Implementation and Analysis of slotted square microstrip antenna

[1]D.Mahanth Mukesh, [2]P.Chandra Sekhar
[1]Student Member IEEE, [2]Assistant Professor
Department of ECE
GITAM University, Visakhapatnam, India

***Abstract*—In this paper, A Square Patch Micro strip antenna with a rectangular slot is presented. The antenna is inset fed with operating frequency from 2GHz to 10 GHz. This antenna operates with return loss of -52.38 dB at 7.44 GHz. Here low cost FR4-lossy substrate with Dielectric Constant 4.3 and loss tangent 0.02 is used. The design is simulated in the software CST Microwave studio 2014.**

***Index Terms*— Square shape, Microstrip Antenna, Inset feed, Return Loss, VSWR.**

I. INTRODUCTION

A Microstrip Patch antenna consists of a dielectric substrate which has a ground plane on one side and a radiating patch on the other side. The dielectric is an insulating substance and the radiating patch is a conductor which can be practically in any shape. Different kinds of dielectric substrates are developed with a large range of dielectric constants. The antenna property varies with different dielectric substrate.

Advantages of Microstrip antenna are light weight, robust in nature, low volume, and thin profile configurations. Fabrication cost is also low and is convenient for mass production, and possible to make dual frequency antennas. Disadvantages are bandwidth is very less, gain is very low [1]. Microstrip antennas are used in high-performance aircraft, spacecraft, satellite, missile applications, mobile radio and wireless communications [2].

Square, Rectangle, Triangle and Circle are commonly used shapes in practice for Microstrip antenna. In this paper a square micro patch antenna is designed with a square dielectric fed by a microstrip line. The square patch and the dielectric are of square shape where the square patch is slotted to minimize the return losses.

II. ANTENNA TOPOLOGY

The geometry and configuration of the square microstrip antenna with a rectangular slot and feeding line are shown in Fig. 1.

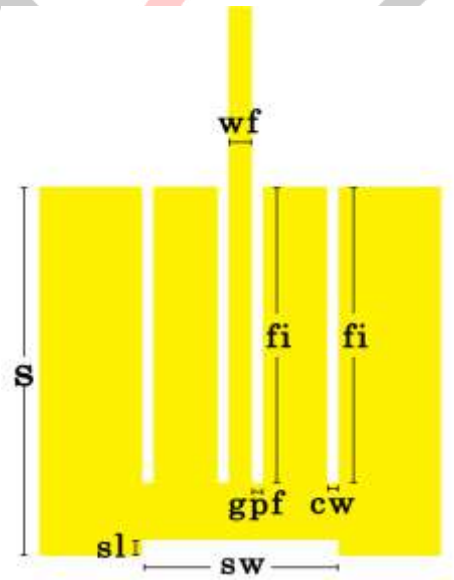

Figure 1: Design Parameters of the Patch

The FR4-lossy substrate with thickness h=1.6mm with dielectric constant 4.3 and loss tangent 0.02 is used. The antenna has three rectangular slots in which two of them are identical. The antenna is provided with inset feed [3]. The dimensions of the slot

and the patch are given in Table.1. The square radiating patch used here is copper (annealed) with a thickness of 0.1 mm [4-11]. The patch is of square shape where side=s and the dielectric substrate is also a square with side=2s [12].

Table 1: Dimension of the antenna

Sr.No.	*Parameter*	*Value (mm)*
1	s	40
2	h	1.6
3	t	0.1
4	fi	32.50
5	wf	2
6	gpf	1.57
7	sw	1.65
8	sl	20
9	cw	1.5

III. PERFORMANCE EVALUATION

The Microstrip antenna was designed and simulated in the software CST Microwave studio 2014. The Microstrip antenna parameters like Return loss, Voltage standing wave ratio, far field patterns are analyzed in CST software.

3.1. Return Loss

Return loss is expressed in negative logarithmic value. The proposed antenna is giving a return loss of -52.38 dB at the frequency 7.44 GHz frequency and -30.86 dB at 9.28 GHz frequency. The bandwidth at -10 dB extends from 7.27 GHz to 7.744 GHz and 9.104GHz to 9.592 GHz. The return loss plot is shown in Fig.2.

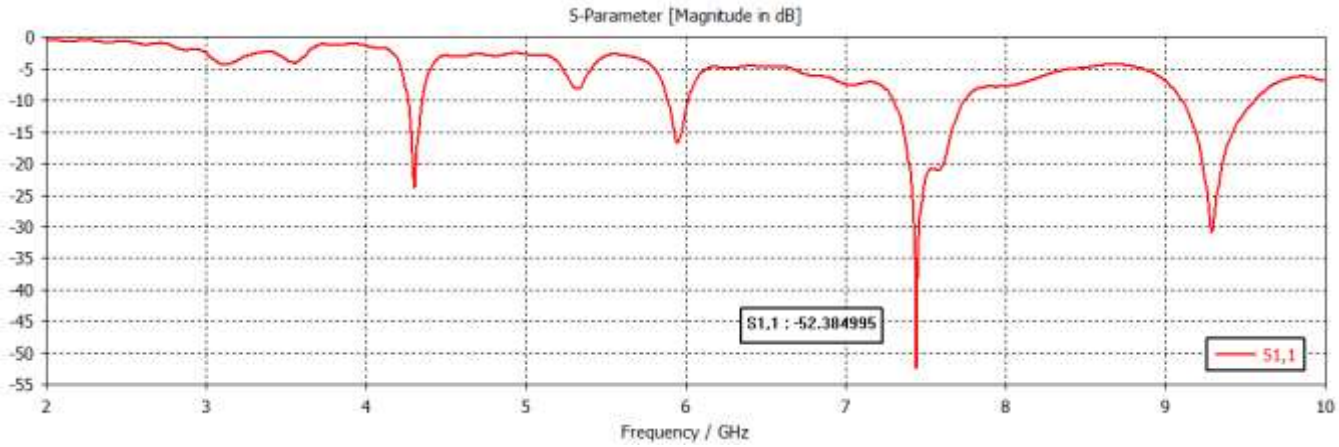

Figure 2: Return Loss plot

3.2. VSWR

The impedance mismatch between the antenna and the transmission line is measured by the VSWR value. Lower is the VSWR value better is the impedance matching between the transmission line and antenna. VSWR value closer to unity is ideal. The VSWR value at 7.44 GHz frequency is 1.0048175 and VSWR at 9.288 GHz frequency is 1.0589547 which is closer to unity. The VSWR vs. Frequency plot is shown in Fig.3.

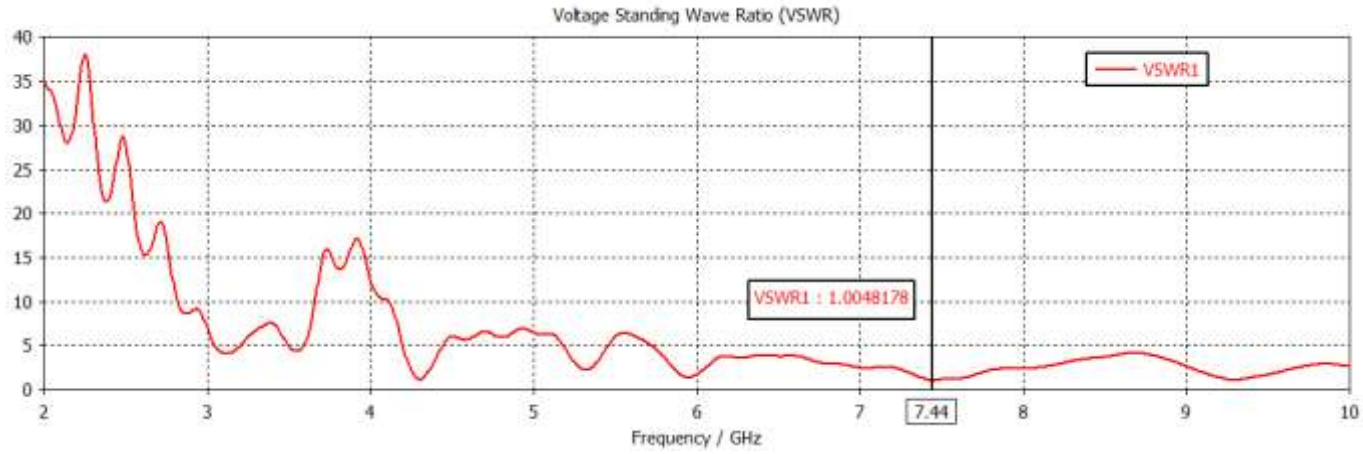

Figure 3: VSWR Plot

3.3. Far field Directivity

The polar plots of the far field pattern of the square shaped slotted microstrip antenna are shown in the Fig.4.

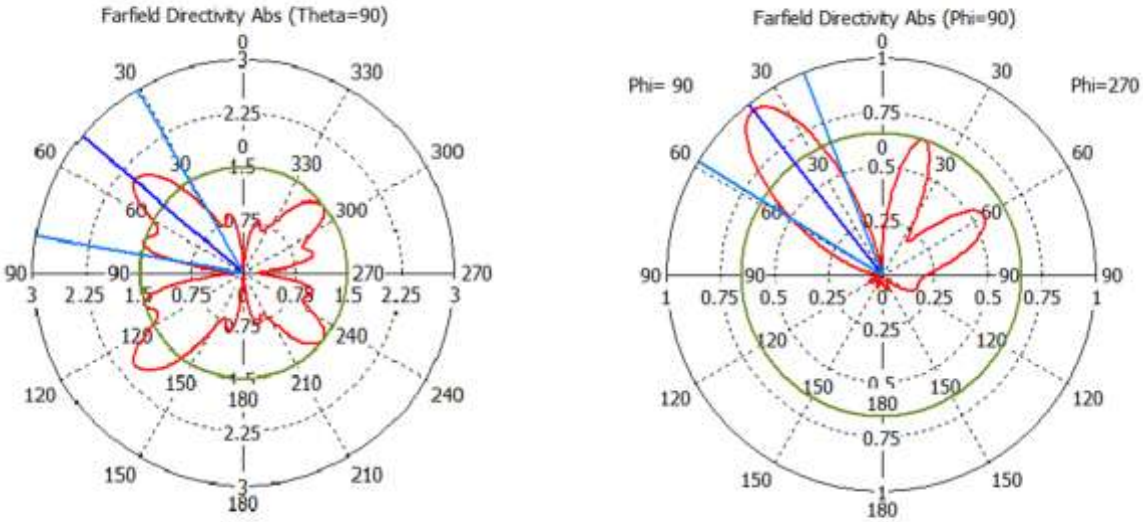

Figure 4: Polar Plot at Theta=90 and Phi=90

IV. CONCLUSION

A novel square slotted microstrip antenna is proposed in this paper which resonates at multiple frequencies. There is a sharp return loss of -52.38 dB at the frequency 7.44 GHz with a VSWR of 1.0048175. It can be concluded that the performance of the proposed antenna is satisfactory and by making some variations in the antenna parameters return loss can be further improved taking care of the practical limitations.

REFERENCES

[1] Garg, Ramesh. Microstrip antenna design handbook. Artech house, 2001.

[2] Balanis, Constantine A. Antenna Theory: Analysis and Design. John Wiley & Sons, 2015.

[3] Jain, Sachin Kumar, and Atal Rai. "Dual-Frequency Band Circular Micro strip Antenna for Radar Application." International Journal of Advance Research and Innovation 2.4 (2014): 752-754.

[4] Chen, Hua-Ming, et al. "Microstrip-fed circularly polarized square-ring patch antenna for GPS applications." IEEE Transactions on Antennas and Propagation 57.4 (2009): 1264-1267.

[5] Chirala, A. P. "HUE Shaped Slotted Microstrip Antenna for Bandwidth Enhancement." International Journal of Future Generation Communication and Networking 7.4 (2014): 141-148.

[6] Roy, Atser A., Joseph M. Mom, and Gabriel A. Igwue. "Enhancing the bandwidth of a microstrip patch antenna using slots shaped patch."American Journal of Engineering Research 2.9 (2013): 23-30.

[7] Tiwari, Rahul. "Return Loss Enhancement of Patch Antenna." Int., Society of Thesis Publication., Journals of Research in Electrical and Electronics Engineering.

[8] Chandrasekhar, P., P. Gowtham Kumar, and K. Santhosh. "Study on Fractal Microstrip Fork Antenna with Enhanced Directivity." International Journal of Application or Innovation in Engineering & Management (IJAIEM) 4.3 (2015): 80-84.

[9] Chandrasekhar, P., and T. Sree Hari. "Study of compact ultrawideband printed elliptical slot antenna." 2014 Annual IEEE India Conference (INDICON). IEEE, 2014.

[10] Arulaalan, M., and L. Nithyanandan. "Return Loss and Gain Improvement in an Inset Fed Triangular Patch Antenna using Koch Boundary." Elsiever International Conference on Recent Trends in Communication and Computer networks COMNET. 2013.

[11] Kushwaha, Ram Singh, D. K. Srivastava, and J. P. Saini. "A multi-slotted wide microstrip patch antenna for dual frequency." Int. J. Comput. Sci. Inf. Technol 3.2 (2012): 3523-3525.

[12] S. Subhani and R. P. Dwivedi, "Square patch antenna with circular polarization for WLAN application," *2016 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET)*, Chennai, India, 2016, pp. 1018-1021.