International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075, Volume-8 Issue-10, August 2019

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 BWof 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 tanδ is 0.025. The Antenna size 30 mm x 30 mm is used as shown in figure 1.

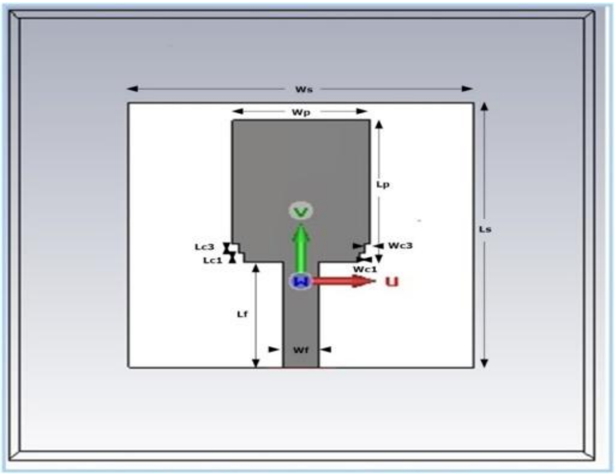


Fig.1 Rectangular microstrip patch antenna (Top layer)

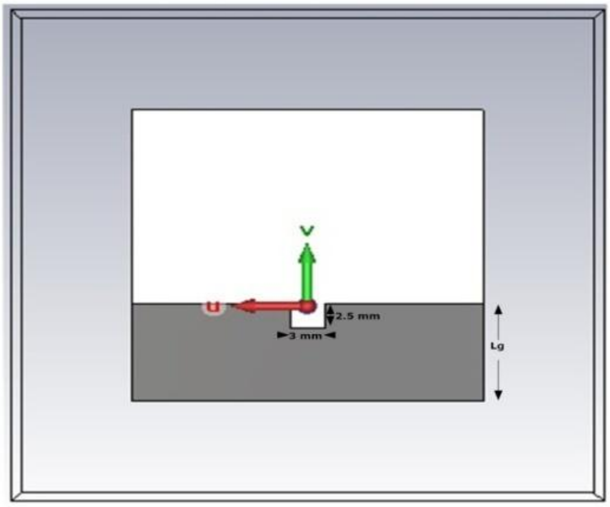


Fig. 2 Rectangular micro strip patch antenna (Bottom layer)

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.

Revised Manuscript Received on August 03, 2019.

Sandeep Kumar Toshniwal ,Department of ECE, J K Lakshmipat University ,India;

Amit Prajapati, ,Department of ECE, KITE, Jaipur, India;

Kanad Ray Corresponding author**,**Department of Physics, Amity School of Applied Sciences, Amity University Rajasthan, India;

M R Ahmad ,CeTRI, UTeM, 76100 Durian Tunggal, Melaka, Malaysia;

B H Ahmad, FECE, UTeM, Malaysia;

P Singh, Amity University Rajasthan, India;

A Bandyopadhyay, NIMS,Japan;

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.

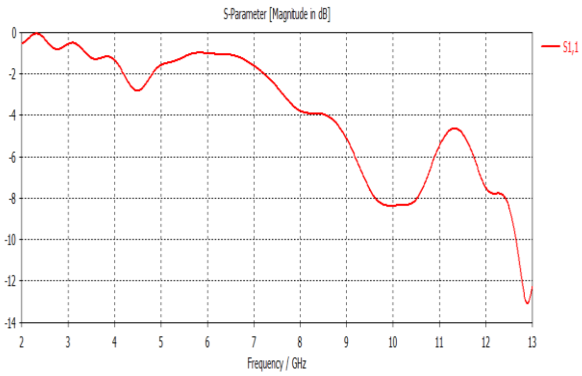


Fig. 3 Effect on return loss with full ground plane

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

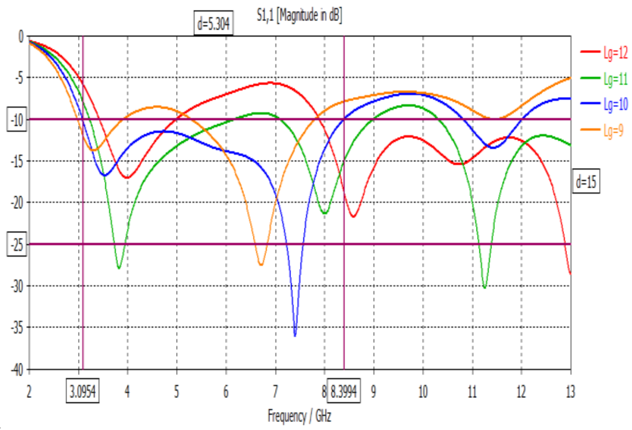


Fig. 4 Analysis of return loss with different ground length l_g

Lg = 10 mm provides better UWB coverage in comparison to others . As Lg 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.

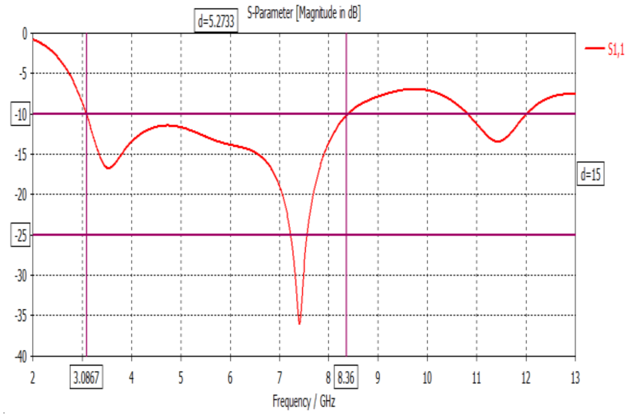


Fig. 5 Return loss with ground length L_g=10

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.

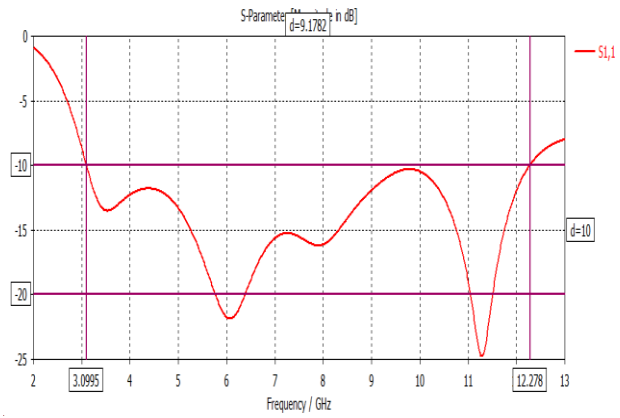


Fig. 6 Simulated result for return loss (S_{11}) parameter of proposed antenna

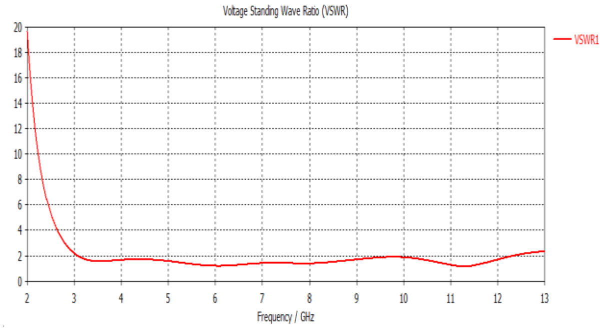


Fig. 7 Simulated result for VSWR of proposed antenna

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

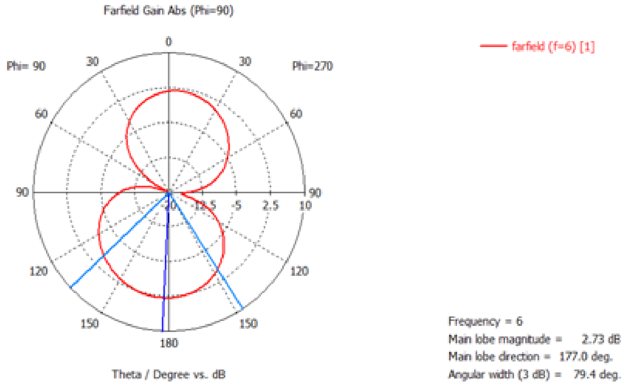


Fig.8. Far field pattern of microstrip patch UWB antenna

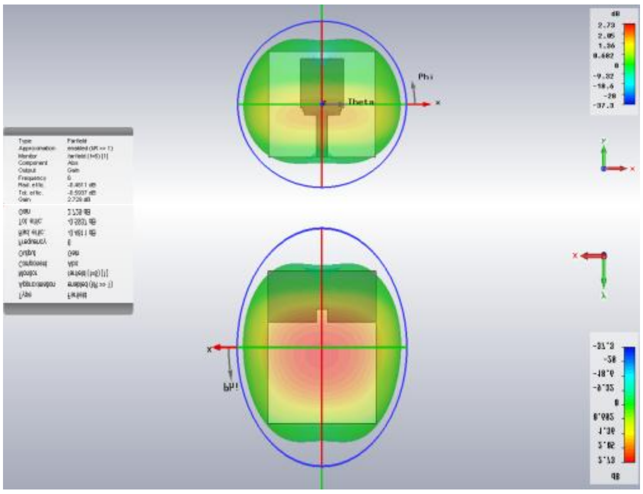
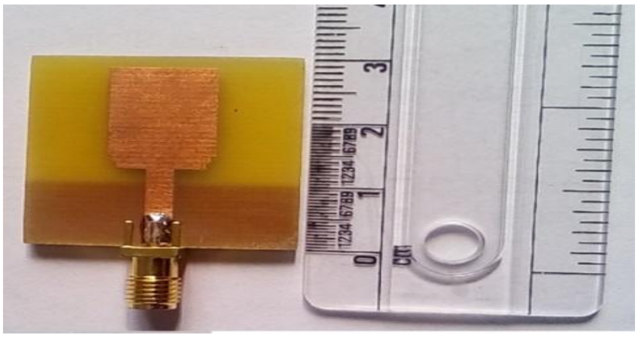


Fig. 9. Far field pattern 3D-view of microstrip patch UWB antenna



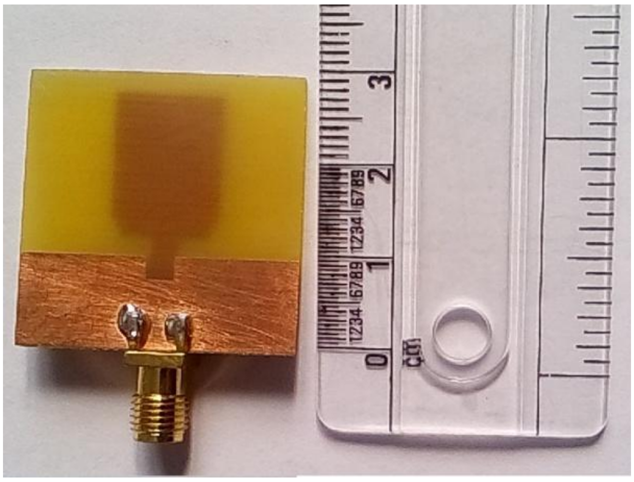


Fig.10. Fabricated antenna

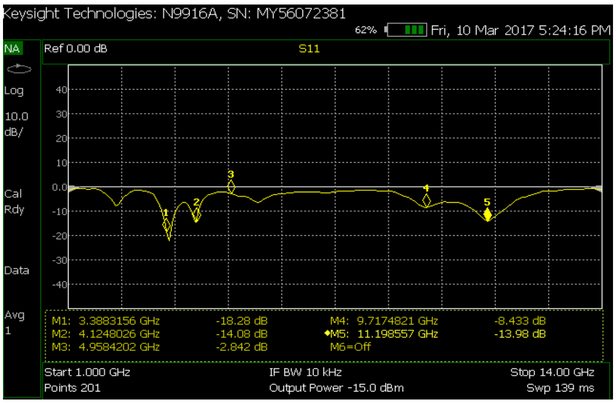


Fig. 11. Measured return loss (S_{11}) of antenna

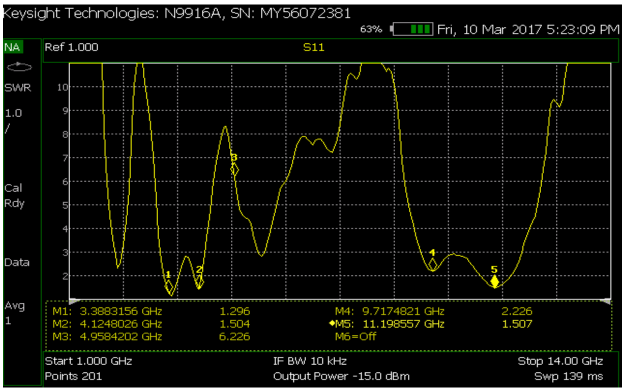


Fig.12. Measured VSWR of the antenna

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

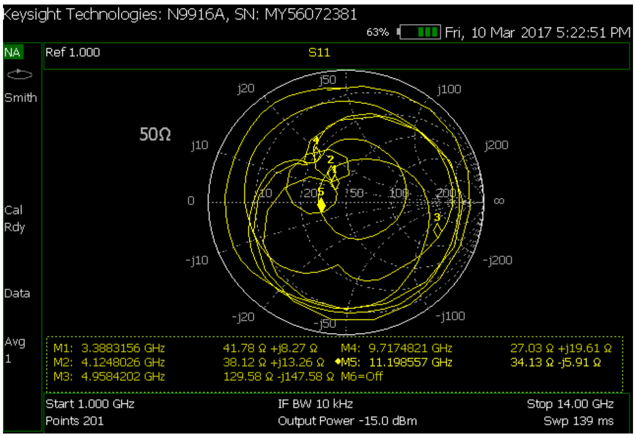


Fig.13. Measured Smith Chart of the antenna

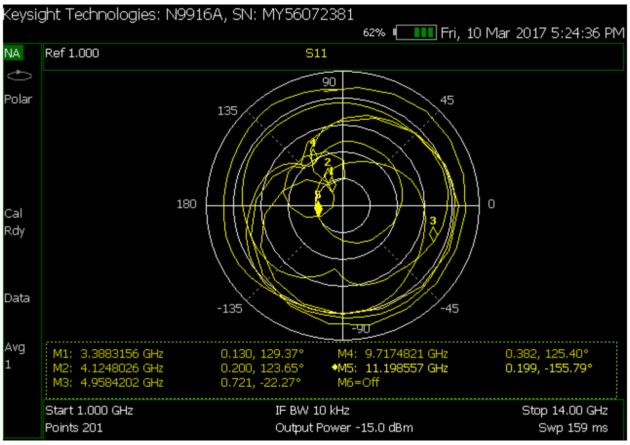


Fig.14. Measured Polar Plot pattern of the antenna

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.

REFERENCES

1. Kumar Toshniwal S., Ray K. (2014) A Technique to Minimize the Effect on Resonance Frequency Due to Fabrication Errors of MS Antenna by Operating Dielectric Constant. In: Babu B. et al. (eds) Proceedings of the Second International Conference on Soft Computing for Problem Solving (SocProS 2012), December 28-30, 2012. Advances in Intelligent Systems and Computing, vol 236. Springer, New Delhi.
2. Sandeep Kumar Toshniwal, Somesh Sharma, Sanyog Rawat, Pushpendra Singh, Kanad Ray: Compact Design of Rectangular Patch Antenna with Symmetrical U Slots on Partial Ground for UWB Applications. IBICA 2015: 535-542
3. Sandeep Toshniwal,TanushriMukherjee**,** Prashant Bijawat, Sanyog Rawat,Kanad Ray "Design and Analysis of Fabricated Rectangular Microstrip Antenna with Defected Ground Structure for UWB Applications"International Conference on Soft Computing: Theories and Applications Springer, New Delhi.
4. Preet Kaur, Rajiv Nehra, Manjeet Kadian, Dr. Asok De, Dr. S.K.Aggarwal, "Design Of Improved Performance Rectangular Microstrip Patch Antenna Using Peacock And Star Shaped Dgs" International Journal of Electronics Signals and Systems (IJESS), ISSN: 2231 - 5969, Vol. -3, Iss. -2, 2013.
5. Vinay Sharma, Rajesh Kumar Vishwakarma. "Microstrip Antenna with Defected Ground Structure (DGS) for Multiband Operation"Proceedings of the International Conference on Recent Cognizance in Wireless Communication & Image Processing pp 879-888DOI: 10.1007/978-81-322-2638-3_99, 29 April 2016.
6. Reza Zaker, ChangizGhobadi, and JavedNourinia, "Bandwidth Enhancement of Novel Compact Single and Dual Band-Notched Printed monopole Antenna with a Pair of L-Slotted Slots".
7. Q. Wu, R. Jin, J. Geng, and M. ding, "Printed omni-Directional UWB monopole antenna with very compact size," IEEE Trans. Antenna propag., vol. 56, no. 3, pp. 896-899, Mar. 2008.