Design of Planar Microstrip Patch Antenna Applicable at 6.3 GHz

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Abstract*—Microstrip patch antennas play an important role in microwave devices and circuits and became a popular key model in recent years for communication systems and design. The proposed design has low cost and easy fabrication as no defected ground structure is used. The design comprises of planar structure which makes it easy for integration of external components in future scope with better s-parameter characteristics performance and multiband operations. The overall size of the proposed microstrip antenna is 40mm x 45mm. The dielectric substrate used in designing the antennae is Rogers RT5880 lossy with thickness 1.6 mm and dielectric constant as 2.2. The proposed antenna consists of a rectangular radiating patch with a rectangular feed line. The operating frequency of the antennae is 6.3 GHz with maximum Return Loss of 17.4 dB applicable to STM link 1 (Synchronous Transport Module level 1) with yield of good rejection performance. The proposed antenna is designed and analyzed in CST Microwave studio. The simulated S-parameter performance characteristic is found to be in good bond with measured result.

***Index Terms*—Planar microstrip patch antenna, CST Microwave studio, Rogers RT 5880, S-parameter, Return loss.**

I. INTRODUCTION

The Microstrip Patch Antenna consist of one layer design. It consists mainly of four parts namely patch, ground plane, substrate, and the feeding part. Microstrip patch antenna works at different frequencies for the different applications. It is mostly used for wireless communication system i.e., to transfer the information from one location to another. The ground plane is placed at the bottom of the substrate and radiating patch is placed at the top of the substrate. They are used because of their salient features such as low profile, lightweight, low cost. Various feeding methods are used such as coaxial probe feed, microstrip line feed, proximity coupled feed and aperture coupled feed. In this paper overall size of proposed antenna is 40mm×45mm.The substrate material used for this antenna is Rogers RT 5880 (lossy) with thickness 1.6mm and dielectric constant as 2.2. The simulation of proposed antenna is carried out in CST Microwave studio.

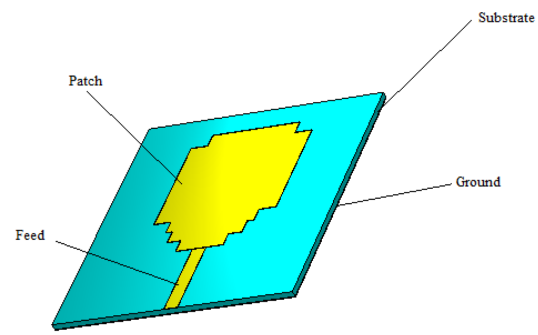

Figure 1. Proposed Antenna Design

Microstrip antenna consists of a very thin metallic strip placed on a ground plane with a di-electric material in-between. The radiating element and feed lines are placed by the process of photo-etching on the di-electric material. Usually, the patch or micro-strip is chosen to be square, circular or rectangular in shape for the ease of analysis and fabrication. An antenna that is formed by etching out a patch of conductive material on a dielectric surface is known as a patch antenna. The dielectric material is mounted on a ground plane, where the ground plane supports the whole structure. Also, the excitation to the antenna is provided using feed lines connected through the patch. As it is formed using a microstrip technique by fabricating on a printed circuit board thus is also known as Microstrip antenna or printed antenna. Generally, patch antennas are considered as low-profile antennas and are used for microwave frequency applications having frequency greater than 100 MHz. The proposed antenna works at a frequency of 6.3 GHz. Various applications of Microstrip patch antennas are GPS, WiMAX, Wi-Fi, Breast cancer detection, Mobile satellite communication and space communication etc.

II. ANTENNA DESIGN

The performance of the Microstrip Patch Antenna is primarily affected by factors such as the physical geometry, dimensions of the structures, and material properties utilized. The choice of shape significantly influences the antenna's performance and its suitability for various applications. In the referenced paper, the rectangular patch shape is adopted due to its ease of design and evaluation. This shape offers certain advantages in terms of simplicity and practicality in the design process and the subsequent assessment of its performance.

The configuration of the proposed 6.3 GHz Planar Microstrip Patch Antenna is shown in Figure 2. Inset feed technique is used in this antenna. The Antenna is designed by using substrate Rogers RT 5880 (lossy) having thickness of 1.6mm with dielectric constant of 2.2 which is placed one above the other optimized resonating frequency of the designed antenna which operating at 6.3GHz for that we have considered length and width of a radiating patch is 40mm×36mm. Dimensions for different parameters are mentioned in the Table 1.

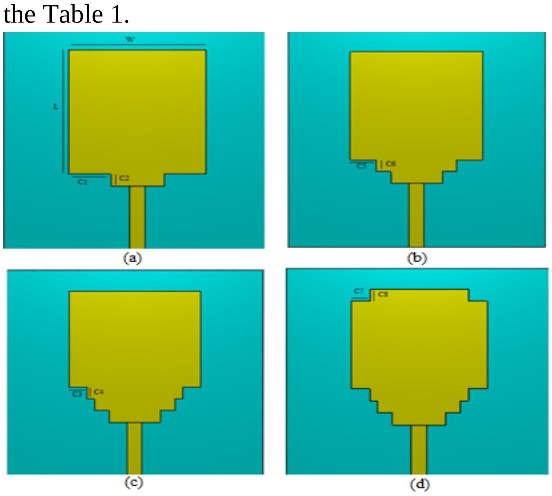

Figure 2. Different antenna structure (a) Structure 1, (b) Structure 2, (c) Structure 3, and, (d) Final structure

Parameter	Dimensions (mm)
L	40
W	36
C1	11
C2	4
C3	7
C4	4
C5	5
C6	4
C7	5
C8	4

Table 1. Dimensions of antenna parameters

III. HARDWARE IMPLEMENTATION

The hardware of the planar microstrip patch antenna is shown in the Figure 3. It has been constructed using Rogers RT 5880 and is been tested in the lab which gave the measured frequency of 6.3 GHz. Thus, the measured VS. simulated graph is being plotted which gives the view of the accuracy of implemented structure.

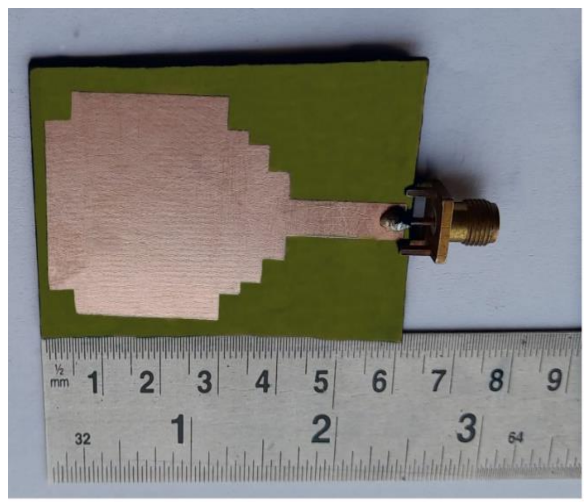

Figure3. Shows the picture of Hardware implementation of proposed antenna

IV. RESULTS AND DISCUSSIONS

In this section, we will showcase the outcomes derived from the antenna simulation carried out using the CST-MWS simulation software.

- Simulation Result

Using CST Return losses for the structures mentioned in Figure 2 are calculated through simulation process of planar microstrip patch antenna at operating frequency 6.67 GHz, 5.39 GHz, 6.04 GHz, and 6.30 GHz. The Comparison between return losses of different structures is shown in Fig.

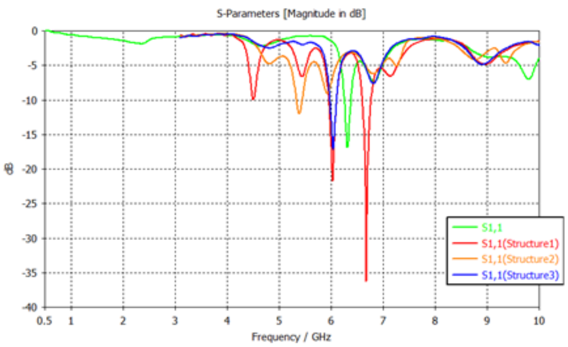

Figure4. Shows the graph depicting different return losses

- Measured Result vs. Simulated Result

The simulated result is obtained by simulating the antenna on CST Microwave studio. The operating frequency is observed to be 6.3 GHz.The measured result is obtained after getting hardware implementation tested in the lab and operating frequency observed to be 6.04 GHz is being.

A difference of 0.26 GHz is being observed from both the result as shown in the Figure 5. This gives the accuracy of the 95.6 % of the fabricated antenna.

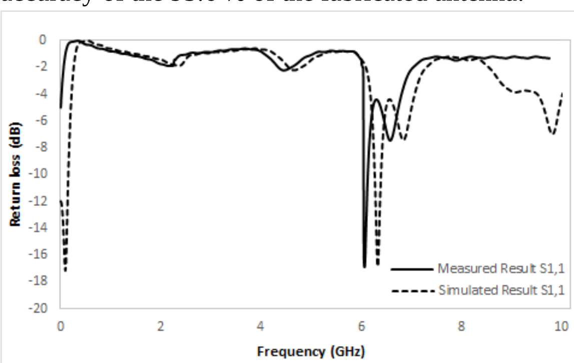

Figure 5. Shows comparative graph of measured and simulated result of proposed antenna

V. CONCLUSION

A compact planner microstrip patch antenna with resonant frequency of 6.3Ghz is proposed, fabricated and measured. The size of the antenna is with a slotted patch. This simple designed and low-cost antenna is very useful in the field of wireless communication. A detailed analysis is made throughout the paper to understand the behavior of each parameter on the design. The observed difference between the measured and expected frequencies is 0.26 GHz. This indicates that the fabricated antenna achieves an accuracy of 95.6% in its performance. A good agreement was obtained between measured and simulated results. Moreover, the measured S1,1 match with that of the simulated S1,1 stating that the proposed antenna configuration is a promising for WLAN, WiMAX, Breast cancer detection, Mobile satellite communication and space communication etc.

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