# DUAL-BAND DUAL-POLARIZED COMPACT MICROSTRIP ANTENNA

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**ABSTRACT:** *Experimental studies on a compact dual-frequency microstrip antenna are presented. This antenna configuration provides an area reduction of 40% compared to a standard rectangular antenna operating at the same frequency without much degradation of the gain. The antenna structure can be modified to achieve the desired ratio between the two resonant frequencies.*  Microwave Opt Technol Lett 25: 328–330, 2000.

**Key words:** *compact; microstrip antenna; dual frequency; dual polarization; frequency ratio*

## 1. INTRODUCTION

With the increase of applications in communications, multi-frequency planar antennas have become highly desirable. A compact drum-shaped antenna, which provides the area reduction, has been discussed in the literature [1, 2]. A coaxial-feed dual-frequency microstrip antenna having the same polarization, realized by adding a shorting pin to the compact microstrip antenna [3] and the rectangular microstrip antenna [4], already have been presented. Compared to those antennas, the proposed one is simpler in construction. In this letter, compactness is achieved using the drum-shaped antenna. By varying the central width of the drum-shaped antenna, it is found that the ratio of the two resonant frequencies changes.

## 2. DESIGN AND EXPERIMENTAL DETAILS

A schematic diagram of the proposed dual-frequency antenna is shown in Figure 1. The configuration consists of a drum-shaped patch etched on a substrate of thickness $h$ and dielectric constant $\epsilon_r$. $L$ denotes the length, $W$ is the width, and $Wc$ is the central width of the antenna. The antenna is found to resonate with orthogonal polarization when excited using a coaxial feed. The ratio of these lower order mode frequencies and the cross-polarization levels can be trimmed by the $W_c/W$ ratio.

In a typical design, a drum-shaped antenna with length $L$ = 5.5 cm, width $W$ = 3.4 cm, and central width $W_c$ = 3.5

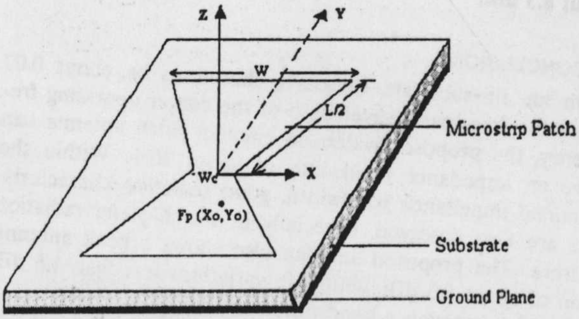


**Figure 1** Geometry of the proposed dual-frequency dual-polarized compact microstrip antenna

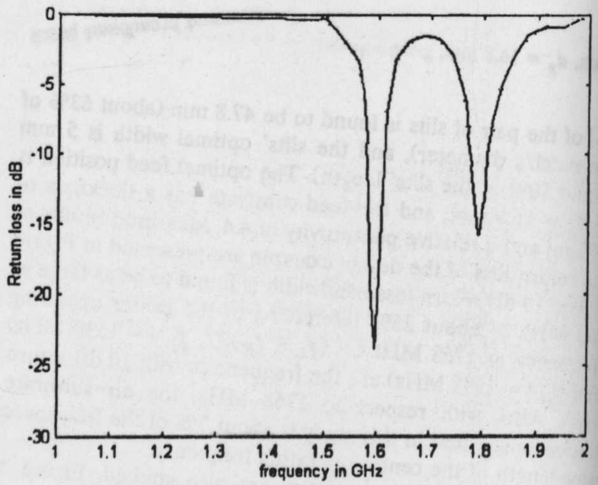


**Figure 2** Variation of return loss with frequency

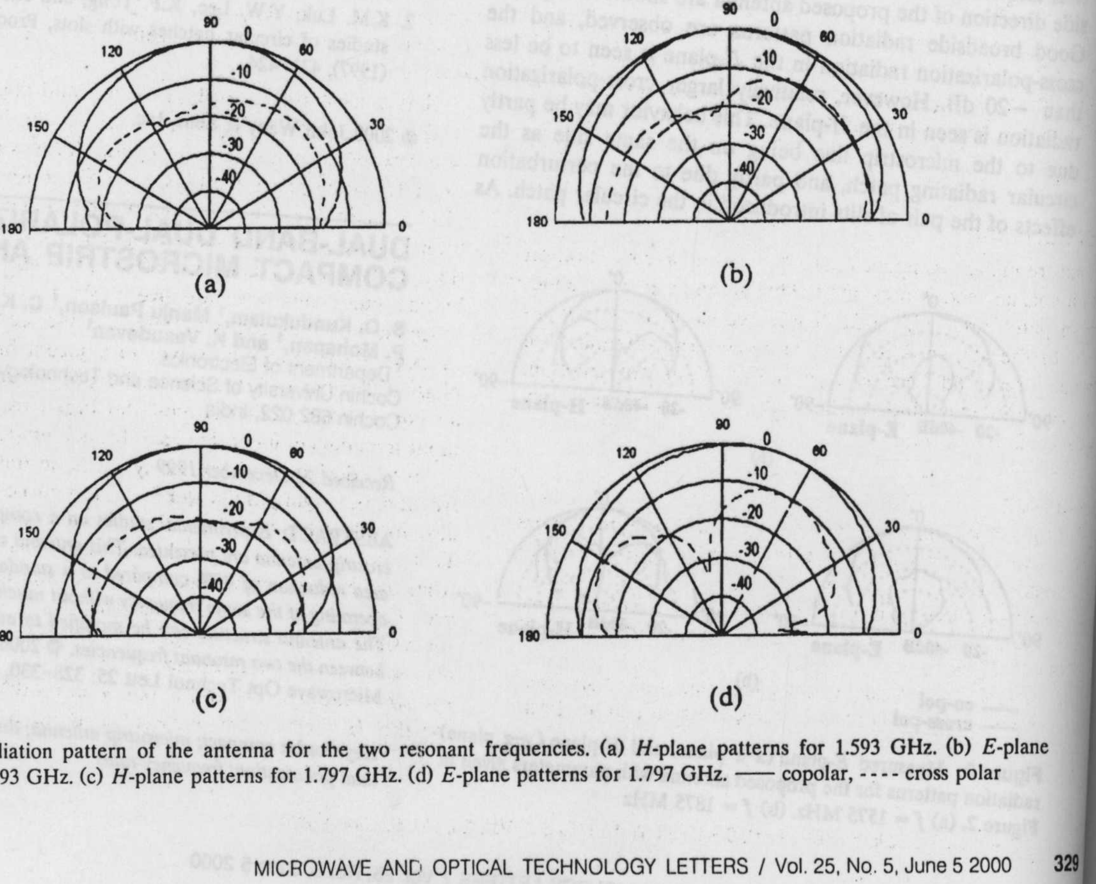


**Figure 3** Radiation pattern of the antenna for the two resonant frequencies. (a) *H*-plane patterns for 1.593 GHz. (b) *E*-plane patterns for 1.593 GHz. (c) *H*-plane patterns for 1.797 GHz. (d) *E*-plane patterns for 1.797 GHz. —— copolar, - - - - cross polar

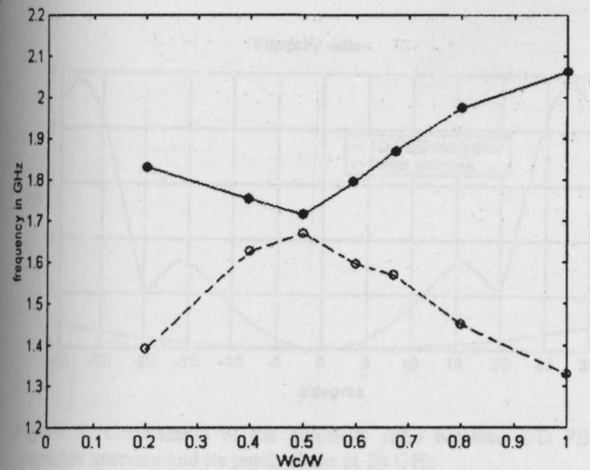


Figure 4 Variation of first and second resonant frequencies with central width. - ○ - first frequency, —●— second frequency

cm is fabricated on a substrate of $\epsilon_r = 4.5$ and $h = 0.16$ cm. By properly adjusting the feed point position $F_p$ ($X_o$ = 1.2 cm, $Y_o$ = 0.9 cm), both of the resonant frequencies can be excited with good matching. This particular antenna is found to resonate with frequencies 1.593 and 1.797 GHz.

Figure 2 shows the variation of return loss with frequency. The frequency ratio is found to be 1.1278. The 2:1 VSWR impedance bandwidths of the antenna are found to be 1.88% for the 1.593 GHz band and 1.78% for the 1.797 GHz band.

The *E*- and *H*-plane copolar and cross-polar patterns at the central frequencies of the two bands are shown in Figure 3.

The gain of the antenna has been studied using a rectangular microstrip antenna fabricated on the same substrate and resonating at the same frequencies. The gain is found to be 1.54 dB less than the standard rectangular patch. However, the area reduction achieved is 40.12%.

Figure 4 shows the variation of two resonant frequencies with the $W_c/W$ ratio. It is seen that, when the ratio is 0.5, the frequency ratio is minimum. The separation of the two frequencies increases for $W_c/W < 0.5$, as well as for $W_c/W > 0.5$.

## 3. CONCLUSION

A dual-frequency compact microstrip antenna configuration with a coaxial feed is presented. This antenna gives a reduction in patch area with a negligible reduction in gain compared to the standard rectangular microstrip antenna. The antenna presented here is very simple in its construction. This antenna may find applications where dual-frequency operation is required.

## REFERENCES


1. J. George, C.K. Aanandan, P. Mohanan, and K.G. Nair, Analysis of a new compact microstrip antenna, IEEE Trans Antennas Propagat 46 (1998), 1712–1713.
2. J. George, M. Deepukumar, C.K. Aanandan, P. Mohanan, and K.G. Nair, New compact microstrip antenna, Electron Lett 32 (1996), 508–509.
3. J. George, K. Vasudevan, P. Mohanan, and K.G. Nair, Dual frequency miniature microstrip antenna, Electron Lett 34 (1998), 1168–1170.

4. K.-L. Wong and W.-S. Chen, Compact microstrip antenna with dual frequency operation, Electron Lett 33 (1997), 646–647.