WIDE BAND RECTANGULAR MICROSTRIP ANTENNA USING SYMMETRIC T-SHAPED FEED

Sreedevi K. Menon, B. Lethakumary, K. Vasudevan, and P. Mohanan
Centre for Research in Electromagnetics and Antennas
Department of Electronics
Cochin University of Science and Technology
Cochin 682 022, India

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ABSTRACT: *Bandwidth enhancement of a rectangular microstrip antenna using a T-shaped microstrip feed is explored in this paper. A 2:1 VSWR impedance bandwidth of 23% is achieved by employing this technique. The far-field patterns are stable across the pass band. The proposed antenna can be used conveniently in broadband communications.* © 2002 Wiley Periodicals, Inc. Microwave Opt Technol Lett 35: 235–236, 2002; Published online in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/mop.10566

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

1. INTRODUCTION

Narrow bandwidth available from printed microstrip patches is the major handicap factor which limits the widespread application of these classes of antennas. Several techniques for bandwidth widening of microstrip antennas have been reported in literature, such as the use of thick substrates [1] and multiple dielectric resonators [2]. In all these cases the impedance bandwidth is found to be less than 10%. The usage of shorting pins [3], and high dielectric constant substrate and superstrates, [4] etc., can be used to reduce antenna size, but in these cases the bandwidth is found to be very narrow in nature. Recently, a T-probe-fed patch antenna used to enhance the impedance bandwidth up to 40% [5] was reported, however, its overall system is highly complex and bulky. In this paper, a novel approach of planar T-shaped feed for feeding microstrip antenna is presented with less complexity. This feeding technique gives a 2:1 VSWR bandwidth of 23.2%.

2. ANTENNA GEOMETRY

A 50 Ω T-shaped feed line is fabricated on a substrate of dielectric constant $\varepsilon_{r1} = 4.28$ and thickness $h_1 = 0.16$ cm. An antenna of dimension $L \times W$ is fabricated on a substrate of ε_{r2} and thickness h_2 and is electro magnetically coupled with the feed line as described in Figure 1.

3. EXPERIMENTAL RESULTS

The performance of the patch with T-shaped feed is evaluated using HP 8510C Network Analyzer. A rectangular patch an-

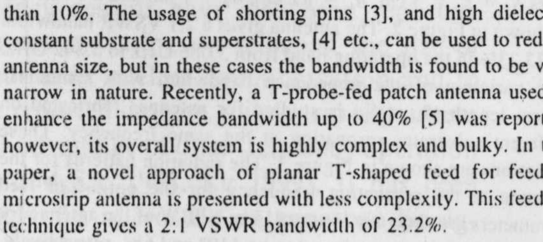

Figure 1 Geometry of the rectangular microstrip antenna with a symmetric T-shaped feed

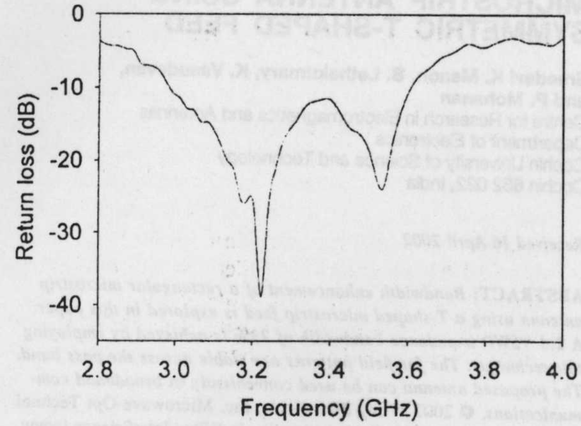

Figure 2 Variation of return loss with frequency: $\varepsilon_{r1} = \varepsilon_{r2} = 4.28$, $h_1 = h_2 = 0.16$ cm, $L \times W = 2 \times 4$ cm^2. $S_1 = S_2 = 3$ cm, $d_1 = 1.2$ cm, $d_2 = 1$ cm, $a = 0.9$ cm

tenna with $L = 4$ cm and $W = 2$ cm resonating at 3.25 GHz is fabricated on a substrate with $\varepsilon_{r2} = 4.28$, $h_2 = 1.6$ mm. The parameters of the symmetric T-shaped feed are optimized to obtain maximum percentage bandwidth. The variation of the return loss of the above antenna with the optimum feed parameters $S_1 = S_2 = 3$ cm, $d_1 = 1.2$ cm, $d_2 = 1$ cm and $a = 0.9$ cm is shown in Figure 2. The antenna gives a 2:1 VSWR bandwidth of 23.23% in the operating band from 3.086 GHz to 3.842 GHz. The variation of the impedance bandwidth with symmetric T-arm length ($S_1 = S_2$) is studied for antennas fabricated on different substrates resonating at the same frequency. These variations are shown in Figure 3. The radiation patterns for the antenna at the resonating frequency for the optimized feed parameters are shown in Figure 4. The HPBW of the antenna for the E- and H-planes are found to be 110° and 68°, respectively. The cross polarization level is found to be better than −35 dB in the principal planes. All the above radiation characteristics are highly suitable for large bandwidth applications.

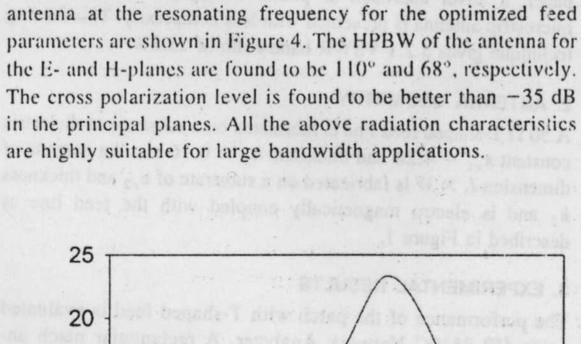

Figure 3 Variation of % bandwidth with feed segment length S_2: $\varepsilon_{r1} = 4.28$, $h_1 = 0.16$ cm; –+– $\varepsilon_{r2} = 10.2$, $h_2 = 0.06$ cm; — $\varepsilon_{r2} = 4.28$, $h_2 = 0.16$ cm; —●— $\varepsilon_{r2} = 2.2$, $h_2 = 0.11$ cm

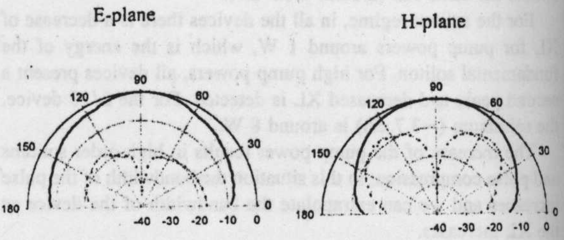

Figure 4 Radiation patterns of the antenna at the resonant frequency: $\varepsilon_{r1} = \varepsilon_{r2} = 4.28$, $h_1 = h_2 = 0.16$ cm, $L \times W = 2 \times 4$ cm^2, $S_1 = S_2 = 3$ cm, $d_1 = 1.2$ cm, $d_2 = 1$ cm, $a = 0.9$ cm; copolar — cross-polar .....

4. CONCLUSIONS

This paper introduces the use of a planar T-shaped feed for rectangular microstrip antenna, with the striking feature of having a reduced feed complexity (as compared with other existing methods) used for bandwidth enhancement. This may find applications in wireless communication and Blue tooth Technology.

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