International Journal of Engineering and Technical Research (IJETR)
ISSN: 2321-0869 (O) 2454-4698 (P), Volume-5, Issue-2, June 2016

Radiation Characteristics of 2*2 Quarter wave Transformer Fed Circular Patch Array Antenna at L Band for Airborne Applications

U.Srinivasa Rao, P Siddaiah

***Abstract*— In this paper, we presented modelling and simulation of a Microstrip Line Quarter Wave Transformer-fed 2x2 Circular Patch Array Antenna is presented. The maximum size of proposed array antenna is 300mm x 450mm x 24mm. The substrate material used for this antenna RTDuroid has thickness of 1.588mm and relative permittivity (εr) is 2.2. The design frequency of the antenna is 2GHz and VSWR ≤ 2. The proposed antenna is modelled and simulated using ANSOFT HFSS. The gain of this array antenna is 10.15 dB and return loss of -21.38dB. The proposed array antenna has beam width of 111.980 and bandwidth of 459 MHz. These type of antennas are very useful for airborne applications.**

***Index Terms*— Microstrip Patch Antenna, Array Anteena, Bandwidth, Beamwidth, Return Loss.**

I. INTRODUCTION

Microstrip patch antennas are popular, because they have some advantages due to their conformal and simple planar structure. They allow all the advantages of printed-circuit technology. A vast number of papers are available in the literature, investigating various aspects of microstrip antennas. Development of microstrip antennas was initiated in 1981, where a space-borne, light-weight, and low-profile planar array was needed for a satellite communication system. Since then, the development of the microstrip antenna has been expanded into three major program areas: mobile satellite (MSAT) communication, earth remote sensing, and deep-space exploration.

The term "Microstrip" comes because the thickness of this metallic strip is in micro-meter range. Microstrip patch antennas are popular, because they have some advantages due to their conformal and simple planar structure. They allow all the advantages of printed-circuit technology. Next we describe the procedure for increasing the antenna bandwidth. Finally, the simulated results are described, and it can be used for communication and other applications.

II. PROCEDURE FOR PAPER SUBMISSION

The radius of the patch is calculated using the formulae

$$a = \frac{F}{\left\{1 + \frac{2h}{\pi\varepsilon_r F}\left[\ln\left(\frac{\pi F}{2h}\right) + 1.7726\right]\right\}^{1/2}} \quad -Eq.1$$

Where

$$F = \frac{8.791x10^9}{f_r\sqrt{\varepsilon_r}} \quad -Eq.2$$

The proposed antenna designed at 2GHz and the dielectric constant and height of the substrate are 2.2 and 1.6mm respectively. Radius of the proposed antenna by using these values is 28.62mm.

III. DESIGN OF PROPOSED ANTENNA

The structure of the single circular patch antenna with the above radius modeled and simulated is shown in fig.1

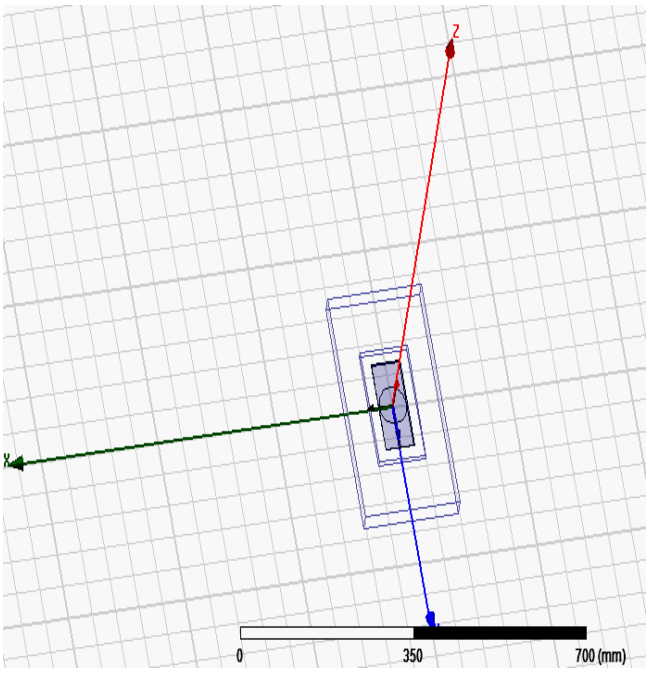

Fig.1.Single Element Circular Patch Antenna

The structure of 2x2 circular patch array antenna designed with the above circular patch antenna modeled and simulated is shown in fig.2. In the array all the elements are fed with same amplitude and same phase.

U.Srinivasa Rao , Associate Professor and Head, Department of ECE in Vignan's Lara institute of Technology and Science, Vadlamudi, Andhra Pradesh, India.

P. Siddaiah , Principal, University College of Engineering and Technology, Acharya Nagarjuna University, Guntur, India.

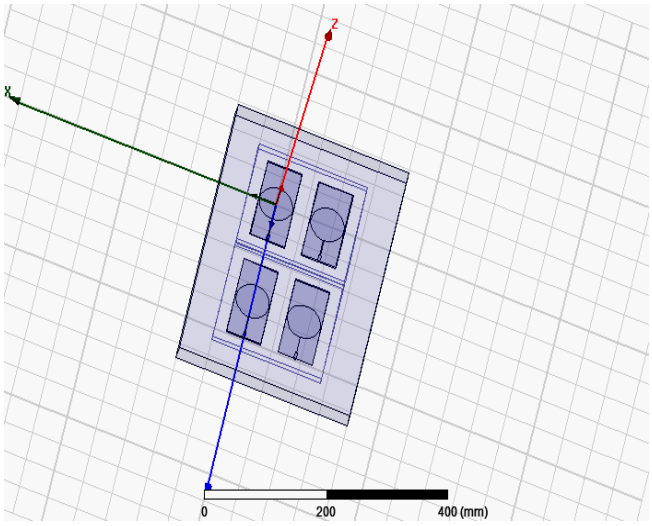

Fig.2 2X2 Circular Patch Array Antenna

IV. RESULTS

The return loss of the proposed array antenna at 2GHz is -21.38dB, VSWR is 1.83 and Bandwidth is 459MHz are respectively shown in Fig.3, 4 and 5.

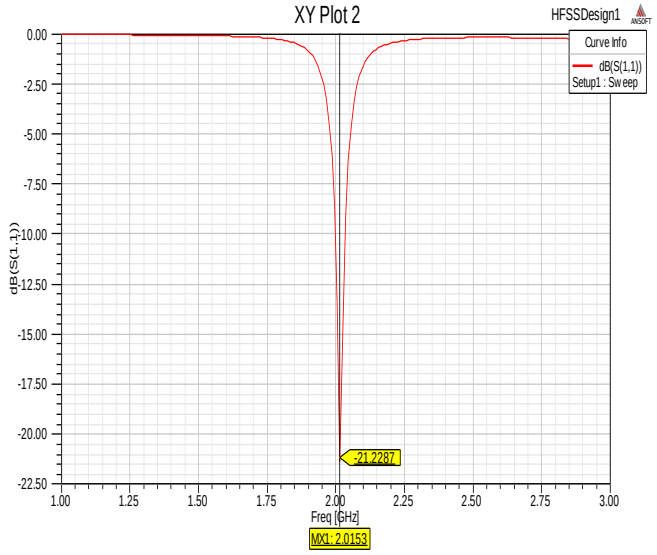

Fig.3 Return Loss

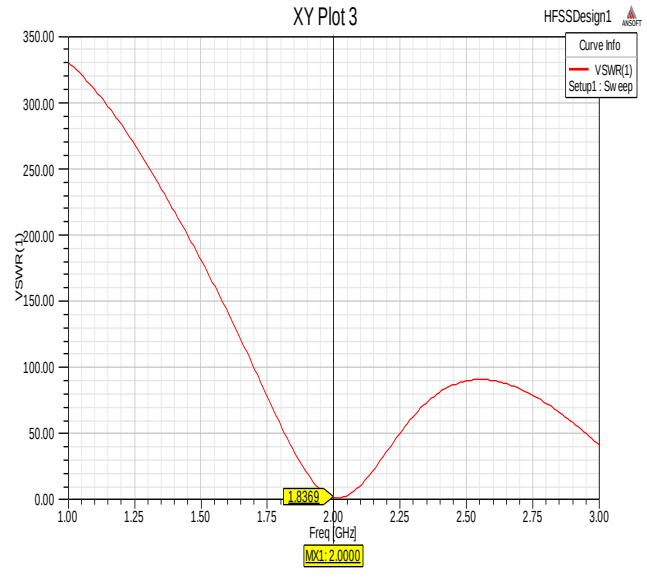

Fig.4 VSWR

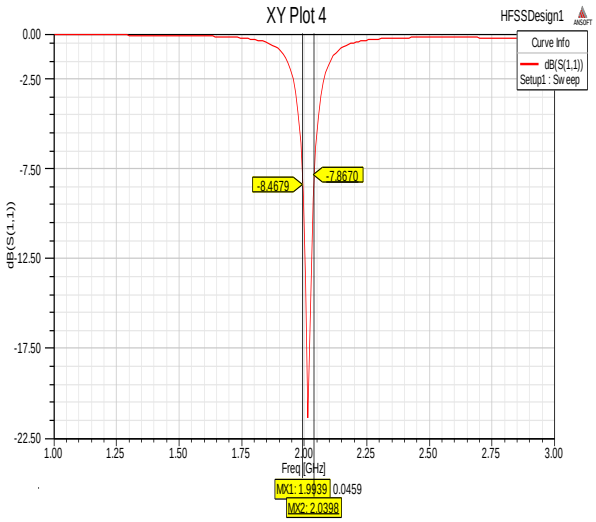

Fig5. Bandwidth

The Beamwidths in elevation and azimuth are 111.98^0 and 23.91^0 are respectively in fig.6 and fig.7

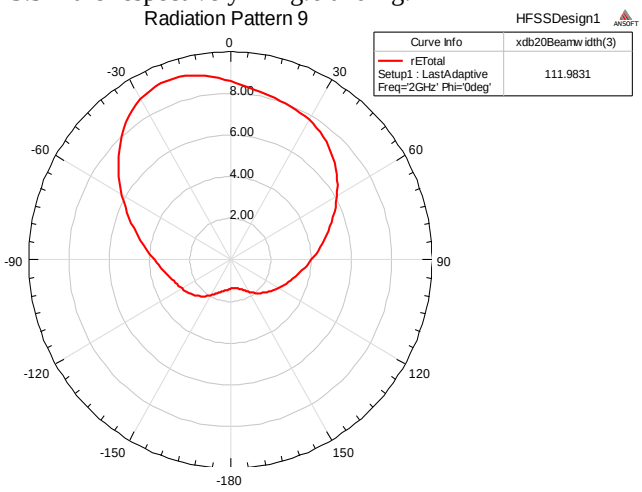

Fig.6. Elecvation Beamwidth

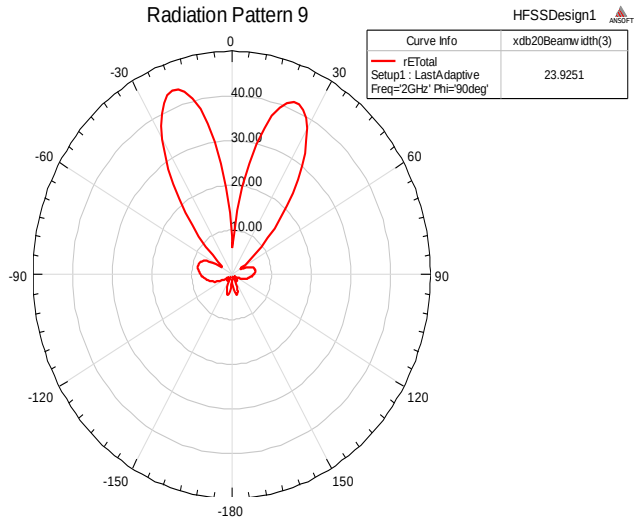

Fig.7. Azimuth Beamwidth.

The Gain, directivity and radiation efficiency are 10.15dB, 10.28dB and 97.9% respectively as shown in fig.8, fig.9 and fig.10.

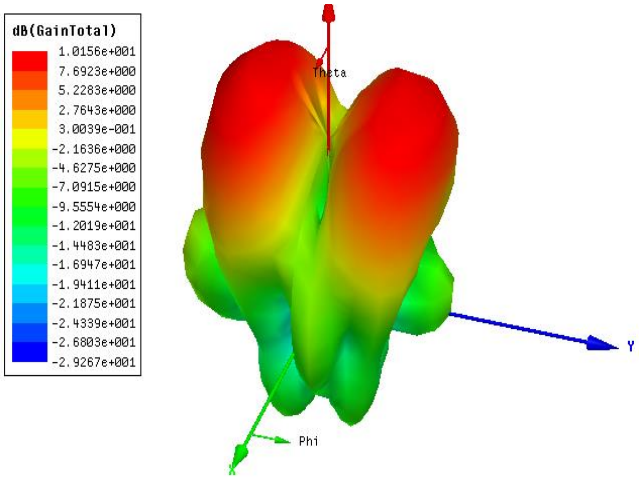

Fig.8. Gain.

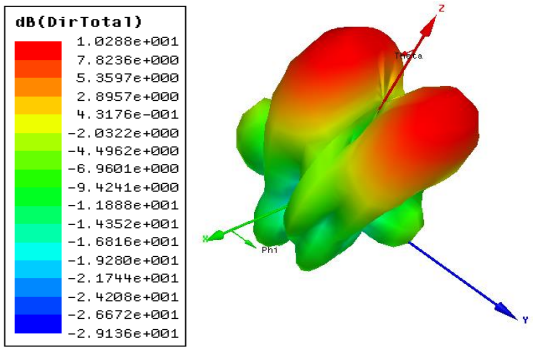

Fig.9. Directivity.

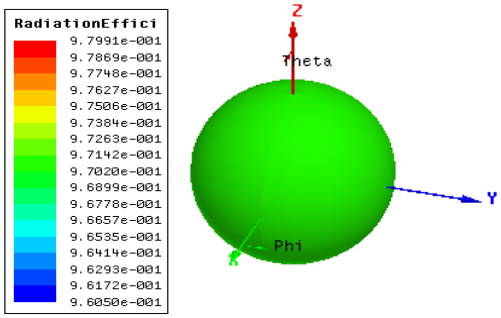

Fig.10. Radiation Efficency.

The polar plot, 3D Rectangular plot for Return loss and 3D Rectangular plot for Electric field is shown in fig.11, fig.12 and fig.13.

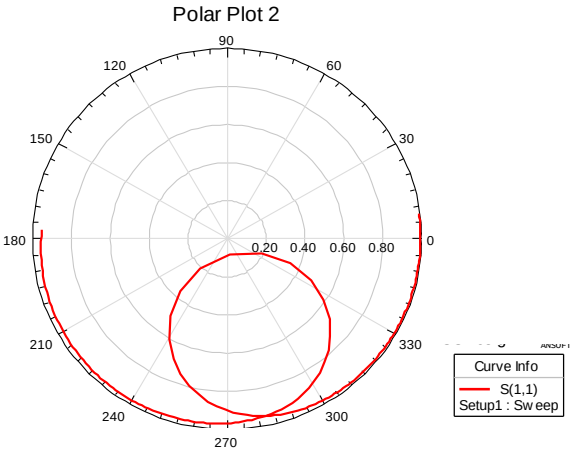

Fig.11. Polar Plot

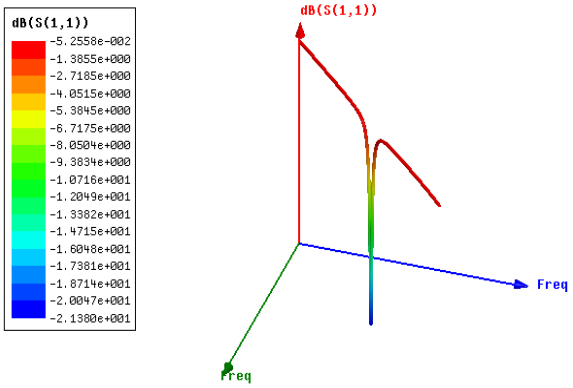

Fig.12. 3D Rectangular plot for Return loss

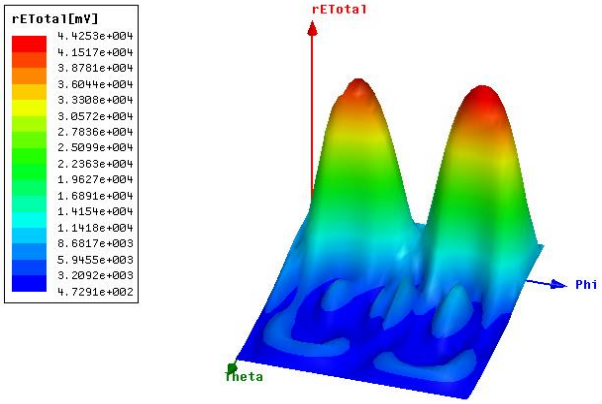

Fig.12. 3D Rectangular plot for Electric Filed

The various Antenna parameters like radiated power, peak gain, Max U, peak realized gain, decay factor, peak directivity, accepted power, incident power, radiation efficiency and field data of the 2X2 circular patch array antenna are given in Table.1 as shown below.

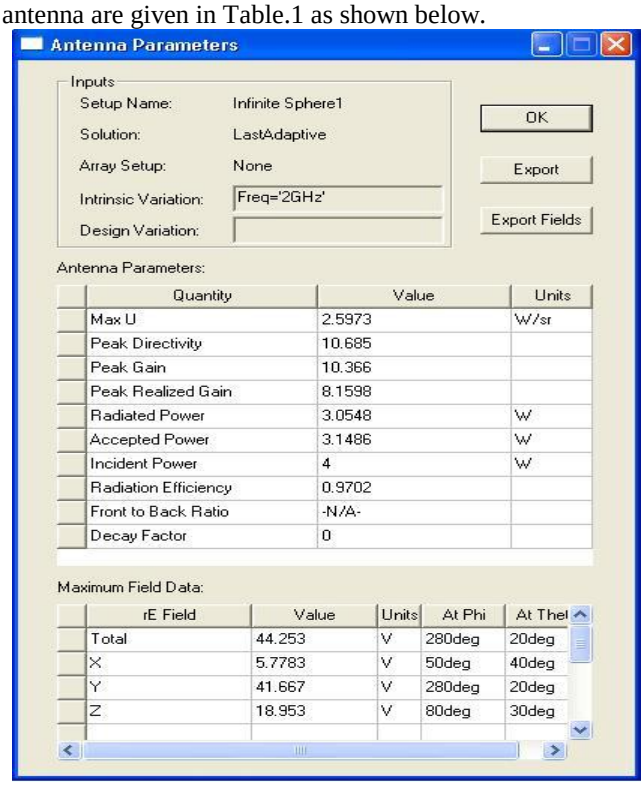

Table.1 Antenna Paramenters and filed data.

V. CONCLUSION

The proposed 2X2 circular patch array antenna is modeled and simulated using ansoft HFSS. The proposed has good gain, return loss and beamwidth, Hence, it can be used for Airbone application

VI. ACKNOWLEDGMENTS

Extending our grateful thanks to the authorities of Acharya Nagarjuna University for their support and encouragement to write this paper.

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BIOGRAPHY

U.Srinivasa Rao obtained his B.Tech degree in Electronics and Communication Engineering from RVR&JC College of Engineering in the year 1997. He received his M.E degree from Osmania University, Hyderabad in 2005. At present, he is pursuing his Ph.D in Acharya Nagarjuna University, Guntur, Andhra Pradesh, India. He is currently working as Associate Professor and Head, Department of ECE in Vignan's Lara institute of Technology and Science, Vadlamudi, Andhra Pradesh, India. He has taught a wide variety of courses for UG students and guided several projects. He is the life member of MISTE. His interested research areas are Microwave antennas, radar and optical communications.

P. Siddaiah obtained B.Tech degree in Electronics and Communication Engineering from JNTUA College of engineering in 1988. He received his M.Tech degree from SV University, Tirupathi. He did his Ph.D program in JNTU Hyderabad. He is the Chief Investigator for several outstanding Projects sponsored by Defense Organizations, AICTE, UGC & ISRO. He is currently working as Principal, University College of Engineering and Technology, Acharya Nagarjuna University, Guntur, India. He has taught a wide variety of courses for UG & PG students and guided several projects. Several members successfully completed their Ph.D under his guidance. Several members pursuing their Ph.D degree. He has published several papers in National & International Journals & Conferences. He is the life member of FIETE, IE & MISTE. **Second Author** personal profile which contains their education details, their publications, research work, membership, achievements, with photo that will be maximum 200-400 words.