

Reduced Ground Microstrip Patch Antenna employing Teflon as Substrate for Civil and Military Radiolocation Applications

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Abstract— This paper demonstrates the analysis of reduced and defected ground microstrip patch antenna employing Teflon as substrate. The Teflon material having dielectric constant 2.1 of thickness 2mm has been sandwiched between the patch and the ground made up of copper material. The proposed antenna covers the frequency range from 3.29MHz to 3.41MHz which is suitable to be employed for the civil and military radiolocation applications. The performance of the proposed antenna has been scrutinized in terms of different antenna parameters such as return loss (S11), gain (dB), directivity (dBi), VSWR, bandwidth (GHz). The proposed antenna has a gain and directivity of 6.747dB and 6.654dBi respectively. The input impedance of the proposed antenna is 50.2 ohms to achieve the maximum power transfer and ensuring minimum reflection losses. The proposed antenna has been designed and simulated using the CST Studio Suite 2017.

Index Terms— CST 2017, Directivity, Gain, Reduced Ground, Teflon, VSWR.

I. INTRODUCTION

The foundation of wireless and communication is formed by the antennas. Their large number of applications find place in RADAR, Wi-fi, WLAN and many other such wireless applications [1], [2], [3], [4]. Microstrip patch antennas were developed in 1970's with the use of printed circuit technology. Nowadays, the focus is on compact size of the microstrip antennas with its various design benefits [5]. The microstrip patch antenna consist of dielectric substrate, radiating patch, and ground plane. However, the MPA suffers from low gain and low bandwidth are the major disadvantages. The appropriate selection of substrate helps in improving the performance of an antenna. To get rid of these drawbacks, the low dielectric constant thick substrate or slotted patch can be employed [6]. The antenna size is dependent on the dielectric constant of a substrate. The size of antenna is inversely proportional to dielectric constant [7]. High dielectric constant substrate can be employed for a fixed frequency microstrip antenna [8]. The notches like Z shape, H shape can be employed on the ground or patch of microstrip antenna to improve the performance of the antenna [9]. The feeding technique employed in MPA is microstrip feed line it is easy to fabricate, therefore its is commonly employed [7]. In the microstrip patch antenna with Teflon substrate of thickness 0.254mm, was reported to have 9 dBi gain covering all frequency bands (57-66GHz), allocated in

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Japan, US and EU. [10]. The section II of this paper describes the antenna geometry. The section III deals with the performance of the proposed antenna in terms of gain, directivity, smith chart and bandwidth. Section IV focus on the conclusion of the proposed research work.

II. ANTENNA GEOMETRY

The proposed microstrip patch antenna has been simulated and designed in the CST Studio Suite 2017 Software. The proposed antenna employs Teflon material as a substrate having dielectric constant 2.1 of thickness 2mm as shown in fig. 1. The substrate is sandwiched between the radiating patch and ground plane made up of copper material of thickness 0.05mm having conductivity of 5.67×10^7 S/m². The front view and bottom view of the proposed antenna has been demonstrated in Fig. 1(a), Fig. 2(b). The radiating element of dimensions 40.00 mm \times 29.51 mm with feedline of width 10.30 mm has been placed on the substrate of dimensions 60 mm \times 40 mm as shown in Fig. 1. The 3-dimensional view of the proposed antenna is also laid out in Fig. 1(c). The power is fed through the feedline to the proposed antenna having impedance of 50.27 ohm making it suitable to be fed by SMA connector of 50 ohm's impedance.

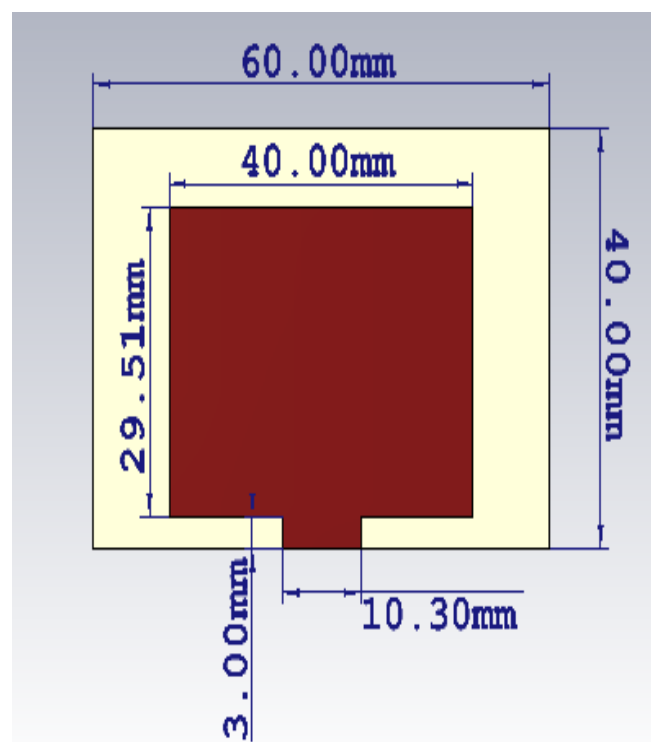


Fig. 1(a) Front view of the proposed antenna

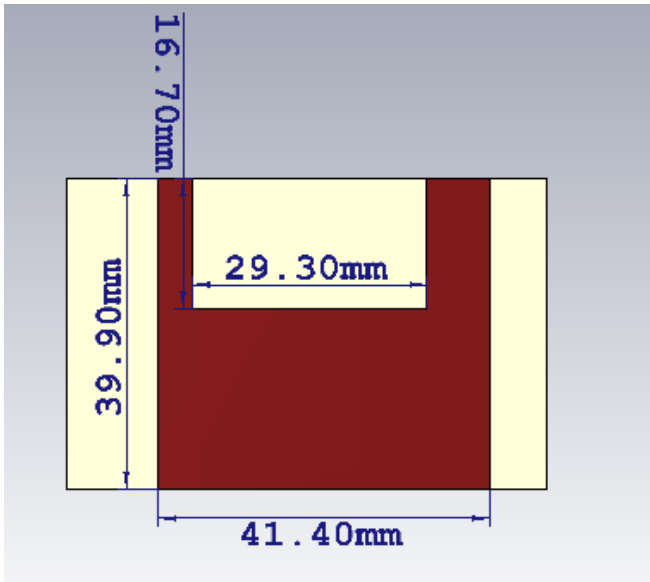


Fig. 1(b) Bottom view of the proposed antenna

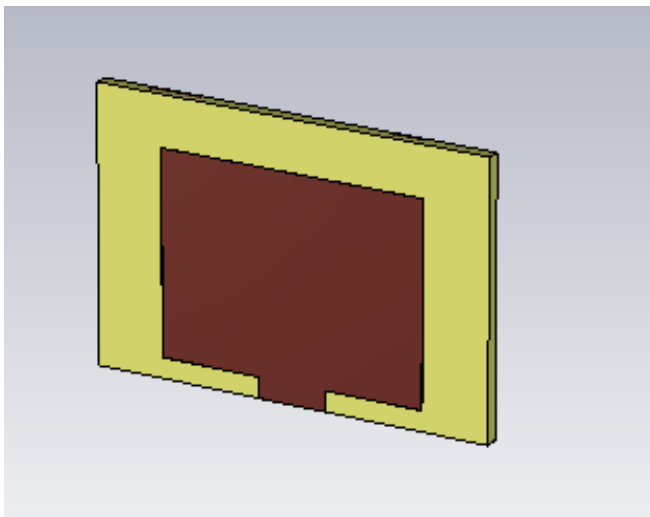


Fig. 1(c) 3-D view

III. SIMULATED RESULTS

In order to design and obtain simulated results of the proposed antenna, the CST Microwave Studio 2017 has been used. The performance of various parameters like, resonant frequency (GHz), return loss (dB), directivity (dBi), gain (dB), bandwidth (GHz), and VSWR has been analyzed. The frequency range of the proposed antenna is 3.298GHz to 3.415GHz with the center frequency 3.35GHz. The return loss of the proposed antenna at resonant frequency is 57.34 dB has been shown in Fig. 2. The Smith Chart plot indicates the variation of impedance of the antenna with respect to frequency and impedance of 50.27 Ω of the prototype microstrip antenna being shown in Fig. 3. The gain and directivity of simulated antenna is 6.748 dB and 6.654 dBi, respectively is as shown in Fig. 4 and Fig. 5. The Voltage Standing Wave Ratio (VSWR) plot of the proposed antenna has been shown in Fig. 6 which is less than the maximum acceptable value, i.e., 2.

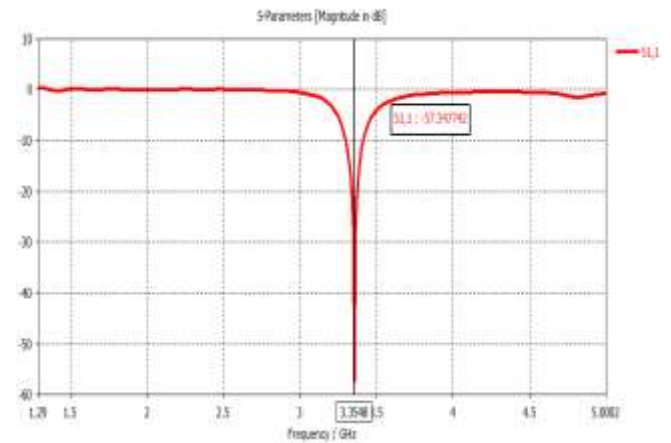


Fig. 2 The Return loss of the proposed antenna in CST studio

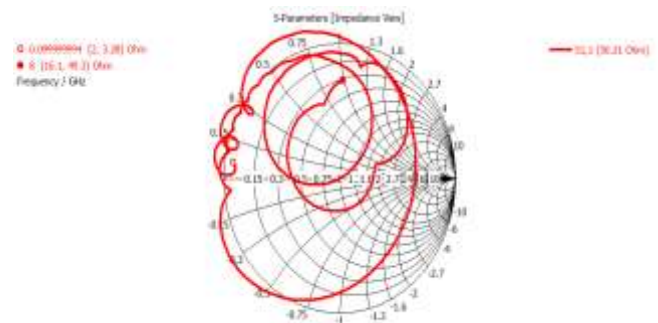


Fig. 3 The Smith chart of the proposed antenna

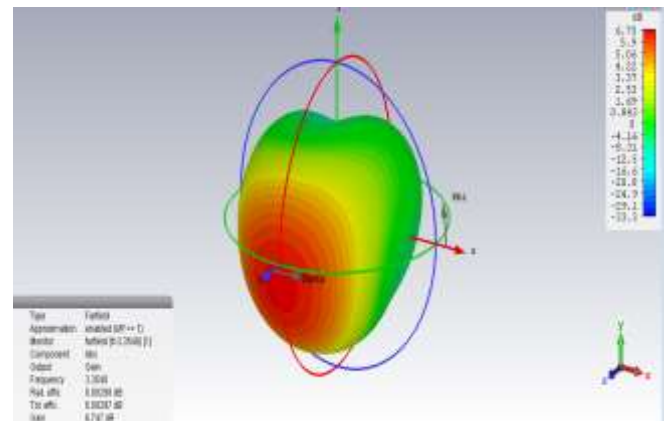


Fig. 4 The gain of the proposed antenna

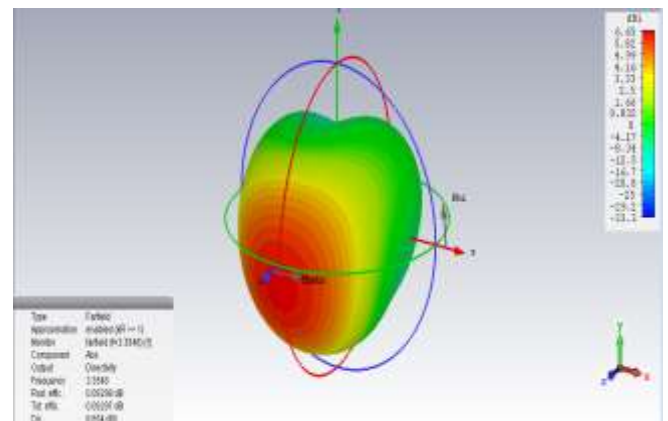


Fig. 5 The directivity of the proposed antenna

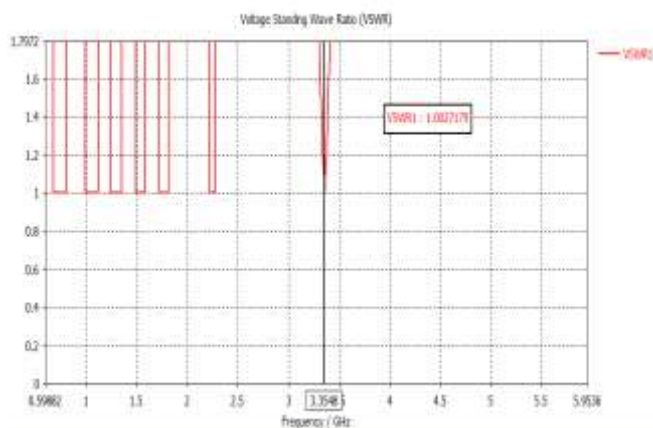


Fig. 6 The Voltage Standing Wave Ratio of the proposed antenna

IV. CONCLUSION

The proposed antenna employs Teflon as substrate which covers the frequency from 3.298GHz to 3.415GHz making it suitable to employed for the radio astronomy, civil and military radiolocation application.

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