

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

Design of Broadband Microstrip Patch Antenna for GPS Application

Balasubramanian.T⁽¹⁾, Jothichitra.R⁽²⁾

PG Scholar, Department of Electronics and Communication Engineering, Adhiparasakthi Engineering College,
Melmaruvathur, Tamilnadu, India ⁽¹⁾

Assistant Professor, Department of Electronics and Communication Engineering, Adhiparasakthi Engineering College,
Melmaruvathur, Tamilnadu, India ⁽²⁾

ABSTRACT: In this work, a compact antenna is proposed for broadband navigation applications. The design of antennas mainly emphasizes miniaturization and compatibility. The widely used frequency for Geo-stationary satellite application that covers operating at an (12GHz–18GHz)bands has been developed with circular polarization operation. The simulated reflection loss less than -10dB and voltage standing wave ratio less than two. The certain results show that the proposed antenna implementation. Analysis and the design of microstrip antenna is achieves by adopting transmission line method. The simulation results of scattering parameter, VSWR, impedance matching, radiation pattern of the proposed antenna have been constructed. The Radiation pattern is achieved for various frequency conditions. Simulation results are presented, showing this compact antenna achieves the required satellite description in terms of frequency bandwidth, circular polarization bandwidth.

KEYWORDS: Broadband antenna, circularly polarized (CP), compact patch antenna, coupling feed, Global Navigation Satellite System (GNSS).

I.INTRODUCTION

The Demands for high data rate transmission links using mobile satellite systems. Circularly polarized antennas have attracted much attention for mobile wireless and satellite communications because they allow for greater flexibility in attitude angle between transmitter and receiver antennas also reduction in multipath reflection. When considering Global positioning systems, the study of the communication devices used for establishing a wireless link between the device and the external base station is to be important. Some examples of applications are: civil, commercial, and military purposes. Consequently, two requirements are imposed to the antennas for such combined satellite communication/navigation system. Global star requires left-hand circular polarization (LHCP), whereas GPS system uses right-hand circular polarization (RHCP), the antennas are supposed to be dual circularly polarized [1]. Due to all these considerations, many patch antennas have been reported with thick air substrate and alternative feeding techniques [2], for covering the required bandwidth. A concentric annular-ring microstrip antenna using the aperture feeding as an alternative to improve the bandwidth is presented. The ring microstrip antenna has the advantage of a compact dimension than that of a circular or rectangular patch when operating in the fundamental mode at a certain frequency [3].

In a compact circularly polarized antenna based on a concentric annular-rings microstrip fed by four apertures is designed and measured. The broadband feed network based on the broadband phase shifter presented in [4] and [5] is used to obtain the required phase shift, thus allowing improvement of the axial ratio in the direction of maximum radiation. The Simulated Circularly Polarized performances for the concentric annular-ring antenna are shown. This antenna used to be installing on a car or a ship for navigation use.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

II.ANTENNA STRUCTURE AND ANALYSIS

We intend to design a compact antenna with circular polarization that covers all the Global navigation frequencies. The antenna should be stable at all the interesting frequencies from the operating bands 12GHz–18GHz. A four probe feed three layer stacked patch configuration is adopted. A wideband feed network with equal phase difference of 90° and magnitude for the four feed points is located at the bottom layer shown in Fig 2.1. The proposed antenna is composed of Rogers RT/duroid 6006 substrate layer is used for reducing the size of the antenna. Substrate separated by air gap has massive amounts of power, the adoption of high permittivity substrate without an air gap between the patch and the ground plane improves the reliability of the antenna. The geometry of the proposed circularly polarized antenna consists of a square substrate of a coaxial line of the microstrip feed is optimized by achieving the input impedance matching.

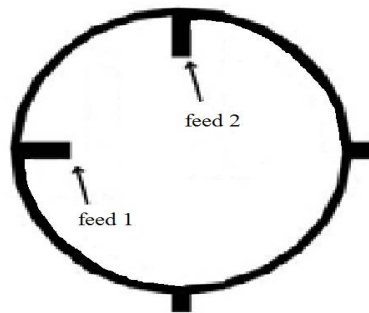


Fig. 2.1. Microstrip Layout

It consists of four layers. The top layer is a square patch with two crossing rectangular slots and two circular holes for feeding that are located with an offset of from the center, where two feeding pads are placed. The second layer is a parasitic square patch for enhancing the bandwidth. It is isolated from the feed with a hole having radius 0.2mm and height 0.24mm. The third layer is the ground with the same size as the whole substrate 40×40 .

Parameter	Dimension(mm)
Ground length	40
Substrate thickness	1.6
Feeding pad radius	1.96
Feeding pad Height	0.24
Patch Length	16
Square Patch	14

Table 2.1. DIMENSIONS FOR THE ANTENNA

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

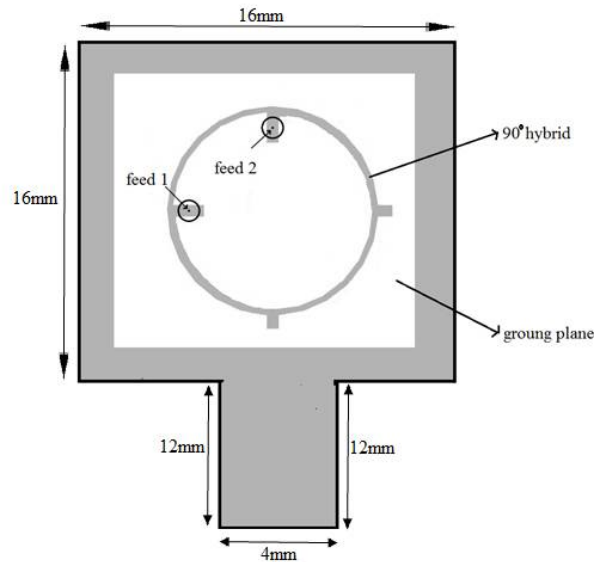


Fig. 2.2 Geometry of the designed antenna

The designed microstrip structure and its simulated performance are shown in Fig. 2.2. A 90° hybrid and a grounded ring are printed on the bottom layer. All the dimensions are listed in Table 2.1.

III.SIMULATION RESULTS

The configuration of the ring shaped antenna is designed on a substrate with Rogers 6006, relative permittivity 6.15 with a loss tangent of 0.0019. The proposed antenna consisting Rogers substrate, the design based on annular ring is etched on the patch of the microstrip feed line antenna. The thickness of the substrate is 1.6mm. It is non-conducting dielectric medium. All of them are substrate from the patch antenna elements. The patch elements made up of copper, it is a conducting material.

For measuring and examining VSWR is when installing and tuning transmitting antennas frequency range. The VSWR value 1.61 achieved in 12.54GHz and 1.16 in 11.28GHz of operating frequency is presented in Fig 3.2, which could satisfy the antenna to work on above operating frequency to suit in their application. The smaller VSWR states the better impedance matching to transmission line and power is delivered to antenna. So, the VSWR and return loss states the impedance matching of a transmission line to the antenna. The better impedance matching delivers and receives more power.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

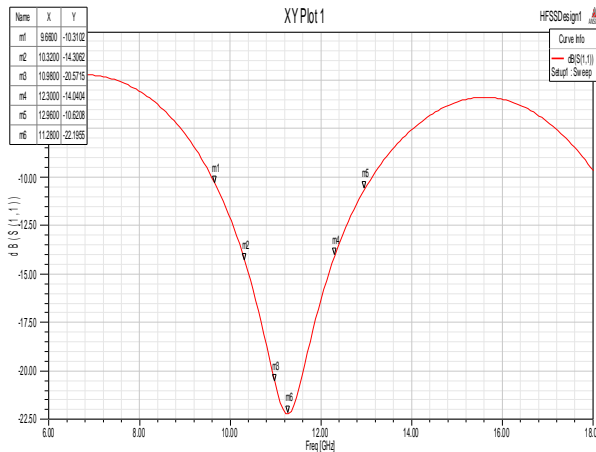


Fig. 3.1 S - Parameter versus Frequency Plot

The return loss value is obtained by using S-parameter are measured in decibel. The simulated return loss is shown in Fig 3.2. Return loss value is must be in the range of greater than the -10dB points are usually covered as the bandwidth of the antenna. The maximum value of return loss is -22.19dB achieved in 11.28GHz. The return loss characteristics of proposed antenna are -14.34dB for the resonant frequencies of 12.5GHz. The simulated radiation pattern of the proposed antenna is presented in Fig 3.3. The great agreement of the simulation validates the design.

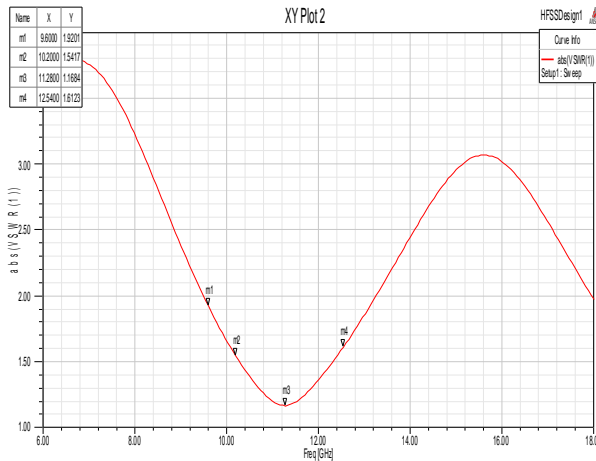


Fig 3.2 Voltage Standing Wave Ratio

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

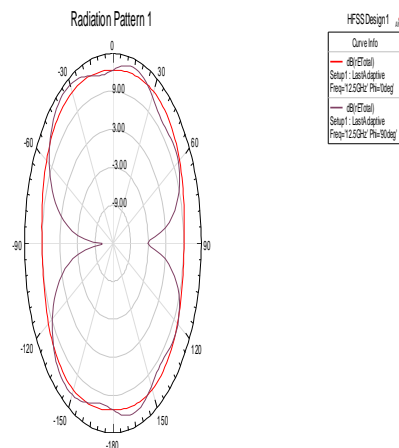


Fig 3.3 Radiation Pattern

IV. CONCLUSION

A Compact and Robust circularly polarized microstrip patch antenna was designed and simulated using High Frequency Simulation Structure tool [8]. The simulated results of antenna consists return loss, VSWR and radiation patterns achieved their optimum values. The Return loss value achieved for less than -10dB and the voltage standing wave ratio less than two. A circularly polarized patch antenna with different shapes of parasitic shorting strips for a new size reduction technique has been investigated analytically. The radiation pattern can be obtained for different shapes of shorting strip. Size reduction of ring shaped patch antenna can be achieved most efficiently by using high permittivity substrate. Simulation results good enough to satisfy our requirement to fabricate it on hardware. The proposed antenna is suitable for GPS satellite communications applications.

V. FUTURE WORK

Fabrication of prototype antenna will be carried out in future and measured results will be compared with simulated results. The size of the antenna will be reduced. The reduced size of the antenna will cover the all the parameters of navigation applications. In order to examine the quality and range, radiation with high gain are required for some application. Simulation of proposed antenna for various substrate thicknesses to obtain required gain and bandwidth coverage's.

ACKNOWLEDGEMENT

We authors would like to thank our Correspondent, Management and Lab Technician for their kind support to complete our research work successfully.

REFERENCES

- [1] Y.-Q. Zhang, X. Li, L. Yang, and S.-X. Gong, 2013, "Dual-band circularly polarized annular-ring microstrip antenna for gnss applications," *IEEE Antennas Wireless Propag. Lett.*, vol. 12, pp. 615–618.
- [2] Y.-X. Guo, L. Bian, and X. Q. Shi, 2009, "Broadband circularly polarized annular-ring microstrip antenna," *IEEE Trans. Antennas Propag.*, vol. 57, no. 8, pp. 2474–2477.
- [3] D. Sievenpiper *et al.*, 2011, "Experimental validation of performance limits and design guidelines for small antennas," *IEEE Trans. Antennas Propag.*, vol. 60, no. 1, pp. 8–19.
- [4] F. Ferrero, C. Luxey, G. Jacquemod, and R. Staraj, 2005, "Dual-band circularly polarized microstrip antenna for satellite applications," *IEEE Antennas Wireless Propag. Lett.*, vol. 4, pp. 13–15, 2005.
- [5] L. I. Basilio, R. L. Chen, J. T. Williams, and D. R. Jackson, 2007, "A new planar dual-band GPS antenna designed for reduced susceptibility to

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

- low angle multipath," *IEEE Trans. Antennas Propag.*, vol. 55, no. 8, pp. 2358–2366.
- [6] Y.Gou, S.Yang, Q. Zhu, and Z.Nie, 2013, "A compact dual-polarized double E-shaped patch antenna with high isolation," *IEEE Trans. Antennas Propag.*, vol. 61, no. 8, pp. 4349–4353.
- [7] M. Heckler, R. Farias, L. Pereira, E. Schlosser, and C. Lucatel, 2013, "Design of circularly polarized annular slot antennas for satellite navigation systems," in *Proc. 7th EuCAP*, pp. 361–365.
- [8] Ansoft HFSS. Ver. 12, Ansys Corporation, Framingham M.A [Online]. Available: www.ansoft.com.
- [9] S.-L. Yang and K.-M.Luk, 2008, "A wideband 1-probes fed circularly-polarizedreconfigurable microstrip patch antenna," *IEEE Trans. AntennasPropag.*, vol. 56, no. 2, pp. 581–584.
- [10] Y. Li, Z. Zhang, Z. Li, J. Zheng, and Z. Feng, 2011, "High-permittivitysubstrate multiresonant antenna inside metallic cover of laptop computer," *IEEE Antennas Wireless Propag. Lett.*, vol. 10, pp. 1092–1095.
- [11] C. A. Balanis, 2005, *Antenna Theory Analysis and Design*, 3rd ed.Hoboken, NJ, USA: Wiley.
- [12] D. M. Pozar, 1998, *Microwave Engineering*, 2nd ed. New York, NY, USA:Wiley.
- [13] W.-T. Hsieh, T.-H.Chang, and J.-F. Kiang, 2012, "Dual-band circularly polarizedcavity-backed annular slot antenna for GPS receiver," *IEEETrans. Antennas Propag.*, vol. 60, no. 4, pp. 2076–2080.
- [14] K.-F. Tong and J.-J. Huang, 2008, "New proximity coupled feeding methodfor reconfigurable circularly polarized microstrip ring antennas," *IEEETrans. Antennas Prop.*, vol. 56, no. 7, pp. 1860–1866.
- [15] X.-Y. Sun, Z.-J.Zhang, and Z.-H. Feng, 2011, "Dual-band circularly polarizedstacked annular-ring patch antenna for GPS application," *IEEEAntennas Wireless Propag. Lett.*, vol. 10, pp. 49–52.