International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-5, March 2020

Design and Analysis of Efficient H-Shaped Multiband Antenna with DGS for Wireless Applications

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Abstract: ***An efficient H-shaped micro strip multiband antenna is constructed and simulated with slot structure of Split Ring Resonator (SRR) in a ground plane as Defected Ground Structure (DGS) for high frequency applications is proposed. Micro Strip patch antenna is mostly preferred because of its very good radiation properties. Also it is the light weight and low cost device so its usage is very high and its fabrication method is very easy. DGS is used to alter the current path in the ground part of the patch antenna by making this it provides multiband support. The H shape patch antenna with the proper ground plane is normally chosen for increasing the bandwidth of the antenna by providing impedance matching and reduce loss. This type of antenna mostly used in where small size and broad beam width are required. In the simulation VSWR, radiation pattern, gain, return loss were measured using simulation software HFSS.***

Keywords- H-shape patch, DGS, multiband, Return loss, HFSS.

I. INTRODUCTION

The data transfer through free space medium is very popular because of very growth in micro strip patch antenna. Our antenna design contains three main layers. First the bottom layer contains the structure called ground, which covers some part of the rectangular shape with a substrate side of (58.9x35.9mm). The middle layer contains substrate, it is manufactured by FR4 material with epoxy resin to provide the value of effective dielectric constant 4.4 also the substrate height is normally chosen with 1.6mm, and loss tangent 0.02. The H-shaped patch covers top surface.

The H-shaped patch has length L=12.5mm, width W=17.5mm respectively. In the proposed system the microstrip line feed is used to obtain impedance matching by adjusting the insert point. Also compared with coaxial cable feeding the method of fabrication is very easy in microstrip line feeding.The type of substrate desires the thickness of the antenna. If FR4 substrate is chosen then the height will be 1.6mm. The narrow-band performance of micro strip antennas limits their applications in modern wireless communication systems. To overcome this problem various structures have been proposed to provide wider bandwidth and multiband. The H-shaped patch along with the SRR (DGS) in the ground plane is used to achieve the multiband and reduction of return loss about -24dB. Being such advantages, H-shape micro strip patch antenna with DGS is considered for our design. This type of antenna can be used in modern wireless communication applications and satellite communications.

Revised Manuscript Received on March 30, 2020.
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II. PROPOSED DESIGN

The width and height of the microstrip antenna is calculated by using some standard formulas by using the parameters frequency, substrate type and thickness of substrate.

2.1 Patch parameter Calculation:

Patch Width (W)

$$W = \frac{c_0}{2f_0}\sqrt{\frac{2}{(1+\varepsilon_{rr})}}$$

Where,

c_0 represent the velocity of the light in free space and its value is 3×10^8 m/s

After calculating the width of the proposed antenna the length value is calculated. To find the length of the antenna the important parameter of the substrate that is effective dielectric constant is computed by using the given formula. The substrate dielectric value is normally greater than unity. The high dielectric constant substrate produces small size antenna. The effective dielectric constant value normally depends upon the frequency.

This value of the effective dielectric constant of the antenna substrate is obtained by using the given formula,

$$\varepsilon_{reff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\left[1 + 12\frac{h}{w}\right]^{\frac{-1}{2}}$$

In this expression the height and width of the antenna is used which is represented by the letters h and w.

Also ε_r indicates the dielectric constant of substrate for FR4 its value is 4.4.

The patch antenna length can be obtained by,

$$L_{eff} = \frac{c_0}{2f_0\sqrt{\varepsilon_{reff}}} - 2dL$$

Where dL is called as differential length which occurs due to effect of fringing field and it affects the electrical length of the antenna and it can be obtained by,

$$dL = 0.412h\frac{(\varepsilon_{reff}+0.3)(\frac{w}{h}+0.264)}{(\varepsilon_{reff}-0.268)(\frac{w}{h}+0.8)}$$

2.2 Ground parameters:

The third layer of the antenna is ground its width and length values are calculated by using the given expressions,

The ground width can be calculated as:

$$W_g = W + 6h$$

The ground length can be calculated as:

$$L_g = L + 6h$$

2.3The feed point location:

For providing best impedance match between antenna and the feed line micro strip line feed method is selected.

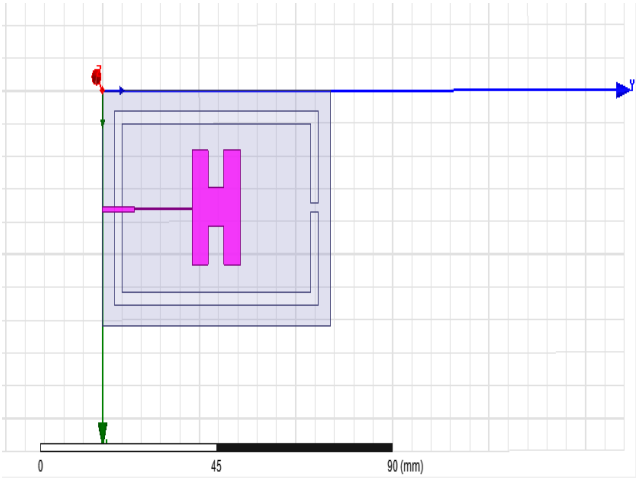

Fig.1. Proposed Antenna

The main use of impedance matching is which provides maximum power transfer. The location of feed points can be calculated by using the given formulas,

$$X_f = \frac{L}{\sqrt{\epsilon_{ff}}}$$

$$Y_f = \frac{W}{2}$$

The feeding of proposed antenna is obtained by micro strip line with 50 Ω input impedance value by edge feeding method. The size of the multiband antenna is reduced by using dielectric substrates with high relative permittivity.

The primary reason for selecting the micro strip line feed to provide impedance matching is it can be inserted at any desired location of the patch antenna and the impedance matching depends on this location. Feed point locations in order to match 50 Ω impedance.

III. III.RESULT AND DISCUSSION

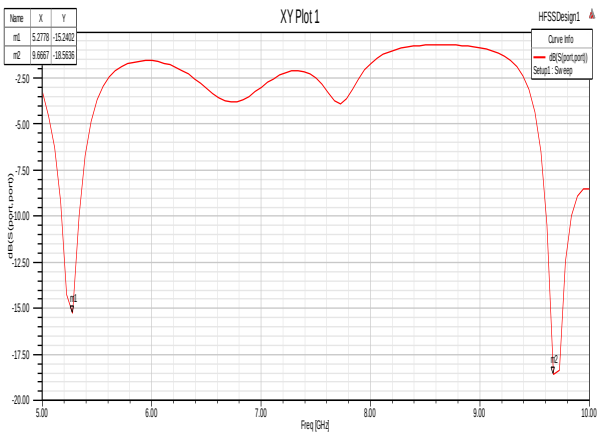

Fig.2. Return Loss

To identify the performance of the proposed antenna reflection coefficient or return loss is plotted which indicates that for two set of frequencies 5.2GHz and 9.9GHz this antenna gives return loss are -15.24dB and -18.9dB respectively both the values are acceptable one.

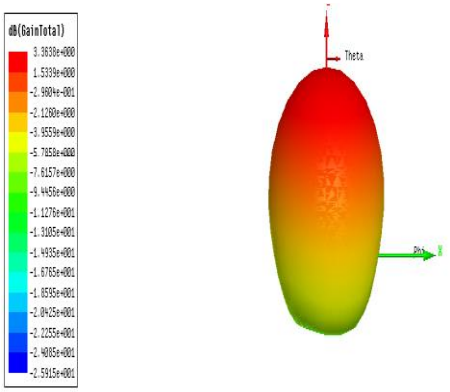

Fig:3. Radiation Pattern

Also its radiation pattern indicates that which provides better result at the desired direction.

IV. CONCLUSION

The H shaped microstrip patch antenna using DGS was successfully simulated using HFSS and it is suitable for wireless applications. The simulated results shows that the wider bandwidth, Lowest return loss, better radiation characteristics and 3D polar plot shows better directivity. Also the best VSWR and increased potential for antenna gain in the simulation. This H shaped microstrip patch antenna using DGS was successfully analyzed. This antenna to fabricate it is suitable for all wireless applications and switching method can be used to implement reconfigurable for antenna operating at various frequencies and to getting various polarization.

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