# A WIDEBAND RECTANGULAR MICROSTRIP ANTENNA USING AN ASYMMETRIC T-SHAPED FEED

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**ABSTRACT:** *An electromagnetically coupled T-shaped microstrip feed used to enhance the impedance bandwidth of a rectangular microstrip antenna is reported. The proposed antenna offers a 2:1 VSWR bandwidth of ~36% with an increase in gain of 0.8 dB.* © 2003 Wiley Peri-

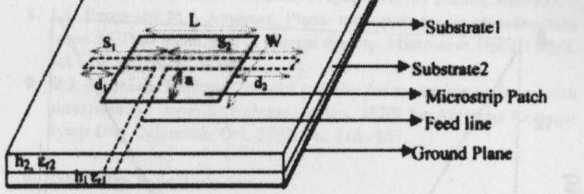


**Figure 1** Geometry of the proposed antenna using asymmetric T-shaped feed

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**Key words:** *microstrip antennas; bandwidth enhancement; T-shaped feed; electromagnetic coupling*

## 1. INTRODUCTION

Narrow impedance bandwidth is recognized as an inherent drawback of printed microstrip antennas. Several techniques such as the use of thick substrate [1], L-probe/strip [2], L-shaped feed [3], T-probe [4], etc. have been suggested for enhancing the bandwidth. Usage of a symmetric T-shaped which offers a bandwidth of 23%, feed has been reported recently [5]. In this paper, use of an electromagnetically coupled asymmetric T-shaped microstrip feed to further enhance the bandwidth is proposed. The experimental results show that the present configuration can offer a 2:1 VSWR bandwidth of 35.5% with a 0.8 dB increase in gain.

## 2. ANTENNA DESIGN

The antenna is electromagnetically fed using a 50Ω asymmetric T-shaped microstrip line fabricated on a substrate of dielectric constant $\varepsilon_{r1} = 4.28$ and thickness $h_1 = 0.16$ cm. A rectangular microstrip patch of dimension $L \times W$, fabricated on another substrate of dielectric constant $\varepsilon_{r2}$ and thickness $h_2$, is electromagnetically coupled to the asymmetric T-shaped feed, as shown in Figure 1.

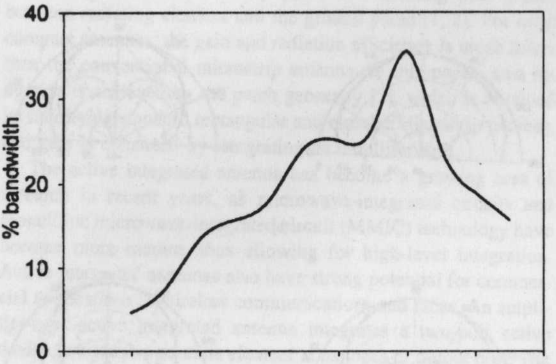


**Figure 2** Variation of % bandwidth with feed segment length ($S_2$): $\varepsilon_{r1} = \varepsilon_{r2} = 4.28$, $h_1 = h_2 = 0.16$ cm, $L \times W = 4 \times 2$ cm$^2$, $d_1 =$ 2 cm, $d_2 = 1.4$ cm, $S_1 = 5.5$ cm, and $a = 0.1$ cm

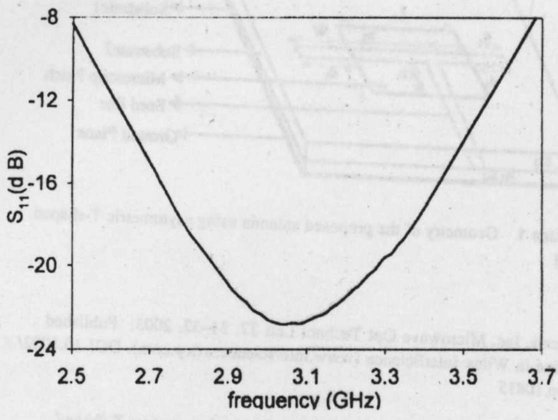


**Figure 3** Variation of return loss with frequency: $\varepsilon_{r1} = \varepsilon_{r2} = 4.28$, $h_1 = h_2 = 0.16$ cm, $L \times W = 4 \times 2$ cm$^2$, $d_1 = 2$ cm, $d_2 = 1.4$ cm, $S_1 = 5.5$ cm, $S_2 = 5$ cm, and $a = 0.1$ cm

## 3. EXPERIMENTAL RESULTS

A rectangular microstrip antenna of dimension $4 \times 2$ cm$^2$ resonating at 3.043 GHz is fabricated on a substrate of dielectric constant $\varepsilon_{r2} = 4.28$ and thickness $h_2 = 0.16$ cm. The characteristics of the patch antenna with asymmetric T-shaped feed are studied using HP8510C Network Analyzer. Variation of percentage bandwidth with asymmetric T-arm ($S_1 \neq S_2$) is shown in Figure 2. Typical variation of return loss with fre-

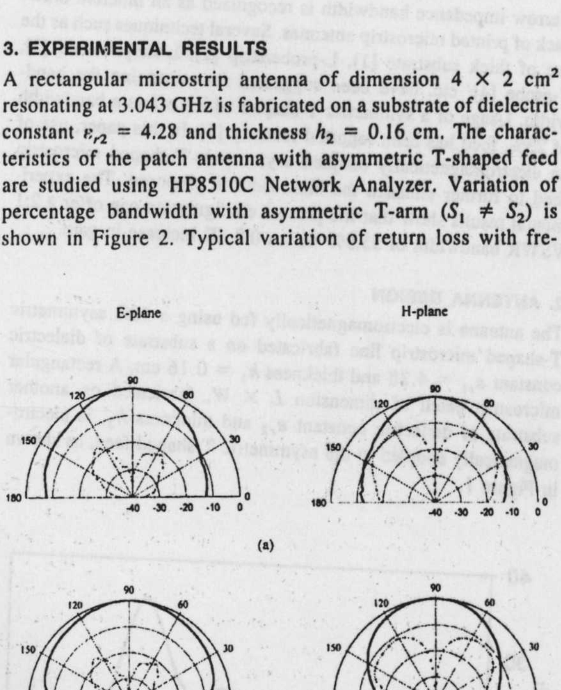


**Figure 4** Radiation pattern of the antenna: $\varepsilon_{r1} = \varepsilon_{r2} = 4.28$, $h_1 = h_2 = 0.16$ cm, $L \times W = 4 \times 2$ cm$^2$, $d_1 = 2$ cm, $d_2 = 1.4$ cm, $S_1 = 5.5$ cm, $S_2 = 5$ cm, and $a = 0.1$ cm. (a) 2.6 GHz; (b) 3.043 GHz; (c) 3.6 GHz; copolar —; crosspolar ····

quency at the experimentally optimized position of the antenna is shown in Figure 3. At the optimum position, with $d_1 = 2$ cm, $d_2 = 1.4$ cm, $S_1 = 5.5$ cm, $S_2 = 5$ cm, and $a = 0.1$ cm, a bandwidth of 35.5% is obtained. It is also observed that at the resonant frequency, the gain of the present antenna is 0.8-dB greater than a standard rectangular microstrip antenna resonating at the same frequency [6]. The radiation patterns of the antenna in the operating band (2.5505–3.6312 GHz) for optimized parameters are shown in Figure 4. The HPBW of the antenna for E-plane and H-plane are found to be 86° and 66°, respectively, at 3.043 GHz, which means that the present antenna is more directive than the conventional rectangular microstrip antenna [6]. The cross polarization along the bore-sight direction is better than −35 dB for both the principal planes. The proposed antenna feeding technique using T-shaped microstrip is an ideal choice for broadband communications.

## 4. CONCLUSION

This paper introduces the use of an asymmetric T-shaped feed for rectangular microstrip antennas with reduced feed complexity for bandwidth enhancement. The present configuration provides a 2:1 VSWR bandwidth of 36%. The enhancement in bandwidth is obtained with a slight increase in gain, which makes it suitable for broadband applications.

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