Ring Structured Patch Antenna for Wideband Applications

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Abstract: ***In this paper Ring shaped patch antenna is designed which is suitable for wireless communications. The antenna is resonates frequency between 2 to 5 GHz that can be useful for the applications such as WLAN, WIFI etc. In this microstrip patch antenna slots are introduced to operate the antenna in different frequencies. This design achieves high bandwidth which is applicable to use with various wireless applications. FR4 substrate is used as dielectric material for this design. The material which is used for substrate has thickness and dielectric constant about 1.6 mm and 4.4 respectively. Different experiments are carried out with patch antenna to achieve better performance of the patch antenna. Simulation work will be done using ADS tool.***

Keywords: Microstrip patch antenna, ADS tool, Ring shaped antenna, wireless application, FR4 Substrate, slots.

I. INTRODUCTION

Wireless communication systems were undergoing an increased demand to enhance the transmission quality of channel and to achieve larger data rate. To design a flexible antenna with good radiation features and to obtain Omni directional pattern for an entire bandwidth uniformly is not an easy tasks in ultra wideband applications. A bendable type orientation is achieved by an antenna which has circular polarization. It also reduces the fading and interferences form the outside environment [10].Strip line feed and FR4 substrate is used for designing an antenna to reduce the overall cost of the antenna. It has uni planar configuration and wider bandwidth. The uni planar design reduces the errors due to misalignment of the transmitter and receiver antenna [11]. In addition, strip line feed is categorized by lower radiation loss, less dispersion and it can be easily integrated in a monolithic microwave integrated circuitry. Accompanied by preferred polarization outline, another important characteristic of the antenna in wideband application is the gain and directionality. The main advantage in strip line fed antennas produces increased gain due to the nonexistence of ground backing. Some other applications of wideband antennas are microwave imaging, detection, penetration radars to ground and biomedical imaging. The uni-directional characteristic of these antennas improves signal to noise ratio.

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This paper presents a novel ring shaped microstrip patch antenna with strip line feed architecture to maintain good radiation characteristics in ultra-wide band frequencies.

II. RELATED WORKS

HefiliaAsokan and Srivatsun Gopalakrishnan (2018) [1] propose a wideband monopole antenna is designed to provide miniaturization and ultra wide bandwidth. The microstrip is split to provide different resonance which connected one over another which will increase the antenna bandwidth. Operating frequency of the patch is between 3GHz to 10.5 GHz.

Noor M.Awad Mohamed and K. Abdelazeez, (2018) [2] proposed an antenna which has one planar UWB antenna and one UWB antenna which is designed to reject two bands. The antenna with rectangular shaped patch is designed with the ground plane which has the round shaped slots at the every corner of the patch. Inserting slots in the patch as well as the feed achieves the band rejection at WLAN and X-bands. The results show that the pass band with higher gain and rejected band with sharp drop. The radiation pattern is in the shape of dipole in E-plane and it is omnidirectional shape at H-plane.

Manisha Gupta and Vinita Mathur, (2017) [3] designed a compact fractal patch antenna for UWB applications. The radiating aerial is converted in some steps to achieve a multiband of antenna with circular polarization. The resultant antenna efficiently operates at 4.3 GHz, 5.0 GHz, 6.1 GHz, 7.4 GHz, 8.9 GHz and 9.2 GHz. Desired polarizations are obtained near resonant frequency. The final antenna design achieves good results, antenna parameters such as gain, bandwidth, directivity, VSWR and axial ratio are measured and compared with the previous results.

AzadehPiroo, etal., (2017) [4] proposed a Circular shaped antenna with dual slit ring resonators are used to improve the gain of the antenna. It is able to be used for WIMAX and Wireless applications. Split Ring Resonator is used to achieve circular polarization and the operating frequency of this patch is 2.9 GHz to 3.65 GHz. Circular shaped antenna is placed at the square shaped sheet and for antenna design FR 4 substrate which has 4.4 dielectric constant was used. Thickness of this design is 1.6 mm.

Deepanshu KaushalT and Shanmuganantham, (2017) [5] proposed a design to make an enhancement in the antenna performance based on that; number of fractal geometry stages are added. The split ring resonator structures in the antenna performance of patch antenna operate it with multi band of frequencies.

Narinder Sharma and Vipul Sharma, (2017) [6] introduced a patch antenna with hybrid fractal slot. The patch design includes partial ground plane for the applications which needs a wide bandwidth. Optimization of bandwidth and gain of antenna is done by varying length of the ground plane. The gain is about 5.62 dB, for the resonant frequencies 8.62 GHz and 2.77 GHz. The fractal slot antennas have the bandwidth for Koch-Minkowski slot is 3326 MHz and for the Koch-Koch slot is 3237 MHz.

Bharathi Anantha, etal., (2017) [7] proposed a single feed antenna which is established to operate with frequency reconfiguration and polarization reconfiguration. It has the shape of truncated square at the corners of the patch antenna. Rectangular ring shaped slots are introduced in the patch antenna. 8 number of PIN diode and 6 number of conducting pads are used to operate the antenna with different reconfiguration. PIN diode is used as switch based on the ON and OFF stages in each switches antenna tuned to different frequencies which made the antenna to function alike frequency reconfigurable antenna. Two different operating frequencies of these reconfigurable antennas are 5.2 and 5.5 GHz.

R.V.S.Ram Krishna, etal., (2014) [8] proposed a Coplanar waveguide slotted antenna is used for wide band application which provide circular polarization using L-shaped strips and the operating frequency of this antenna is 2.35 GHz to 10.2 GHz. Overall performances of this antenna was improved by a circular patch and double square surface loop. Combines a circular slot, circular strip and it control patch parameters. FR4 material is used for antenna design with dielectric constant, thickness and loss tangent values are 4.4, 1.58 mm and 0.002.

Sumitha Mathew, etal., (2014) [9] proposed a circular disc sector patch is truncated at one corner so to obtain a fan shape. The single coaxial probe fed antenna generates circularly polarized radiation and covers WLAN (2.4-2.484 GHz) with measured -10dB return loss bandwidth of 4% and -3dB axial ratio bandwidth of 1.4%.

III. PROPOSED DESIGN

Ring shaped patch antenna is designed for wideband applications with the frequency of (2- 5) GHz frequency FR4 substrate with 4.6 dielectric constant and strip line feed is used for this design.

To cover wide band of frequency circular ring shaped antenna is proposed which is designed with finite ground plane structure. Layout and substrate designs are carried out by ADS 2014 Software.

Layout Design for infinite ground plane

For layout design dimensions of the patch antenna is specified below, which shows the designed patch antenna using ADS Tool.

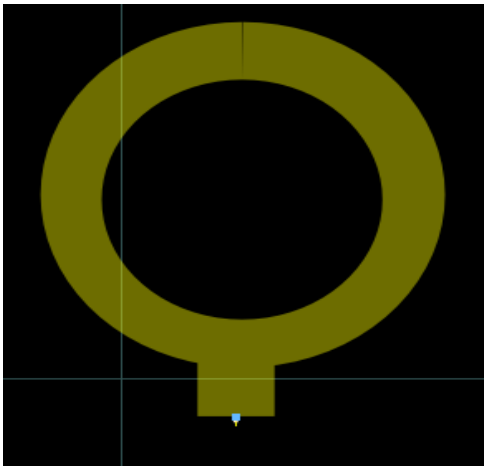


Fig. 1 Layout design for infinite ground plane

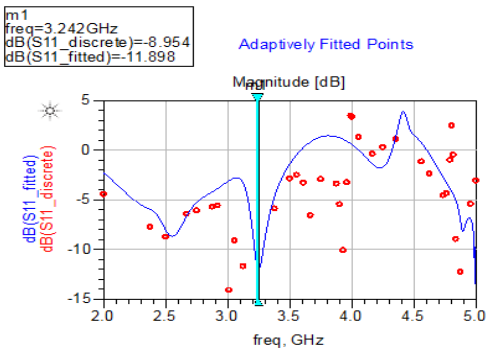
Substrate design

Substrate is designed with the thickness is about 1.6 mm for FR4. Dielectric constants used for FR4 is 4.4. Copper material is used for patch antenna. Different dielectric constants can also be used to test the results to identify the better performance of the antenna.

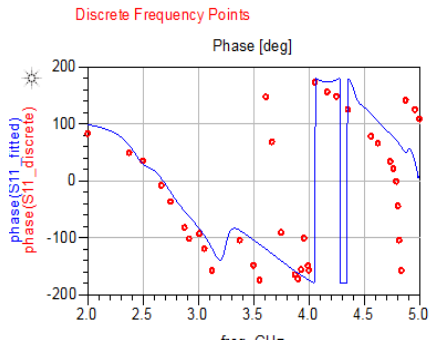
Fig. 2 Substrate design of ring shaped patch antenna

Infinte ground plane graph

- In infinite ground plane ,the result we achieved was -11.898 db,return loss at the frequency of 3.24GHz.
- The result will be better, if the return loss is greater than -10 db.
- Fig.No: 3 (a), (b) shows the resturn loss graph and phase plot for ring shaped antenna at 3.24 GHz frequency. Further slots can be introduced to improve the operating frequency range of this antenna.



(a)



(b)

Fig. No: 3 (a), (b) Infinite ground plane graph

IV. CONCLUSION

In this paper the aim is to design a ring shaped patch antenna for wide band application. This proposed design produces return loss of -15 dB at 3.03GHz frequency and in future various design techniques to be used to provide wide bandwidth. In future experiment various substrate materials and different feeding techniques can be incorporated with patch design which may improves the results further to operate the antenna with improved efficiency of the antenna.

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