Performance of a Swastik Shape Microstrip Patch Antenna With Wide Bandwidth

Beena[1], Paritosh kumar[2],Amit Kumar Gupta[3]& R.K.Prasad[4]
Department of Electronics &Communication Engineering
Madan Mohan Malaviya Engineering College, Gorakhpur, Uttar Pradesh, India
beenak641@gmail.com[1], paritosh_62@yahoo.co.in[2],amit165k@gmail.com[3], rkp.sikarpur@gmail.com[4]

ABSTARCT

In this paper, a novel swastik shape microstrip patch antenna with enhanced bandwidth is presented and discussed. The proposed design offers low profile,enhanced bandwidth and compact antenna element. The maximum gain is 3.61 dBi at 2.5 GHz, antenna efficiency is 88.20% while the radiation efficiency is more than 91%.Thebandwidth obtained is 27.73%.The VSWR parameter was found to be less than 2 within the operating frequency range. The substrate material of relative permittivity 4.2 and loss tangent of 0.0013 is used in this proposed antenna. The designing and simulation of the antenna structure is done over IE3D simulation software version 15.20

Keywords: Coaxial probe, enhanced bandwidth,IE3D software, Microstrip Antenna,swastika shape.

I. INTRODUCTION

Now a days, due to theirseveral key advantages over conventional wire and metallic antennas, microstrip antennas have been used for many applications, such as Direct Broadcasting Satellite (DBS) systems, mobile communications, Global Positioning System (GPS) and various radar systems [1]. Their advantages include low profile, light weight, low cost, ease of fabrication and integration with RF devices etc. They can also be made conformal to mounting structures [2]. However, when they are applied in the frequency range below 2GHz, the sizes of conventional rectangular microstrip patches seem to be too large, which makes it difficult for them to be installed on televisions, notebook computers or other hand-held terminals, etc. Several techniques have thus been proposed to reduce the sizes of conventional half-wavelength microstrip patch antennas. Material of high dielectric constant has been used. However, this will lead to high cost and high loss. Also, poor efficiency due to surface wave excitation is another drawback of this method [3-5]. In this paper, we propose a compact swastika shaped patchantenna.The objective of the proposed design is to improve the impedance bandwidth. Simulation of the proposed antenna has been carried out using IE3D software [6] and its various characteristics have been investigated.

II. ANTENNA DESIGN

In this section a swastika shaped patch antenna is designed, *fig*.1 depicts the geometry of the proposed patch antenna.The FR4 material is used as the substrate. The thickness of the substrate is 1.6mm. The dielectric constant of the material is εr=4.2 and loss tangent=0.0013.The Ground plane size is 60mm x 75mm and the size of patch is 50mm x 55mm.The proposed antenna is simulated using IE3D software version 15.20

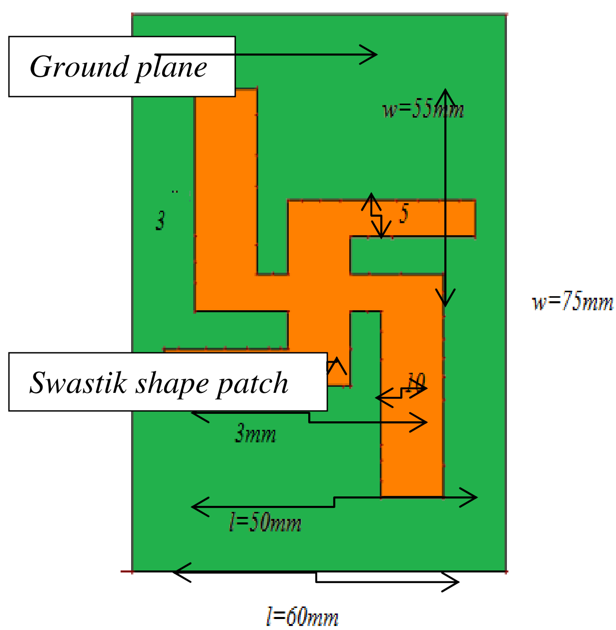

Fig.1 Design of Swastik shaped Microstrip Patch Antenna

Table 1: *Dimensions of antenna structure*

Description	***Dimensions(in mm)***
Ground Plane	*l=60 , w= 75*
Patch	*l=50, w=55*

III. RESULTS AND DISCUSSIONS

a. Return Loss

The simulated results of the input return loss for the proposed antenna is shown in *fig*.2. The bandwidth at the optimum dimension is found to be 27.37% at the center frequency of 2.38GHz.

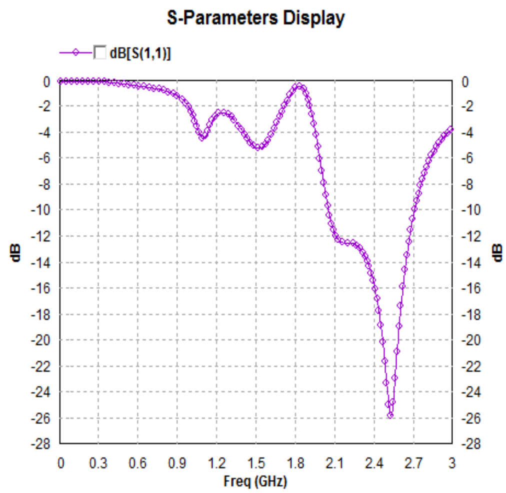

Fig. 2 Return Loss Curve of the Designed Antenna Structure

Analyzing the curve shown in *fig*.2 we can observe the frequency band in which this patch antenna can work. Calculating the bandwidth of the antenna as shown in equation belowwe can see the amount of bandwidth achieved.

Calculation of the bandwidth

f_l=2.05GHz

f_h=2.71GHz, f_c=2.38GHz

$$Bandwidth=\frac{2.71-2.05}{2.38}= \mathbf{27.73\%}$$

b. VSWR

Another very important factor which is related to the bandwidth is the VSWR. The VSWR should beless than 2 in the frequency band in which the antenna has to operate. The VSWR curve of the antenna structure is shown in *fig*3.

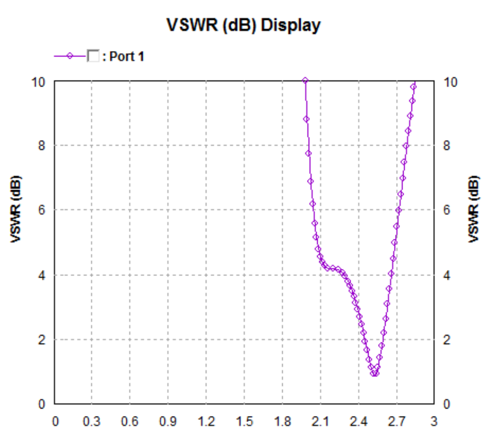

Fig. 3 VSWR Curve

c. Gain

Another important parameter which has to be considered is the gain of the antenna. The total field gain Vs frequency curve is shown in *fig.4*.

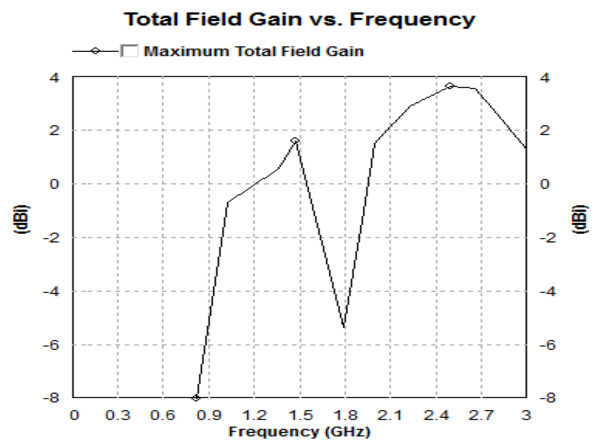

Fig. 4 Total Field Gain Vs Frequency Curve

Analyzing the curve shown in *fig. 4* it can be clearly observed that the designed antenna structure provides a satisfactory amount of gain i.e. 3.61dBi at 2.5GHz which is highly desirable for various applications.

d. Directivity

The simulated directivity of the proposed patch antenna at various frequencies is shown in *fig*.5. The maximum achieved directivity is 4.67 dBi at the frequency of 2.98 GHz.

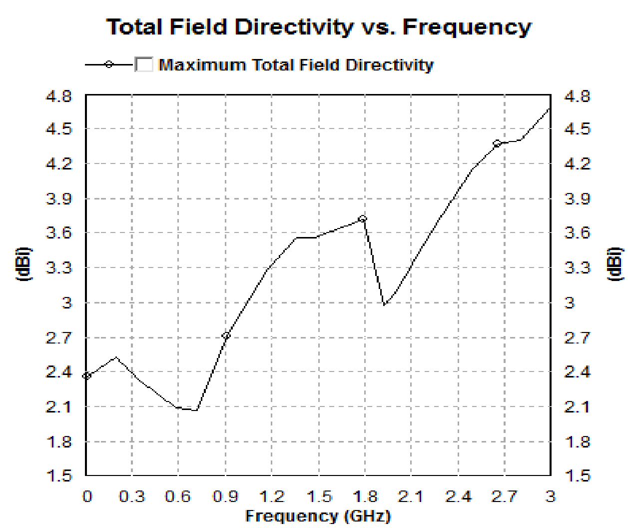

Fig. 5 Total Field Directivity Vs Frequency

e. Antenna Efficiency and Radiation Efficiency

The efficiency of proposed antenna structure is shown in *fig*.6 while the *fig*.7 shows the radiation efficiency of the proposed antenna structure.

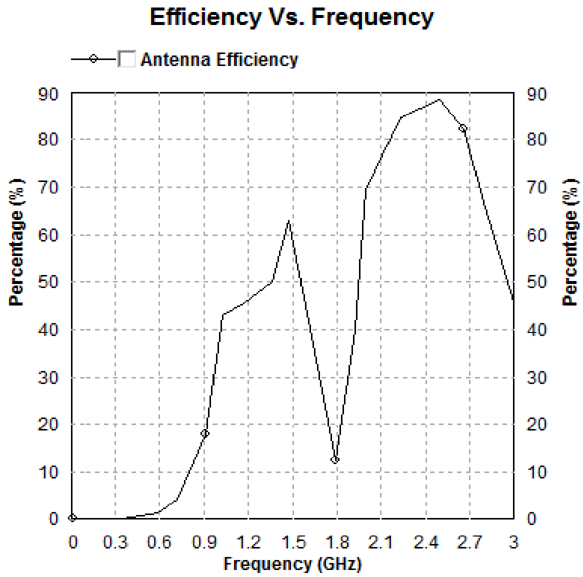

Fig. 6 Antenna Efficiency

Analyzing the antenna efficiency curve we can see antenna efficiency of 88.20% which quite good whileconsidering the microstrip patch antenna structure.

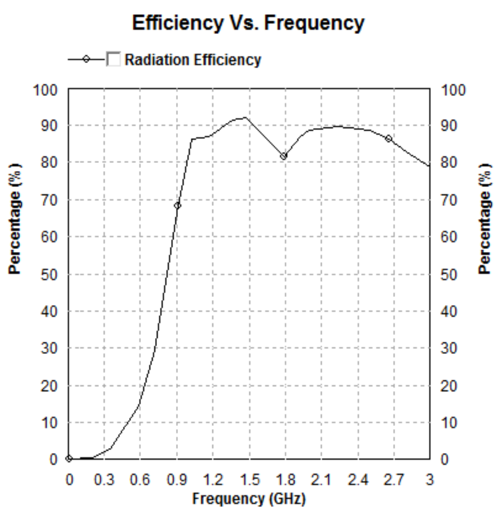

Fig.7 Radiation Efficiency

Similarly analyzing the radiation efficiency curve we can see a radiation efficiency of more than 91%which quite good while considering the microstrip patch antenna structure.

IV. CONCLUSION

From the simulated results we can say that swastikshaped patch antenna geometry provides a good amount of bandwidth i.e.27.73% ,also provide good performance in the VSWR. along with the bandwidth the antenna structure also provides good amount of gain i.e. 3.61dBi, directivity of 4.67 dBi, antenna efficiency of 88.20% and radiation efficiency of 91.98%.

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REFERENCES

[1] Ramesh Garg, Prakash Bhatia, Inder Bahl and Apisak Ittipiboon. Microstrip Antennas, Artech House, Inc.2001.

[2] D.M.Pozer, "Microstrip Antennas," Proc.IEEE Trans. Antennas and Propagation Vol.80,1982.

[3] Carver, K., R., and Mink , J., R. "Microstrip antenna technology", IEEE Trans. On Antennas and propagation, 1981, Vol.AP-29, pp. 22-24.

[4] R.E. Collin, Foundations for Microwave Engineering. New York;McGraw-Hill,1966.

[5] J.R. James and P.S. Hall "Hand Book of Microstrip Antennas, Peter Peregrinus, London,1989.

[6] IE3D Software Released & Developed by M/S Zeland Software,Inc.

[7] C.A. Balanis, Antenna Theory, 2nd ed. New York: John Wiley & Sons, Inc., 1997

[8] Vinod K. Singh, Zakir Ali, "Dual Band U-Shaped Microstrip Antenna for Wireless Communication",
International Journal of Engineering Science and Technology, Vol. 2(6), p.p.1623-1628, 2010.

[9] www.google.co.in

[10] http://ieeexplore.ieee.org/Xplore/guesthome.jsp