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Compact Dual Band Antenna using Bended Fork Resonator with DGS for 2.75/5.3GHz WLAN Application

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***Abstract*—In this paper a compact dual band antenna is designed that is going to be used Wireless Local Area Network(WLAN) application. Initially the dual band antenna is designed for 2.75GHz using bended fork resonator. Microstrip feed is used to give the input to antenna. Then the antenna is designed by combining bended fork resonator with a circular slot in Deflected Ground Structure(DGS). This antenna model is simulated using Advanced Design System(ADS) software. The designed antenna is having the good return loss of nearly -15dB at 2.75GHz and 5.3GHz and the size of the antenna is 7.475mm x 7.509mm which is printed on FR4_epoxy substrate with dielectric constant of 4.4 and the loss tangent of 0.02.**

Keywords— Wireless application; bended fork resonators; microstrip; WLAN; DGS; ADS.

I. INTRODUCTION

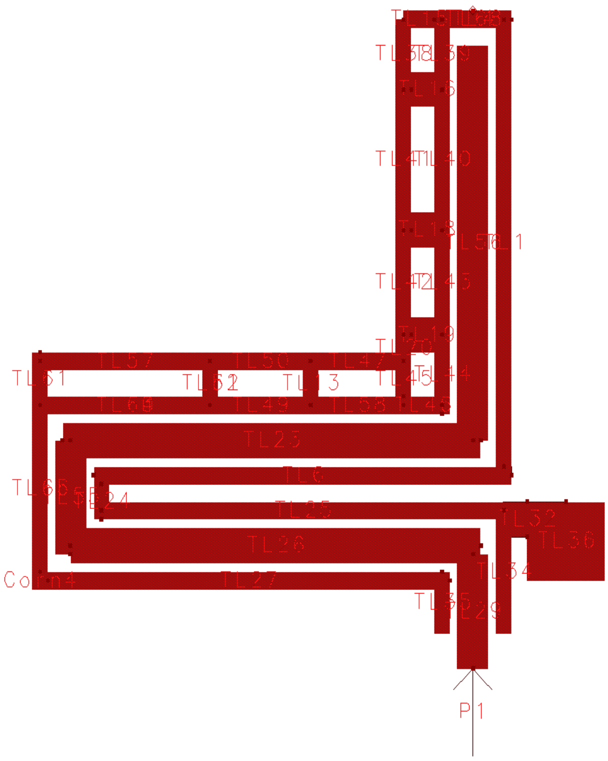
The great success in the mobile communication industry has fostered the development of various wireless communication systems, which require complex antenna systems to achieve high quality performance. For this, the multiple antenna approach has received much attention in both antenna and wireless communications sectors. Microstrip antennas are widely used for achieving directional radiation patterns due to their low profile, light weight, low costs, and flexible structure. Due to the rapid development of the wireless communication over the last few decades, especially for the WLAN communication, a number of antenna designs have been proposed to be with dual- or multi-band performances to satisfy WiMAX (2.5–2.69GHz, 3.4–3.69GHz and 5.25–5.85GHz) application. Nowadays modern communication systems require microwave components with high performance and small size, so compact antennas are required.

Under this situation, various antennas are reported to achieve dual-band or multi-band operations in the literature, such as the G-shaped monopole antenna [1–3], the double T shaped monopole antenna [4], the F-shaped monopole antenna [5], the L-shaped monopole antenna [6–8] and the triangle-shaped monopole antenna [9] etc. As can be recognized, all of them can only support one application. There are also designs for dual WLAN application [10–17]. In [10–14], though the proposed monopole antennas have good characteristics for WLAN application, they are complicated in structures and large in size. The microstrip fed circular disc monopole [15] can support tri-band operations, but with poor radiation patterns. The antennas in [16, 17] are small in size, but offer narrow impedance bandwidth characteristics in 2.4 GHz-band and 3.4 GHz-band.

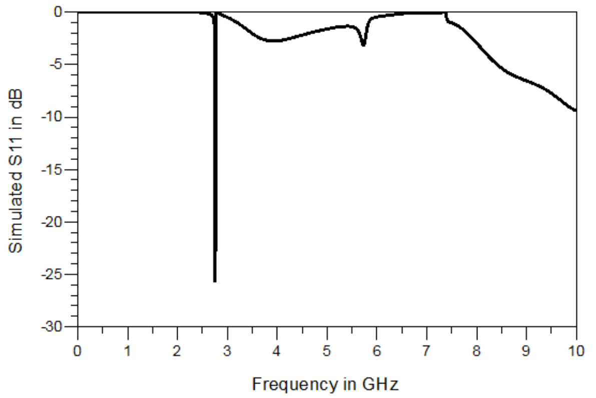
In this paper, a novel compact dual-band antenna, which is suitable for WLAN application, is proposed. Dual band characteristics are achieved by using bended fork resonator.

II. DESIGN OF DUAL BAND ANTENNA

A. Design of Bended Fork Resonator



(a)



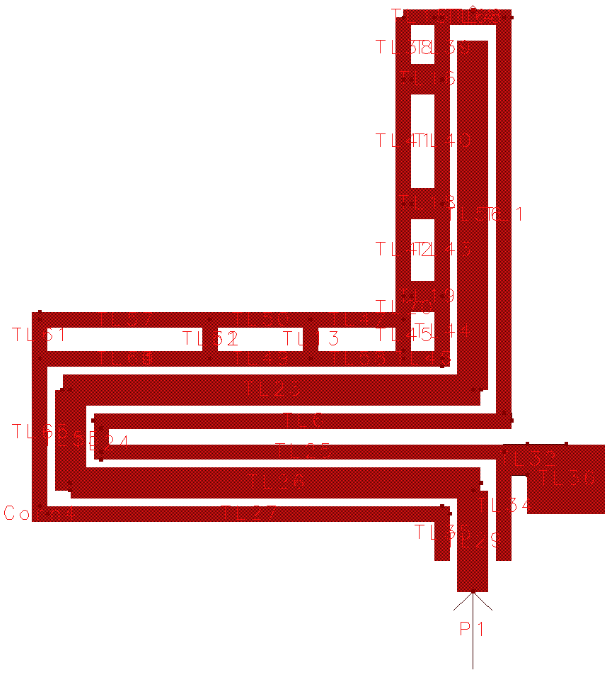
(b)

Fig. 1. Layout of bended fork resonator (a) and its simulated S11 result(b).

The bended fork resonator consists of three arms which are the respective impedance line with two arms connected. In this design the two arms are connected where the third arm is kept in between the two to resonate at a particular frequency of 2.75GHz is shown in Fig. 1. consisting of bended fork resonator.

B. Design of Dual Band antenna

The fork resonator generally provides both the lower and higher resonance. Here in designing the dual band antenna the lower resonance of the fork resonator is used and in this case there is more design freedom since the higher resonant mode of the fork resonator is not used. Initially the dual band antenna is designed by embedding bended fork resonator with finite ground structure as shown in Fig. 2.



(a)

(b)

Fig. 2. Bended fork resonator (a) and finite ground structure (b).

The simulated S11 result shows thst the finite ground provides higher resonance. But should be optimized in order to obtain required dual frequency relating wireless applications shown in Fig. 3.

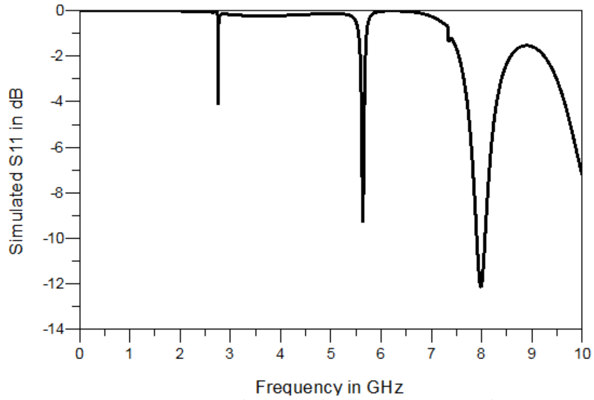
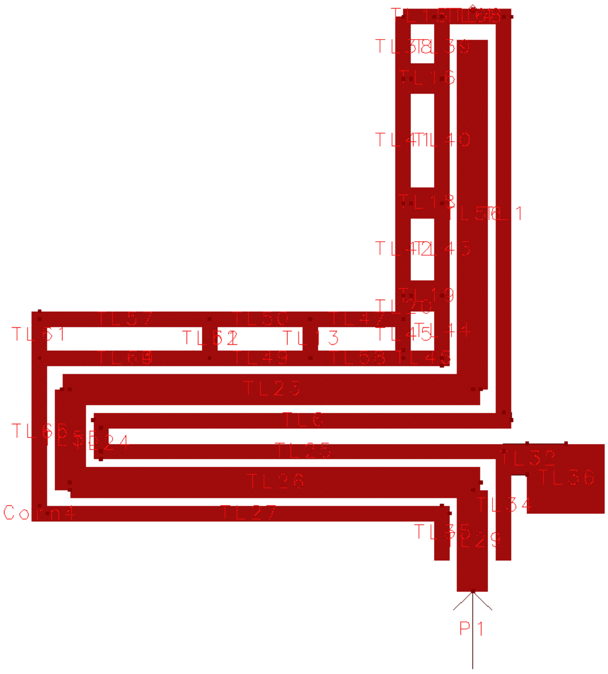


Fig. 3. Simulated S11 result of bended fork resonator with finite ground structure.

Then the DGS is employed in order to obtain proper resonating frequency. DGS is an etched periodic or non-periodic cascaded configuration defect in ground of a planar transmission line (e.g., microstrip, coplanar and conductor backed coplanar wave guide) which disturbs the shield current distribution in the ground plane cause of the defect in the ground. This disturbance will change characteristics of a transmission line such as line capacitance and inductance. In a word, any defect etched in the ground plane of the microstrip can give rise to increasing effective capacitance and inductance.



(a)

(b)

Fig. 4. Bended fork resonator (a) and DGS (b).

The simulated S11 result shows thst the DGS provides multiple resonance. The required frequency must be kept and other frequencies are suppressed by using slotting technique shown in Fig. 5.

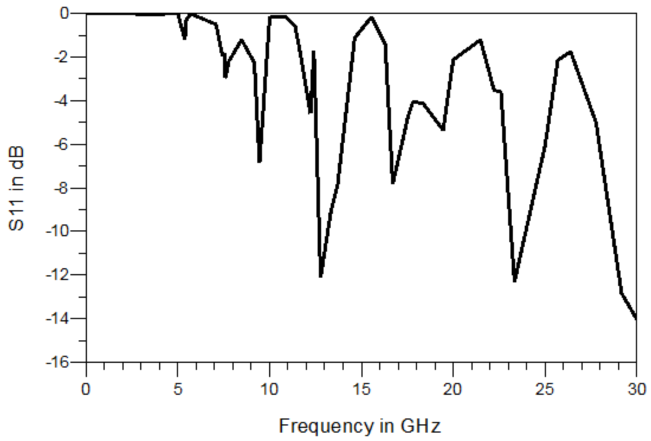
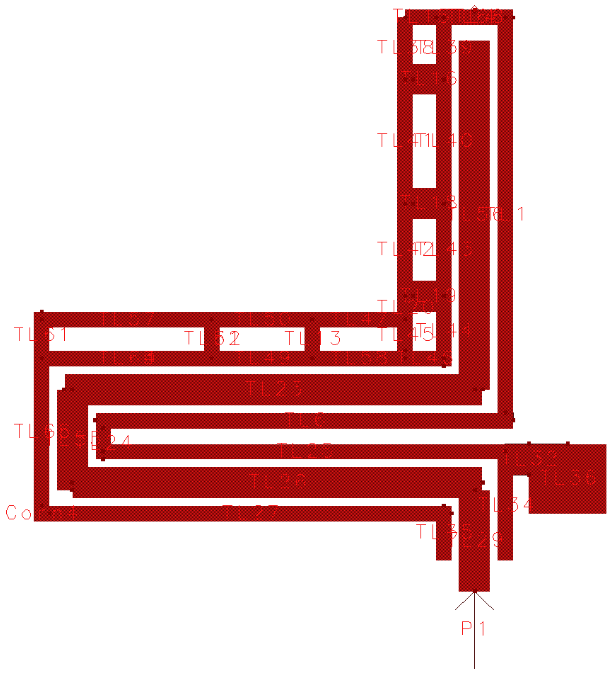
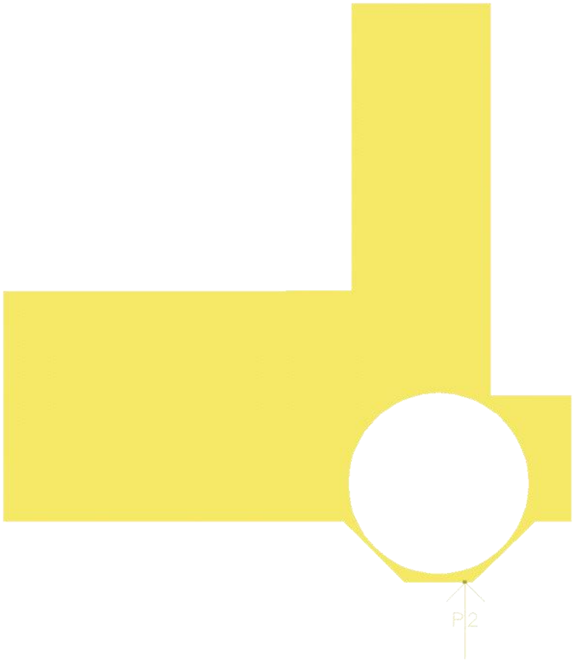


Fig. 5. Simulated S11 result of bended fork resonator with DGS.

In this design bended fork resonator integrated with DGS which will give the required resonance frequency and increase in return loss in antenna, which is designed by selecting the width of the center arm of the fork resonator and the radius of the circular slot in DGS as 0.367mm and 1.212mm respectively. The DGS dimensions are similar to that of dimensions used in Fig. 4(b). By choosing the proper circular slot dimension and center arms width the operating frequency is made to resonate at 2.75GHz and 5.3GHz frequencies with good return loss of 15dB which is shown in Fig. 7. The designed antenna is optimized for 2.75GHz and 5.3GHz frequencies which is very narrowband is suitable for WLAN applications as shown in Fig. 6.



(a)



(b)

Fig. 6. Bended fork resonator (a) and DGS with circular slot (b).

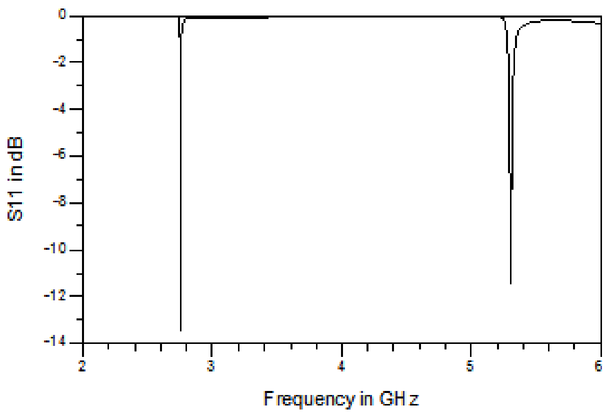
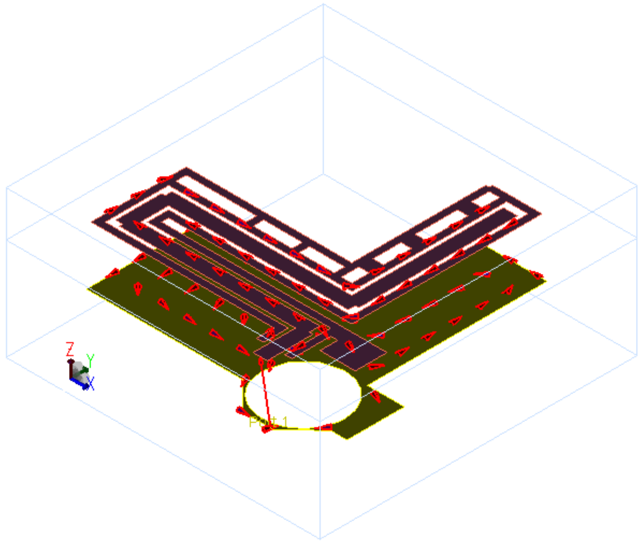


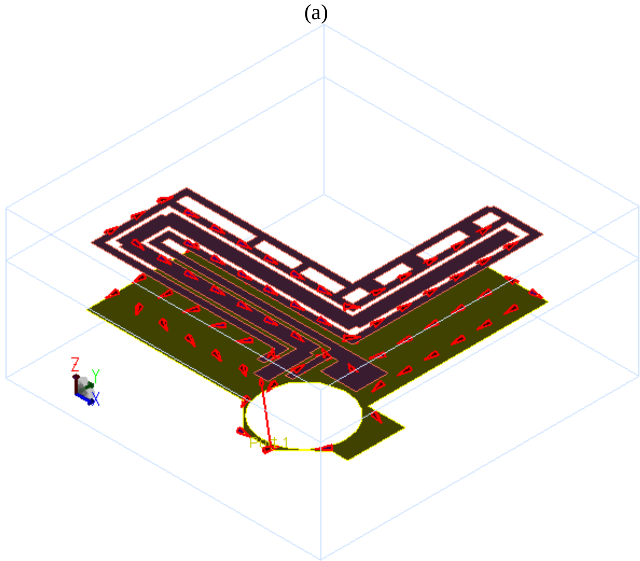
Fig. 7. Simulated S11 result of bended fork resonator with DGS consisting of circular slot.

III. RESULTS AND DISCUSSIONS

The current distribution for 2.75GHz and 5.3GHz frequencies at zero phase are obtained from the ADS software after simulation is given in the Fig. 8.



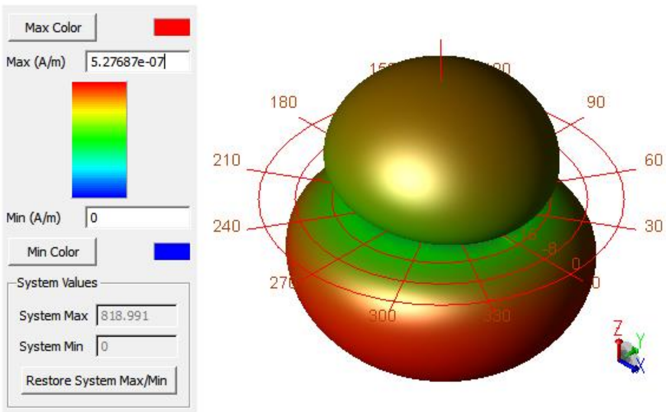
(a)



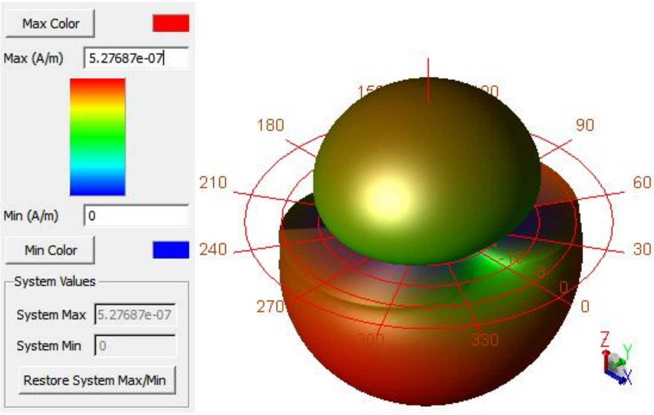
(b)

Fig. 8. Current Distribution at 2.75GHz (a) and 5.3GHz (b) frequencies.

The 3D radiation pattern of the antenna shows that the antenna is omnidirectional for both 2.75GHz and 5.3GHz frequencies is shown in Fig. 9.



(a)



(b)

Fig. 9. 3D Radiation Pattern for 2.75GHz (a) and 5.3GHz (b) frequencies.

The gain and directivity of 2.75GHz and 5.3GHz frequencies are 4dBi and 5dBi for 2.75GHz and 6dBi and 6dBi for 5.3GHz respectively.

IV. CONCLUSION

In this paper, the performance of a dual band antenna has been presented. The antenna operates well at return loss of nearly -15dB at 2.75GHz and 5.3GHz frequencies for WLAN application and the size is 7.475mm x 7.509mm which is very compact compared to other design. The narrow band and good return loss of the antenna are achieved by properly selecting the dimensions of the circular slot and the center arm of the fork resonator. In future this work is extended for multi band wireless applications.

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