WIDEBAND GAP-COUPLED COMPACT SECTORAL MICROSTRIP ANTENNAS

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1. Introduction

A compact shorted 90^0 sectoral microstrip antenna (MSA) [1] and 30^0 sectoral MSA [2] have been reported, which have the same resonant frequency as that of the circular MSA (CMSA) and equilateral triangular MSA (ETMSA), with area reduction by a factor of four and five, respectively. However, these compact shorted MSAs have narrower bandwidth as compared to the corresponding CMSA and ETMSA. This is due to its smaller size and larger impedance variation because of the shorting posts. In the proposed experimental investigations, the bandwidth of these compact MSAs has been increased by using planar coupled resonator technique. The compact co-axially fed shorted 90^0 or 30^0 sectoral patch is gap coupled to the shorted 90^0 or 30^0 sectoral parasitic patch, respectively. The area of the wideband coupled 90^0 sectoral MSA is half as compared to that of the CMSA and broadband gap coupled semicircular MSA [3, 4]. Similarly, the area reduction factor achieved in the case of wideband coupled 30^0 sectoral MSA is 2.5 as compared to the corresponding ETMSA.

2. Wideband gap-coupled shorted 90^0 sectoral MSA

Two gap-coupled shorted 90^0 sectoral MSAs of radius 3.0 cm are shown in Fig. 1. Only one patch is fed with 50 Ω co-axial line and the other patch is parasitically coupled. The antenna was fabricated on glass epoxy substrate ($\varepsilon_r = 4.3$, h = 0.16 cm, and $\tan\delta = 0.02$). The shorting was done with closely spaced posts having diameter of 0.4 mm. The feed point was experimentally optimized at x = 0.75 cm. The measured input impedance and VSWR plots are shown in Fig. 2. The measured bandwidth for VSWR ≤ 2 was 69 MHz at the center frequency of 1.358 GHz. For comparison, the measured response of a CMSA with radius of 3.0 cm is also given in Fig. 2. The bandwidth of the CMSA is 28 MHz at 1.375 GHz. Therefore, the bandwidth of the proposed configuration is almost 2.5 times that of the CMSA with approximately half the area.

The radiation pattern of the gap-coupled MSA remains in the broadside in the entire bandwidth. The measured E and H plane radiation pattern at the center frequency was compared with that of the CMSA. The half – power beam widths (HPBW) in the E and H planes of the gap-coupled antenna are 98^0 and 77^0 respectively as compared to 87^0 and 82^0 of the CMSA. However, the cross-polar levels of the gap-coupled shorted sectoral MSA are higher than that of the CMSA.

The resonant frequency of the shorted MSA decreases with decrease in number of the shorting posts and it is minimum when a single shorting post is used [1, 2, 5, 6]. The above gap-coupled concept has been utilized to obtain the wide bandwidth at lower frequency by reducing the number of shorting posts. Several experiments were carried out by decreasing the number of shorting posts from fully shorted edge to a single shorting post. Wide bandwidth has been achieved at various frequencies in the range of 1358 to 784 MHz using the same antenna dimensions. With a single short, the bandwidth of 41 MHz has been achieved at 784 MHz, whereas the bandwidth of 69 MHz at 1358 MHz was obtained for fully shorted edge of both the sectoral MSA.

3. Widedband gap-coupled shorted 30^0 sectoral MSA

The resonant frequency of a 30^0 sectoral MSA with its curved edge fully shorted is same as that of an ETMSA [2]. The gap coupled 30^0 sectoral MSA with radius of 2.5 cm was fabricated on the glass epoxy substrate as shown in Fig. 3. The antenna was fed at 0.4 cm from the short. The gap between the fed and the parasitic patch was optimized as 0.8 mm.

The measured impedance and VSWR plots are shown in Fig. 4. The bandwidth obtained is 105 MHz at 2.036 GHz. For comparison, the corresponding ETMSA was fabricated with side length of 4.3 cm. The impedance and VSWR plots of the ETMSA are also shown in Fig. 4. The measured bandwidth of the ETMSA is 48 MHz at 2.076 GHz. The bandwidth of the gap-coupled shorted 30^0 sectoral MSA is more than 2 times as compared to that of an ETMSA.

The measured E and H planes radiation pattern at the center frequency was compared with that of the ETMSA. The half power beamwidth in E and H plane of the coupled antenna are 159^0 and 80^0 respectively as compared to 112^0 and 72^0 of ETMSA, indicating that the antenna has lower gain than the ETMSA. The higher cross polar levels have been noted in the radiation pattern.

The wide bandwidth has also been obtained at lower frequencies by partially shorting the fed and the parasitic 30^0 sectoral MSAs.

By increasing the coupling between the fed and parasitic patches using shorting strip across the gap, dual band operation has been obtained for both the configurations. By changing the width of the shorting strip, the ratio of the two frequencies has been tuned. The details of these results will be presented at the symposium.

4. Conclusion

Compact broadband configurations have been proposed by using two gap-coupled shorted 90^0 or 30^0 sectoral MSAs. The bandwidth of the coupled shorted 90^0 MSA is nearly 2.5 times the bandwidth of the corresponding CMSA with half the area. The bandwidth of the coupled shorted 30^0 MSA is nearly 2 times the bandwidth of the corresponding ETMSA with area reduction by a factor of 2.5. However, higher cross-polar levels have been observed in the radiation pattern.

References

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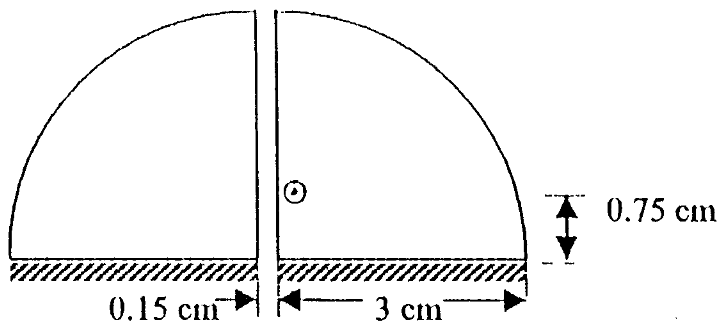

Fig. 1 Wide band gap-coupled shorted 90^0 sectoral MSA

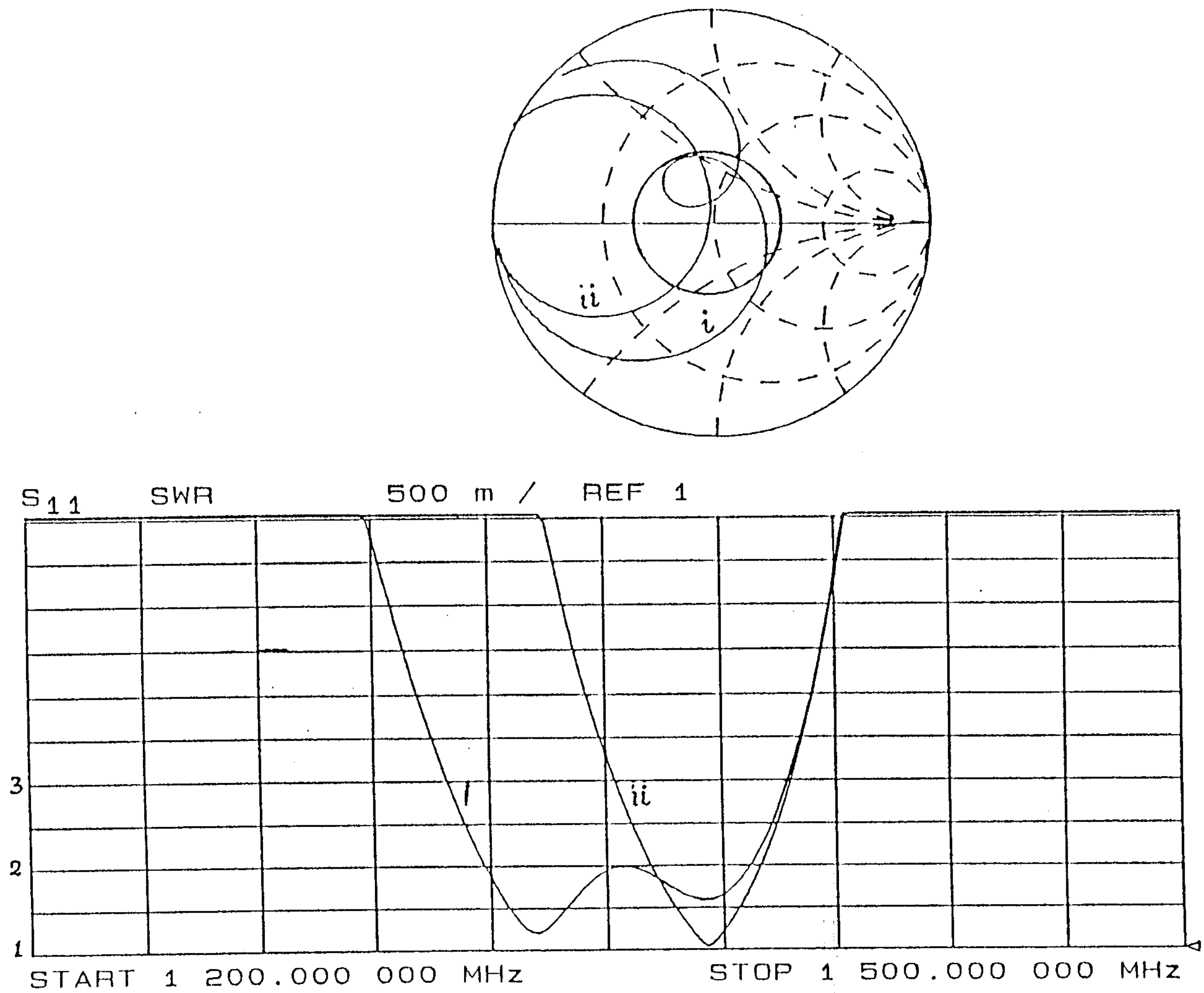

Fig. 2 Measured impedance and VSWR plots for
i - gap-coupled shorted 90^0 sectoral MSA
ii - the corresponding CMSA

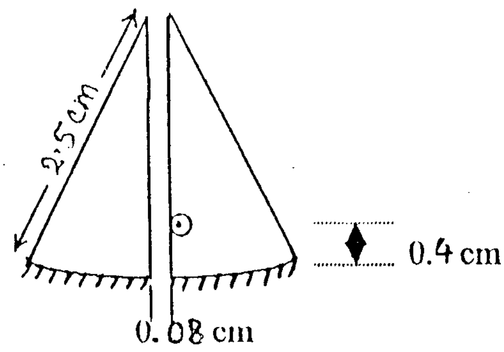

Fig. 3 Wide band gap-coupled shorted 30^0 sectoral MSA

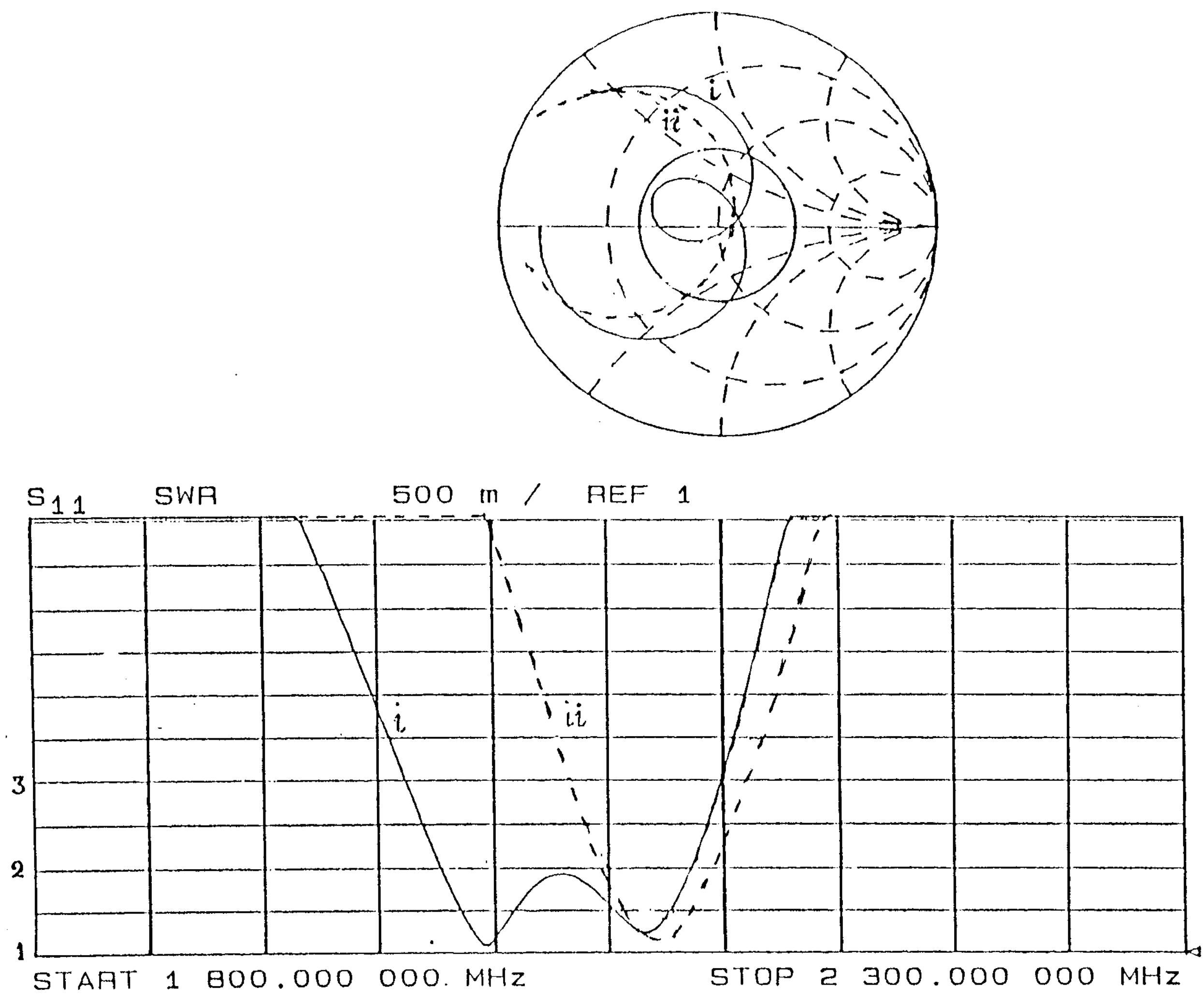

Fig. 4 Measured impedance and VSWR plots for
i - gap-coupled shorted 30^0 sectoral MSA
ii - the corresponding ETMSA