

SIMULATION OF RECTANGULAR MSA USING GENESYS

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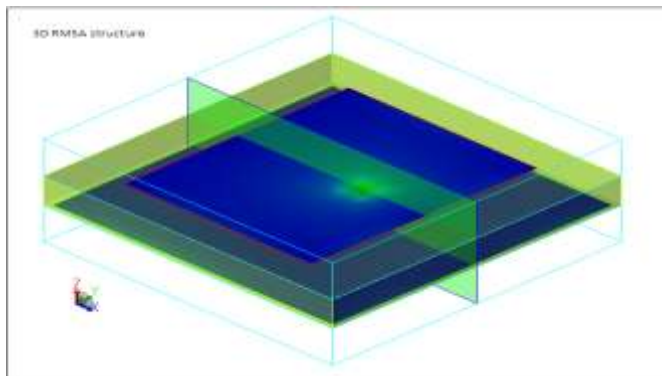
ABSTRACT

Microstrip patch antennas with slots are a promising candidate for ultra-wideband (UWB) radio communication that has created interest in the subject of UWB antennas. Many designs for UWB antennas have been proposed. In the present work, a microstrip patch antenna with tapered slots at the patch center has been used to provide a return loss of about -9 dB for a frequency range from 4 to 7 GHz.

Key Words: *Multi-Band Antenna, Patch Antenna , Paper Thin Antenna , Slot Antennas, Ultrawide Band Antenna, Microstrip Antenna, Fringing Fields, Effective Length And Width, Resonating Frequency, Radiation Fields, E Plane & H Plane Fields*

I. INTRODUCTION

Microstrip Antennas (MSA) are popularly known for their light weight, compact structure, moderate gain in communication industries. The significant limitations of MSA are narrow bandwidth with moderate gain. There are various methods to improve the bandwidth of MSA. The methods like planar configuration, stacked configuration, multiple elements are few of these bandwidth enhancement techniques popularly used for MSA. MSA's are fabricated on dielectric substrate backed by ground plane. The thickness of dielectric material is important factor for BW enhancement when particularly substrate having low dielectric constant. The microstrip antenna is low profile meaning it can be fabricated with low cost material resulting in moderate expectable radiation properties. MSA's are inherently linearly polarized, however circular polarization can be obtained using couple of feeds or by modifying the structure of antenna itself.



RMSA 3D Structure with Ground Plane and Patch in Blue Colour, Substrate in Green Colour)

II. ANTENNA DESIGN

For simulation of rectangular MSA we use following design statement:

Statement: Design a rectangular microstrip antenna on RT/Duroid 5880 substrate with $\epsilon_r = 2.2$ ($\tan \delta = 0.0018$) and $h = d = \text{thickness} = 1.588 \text{ mm}$ with linear polarization such that it will operate at 2.45 GHz for Bluetooth applications. This antenna is fed with coaxial probe of 0.6 mm radius using SMA connector with provides 50 Ohm matching. Find the impedance bandwidth, return loss for $\text{VSWR} \leq 2$

Given data:

Dielectric constant of substrate material = $\epsilon_r = 2.2$

Dielectric loss tangent of substrate material = $\tan \delta = 0.0018$

Dielectric substrate thickness = $h = d = 1.588 \text{ mm}$

Resonating frequency of MSA = $f = 2.45 \text{ GHz}$

VSWR of antenna at operational frequency ≤ 2

We calculate reflection coefficient and hence return loss for $\text{VSWR} = 2 = S$

Therefore return loss = $RL = 10 \log_{10} || = -9.551 \text{ dB}$

Hence we note that impedance bandwidth is calculated for $RL \leq -9.551 \text{ dB}$

We calculate the width of patch antenna = $0.0483 \text{ m} = 48.3 \text{ mm}$

Therefore the ratio $W/h = W/d = 30.416$ and $h/W = d/W = 0.0329$

We calculate effective dielectric constant of the MSA = 2.108

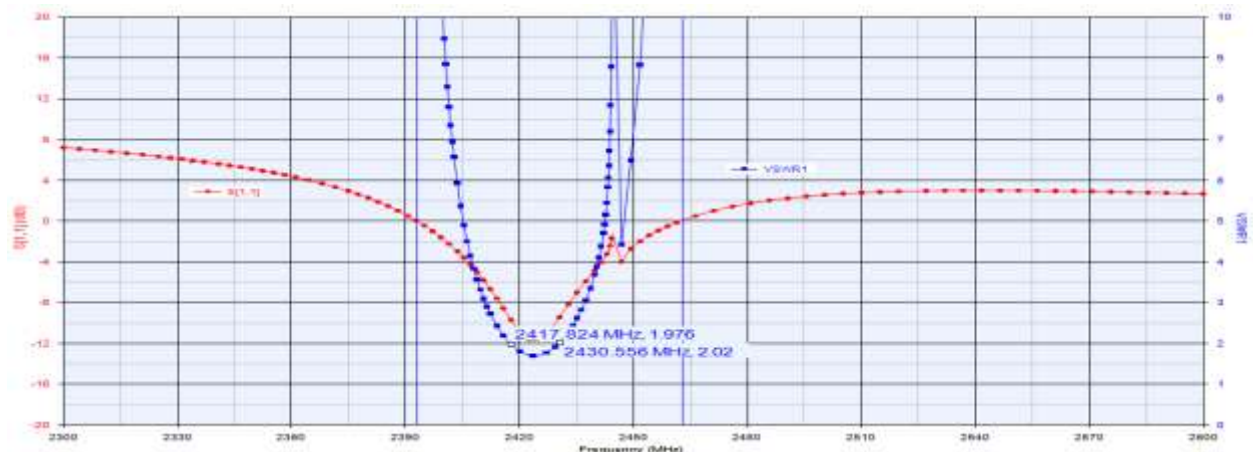
We calculate length extension on each end of MSA = $8.15 \times 10^{-4} \text{ m}$

Effective length of MSA = 40.91 mm

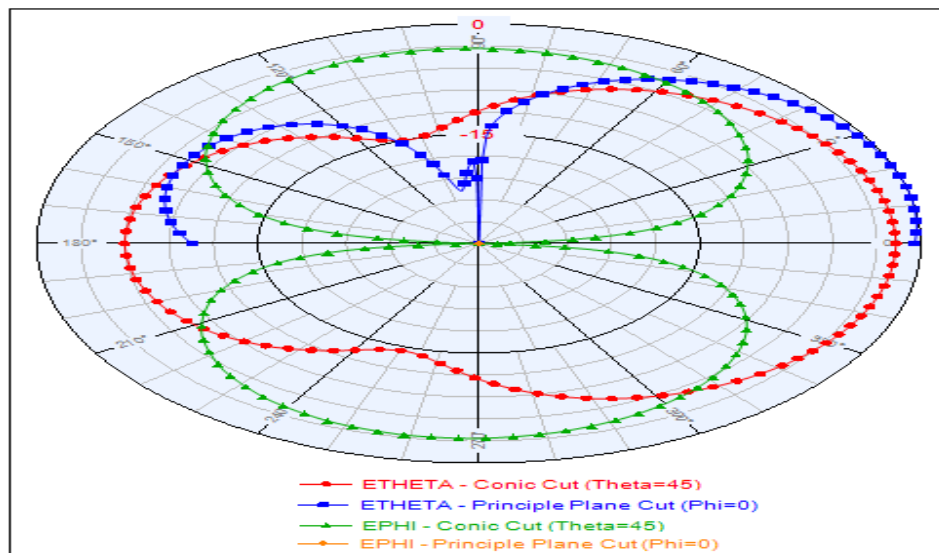
Procedure:

1. Open a new design window in Genesys. In the project window click on schematic and launch new layout
2. Give suitable name to file project and save. Add dielectric into file project with right click operation. Set the parameters of dielectric material as given in design statement and click ok.
3. Double click on layout window and go to layer tabs. Load singly layer default layer and keep top metal, substrate, bottom metal layer layers sandwiched between air layers. Make sure that all the five layers including air layers are used.
4. Go to the substrate row and select the dielectric material which is added in the project file. Select ok.
5. In the layout window draw the geometry of RMSA with width and height as calculated above. (Note height = 48.3 mm and width = 40.91 mm while entering in software geometry) The RMSA will be top conducting metal. Take ground plane of size $60 \text{ mm} \times 60 \text{ mm}$ respectively.
6. Select the top patch and apply port with radius 0.6 mm , with internal type and place it at location 27.1 mm and 24.15 mm (Note that this position of port is pre-decided to achieve maximum matching)
7. After drawing geometry of RMSA, add momentum analysis to the project with start frequency = 1 GHz and stop frequency = 3 GHz , with selection of adaptive sampling, make simulation on microwave mode.
8. After simulation, re-run same simulation for radiation pattern parameters and plot non-radiating properties (VSWR bandwidth with S_{11} return loss) and radiating properties (E plane and H plane at resonating frequency)
9. In the view tab menu, visualize 3D and note down all the antenna parameters including gain and directivity.
10. Plot VSWR verses S_{11} return loss on rectangular graph.
11. Plot E plane and H plane radiation patterns on antenna plot.
12. Plot co-polar and cross-polar components in E & H plane in 3 D visualization
13. Plot total E field in 3 D visualization

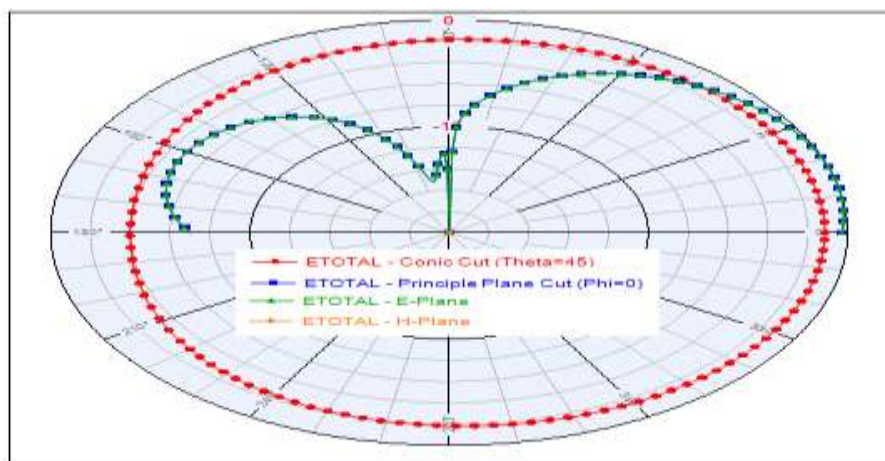
III. SIMULATION RESULTS



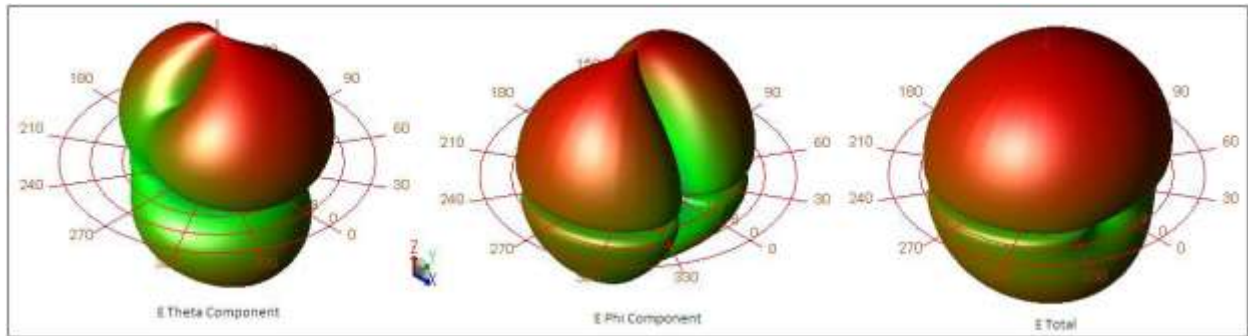
(Simulated Return Loss and VSWR Measurement of RMSA)



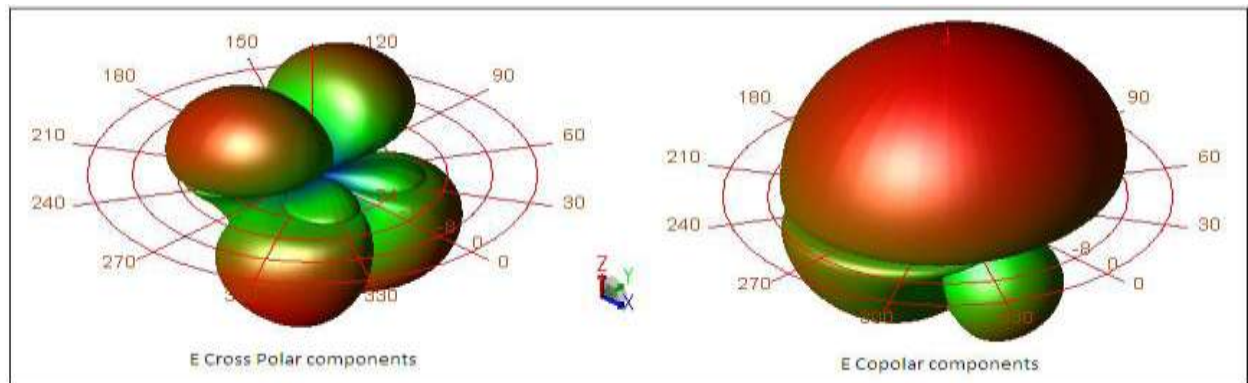
(2D Radiation Pattern of RMSA in Different Planes at Single Frequency 2.444 GHz)



(2D Total E Field Radiation Pattern of RMSA at Single Frequency 2.444 GHz)



(3 D Radiation Patterns of RMSA at 2.444 GHz)



(3 D E Field Components of RMSA at 2.444 GHz)

IV. CONCLUSION

Thus we have studied and implemented Rectangular MSA using Genesys software

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