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The Comparative Study of Rectangular Microstrip Patch Antenna for HiperLAN/2 and SDMB

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Abstract:

This paper presents, for the given resonant frequency the micro strip antenna slot dimensions are computed. Rectangular Microstrip Patch Antenna (RMPA) selected for two frequencies one in S band and C band. S band frequency in 2.6GHz and C band frequency in 5.6GHz these frequency was selected and using basic equation we calculated dimensions and the nature of the curves are compared.

Index Terms: RMPA, HiperLAN/2, SDMB.

I. INTRODUCTION

MATLAB (matrix laboratory) is a multi-paradigm numerical computing environment and fourth-generation programming language. A proprietary programming language developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, C#, Java, Fortran and Python[1].

Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing abilities. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems [1].

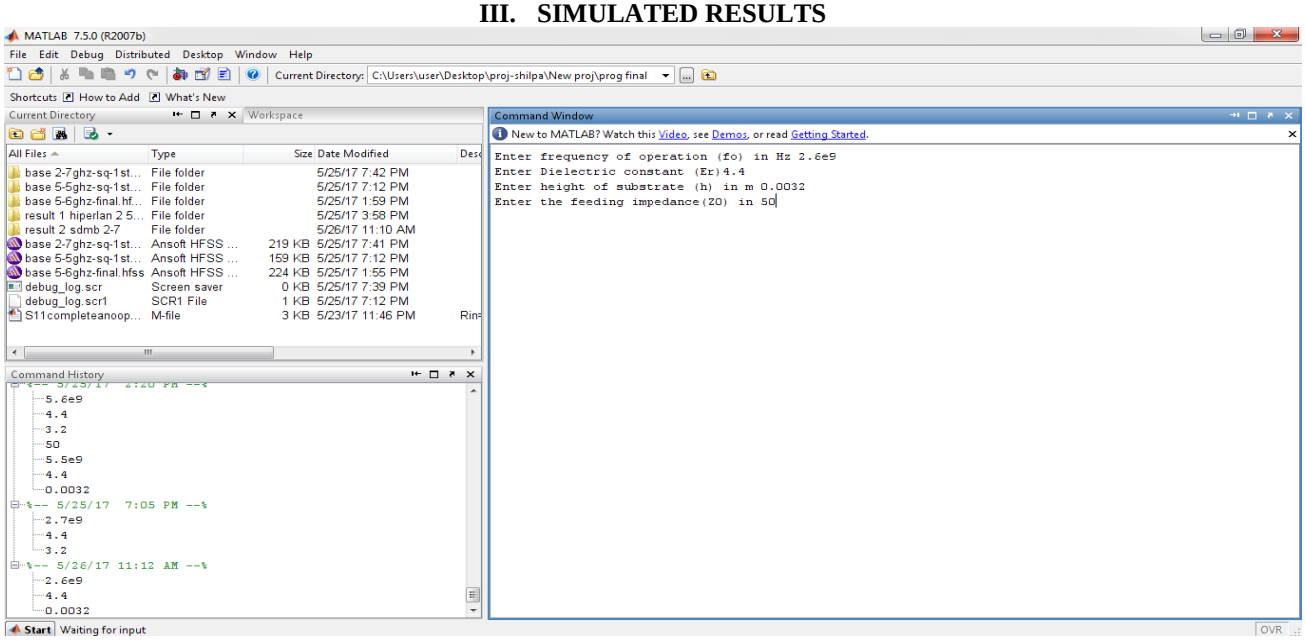
The most important high-data-rate wireless broadband networking systems for next generation wireless communications are European Telecommunications Standards Institutes (ETSI) ,High Performance Local Area Network type 1 (HIPERLAN/1) and High Performance Local Area Network type 2 (HIPERLAN/2) which uses the frequency bands 5.150 GHz– 5.350 GHz and 5.470 GHz- 5.725 GHz[2].

Matlab have antenna toolbox we wanted to use the basic equations [2] and compare the nature of the curve with a standard simulator for the different frequencies.

II. ANTENNA DESIGN

We have selected two frequencies in one in S band and C band. S band frequency in 2.6GHz and C band frequency in 5.6GHz these frequency was selected and using basic equation to calculate the required dimensions [2]. These antennas are fabricated on substrate of FR4_epoxy with relative permittivity $\varepsilon_r = 4.4$ and the thickness of 3.2mm. The lengths and widths of patch are tabulated in Table 1.

III. SIMULATED RESULTS



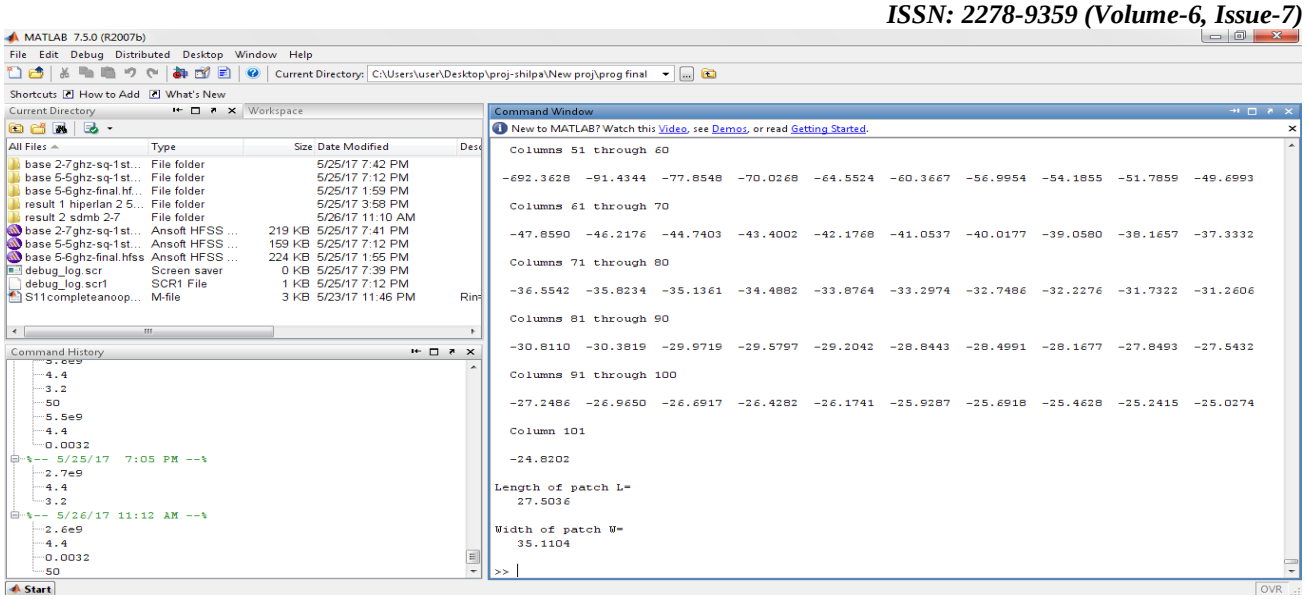


Figure.1 Matlab input and output in command window for 2.6GHz

We have used transmission line model and calculated all basic dimensions using the this model, we have calculated length, width and required dimensions by taking inputs like frequency, effective co-efficient, height of substrate and Zo . We have outputs like S11, VSWR, input impedance, output impedance and probe position optimization

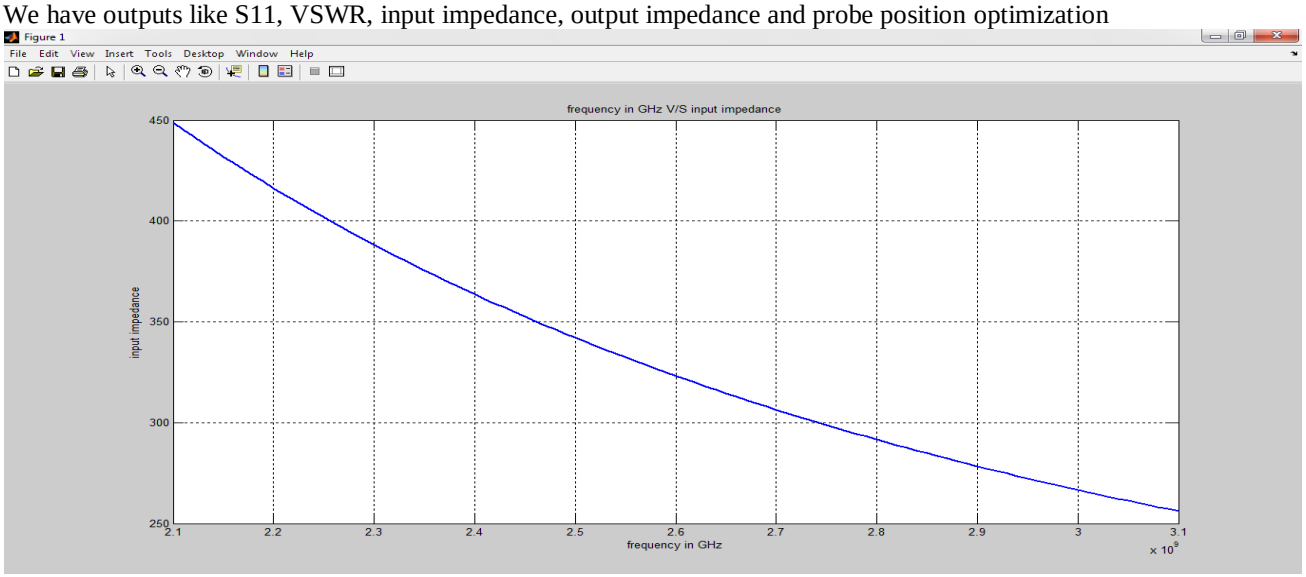


Figure.2 Input impedance versus Frequency

From fig.2 we can visualize the input impedance with respect to frequency where it swiftly and moves low.

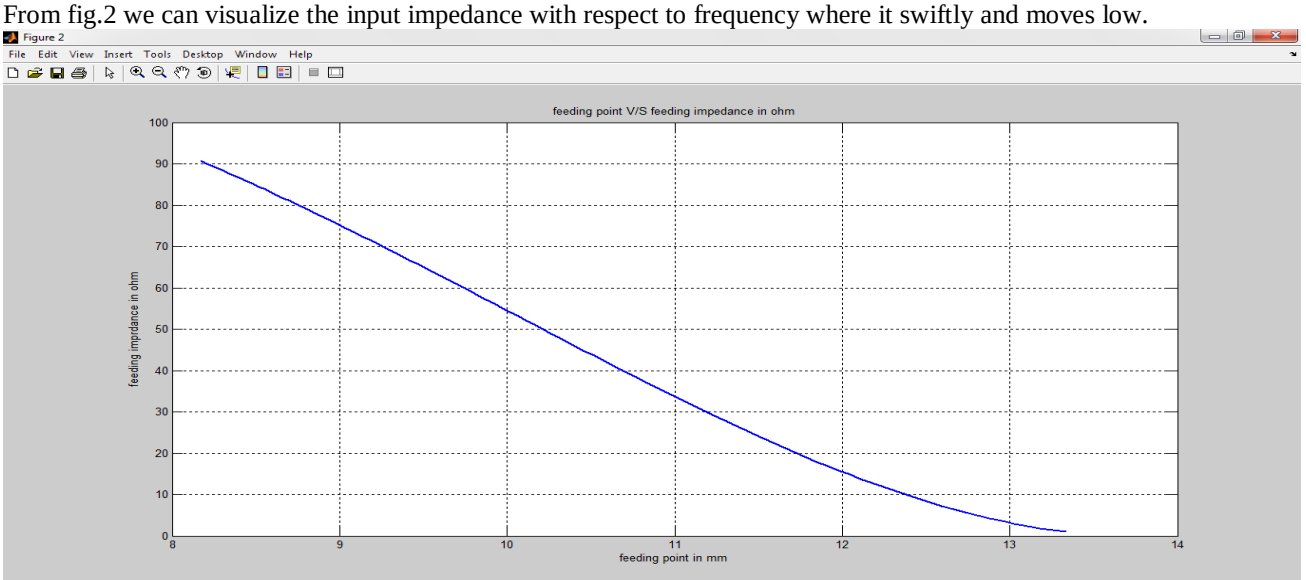


Figure.3 Probe position versus distance from edge of patch

The figure 3 demonstrates the feeding impedance with respect to the distance from the edge of patch. Feeding impedance must be 50ohms to have optimum amount of radiation. We have done changed the position of probe in EM simulator and captured the S11 and VSWR.

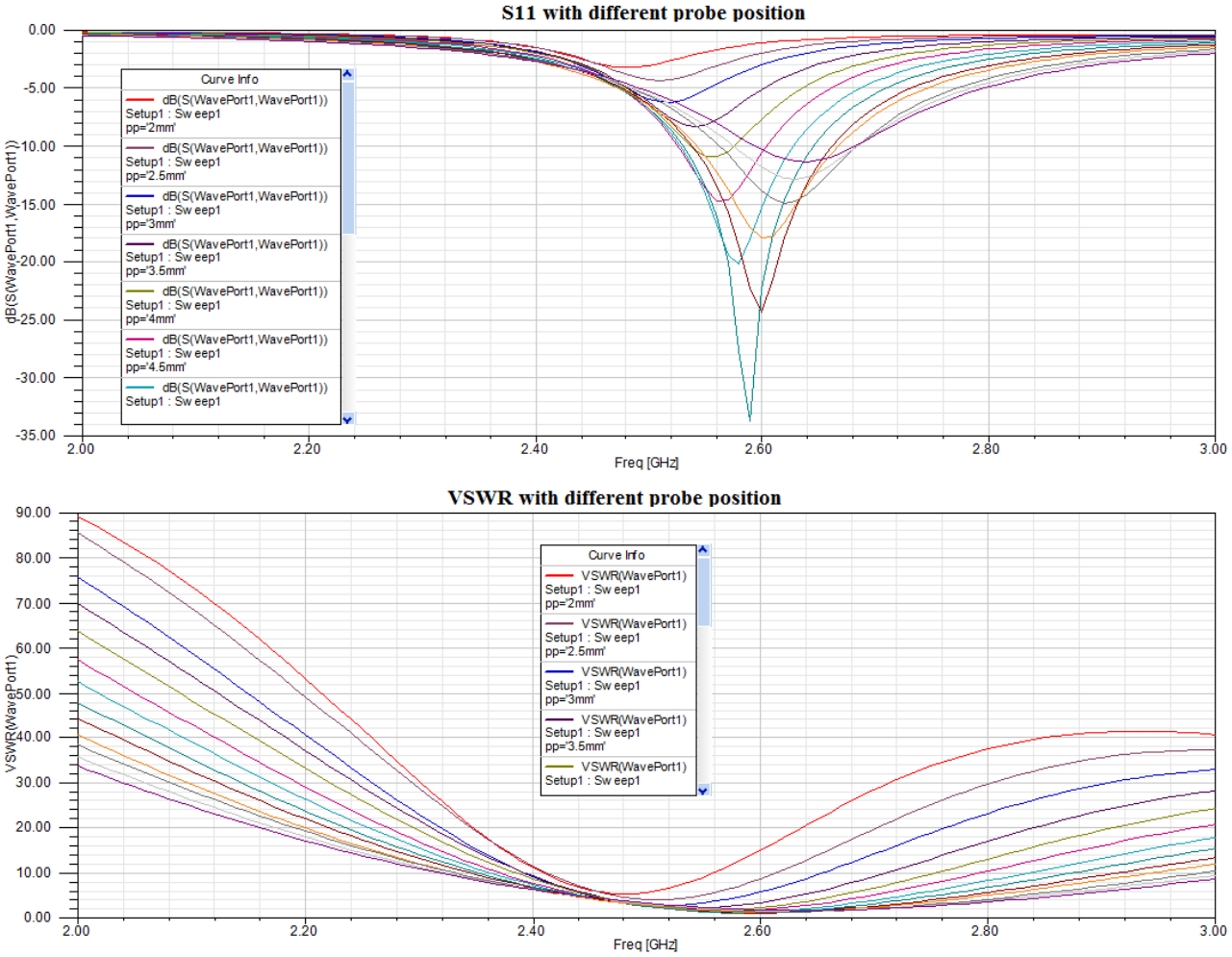


Figure.4 S11 and VSWR for varying the position of probe

Figure 4 perfectly resembles the importance of probe position and as per figure 10.2mm from edge have perfect match of 50ohms, EM simulator shows lowest return loss and reflection coefficient very near to that point.

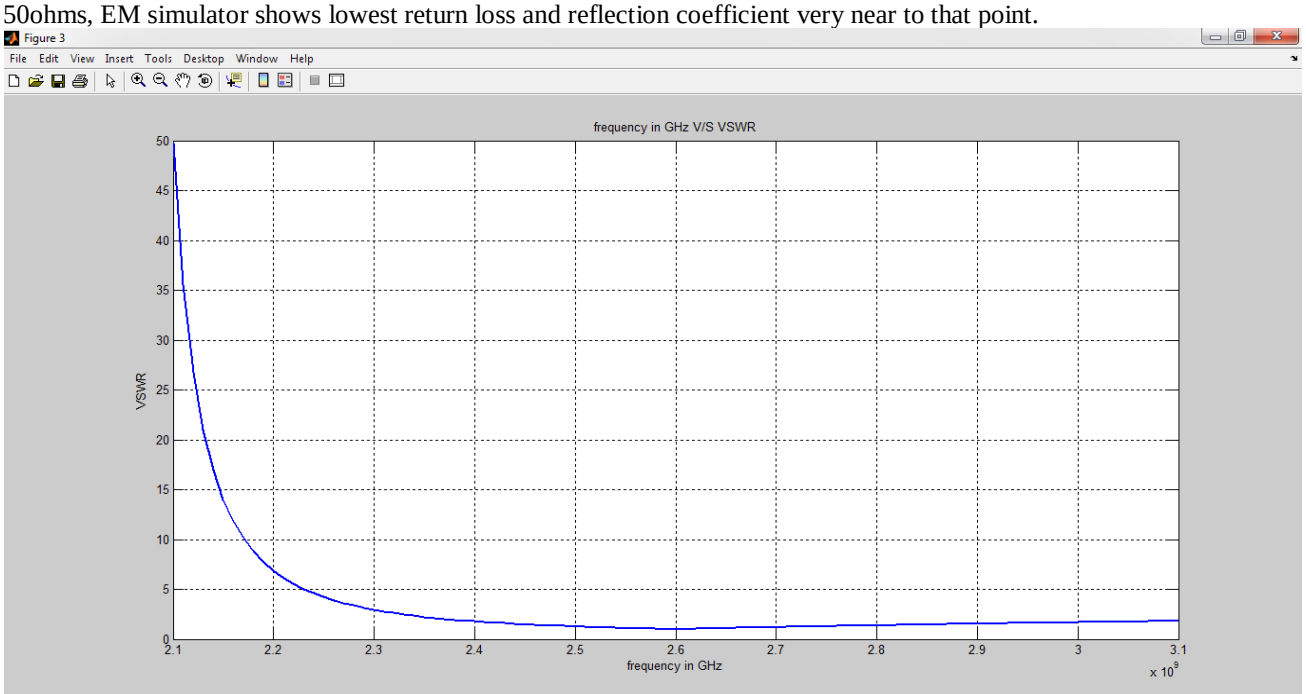


Figure.5 VSWR in Matlab

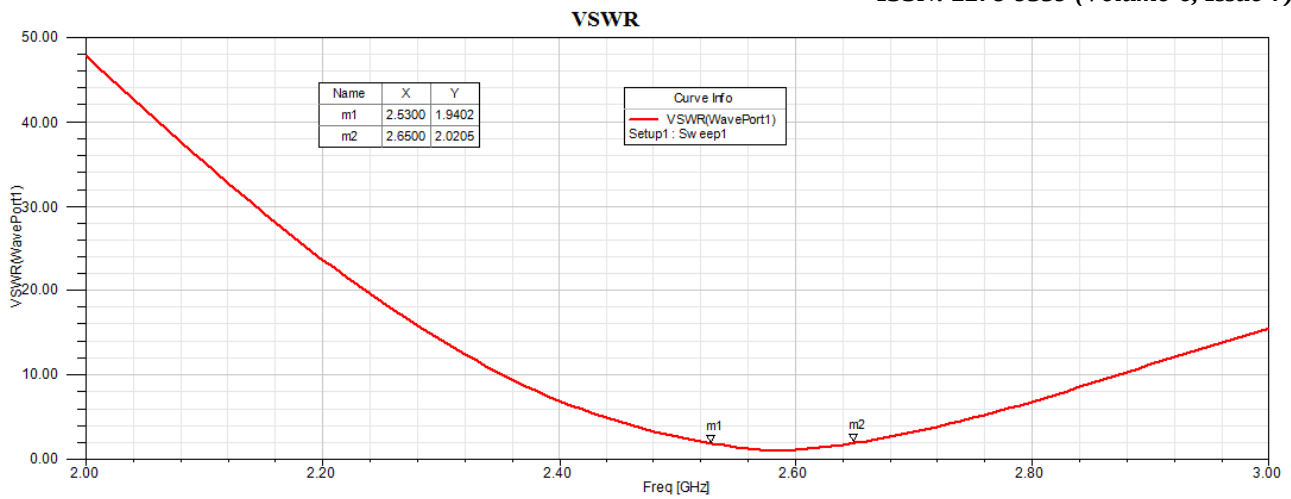


Figure.6 VSWR in EM simulator

The important property of any antenna is VSWR in our proposed antenna we have achieved VSWR < 2 over the operating frequency in both Matlab and EM simulator where both nature curves are similar in fig 5 and fig 6.

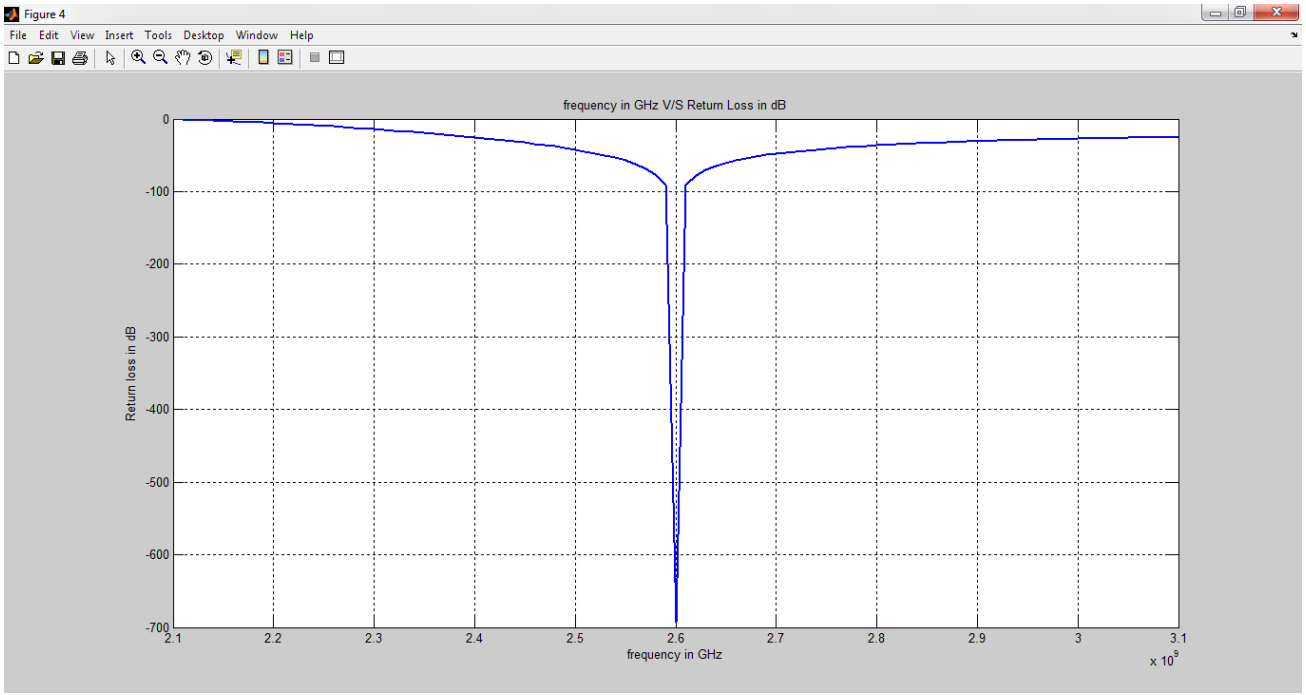


Figure.7 S11 in Matlab

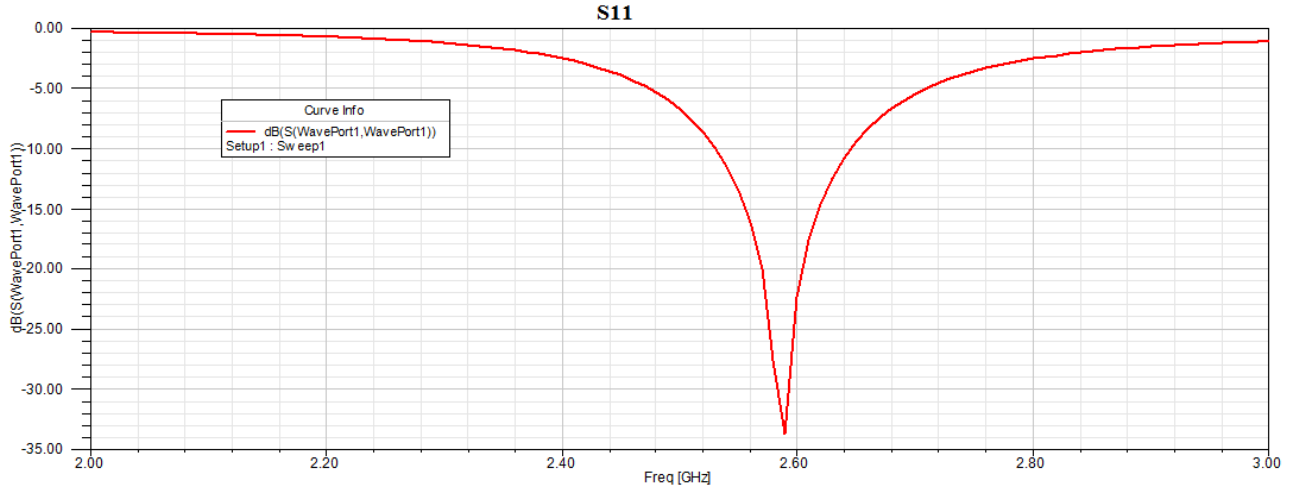


Figure.8 S11 in EM simulator

The S11 is most widely observed parameter of any antenna, the proposed antenna has a very low reflection co-efficient figure 7 shows S11 in matlab and fig 8 showing S11 in EM simulator both the nature of curves looks very similar but due to practical imperfections the S11 in EM simulator is bit low reflection co-efficient compared to theoretical matlab curve.

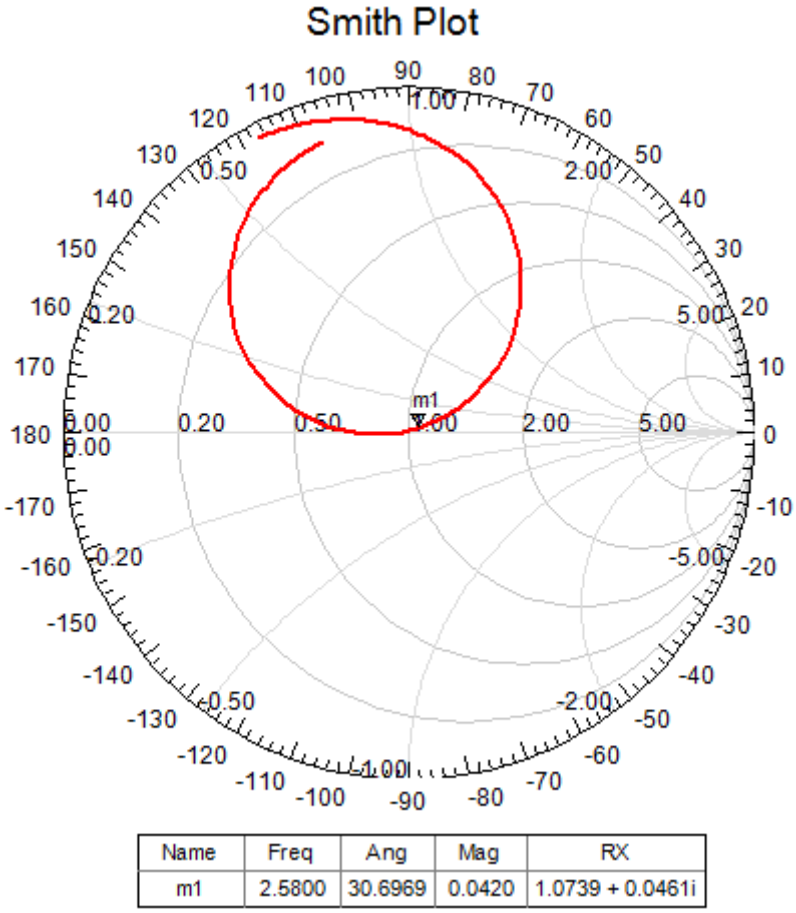
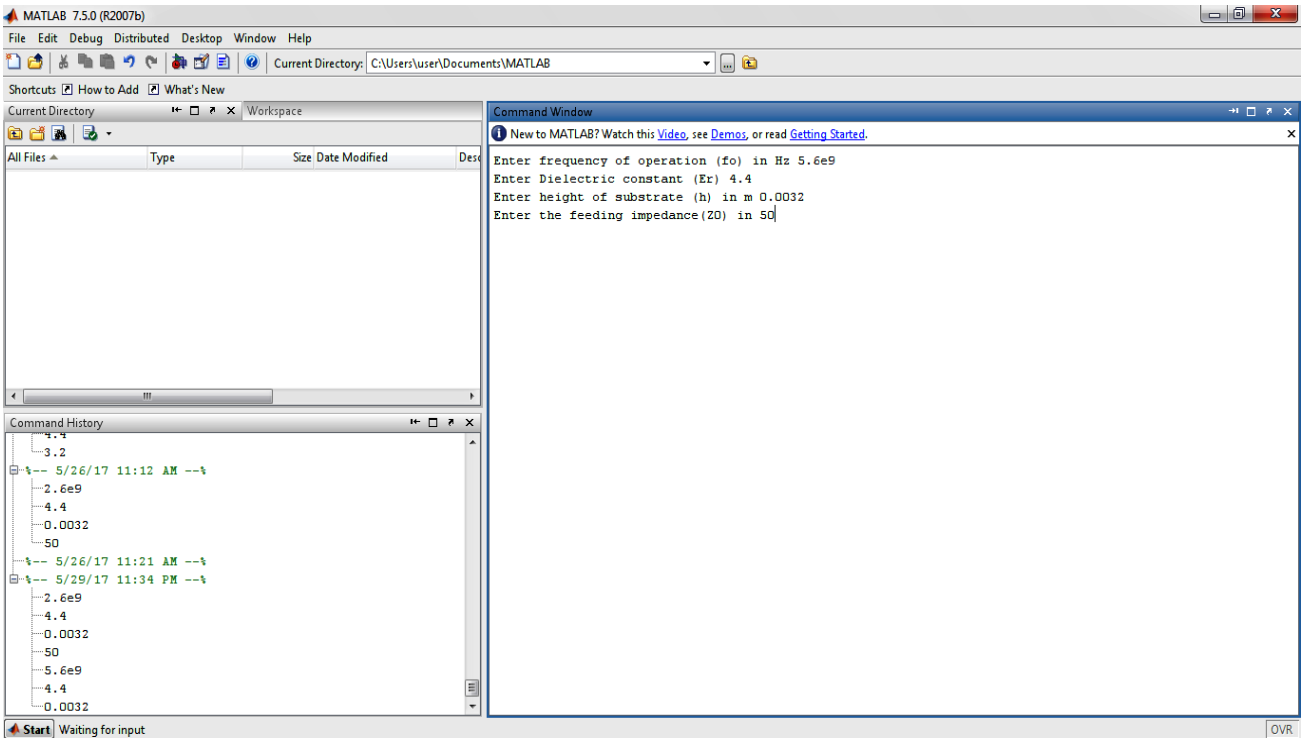


Figure.9 Smith plot

Smith plot is plotted to see the matching of the antenna point 1 in plot is perfectly matched and the curve around 1 is range of frequency of matched.

Similarly we have calculated same for 5.6 GHz and compared with the simulations in EM simulator.



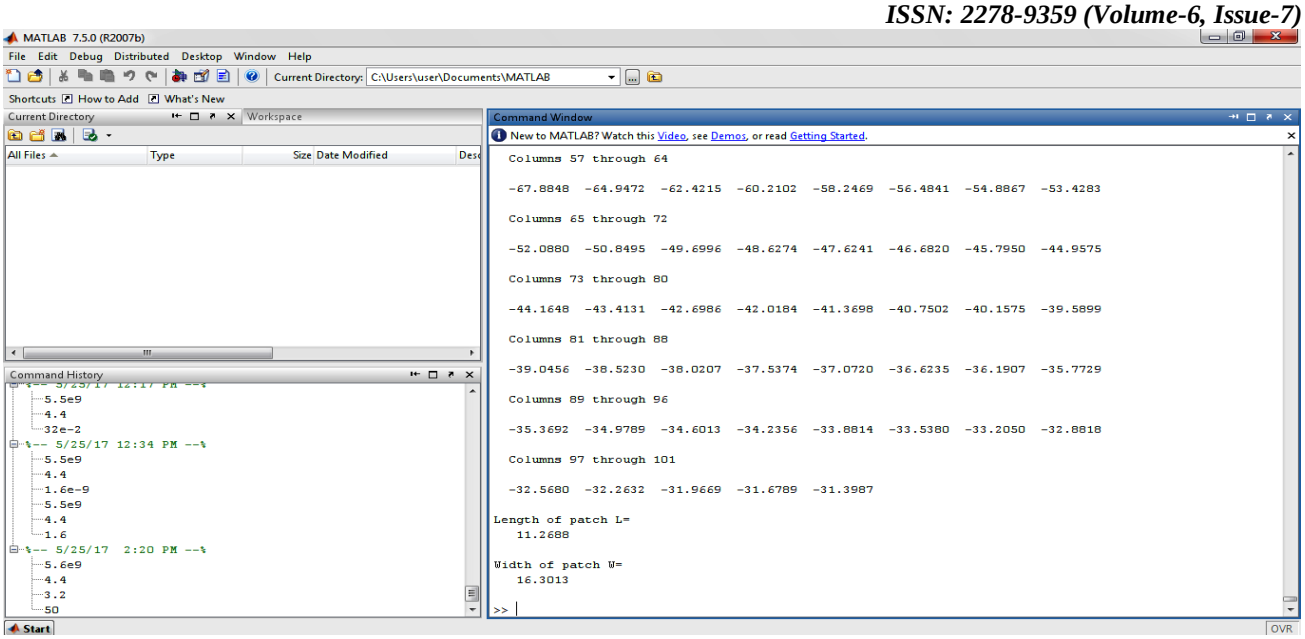


Figure.10 Matlab input and output in command window for 5.6GHz

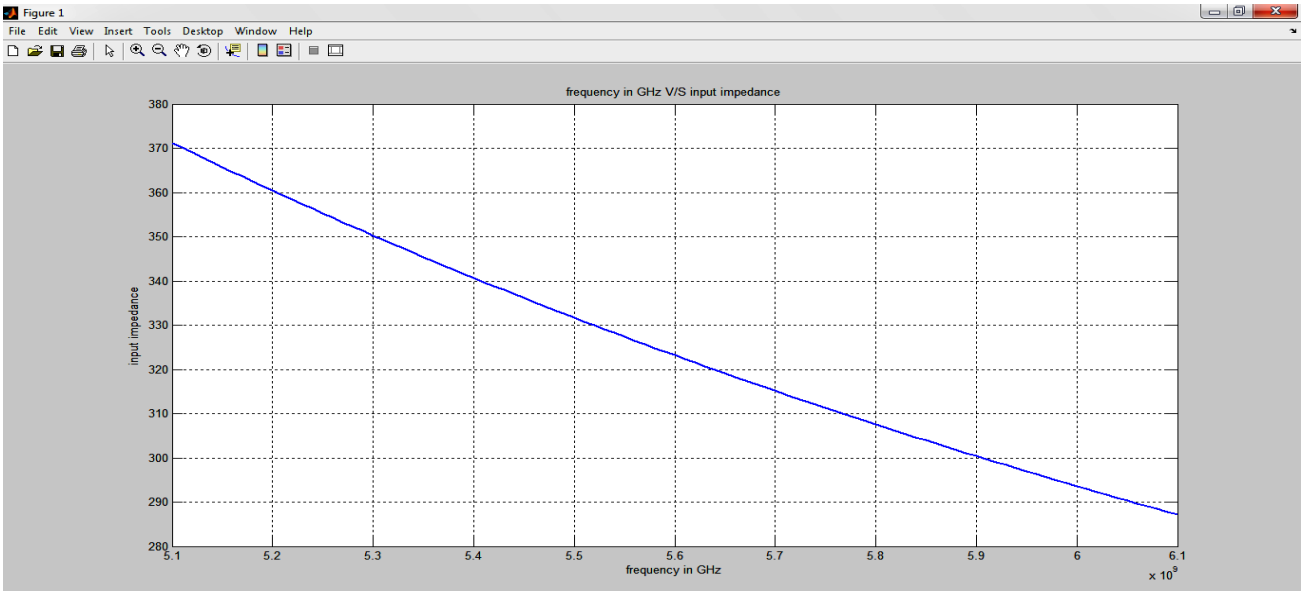


Figure.11 Input impedance versus Frequency

From fig.11 we can visualize the input impedance with respect to frequency where it swiftly and moves low.

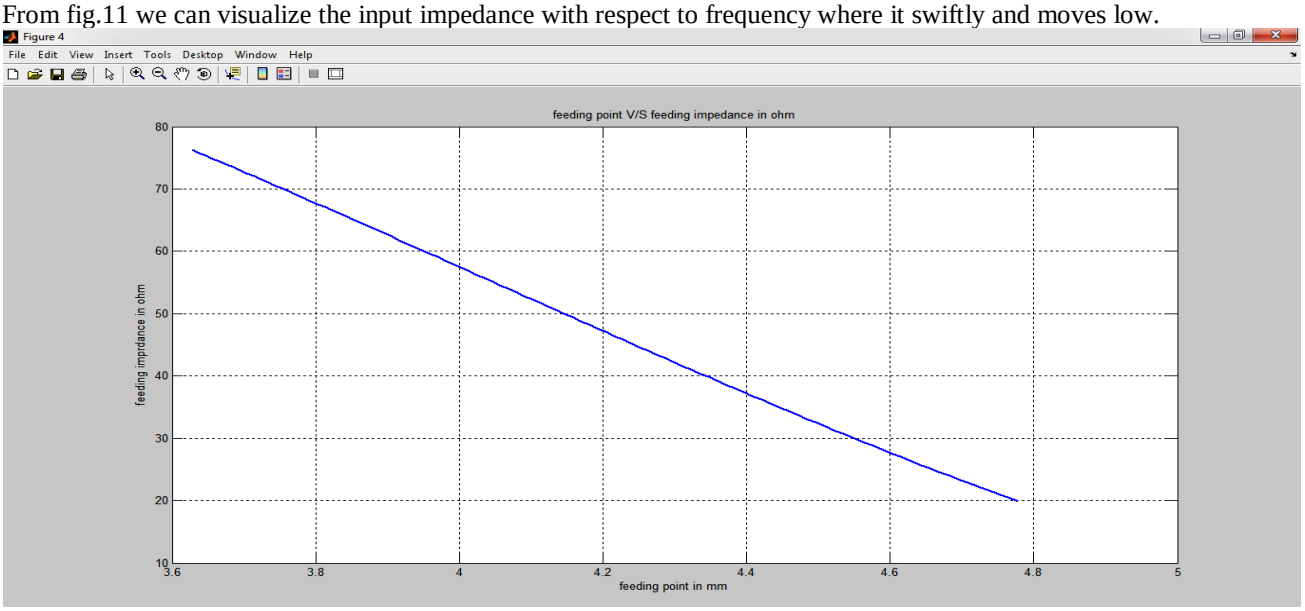


Figure.12 Probe position versus distance from edge of patch

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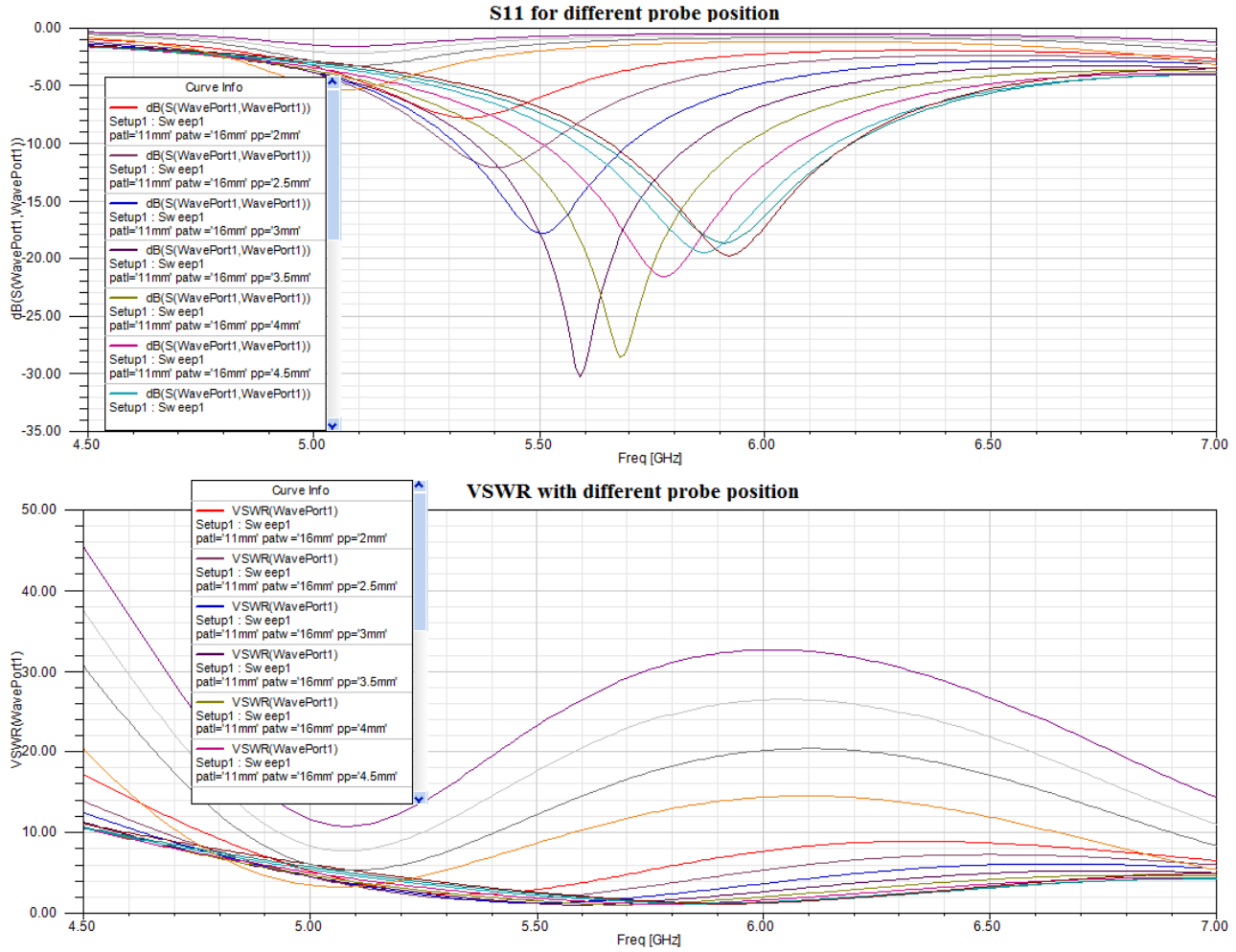


Figure.13 S11 and VSWR for varying the position of probe

Figure 13 perfectly resembles the importance of probe position and as per figure 4.1mm from edge have perfect match of 50ohms, EM simulator shows lowest return loss and reflection coefficient very near to that point.

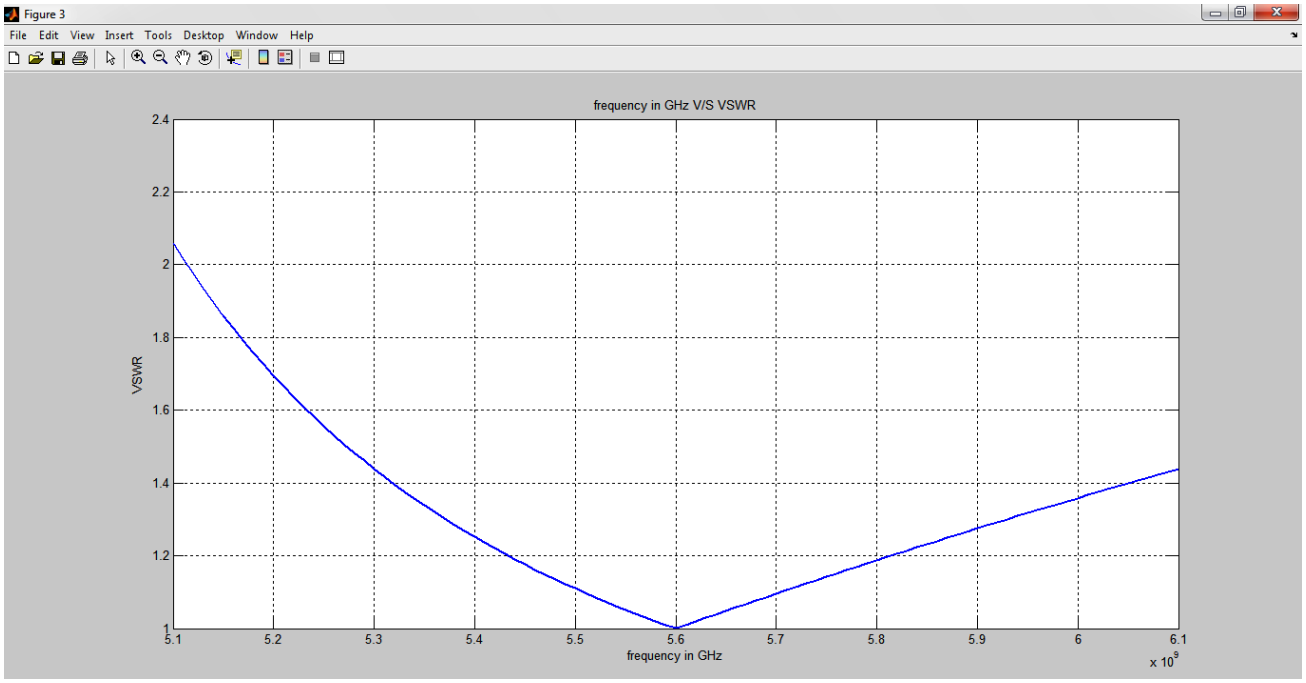


Figure.14 VSWR in Matlab

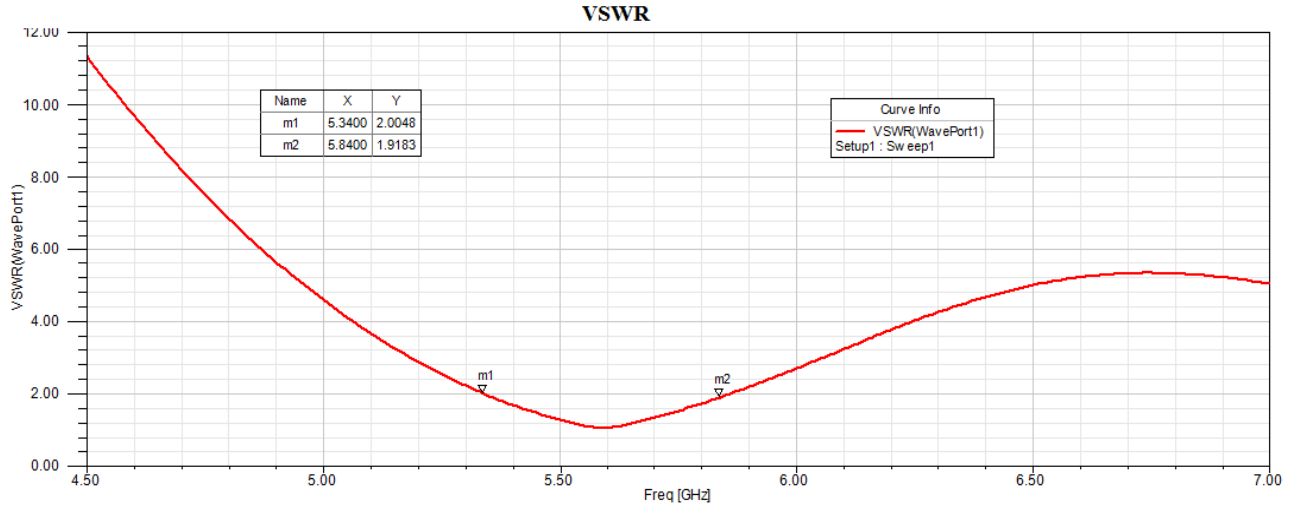


Figure.15 VSWR in EM simulator

The important property of any antenna is VSWR in our proposed antenna we have achieved VSWR < 2 over the operating frequency in both Matlab and EM simulator where both nature curves are similar in fig 14 and fig 15.

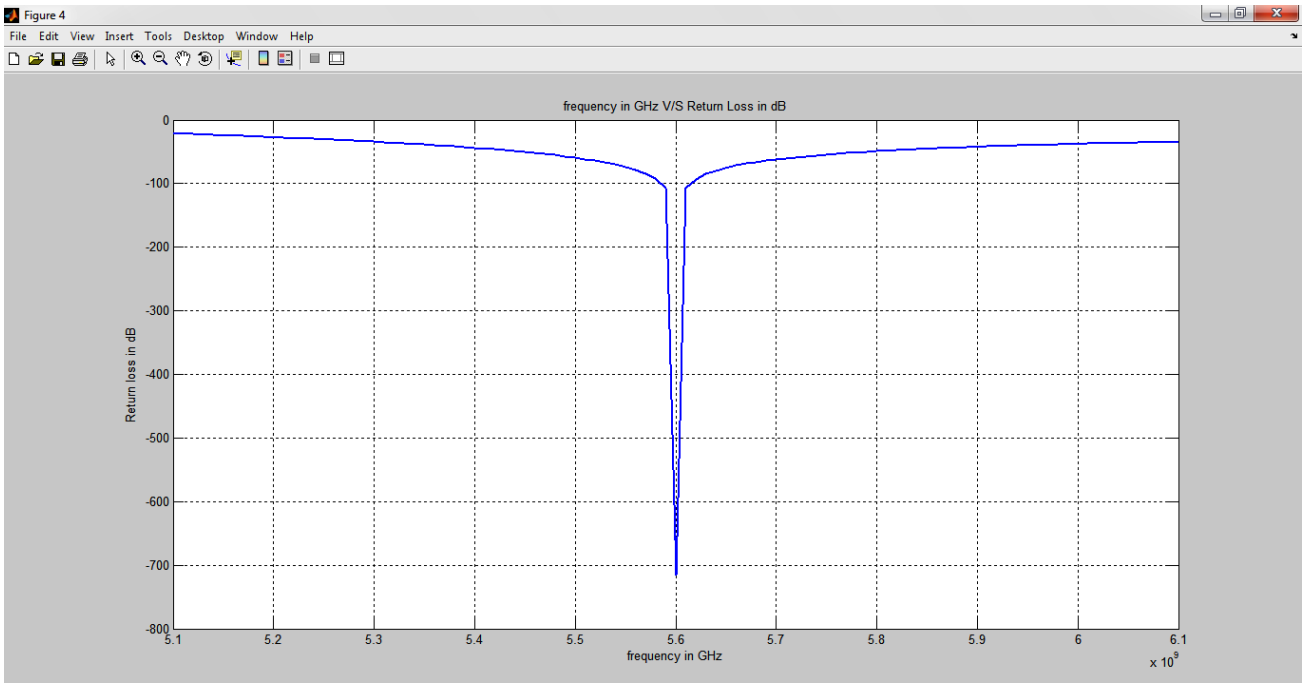


Figure.16 S11 in Matlab

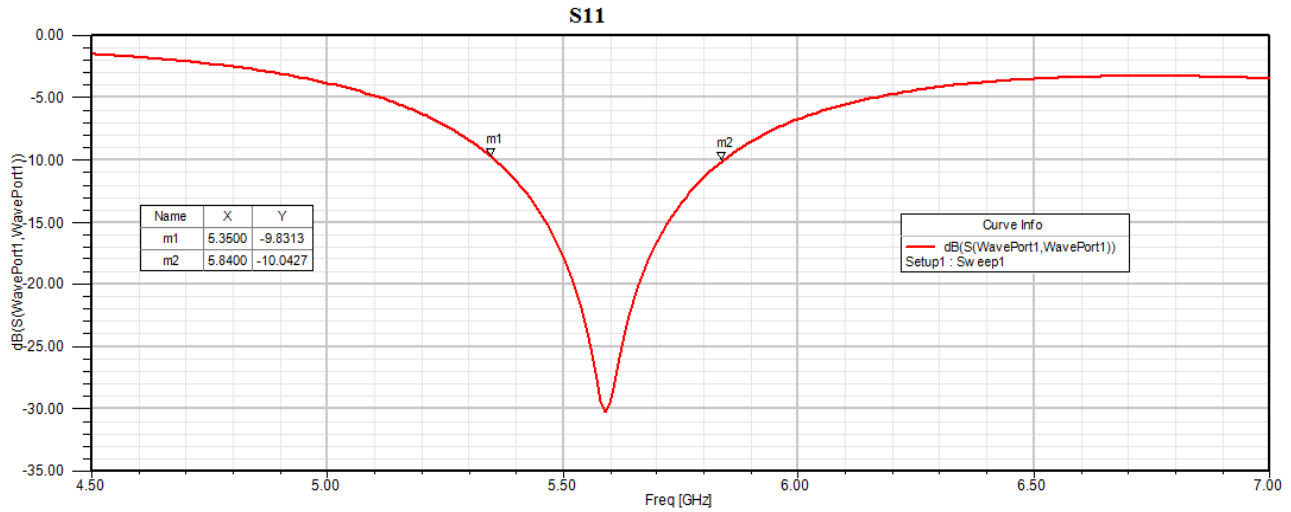
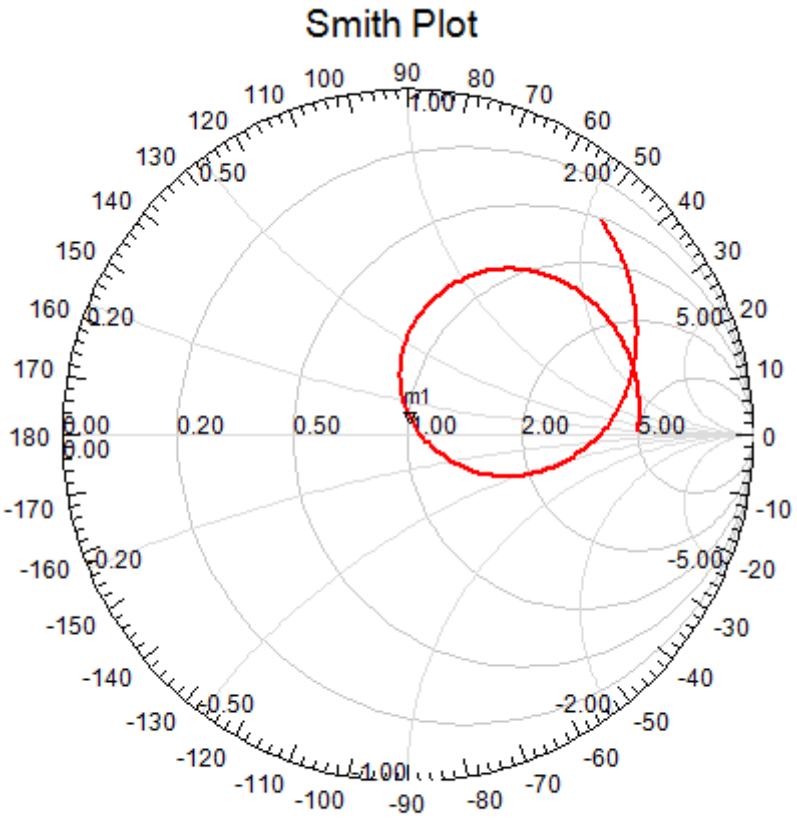


Figure.17 S11 in EM simulator

The S11 is most widely observed parameter of any antenna, the proposed antenna has a very low reflection co-efficient figure 16 shows S11 in matlab and fig 17 showing S11 in EM simulator both the nature of curves looks very similar but due to practical imperfections the S11 in EM simulator is bit low reflection co-efficient compared to theoretical matlab curve.



Name	Freq	Ang	Mag	RX
m1	5.6100	71.9951	0.0405	1.0223 + 0.0790i

Figure. 18 Smith plot

Smith plot is plotted to see the matching of the antenna point 1 in plot is perfectly matched and the curve around 1 is range of frequency matched.
All dimensions of antennas are tabulated in Table 1.

Table 1 Parameters and Dimensions of RMPA

Parameters and Dimensions of RMPA 2.6GHz		
Dimensions	Matlab	EM Simulator
Patch Length	27.5036	25.5mm
Patch Width	35.1104	33mm
Ground Plane Length	Infinite length	70mm
Ground Plane width	Infinite width	70mm
Probe Position from edge	10.2	7.25mm
Parameters and Dimensions of RMPA 5.6GHz		
Patch Length	12.7695	11mm
Patch Width	16.3013	16mm
Ground Plane Length	Infinite length	40mm
Ground Plane width	Infinite width	40mm
Probe Position from edge	4.74mm	2mm

IV. CONCLUSION

In this paper design we have coded theoretical equations in mat lab and got dimensions and parameters in matlab. We have fed dimensions in a EM simulator and compared parameters with Matlab parameters, where nature of curves are very similar. The dimensions are tabulated in table.1.

ACKNOWLEDGEMENT

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