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An Ultra-wideband Asymmetric Feed Micro-strip Patch Antenna for Sub-6 GHz Applications

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Abstract

The In this article, an asymmetric feed micro-strip patch antenna for frequency band of sub-6 GHz is designed and implemented. The inverting F-slot cut from the radiating patch is used to achieve three resonating bands at 1.35 GHz, 2.65 GHz and 4.85 GHz. By using partial ground, an ultra-wideband from 0.65 GHz- 5.8 GHz is obtained. The simulated peak gain of 3.6 dBi is obtained over the operating frequency band. A prototype of the proposed micro-strip patch antenna is fabricated and measured. The Ansys-HFSS 19.1 software is used to simulate the results. A good agreement between the simulated and measured return loss parameters validate the good performance of proposed antenna within the operating frequency band.

Keywords: Sub-6 GHz, partial ground, radiating patch, wideband.

1. Introduction

In modern wireless communication system, the increasing demand of wider bandwidth, high data rate is the key challenges for commercial and satellite applications [1]. Sub-6 GHz frequency bend is the possible solution to achieve high data rate for various applications. 5G bands are classified as sub-6 GHz and millimeter wave bands. The bands below 6 GHz is sub-6 frequency band and has been proposed to work as 5G in different countries between 3.4GHz to 5GHz in the countries. Microstrip patch antenna plays an important role in wireless communication due to its low profile, simple planar structure and conformal nature [3]. An antenna is a radiating element that is used to transmit and receive the electromagnetic waves [4]. The numerous techniques have been proposed to enhance the bandwidth of MPAs, such as increasing the thickness of the substrate [5, 6], decreasing the substrate dielectric constant [7], using stacking layer [8] and complimentary rhombus resonator [9].

In this article partial ground plane is used mentioned above or defect ground plane that improves the front to back ratio of the antenna and BW is increased by suppression the surface wave. The proposed antenna design is simulated and fabricated. The simulated results are in good agreement with the fabricated results, which illustrates that the proposed antenna can be a good candidate for practical ultrawideband applications. The remaining part of the paper is organized as follows. In section II, Design specification of proposed antenna is described. In section III, results and discussion is explained. The paper is concluded in section IV.

2. Design Specification of Proposed Antenna

Fig.1 illustrate the schematic geometry of proposed antenna. The proposed antenna is fabricated on FR-4 substrate with permittivity (εr) of 4.4 with substrate height h=1.6mm. The material used for the ground is of copper with h=0.035mm.

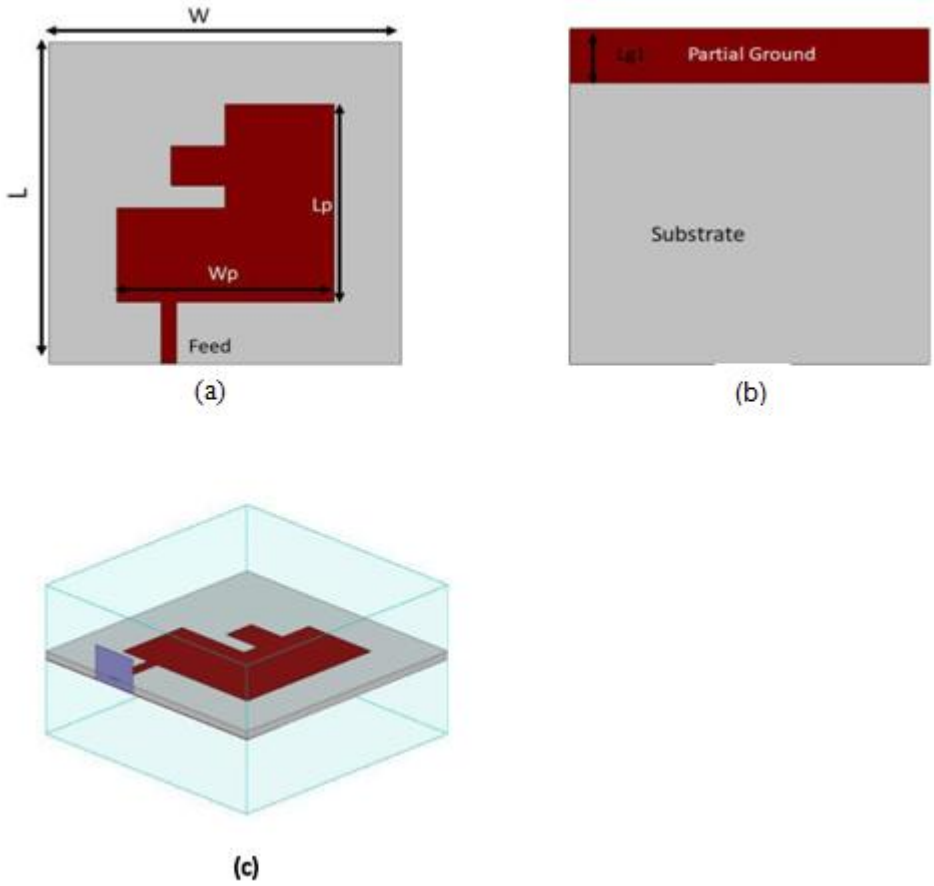


Fig-1 Simulated Antenna Design (a)Top (b) Bottom View (c) Side View

The partial ground is used in ground side to enhance the characteristics of antenna. The design dimensions are shown as in Table 1.

Table.1 Antenna Design parameters

Sr No.	Parameters	Dimension(mm)
1.	L	65
2.	W	65
3.	Lp	40
4.	Wp	40
5.	Lg1	10.5

3. Results and Discussion

The fabricated model of the proposed antenna is shown as in Fig.2.

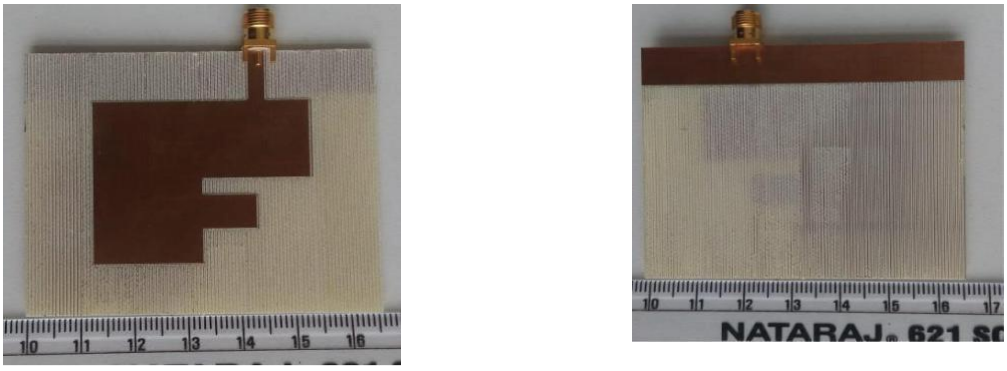


Fig-2 Fabricated Antenna Design (a) Top (b) Bottom View

The simulated return loss of the proposed antenna is shown as in Fig.3. The bandwidth attained for - 10-dB is 5.18 GHz from 0.62GHz-5.8GHz.

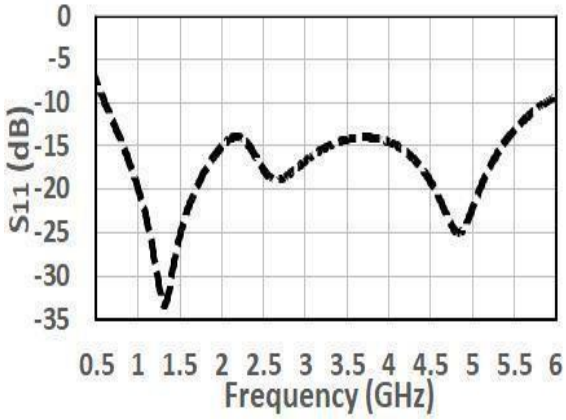


Fig-3: Return Loss (Simulated)

The VSWR (Voltage standing wave ratio) of antenna is another parameter, which is responsible for impedance matching of antenna. The VSWR plot of antenna design is shown as in Fig4. The graph shows that over the operating band VSWR response is less than 2.

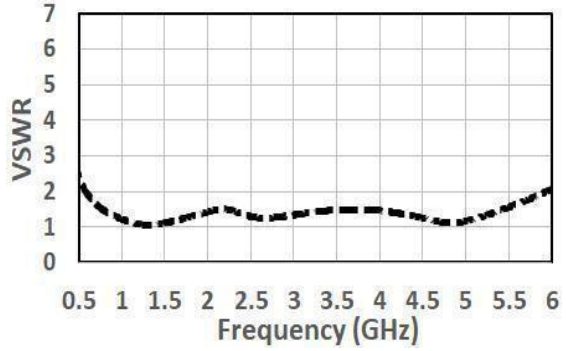


Fig-4: VSWR plot of (Simulated)

The peak gain of proposed antenna is illustrating in Fig.5. Over the operating frequency band, the peak gain of antenna is 3.8dBi.

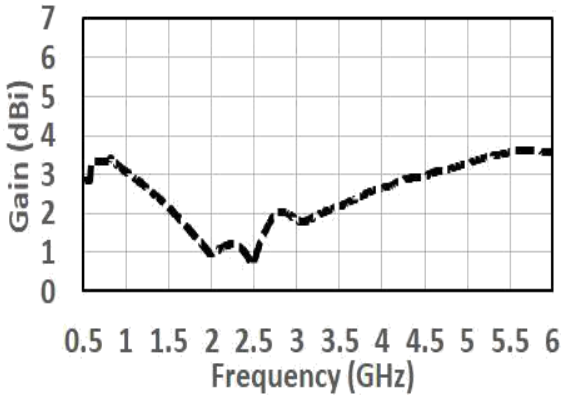
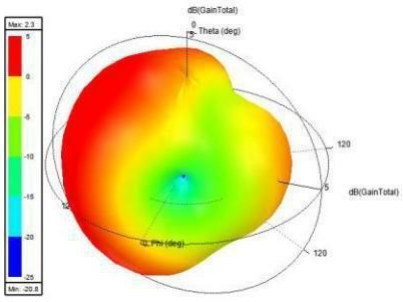


Fig-5: Gain plot of the antenna

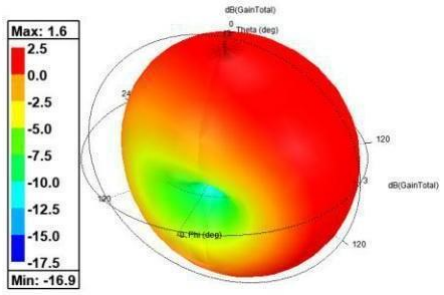
The 3D gain plot of the proposed antenna at 1.35GHz, 2.65GHz and 4.85GHz is shown as in Fig.6.

- At f=1.35GHz:



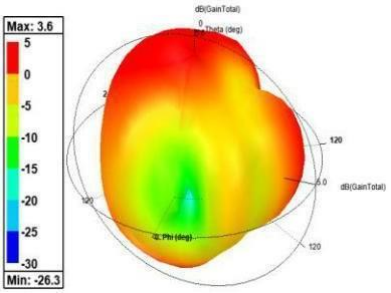
(a) 3D gain plot at f=1.45GHz

- At f=2.65GHz:



(b) 3D gain plot at f=2.65GHz

- At f=4.85GHz:



(c) 3D gain plot at f=4.85GHz Fig.6: 3D Gain plot of Proposed antenna

The simulated results are validated using with fabricated results. The fabricated results have good agreement with simulated results. The comparison between simulated and measured result is shown as in Fig.7.

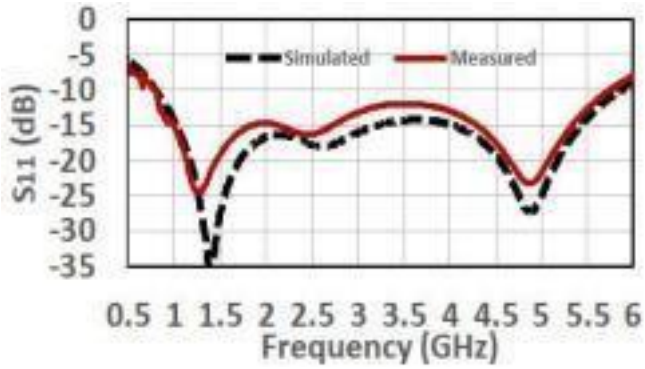


Fig-7: Return Loss of simulated and fabricated of proposed antenna

4. Conclusions

A microstrip patch antenna with asymmetric feed is simulated and fabricated for sub-6 GHz frequency band. The proposed antenna is designed and simulated using Ansys HFSS 19.1 software. The inverting F-slot cut from the radiating patch is used to achieve three resonating bands at 1.35 GHz, 2.65 GHz and 4.85 GHz. measured results are quite similar to simulated results. Using partial ground, the fractional bandwidth of 161% is achieved. The -10dB impedance bandwidth of the proposed antenna is from 0.62GHz-5.8GHz. The peak gain of the proposed is 3.8dBi over the operating frequency band.

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