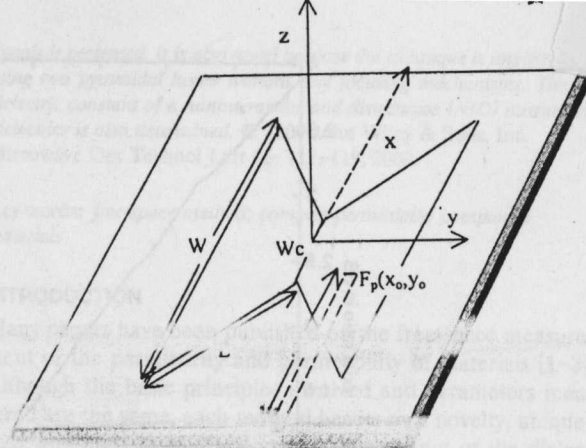


CIRCULARLY POLARIZED COMPACT MICROSTRIP ANTENNA

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ABSTRACT: A compact microstrip antenna with circular polarization radiation is demonstrated. A reduction in the required parameters for achieving CP radiation makes the present antenna design simpler. This reduction of 42% compared to a standard



microstrip antenna

bandwidth of $\approx 1\%$ has been demonstrated. Microwave Opt Technol Lett 26: 308-309, 2000.

Key words: compact; circular polarization; microstrip antenna; 3 dB CP bandwidth; axial ratio

1. INTRODUCTION

Circularly polarized (CP) antennas find applications in mobile satellite communication and direct broadcasting satellite systems as they do not need polarization tracking. They are also used in radar to reduce the clutter from spherically symmetric objects like raindrops, hail, etc. A compact drum-shaped antenna, which provides a substantial reduction in area, has been discussed in the literature [1-3]. Modification using spur lines for achieving CP from a triangular microstrip antenna also has been presented in the literature [4], and a circularly polarized patch-loaded square slot antenna was discussed in [5]. A compact CP microstrip antenna is presented in this paper. Here, the compactness is achieved using a drum-shaped structure, and CP can be obtained by appropriate selection of the central width. The proposed design requires only the adjustment of a single parameter so that its construction is simpler compared to the above-mentioned antennas.

2. ANTENNA DESIGN AND EXPERIMENTAL RESULTS

Figure 1 shows the proposed compact drum-shaped antenna for CP radiation. The structure consists of a drum-shaped patch etched on a substrate of thickness h and dielectric constant ϵ_r . L denotes the length, W is the width, and W_c is the central width of the antenna. By choosing a suitable dimension for the central width W_c , two orthogonal resonant modes for the circular polarization can be excited. The antenna is excited by an electromagnetic coupling using a 50Ω microstrip feedline of length L_p at $F_p(x_0, y_0)$, as shown in the figure.

A drum-shaped antenna of length $L = 4.8$ cm, width $W = 5.4$ cm is fabricated on a substrate of $\epsilon_r = 4.5$ and $h = 0.16$ cm. A microstrip line of length $L_p = 5.8$ cm and $W_p = 0.3$ cm on a substrate of the same thickness and permittivity is kept below the antenna to provide the coupling. It is found that, for a central width $W_c = 2.4$ cm, two orthogonal resonant modes merge to produce circular polarization. By

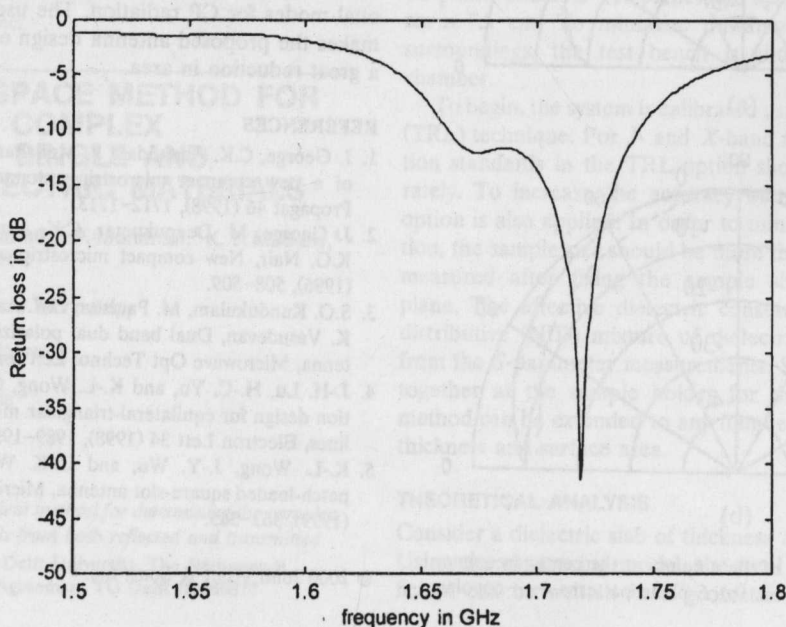


Figure 2 Variation of return loss with frequency

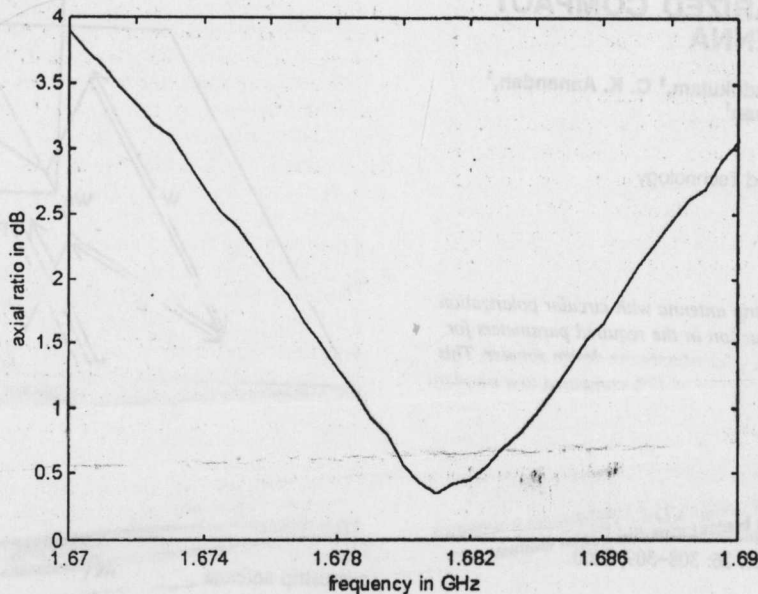


Figure 3 Measured axial ratio against frequency

properly adjusting the feedpoint position F_p ($x_0 = 0.8$ cm, $y_0 = 0.8$ cm) the maximum CP bandwidth is achieved.

Figure 2 shows the measured return loss against frequency of the proposed antenna. The 2:1 VSWR impedance bandwidth is 88 MHz, and the 3 dB axial ratio bandwidth is 17 MHz. By considering the center frequency at 1.68 GHz, where a minimum axial ratio is observed, the proposed design

has an impedance bandwidth of 5.2% and a CP bandwidth of 1.013%.

The measured axial ratio versus frequency is presented in Figure 3. The W_c/W ratio is the parameter which decides the separation between two resonant frequencies, and when it becomes 0.4444, the separation between the two frequencies is minimum, and circular polarization is achieved.

The E - and H -plane copolar and cross-polar patterns at the center frequency are shown in Figure 4. The copolar patterns are almost similar to that of a drum-shaped antenna. This microstrip antenna provides an area reduction of 42% compared to a standard rectangular antenna operating at the same frequency, and this accounts for its compactness.

3. CONCLUSION

A compact circularly polarized microstrip antenna is presented. This antenna uses the variation of the central width of the drum-shaped antenna for the excitation of two orthogonal modes for CP radiation. The use of a single parameter makes the proposed antenna design easily implemented with a great reduction in area.

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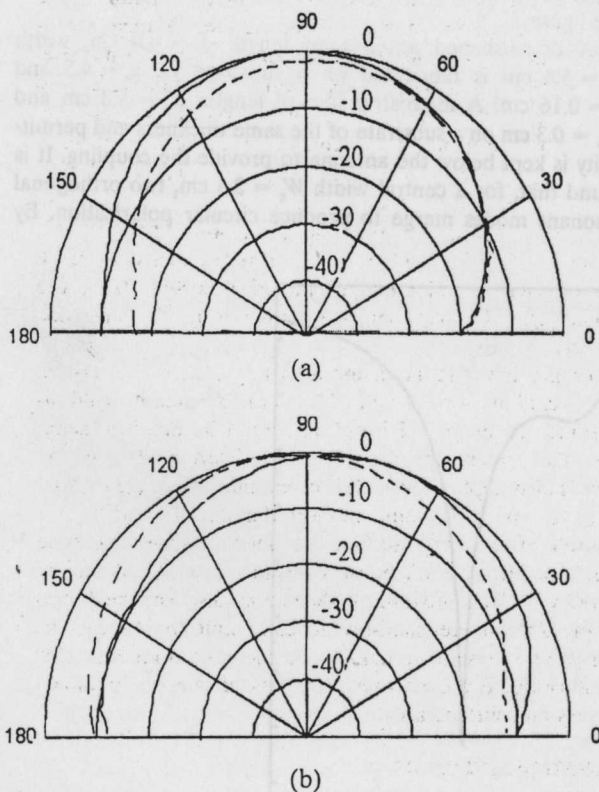


Figure 4 Radiation pattern of the antenna at the center frequency 1.68 GHz. (a) H -plane patterns. (b) E -plane patterns. — copolar, ---- cross polar

tremely sharp peaks at the lateral spectral frequencies that coincide with the real parts of the surface-wave poles. Therefore a more sophisticated method should be utilized for accurate integration, such as a 20-point Gaussian quadrature. Besides, the original finite integration limits effectively may be replaced by $k_x/k_0 = -20.0$ and $+20.0$ without causing noticeable errors since a significant variation concentrates between the two points. Similarly, remarkable peaks exist in the low spectral range for the off-diagonal spectral matrix elements, and a major amplitude variation resides between $k_x/k_0 = -40.0$ and $+40.0$, which are recommended to replace the original infinite limits as well.

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