CONCLUSION

For the first time, corrugated surfaces have been suggested in order to improve wireless-signal coverage, at selected frequencies, in the shadow region of buildings. Assuming no multipath in the particular scenario considered, an improvement of more than 12 dB in the received power was observed. This figure increases when the receiving and transmitting antenna mechanisms of higher gain, such as horns, are employed.

ACKNOWLEDGMENT

This work was funded by Ofcom under the Spectrum Efficiency Scheme and was managed by the National Physical Laboratory.

REFERENCES

1. M.J. Ehrlich and L.L. Newkirk, Corrugated surface antennas, IRE Natl Convention Record, 1953, pp. 18–33.
2. R.S. Elliott, On the theory of corrugated plane surfaces, IRE Trans Antennas Propagat 2 (1954), 71–81.
3. R.E. Lawrie and L. Peters Jr., Modifications of horn antennas for low sidelobe levels, IEEE Trans Antennas Propagat 14 (1966), 605–610.
4. R.E. Collin, Field theory of guide waves, 2nd ed., IEEE Press, New York, 1991.

A NOVEL COMPACT CABLE-FED ANTENNA FOR A GSM/DCS HANDSET

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Received 17 February 2005

ABSTRACT: *By using a branch-line ground plane, a monopole radiator, and parasitic patches, a newly compact cable-fed antenna is investigated in order to overcome the thickness problem of the planar inverted-F antenna (PIFA). The designed antenna has dimensions of only 40 × 12 × 1 mm and the impedance bandwidth of the proposed antenna is able to cover the GSM, DCS, and PCS bands.* © 2005 Wiley Periodicals, Inc. Microwave Opt Technol Lett 46: 469–471, 2005; Published online in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/mop.21019

Key words: *antenna; size reduction; wideband*

1. INTRODUCTION

Due to the development of modern integrated-circuit technology and the requirements of consumers, the size and weight of mobile handsets are being reduced rapidly. Since the antenna component accommodates the largest volume inside an integrated wireless device, antenna miniaturization is necessary in order to meet market demand.

In addition to reduced antenna size, mobile phones require multiple frequency bands for cellular applications, PCS, and other wireless-communication systems. To satisfy the above criteria, inverted-F shaped wire-form antenna (IFA), and planar inverted-F antenna (PIFA) concepts have been discussed in the literature [1–3]. According to the practical knowledge of the PIFA structure, the impedance bandwidth is broadened as the thickness of the radiating element is increased up to a certain thickness; beyond that point, a monotonic decrease in gain is indicated, followed by increases and decreases. In other words, designing an internal small antenna using PIFA concepts requires a trade-off between gain and impedance. As a result, these concepts are not suitable for high gain requirements or the implementation of a thinner handset case. This drawback limits the practical applications of IFAs and PIFAs.

This paper proposes a novel compact and dual-band cable-fed patch antenna. To achieve compact and wideband characteristics for covering the GSM, DCS, and PCS bands, two inductive parasitics on the ground plane and a gap capacitance are used. Details of the design and experimental results are presented and discussed.

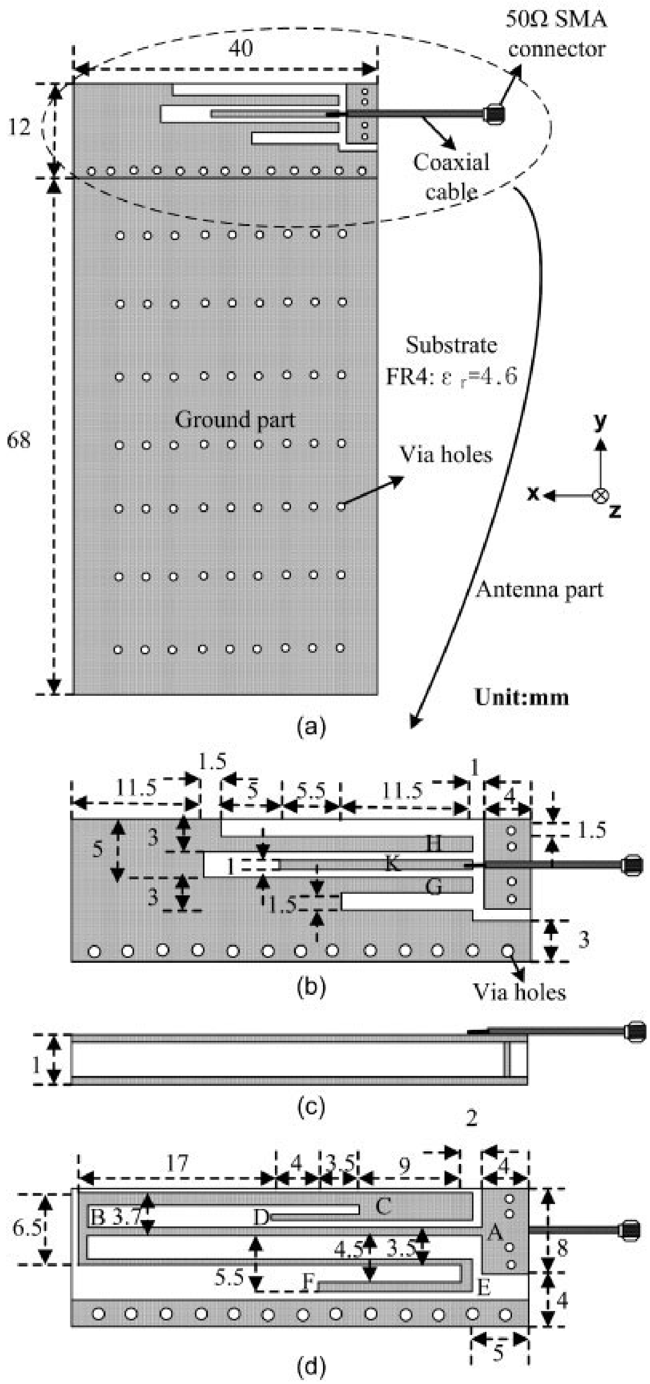

Figure 1 Geometry of the proposed antenna: (a) overall dimensions; (b) top view; (c) side view; (d) bottom view

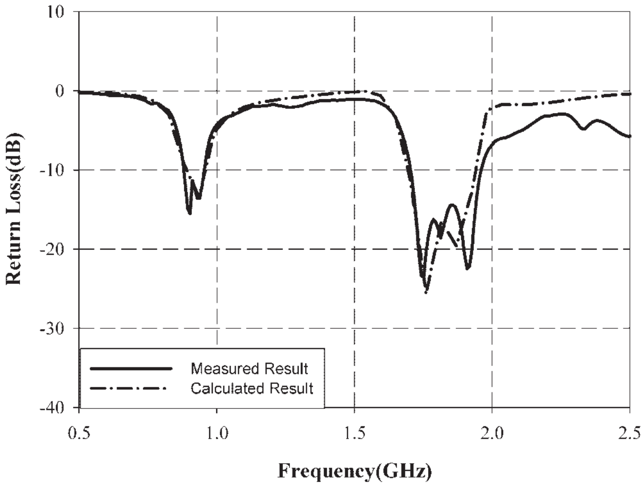

Figure 2 Measured and simulated return losses of the proposed antenna

2. ANTENNA DESIGN

The geometrical configuration of the proposed dual-band cable-fed planar-type antenna is depicted in Figure 1. This antenna was printed on FR4 substrate with 1-mm thickness and relative permittivity of 4.6. The antenna size is 40 × 12 × 1 mm; an additional ground with dimensions of 40 × 68 × 1 mm is used to consider practical mobile-handset circumstances. Two different via holes are used to connect the ground plane of the antenna and more effectively enlarge the antenna ground. The bottom side of the antenna ground mainly affects the impedance matching. A folded path, starting from point A to the end point D and passing through points B and C, is chosen to be 73 mm. Another meandering line, starting from point A to the end-point F and passing through point B and E, is chosen to be 87 mm. In this design, the two branches of meandering lines on the ground plane produces two slightly different surface-current paths, corresponding to about a half-wavelength ($\lambda_g/2$), where λ_g is the wavelength at its first resonance (GSM band) frequency. The higher-frequency DCS band is then accomplished by using a monopole strip line (part K) 17 mm in length, corresponding to about a quarter of one electric wavelength ($\lambda_g/4$ at 1.8 GHz), and the parasitic subpatches (parts G and H) of the top plane. To compensate the narrow impedance band due to the small thickness of the antenna element, two surface-current paths are necessary to broaden the bandwidth. In order to obtain the desired bandwidth, the parameters of the antenna are tuned and optimized. The associated dimensions are shown in Figures 1(b) and 1(d).

3. SIMULATED AND MEASURED RESULTS

The proposed antenna is calculated using the high-frequency structure simulator (HFSS) software by Ansoft. The numerical method is used for the optimization of parameters and expected radiation characteristics. Figure 2 shows the measured and simulated input impedance of the antenna, which are in good agreement. The proposed internal antenna is suitable for the GSM (0.88–0.96 GHz), DCS (1.7–1.96 GHz), and PCS (1.75–1.87 GHz) bands.

The measured and calculated radiation patterns of the proposed antenna in the x–y, x–z, and y–z planes at resonant frequencies of 0.9 and 1.75 GHz are shown in Figures 3 and 4, respectively. The simulated and measured results exhibit good agreement with each other. However, there is a slight discrepancy between the simulation and measurement, which is mainly due to the effect of the feeding cable. The simulated and measured gains at the frequency

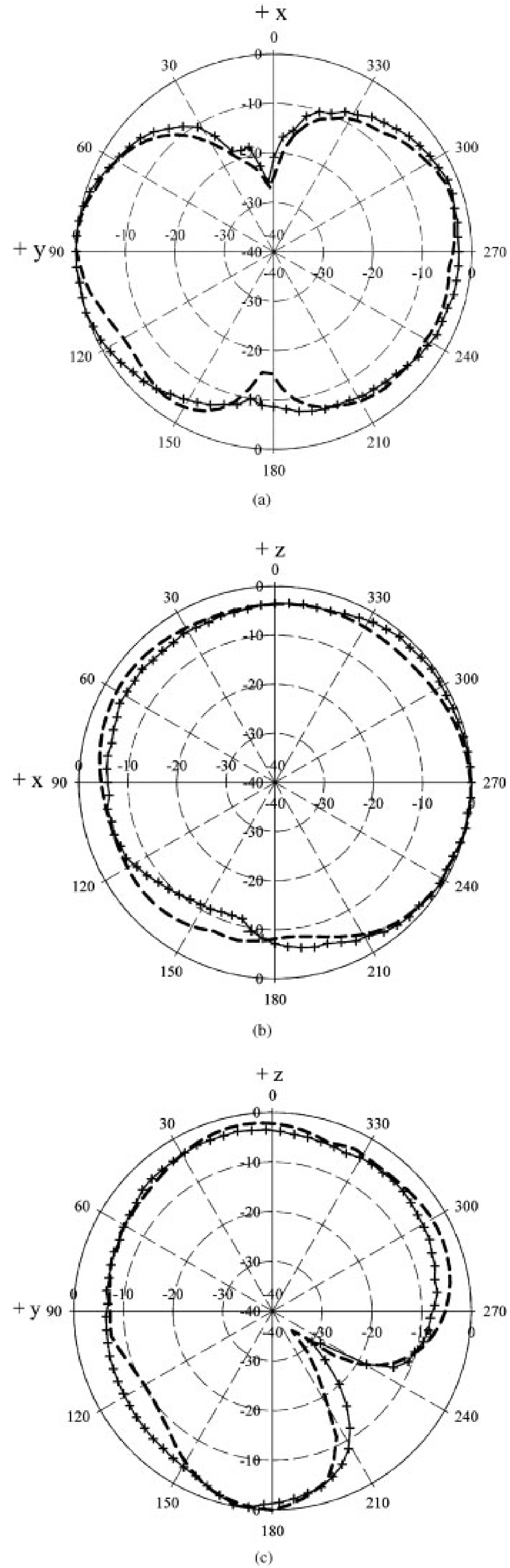

Figure 3 Measured and simulated co-polarized radiation patterns at the frequency of 0.9 GHz (+++: measured result, −−−: simulated result): (a) x–y plane; (b) z–x plane; (c) z–y plane

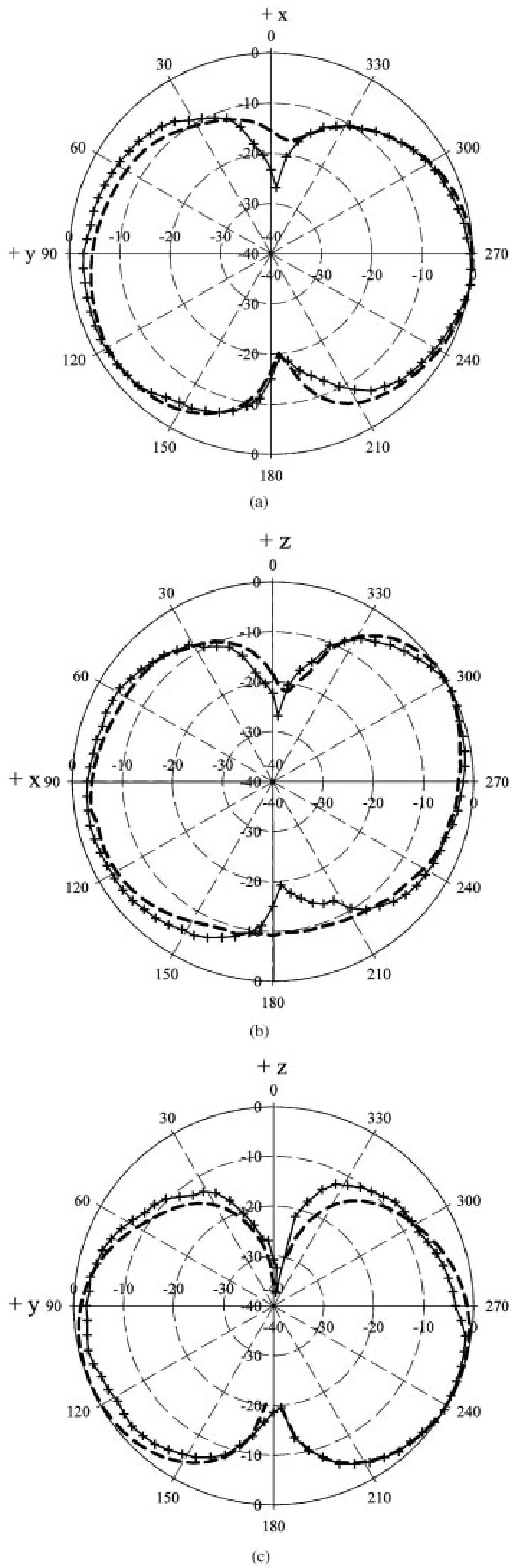

Figure 4 Measured and simulated co-polarized radiation patterns at the frequency of 1.75 GHz (+++: measured result, −−−: simulated result): (a) x–y plane; (b) z–x plane; (c) z–y plane

of 0.9 GHz are 1.35 and 1.37 dBi, respectively. The simulated and measured gains at the frequency of 1.75 GHz are 3.71 and 3.84 dBi, respectively. The proposed antenna has relatively high gains, while the thickness of the antenna element is decreased.

4. CONCLUSION

A newly compact and cable-fed patch antenna with dual-band performance has been proposed and implemented. By using a modified ground plane, a monopole radiator, and parasitic patches, the proposed small antenna can cover the GSM and DCS bands. In addition, the antenna has sufficiently high gain to be applied effectively in practical handset-antenna applications.

ACKNOWLEDGMENT

This work was supported by the National Research Laboratory (NRL) of the Ministry of Science and Technology, Korea, under contract no. M1-0203-00-0015.

REFERENCES

1. M. Yang and Y. Chen, A novel U-shaped planar microstrip antenna for dual-frequency mobile telephone communications, IEEE Trans Antennas Propagat 49 (2001), 1002–1004.
2. C.W. Chiu and F.L. Lin, Compact dual-band PIFA with multi-resonators, Electron Lett 38 (2002), 538–540.
3. Z.D. Liu, P.S. Hall, and D. Wake, Dual-frequency planar inverted-F antenna, IEEE Trans Antennas Propagat 45 (1997), 1451–1458.

WAVEGUIDE BANDPASS FILTERS FOR MMIC APPLICATIONS

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Received 10 March 2005

ABSTRACT: *Novel 3D multilayer waveguide structures for MMIC filter applications are proposed and examined in this paper. Periodic multilayer-waveguide resonant structures, which can be used for bandpass filters, are presented. The structure has a high* Q *and supports a simple fabrication process. An MMIC filter based on this proposed periodic-resonator configuration is designed at 74 GHz using the commercial software package HFSS. The simulated* S*-parameter responses and a photomicrograph of the fabricated monolithic dielectric filled rectangular waveguide on GaAs substrate are presented.* © 2005 Wiley Periodicals, Inc. Microwave Opt Technol Lett 46: 471–473, 2005; Published online in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/mop.21020

Key words: *multilayer MMIC structures; waveguides; resonators; bandpass filter*

1. INTRODUCTION

The steadily growth of commercial interest in millimiter-wave and submillimiter wave applications, especially in wireless communications, security and sensory applications, and military and transport electronics, has provided a significant challenge to conventional microwave circuits and their design methodologies. High-performance narrowband bandpass filters exhibiting low insertion loss, compact physical size, and low fabrication cost are important