



DESIGN OF UHF ANTENNA FOR WIRELESS APPLICATIONS USING DEFECTIVE GROUND

Govardhani Immadi, M. Venkata Narayana, Ch. S. S. Reddy, P. J. Sivani and P. V. S. Anil Kumar
Department of Electronics and Communication Engineering, KL University, Vaddeswaram, Guntur (Dt), Andhra Pradesh, India
E-Mail: govardhaneec@kluniversity.in

ABSTRACT

In this article, we describe a novel type of defective ground surface (DGS) microstrip antenna which has higher gain, multi resonant frequency with compact size. It consists of hexagonal shaped patch with small volume and the ground plane is cut into six triangular slots just below the corners of the hexagonal patch. Antenna is circularly polarized one with gain 3.6dBi. The antenna shows multi resonant frequency. The proposed antenna is simple in structure compared with coplanar parasitic patch antennas. It is mostly suitable for wireless communications. Slots is placed for improving the bandwidth.

Keyword: defective ground structure, slots, returns loss, gain, radiation pattern.

1. INTRODUCTION

Micro strip antennas are widely used in broad range of military and commercial applications mainly because of their advantages like low cost, light weight and easy manufacturability. The main disadvantages are low gain and narrow bandwidth. There are several methods which can be used to improve the gain of patch antenna. The resonance gain involves the addition of cover layer over the substrate. The gain of patch antenna can also be increased using a reduced surface wave antenna and double layer array antenna. All of them compel to increase the antenna height at the same time presence of superstrate above an antenna may affect the antennas basic characteristics efficiency, radiation pattern and resistance. Use of costly substrate like electromagnetic crystal substrate is also reported.

In this paper we introduce a new compact hexagonal patch antenna for high gain and multi frequency. A defective ground surface is used to increase the gain of conventional hexagonal patch antenna. Higher gain along with multi frequency and compactness are achieved by cutting six triangular slots on the ground plane. These characteristics suggest that the embedded triangular slots in the ground plane are more effective than the techniques reported.

2. DESIGN PROCEDURE

A conventional hexagonal patch antenna is designed as a reference antenna for parametric study purpose. Figure-1 shows the geometry of reference hexagonal patch antenna which is printed on a finite unmodified rectangular ground plane of size 60 mm x 50 mm.

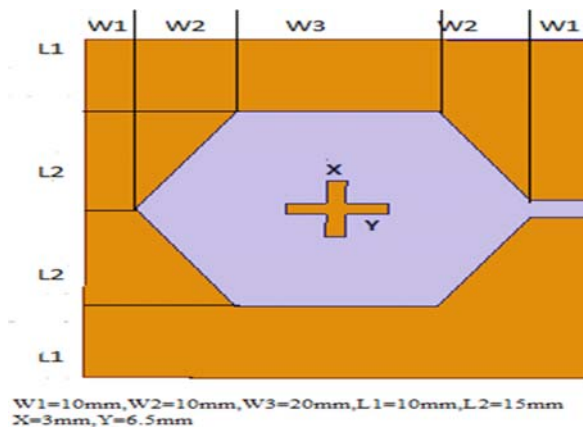


Figure-1. Antenna patch geometry.

Now to achieve higher gain along with multi frequency and compactness six triangular slots, addition slot have been cut on the ground plane just below the six corners and middle of the hexagonal radiating patch and that leads to the proposed antenna "B".

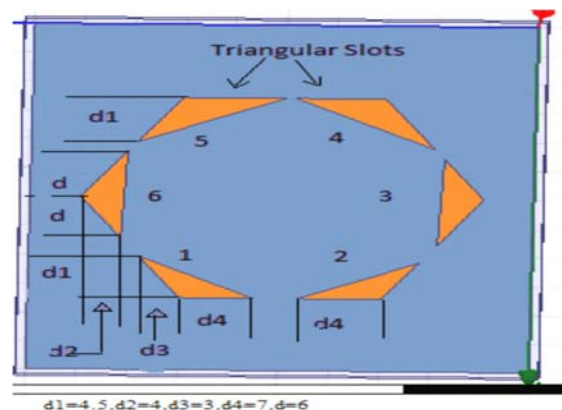


Figure-2. Antenna defective ground.

Figure-2 shows the geometry of proposed high gain antenna with a defective ground surface. Antennas



“A” and “B” are printed on a less costly corning glass of thickness 1.5 and relative permittivity 5.75. Six (1, 2, 3, 4, 5 and 6) triangular slots and addition slots having different side lengths are properly placed in the rectangular ground plane just below the six corners and middle of hexagonal patch. Triangular slots 1, 2, 4 and 5 are having same dimensions and 3 and 6 are with same dimensions. Addition slots 1 and 3 are with same dimensions, 2 and 4 are having same dimensions. The detailed dimensions of the reference and proposed antenna are mentioned in the Figure-1.

These dimensions are finalized after a good number of simulations. The patch was fed by a 50Ω coaxial probe of outer diameter 0.5mm. The feed location was optimized at 35mm x30mm position from the lower left most corner of ground plane to provide good impedance matching. The proposed antenna as well as the reference antenna is prototyped.

3. RESULTS AND DISCUSSIONS

S11 for the antenna structure at frequency 7GHZ. At 7GHZ we got a return loss which is suitable for good gain. This may be due to capacitive and inductive effects caused by the electromagnetic coupling effects between the patch and slotted ground plane.

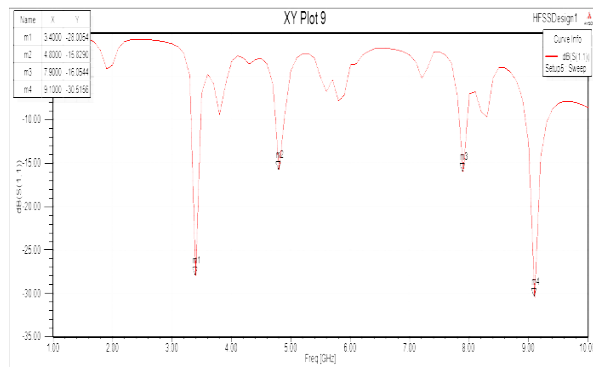


Figure-3. Return loss of the simulated antenna.

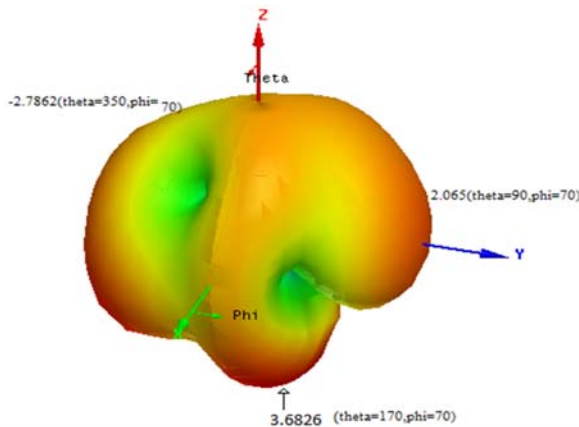


Figure-4. 3D Radiation pattern.

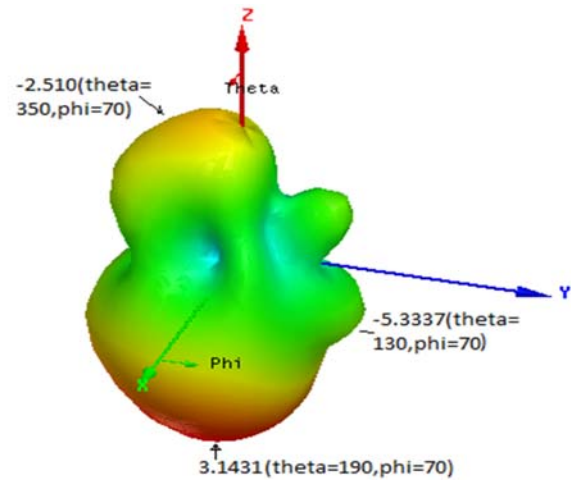


Figure-5. 3D Radiation pattern.

Figure-4 shows the plots of simulated impedance S11 for the antenna structure at frequency 9 GHZ. At 9 GHZ we got a return loss which is suitable for good gain. This may be due to capacitive and inductive effects caused by the electromagnetic coupling effects between the patch and slotted ground plane.

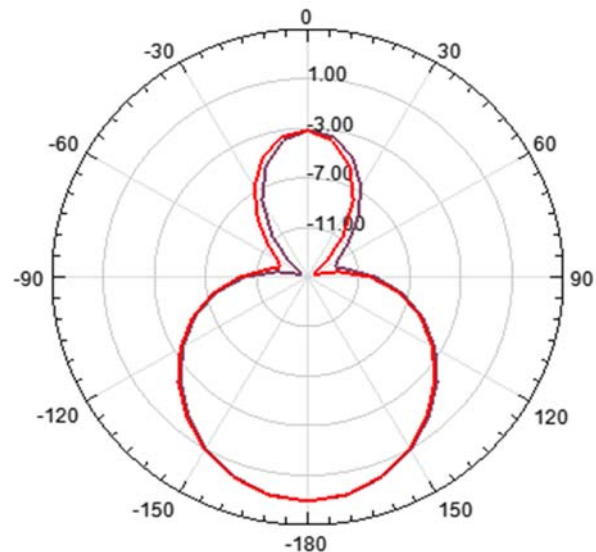


Figure-6. Horizontal pattern.

Figure-6 shows the simulated radiation pattern at 7GHZ where it is a horizontal pattern (theta is constant) and phi value is shown at 180 and 360.

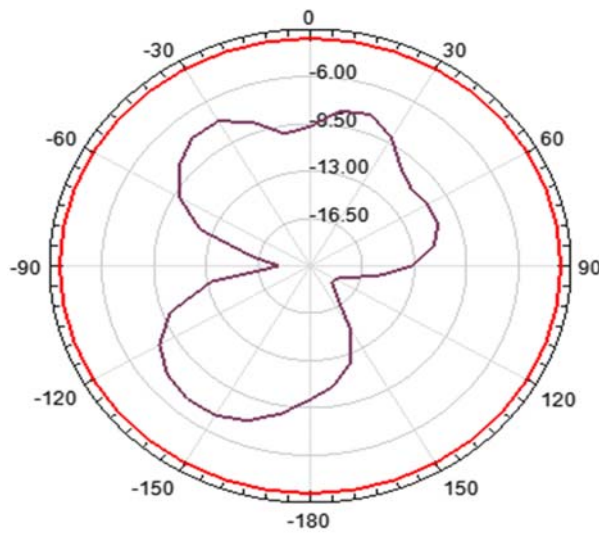


Figure-7. Radiation pattern vertical.

Figure-7 shows the simulated radiation pattern at 7GHz where it is a vertical pattern (ϕ is constant) and theta value is shown at 0 and 90.

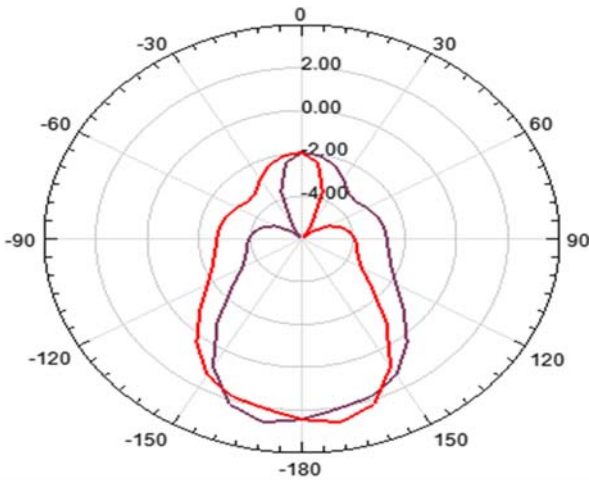


Figure-8. Horizontal radiation pattern.

Radiation pattern at 9GHz where it is a horizontal pattern and ϕ value is shown at 180 and 360.

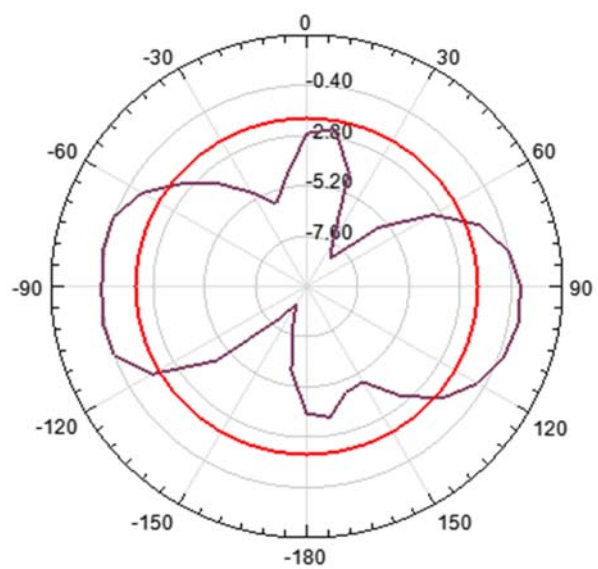


Figure-9. Vertical radiation pattern.

Radiation pattern at 9GHz where it is a vertical pattern (ϕ is constant) and theta value is shown at 0 and 90.

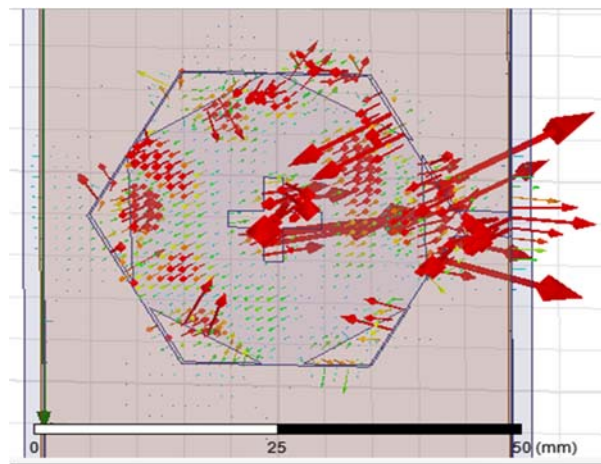


Figure-10. Electric field distribution.

Electric field vector at 9ghz. The bulk of arrows represents the feed position of the antenna where electric field is very high when compared to other areas.

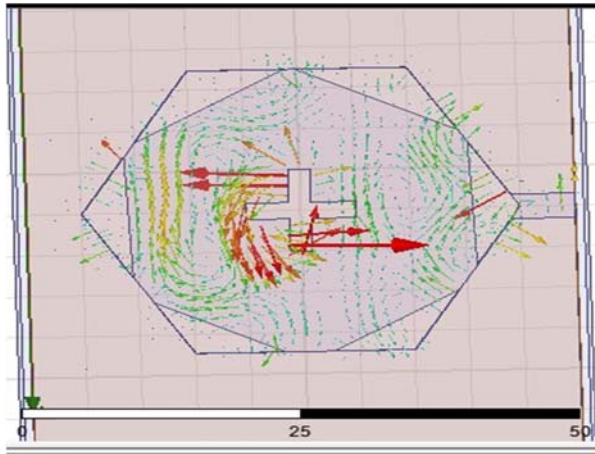


Figure-11. H-field distribution.

H field vector at 9 ghz. Here the closed loop represents the magnetic field.

CONCLUSIONS

Antenna designed for wireless application has the lower return loss at frequencies 3.5 GHz, 4.9 GHz, 7.9 GHz and 9.1GHz. It was applicable to UHF applications.

REFERENCES

- [1] M A Matin, M.P Saha, H. M. Hasan. 2010. Design of Broadband Patch Antenna for WiMAX and WLAN. ICMMT 2010 Proceedings. pp. 1-3.
- [2] F. Yang, X. X. Zhang, X. Ye and Y. Rahmat-Samii. 2001. Wide-band E shaped patch antennas for wireless communications. IEEE Trans. Antennas Propag. 49(7): 1094-1100.
- [3] M. Sanad. 1995. Double C-patch antennas having different aperture shapes. in Proc. IEEE AP-S Symp., Newport Beach, CA. pp. 2116-2119.
- [4] Shackelford A.K., Lee K.F. and Luk K.M. 2003. Design of small-size widebandwidth microstrip-patch antennas. IEEE Antennas Propag. Mag. AP-45(1): 75-83.
- [5] H. F. AbuTarboush, H. S. Al-Raweshidy, and R. Nilavalan. 2008. Triple band double U-slots patch antenna for WiMAX mobile applications. in Proc. Of APCC, Tokyo. pp. 1-3.
- [6] Waterhouse R.B. 1999. Broadband stacked shorted patch. Electron. Lett. 35(2): 98-100.
- [7] Guo, Y.X., Luk, K.M. and Lee, K.F. 1999. L-probe proximity-fed short circuited patch antennas. Electron. Lett. 35(24): 2069-2070.
- [8] K.L. Lau and K.M. Luk. 2005. Wideband folded L-slot shorted-patch Antenna. Electronics Letters. 41(20).
- [9] Madhur Deo Upadhyay, A.Basu, S.K.Koul and Mahesh P. Abegaonkar. Dual Port ASA for Frequency Switchable Active Antenna. 978-1-4244-2802- 1/09/\$25.00 ©2009 IEEE, pp. 2722-2725.
- [10] R.Chair, K.F. Lee, K.M. Luk. 1999. Bandwidth and crosspolarisation characteristics of quarter wave shorted patch antenna. Microwave and op. technol. Latt. 22(2): 101-103.