EXPERIMENTAL STUDY ON BROAD BAND TRIANGULAR MICROSTRIP ARRAY ANTENNA

P.S. Bhatnagar
Central Electronics Engineering Research Institute, Pilani (Raj.), India
C. Terret, J.P. Danial, K. Mohdjoubi,
Universite de Rennes I, France

ABSTRACT

The broad band behaviour of a stacked triangular microstrip antennas is investigated experimentally. Experiments have shown that the band width of a Triangular Microstrip Antenna (TMA) can be broadened to as high as 19% by optimizing the dimensional ratio of the pair of stacked microstrip patches.

Introduction

Microstrip antennas have been enjoying a growing popularity. They posses attractive features such as light weight, small volume, low profile and low production cost but a narrow impedance bandwidth is a series limitation. Need for improving the band width of microstrip patch antenna is well known and several suggestions[1-2] using variety of shapes and configurations for this purpose have been reported in literature. The stacked triangular microstrip antenna (STMA) proposed in this paper are experimented at frequencies in S band. An equilateral triangular patch of L = 37 mm is fabricated on a cuclad substrate of thickness h = 1.6 mm and relative permitivity 2.55. The upper element with different dimensions is space coupled (i.e. parasitically coupled) only through the fringing field and aligned exactly above the lower patch. The lower patch is provided with a coaxial feed at the appropriate distance Fd = 13.5 mm.

The air gap thickness 't' is controlled by using foam material of uniform thickness. The geometry for the proposed structure is shown in Fig. 1.

Experimental Investigations

The functional behaviour of the impedance characteristics for varying air gap thickness (1.5 mm to 9 mm) and sizes of parasitic element is (b/a = 0.98 to 1.06) presented in Fig. 2.

An experimental bandwidth of 595 MHz is obtained for STMA (b/a = 1) with t = 5 mm, $h_1 = h_2$ = 1.6 mm, Fd = 13.5 mm. This is about 17.5% at the center frequency of[1] 3.407 GHz. This band width is further optimized by changing b/a ratio from 0.98 to 1.06 keeping other dimensions same. An experimental bandwidth of about 640 MHz is obtained for STMA (b/a = 1.02) for dimensions a = 37 mm, b = 37.7, t = 5 mm, $h_1 = h_2$ = 1.6 mm and Fd = 13.5 mm. This is about 18.8% at the centre frequency of[2] 3.4 GHz. The input impedance locus is plotted in Fig. 3. The variation of VSWR with frequency is also shown in Fig. 3. The radiation pattern of the proposed STMA is measured in both E plane and H plane at various frequencies covering the entire impedance bandwidth of the proposed antenna. The experimental variations of E plane pattern with frequencies are shown in Fig. 4. The beam width varies from 55° to 65°. The cross polar level is better than 17 dB. The H plane pattern were also taken at various frequencies as shown in Fig. 5. The beam width varies from 75° to 85° and cross polar level is better than 14 dB. It has been observed that there is no significant variation in the radiation pattern by using different stacked patches of b/a ratio.

The antenna described may be suitable for use in both plannar and conformal arrays.

References

1. Sabban, A., A new broad and stacked two layer microstrip antenna, IEEE AP-S International Symposium Digest 1983, pp 63-66.

2. Dehale, J.S., "Theory and experiments on Microstrip antenna with air gap", IEE Proc. H. Microwave, Antennas & Prop., 1985, 132, pp 455-460.

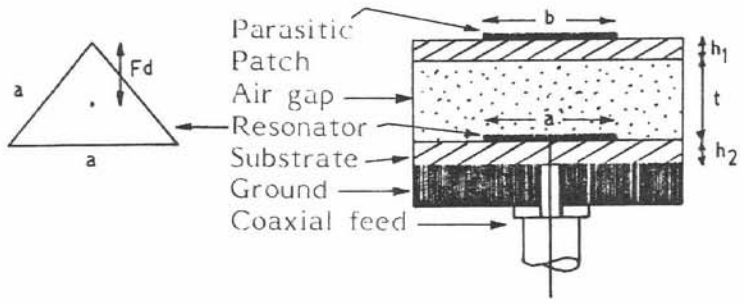

FIG. 1 GEOMETRY OF STACKED TRIANGULAR MICROSTRIP ANTENNA

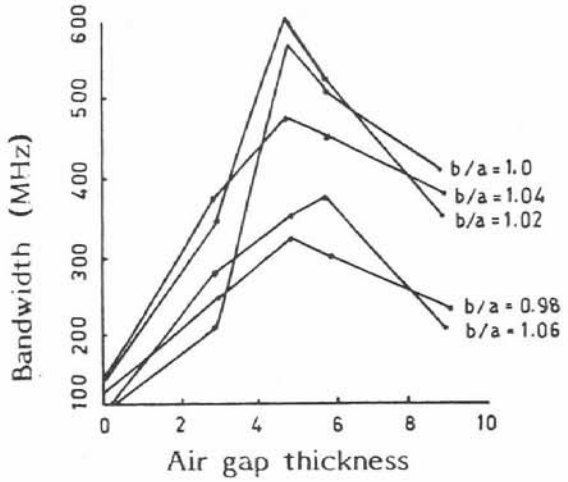

FIG. 2 BANDWIDTH VARIATION AGAINST AIR GAP THICKNESS

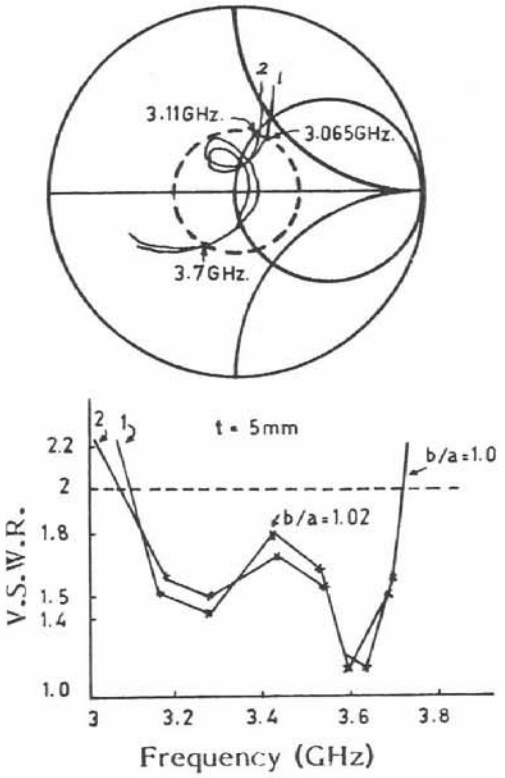

FIG. 3 FREQUENCY DEPENDENCE OF MEASURED VSWR

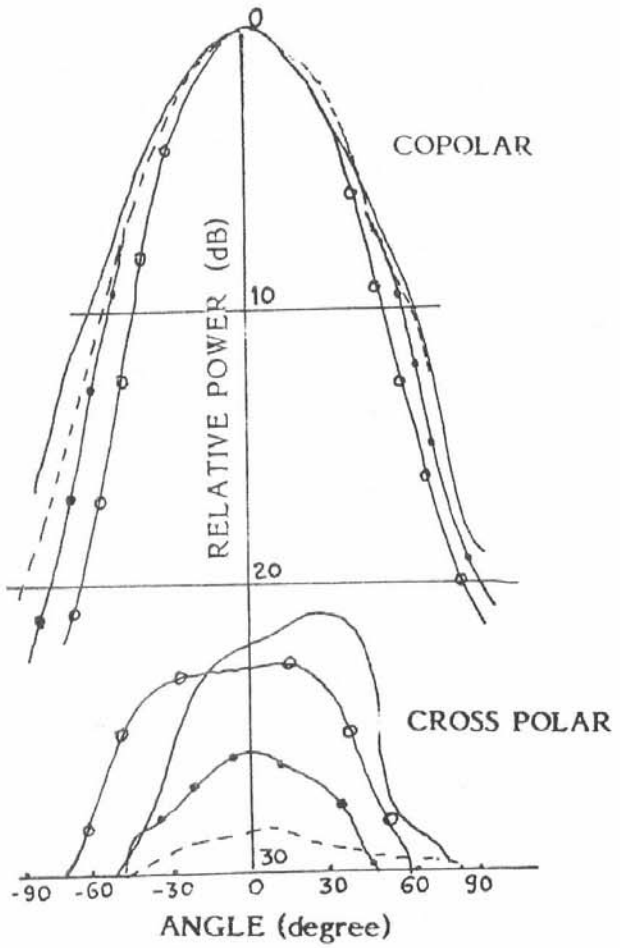

FIG. 4 E PLANE RADIATION PATTERN

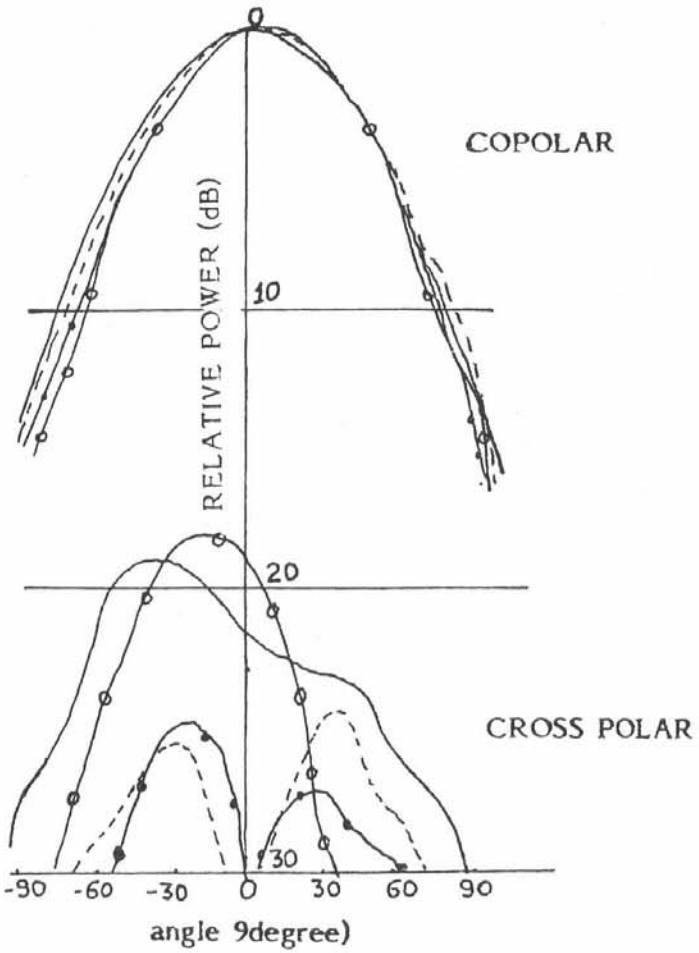

FIG. 5 H PLANE RADIATION PATTERN

——— 3.05 GHz - - - - - - - - 3.3 GHz

—·—·— 3.5 GHz —o—o—o— 3.7 GHz