Western New England University
College of Engineering
ECE Department
Wave Transmission and Reception
EE 457/557
Fall 2023
Design Project #3
Due: November 21, 2023

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Design Project #3

Element	Score	Max
Design		400
HFSS		400
Tables		100
Presentation		100
Overall		1000

1. Design a pyramidal horn antenna with a gain of 25 dB at 14 GHz. The horn is fed by a WR 62 waveguide.

   - Determine a value for the aperture efficiency (ε_{ap}).
   - Determine a value for the dimensions of the horn (A , B , and R_P).
   - Determine a value for the E-Plane beamwidth (BW_{EP}) at a frequency of 14 GHz.
   - Determine a value for the H-Plane beamwidth (BW_{HP}) at a frequency of 14 GHz.

2. Simulate the horn using HFSS.

   - Plot (polar plot in dB) the E-Plane and H-Plane radiation pattern.
   - Determine a value for the gain (G) at a frequency of 14 GHz.
   - Determine a value for the E-Plane beamwidth (BW_{EP}) at a frequency of 14 GHz.
   - Determine a value for the H-Plane beamwidth (BW_{HP}) at a frequency of 14 GHz.
   - Plot $|S_{11}|$ over the range of -40 to 0 dB. Employ a frequency range of 12.5 to 15.5 GHz.

3. Complete the following tables (Table 1 and Table 2).

Table 1 Summary of the pyramidal horn antenna design parameters.

ε_{ap}		%
A		mm
B		mm
R_P		mm

Table 2 Summary of the calculated and simulated response (at a frequency of 14 GHz) for the pyramidal horn antenna.

Parameter	**MATLAB**	**HFSS**	
G			W/W
G			dB
BW_{EP}			°
BW_{HP}			°

Pyramidal Horn Antenna

By : Satya Surya Lakshmi Vasuki Siva Srinivas Nittala

Student Id: 620094

Horn Antenna fed by WR-62 Waveguide

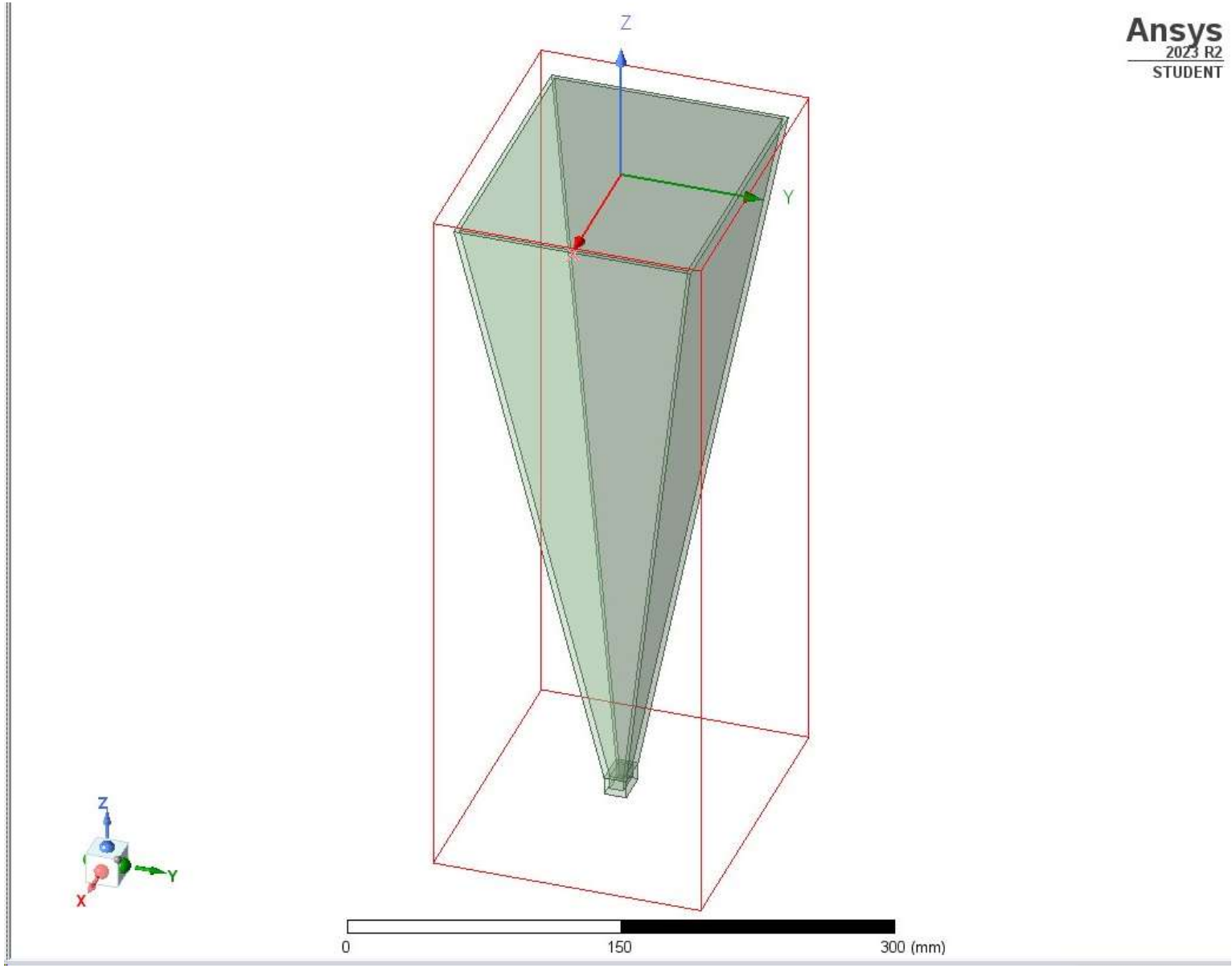
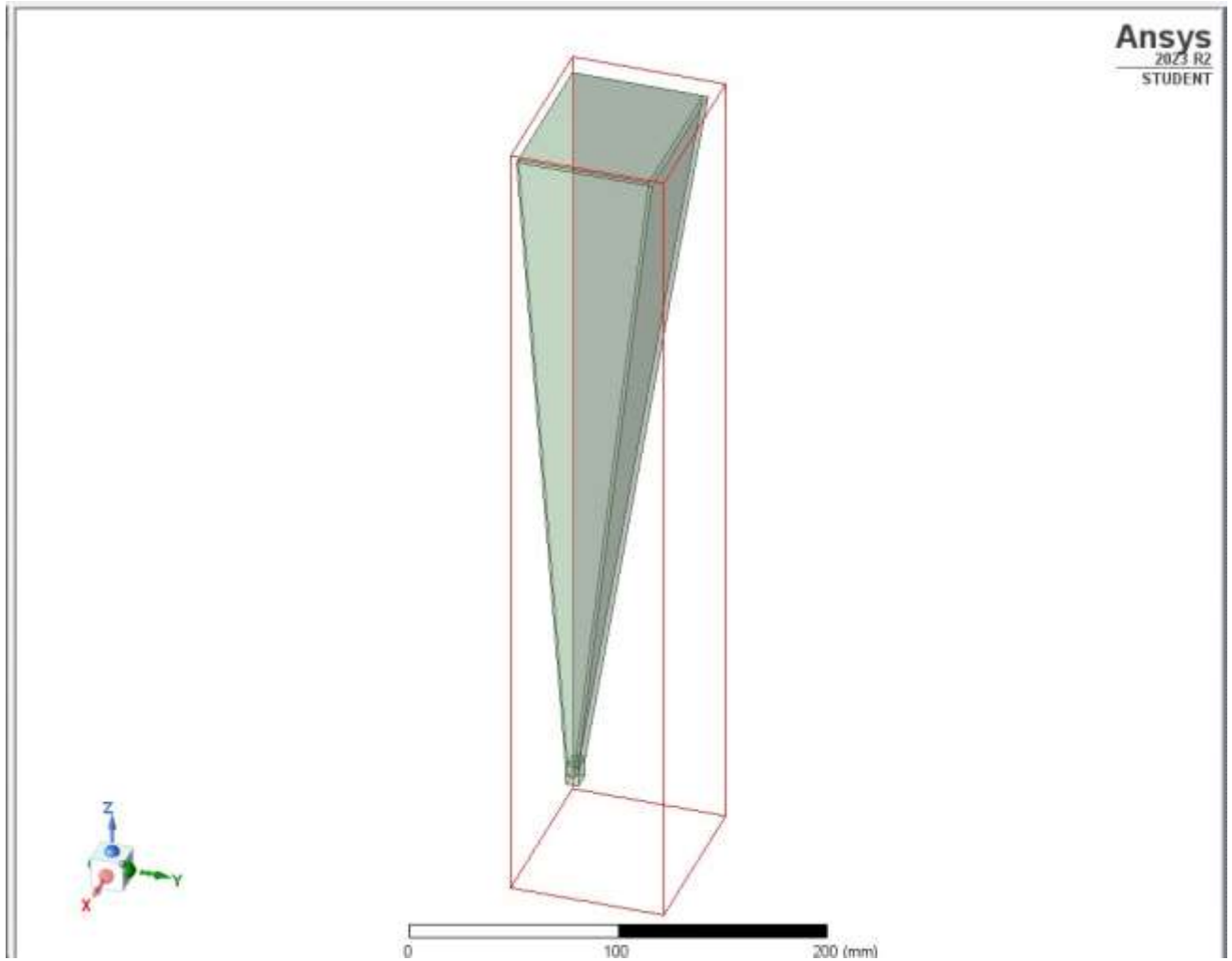


Table 1 Design Parameters

Parameters		
ε_{ap}	51.7991	%
A	166.8913	mm
B	133.6655	mm
R_p	392.2487	mm

Table 2 Summary at 14 GHz

Parameter	MATLAB	HFSS	
G	316.2277	330.9405	W/W
G	25.0000	25.1975	dB
BW_{EP}	8.6415	8.5243	°
BW_{HP}	10.0177	9.9433	°



Properties

Name	Value	Unit	Evaluated V...	Type
a	15.7988	mm	15.7988mm	Design
b	7.8994	mm	7.8994mm	Design
t	2.54	mm	2.54mm	Design
aw	a+2*t		20.8788mm	Design
bw	b+2*t		12.9794mm	Design
Aap	166.8913	mm	166.8913mm	Design
Bap	133.6658	mm	133.6658mm	Design
Rp	392.2487	mm	392.2487mm	Design
Aapw	Aap+2*t		171.9713mm	Design
Bapw	Bap+2*t		138.7458mm	Design
L	0.5*a		7.8994mm	Design

S Parameter Plot 1

Horn Antenna Half Model

Ansys
2023 R2
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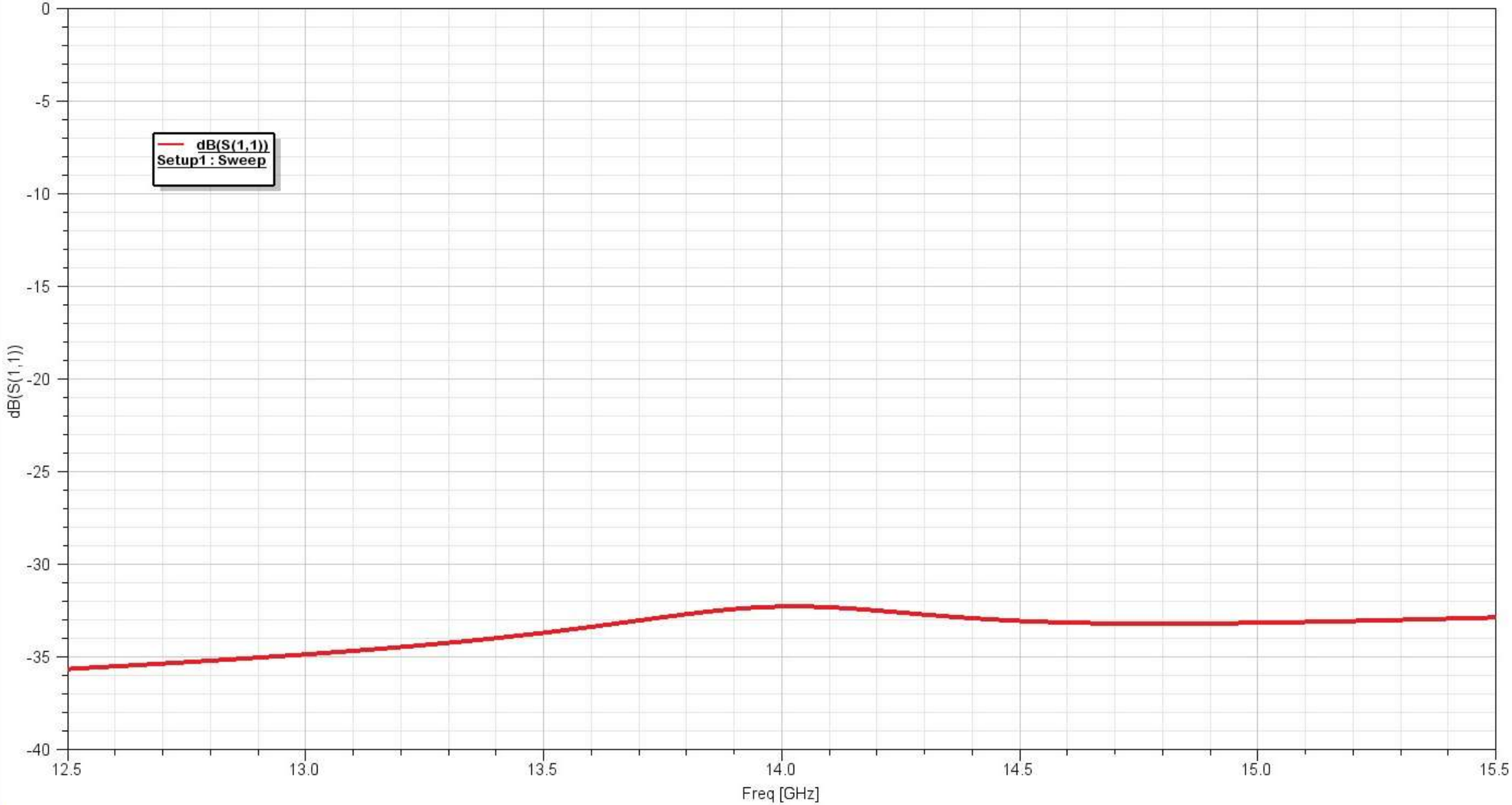

Gain Plot 1

Horn Antenna Half Model

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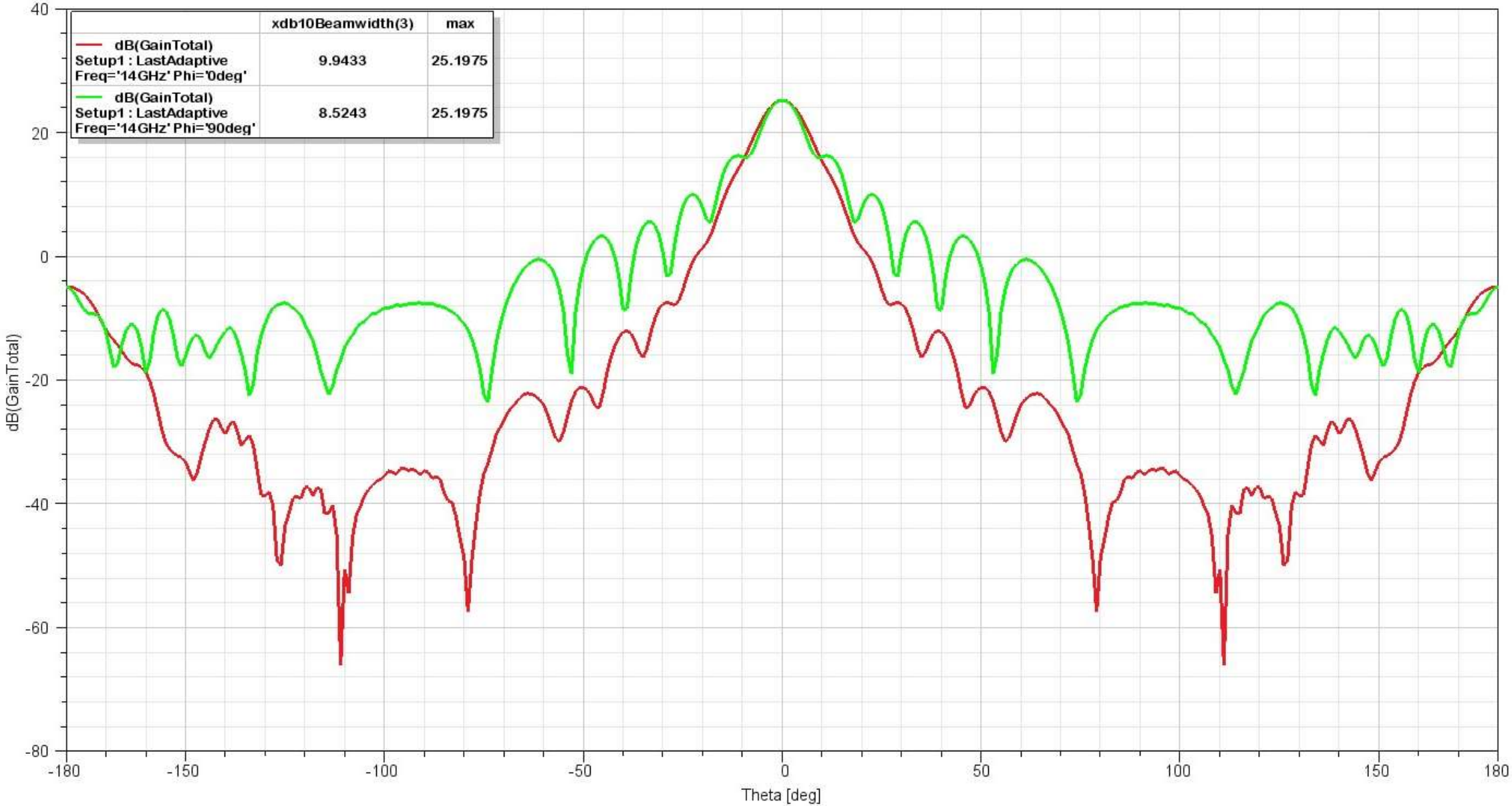

Gain Plot 2

Horn Antenna Half Model

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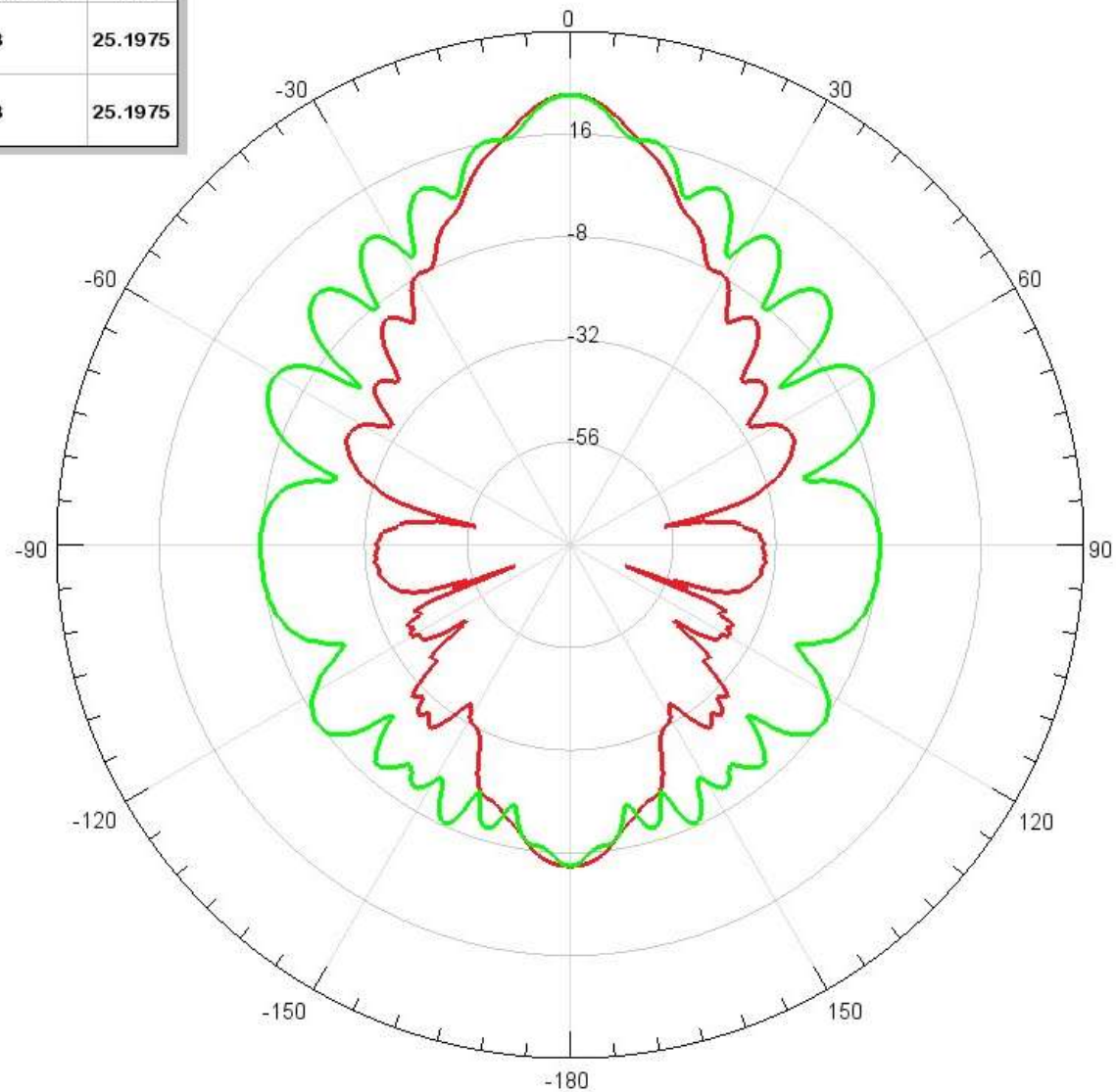
	xdb10Beamwidth(3)	max
dB(GainTotal) Setup1 : LastAdaptive Freq='14GHz' Phi='0deg'	9.9433	25.1975
dB(GainTotal) Setup1 : LastAdaptive Freq='14GHz' Phi='90deg'	8.5243	25.1975



Appendices

- HFSS
- Matlab

```
>> Iterations = 1.0000

Iterations =

     1

>> A

A =

  168.1807

>> B

B =

  134.7190

>> Lambda
Unrecognized function or variable 'Lambda'.

Did you mean:
>> lambda

lambda =

   21.4286

>> Eap =51.0000

Eap =

    51
```

```
>> EE457_Horn_Analysis
>> Iterations = 2.0000

Iterations =

     2

>> A

A =

  166.8999

>> B
```

```
B =

  133.6729

>> e_ap

e_ap =

   51.7991

>> EE457_Horn_Analysis
>> Iterations = 3.0000

Iterations =

     3

>> A

A =

  166.8913

>> B

B =

  133.6599

>> e_ap

e_ap =

   51.7992
```

```
>> EE457_Horn_Analysis
>> Iterations = 4.0000

Iterations =

     4

>> A

A =

  166.8913

>> B


B =

  133.6658

>> e_ap

e_ap =

   51.7991
```

```
>> Iterations = 5.0000

Iterations =

     5

>> A

A =

  166.8913

>> B

B =

  133.6655

>> e_ap

e_ap =

   51.7991
```