2B1-2

The Design of Multi-Band Antenna using a Backed Microstrip Line

#Jung-Nam Lee, Jin-Hee Yoo, Jin-Suk Kim, and Jong-Kweon Park

Department of Radio Wave Engineering, Hanbat National University,
San 16-1, Dukmyung-Dong, Yuseong-Gu, Daejeon, 305-719, Korea
ingpark@hanbat.ac.kr

1. Introduction

Wireless communications have been developed widely and rapidly in the modern world, which leads to a great demand in designing compact, low-profile, and multiband antennas. To meet these requirements, compact high-performance multiband planar antennas with good radiation characteristics are needed. Recently many antennas with multiband characteristics have been designed for wireless applications [1-8]. Much effort has been spent on the research of such compact and multiband/wideband antennas [1]. A variety of compact multiband antennas have been developed so far, such as various kinds of printed monopole antennas [2-4], triangular-shaped meander monopole antenna [5], internal folded planar monopole antenna [6], and dual-band antenna with a backed microstrip line [7].

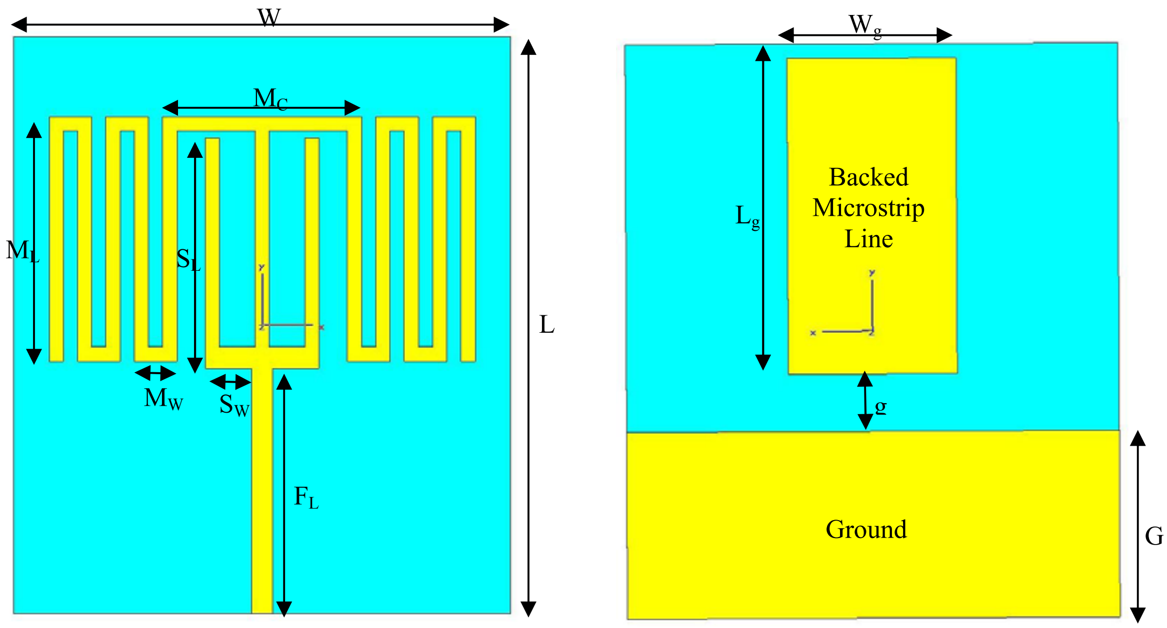
In this paper, we have proposed a multiband meander antenna with a backed microstrip line for mobile telecommunication systems (GSM, DCS, ISM, WiMAX). The proposed antenna consists of a meander line, U-shaped line, and a backed microstrip line. We have used meandering technique [6, 8] and U-shaped line to produce the GSM and DCS bands, respectively. A backed microstrip line technique [7] is used to produce the ISM & WiMAX band. Parametric studies and radiation characteristics for this antenna are presented. Ansoft high frequency structure simulator (HFSS) [9] is used to simulate the proposed antenna. Prototypes of the multiband antennas have been successfully implemented. The measured results of the fabricated prototype will be given and compared with the simulated results.

2. Antenna Design and the Measured/Simulated Results

The geometry and parameters of the multiband meander antenna with a backed microstrip line are shown in Figure 1. The proposed antenna consists of a meander line, U-shaped line, and a backed microstrip line. The antenna is supported by a dielectric substrate of a height equal to 0.8 mm and a relative dielectric constant of 4.5. The antenna is excited using 50 Ω microstrip feed line. The optimal parameters can be chosen as W = 35 mm, L = 40 mm, MC = 14 mm, ML = 17 mm, MW = 3 mm, SL = 16 mm, SW = 3 mm, FL = 17 mm, Wg = 12 mm, Lg = 22 mm, GL = 13 mm, and g = 4 mm based on extensive simulation using HFSS [9]. In designing of the antenna, we have

ISBN: 978-4-88552-223-9 C3055©IEICE

used the U-shaped line, the meandering technique, and the backed microstrip line technique of [7]. The proposed antenna was simulated and prototypes of the antenna were constructed and measured.



(a)Top View (b) Back View

Fig 1. Geometry of the proposed multiband meander antenna

Figure 2 shows the measured and simulated return losses of the proposed antenna in Figure 1. The measured data in general agree with the simulated results. Although good agreement can be seen, there are small discrepancies between the simulated and measured results, which may occur because of the effect of the SMA connector and fabrication imperfections. Three separate resonant frequencies are clearly excited at 920 MHz, 1.8 GHz, and 2.5 GHz simultaneously with a good matching condition. The measured -10 dB impedance bandwidths are 13% (880-1003 MHz), 4.5% (1.75-1.83 GHz), and 24% (2.2-2.8 GHz) at each frequency bands.

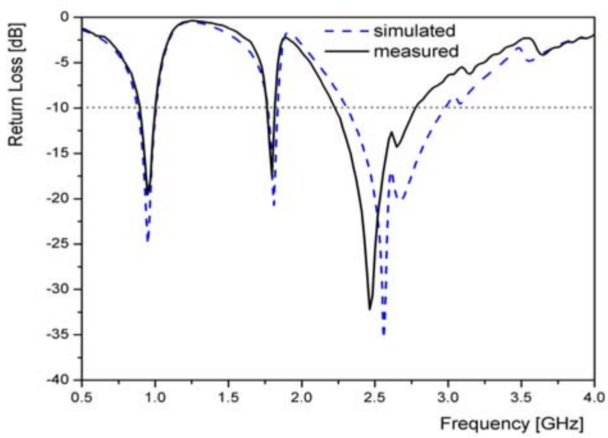


Fig 2. Measured and simulated return losses for the proposed antenna

Figure 3 shows the effect of the backed microstrip line on the measured return losses. As can be seen from the figure, the backed microstrip line can produce the additional band (DCS).

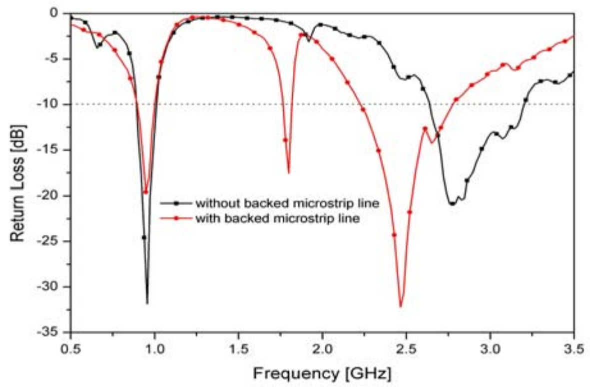
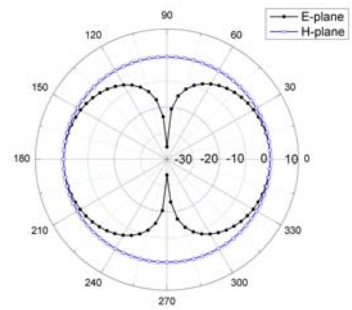
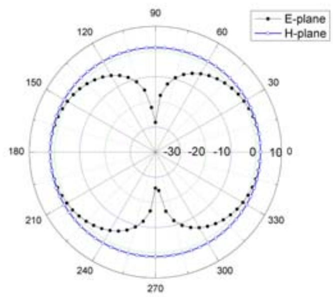


Fig 3. Effect of the backed microstrip line on the return loss

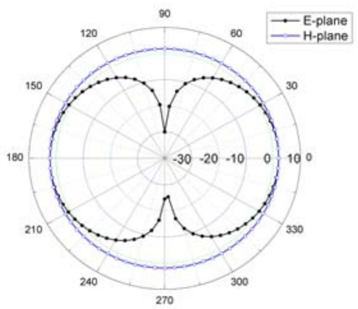
The simulated radiation patterns at 0.92, 1.8, 2.45, and 2.6 GHz for the proposed antenna are plotted in Figure 4. It can be seen that the radiation patterns in the H-plane are nearly omni-directional for all frequencies and those in the E-plane are very monopole-like. Also, the radiation patterns are stable across the respective operating frequency bands.



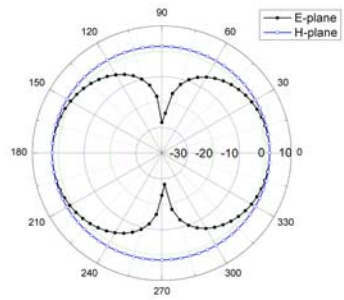
(a)



(b)



(c)



(d)

Fig .4 Simulated radiation patterns: (a) GSM(920 MHz), (b) DCS(1.8 GHz), (c) ISM(2.45 GHz). (d) WiMax(2.6 GHz)

3. Conclusion

A novel multiband meander antenna with a backed microstrip line has been proposed for mobile telecommunication systems (GSM, DCS, ISM, WiMAX). The effect of the antenna parameters was studied. The measured -10 dB impedance bandwidths are 13, 4.5, and 24% at each frequency bands. The simulated radiation patterns are very monopole-like and stable across the entire frequency band. Therefore, the proposed antenna is a good candidate for multiband communication applications.

Acknowledgments

This work was supported by the second stage of BK21.

References

[1] A. K. Skrivervik, J. F. Zurcher, O. Staub, and J. R. Mosig, PCS antenna design: the challenge of miniaturization, IEEE Antennas Propagat Magn 43, pp.12-27, 2001

[2] Y. L. Kuo and K. F. Wong, Printed double-T monopole antenna for 2.4/5.2 GHz dual-band WLAN operations, IEEE Trans Antennas Propagat 51, pp.2187-2192, 2003

[3] E. Lee, P. S. Hall, and P. Gardner, Compact wideband planar monopole antenna, Electron Lett 35, pp.2157-2158, 1999

[4] F. S. Chang and K. L. Wong, Planar monopole folded into a rectangular-disk-like structure as surface-mountable antenna for 2.4/5.2-GHz dual-band operation, Microwave Opt Technol Lett 34, pp.166-169, 2002

[5] H.D. Chen, Triple-band triangular-shaped meander monopole antenna with two coupled lines, Microwave Opt Technol Lett 37, pp.232–234, 2003

[6] Kin-Lu Wong, Wei-Cheng Su, and Fa-Shian Chang Wideband Internal Folded Planar Monopole Antenna for UMTS/WiMAX Folder-Type Mobile Phone, Microwave Opt Technol Lett 48,pp.324-327, 2003

[7] Seok H. Choi, Jong K. Park, Sun K. Kim, and Hak S. Kim, Design of Dual-Band Antenna for the ISM Band Using a Backed Microstrip Line, Microwave Opt Technol Lett 41, pp.457-460, 2004

[8] W. Choi, S. Kwon, and B. Lee, Ceramic chip antennas using meander conductor lines, Electron Lett 37, pp. 933-934, 2001

[9] HFSS, High-Frequency Structure Simulator ver.10, Finite-element package, Ansoft Corporation.