A Triple-Band Antenna using CPW-Fed and Meander-line for PCS/IMT-2000/Bluetooth Applications

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Abstract-In this paper, the design procedure and electrical performance of a new triple-band antenna are reported and investigated. The operating frequency of the proposed antenna includes the PCS/IMT-2000/Bluetooth bands for the mobile communication system. It adopt the CPW-fed structure that is easily integrated with MMICs and fabricated in a simplified configuration. For the radiating elements, the proposed antenna employs a meander-line structure for the size reduction. By adjusting the gap of the CPW ground and the feed line, the antenna achieves a good matching between the input impedance of the antenna and microstrip feed line. The resonant frequency was obtained by adjusting the length of the meander-line, the relative position of the CPW feed line and radiating elements(R). In addition, the width of the radiating elements and the size of the CPW ground play important roles in achieving increased input impedance bandwidth. 10dB return loss with the required bandwidth can be obtained by adjusting the gap of the meander-line. It is expected that the proposed antenna is small enough to be applicable for the practical mobile communication system.

I . INTRODUCTION

The advance of the mobile communication systems has required the multiple-band antenna for a variety of applications in mobile communication systems. For such a reason, these requirements lead the numerous designs for multi-band monopole antennas including the use of a center-fed monopole sandwiched by multiple parasitic elements[1], [2], a multi-branch monopole[3], [4], and a bent folded monopole with structural modification[5]. Recently, CPW-fed (Coplanar Waveguide fed) monopole antennas have been reported for dual-band application[6]. Generally, because of easy integration with MMICs and a low radiation loss like a TEM-mode transmission line, CPW-fed antennas have been considerably attracted by many researchers. Moreover, it is well-known that using high dielectric substrate to reduce the guided wavelength and optimizing the shape of the radiating elements for a given operating frequency are good candidates for minimizing the overall size of multi-band planar monopole antennas.

In this paper, a novel triple-band antenna using CPW-fed and meander-line was proposed. The proposed antenna is designed for 1800MHz-band PCS, 2000MHz-band IMT-2000, and 2400MHz-band Bluetooth applications[7].

II. ANTENNA DESIGN

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The commercially available software package, CST MW studio, based on FDTD algorithm has been used for obtaining the predicted results. A FR4 dielectric substrate with a thickness of 1.6mm, a relative dielectric constant of 4.6 and copper thickness of 37μm has been used for the proposed antenna shown in Fig.1.

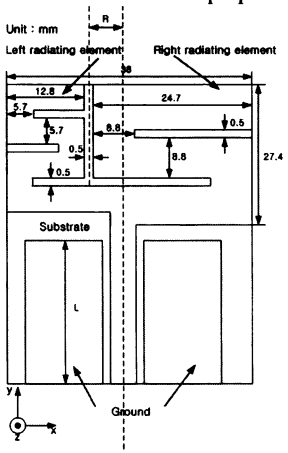

Fig. 1. The proposed antenna configuration.

The overall dimension of the substrate in 38mm×27.4mm. The radiating elements of the proposed antenna has a CPW-fed input port and is mounted on the substrate as a uniplanar structure. By adjusting the gap of the CPW ground and the feed line, the antenna achieves 50Ω input matching between the input impedance of the antenna and microstrip feed line. This gap is about 0.4mm. Furthermore, it is noted that the impedance matching was not affected by varying the size of the ground plane and feed line. The resonant frequencies could be obtained by adjusting the length of the meander-line, the relative position of the CPW feed line and radiating elements. The length of the right and left radiating element is each 24.7mm and 12.8mm. In order to obtain the increased bandwidth, the width of the radiating elements and the size of the CPW ground play important roles at the resonant frequencies. Also, the length of the CPW ground in x-direction is an important parameter of the bandwidth increase. This length was optimized in 7mm. The photograph of the proposed antenna was shown in Fig. 2.

III. EXPERIMENTAL RESULTS

The measured and simulated return loss for the proposed antenna was shown in Fig. 3. Fig.3 shows that the proposed antenna has a wide input impedance bandwidth in the PCS/IMT-2000 bands including the Bluetooth band. The measured 10-dB bandwidth is approximately 20% at the lower frequency band covering the PCS (1750-1870 MHz) and IMT-2000 (1920-2170 MHz) bands.

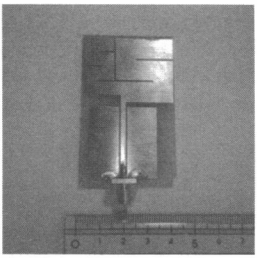

Fig. 2. The photograph of the proposed antenna.

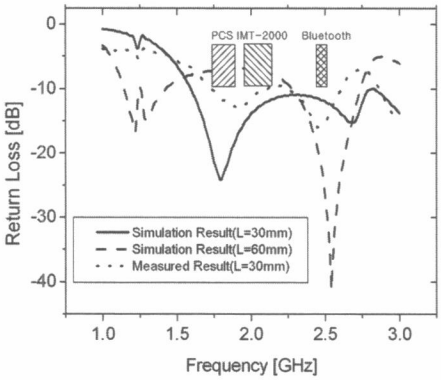

Fig. 3. Simulated and measured results for the proposed antenna.

The simulated radiation patterns for the proposed antenna at the resonant frequency of 2.0GHz is plotted in Fig. 4, respectively. The simulated radiation patterns at 2.0GHz nearly those of y-directed monopole antenna. The maximum radiation gain at 2.0GHz is 2.457 dBi.

IV. CONCLUSION

It is shown that the proposed antenna employing the CPW-fed and the meander-line structure for the size reduction can serve the PCS/IMT-2000/Bluetooth bands for the mobile communication systems. By adjusting the gap of the CPW ground and the feed line, the antenna achieves a good input matching between the input impedance of the antenna and microstrip feed line. In addition to that, it is described that the resonant frequency was obtained by adjusting the length of the meander-line, the relative position of the CPW feed line and radiating elements. Also, the width of the radiating elements and the size of the CPW ground play important roles in achieving increased bandwidth. Moreover, the required return loss could be obtained by adjusting the gap of the meander-line. Finally, it was

expected that the proposed antenna can be applied for the practical mobile communication system.

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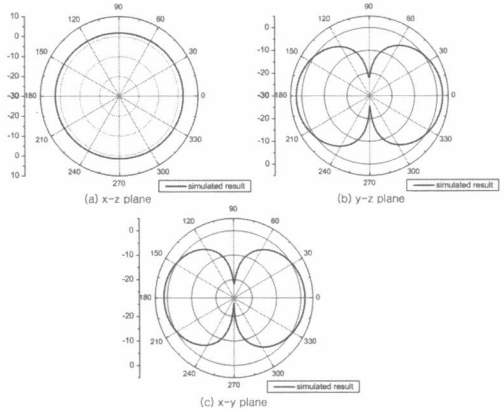

Fig. 4. Simulated radiation patterns for the proposed antenna at the frequency of 2.0GHz. (a)x-z plane (b)y-z plane (c)x-y plane.