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Design of a Compact Ultra-Wideband Planar Monopole Antenna for Mobile Wireless Devices

Jae-Hoon Choi, Yeon-Sik Yu
Division of Electrical and Computer Engineering, Hanyang University
17 Hangdang-Dong, Sungdong-Gu, Seoul, 133-791, Korea
Tel. +82-2-2220-0376, Fax. +82-2-2293-0377, E-mail: # choijh@hanyang.ac.kr

Abstract

A compact ultra-wideband planar monopole antenna operating over DCS 1800/1900, IMT-2000, Wibro, WLAN, DMB and UWB frequency bands is proposed. The antenna consists of a rectangular path with four notches and small ground. The proposed antenna has a small volume of 23 mm × 17 mm × 1.6 mm. the simulated return loss of the proposed antenna over the frequency band of interest is better than 10 dB.

Key words: mobile wireless device, monopole, antenna, ultra-wideband.

1. Introduction

Nowadays, much attention has been paid to new technologies in future wireless communication system. The people are demands for various communication and multi-media services wherever they go. For this reason, evolution of wireless communication is characterized by the convergence toward the ubiquitous seamless access and business needed to satisfy the higher resolution and higher data rate requirements.

Ultra-wideband (UWB) communication system covering from 3.1 GHz to 10.6 GHz has been released by the FCC in 2002 [1]. UWB enables revolutionary high-speed, short range data transfer and higher quality services to the user. Planar monopole antennas are promising for applications in UWB communication systems due to their attractive features for wide impedance bandwidth, simple structure and omni-directional radiation pattern [2-3]. This antenna could be made as small as possible to satisfy the severe space constraints imposed on the mobile wireless devise. Planar wideband antennas using various disk shapes had been studied [4]. To improve the bandwidth performance further, a shorting pin was added in [5], a bevel and a shorting pin were used in [7], and also a radiator with a dielectric slab was suggested in [8]. Recently, it has been demonstrated that wideband monopole antennas [8-11] are promising to be used for mobile wireless devices such as notebook computer, mobile phones, and PDA phones.

In this paper, a compact wideband planar monopole antenna is proposed. The antenna has characteristic of compact and simple structure, low cost, and ease of construction. The proposed antenna simultaneously satisfies the 10 dB return loss requirement for DCS1800 (1.71 GHz – 1.88 GHz) or 1900 (1.85 GHz – 1.99 GHz), IMT-2000 (1.885 GHz – 2.2 GHz), Wibro (2.3 GHz – 2.39 GHz), WLAN (2.4 GHz – 2.483 GHz), DMB (2.605 GHz – 2.655 GHz), and UWB (3.1 GHz – 10.6 GHz) bands.

2. Antenna Design

Figure 1 show the configuration of the proposed ultra-wideband antenna. The antenna having dimension of 23 mm × 17 mm is constructed on FR4 substrate with thickness of 1.6 mm and relative dielectric constant of 4.4. It consists of a rectangular radiating patch with four notches and small ground. As shown in Figure 1, the radiating patch with size of 17 mm × 17 mm is printed on the substrate and small ground plane having dimension of 17 mm × 4 mm is printed on the other side. Notch 1 has dimension of 4.5 mm × 3 mm at the right lower corners of the patch and notch 2 has dimension of 4.5 mm × 6.5 mm at the left lower corners of the patch. The notch 3, which has

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dimension of 0.5 mm × 3 mm, is imbedded in the radiating patch along the microstrip feedline. In this design, the mutual coupling between the radiating patch and ground provide the way of controlling the required bandwidth and impedance matching. The use of three notches in the radiating patch has improved the impedance matching at the whole frequency band. The width of the microstrip feedline is fixed at 1.6 mm. The simulated results are obtained using the Anosft High-Frequency Structure Simulator (HFSS V10) [12].

3. Numerical Result

The proposed antenna with various design parameters were construct and analyzed. Figure 2 shows the simulated return loss characteristic for various values of D. By changing the value of D, the mutual coupling between the radiating patch and small ground can be altered and the resulting bandwidth performance can be improved.

In Figure 3, it is observed that, for the antenna without notch 1, the impedance matching is very poor over the UWB frequency band. However, the simulated results show that the notch 1, which is inserted in the right lower corners the patch, produce impedance matching for higher frequency band.

To verify the effect of the notch 2 and notch 3, the simulated return loss characteristics for the proposed antenna, the antenna with notch 2 and/or notch 3, and the simple antenna with only notch 1 is compared in Figure 4. It is found that the impedance matching improves at higher frequencies between 6 GHz and 12 GHz by addition notch 2 and notch 3. Figure 5 shows simulated return loss of the optimized antenna.

4. Conclusion

A compact ultra-wideband planar monopole antenna is proposed. The antenna has a simple and compact structure. This antenna is capable of covering the wide bandwidth starting from DCS 1800/1900, IMT-2000, Wibro, WLAN, DMB, and up to UWB frequency bands: It is shown that antenna is achieved the impedance matching of the proposed by utilize the mutual coupling between the radiating patch and small ground by using three notches on the main patch

Since the size of proposed antenna is small enough to satisfy the constraint imposed on the mobile handset antenna, it can be a good candidate for mobile applications.

Acknowledgments

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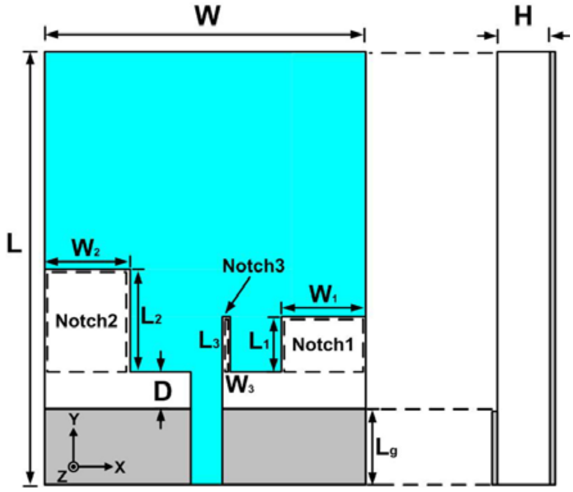

Figure 1: Geometry of an ultra-wideband printed antenna

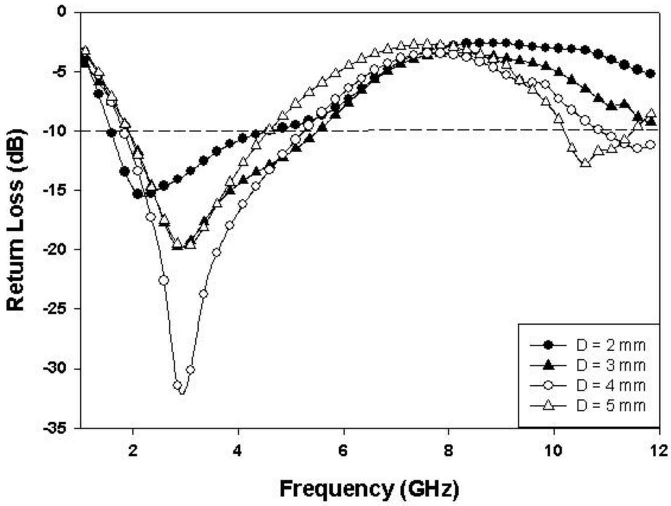

Figure 2: Simulated return loss characteristics for various values of D

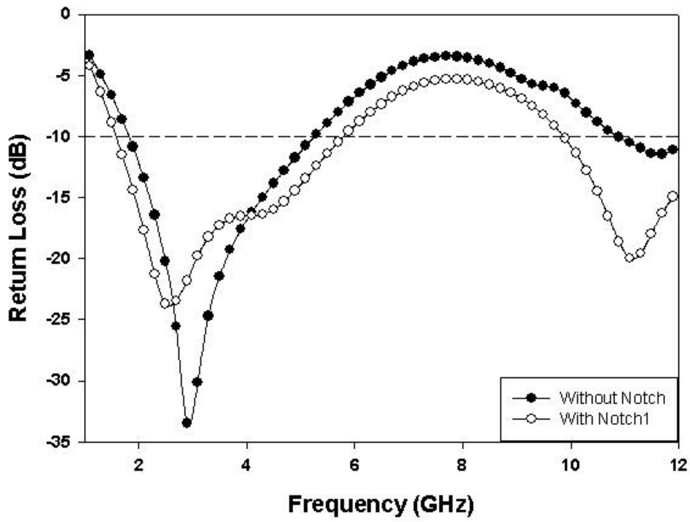

Figure 3: Comparison of simulated return loss characteristics with and without notch 1

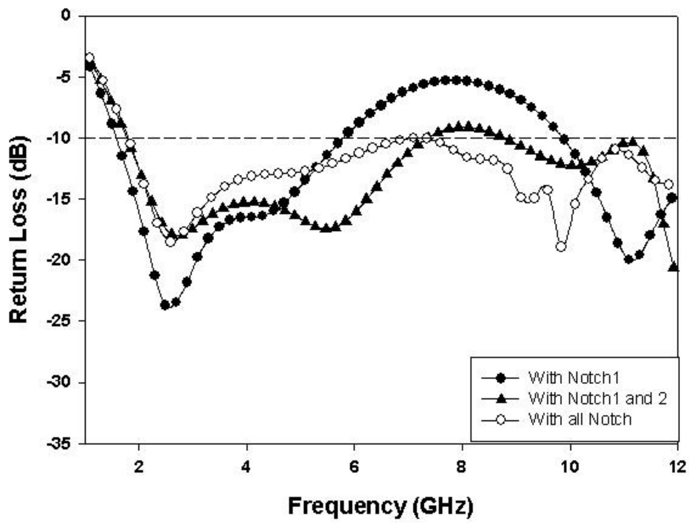

Figure 4: Comparison of simulated return loss characteristics for various configurations

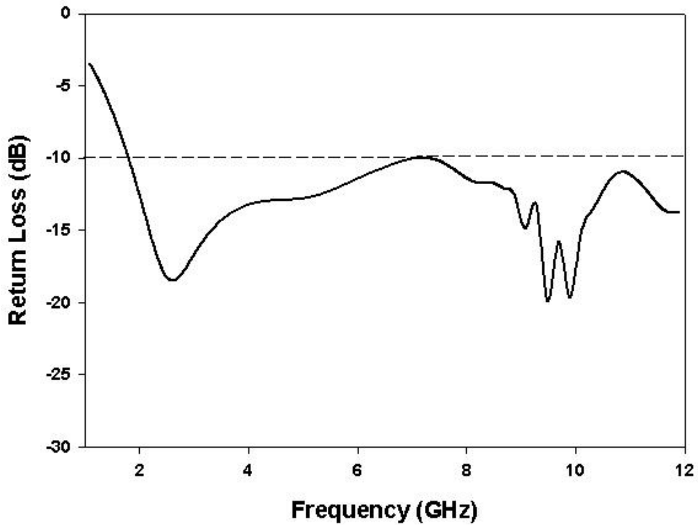

Figure 5: Simulated return loss of the optimized antenna

References

[1] Anon., FCC First Report and Order on ultra-Wideband Technology, Feb. 2002.

[2] E. Antonino-Daviu, M. Cabedo-Fabre's, M. Ferrndo-Bataller, and A Valeo-Nogueira, "Wide-band double-fed planar monopole antennas," *Electron. Lett*., vol. 39, pp. 1635-1636, Nov. 2003.

[3] M. Hammoud, P. Poey, and F. Colombe, "Matching the input impedance of a broadband disc monopoe," *Electro Lett*., vol. 29, pp. 064-407, Feb. 1993.

[4] Agawall, P A., Kumar, G., and ray, K., "Wideband planar monopole antennas," *IEEE Trans. Antennas Propag*., vol. 46, pp. 294-295, Feb. 1998.

[5] E. Lee, P. S. Hall and P. Gardner, "Compact wideband planar monopole antenna," *Electro Lett*., vol. 46, no. 2, pp. 294-295, 1998.

[6] M. J. Ammann and Z. N. Chen, "A wide-band shorted planar monopole with bevel," *IEEE Trans. Antennas Propag*., vol. 51, no. 4, pp. 901-903, 2003.

[7] Z. N. Chen, "Broadband planar monopole antenna," *IEEE Proc. Microw. Antennas Propag*., vol. 147, no.6, pp. 526-528, DEC. 2000.

[8] J. H. Jung, K. M. Seol, W. Y. Choi, J. H. Choi, "Wideband monopole antenna for various mobile communiation applications," *IEE Eletronics Lett*., vol. 41, no. 24, pp. 1313-1314, Nov. 2005.

[9] J. H. Jung, Y. S. Yu, J. H. Choi, "A Small Wideband Planar Monopole antenna for mobile wireless devices," *Microwave and Otical Technology Lett*., vol. 48, no. 4, pp. 736-740, April 2006.

[10] K. L. Wong, L. C. Chou, and H. T Hen,, "Ultra-wideband metal-plate monopole antenna for laptop application," *Microwave and Otical Technology Lett*., vol. 43, pp. 384-386, 2004.

[11] M. J. Ammann and Z. N Chen, "Wideband monopole antennas for multiband wireless systems," *IEEE Antenna Propag*., vol. 45, pp. 146-150, 2003.

[12] Ansoft High Frequency Structure Simulator (HFSS) Version 10.0, Ansoft corporation, 2005.