Impact Factor (SJIF): 5.301

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 5, Issue 3, March-2018

QUAD BAND POLARIZED ANTENNA FOR INDOOR APPLICATIONS

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ABSTRACT:

The design of multiband antenna intended for existing wireless services including Global Positioning System, Global System Mobile Communication, Personal Communication Service, Distributed Control System, Universal Mobile Telecommunication Service bands is proposed. The present techniques available in open literature consists the modification of the main radiator via bending, folding, meandering and wrapping. Each approach possess different advantages, that depends on the required application. The introduction of a ground slot in finite antenna ground plane is further extended to include reconfigurable features. Thus, such antennas that are compact have multiband capability are promising candidates for many wireless applications. Now in this slotted multi band planar system is proposed to intend on working on frequency bands such as in Global Positioning System, Wireless Local Area Network (over two frequency band spectrum), and Worldwide Interoperability for Microwave Access.

INDEX TERMS:

Antenna radiation patterns, Microstrip antenna, operating frequency, S-parameter, Standing wave ratio.

I. INTRODUCTION

In this rapid changing world the wireless communication systems, multiband antenna plays an important role for wireless service requirements. Through the years, slotted microstrip patch antenna structure are the most common option. It is used to realize millimeter wave monolithic integrated circuits for microwave, radar and communication purposes. The antenna should have stable response in terms of gain, radiation pattern, polarization etc within this operating frequency. It should be of small size, conformal, low cost and should be easily integrated into the Radio Frequency circuits at the same time.

Slotted microstrip patch antenna are easily printed directly onto circuit board. The slotted microstrip patch antenna requires few materials, it is of low cost, it is easy to manufacture and light weight. Slotted microstrip patch antenna is made up of a dielectric substrate and with a ground plane on other side. Due to these advantages such as low weight, low profile planar configuration and capability to integrate with micro wave integrated circuits technology, the slotted microstrip patch antenna is very well suited for applications such as wireless communication systems, cellular phones, pagers, radar systems and satellite communication systems.

The frequency of the slotted microstrip patch antenna is inversely proportional to its size. The slotted microstrip patch antennas are generally used for ultra-high frequency signals for this reason. Slotted microstrip patch antenna can sense frequencies lower than microwave would be too large to use. A wide variety of wireless service have been

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successfully introduced worldwide in the past few years with the rapid development of modern communication and semiconductor technologies . Antenna plays a vital role in all wireless communication. The complexity can be relaxed and improves the performance of the receiver can be improved with a well designed antenna. The dimension, type and the configuration of the antenna depends on the application and the operating frequency.

II. EXISTING SYSTEM

The existing system have high return loss, and VSWR. Increase in total gain is also considerably needed . Frequency coverage is only for the three frequency bands that are generated.

The drawbacks of the available antennas are identified as Less reception due to high return loss and due to single patch antenna are used for each individual device.

It is not compatible for the future multiband antenna system applications. Each antenna requires all of them a separate processor to execute the particular data reception operation.

III. PROPOSED SYSTEM

•Ultimate goal of this proposal is to build a wireless broadband multiple frequency accessible antenna.

•Then achieve VSWR less than 2, to obtain optimum return loss and radiation pattern.

•To determine and then compare the performance of microstrip patch antennas with microstrip feed line and coaxial feed line techniques.

IV. PROCESS FLOW DIAGRAM:

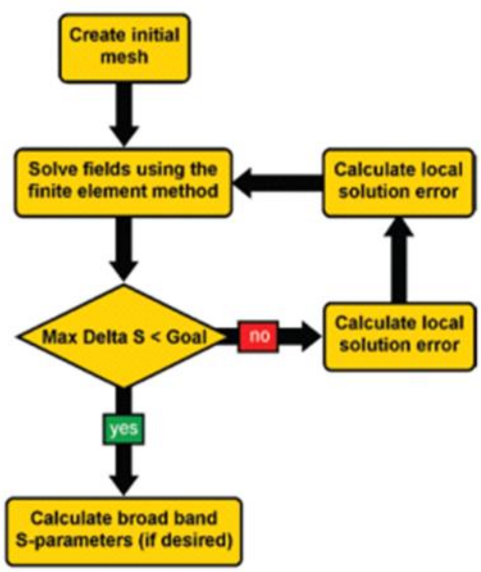

Fig.1: Design flow

The adaptive analysis is a solution process in that the mesh is refined iteratively. Refinement of the mesh is localized to the regions where the electric field solution error is high. This adaptive refinement increases the solution's accuracy in each and every adaptive solution. The user sets the criteria that control mesh refinement

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during an adaptive field solution. Most of the CST problems can only be accurately solved by using the adaptive refinement process.

V. FLOW DESIGN

Every CST simulation will go through, the all of the following six steps. Since, it is not mandatory to follow these steps in an exact order, it is good modeling practice to follow them in a consistent model-to-model manner. There are six main steps to solve a proper CST simulation.

- Create model/geometry
- Assign boundaries
- Assign excitations
- Setup the solution
- Solve
- Post process the results

VI DESIGN OF MICROSTRIP PATCH ANTENNA

The three essential parameters of the design of a slotted microstrip patch are given below.

VI.a OPERATING FREQUENCY (f0)

The resonant frequency of the antenna can be selected appropriately. The frequency range selected is from 0to10 GHz for the multiband operation. Hence the antenna designed should be able to operate in this high frequency range. The resonant frequencies selected for my design are 2.4GHz, 3.5GHZ, 5.3 GHz and 5.8GHz.

VI.b DIELECTRIC CONSTANT OF THE SUBSTRATE(εR)

The dielectric material selected for our design Taconic RF-5. It has a dielectric constant of 2.2. A substrate with a low dielectric constant must be selected. Since it increases the bandwidth of the antenna.

VI.c HEIGHT OF DIELECTRIC SUBSTRATE(H)

It is essential that the antenna is not bulky for the microstrip antenna that shouls be used in multiband applications. The height of the dielectric substrate is selected as 1.52mm for this reason.

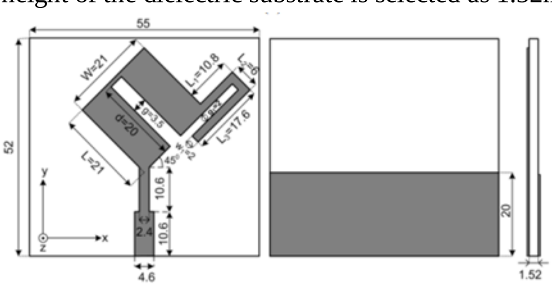

Fig.2:Proposed antenna geomettry

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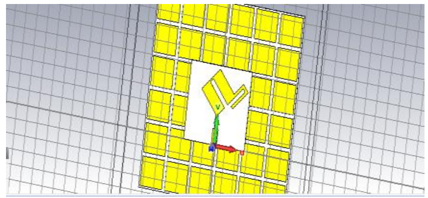


Fig.3: Design on CST

Figure 2 shows the proposed antenna that indicates the radiator fed with the microstrip feed line. The radiator consists of a slot along with the feed in the radiating edge. The return loss is reduced to a greater extent due to these slot with feed.

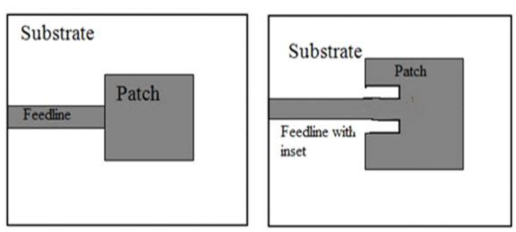
Cutting of these slots in antenna increases the current path which inturn increases the current intensity, as a result efficiency is also increased. The basic structure of antenna is made of ground plane, substrate, patch and feed line. The preferred method of analysis for calculating the various dimensions of the slotted microstrip patch antenna is the transmission line.

The transmission line model is applicable only to the infinite ground planes. However, for practical considerations it is predominately essential to have a finite ground plane. It has been shown by that similar results for finite and infinite ground plane can be obtained the patch dimensions by approximately six times the substrate thickness all round the periphery is less than the size of the ground plane.

VII. FEEDING TECHNIQUES

VII.a MICROSTRIP LINE FEED

This type of feeding technique includes a conducting strip is connected directly to the edge of the microstrip patch shown in the figure 2.4.1. The conducting strip is smaller in width as compared to the patch and this kind of feed arrangement has the advantage that the feed can be etched on the same substrate to provide a planer structure. The insight of the inset cut in the patch is to match the impedance of the feed line to the patch without the need for any subsidiary matching element. This results in getting proper controlling the inset position. This is an easy feeding technique, since it is user friendly in fabrication and simplicity in modeling as well as impedance matching. Though thickness of the dielectric substrate being used, increases, surface waves and spurious feed radiation also increases, which boosts the bandwidth of the antenna. The feed radiation leads to undesired cross polarized radiation



. Fig.4 Microstrip Line Feed

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VIII. METHOD OF ANALYSIS

VIII.a TRANSMISSION LINE MODEL

In this model, the microstrip antenna possess two slots of width W and height h, separated by a transmission line of length L. Basically, the microstrip is a non homogenous line of two dielectrics, typically the substrate and air. Figure 3.8 illustrates this

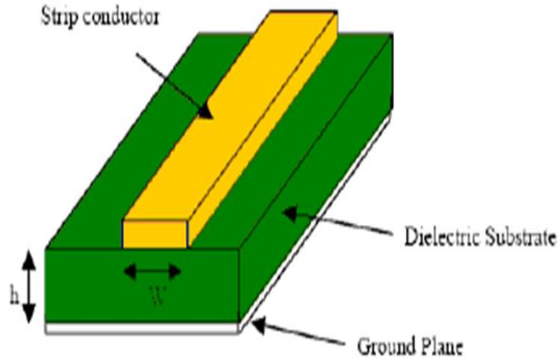

Fig.5: Microstrip patch line

As shown in the figure 4, most of the electric field lines reside in the substrate and parts of some lines are in air. Thus, this transmission line cannot support pure transverse electric-magnetic (TEM) mode of transmission, since the phase velocities would be different in the air and the substrate.

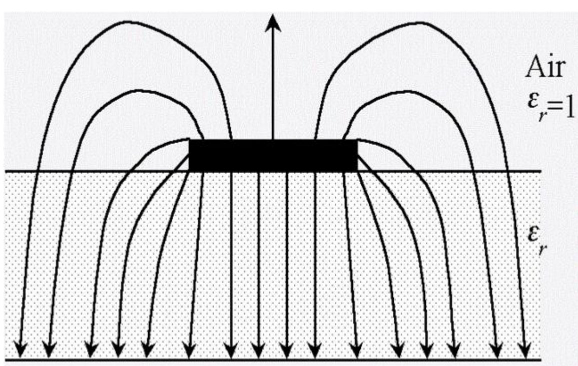

Fig.6: electric Field Line

Instead, the dominant propogation mode would be the quasi-TEM mode. Hence, an effective dielectric constant (ε_{reff}) must be obtained for the fringing and the wave propagation in the line. The value of ε_{reff} is slightly less than ε_r because the fringing fields around the periphery are not confined in the dielectric substrate but are also spread in the air as shown in figure 5.

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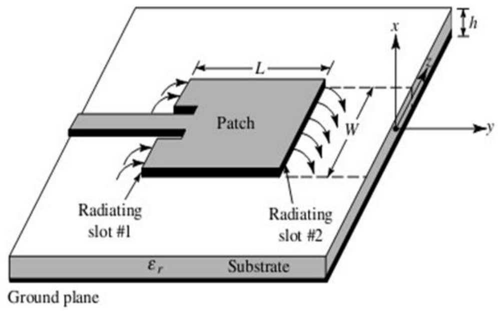

Fig.7: Microstrip patch Antenna

Figure 2.5.3 shows a rectangular microstrip patch antenna which possess length L, width W resting on a substrate of height h. The co-ordinate axis is selected in such a way that the length is along the x direction, width is along the y direction and the height is along the z direction. In order to operate in the fundamental TM mode, the length of the patch must be slightly less than whereas the wavelength in the dielectric medium is equal to 0/ reff) where wavelength of free space is zero. The TM mode implies that the field varies one /2 cycle along the length, and there is no variation along the width of the patch. In figure 3.11 the microstrip patch antenna is represented by two slots ,which has been separated by a transmission line of length L and open circuited at both the ends. Along the width of the patch, the voltage is maximum and current is minimum due to the open ends. The electomagnetic fields radiated at the edges can be trigonometrically resolved into normal and tangential components with respect to the ground plane.

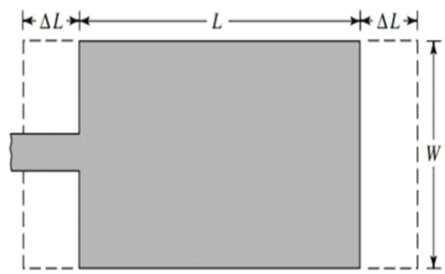

Fig.8: Top view of Antenna

In figure 2.5.4, the electric field projects its normal component at the two edges along the width finds to be in opposite directions and out of phase. T he patch is /2 long and hence they cancel each other in the broadside direction. The tangential components, which are in phase, means that the resulting fields combined to give maximum edges along the width can be represented as two radiating slots, which are /2 apart and excited in phase and radiating in the half space above the ground plane.

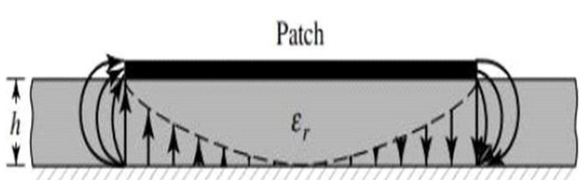

Fig.9: Side View of Antenna

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The fringing fields projected out from the width can be designed as radiating slots and the patch of the microstrip antenna was found to be greater than its physical dimensions electrically

IX. SIMULATION RESULT

Computer Simulation Technology (CST) is the software used to model and simulate the microstrip patch antenna.

CST is used to calculate parameters such as S-parameters, Resonant frequency and Fields. CST is a full-wave electromagnetic simulator depending on the method of moments. It analyzes the 3D and multilayer structures of general shapes. Ansoft pioneered the use of Finite Element Method(FEM) for EM simulation by developing or implementing the technologies such as tangential vector finite elements, adaptive meshing and Adaptive Lancozos Pade Sweep(ALPS).CST is widely used in the design of RFICs, patch antennas, wire antennas and other RF or wireless antennas. It is used to calculate and plot the S11 parameters, VSWR, current distributions as well as the radiation pattern.

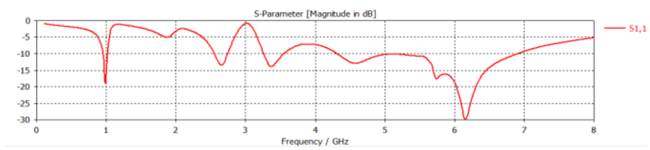

Fig.10: Return loss

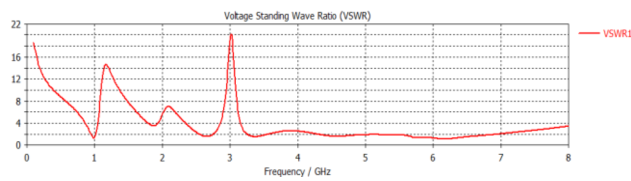

Fig.11:Axial ratio

Figure 10 shows the proposed microstrip patch antenna with slot using microstrip feed line as a feeding technique, which gives the return loss or reflection coefficient value as -43 dB in the frequency range of 4.3 GHz.

The transmission feed used in design to have a frequency range of 2.4 GHz is selected such that to obtain accurate results.

X. RADIATION PATTERN

The radiation field of the slotted microstrip patch antenna is shown in figure 10 which is determined using either an “electric current model” or a “magnetic current model”.

It can be proven that the electric and magnetic current models yield exactly the same results for the far-field pattern, provide the pattern of each current is calculated in the presence of the substrate at the resonant frequency of the patch cavity model. Figure 3.5 shows that at 2.4 GHz a graphical representation in polar coordinates of spatial distributions of fabricated antenna is shown.

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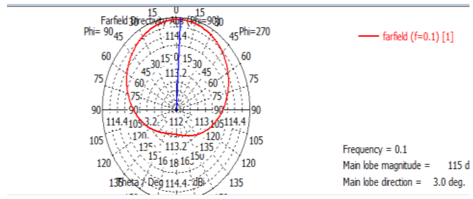

Fig.12: 2D Radiation pattern at 0.1GHz

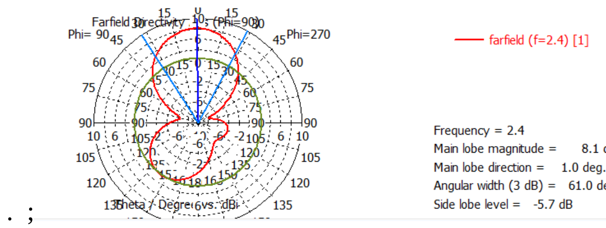

Fig.13: 2D Radiation pattern at 2.4GHz

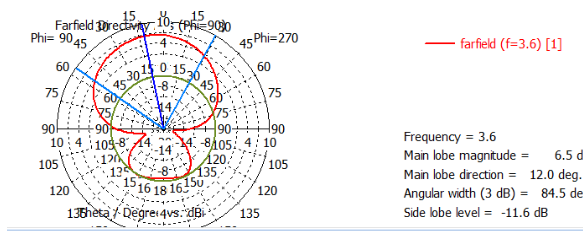

Fig.14: 2D Radiation pattern at 3.6GHz

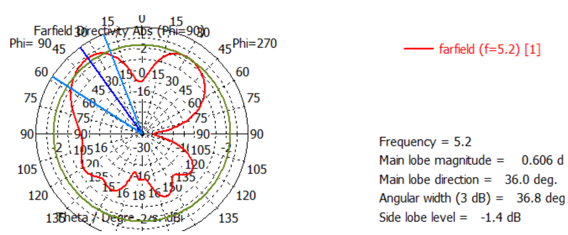

Fig.15: 2D Radiation pattern at 5.2GHz

XI. CONCLUSION

A patch antenna in the radiator and partial ground plane is designed and simulated. The proposed antenna exhibits five bands. It supports for 2.4 GHz, 3.5GHZ, 5.3 GHz and 5.8GHz as well as good radiation properties. Therefore this antenna suitable for Super High Frequency application or other wireless applications that works in these frequencies. For multiband frequency applications, patch antenna with MIMO technique is simulated.

XII. REFERENCES

[1] S. Gao, Q. Luo, and F. Zhu, “Circularly polarized antennas,” Wiley IEEE Press, New York, November 2013.

[2] S. Verma and P. Kumar, “Compact triple-band antenna for WiMAX and WLAN applications,” Electron. Lett., vol. 50, no. 7, pp. 484–486, 2014.

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[3] T. Wu, X. W. Shi, P. Li, and H. Bai, "Tri-band microstrip-fed monopole antenna with dual-polarisation characteristics for WLAN and WiMAX applications," Electron. Lett., vol. 49, no. 25, pp. 1597–1598, 2013.

[4] T. T. Le and H. C. Park, "Very simple circularly polarised printed patch antenna with enhanced bandwidth," Electron. Lett., vol. 50, no. 25, pp. 1896–1898, 2014.

[5] J. G. Baek and K. C. Hwang, "Triple-band unidirectional circularly polarized hexagonal slot antenna with multiple L-shaped slits," IEEE Trans. Antennas Propag., vol. 61, no. 9, pp. 4831–4835, 2013.

[6] X. L. Bao and M. J. Ammann, "Printed triple-band circularly polarised antenna for wireless systems," Electron. Lett., vol. 50, no. 23, pp. 1664–1665, 2014.

[7] T. V. Hoang and H. C. Park, "Very simple 2.45/3.5/5.8 GHz triple-band circularly polarised printed monopole antenna with bandwidth enhancement," Electron. Lett., vol. 50, no. 24, pp. 1792–1793, 2014.

[8] K. Agarwal, Nasimuddin, and A. Alphones, "RIS-Based compact circularly polarized mircostrip antennas,"IEEE Trans. Antennas Propag., vol. 61, no. 2, pp. 547–554, 2013.

[9] K. Agarwal, Nasimuddin, and A. Alphones, "Triple-band compact circularly polarised stacked microstrip antenna over reactive impedance meta-surface for GPS applications," IET Microw. Antennas Propag., vol. 8, no. 13, pp. 1057–1065, 2014.

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