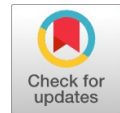


A Compact UWB Antenna Design using Modified Ground Plane



S K Toshniwal, A Prajapati, K Ray, M R Ahmad, B H Ahmad, P Singh, A Bandyopadhyay

Abstract: A compact rectangular MS antenna for Ultra Wide Band applications is designed. In the proposed design the rectangular patch antenna designed with cutting a slot in ground of length and width 2.5mm and 3.0mm respectively at the back of feed line. By using the defective ground plane a wide BW of 9.782 GHz with frequency band 3.099 GHz to 12.278 GHz is achieved. The designed antenna with a compressed size of 30 mm x 30 mm is fabricated and tested. The antenna's return loss and VSWR plots are presented here to confirm the complete UWB bands. Special configuration of patch antenna with slotted partial ground was designed and optimized using CST Microwave Studio.

Index Terms-Dual-band antenna, Defected Ground structure, VSWR and planar antenna.

I. INTRODUCTION

In this paper, the performance and characteristics of proposed MSA with effect of modified ground are presented. Then a practical model is designed and physical parametric performance is also presented on the basis of various parameters. To Enhance bandwidth of MS Antenna partial ground is used. To find complete UWB range further modification is done by cutting a rectangular slot in ground.

II. ANTENNA DESIGN

In the proposed UWB antenna, FR4 epoxy of thickness 1.6 mm is used as dielectric material with loss tangent $\tan\delta$ is 0.025. The Antenna size 30 mm x 30 mm is used as shown in figure 1.

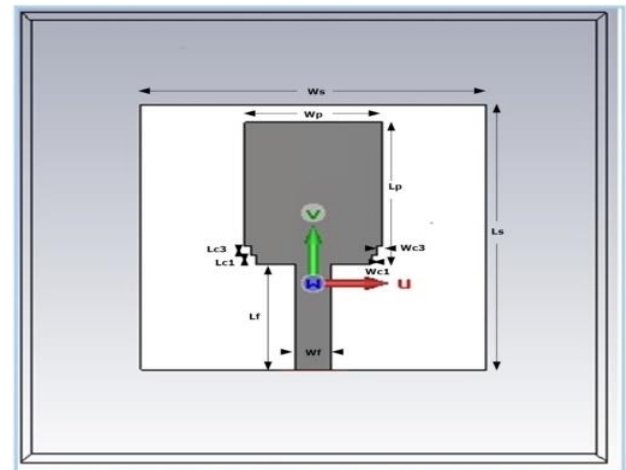


Fig.1 Rectangular microstrip patch antenna (Top layer)

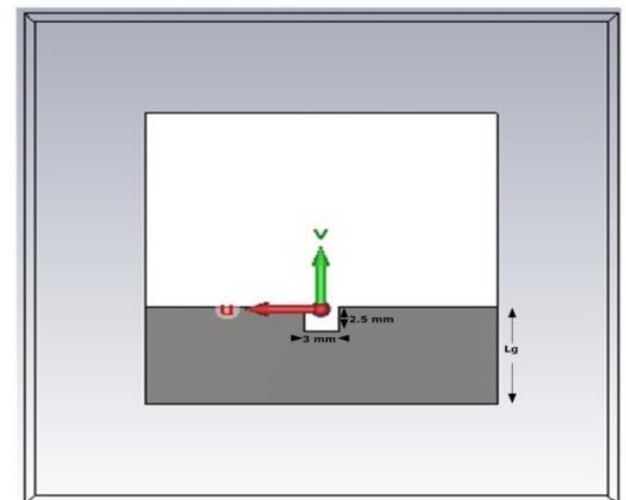


Fig. 2 Rectangular micro strip patch antenna (Bottom layer)

For better impedance matching a feed is provided to patch using 3.1 mm wide microstrip line with 50Ω characteristic impedance. Fig. 1 & Fig.2 shows Front and Back views of the proposed antenna respectively.

The table 1 shows various design parameters of proposed antenna as follows.

Manuscript published on 30 August 2019.

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Table 1 Design Parameter of Uwb Antenna

Parameters	Description	Value (mm)
W_s	Substrate Width	30
L_s	Substrate Length	30
W_p	Patch Width	12
L_p	Patch Length	16
W_f	Width of feed line	3.1
L_g	Length of ground	10
L_f	Length of feed line	12
L_{c1}	Stair 1 Length	1
L_{c3}	Stair 2 Length	1
W_{c1}	Stair 1 Width	1
W_{c3}	Stair 2 Width	0.5

To reduce the size of antenna and get required frequency band, there is a requirement of modification in ground plane. According to basic design with full ground the resultant return loss is as per figure 3 shown below.

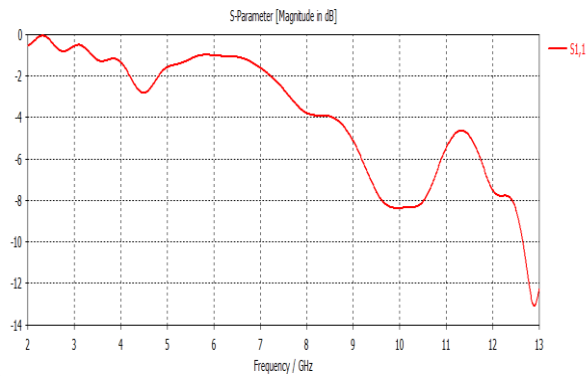


Fig. 3 Effect on return loss with full ground plane

To find required bandwidth various ground plane lengths analysed using simulation.

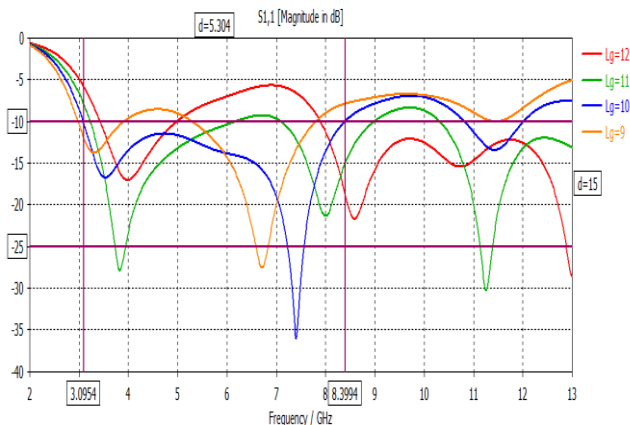


Fig. 4 Analysis of return loss with different ground length L_g

$L_g = 10$ mm provides better UWB coverage in comparison to others. As L_g is reduced to 10 mm the bandwidth of 5.27 GHz achieved with frequency band 3.08 GHz-8.36GHz but it does not provide complete UWB which is shown in figure 5.

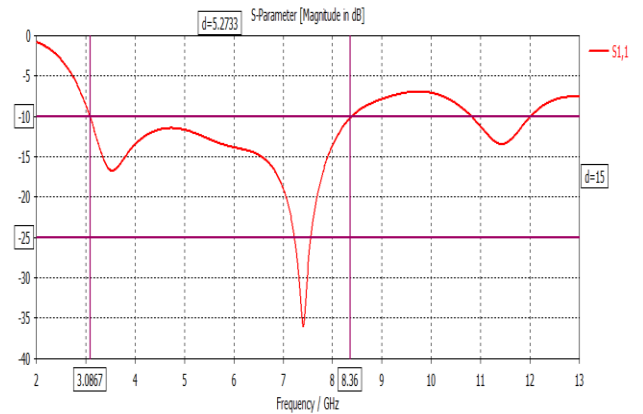


Fig. 5 Return loss with ground length $L_g=10$

Further to include the complete UWB frequency some modification done in ground structure. So for required bandwidth a modified ground structure required.

To find complete UWB range further improvement is achieved by cutting a slot in ground of length and width 2.5mm and 3.0mm respectively at the back of feed line. Due to this a wide bandwidth of 9.782 GHz with frequency band 3.099 GHz to 12.278 GHz is achieved which is observed in figure 6.

III. RESULTS AND DISCUSSION

The Fig. 6 shows return loss for proposed Antenna. The designed antenna provided bandwidth of 9.178GHz in frequency band of 3.099GHz – 12.278GHz. The antenna has bandwidth of 122.37% with two resonant frequencies at 6.04 GHz with S_{11} -21.86 dB and 11.303 GHz with S_{11} -24.76 dB. Fig. 7 presents the VSWR of proposed Antenna. VSWR of designed antenna obtained within desired 2:1 VSWR ratio.

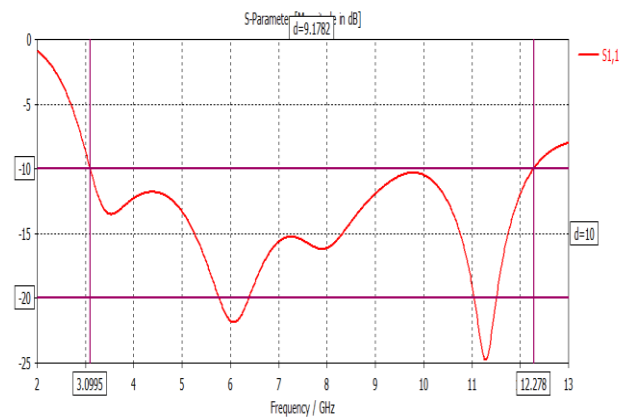


Fig. 6 Simulated result for return loss (S_{11}) parameter of proposed antenna

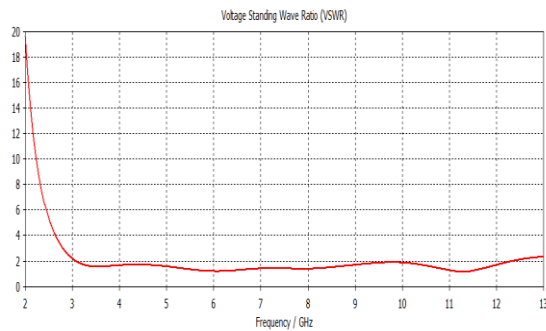


Fig. 7 Simulated result for VSWR of proposed antenna

The figure 8 and 9 show the simulated result of far pattern and its 3D view.

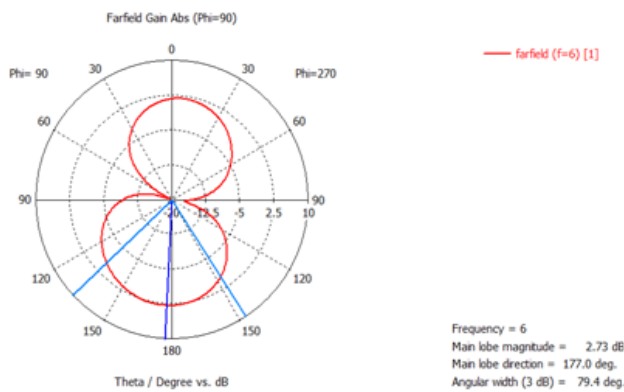


Fig.8. Far field pattern of microstrip patch UWB antenna

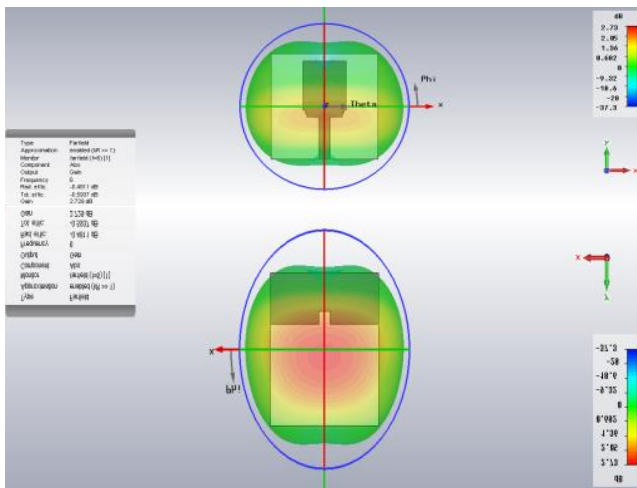


Fig. 9. Far field pattern 3D-view of microstrip patch UWB antenna

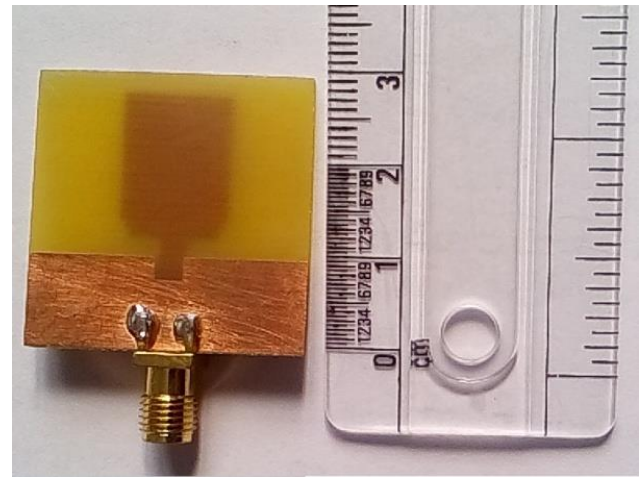


Fig.10. Fabricated antenna

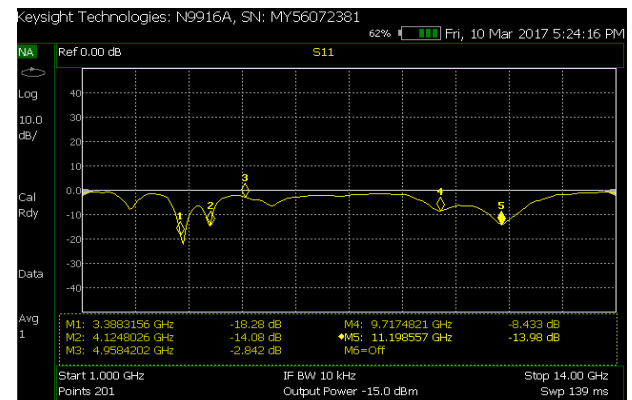


Fig. 11. Measured return loss (S_{11}) of antenna

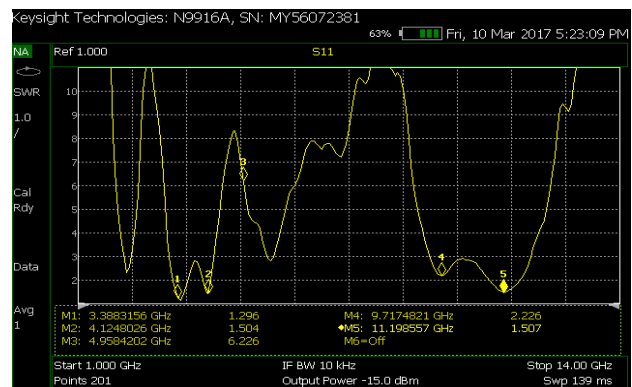
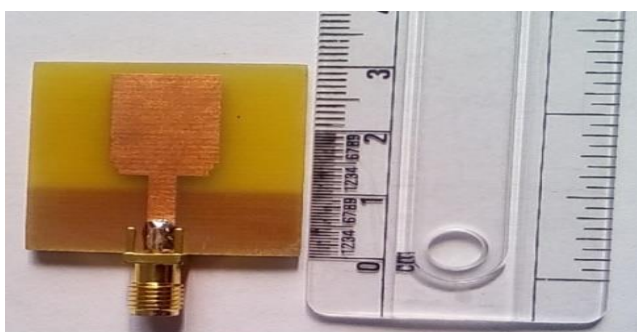


Fig.12. Measured VSWR of the antenna



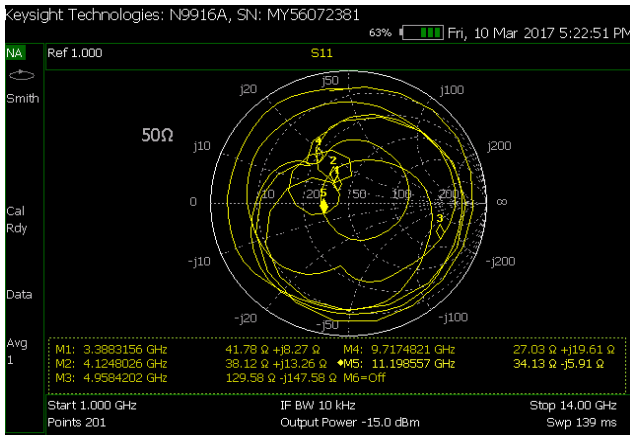


Fig.13. Measured Smith Chart of the antenna

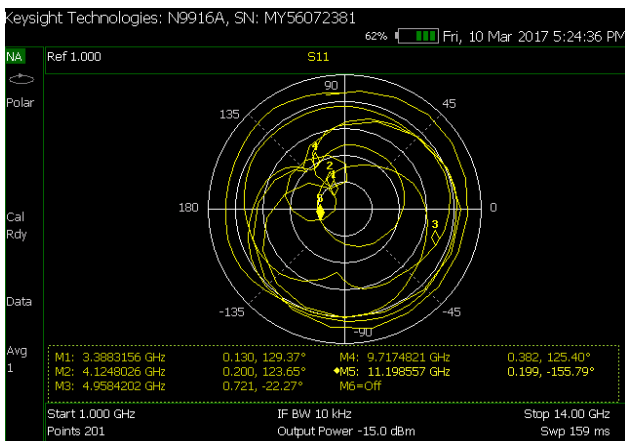


Fig.14. Measured Polar Plot pattern of the antenna

IV. CONCLUSION

A compact MS Antenna with modified ground plane fed by a micro strip line is designed for UWB applications. In this antenna a rectangular shaped stair cut patch and a defected ground structure is used minimizing the dimension of the antenna for achievement of excellent impedance performance. Thus the simulated results strongly admitted for the UWB performance of designed antenna as per required standards. The practical results also give satisfactory results in terms of various antenna parameters.

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