Circular shaped UWB Antenna for Wireless Applications

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Abstract

A Circular-shaped double-sided UWB antenna is presented. The total size of the proposed antenna is 24mm× 24mm, printed on 1.6 mm FR4 thick substrate. In this a modified circular-shaped radiator is studied with modified ground. The circular-shaped radiator and the ground plane are used for the improvement of impedance matching. The suitable combination of the fed and the radiator provides wide band. The result predicts that the antenna is suitable for wireless applications.

Keywords: UWB, Microstrip feed

I. INTRODUCTION

In recent years wireless technology has attracted the attention of many researches in various fields. The major issue faced by the researchers is to design compact and multi-functional antenna that can be integrated with handy systems, as it reduces the complexity of system. Generally microstrip antenna has various advantages like light weight, easy of fabrication, low profile and easy integration with circuits. In the literature various methods for bandwidth enhancement have been reported such as shorting pins [2], semi-elliptic slot [3] and bow-tie [4]. Shapes like octagonal-shaped, tapered-slot [5-6]. In [7] a circular slot feed with trident-shaped was reported. Inverted-L-Shaped and hexagonal shaped are reported in [8-9].

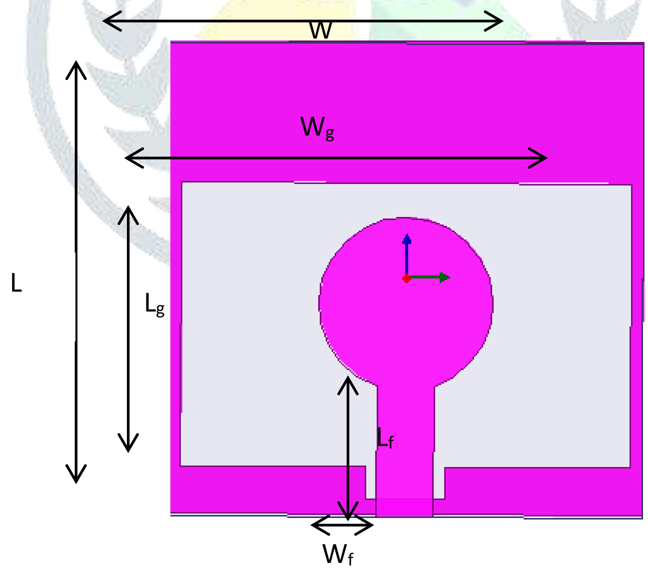


Fig. 1. Configuration of the UWB antenna

A modified circular-shaped antenna of 22 mm× 24 mm with modified ground plane is reported to carter the present communication system. Bandwidth enhancement at lower frequency is achieved by etching a slot on the lower side near fed. Next section discuss about the antenna design and the variables that affect the performance of the antenna

Table 1
Various configuration of the designed antenna

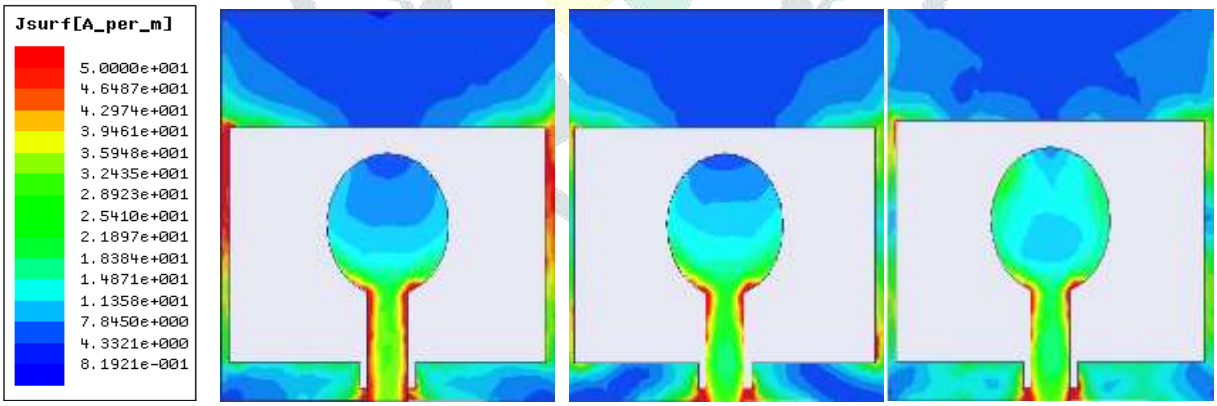
Parameters	L	W	W_f	L_f
Units(mm)	22	24	3	6
Parameters	r	W_g	L_g	
Units(mm)	2.75	18	10.7	

II. DESIGN ANALYSIS

The major drawback of microstrip antenna was a narrow bandwidth. But with appropriate implementation of certain techniques they can generate wideband. Fig.1 depicts the front view of reported circular-shaped antenna. It is printed on commercially available FR4 dielectric substrate. Initially complete ground plane was considered and after that in order to achieve impedance bandwidth modifications were done. At the back of the radiator a slot was etched of length and width of L_g and W_g.. Further a slot near a feeding-line was etched in order to achieve lower band. The radiator consists of a circular-shape of radius 2.75mm and fed by a microstrip line of $L_f \times W_f$. The overall size of the antenna is very small so the ground plane also act as a radiator.

A. Current Distribution

Simulated surface current distribution at (a) 6 GHz (b) 6.4 GHz and (c) 9.2 GHz frequencies is shown in fig 3. The lower frequency is affected by the rectangular slots on the ground, higher concentration of current at the rectangular slits on both sides of the ground plane, clearly revealed in Fig 3 (a), Similarly, Fig3 (b) states that the higher concentration of current is on the joining of the feed and the circular-shaped radiator and on the corner of the ground plane. In Fig 3(c) It is seen from the figure that the currents are dispersed unequally somewhere higher and other have minimum current concentration.



(a) (b) (c)

Fig. 3. Simulated Current distribution of the circular-shaped antenna.

III. RESULT AND DISCUSSION

In this section, the simulated results as S parameters, group delay and patterns are presented after optimization. The software Ansoft HFSS ver. 14 solver is used to analyse the design. Figure 4 depicts S11, the variation of S-parameter and frequency and from figure it is seen that the antenna covers the ultra wide band from 3.1-10.6 GHz.

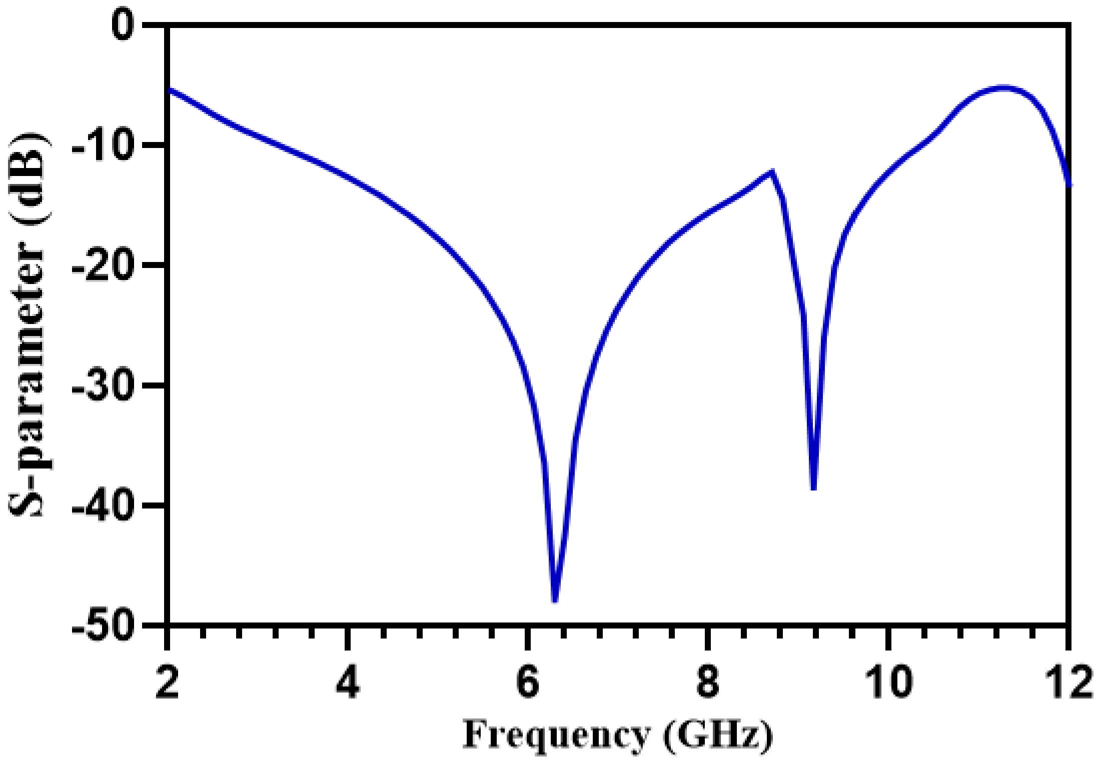


Fig. 4. S_{11} of the circular-shaped antenna.

Group delay depicts the distortion of the transmitted pulse and is also a substantial factor. Figure 5 shows the constant group delay i.e. around 1 ns (almost constant) for the wide band.

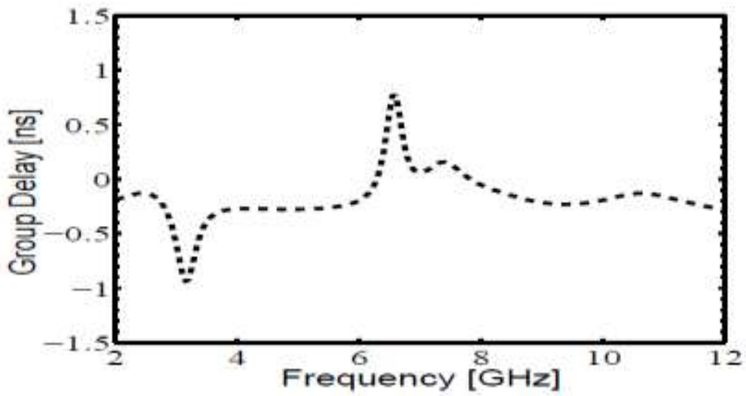
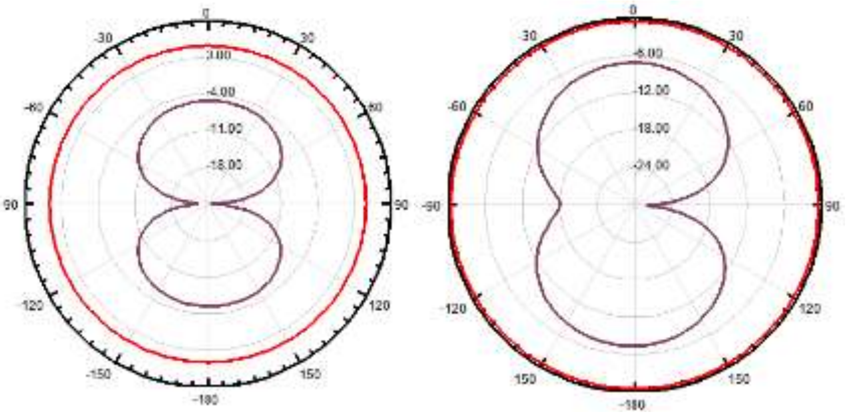


Fig. 5. Delay of circular-shaped antenna.

Fig.6 (a)-(b) depicts, radiation pattern at two resonant frequencies (a) 6.4 GHz (b) 9.2 GHz. At 6.4 GHz (lower frequency) it is observed that the omnidirectional patterns exist in the E-plane and at higher frequencies there are fewer omnidirectional patterns due to higher-order resonant modes.



(a) 6.4 GHz (b) 9.2GHz

IV. CONCLUSION

A Circular-shaped microstrip-fed antenna is presented in this article. The simulated results show S_{11} from 3.1 to 10.6 GHz which shows that the antenna convers wide band with good impedance matching. It is suitable for various applications as it shows wide band characteristics with stable pattern and constant group delay.

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