

Block Based Antenna and Microwave Component Design Methodology with Reusable Bricks

A Brief Explanation of the Concept

Umut Bulus

uc3m Contents

- Reusable Building Blocks
- How This Concept Works ?
- Horn Antenna Example

uc3m Reusable Building Blocks

Video



Dielectric Constant : 2.6

Dielectric Constant : 4.4

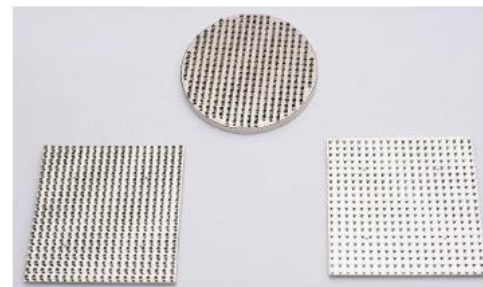
Dielectric Constant : 8



Metal Cells



Absorber Cells

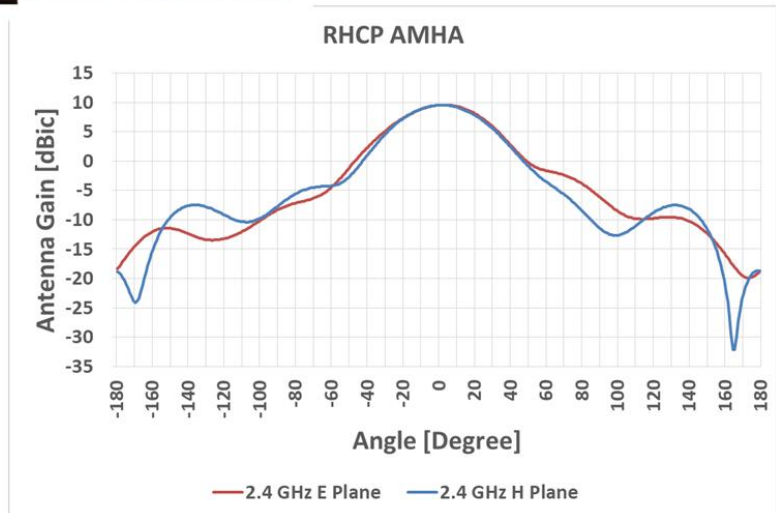
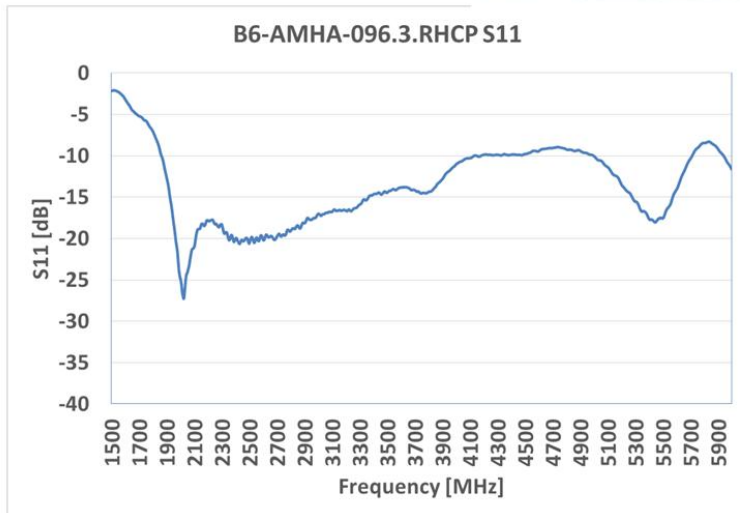
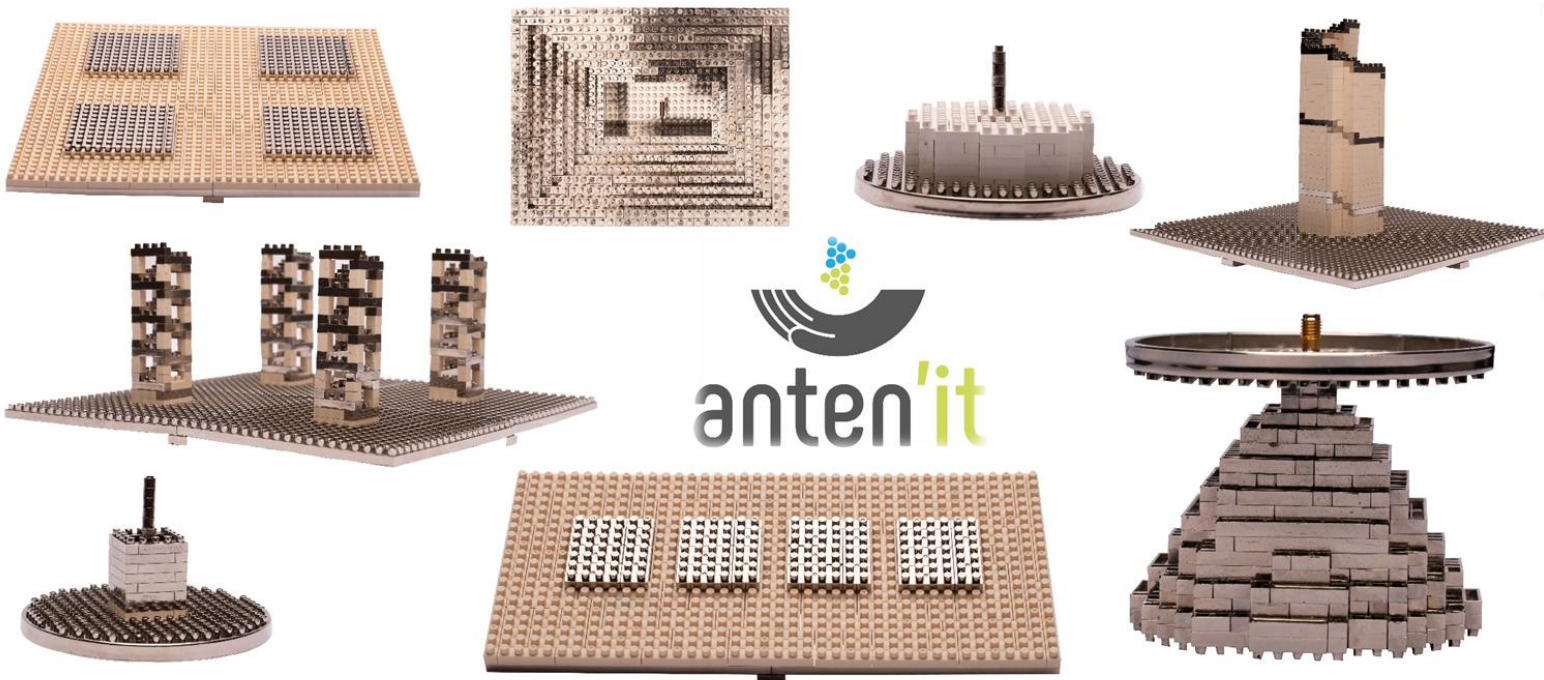


Ground Planes



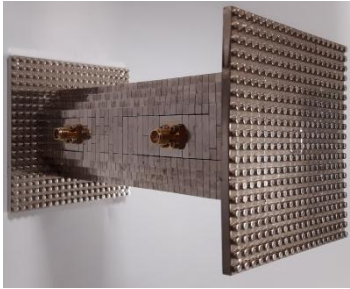
Connectors

The dielectric materials have **better than 0.002 loss tangent** up to 12 GHz



uc3m Microwave Design and Training Hardware

- Microstrip passive components
- Waveguide passive components



Circular Waveguide



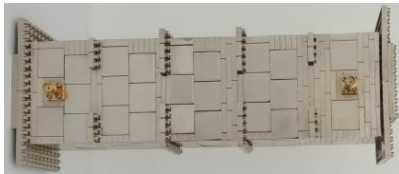
Inductive Post Filter



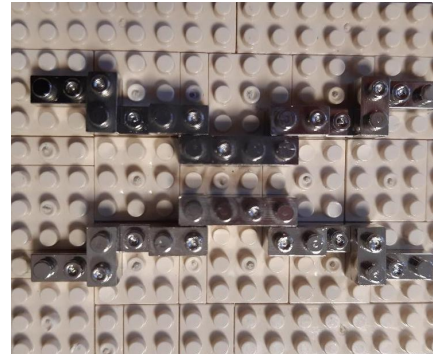
Waveguide Load Absorber



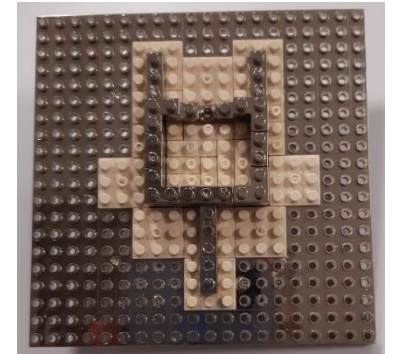
Bandpass filter



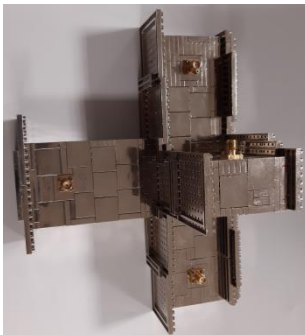
Iris Filter



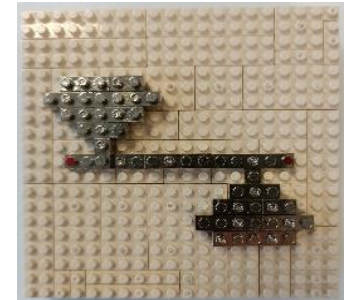
Coupled Line Directional Coupler



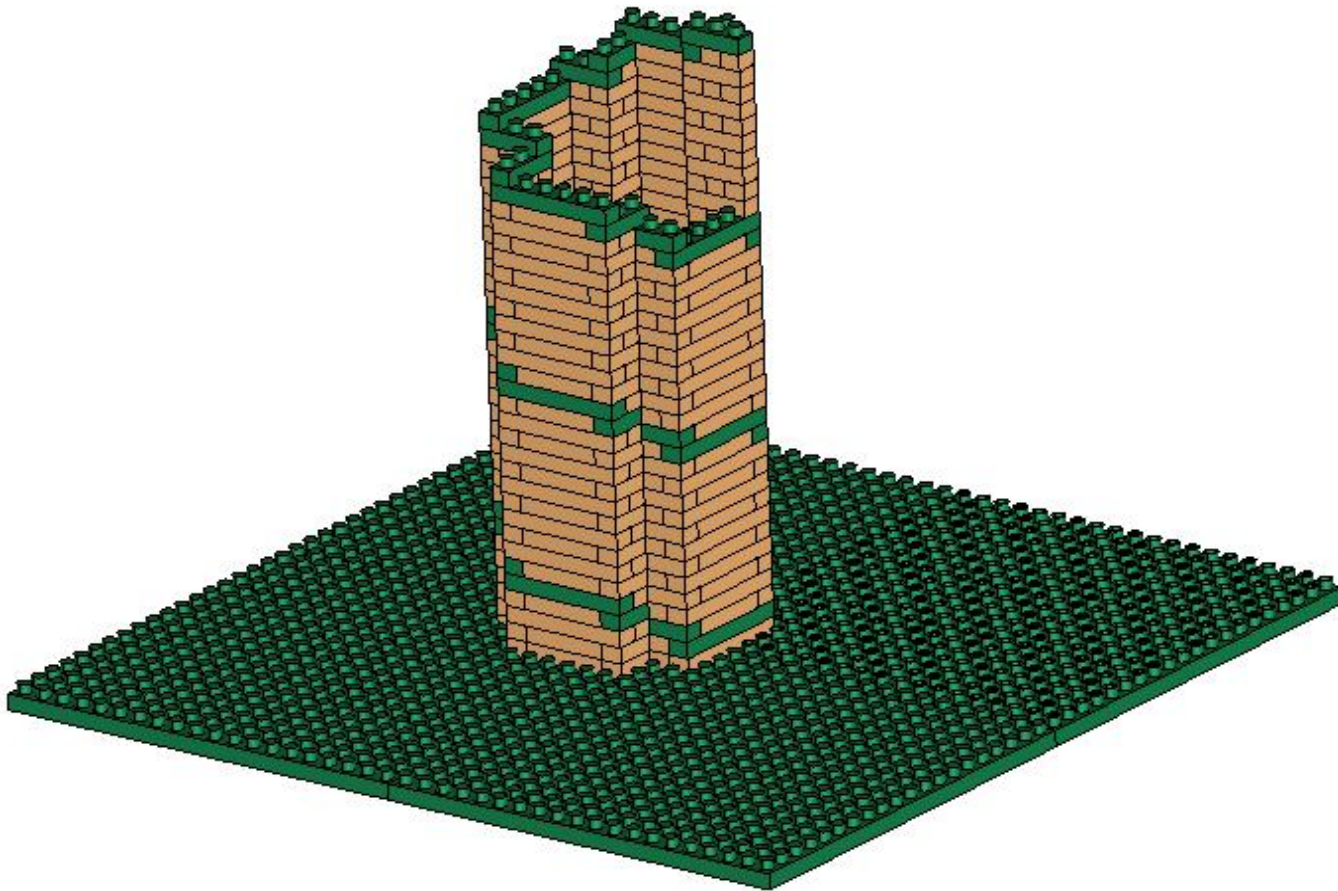
Magic Tee



20 dB Directional Coupler

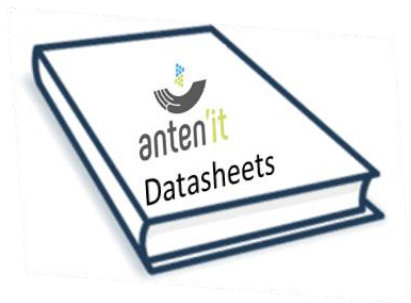


Stop Band Filter



Stop Band Filter

1- Look at the Datasheet Booklet which includes hundreds of datasheets



2- Find the appropriate datasheet that matches to your requirements

antenom antenna technologies
Game-Changing Antenna Technology

Omni-directional Antenna
467-578 MHz
Normal Mode Helix Antenna

antenit

Typical Specification

Frequency	467-578 MHz
VSWR	< 2.0:1
Gain	0 dB
Dimensions	Height: 80 mm Ground Plane: 80 mm X 80 mm
Connector	SMA
Antenna Pattern	Omni-directional



3- Build the antenna by the help of instructions

antenom antenna technologies
Game-Changing Antenna Technology

Building Instructions
467-578 MHz
Normal Mode Helix Antenna


antenit

Components

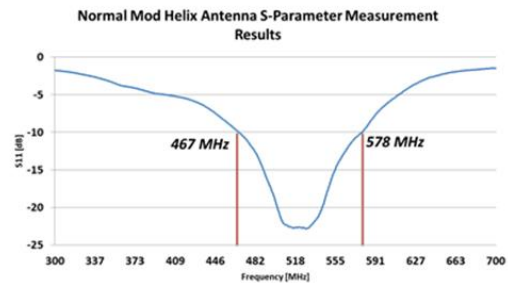
1. Connectorized A-1 ground plane
2. Beige Dielectric Cells:
 - 3 pieces of 2x4
 - 1 piece 1x4
 - 1 piece 1x3
 - 39 pieces 1x1
3. Metal Cells
 - 23 pieces 1x4

Instructions

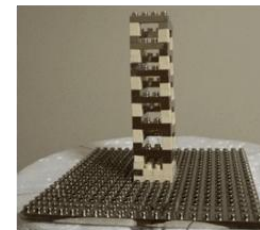
1. Put 2 of 2x4 beige dielectric cells on the ground plane. Then, put the 1x4 metal cell to the on the 2x4 beige dielectric cell. Red circle in the figure below shall be connected to the connector. Put 1x4 beige cell near the metal cell and put 2x4 beige cell next to it.



2. Put 1x3 beige cell over the metal cell as in Figure below.

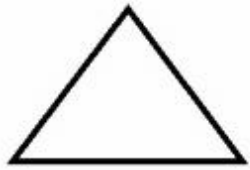


4- You have the antenna



uc3m How This Concept Works ?

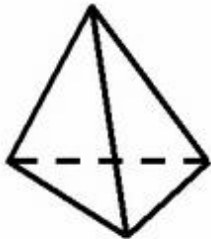
Mesh Cells in Computational Electromagnetics (CEM) Software



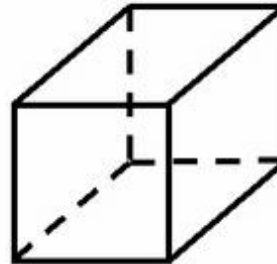
Triangle
("tri")



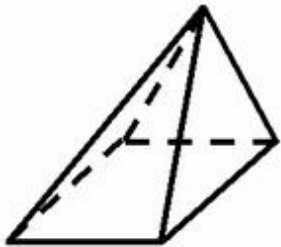
2D Prism
(quadrilateral or
"quad")



Tetrahedron
("tet")



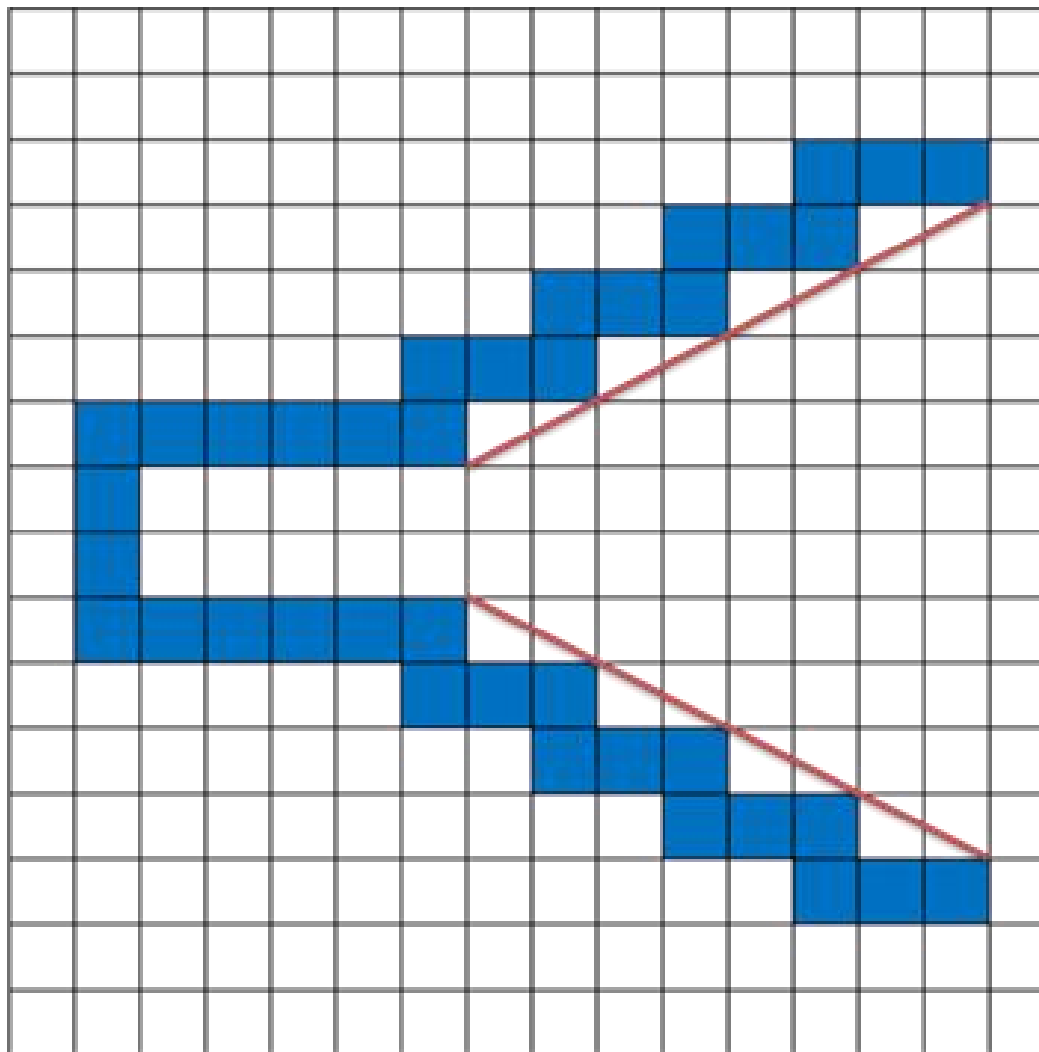
Prism with
quadrilateral base
(hexahedron or "hex")

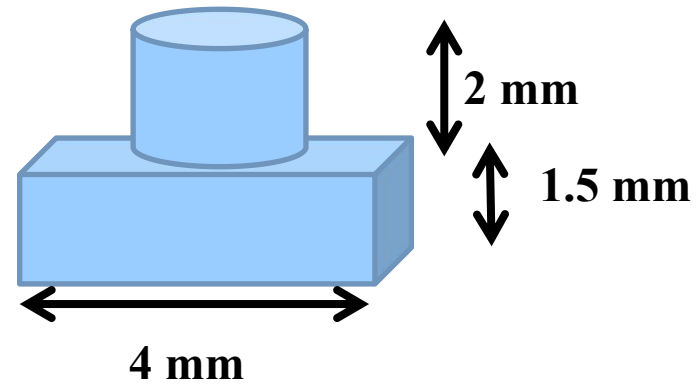
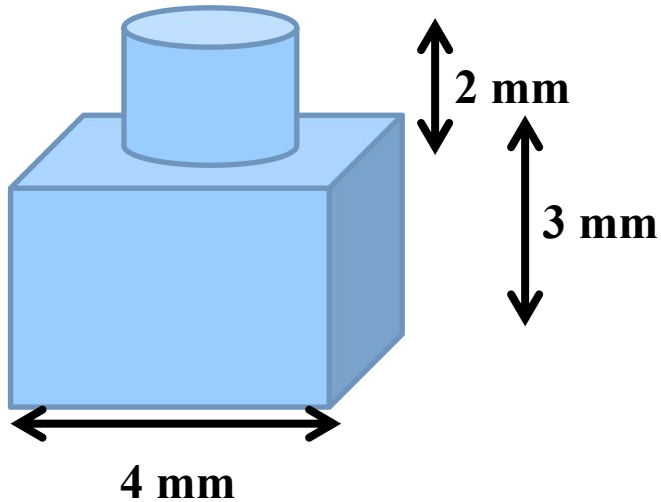


Pyramid



Prism with
triangular base
(wedge)





Physical Dimension	Electrical Dimension	Frequency
4 mm	$\lambda/20$	@ 3.75 GHz
4 mm	$\lambda/12.5$	@ 6 GHz
4 mm	$\lambda/10$	@ 7.5 GHz

Analytical Calculations:

Frequency = 3.9 GHz

X and Y are dimensions of WR229:

X: 58.166 mm

Y: 28.083 mm

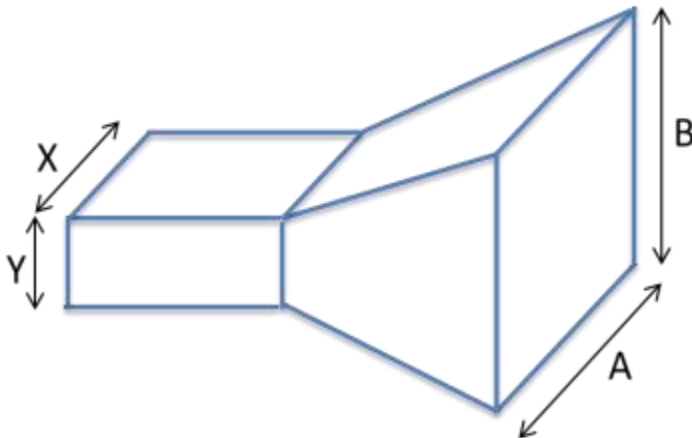
Flare Angle: 34°

A: 80 mm

B: 52 mm

$$D = \frac{4\pi}{\lambda^2} AB$$

D = 9.53 dBi



Calculations**@3.9 GHz**

$$X = 58.166 \text{ mm}$$

$$Y = 28.083 \text{ mm}$$

$$A = 80 \text{ mm}$$

$$B = 52 \text{ mm}$$

$$\text{Flare Angle} = 34^\circ$$

Waveguide Frequency Range:
3.3-4.9 GHz

**Anten'it Dimensions****@3.9 GHz**

$$\underline{X} = 56 \text{ mm}$$

$$\underline{Y} = 28 \text{ mm}$$

$$A = 80 \text{ mm}$$

$$B = 52 \text{ mm}$$

$$\text{Flare Angle} = 34^\circ$$

Waveguide Frequency Range:
3.3-5.1 GHz

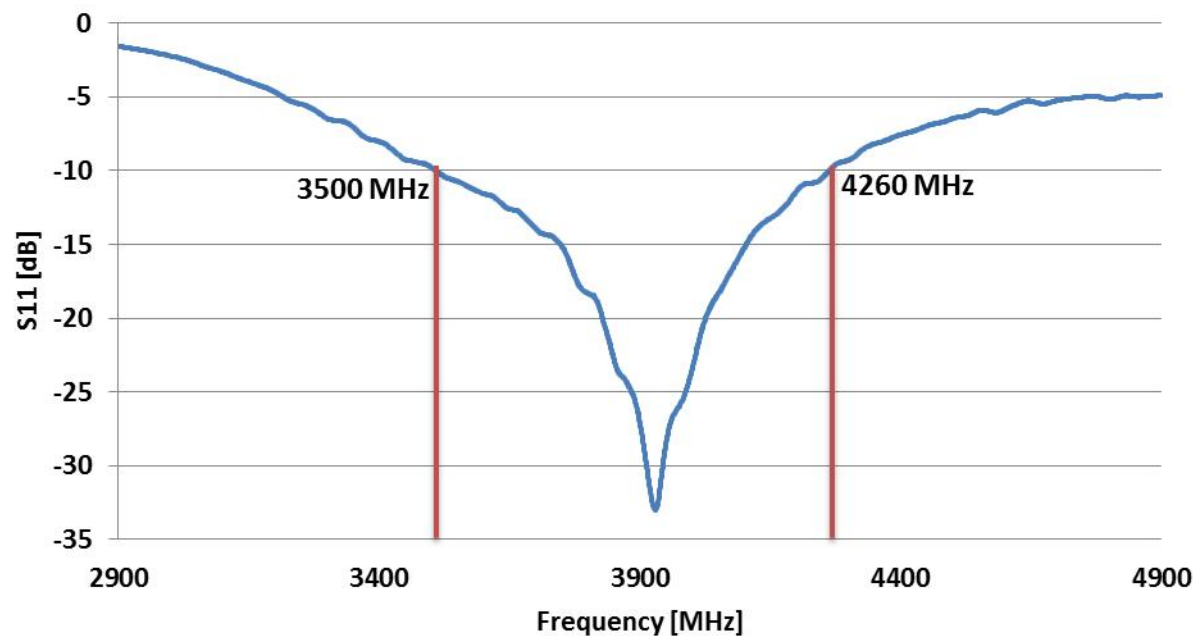
Anten'it Resolution:

Height: 3 mm

Length and Width: 4mm



Horn Antenna S-Parameter Measurement Results

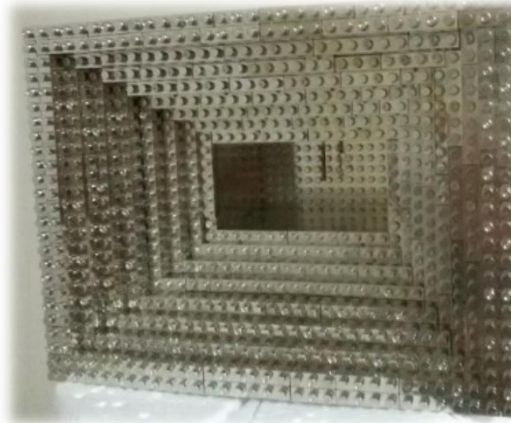


3500 - 4260 MHz frequency range

Increasing the Gain of the Horn Antenna

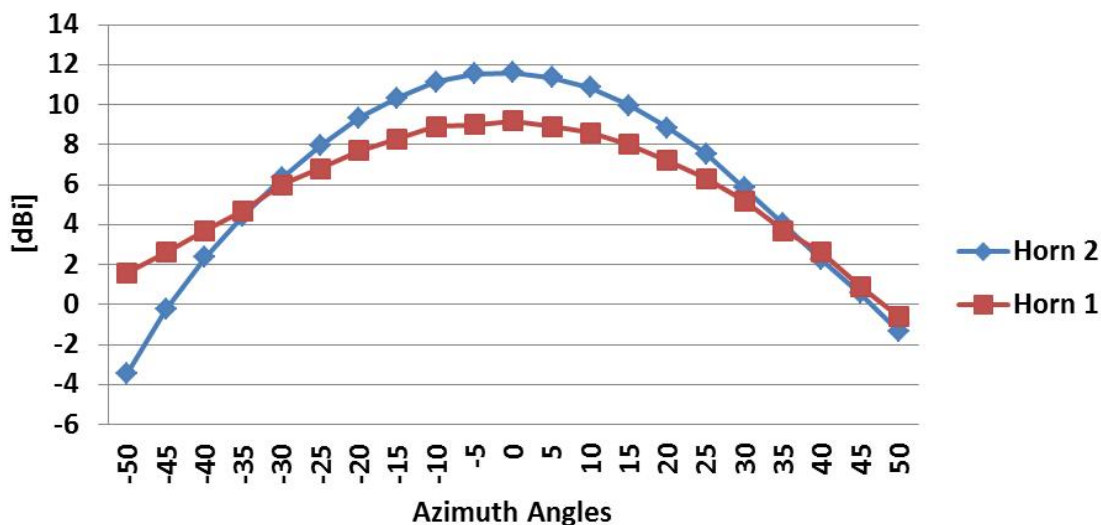


80 mm X 52 mm (A X B)
Antenna Gain: 9.2 dBi
Azimuth HPBW: 55°



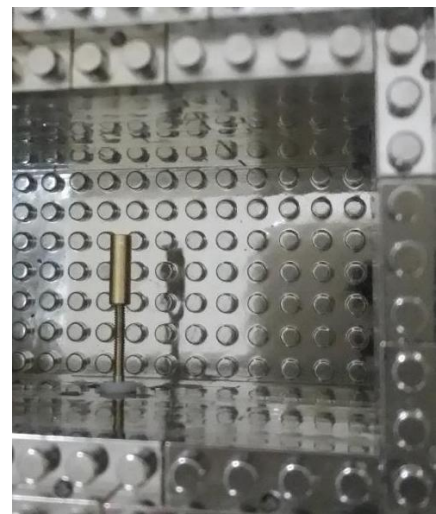
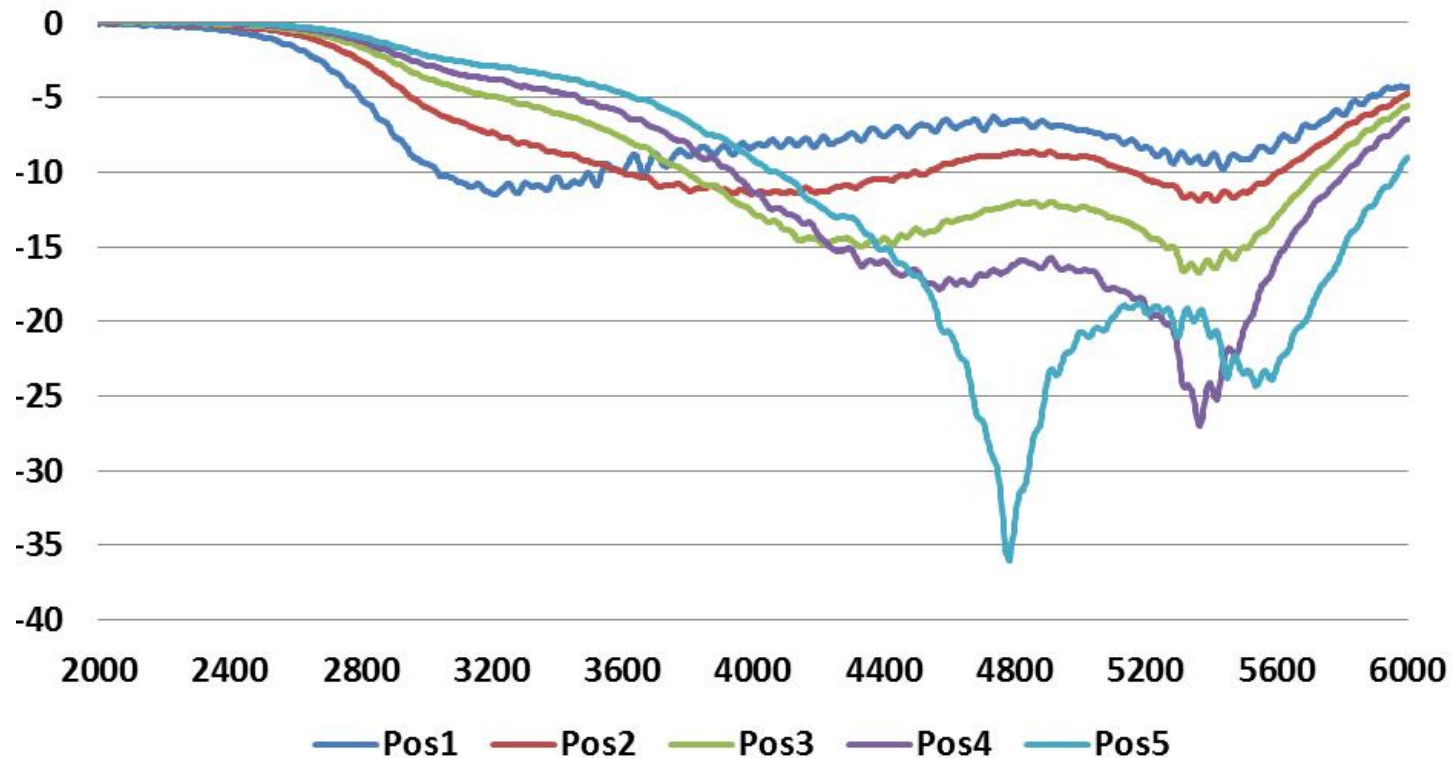
112 mm X 84 mm (A X B)
Antenna Gain: 11.6 dBi
Azimuth HPBW: 43°

3900 MHz Horn-1 and Horn-2 Gain Comparison



The position of the ring changes the center frequency

Horn Antenna S-Parameter Sweep with Feed Length Change



- Thanks for Listening!