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High Gain Stacked Slotted T-Shaped Microstrip Patch Antenna for LTE, IMT, WiMAX and USB Dongle Applications

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Abstract— In this paper, the distinct slotted structures have been used in various microstrip patch antenna designs in order to enhance bandwidth. This paper presents a stacked slotted T-shaped microstrip patch antenna for LTE, IMT, WiMAX and USB Dongle applications with a bandwidth of 2.05 GHz (2.4985 GHz to 2.7035 GHz). The Teflon material with dielectric constant (ϵ_r) 2.1 of thickness 8 mm has been used as substrate and copper has been used for patch, feedline and ground. The stacked substrate and defected ground has been employed to enhance the antenna performance parameters. The antenna is resonant at resonant frequency of 2.58 GHz and return loss of -23.19 dB. The proposed antenna has a gain of 6.059 dB and directivity of 5.984 dBi at resonant frequency of 2.58 GHz. The performance of antenna has been analysed in terms of return loss(dB), gain (dB), directivity (dBi), impedance and VSWR.

Keywords— LTE, Microstrip patch, IMT, Slotted, VSWR, WiMAX

I. INTRODUCTION

Communication systems are becoming compact in size and compact antennas with enhanced performance are required for modern communication systems. Microstrip patch antennas with improved performance are best suitable for wireless communication applications. A conventional microstrip patch antenna has narrow bandwidth, low gain and operates at single resonance frequency. However, they are planar structures and are compact in size, light in weight and they can be easily put inside the handset without protruding out [1][2][3]. Nowadays, the bandwidth enhancement and size reduction are major challenges in the antenna design. In order to elevate the broadband performance of microstrip patch antenna, the variety of antenna structure consisting of sector slots, notch or slits in patch etc. have been proposed by various researchers till date [4][5][6][7]. The slotted microstrip patch antenna has various advantages such as low profile, light weight and ease of fabrication [8].

In this paper, the design of slotted stacked microstrip patch antenna operating at frequency of 2.58 GHz is presented. The substrate is stacked and defected ground surface is employed in order to enhance the performance parameters of the proposed antenna. The simulated results shows that the proposed antenna has a good multiband characteristics to cover LTE (2.496-2.690 GHz), IMT (2.5-2.6 GHz), WiMAX (2.5-2.7 GHz) and USB Dongle (2.5-2.7 GHz) applications.

II. ANTENNA GEOMETRY

The antenna geometry has been shown in fig. 1. The proposed antenna has been designed using Teflon substrate having dielectric constant of 2.1 and thickness of 8 mm. The copper of thickness 0.1 mm has been employed both for radiating patch as well as ground surface. The antenna's substrate having dimensions of 100mm×100mm is provided with defected ground of dimensions 94mm×88mm has been shown in fig. 2. The antenna has a slotted 'T' shaped radiating patch with rectangular slot of dimensions 20mm×2mm. The substrate of the antenna's ground can be seen from the top view which has been shown in fig. 3.

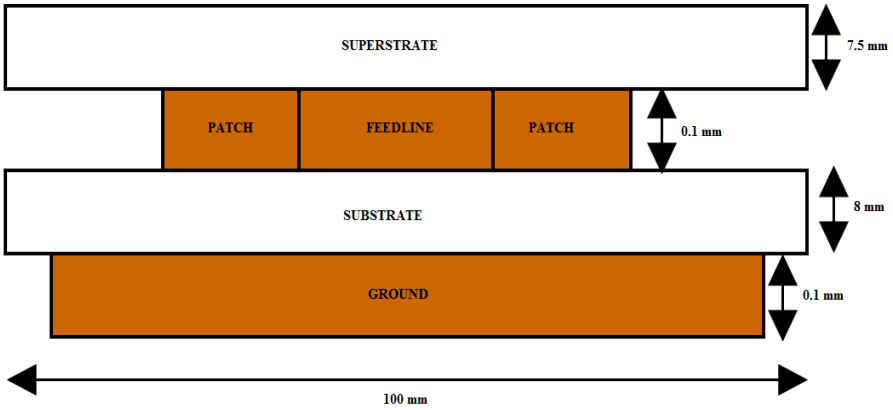

Fig. 1 Front view of the proposed antenna

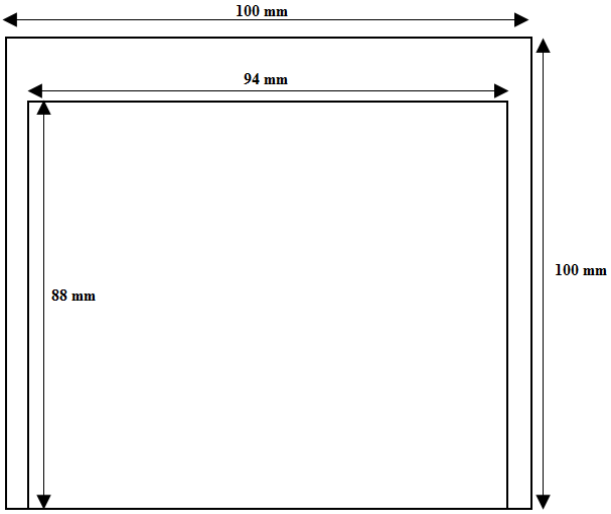

Fig. 2 Bottom view of the proposed antenna

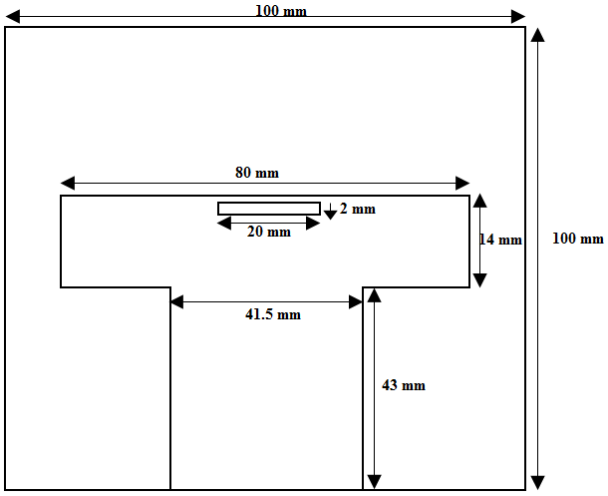

Fig. 3 Top view of the proposed antenna

III. RESULTS

The proposed antenna has been designed and simulated using CST Microwave Studio 2014. The performance of proposed antenna has been analyzed in terms of return loss (dB), directivity (dBi), gain (dB), impedance bandwidth (GHz), VSWR and impedance (ohms). The return loss plot of the proposed antenna has been shown in fig. 4 which indicates that the antenna has the resonant frequency of 2.58 GHz with the bandwidth of 2.05 GHz (2.4985 GHz to 2.7035 GHz). The gain and directivity of antenna is 6.059 dB and 5.984 dBi respectively at frequency of 2.58GHz which has been shown in fig. 5 and fig. 6. The VSWR plot of the proposed antenna design has been shown in fig. 7 which implies that the value of VSWR lies below the maximum acceptable value of 2. The Fig. 8 illustrates the Smith chart plot of the proposed antenna. It has been observed that the proposed antenna has impedance of 49.98Ω. The proposed antenna can be employed for LTE, IMT, WiMAX and USB Dongle applications.

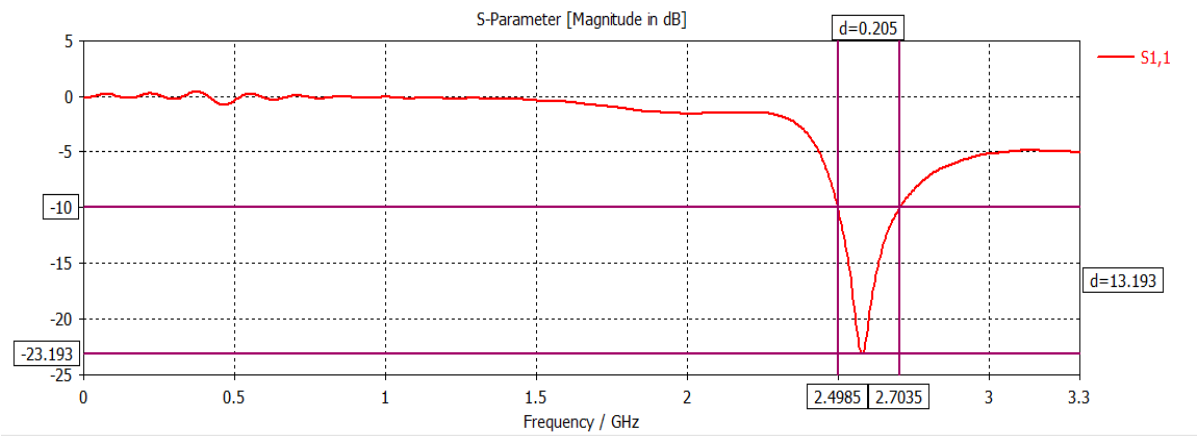

Fig. 4 Return loss plot of the proposed antenna at 2.58 GHz

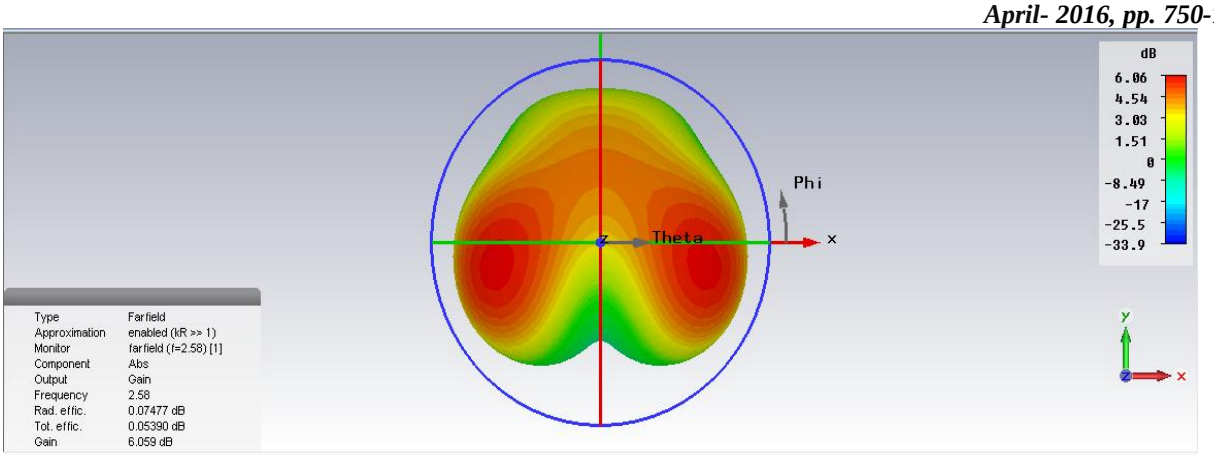

Fig. 5 Gain of the proposed antenna at 2.58 GHz

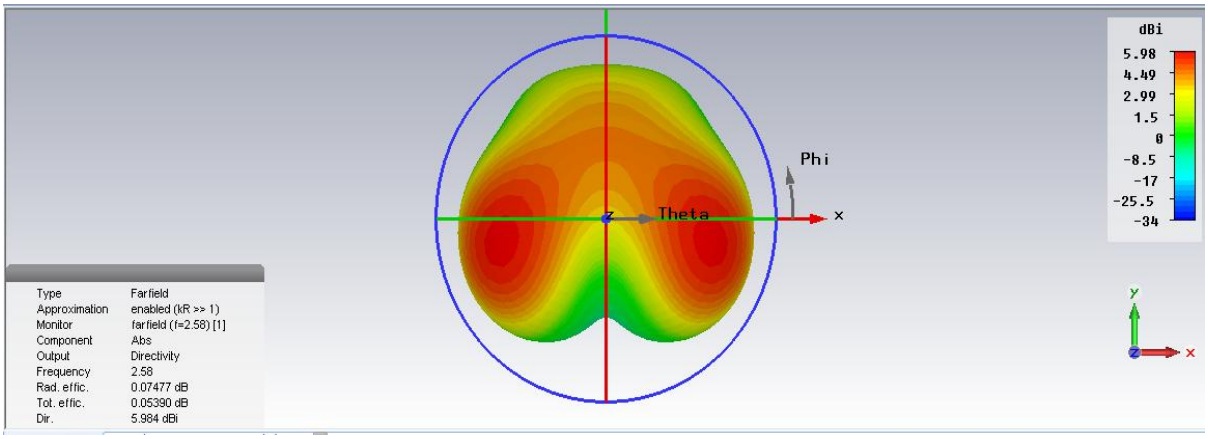

Fig. 6 Directivity of the proposed antenna at 2.58 GHz

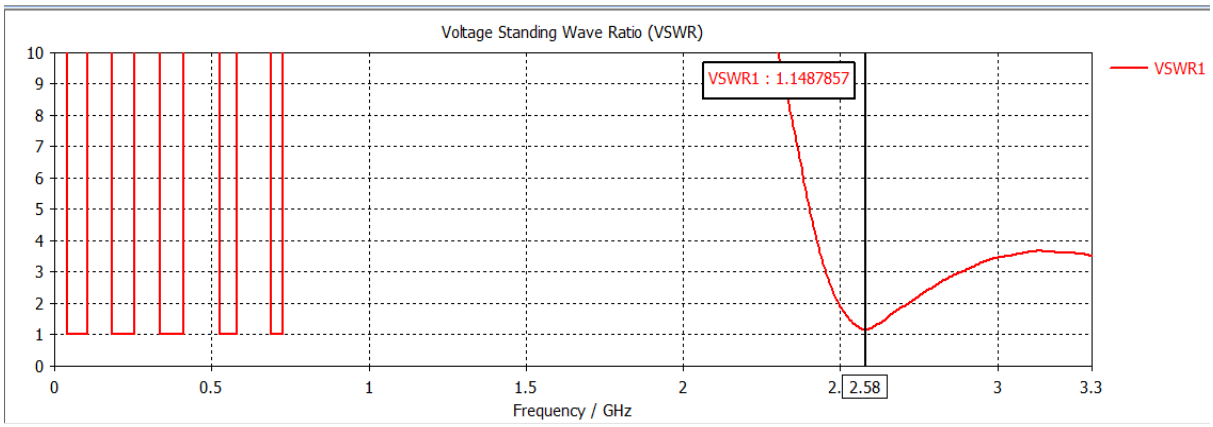

Fig. 7 VSWR plot the proposed antenna at 2.58 GHz

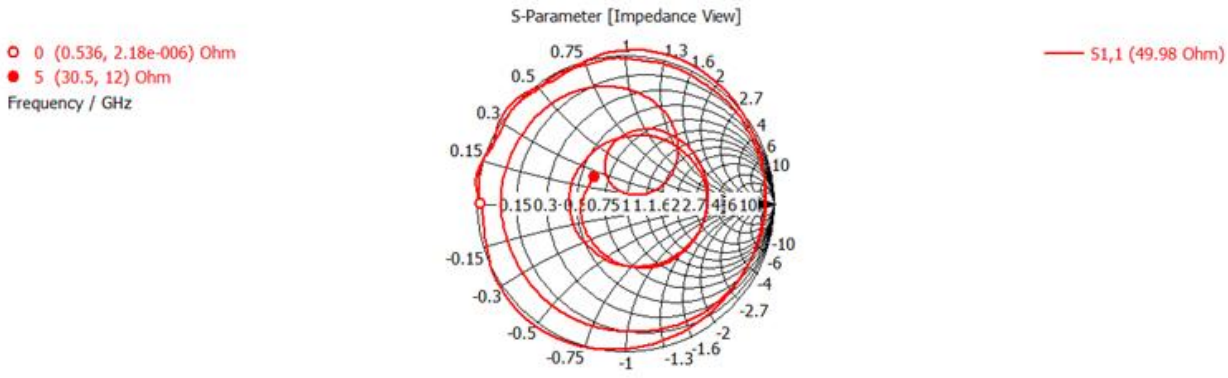

Fig. 8 Smith chart plot of the proposed antenna at 2.58 GHz

IV. CONCLUSIONS

The slotted stacked 'T' shaped microstrip patch antenna has been simulated and analyzed in CST Microwave Studio 2014. It has been observed that the proposed antenna has a return loss of -23.19 dB at resonant frequency of 2.58 GHz illustrating that the antenna is capable of radiating at the specified frequency with minimal reflection losses. The antenna has the gain and directivity of 6.059 dB and 5.984 dBi at resonant frequency of 2.58 GHz respectively. The antenna has impedance bandwidth of 2.05 GHz with resonant frequency of 2.58 GHz which makes it potentially suitable to be employed for LTE (2.496 GHz – 2.690 GHz), IMT (2.5 GHz –2.6 GHz), WiMAX (2.5 GHz – 2.7 GHz) and USB Dongle (2.5 GHz – 2.7 GHz) applications.

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