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Design and Analysis of Extended S-Shaped Microstrip Patch Antenna for Wideband Application

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Abstract: This paper presents design and analysis of extended S- shaped microstrip patch antenna for wideband application. Design and simulation of this antenna is performed over IE3D software Ver. 15.2. We have taken a ground plane of 50x70 mm and patch size of 30x50 mm. By using IE3D software we obtain percentage fractional bandwidth in triple band- a bandwidth of 2.33% at 0.8761365 GHz frequency band, a bandwidth of 18.52% at 1.435225 GHz frequency band, a bandwidth of 21.08% at 2.26351 GHz frequency band. The obtained gain is of 4.04559 dBi at 2.25688 GHz, a directivity of 5.00112 dBi at 1.89908 GHz, antenna efficiency of 89.7263% at 1.47706 GHz, radiation efficiency of 90.6678% at 1.46789 GHz.

Keywords: Extended S-shape, Ground plane, Patch antenna, Triple band

I. INTRODUCTION

Wireless technology is the main research area in communication systems. Analysis of wireless s ystem is easiest with the help of small size antenna. There are many conventional antennas like Yagi Uda, Horn, Helical etc. All these antennas have high gain and bandwidth but they have large size, so they are not well suited for wireless system. For wireless systems microstrip antennas are best suited. The advantages of these antennas are low volume and weight, low profile planar configuration, support both linear and circular polarization, low fabrication cost etc but disadvantages are narrow bandwidth, low efficiency, low gain, low power handling capability etc. There are various methods to overcome these disadvantages like using various patch shape(E shape[1],C shape[2], H shape),changing the dielectric constant of material, changing the substrate thickness of material, stacking etc.

In this paper we present S shaped microstrip patch antenna to enhance the gain and bandwidth.

II. RESEARCH METHODOLOGY

The S-shaped microstrip patch antenna is designed by cutting two opposite notches in rectangular patch shape and we use co-axial probe feeding technique to feed this antenna. Finally this design is simulated using IE3D software to obtain respective parameters.

III. ANTENNA DESIGN

The design of extended S-shaped microstrip patch antenna is shown in *fig. 1*.

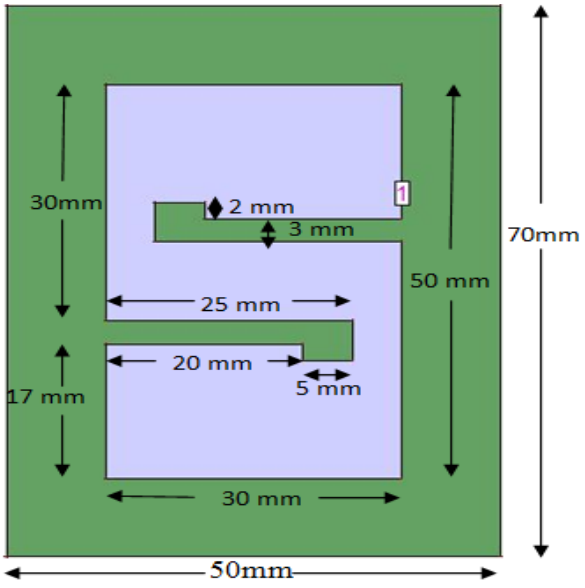

Figure.1 S-shaped microstrip patch antenna

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IV. RESULT AND DISCUSSION

The most important parameter to be analyzed is the bandwidth of the antenna and to analyse it the S parameter curve is shown in *fig. 2.*

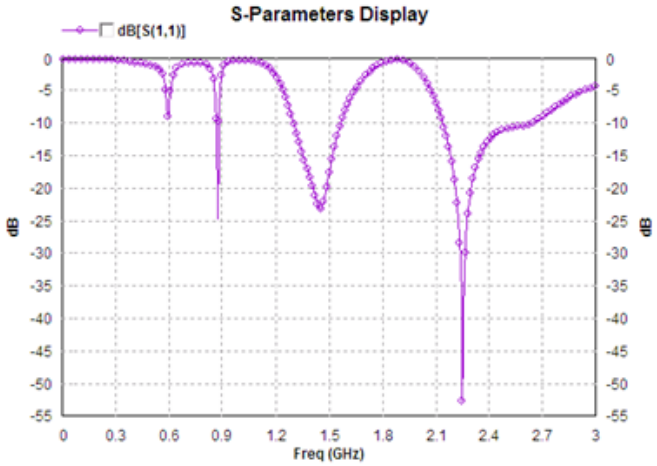

Figure.2 S-parameter Vs frequency curve

From *fig. 2* it is clear that we obtain the bandwidth in triple band because the curve is crossing -10 dB line three times

Calculation of Bandwidth

$$\% \text{ fractional bandwidth} = \frac{f_h - f_l}{f_c}$$

where $f_c = \frac{f_h + f_l}{2}$

Freq. Band 1

f_{l1} = 0.865909 f_{h1} = 0.886364 f_{c1} = 0.8761365

BW_1 = **2.33%**

Freq. Band 2

f_{l2} = 1.30227 f_{h2} = 1.56818 f_{c2} = 1.435225

BW_2 = **18.52%**

Freq. Band 3

f_{l3} = 2.14091 f_{h3} = 2.64545 f_{c3} = 2.39318

BW_3 = **21.08%**

Another important parameter related to the bandwidth of the antenna is its VSWR curve which shows that the antenna can work in the entire frequency band shown in S-Parameter curve. The VSWR vs Freq curve is shown in *fig. 3.*
From figure it is clear thar VSWR is below 2 in desired frequency range, so calculated bandwidth is useful.

Next figure gives information about gain of antenna which is very useful parameter. The gain curve is shown in *fig. 4*

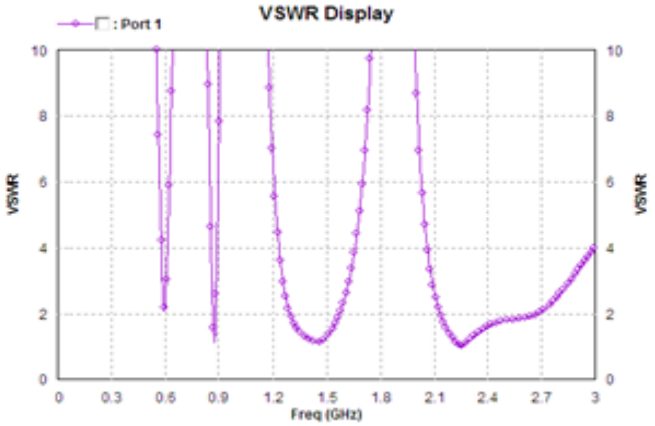

Figure. 3 VSWR Vs frequency curve

Analysing the curve shown in *fig. 4* we can clearly observe that the gain of the designed antenna is about 4.04559 dBi at

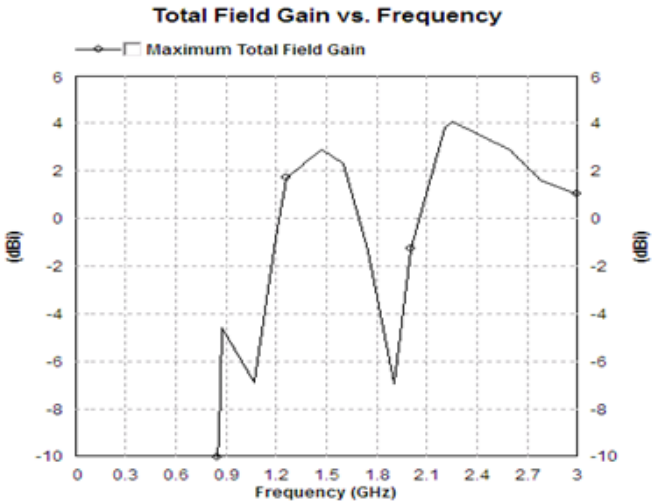

Figure.4 Gain Vs frequency curve

1.89908 GHz which is quite good for any wireless system.

Another important term related to the gain is antenna directivity. The directivity curve is shown in *fig. 5*

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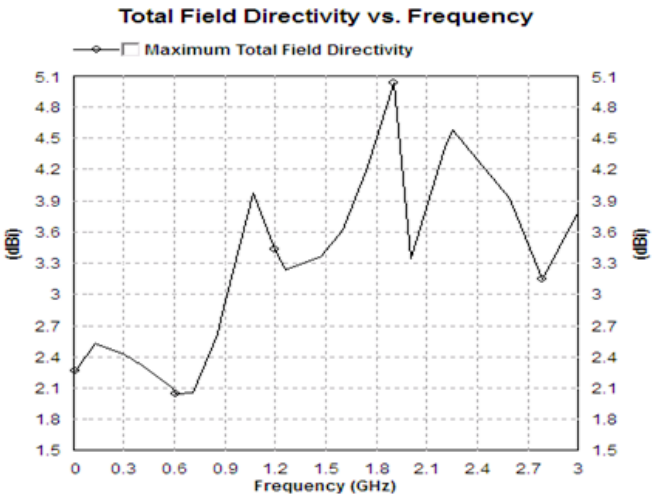

Figure.5 Directivity Vs frequency curve

The directivity defines the directional property of an antenna. The directivity is 5.00112 dBi at 1.89908GHz.

Antenna efficiency is shown in *fig. 6*

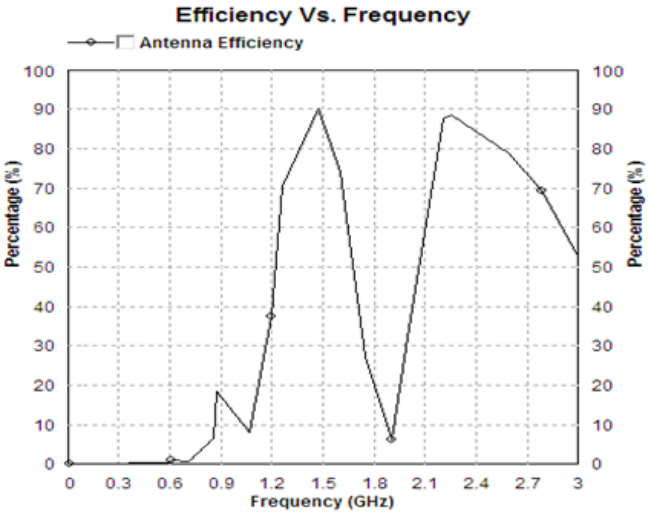

Figure.6 Antenna efficiency Vs frequency curve

From the figure it is clear that antenna efficiency is 89.7263% at 1.47706 GHz.

Another important parameter i.e. radiation efficiency is shown in *fig. 7*

Analysing the curve shown in *fig. 7* we can clearly observe that the designed antenna provides a radiation efficiency of 90.6678% at 1.46789 GHz.

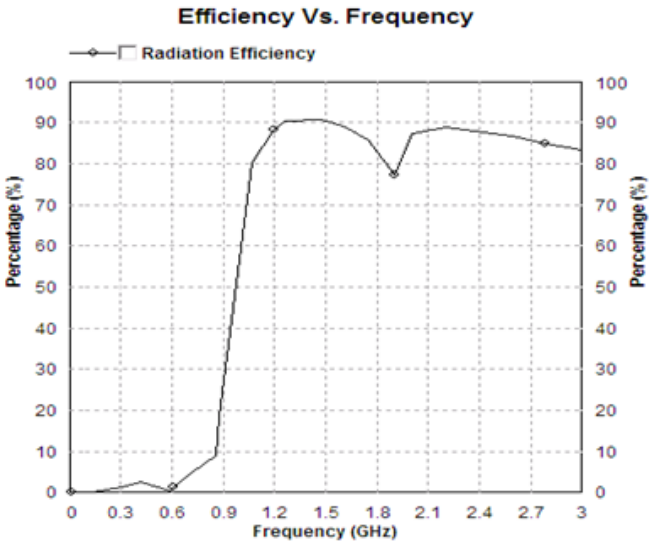

Figure 7.Radiation efficiency Vs frequency curve

Next figure gives 3-D radiation pattern of this antenna which is shown in *fig. 8*

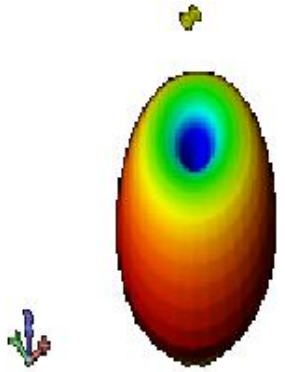

Figure 8. 3-D radiation pattern of proposed antenna

V. CONCLUSION

Finally extended S-shaped microstrip patch antenna is realized using IE3D software with quite good amount of bandwidth in triple bands(a bandwidth of 2.33%, a bandwidth of 18.52%, a bandwidth of 21.08%),a gain of 4.04559 dBi, a directivity of 5.00112 dBi, antenna efficiency of 89.7263% and radiation efficiency of 90.6678%. Further development of improving the bandwidth and gain of microstrip antenna with different techniques is still in progress.

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