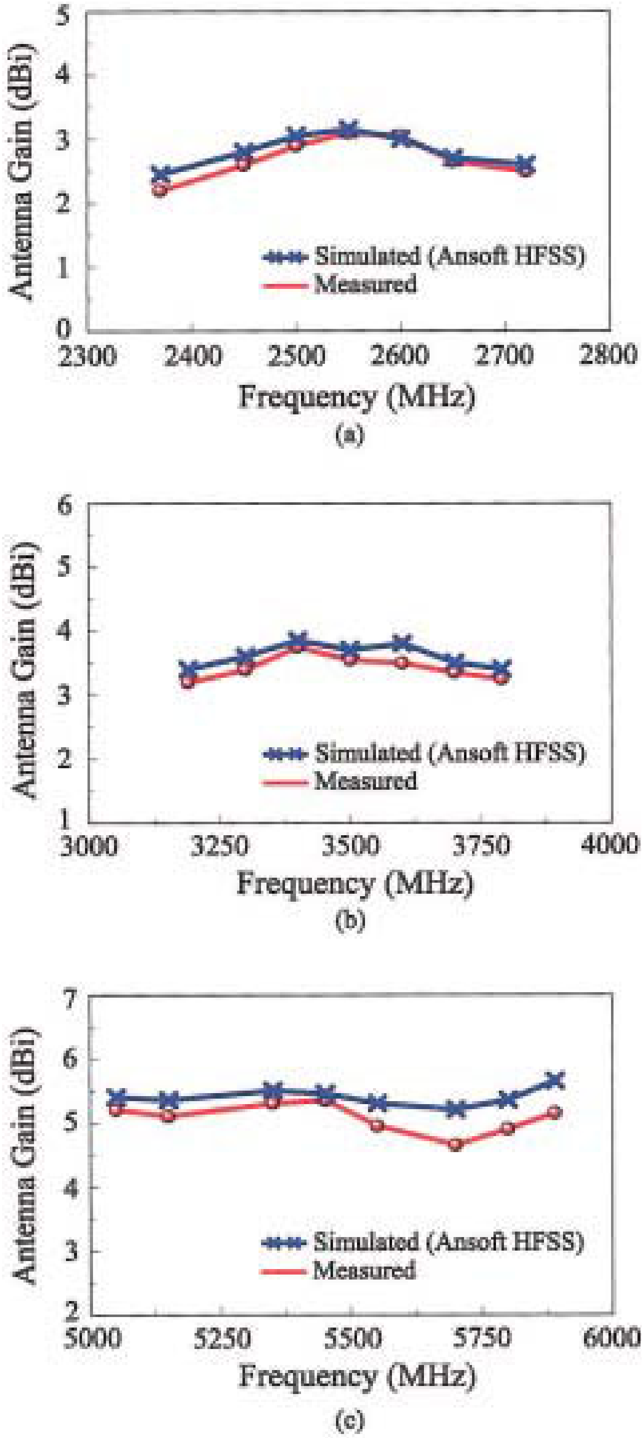

Figure 8 Measured and simulated antenna gain vs. frequency for (a) the first resonant mode, (b) the second resonant mode, and (c) the third resonant mode. [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com]

For frequencies over the three operating bands, good radiation characteristics have also been obtained for the proposed composite monopole antenna.

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A WIDEBAND PRINTED MONOPOLE ANTENNA FOR 2.4-GHz WLAN APPLICATIONS

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ABSTRACT: *A planar monopole antenna suitable for broadband wireless communication is designed and developed. With the use of a truncated ground plane, the proposed printed monopole antenna offers nearly 60% 2:1 VSWR bandwidth and good radiation characteristics for the frequencies across the operating band. A parametric study of the antenna is performed based on the optimized design, and a prototype of the antenna suitable for 2.4-GHz WLAN application is presented. The antenna can be easily integrated into wireless circuitry and is convenient for application in laptop computers.* © 2006 Wiley Periodicals, Inc. Microwave Opt Technol Lett 48: 871–873, 2006; Published online in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/mop.21503

Key words: *monopole antenna; wide band; WLAN antenna*

1. INTRODUCTION

The rapid development of new multimedia communications demands the need of wideband or multiband antennas. The imperative need of low-profile, compact, and wideband antennas has attracted the attention of antenna researchers. Printed monopole antennas are very suitable to be integrated into system circuit board of communication device due to their attractive features of small volume and low fabrication cost. Several

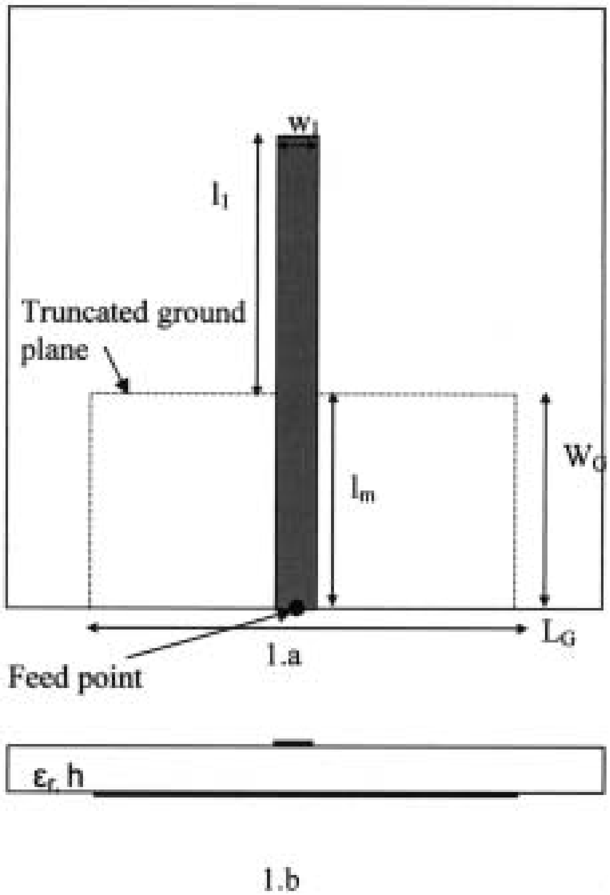

Figure 1 Geometry of the proposed antenna: (a) top view; (b) side view

interesting designs of printed monopoles have been demonstrated recently [1–3]. Different techniques have been proposed to increase the bandwidth of planar monopole antennas. The antenna presented in [1] uses a square conductor-backed parasitic plane for a microstrip-fed printed antenna. The T-shaped monopole antenna presented in [2] uses a shorting pin for achieving wide bandwidth. A broadband planar monopole antenna [3] excited by a probe feed can be mounted on large ground plane, which increases the overall dimensions.

In this paper, we propose a novel wideband printed monopole antenna with good radiation and reflection characteristics, covering the 2.4-GHz WLAN band. The effect of ground-plane truncation is incorporated in the design in order to broaden the bandwidth of a simple strip monopole. The antenna comprises of a microstrip-fed strip monopole printed on standard FR4 substrate. A 2:1 VSWR impedance bandwidth of 60% is achieved with the proposed design. Wide impedance bandwidth is achieved via truncation of the ground plane. In addition, the uniplanar nature of the proposed antenna makes it easy to fabricate and integrate into the system circuit board of a communications device. The parametric effects of the antenna are experimentally determined and necessary design information is also presented.

2. ANTENNA GEOMETRY

The geometry of the proposed antenna is depicted in Figure 1. The antenna is comprised of a monopole of length l_1 excited by microstrip feed line of length l_m with a truncated optimum ground plane. The antenna is printed on substrate of $\varepsilon_r = 4.36$ and height $h = 1.6$ mm. A 50Ω microstrip feed line with a truncated ground plane excites a strip monopole of width w_1 and length l_1, and L_G and W_G denote the length and width of the finite ground plane of the microstrip line. The width w_1 of the strip monopole is set as the width of the 50Ω microstrip feed line. The length l_1 of the monopole determines the resonant frequency. The bandwidth is mainly controlled by the finite ground dimensions and length l_m of the microstrip feed. When the width of ground plane is decreased, the effective resonant length of the monopole is increased, which accounts for the lowering of resonant frequency. For the proposed antenna, a wide impedance bandwidth is obtained due to the merging of the two resonant frequencies, which are obtained due to the combined effect of the truncated ground plane and the strip monopole. As the ground-plane width is decreased, the second resonance shifts towards high-frequency region, which lowers the bandwidth of the low frequencies. The dimensions of the antenna are optimized for maximum bandwidth. The length of the monopole is adjusted to fix the first resonant frequency to the desired value. The ground-plane dimensions are adjusted so as to obtain the second resonance close to first resonance. By choosing two frequencies close to each other, broadband operation is achieved. The parameters of the proposed antenna are optimized and the radiation and reflection characteristics of the antenna, suitable for WLAN (2400–2484 MHz) applications, are discussed.

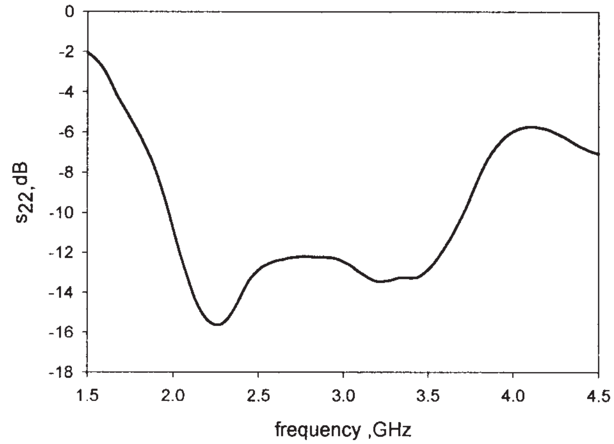

Figure 2 Return-loss characteristics of the antenna at 2.4 GHz ($L_G = 93$ mm, $W_G = 43$ mm, $l_1 = 20$ mm, $w_1 = 3$ mm, $\varepsilon_r = 4.36$, $h = 1.6$ mm)

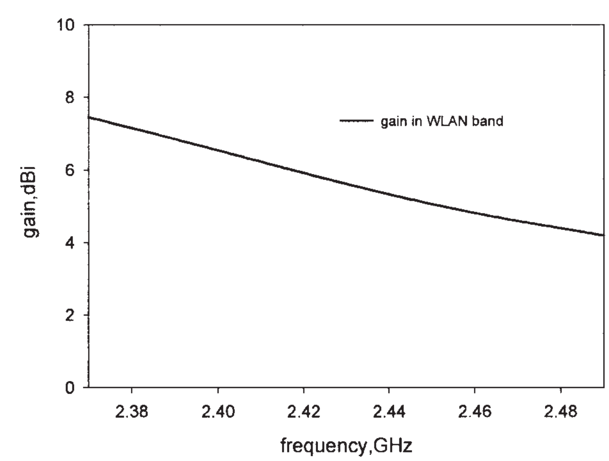

Figure 3 Gain of the antenna at the WLAN band ($L_G = 93$ mm, $W_G = 43$ mm, $l_1 = 20$ mm, $w_1 = 3$ mm, $\varepsilon_r = 4.36$, $h = 1.6$ mm)

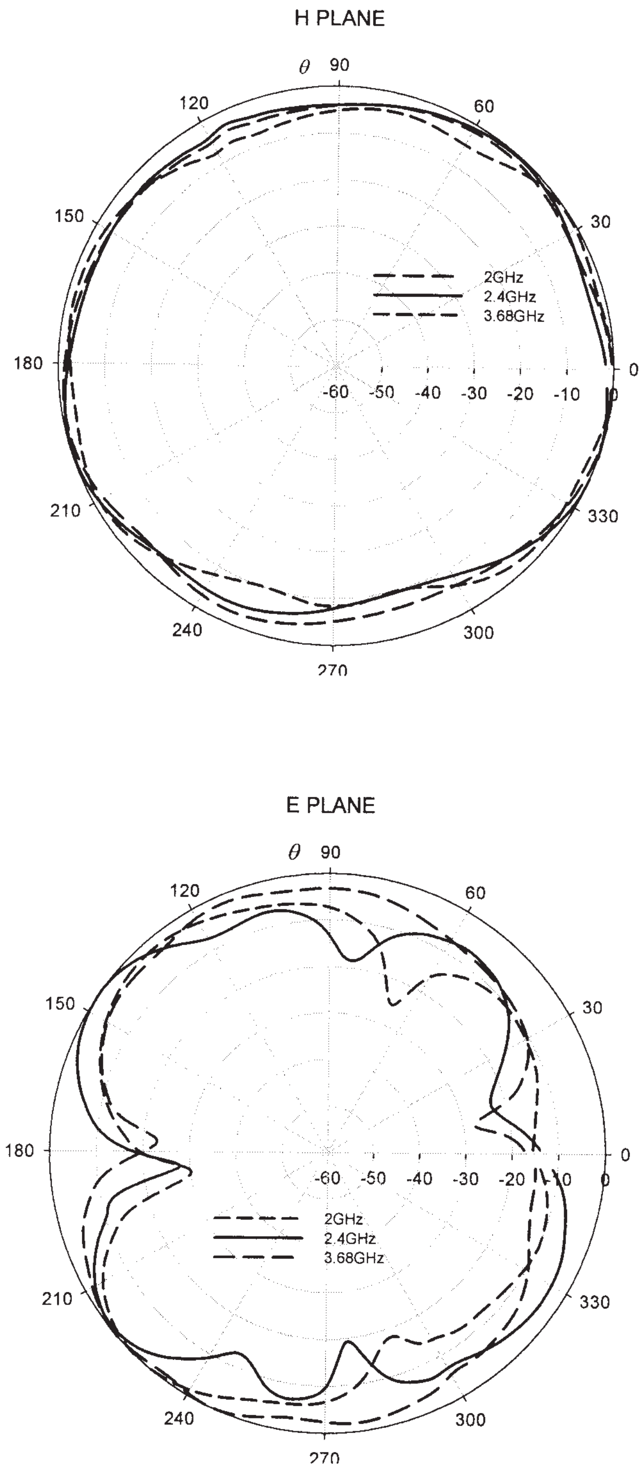

Figure 4 Radiation patterns of the antenna at 2, 2.4, and 3.68 GHz (L_G = 93 mm, W_G = 43 mm, l_1 = 20 mm, w_1 = 3 mm, ε_r = 4.36, h = 1.6 mm)

3. EXPERIMENTAL RESULTS

A prototype of antenna suitable for 2.4-GHz WLAN application was fabricated and its reflection and radiation characteristics were studied using an HP8510C vector network analyzer. The reflection characteristics of the antenna are shown in Figure 2. The proposed antenna offers a wide bandwidth of 1.68 GHz (2–3.68 GHz) for 2:1 VSWR. The gain of the antenna in the 2.4-GHz WLAN (2400–2484 MHz) band is presented in Figure 3. The peak gain of the proposed antenna in WLAN band is 7.4 dBi and average gain is 5.7 dBi.

Figure 4 presents the radiation characteristics of the proposed antenna at 2.4 GHz in both the principal planes. The antenna offers nearly omnidirectional radiation coverage. The proposed antenna exhibits cross-polar discrimination of better than 20 dB along the boresight direction. From the parametric study, the design parameters of the proposed antenna for wide impedance performance have been optimized. The design parameters investigated are $L_G = 0.34\lambda_d$, $W_G = 0.154\lambda_d$, $l_m = 0.154\lambda_d$, $l_1 = 0.15\lambda_0$, where λ_0 is the free-space wavelength corresponding to the first resonant frequency (first dip in Fig. 2) and $\lambda_d = \lambda_0/\sqrt{\varepsilon_r}$ is the wavelength inside the dielectric.

4. CONCLUSION

The radiation and reflection characteristics of a new printed strip monopole antenna have been investigated and presented in this paper. The results show that the antenna can provide sufficiently wide impedance bandwidth with simple structure. The wideband and nearly omnidirectional radiation characteristics of the proposed antenna make it a potential candidate for wireless and mobile units.

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AN L-BAND, CIRCULARLY POLARISED, DUAL-FEED, CAVITY-BACKED ANNULAR SLOT ANTENNA FOR PHASED-ARRAY APPLICATIONS

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ABSTRACT: *The results of a parametric study for the development of an L-band, circularly polarised, dual-feed, cavity-backed annular slot antenna is presented. The study includes detailed numerical simulations and measurements on a prototype with different ground planes in order to assess the antenna's applicability as an element in a small phased array antenna.* © 2006 Wiley Periodicals, Inc. Microwave Opt Technol Lett 48: 873–878, 2006; Published online in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/mop.21504