Wideband Internal Antenna for LTE/GSM/WiMAX Applications

#Jaeick Kim[1], Byeongkwan Kim[1], Hyunho Wi[1], Chang Won Jung[2], Myun-Joo Park[1], Young-Seek Chung[1], Byungje Lee[1]
[1] Department of Wireless Communications Engineering, Kwangwoon University
447-1, Wolgye-Dong, Nowon-Gu, Seoul, 139-701, Korea
[2]Graduate School of NID Fusion Technology, Seoul National University of Science and Technology, 172, Seoul, 139-743, Korea
bj_lee@kw.ac.kr

Abstract

This paper presents a wideband/multiband internal antenna operated in the LTE13/ GSM850/GSM900/WiMAX bands. The wide bandwidth is obtained by dual resonances in the lower frequency band. With the size of 2.4 cm^3, the efficiency of the proposed antenna is higher than 40 % in the entire operating band.

Keywords: Wideband antenna Compact size Long Term Evolution

1. Introduction

Recently, a mobile communication moves to the 4th generation mobile communication (LTE and WiMAX) from the 3rd generation mobile communication. Thus, an internal handset antenna is required to design for the 3rd generation mobile communication bands as well as the candidate bands of the 4th generation mobile communication. Especially it is need to obtain a wide bandwidth to cover the LTE13/GSM850/GSM900 bands (746 MHz - 960 MHz) because the LTE class 13 band (746 MHz - 787 MHz) is adjacent to the GSM850/GSM900 bands (824 MHz - 960 MHz). Besides the demand of a wide bandwidth operation, the slim design is required because the space allocated for the antenna is gradually reduced due to the handset device adding the various multimedia components such as camera, sensor, and wide LCD. Thus, the study for antennas with a wide bandwidth in the compact size has been demanded.

There have been several researches to improve the bandwidth of an internal antenna with an additional resonator and an external matching circuit [1, 2]. In case of using additional elements, the volume and complication of the structure should be increased. The method using the matching circuit has a limitation to improve the bandwidth. In addition, the method of proximity coupled feed is used to improve the bandwidth [3]. However, the height is too high to design slim antenna for the practical handset applications. In this paper, the proposed antenna has dual resonances using the proximity coupled feed, so that the wide bandwidth can be obtained within compact size (2.4 cm^3) and the low profile.

2. Structure and Results

Fig. 1 shows the geometry of the proposed antenna. The overall structure of the proposed antenna is shown in Fig. 1(a). Fig. 1(b) shows the structure of the radiator. The overall dimension of the proposed antenna is 60 mm × 10 mm × 4 mm, and the size of the ground plane is 60 mm × 100 mm × 1 mm. The FR-4 is used as the substrate (dielectric constant = 4.4). This antenna structure is designed and analyzed using the SEMCAD X 3D EM field simulation tool [4]. The proposed antenna uses the proximity coupled feed, which is one of the wideband techniques, and achieves dual resonances in the lower frequency band (746 MHz -960 MHz). The proposed antenna has the structure of the modified PIFA by combining the monopole and the PIFA resonance (dual-resonances). The LTE13/GSM850/GSM900 bands (746 MHz - 960 MHz) are obtained from the fundamental modes by dual-resonances, and the WiMAX band (2300 MHz - 2690 MHz) is obtained from the higher mode. The proposed antenna has dual resonances in the lower frequency band. The one is obtained from the PIFA resonance by the short point to the open point, and the other comes from the monopole resonance by the coupling fed radiator to the open point. The impedance matching achieved by the inductance variation with varying the length of the proximity coupled feed line. Fig. 3 presents the measured S_{11} and the efficiency of the fabricated antenna as shown in Fig. 2. The impedance bandwidth (VSWR<3) covers the entire LTE13/GSM850/GSM900/WiMAX (738 MHz - 990 MHz and 2140 MHz - 2690 MHz) bands. The bandwidth of the lower and higher frequency bands is 29 % and 22 %, respectively. The peak gain of the proposed antenna is 3.8 dBi at 840 MHz, and the measured efficiency is higher than 40 % in the entire operating frequency band. Fig. 4 shows the measured radiation pattern at the y-z plane and the x-y plane.

3. Conclusion

In this paper, a wideband internal antenna operated in the LTE13/GSM850/GSM900/ WiMAX application is proposed. The proposed antenna gives a wide bandwidth generating dual resonances in the lower frequency band and has a compact size (2.4 cm^3) with the modified PIFA by combining the monopole and the PIFA resonance and using the proximity coupled feed.

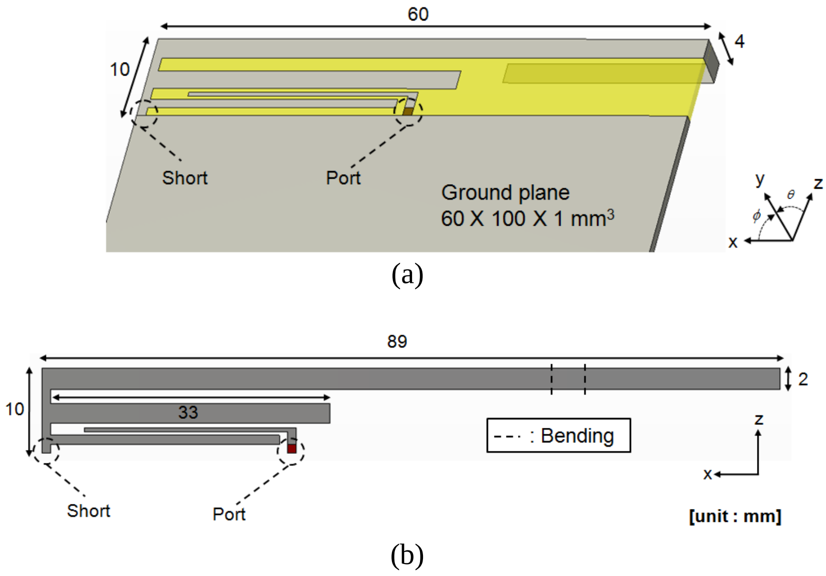
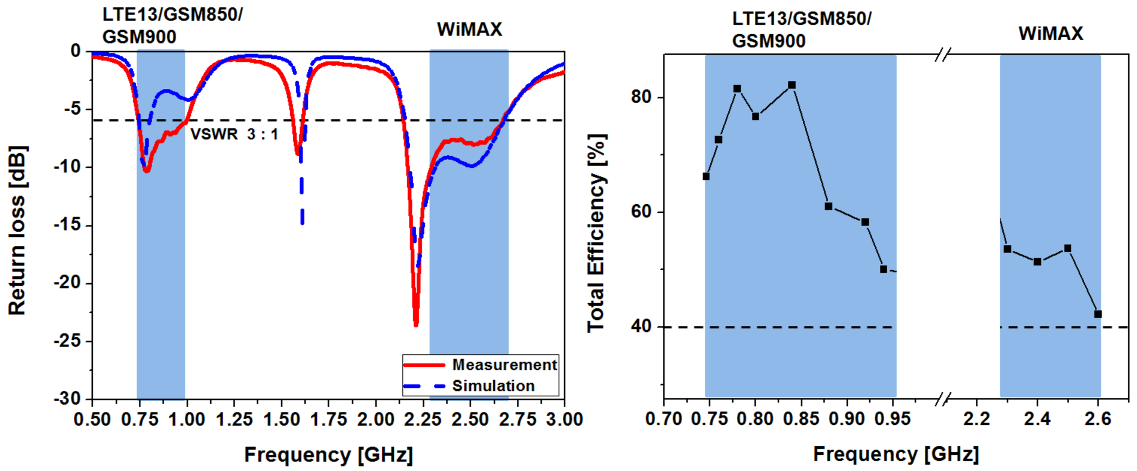


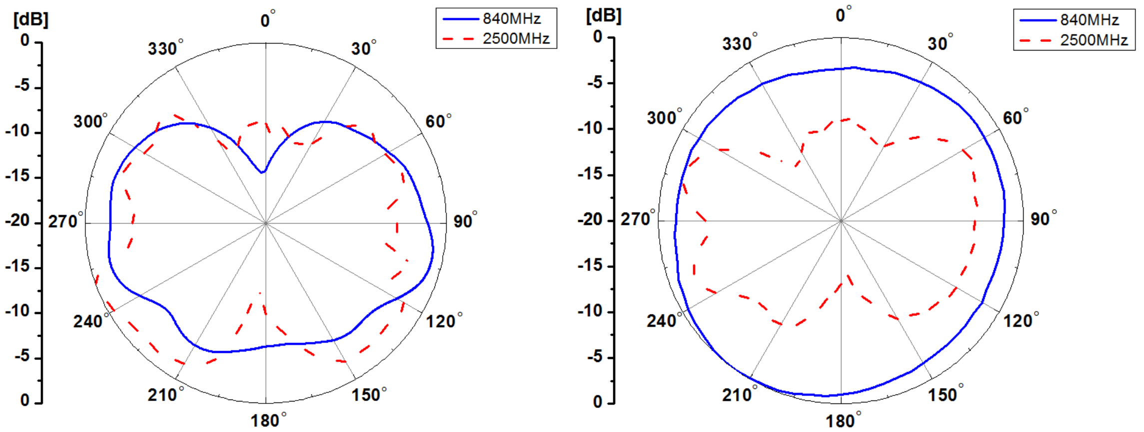
Figure 1: Geometry of the proposed antenna; (a) overall view, (b) detailed view of antenna pattern.

Figure 2: Photograph of fabricated antenna.



(a) (b)

Figure 3: Measured results of the proposed antenna; (a) S-parameters, (b) total efficiency.



(a) (b)

Figure 4: Measured radiation patterns of the proposed antenna; (a) y-z plane, (b) x-y plane.

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Acknowledgments

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