VIA HOLE - DUAL RECTANGULAR SLOTTED MICROSTRIP PATCH ANTENNA (MPA) DESIGN FOR RADIO ASTRONOMY, SATELLITE, CIVIL AND MILITARY APPLICATONS

Simarjit Singh Saini[1], Avneet Kaur[2], Ekambir Sidhu[3]

[1]*Student, Electronics and Communication Engineering, Punjabi University, Punjab, India*
[2]*Student, Electronics and Communication Engineering, Punjabi University, Punjab, India*
[3]*Assistant Professor, Electronics and Communication Engineering, Punjabi University, Punjab, India*

Abstract

In this paper, via hole drilled microstrip patch antenna employing two rectangular slots on patch, FR4 substrate having thickness of 1.6mm and dielectric constant of ε_r = 4.4 has been proposed. The proposed antenna has been designed and analysed using Computer Simulation Technology (CST) Microwave Studio 2014. The proposed antenna has compact size, light weight and wide band operation. The via hole slot and rectangular slots have been cut in the proposed antenna in order to increase the return loss and impedance bandwidth of the antenna. The proposed antenna ground and patch has been designed using copper of thickness 0.1mm. It has been analysed that the proposed antenna has an impedance bandwidth of 725MHz with an operating frequency range of 2.6787-3.4038GHz and is resonant at 2.905 GHz. The gain, directivity and return loss of the proposed antenna are 4.52dB,4.011dBi and -72.93dB at resonant frequency of 2.905GHz, respectively. The proposed antenna can be suitably employed for Aeronautical, Weather Radar applications (2700MHZ-2900MHz), Civil and Military applications (2900MHz-3100MHz) and Satellite applications (3100MHz-3300MHz.)

Keywords: *Gain, Directivity, Resonance Frequency, Microstrip Patch Antenna, Via hole, VSWR*

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1. INTRODUCTION

The antennas form the foundation of wireless communication systems. Their extensive applications find place in RADAR, WLAN, Wi-Fi, Bluetooth and many other such wireless technologies [1][2][3][4]. The microstrip antennas are widely used due to their small size, low profile, ease of integration, light weight, multiple frequency operation [5]. The concept was introduced by Deschamps in US in 1950's and by Gutton&Baissinot in France. Such antennas were developed with the advent of Printed Circuit technology in the 1970's [6]. The design plays an important role in deciding antenna's performance parameters. Every micro strip antenna has a radiating patch, dielectric substrate and a ground plane [7].The variation in shape of patch and material used for substrate is responsible for the creation of different antennas to accommodate different applications. The selection of resonant frequency and dielectric material is the primary step in designing the microstrip patch antenna [8]. The limitation of microstrip antenna is its narrow bandwidth posing a problem in WLAN applications [9]. Keeping an eye on the advantages, many techniques are developed and are being developing to improve the limitations [10][11].There are various sections provided in the paper. The antenna geometry has been discussed in section II. The simulated results have been discussed in section III and Section IV focus on the conclusion of the proposed work.

2. ANTENNA GEOMETRY

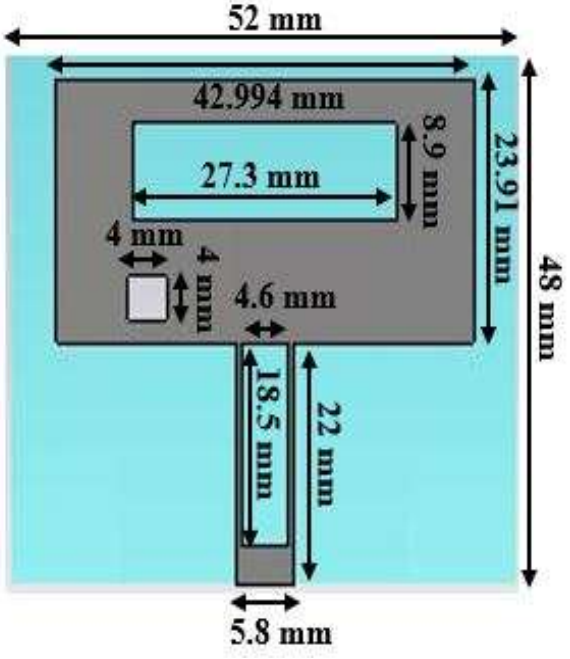

Fig.-1(a): Top View of the Proposed Antenna

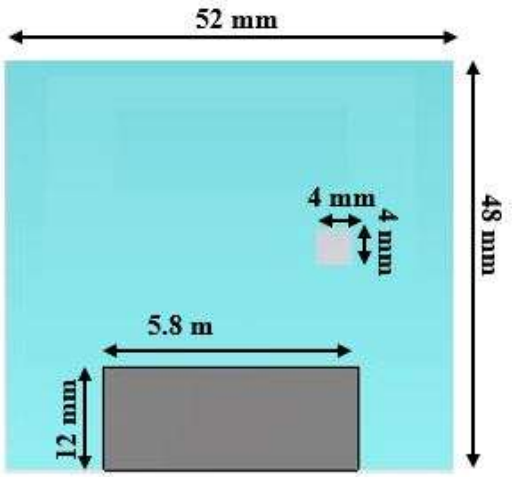

Fig.-1(b): Bottom View of the Proposed Antenna

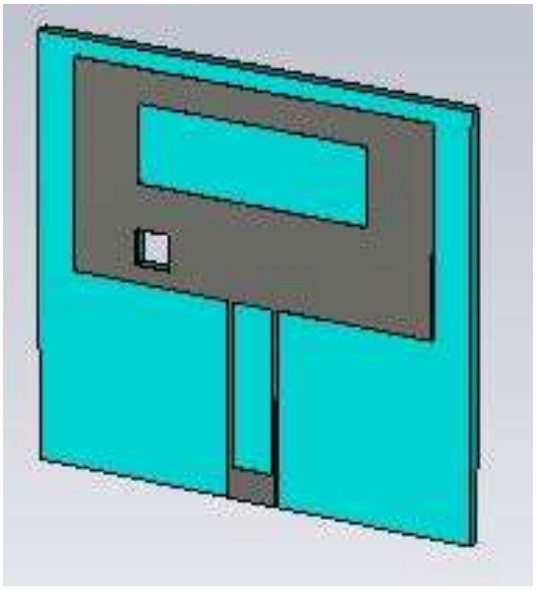

Fig -2: 3D view of the proposed antenna

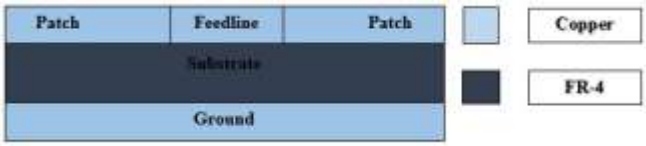

Fig. -1(c): Front view of the Proposed Antenna

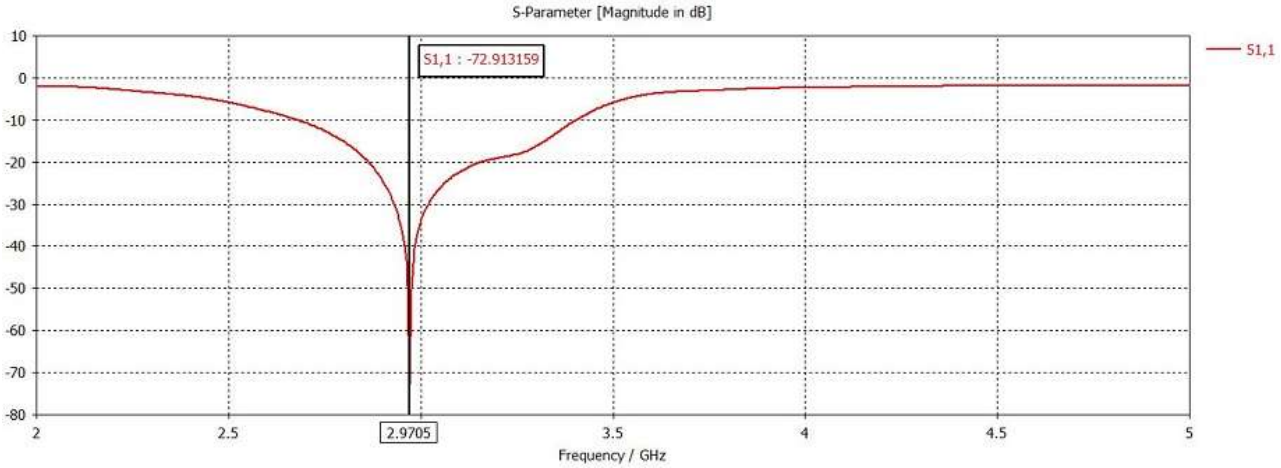

Fig.-3: Return Loss of the Proposed Antenna

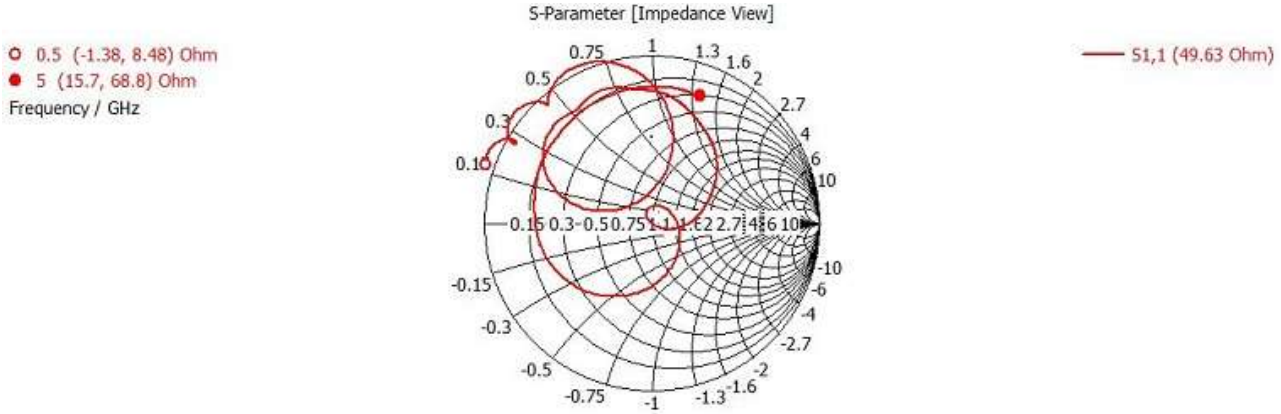

Fig.-4: Smith Chart of Proposed Antenna

The microstrip patch antenna as been designed and simulated in the CST Microwave Studio 2014 Software. The geometry of the proposed is demonstrated in fig. 1.The Flame Retardant 4 (FR-4) material with a dielectric constant of 4.4 has been employing as substrate of the microstrip patch antenna with thickness of 1.6 mm. The width of the patch is 0.1mm which is copper material. The arrangement of patch, substrate and ground as shown in fig. 1(a), 1(b) and 1(c). The patch of the antenna is rectangular in shape with two rectangular slots which has been shown in fig. 1(a). A square via hole is provided in the antenna through patch, substrate and ground. Two slots have been cut in the patch of antenna in order to improve the return loss.

3. RESULTS

The CST Microwave Studio 2014 has been employed to design the proposed microstrip patch antenna. The performance of proposed antenna has been analyzed in terms of return loss (dB), resonant frequency (GHz), directivity (dBi), gain (dB), impedance bandwidth (GHz), VSWR and impedance (ohms). The return loss plot illustrates that the antenna is resonant at 2.905 GHz with a return loss of -72.91 Db as shown in fig. 3. The Smith Chart has been shown in fig. 4 which indicates that the proposed antenna has impedance of 49.63Ω. The respective gain and directivity at 2.905GHz is found to be 4.52 dB and 4.011 dBi as shown in Fig. 5 and Fig. 6. The VSWR plot of the antenna has been shown in Fig. 7 which implies that the VSWR of the proposed antenna design lies below the minimum acceptable value of 2. The power flow of the antenna is shown in fig. 8.

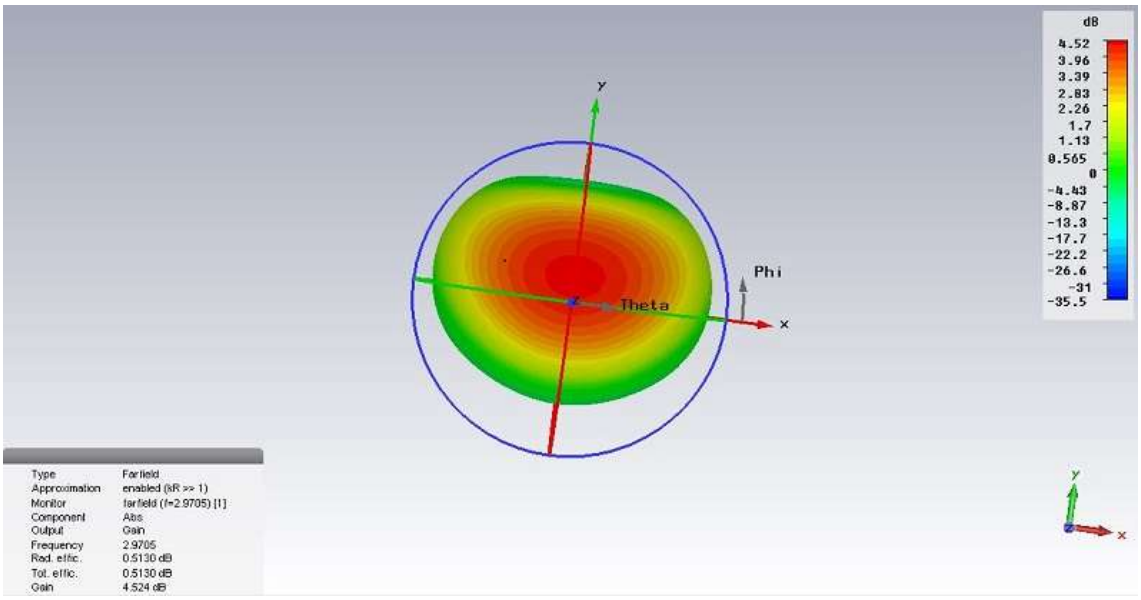

Fig. -5: Gain of the Proposed Antenna

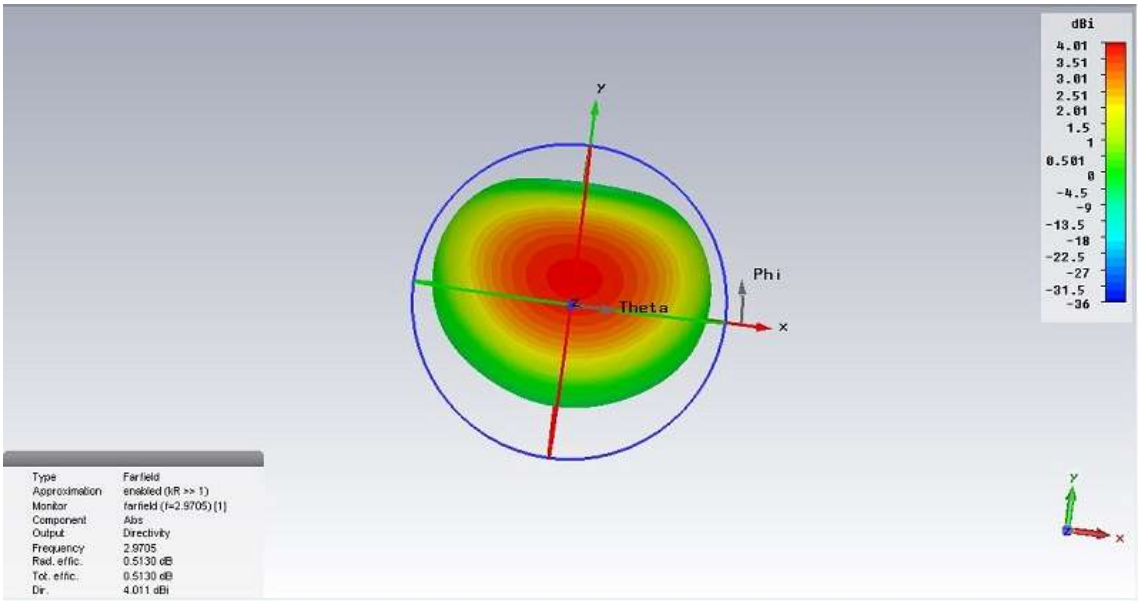

Fig. -6: Directivity of the Proposed Antenna

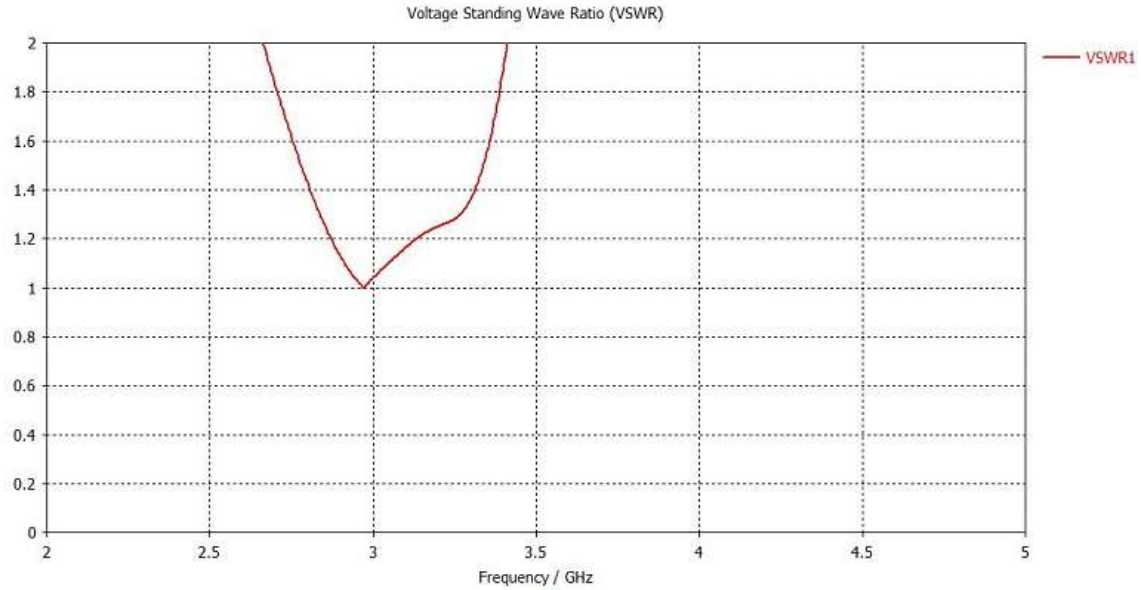

Fig. - 7: VSWR Plot of the Proposed Antenna

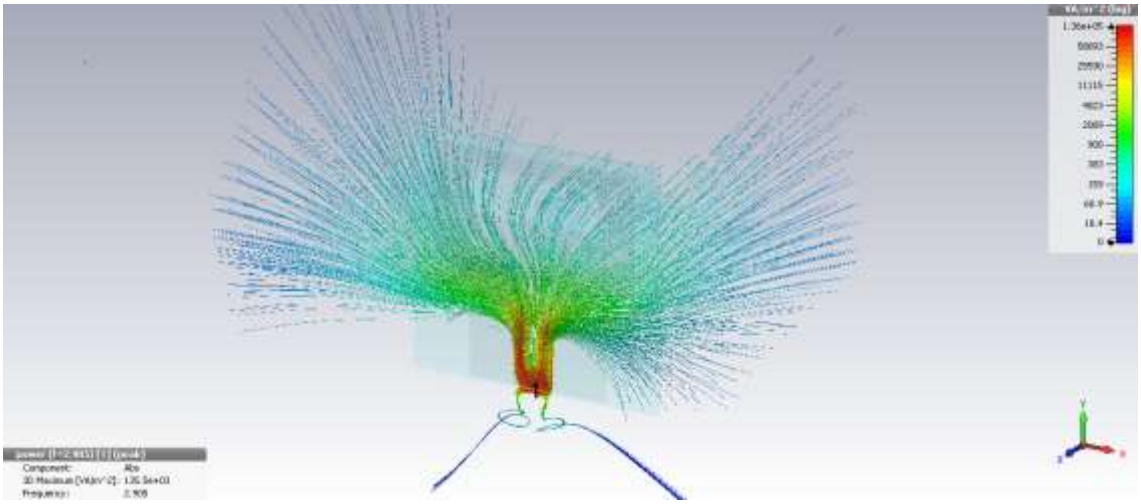

Fig. -8: Power flow of the proposed antenna

4. CONCLUSION

In this paper, the microstrip patch antenna employing rectangular slot and via hole has been proposed. The antenna with a resonant frequency of 2.905 GHz has been designed and analyzed in this paper. The proposed antenna has been designed and simulated using CST Microwave Studio 2014. The proposed antenna has the impedance bandwidth of 2.6787 GHz – 3.4038GHz (725 MHz).The proposed antenna can be suitably employed for Aeronautical, weather radar application (2700MHZ-2900MHz),civil and military applications (2900MHz-3100MHz) and satellite applications (3100MHz-3300MHz).

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BIOGRAPHY

Simarjit Singh Saini is a student at Department of *Electronicsand Communication Engineering*, Punjabi University, Patiala. He is pursuing his Bachelor of Technology (B.Tech) in the field of *Electronics and Communication* at Punjabi University, He is a student member of IEEE(Institute of Electrical and Electronics Engineers) and member of ASME (American Society of Mechanical Engineers). His areas of technical interest are Energy Harvesting, Embedded System and Antennas

Avneet Kauris student at *Department of Electronics and Communication Engineering*, Punjabi University, Patiala. She is final year student of Bachelor of Technology (B.Tech) at Department of *Electronics and Communication Engineering*. Her areas of technical interest are Energy Harvesting, Microwave Antennas and Embedded systems.Sheisastudent memberof IEEE (Institute of Electrical and Electronics Engineers) and member ofASME(American Society of Mechanical Engineers)

Er. Ekambir Sidhuisan Assistant Professor at *Department of Electronics and Communication Engineering*, Punjabi University, Patiala since September, 2012. His area of specialization is Antenna Systems and Energy Harvesting Systems. He has published papers in the field of Microwave Antennas, Optical Antennas, Embedded Systems, and Energy Harvesting Systems. He is an Associate Member of IETE (Institute of Electronics and Telecommunication Engineers) and member of IEEE (Institute of Electrical and Electronics Engineers).