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Ultra Wideband patch antenna for wireless communication

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ABSTRACT

This antenna operate for 700 MHz to 11.1 GHz who covering all the desired frequency bands, such as GSM 900, DCS 1800/1900, IMT-2000, WIBRO, WLAN, DMB, and UWB. Simulation and experiment results of the designed wideband antenna are presented.

Keywords: wireless communication, ultra wideband, patch antenna

1 INTRODUCTION

Recently, wireless communication technology development had led to a formidable explosion of cellular telephones and satellites for television. Furthermore, users demand, requiring more and more in terms of flow, reliability and safety is continuously increasing, which may rapidly lead to overloaded RF bands. In order to find a technology which will make theses requirement possible, several efforts directed by many research and development organizations has been carried out all over the world. The aim is to propose standards that allow mobile telecommunications to provide services in Ultra Wide Bands (UWB).

UWB wireless technology is being considered as a good solution to overcome data rate bottlenecks incurrent mobile networks. This ability is due to the fact that it transmits data over a very large chunk of the frequency spectrum. As currently approved by the U.S. Federal Communication Commission, it utilizes 7.5 GHz of spectrum between 3.1 GHz and 10.6 GHz. It has been demonstrated that the monopole antenna wideband [1], [2], [6] is promising to be used for mobile phone, wireless communication and microwave.

In this paper, we propose an Ultra Wideband patch antenna for wireless communication operate for 700 MHz to 11.1 GHz. It consist of a rectangular patch with a simple meander line slot is inserted into the radiating patch, and a partial ground plane. The excitation is a 50 Ω microstrip line. The antenna is printed on Duroid substrate with dielectric constant of 2.17 and substrate thickness of 1.575 mm. Investigations based on experiments and simulations were conducted. Simulation tries were performed using the commercially available simulation software HFSS.

2 ANTENNA DESIGN

As depicted in figure 1, the configuration of the proposed small planar monopole antenna which consists of a rectangular patch with a single slot on the patch, and a partial ground plane. The antenna, which has compact dimensions of 21 x 21 mm^2, is constructed on Duroid substrate with thickness h of 1.575 mm and relative dielectric constant ε_r of 2.17. The dimension of the patch is 11.2 X 10.5 mm^2 and the dimension of the partial ground plan is 5.9 X 21 mm^2. The dimensions of partial ground plan are also recognized as important parameters for determining the sensitivity of impedance matching at lower frequencies [1], [3] and [4]. And the height between the ground plane and the patch as important parameters, the effect of the variation this parameter on the bandwidth performance will be explored in the experimental results section (III). The optimal dimension of slot determined from many simulation results are as follows: L_1=6.5 mm, W_1=0.62 mm, L_2=0.5 mm, W_2=1 mm, L_3=6 mm, W_3=0.62 mm, L_4=0.5 mm, W_4=0.78 mm, L_5=6 mm, W_5=0.6 mm, L_7=6 mm, W_7=0.5 mm, L_8=0.62 mm, W_8=1 mm. The excitation is a 50 Ω microstrip line.

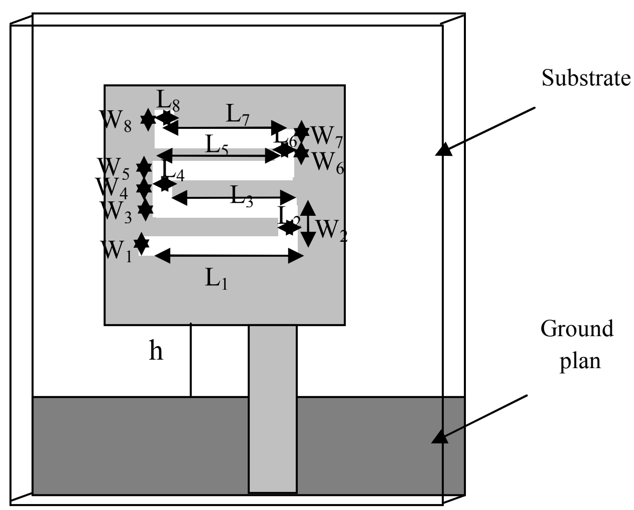


Figure.1 : Geometry of the antenna.

3 EXPERIMENTAL RESULTS

In this section, we give the simulation and measure results of the above UWB antenna. Figure 2 shown the prototype Ultra Wideband patch antenna for wireless communication.

Figure. 2. UWB antenna prototype

3.1 Return loss

Based on the design parameters illustrated in figure 1, the proposed antenna was constructed and its characteristics were analyzed. The numerical analyze was performed using the simulation software High Frequency Structure Simulation (HFSS) [5]. To demonstrate the effects of the variation of the height between the ground plane and the patch on the bandwidth performance, the return losses are simulated, as shown in figure 3. It is clearly observed that the -10 dB bandwidth significantly changes with varying h.

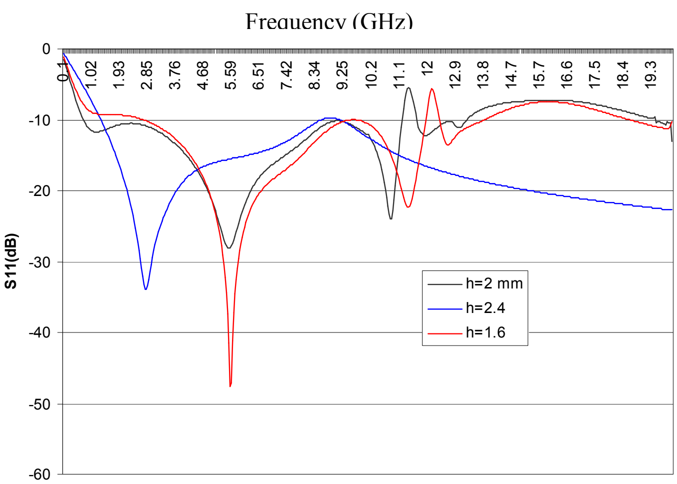


Figure. 3. Simulation returns loss the antenna for difference value of h

As a result, the impedance bandwidth can be optimized with of 2 mm. The simulated and measured return losses with his height are presented in figure 4. The realized antenna satisfies the -10 dB return loss requirement form 700 MHz to 11.1 GHz.

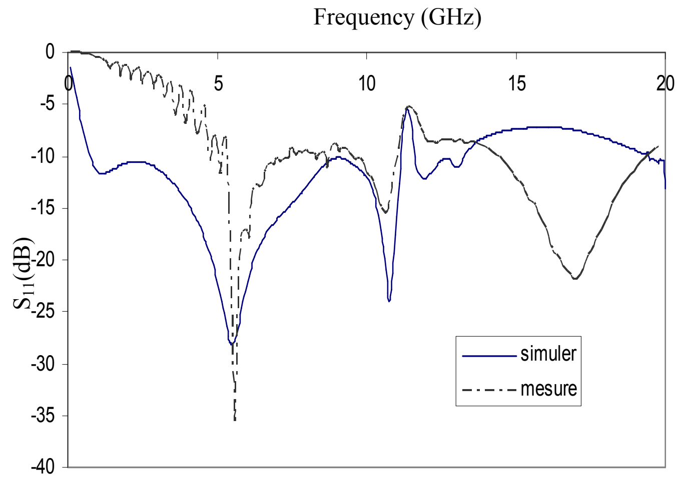


Figure.4. Measured and simulated return losses for the antenna.

3.2 Radiation patterns

Figure 5 to 8 show the E_θ and E_φ measured radiation patterns for the proposed antenna at F= 4.078 Ghz and F=.902 Ghz. This measure is made by considering only the direct way and by eliminating all the multiple routes. They are made in the anechoic chambers of type STARGATE32.

This device of measure includes a network of 32 bipolarized probes and software recovering the automation of the sequences of measure, as well as the acquisition and the data processing. This technique of measure allows having radiation patterns in 3D.

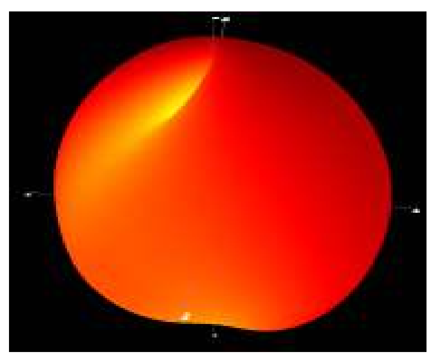


Figure 5: E_θ (dB) measured radiation patterns at 4.7566 Ghz

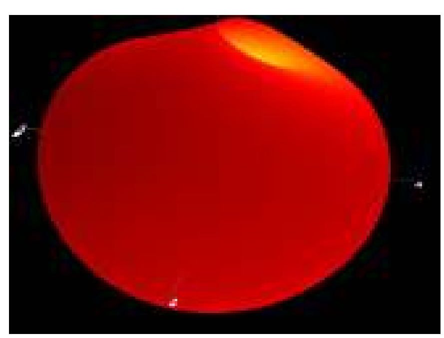
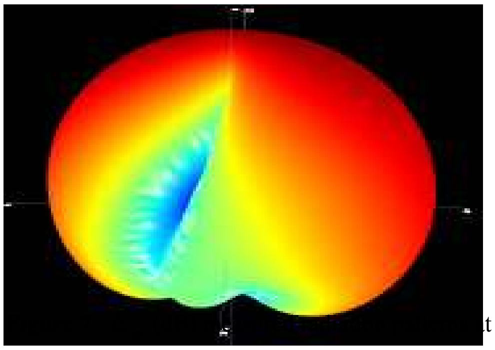


Figure 6: E_θ (dB) measured radiation patterns at 5.8312 Ghz



4.7566 Ghz

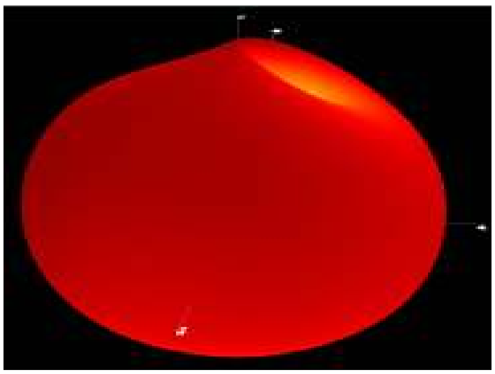


Figure 8 E_{φ} (dB) measured radiation patterns at 5.8312 Ghz

3.3 Radiation efficiency

The measure the radiation efficiency is made in the reverberation chambers of size 2.9 m x 3.7 m x 8.7 m in the functioning frequency 200 Mhz. the measure radiation efficiency antenna is a measure in double weighed.

Table1 : Radiation efficiency

Frequency (GHz)	Efficiency
4.7566	74 %
5.5	91 %
5.473	87 %
5.7118	75 %
5.8312	84 %

4 CONCLUSION

A Ultra Wideband patch antenna for wireless communication has been presented. The proposed antenna has a simple configuration and is printed on Duroid substrate with dielectric constant of 2.17 and substrate thickness of 1.575 mm. This antenna operate for 700 MHz to 11.1 GHz who covering all the desired frequency bands, such as GSM 900, DCS 1800, DCS1900, IMT-2000, WIBRO, WLAN, DMB, and UWB.

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