Step Slotted Micro strip Patch Antenna withDefected Ground Structure (DGS) for wideband applications

Dr.M.Surendra Kumar
Principal
Department of ECE
KLR college of Engineering and technology, paloncha.

Abstract--- *In this research, a wideband rectangular Microstrip patch antenna with a broad impedance bandwidth and low return loss is developed for use in wireless local area networks (WLANs), wireless metropolitan areas (WiMAX), and cellular enhanced data rates (IMT). CST Microwave Studio 2010 was used for both the antenna's design and simulation. The modeled antenna is a dual-resonant structure with a bandwidth of 4.2857 GHz, a return loss of -30 dB, and resonant frequencies of 3.8 and 5 GHz. At high resonant frequency, the gain and directivity are maximized.*

Keywords- Microstrip patch antenna, wideband, step-slotted patch, reduced-loss ground plane, and return-loss.

INTRODUCTION

The proliferation of wireless technology has increased the need for small antennas that can be readily integrated into mobile devices for both transmission and reception. Microstrip patch antennas are one kind of antenna that are well-suited for usage in wireless applications [1] because to its many benefits, including their compact design, low weight, and simplicity of production and installation. It's made up of a substrate with a ground plane at the base and a conducting patch at the top. Perfect electric conductor (PEC) material is required for the patch and ground, whereas the substrate is comprised of dielectric material with a certain permittivity. Any form, including square, circle, ellipse, ring, etc., may be used for the patch [2]. Microstrip patch antennas have poor efficiency and a limited frequency range [3].

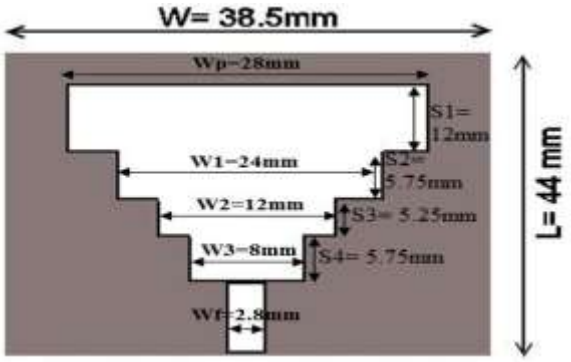
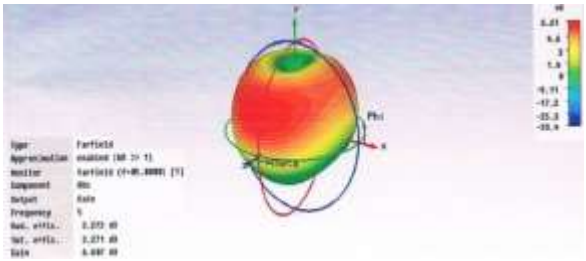


Fig.1Top view of step slotted MPA.

The employment of a step-slotted patch on a defective ground plane. Step slotted patches are used to minimize the antenna's overall footprint while simultaneously increasing bandwidth. It has also been calculated that the reduced ground plane, which includes defects, improves bandwidth performance more than the entire ground plane.

1. ANTENNA GEOMETRY

Fig. 1and Fig. 2 represents the geometry of step slotted microstrip patch antenna showing front and bottom view respectively. As shown in the Fig.1, there are many step slots cut on the patch and Fig.2 shows that the ground plane is reduced and partially slotted. The patch is fed by a microstrip feed line of certain specified width so as to properly match with the port impedance of typically 50 ohms. The antenna is fabricated on FR4 substrate having relative permittivity of 4.4 and thickness of 1.6mm. The widthof the feed line is adjusted to make sure that the impedance of antenna is 50 ohms. The various dimensions of proposed antenna are listed in Table1.



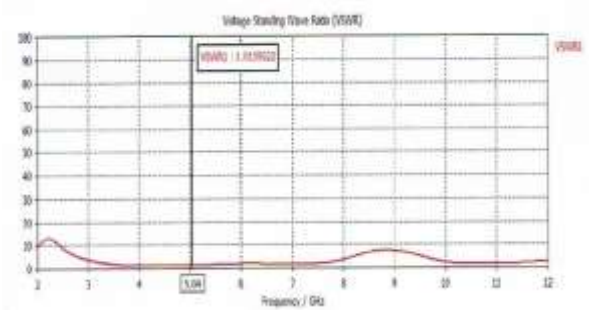
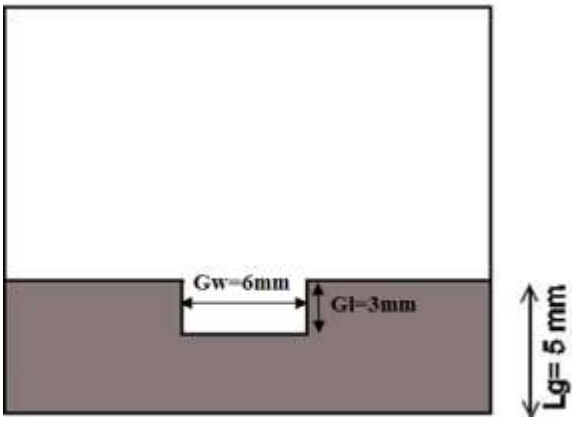


Fig. 1(b) Bottom view of step slotted MPA.

Table 1 Dimensions of step slotted MPA



3Fig. 3 Return loss plot of step slotted MPA

Fig.4 (a) and Fig.4 (b) represents the 3D radiation pattern showing directivity of step slotted MPA at both resonant frequencies. The directivity is 3.1dBi at 3.8GHz and 4.3 dBi at 5.0 GHz. It has been observed that directivity is better for higher resonant frequencies.

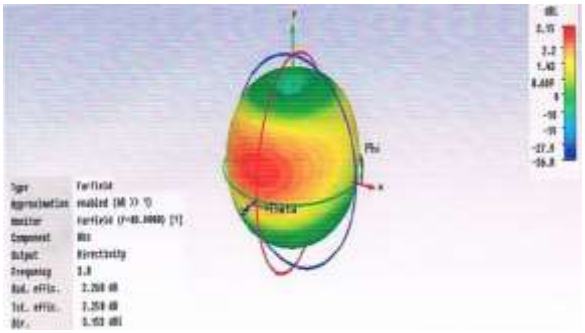


Fig. 4(a) Directivity of step slotted MPA at 3.8 GHz

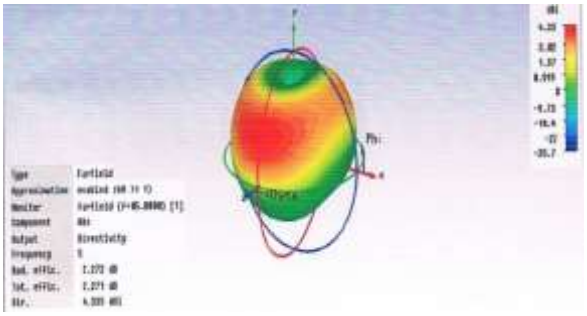


Fig. 4(b) Directivity of step slotted MPA at 5.0 GHz

Fig.5 (a) and Fig 5 (b) illustrates the simulated results of gain for the designed MPA. The 3D radiation pattern shows that the gain is 5.4dB at 3.8 GHz and 6.6dB at 5.0 GHz. It shows clearly that the value of gain is higher for higher frequencies.

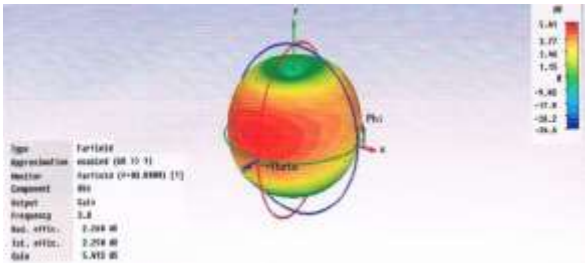


Fig. 5(a) Gain of step slotted MPA at 3.8 GHz

Fig. 5(b) Gain of step slotted MPA at 5.0 GHz

Fig.6 shows the simulated VSWR plot for the designed MPA. For efficient working of the antenna, the VSWR should be less than 2. From the results, it can be seen that the designed antenna works satisfactorily as VSWR is less than the maximum acceptable value of 2.

Fig. 6 VSWR plot of step slotted MPA

3. FABRICATED ANTENNA DESIGN AND PRACTICAL RESULTS

The proposed antenna has been designed practically by fabrication process as shown in Fig. 7 and tested using E5071C ENA series network analyzer. The

practical results of step slotted MPA is shown in Fig. 8 which approximately matches with the simulated results.

Fig. 7 Fabricated Step slotted MPA

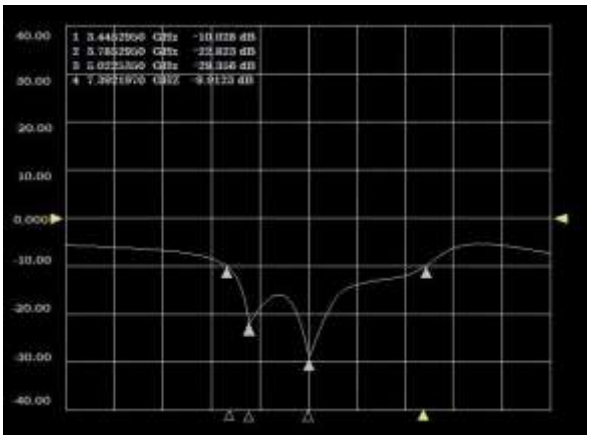


Fig. 8 Practical Results for step slotted MPA

4. CONCLUSION

Step slotting the patch and using the defective ground (reduced ground with slot) approach have been found to provide the highest possible bandwidth. It has been shown that return loss (S11) performance and impedance bandwidth are affected by the cutting of ground slot and etching of the steps in patch. In terms of return loss and impedance bandwidth, the slotted antenna with the flawed ground construction performs better than the un-slotted antenna.

REFERENCES

Review of Microstrip Patch Antenna for WLAN and WiMAX Application, Neha Parmar, Manish Saxena, and Krishnkant Nayak, International Journal of Engineering Research and Applications, Volume 4, Issue I, Pages 168–171 (January 2014).

Research on an Ultrawideband Pentagon-Shaped Microstrip Slot Antenna for Wireless Communications, IEEE Transaction on Antennas and Propagation, Volume 57, Issue 5 (May 2009) [2].

Design of microstrip patch antenna for WLAN applications employing back-to-back connection of two E-shapes, International Journal of Engineering Research and Applications, Volume 2, Issue 3, May-June 2012, Pages 319-323, Govardhani Immadi, K. Swetha, M.Venkata Narayana, M.Sowmya4, R.Ranjana.

Increasing the bandwidth and gain of a microstrip patch antenna by shifting its elliptical slot is a 2011 paper by Isha Puri that was published in the International Journal of Engineering Science and Technology (IJEST).

Design of Dual Rectangular Ring Antenna with DGS Technique for Wireless Application, M.K. Mohamed Amin, M.T. Ali, S.Saripuden, A.A. Ab Aziz, IEEE Symposium on Wireless Technology and Applications (ISWTA), September 23-26, 2012, Bandung, Indonesia [5].

2010 IEEE APS, Middle East Conference on Antennas and Propagation (MECAP), Cairo, Egypt, 20. 10. 2010. [6] Mohamed A. Hassanien and Ehab K.I. Hamad, Compact Rectangular U-Shaped Slot Microstrip Patch Antenna For UWB Applications.

Bandwidth Improvement of Microstrip Patch Antenna Using H-Shaped Patch, by Sudhir Bhaskar and Sachin Kumar Gupta, appeared in the January-February 2012 issue of the International Journal of Engineering Research and Applications (Vol.2, No.1).