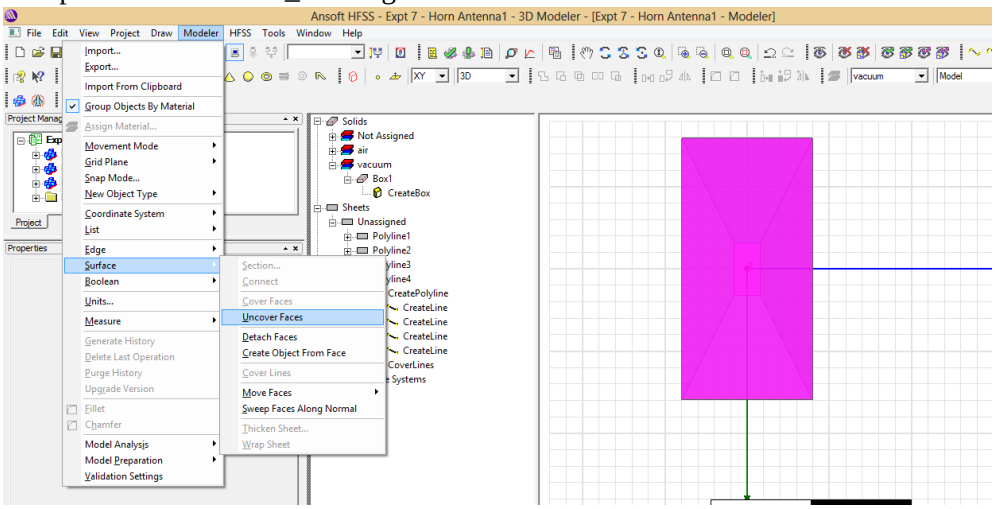
| | Name | Value | Unit | Evaluated Value | Description |
|---|---|---|---|---|---|
| | Segment Type | Line | | | |
| | Point1 | -w1 ,w1/2 ,h1 | | -0.795in , 0.397... | |
| | Point2 | -l2/2 ,w2/2 ,h3 | | -3.975in , 1.987... | |

Line 4

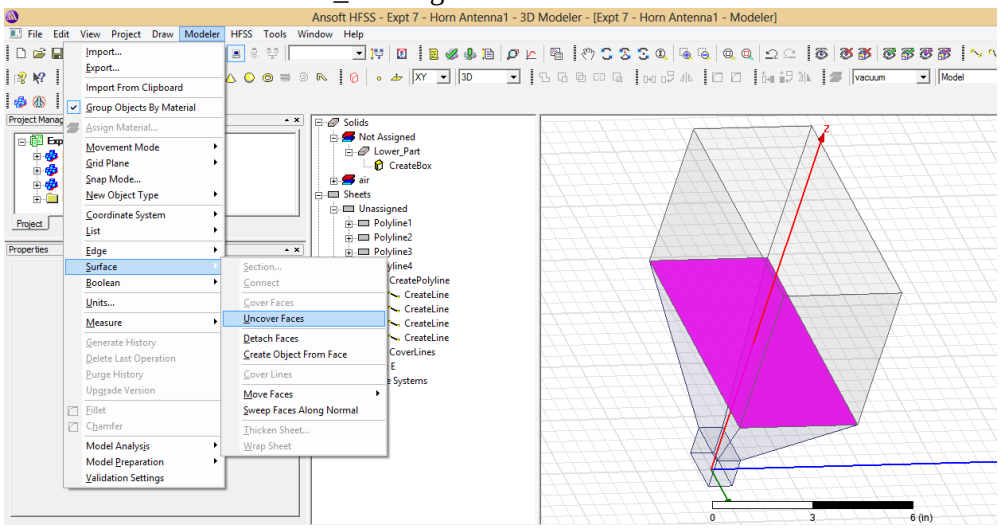
| | Name | Value | Unit | Evaluated Value | Description |
|---|---|---|---|---|---|
| | Segment Type | Line | | | |
| | Point1 | -l2/2 ,w2/2 ,h3 | | -3.975in , 1.987... | |
| | Point2 | -l2/2 ,-w2/2 ,h3 | | -3.975in , -1.98... | |

For any doubt please check this video:[Link: https://www.youtube.com/watch?v=pUYQRftD-AU] Go to time: 3.24 min.

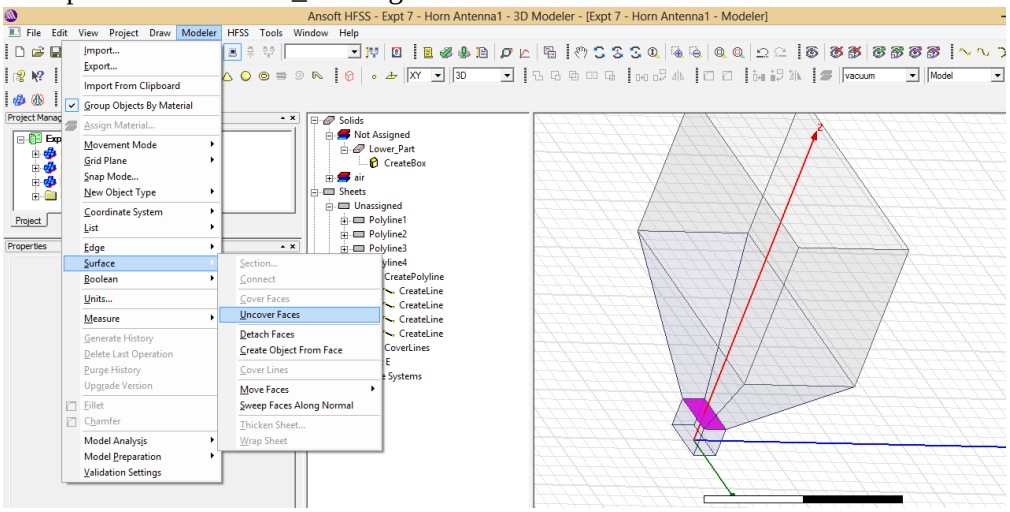
4. Select the top surface of **Part-1**_Rectangular Box > Modeler > Surface > Uncover faces



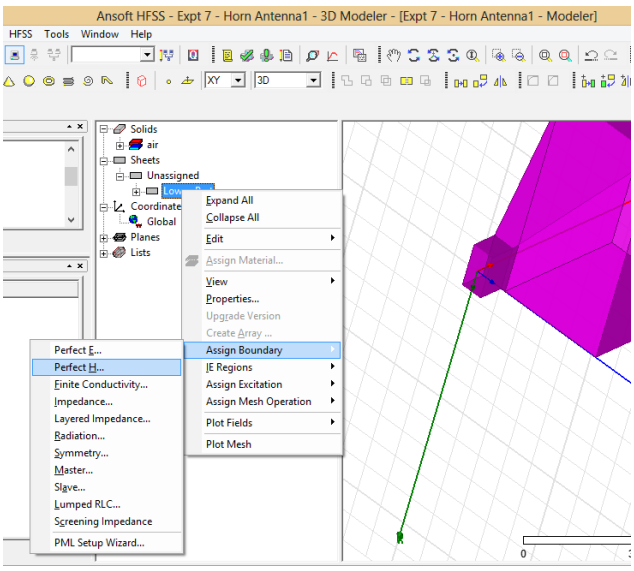
5. Select the bottom surface of **Part-1**_Rectangular Box > Modeler > Surface > Uncover faces




6. Select the top surface of **Part-2**_Rectangular Box > Modeler > Surface > Uncover faces

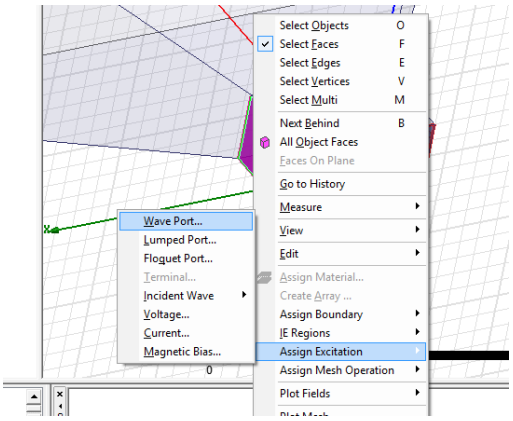


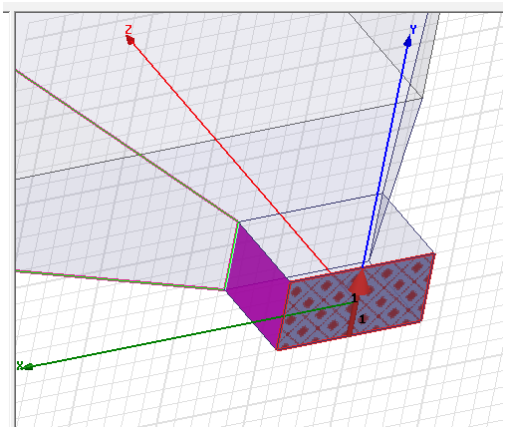

7. Select (all polylines + Part 1 rectangular box + Part 2 rectangular box) > Right click > Assign boundary > Perfect E



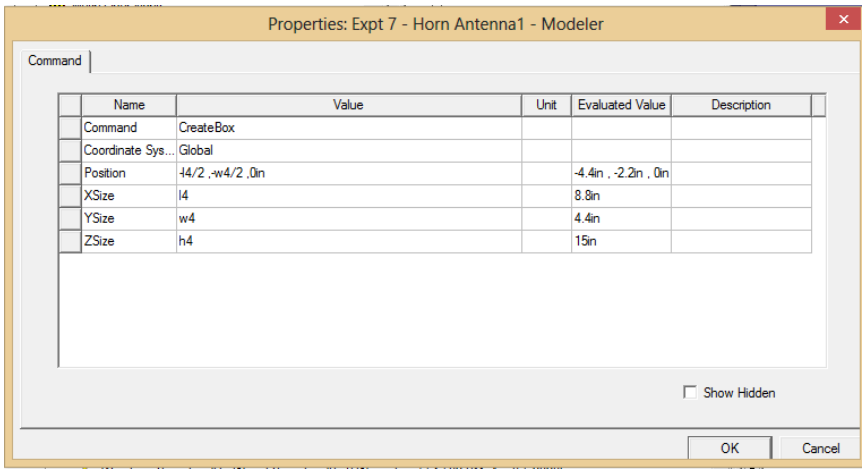
## Excitation

8. Select the bottom surface of **Part-2_** > Assign Excitation > Wave Port



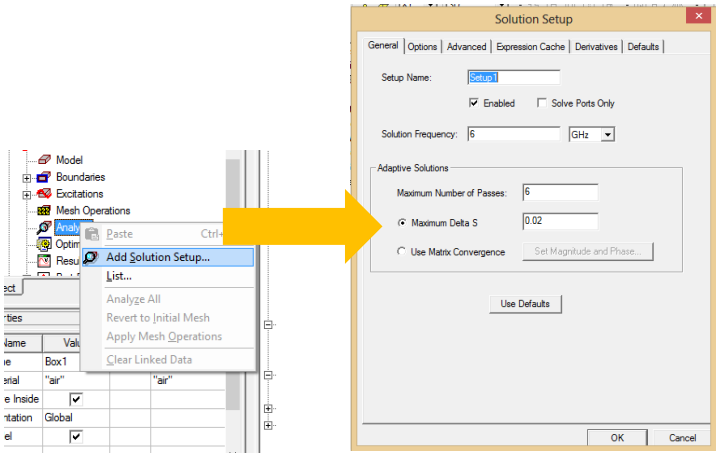

9. Now create Rectanagular Box 3. Centre (-l4/2, -w4/2, 0 in), X size = l4, Y size= w4, Z size = h4. Where, l4 = 8.8 in, w4 = 4.4 in, h4 = 15 in.



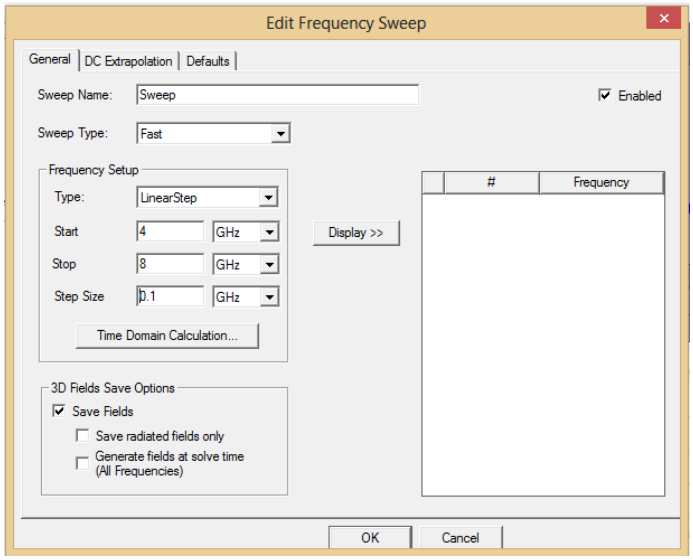

10. Assign material ‘Air’ to the radiation box.

11. Assign radiation only boundary to the radiation box. Right click > Assign boundary > Radiation

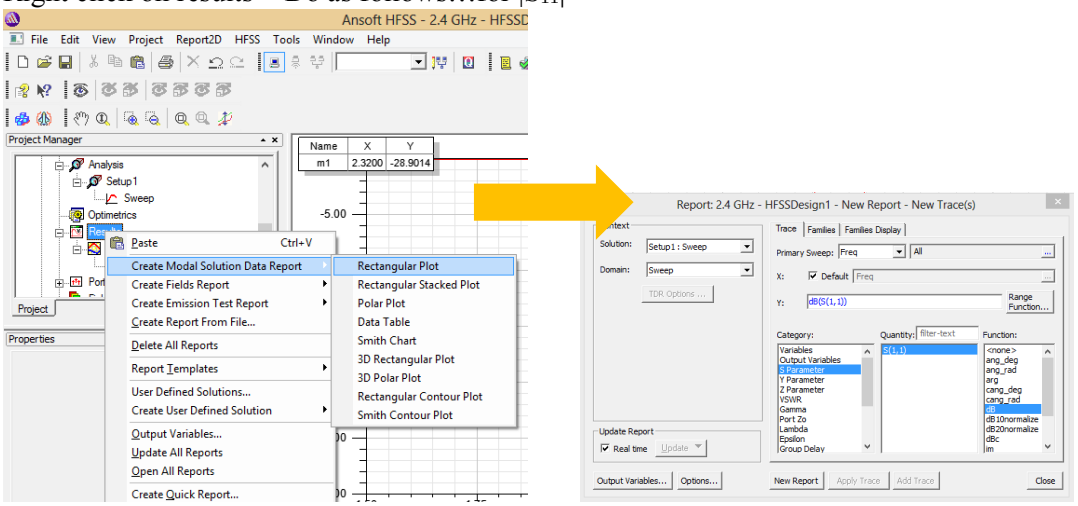
12. Right Click on analysis > Add solution setup → add 6 GHz > Ok

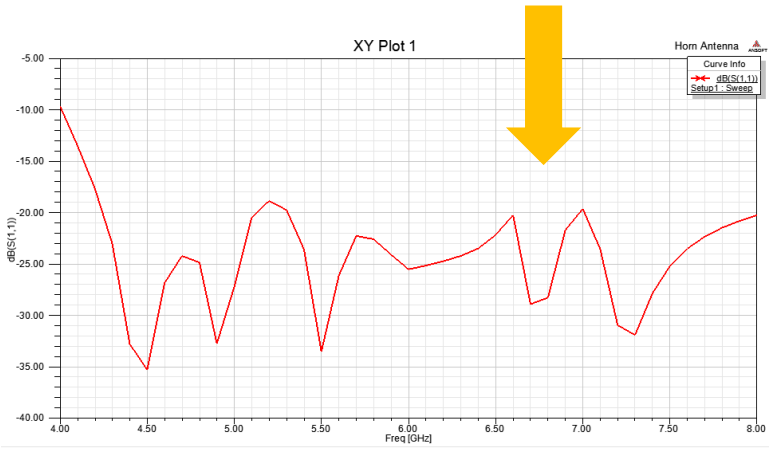



13. Click '+' of the analysis → Right click on setup → Add frequency sweep → Edit frequency sweep (Sweep type Fast, Frequency range 4 GHz to 8 GHz, Step size 0.1 GHz) → Ok

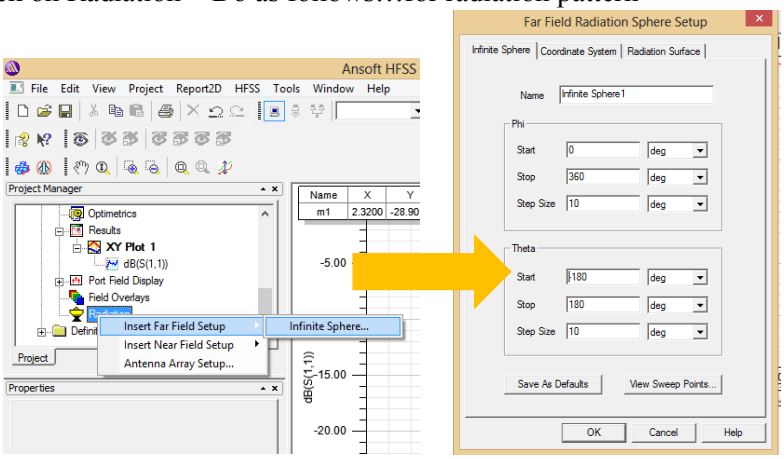



14. Right click on results > Do as follows…for $|S_{11}|$

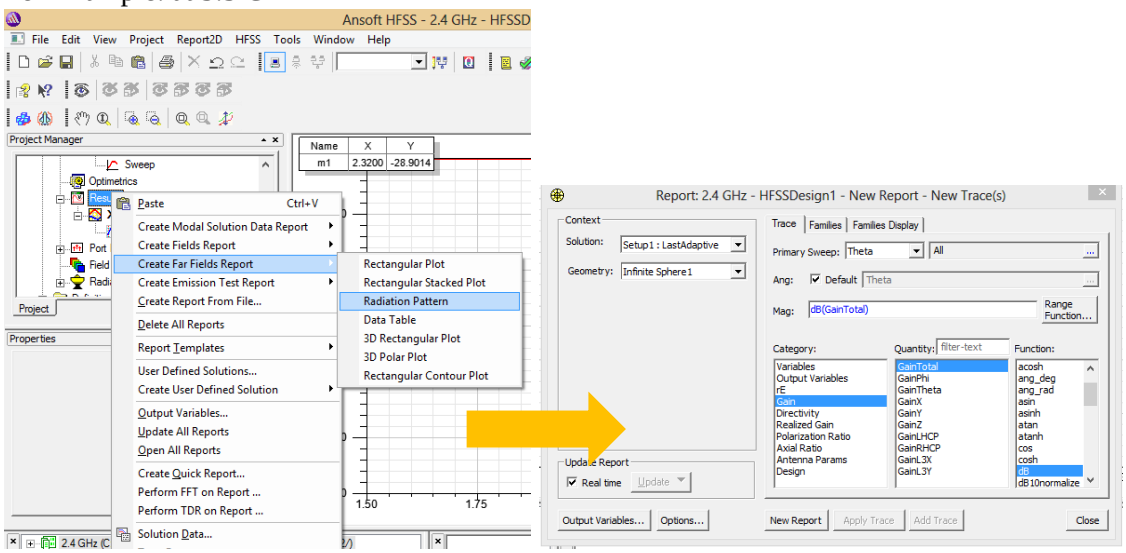




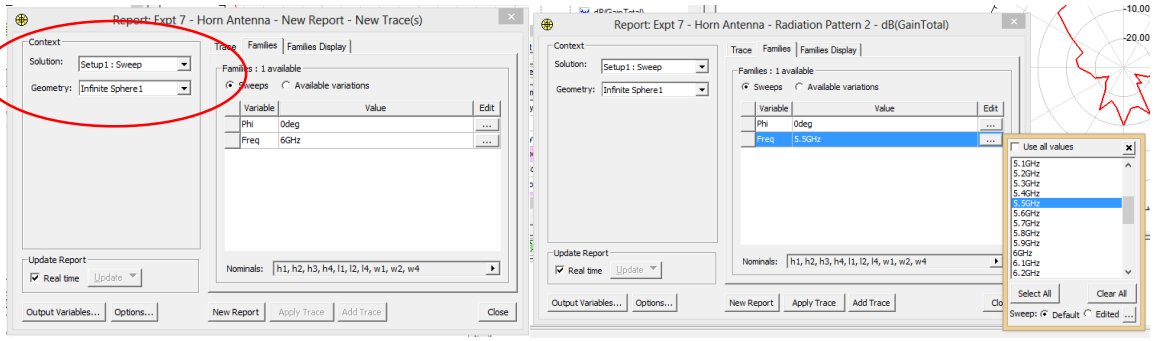

15. Right click on Radiation > Do as follows…for radiation pattern



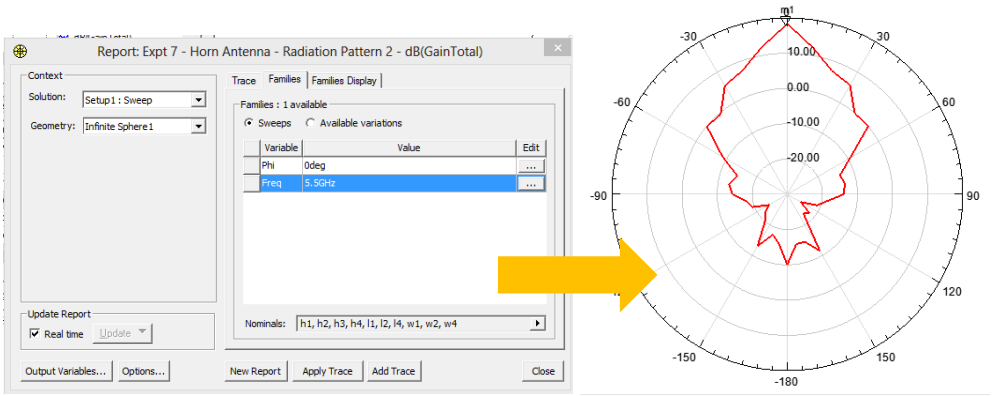

16. Then Right click on Results > Do as follows…for radiation pattern at all resonating frequencies. For Example: at 5.5 GHz



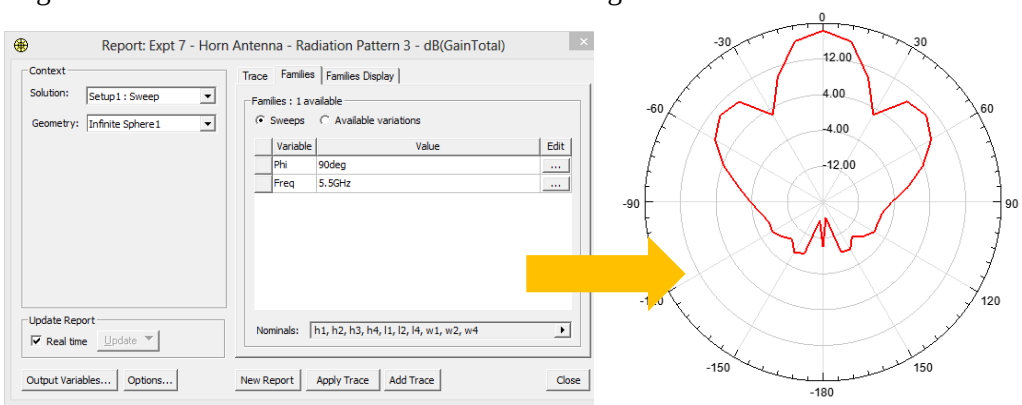

Select Solution type: Sweep



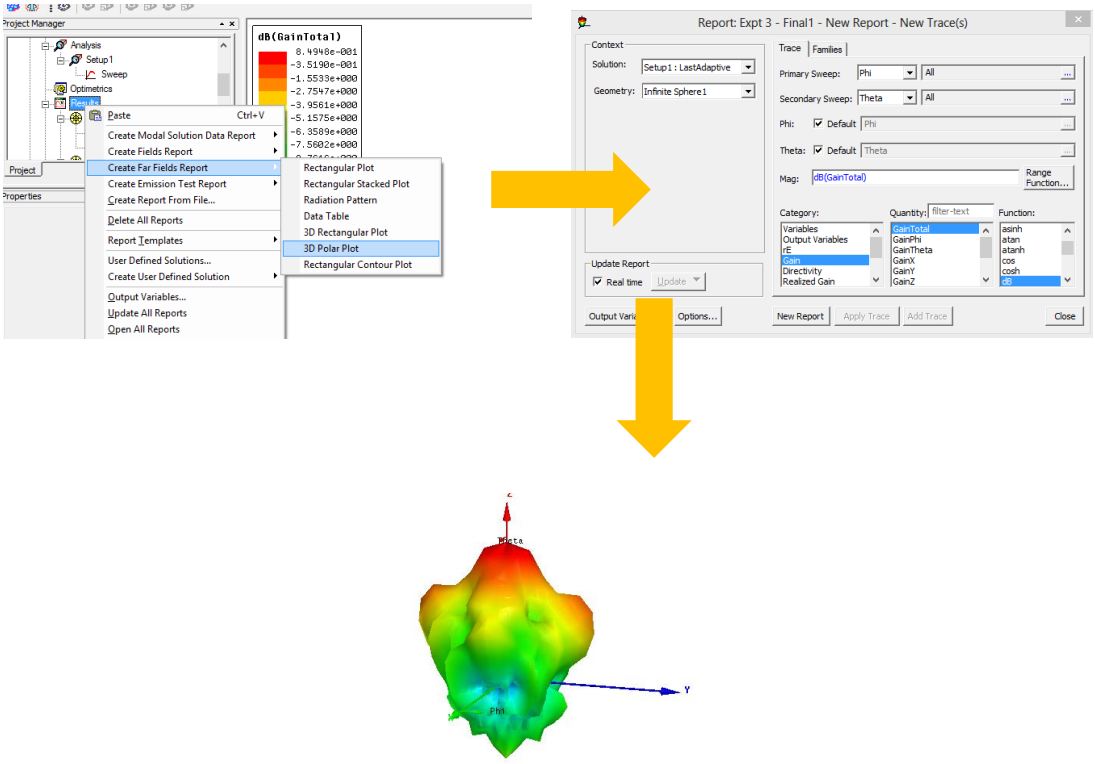

Then go to Families and do as follows for Phi = 0 Degree




Then go to Families and do as follows for Phi = 90 Degree




17. Draw 3D polar plot. Follow the below procedure:


Project Manager
Analysis
Setup1
Sweep
Optimetrics
Results
Paste Ctrl+V
Create Modal Solution Data Report
Create Fields Report
Create Far Fields Report
Create Emission Test Report
Create Report From File...
Delete All Reports
Report Templates
User Defined Solutions...
Create User Defined Solution
Output Variables...
Update All Reports
Open All Reports
Rectangular Plot
Rectangular Stacked Plot
Radiation Pattern
Data Table
3D Rectangular Plot
3D Polar Plot
Rectangular Contour Plot
dB(GainTotal)
Project
Properties
Report: Expt 3 - Final1 - New Report - New Trace(s)
Context
Solution: Setup1 : LastAdaptive
Geometry: Infinite Sphere1
Trace
Families
Primary Sweep: Phi
Secondary Sweep: Theta
Phi: Default
Theta: Default
Mag: dB(GainTotal)
Range Function...
Category:
Quantity:
Function:
Variables
Output Variables
rE
Gain
Directivity
Realized Gain
GainTotal
GainPhi
GainTheta
GainX
GainY
GainZ
asinh
atan
atanh
cos
cosh
dB
Update Report
Real time
Update
Output Vari
Options...
New Report
Apply Trace
Add Trace
Close


Theta
Phi
Y