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Dual Band U-Shaped Microstrip Antenna

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ABSTRACT

A design of a dual band coaxial fed microstrip U-shaped antenna is presented. It contains a metallic U-shaped patch printed on the substrate and a slot etched in the ground. The antenna has an overall size of 36mm x 34mm, suitable for portable applications. A Rogers RO4350 substrate with a relative permittivity of 3.66, tangential loss of 0.004, and thickness of 1.524mm is used for implementation. The simulated and measured results show that the antenna operates at frequencies 1.22GHz, and 5.7GHz with bandwidths 20MHz, and 90MHz respectively. It fulfils the requirements of GPS and Wireless Sensor Networks applications. The design criteria of this antenna as well as the outcome of the experimental results are presented in this paper. The measured and simulated results are in good agreement.

1. Introduction

In recent years, the wireless communication systems around the world faced rapid growth and development. Mobile phones currently operate at different frequency bands, and the introduction of new technologies such as GPS and wireless sensor networks placed a demand on the industry for the design of compact, low profile antennas that were able to operate at multiple frequency bands. Microstrip antennas have found different application in the wireless communication industry due to their numerous attractive features such as ease of fabrication, low cost, simple structure and near omnidirectional radiation characteristics. A lot of multiple frequency antennas have been proposed in literature [1-10]. In this article, a design of a dual band antenna is proposed, using a coaxial cable for feeding. The antenna is consisting of a U-shape patch printed on the substrate and a U-shape slot etched in the ground. It is required to operate at frequencies 1.22GHz, and 5.7GHz, with bandwidths of 20MHz, and 90MHz respectively. Various parameters of the antenna are tested and the reflection and radiation characteristics are presented. The antenna is fabricated and the

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return loss is measured using the vector network analyzer. The measured and simulated results are in good agreement.

2. Antenna Design

The dual band antenna is implemented on a Rogers RO4350 substrate with a relative permittivity of 3.66, tangential loss of 0.004, and thickness of 1.524mm, the length and width of the substrate is 36mm and 34mm respectively. It has two U-shapes as shown in Figure 1. The first one is a patch printed on the substrate with L_p=26mm, W_p=26mm, and K_p=5mm, and the second one is a slot etched in the ground has L_s=13mm, W_s=32mm, and K_s=4.63mm. A coaxial cable is used for feeding. It is fabricated on a Rogers RO4350 substrate with a relative permittivity of 3.66, tangential loss of 0.004, and thickness of 1.524mm and a SMA connector is welded to the coaxial feed of the antenna as seen in Figure 2. The antenna has two resonances; the first one is centered at 1.22GHz with bandwidth of 20MHz, while the second one is centered at 5.7GHz with bandwidth of 90MHz. This antenna meets the bandwidth requirements of GPS and wireless sensor networks.

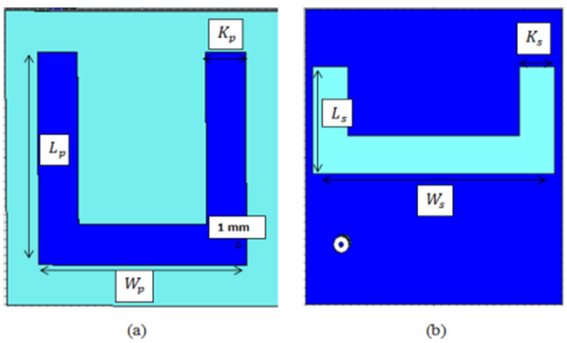


Fig. 1. U-Shaped Microstrip Antenna (a) Front view (b) Back view

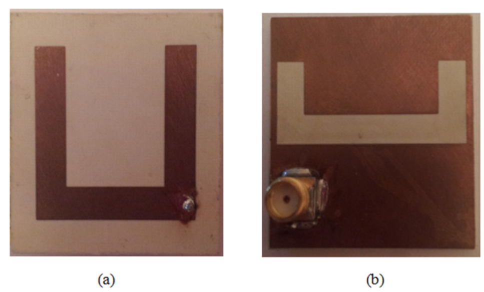


Fig. 2. Fabricated U-Shaped Microstrip Antenna (a) Front view (b) Back view

4. Results and Measurements

The return loss of the antenna is measured using a vector network analyzer as shown in Figure 3. It is clear that the simulation and measured results meet the design requirements where the antenna resonates at 1.22GHz, and 5.7GHz, with bandwidths: 20MHz, and 90MHz respectively, as illustrated in Figure 4, which covers the bands of GPS and Wireless Sensor Network.

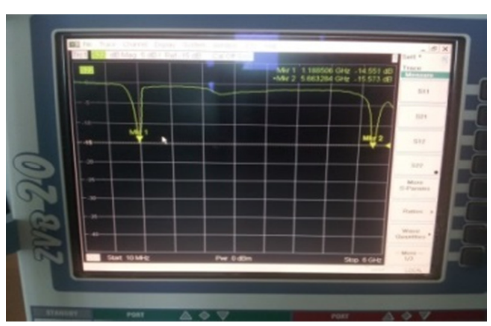


Fig. 3. Measured Return Loss of the Antenna

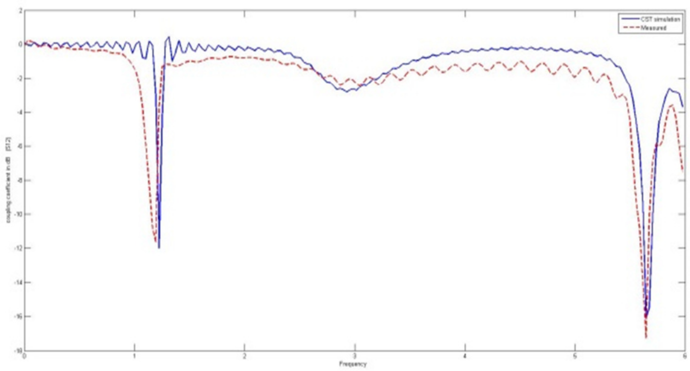
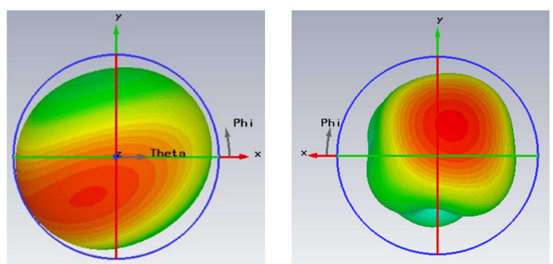


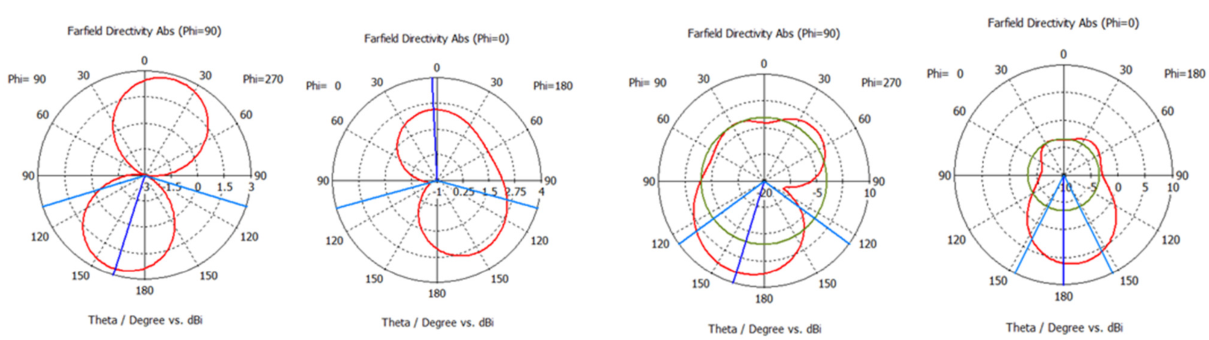
Fig. 4. Measured and Simulated Return Loss of the U-Shaped Microstrip Antenna

More over there is a good matching between the measured and simulated results. **Figure 5** shows, the 3D radiation pattern of the antenna at the two frequency bands, where the directivities are 3.021 dBi, and 6.823 dBi. E-plane and H-plane are illustrated in **Figure 6**.



(a) (b)

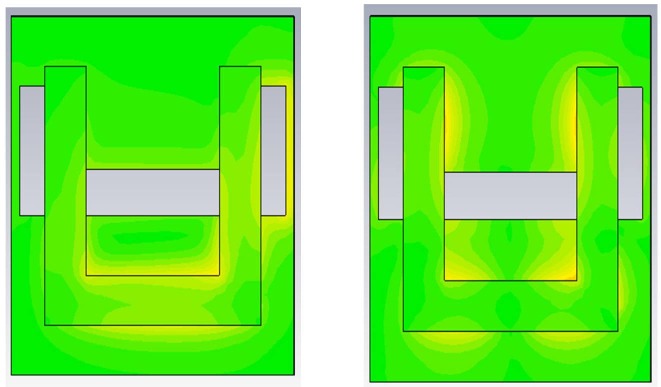
Fig. 5. 3D Radiation Pattern at (a) f = 1.22GHz (b) f = 5.7GHz



(a) (b)

Fig.6. E-Plane and H-Plane (a) f = 1.22GHz (b) f = 5.7GHz

The surface current of the U-shaped antenna is depicted in Fig. 7. It is clear that the current is outlined at antenna edges accurately.



(a) (b)

Fig. 7. Surface Current of the U-Shaped Antenna at (a) f = 1.22GHz (b) f = 5.7GHz

4. Conclusion

A compact, dual band microstrip antenna for GPS and Wireless Sensor Networks applications is presented and discussed. It has overall dimensions 36mm x 34mm and fabricated on a Rogers RO4350 substrate. It resonates at 1.22GHz, and 5.7GHz, with bandwidths: 20MHz and 90MHz respectively. The return loss is measured using a vector network analyzer. The measured and simulated results are in good agreement with one another. The design can be effectively used for constructing compact antennas for wireless devices.

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