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. © 2000 John Wiley & Sons, Inc. 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 $\varepsilon_r$. $L$ denotes the length, $W$ is the width, and $W_c$ 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 $W_c = 3.5$ cm...
cm is fabricated on a substrate of $\varepsilon_r = 4.5$ and $h = 0.16$ cm. By properly adjusting the feed point position $F_P (X_P = 1.2$ cm, $Y_P = 0.9$ 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 SWR 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


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