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A Hat Shaped Folded Patch Antenna for Advanced S-Band Wireless Communication

Mukesh Kumar[1], Deepak Kumar[2]

PG Student [Microwave Engineering], Dept. of ECE, SRMSCET, Bareilly, India[1]

Assistant professor, Dept. of ECE, SRMSCET, Bareilly, India[2]

ABSTRACT: This paper describes problems related to antenna technology. The paper shows the construction of different micro strip antennas on a dielectric substrate operating on the frequency 3.61 GHz. A circularly polarized patch antenna for Advanced S-Band Wireless communication is presented. In this paper beam width and Miniaturization enhancement of a patch antenna are the two main areas to be discussed. Micro-strip antennas technology appeared relatively late, but in recent years has been a very large development of the design of these antennas. For each of the antenna models designer set parameters such as input resistance, VSWR, input reactance and radiation pattern. Antenna model that characterized the best parameters was constructed. This article also analyses the results of computer simulations and measurements, there by demonstrating the advantages and disadvantages of micro strip antennas. A parametric study of the effect of the metallic block and the surrounding dielectric substrate on the gain at a low elevation angle and the axial ratio of the proposed antenna are presented.

KEYWORDS: Antenna radiation patterns, beam width enhancement, micro strip patch antennas, satellite antennas.

I.INTRODUCTION

The microstrip antennas have been one of the most innovative fields of antenna techniques for the last sixteen years. In high-performance aircraft, missile, spacecraft, and satellite applications, where cost, performance, size, weight, ease of installation, and low profile, aerodynamic profile are constraints antennas may be required. Presently, there are many other commercial and government applications, such as wireless and mobile radio communications that have similar specifications. To meet these requirements, micro strip antennas can be used. Basically patch shape and mode are selected they are very versatile in terms of polarization, resonant frequency, pattern, and impedance.

However, Advanced Wireless communication includes the function of satellite communication. Terrestrial cellular system has been well developed in urban area to provide good coverage and high quality of telecommunication service. Users are able to enjoy instantaneous two-way voice, message and even data communications for sharing photos or watching streaming video. However, the existing terrestrial network may not fully cover all remote areas in the world. In order to obtain ubiquitous wireless coverage on the earth, mobile satellite communication service [1] is the complement. It offers services including safety communications, broadcasting and accurate global positioning. In addition, by adding loads between the patch and the ground plane, such as pins, adaptive elements with variable resonant frequency, polarization, impedance, and pattern can be adjusted [2]. Radiating patch may be square, rectangular, triangular, circular, elliptical, and any other configuration. In this work, A Hat Shaped Folded Patch Antenna are the under consideration. The mobile satellite system requires the radiation patterns of antennas be able to cover the complete azimuth range and wide range of elevation angles, such that the communication channel can be established without paying effort to track the satellite. The field of view of the antenna can be accomplished with a directional, omni-directional or semi directional pattern [3].

II. ANTENNA DESIGIN

This paper aims at designing a handheld CP patch antenna with wide beam width and high gain at the low elevation angles for handset use in future advanced mobile satellite communication. To full the requirement of handset mobile satellite communication, we use HFSS 14.0 version to design reduce the size of the antenna but retain the original features of broadside radiation pattern, acceptable gain and axial ratio bandwidth. The patch at the top and the double sided printed-circuit-board (PCB) are displayed separately for clarity in Fig. 1(b). The radiating element, a circular hat-shaped folded patch, of diameter D_p = 22 mm and thickness of 1 mm, is placed above the feed substrate of ph. Twelve slots are loaded in the hat-shaped patch to reform its structure. All slots are identical with dimensions ps_h = 3 mm, ps_L = 2.79 mm and ps_w = 1 mm. Each slot is separated to adjacent slot at an angle of 30˚ with respect to the center of the patch. The feeding structure is fabricated on a square PCB with side length G = 30 mm, thickness h = 1.5 mm, dielectric constant =2.60 . On the top side of the PCB, four identical L-shaped slots are etched on the ground plane. The grounded slot has a width of sw = 0.5 mm and a length of $s_{Lt} = s_{L1} + s_{L2}$. The separation between each opposite slot is s = 4 mm. At the bottom side of the PCB, a ring-shaped feeding micro strip line of outer diameter tx_D = 16.7 mm and width txw_1 = 0.60 mm is printed.

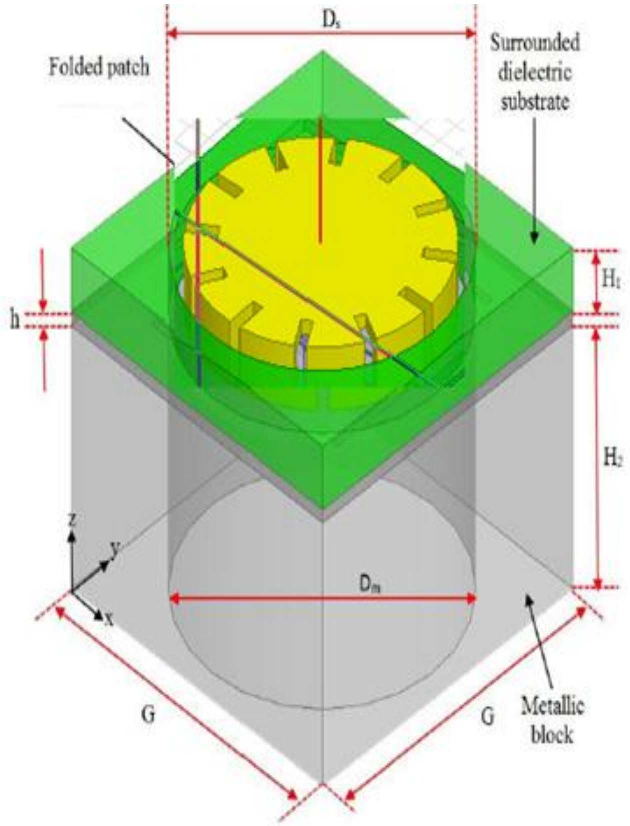

Fig.1.a. Design propose antenna

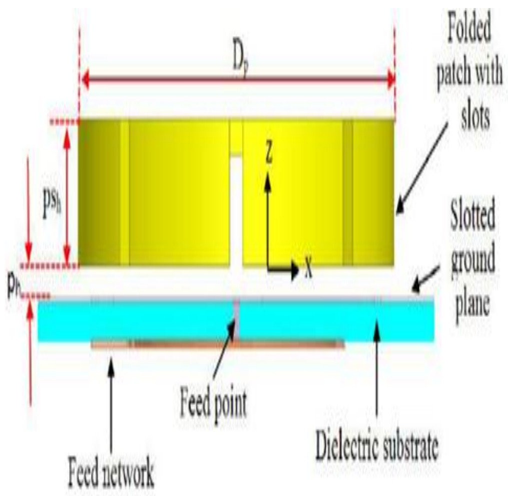

Fig.1.b. Design propose antenna

The HFSS14.0 version software used to model and simulate the microstrip patch antenna and it also used for calculating and plotting Return Loss, VSWR, the best result of return loss can be found in the valley below -10dB Above the double-sided PCB, , the circular hat-shaped patch is surrounded by a dielectric substrate with side length G = 30 mm, thickness H_1 = 4.5 mm, dielectric constant = 2.60 . A cylindrical cavity with diameter Ds = 24mmof the surrounded substrate is created. Below the PCB, a metallic block with height of H_2 = 20mm is attached. Similar to the surrounded dielectric substrate, a cylindrical hole with diameter of Dm = 26 mm is formed at the centre of the metallic block.

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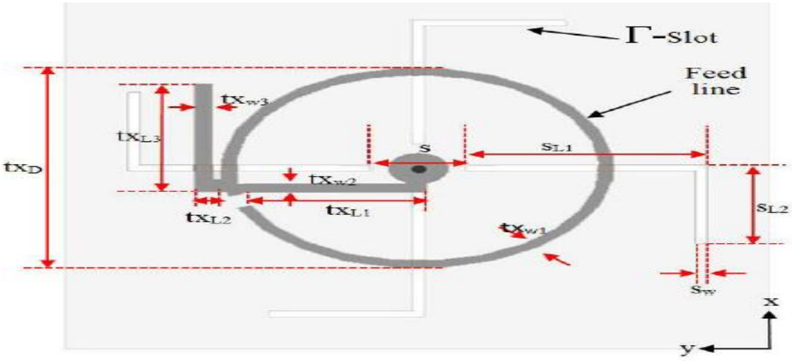

Parameters	tx_D	tx_{L1}	tx_{L2}	tx_{L3}	tx_{w1}	tx_{w2}	tx_{w3}	s	s_{L1}	s_{L2}	s_w
mm	16.7	7.8	1.39	8	0.65	0.8	0.8	4	10.3	6.55	0.5

Fig.1.c. Design propose antenna

III.THE MEASUREMENT RESULTS

In order to verify the results obtained in the simulation we performed measurements of electrical parameters and radiation characteristics of selected antenna. In order to investigate the antenna were measured the following parameters: Return loss, VSWR, gain, radiation patterns and input impedance.

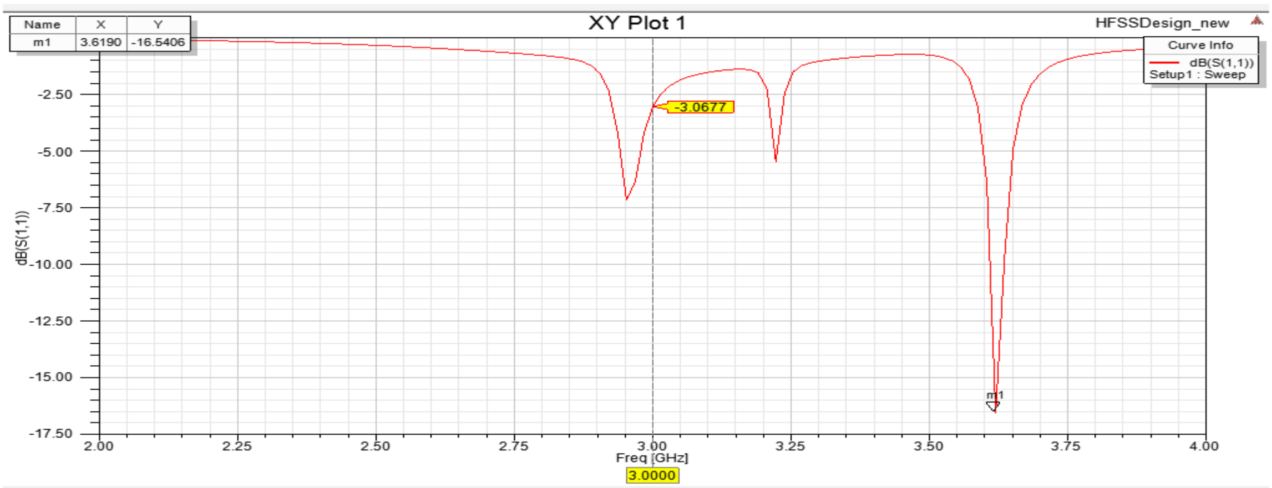

Fig.2 Simulated Return loss

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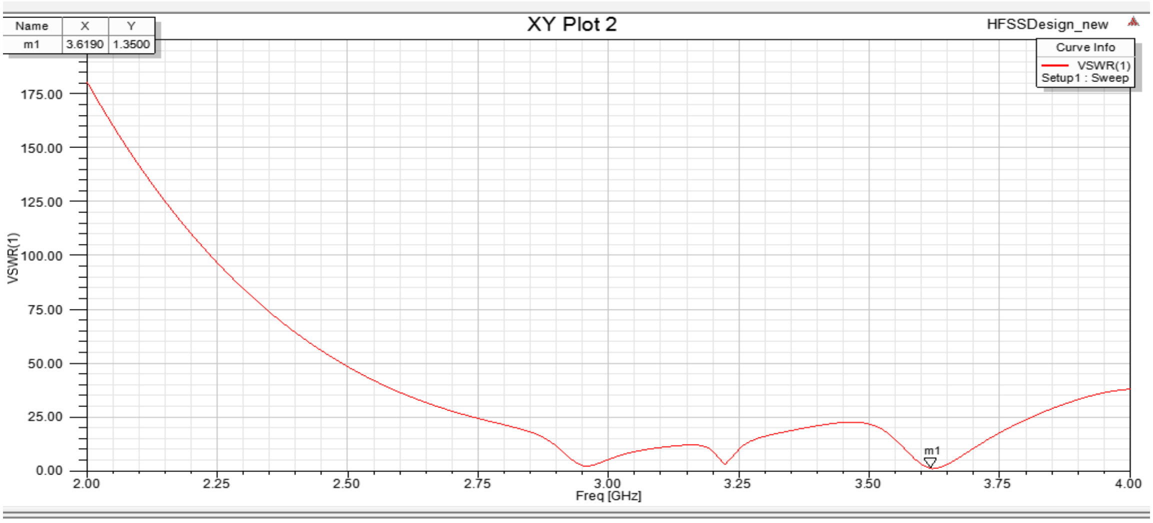

Fig.3 Simulated VSWR

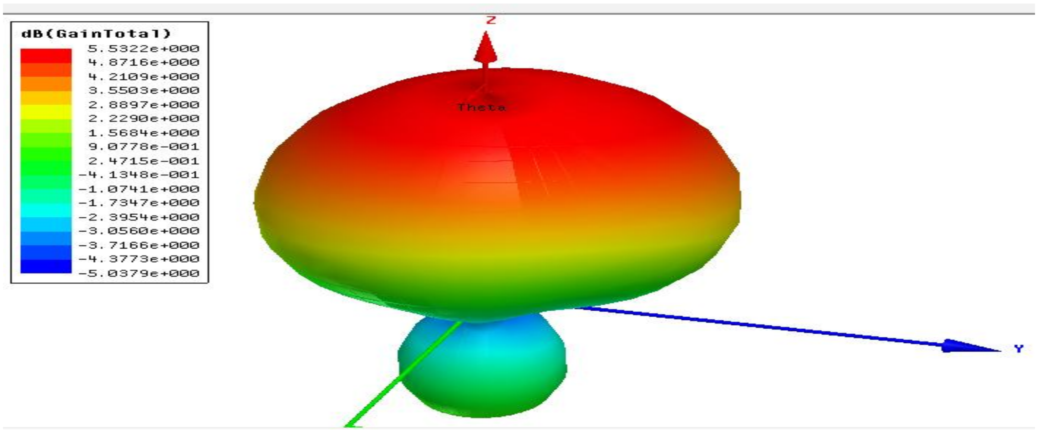

Fig.4 Simulated Gain

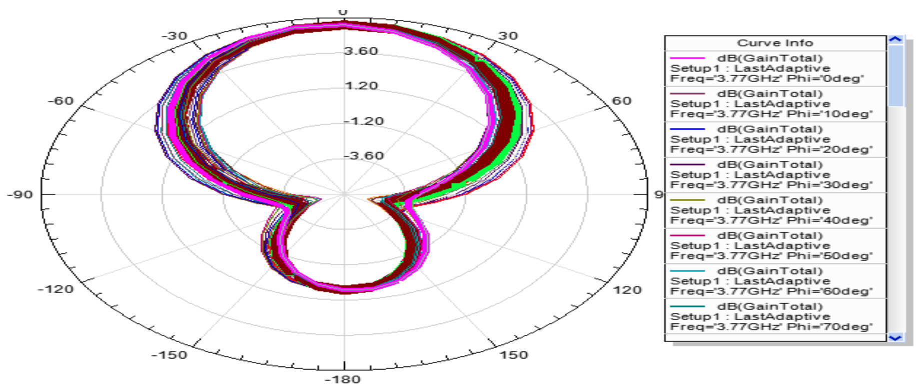

Fig.5 Simulated Radiation pattern

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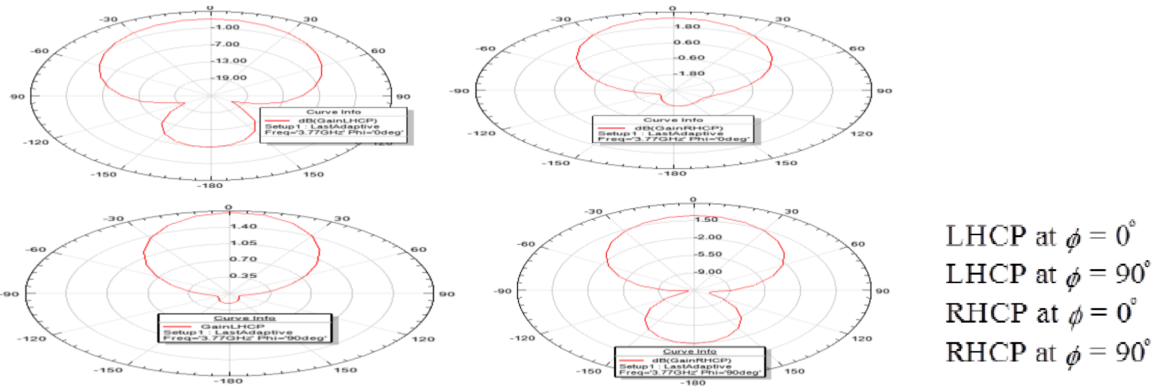

Fig.6 Simulated Radiation pattern LHCP & RHCP

IV. CONCLUSION

Results of the simulation electrical parameters and characteristics of antenna has been confirmation by measurements. Measurements of patch antenna can be stated that the selected antenna is characterized by good electrical parameters. The shape of the radiation characteristics is consistent with theoretical assumptions. The antenna was fabricated with an impedance bandwidth of 6.5% and the maximum gain of 5.53dBic. The AR bandwidth is 2.78 %. With the proposed structure, the antenna retains broadside and symmetric radiation patterns. Furthermore, experimental result shows more than 40% size reduction comparing with a conventional half-wavelength square patch antenna. This new size reduction technique is useful for small advanced CP antenna designs. The measurement results show that the CP antenna is able to cover wide elevation angles and the complete azimuth range (0˚to 360˚)

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