A TRUMPET-LIKE ANTENNA DESIGN FOR GSM/DCS/PCS APPLICATION

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1. Introduction

Many techniques have been developed to meet the needs for a multi-band and multimedia handset antenna for the third generation mobile system [1-3]. Among the published, printed monopole is noticed especially. In the published articles [1], the antenna with three-meandered line is constructed like as a rectangular-box-like structure. It indicates that the operation of triple bands operation can be achieved. However, the structure is difficult to implement and the total antenna dimension is larger than 110 x 35 mm^2.

In this paper, the funneled planar monopole is used instead of two meandered strips. One funneled planar monopole and one meandered strip are printed on an FR4 substrate, and shaped likely as a trumpet. Because of the characteristic of wideband of the funneled planar monopole, the large impedance bandwidth (1:2 VSWR) is expectable. In this design, the operating bands include GSM (890-960 MHz), DCS (1710-1800 MHz) and PCS (1850 - 1990 MHz). Moreover, the experimental results show that the omnidirectional radiations are obtained for three operating bands. All these performances and the quite compact size (about 29 mm x 22 mm) suggest that the proposed antenna is suitable for application in mobile communication system. Also, the study investigates the tuning effects of the geometry parameters on impedance matching.

2. Antenna Design

The structure of the proposed antenna is shown in Fig.1. The configuration consisted of two parts: meandered line and the funneled planar monopole, the both were printed on FR4 substrate and formed as a trumpet. In this design, the CPW feeding was used to excite the antenna through a main strip. One end of the main strip was connected to the feed point, and the other end stuck out two branches. One branch was a densely meandered line and operated at GSM band. The meandered line just mentioned is with total length of 212 mm. It is about 0.636 wavelength at 900 MHz. the strip length is larger than quarter wavelength. The coupling effect between the adjacent strips is the possible cause. The another one is a funneled planar monopole. The strip length a and the open angle θ can be adjusted for impedance matching. As the open angle of the funnel-like planar monopole is increased, the current path is lengthened. Consequently, the resonant frequency of the operated band is decreased. In addition,

ISBN: 4-88552-207-2 C3055©IEICE

by adjusting the dimensions of *a*, the higher frequency band can be shifted to match the requirement.

3. Experimental Results and Discussion

Fig.2 shows the measured return loss for the proposed prototypes, which are designed with various angle of θ. Two appearances are worthily noted. Firstly, the impedance matching of the GSM band is almost not affected by the adjusting of θ. Also, it indicates that the lower frequency of the operating band is lowered and the bandwidth is increased with the angle increases. In addition, the dimension of the strip length *a* also affects the impedance bandwidth. Fig.3 shows the measured return loss against the strip length. Otherwise, an additional short stub located above the main strip can provide further tuning for impedance matching. From the experimental results, it is seen that the optimum case is with open angle of 90° and strip length of 4 mm. The operating bands exactly cover GSM, DCS, and PCS.

Fig.4 plots the measured radiation patterns of the optimum case at the center frequency of the cellular communication systems: GSM, DCS, and PCS. The monopole-like patterns are observed for all measured frequencies. However, the large cross-polarization is also seen. It is possibly caused by the perpendicular current distribution of the meandered line monopole.

4. Conclusions

The trumpet-like antenna with triple bands operation is successfully implemented. The novel design has a compact dimension of only 29 x 22 mm^2, and consists of a meandered line monopole and a funneled planar monopole antenna. The both monopole are branched from the main strip to form as a trumpet. The meandered strip contributes to the operation of GSM band operation, and the funneled branch participates in the DCS and PCS bands. By adjusting of the geometry parameters, the impedance bandwidths are matched with the requirements of the real application.

Reference

[1] P. L. Teng and K. L. Wong, “Planar monopole folded into a compact structure for very low-profile multiband mobile-phone antenna,” *Micro. & Opt. Technol. Lett.*, pp. 22-25, 2002.

[2] C. Soras, M. Karaboikis, G. Tsachtsiris and V. Makios, “Analysis and design of an inverted-F antenna printed on a PCMCIA Card for 2.4 GHz ISM band,” *IEEE Antennas and Propagat.*, vol. 44, pp. 37-44, Feb. 2002.

[3] S. Dey, K. A. Jose, C. K. Aanandan, P. Mohanan, and K. G. Nair, “Widebande printed dipole antenna,” *Micro. & Opt. Technol. Lett.*, pp. 417-419, 1991.

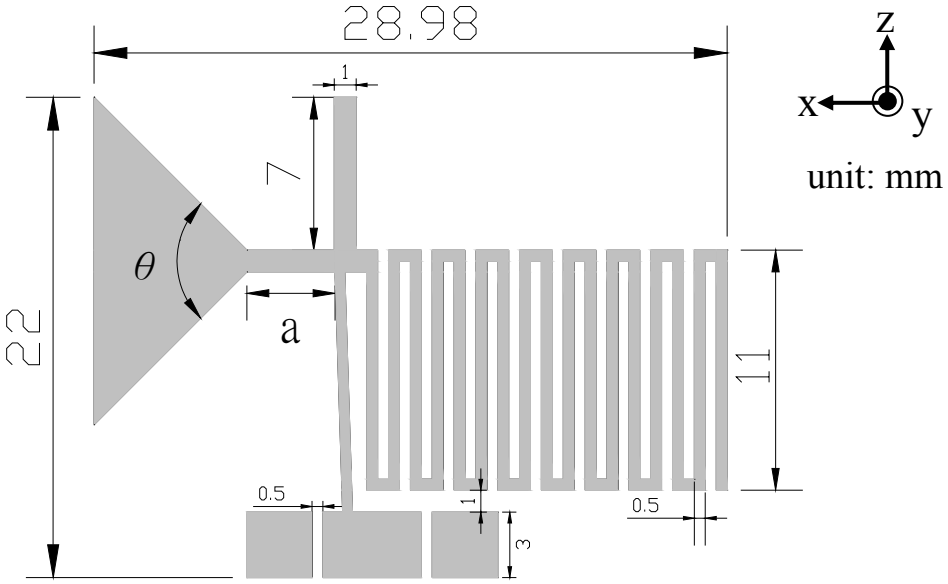


Fig.1 Configuration of the proposed trumpet-like antenna.

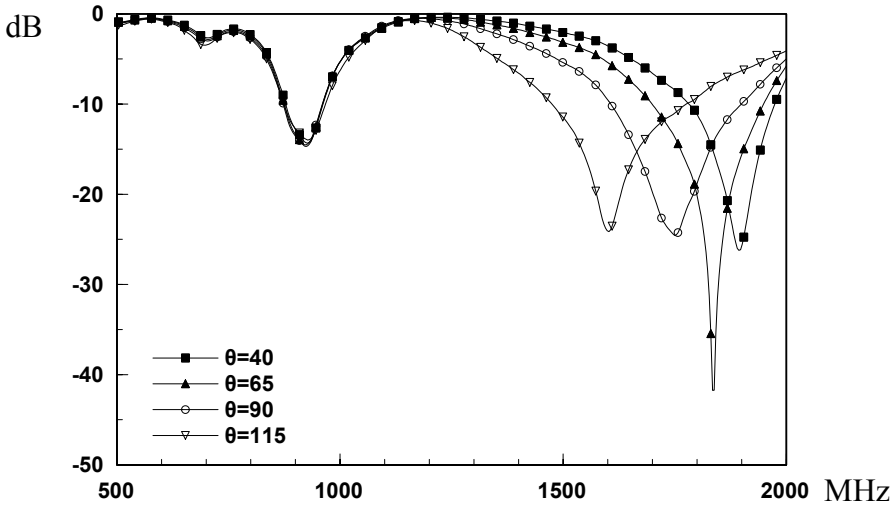


Fig.2 Measured return loss with various angular magnitude θ.

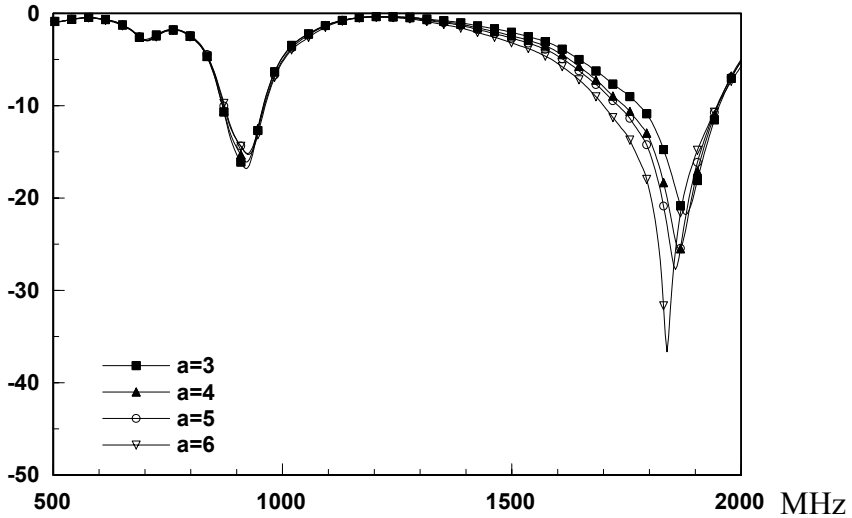
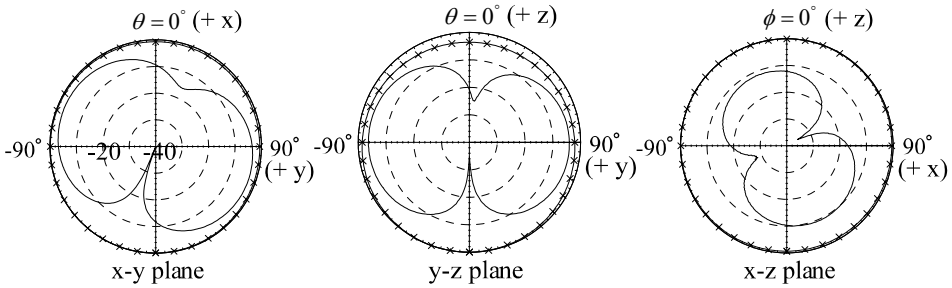
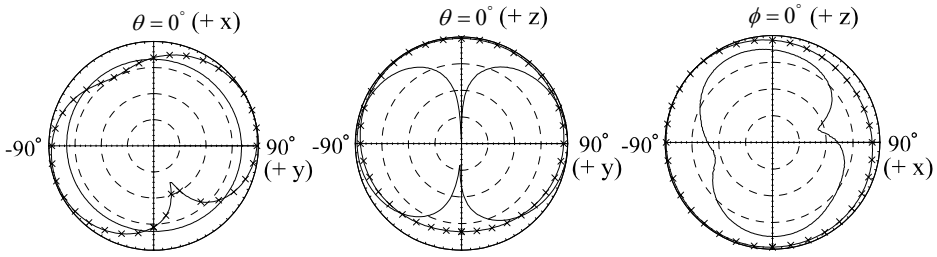


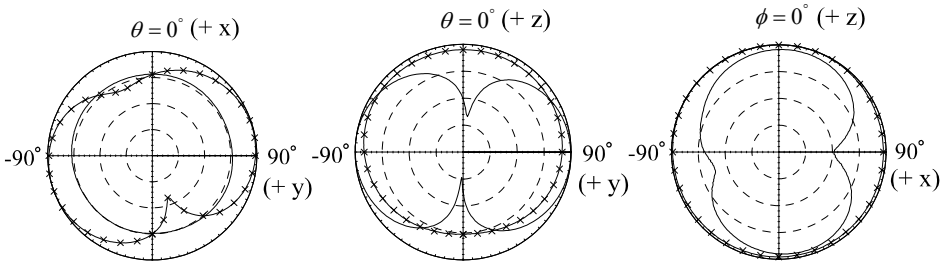
Fig.3 Measured return loss against strip length *a*.



(a) 900MHz



(b) 1800MHz



(c) 1900MHz

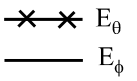


Fig.4 Measured radiation patterns for the trumpet-like antenna at the center frequencies of the cellular communication systems. (a) 900 MHz for GSM (b) 1800 MHz for DCS (c) 1900 MHz for PCS