Aperture Coupled Microstrip Antenna with a U-Slot

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ISAP topics A10 Microstrip Antenna

1. Introduction

Narrow bandwidth is an intrinsic weakness of microstrip antenna. Bandwidth enhancement methods using parasitic patches will either increase the thickness or the lateral size of the antenna[1]. Recently, Lee and Huynh [2] demonstrated that a single-layer single-patch coaxially fed microstrip antenna with a U-shaped slot can attain over 30% impedance bandwidth. This antenna can retain the advantages of thin profile and small size. In this paper, we will present an aperture coupled microstrip antenna with a U-slot that also exhibit wide bandwidth and good radiation characteristics. A comparison between an aperture coupled microstrip antenna with and without a U-slot is also investigated.

2. Experimental Results

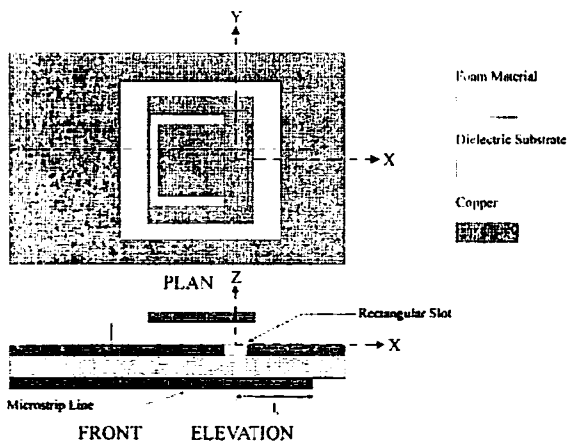


Figure 1. Basic geometry of an aperture coupled microstrip antenna with a U-slot

The geometry of an aperture coupled microstrip antenna with a U-slot was shown in figure 1. The antenna basically consisted of a feed layer and a resonating patch with a U-slot. The feed layer was a piece of dielectric substrate of dielectric constant equal 2.32 and thickness equal 1.59mm. On one side of the feed layer, there was a rectangular slot of dimensions $1.5x20mm^2$ located at the origin of the rectangular coordinate system, i.e., (x, y, z)=(0,0,0). Moreover, there was a microstrip line of characteristic impedance $Z_0=50\Omega$ on the other side of the feed layer. The distance between the open end of the microstrip line and the centre of the slot was $L_f = 9mm$. The resonating patch was made of a piece of copper sheet of dimensions $32x44mm^2$ stuck on a 5mm thick foam materials. A 2mm thick U-shaped slot was located at 1mm from a radiating edge of the copper patch.

It was found that the dimensions of the U-slot was closely related to the resonating behaviour of the patch, so the dimensions of the U-slot was investigated initially. When a good VSWR impedance bandwidth was achieved. The stub length L_f was fine tuned. The measured VSWR versus frequencies was given in figure 2. The bandwidth (VSWR=2) was about 20%. The resonating frequency started from 3.08GHz to 3.78GHz. A similar dimensions aperture coupled microstrip antenna without a U-slot was fabricated and the bandwidth of the antenna was 16%, start from 3.06GHz to 3.62GHz.

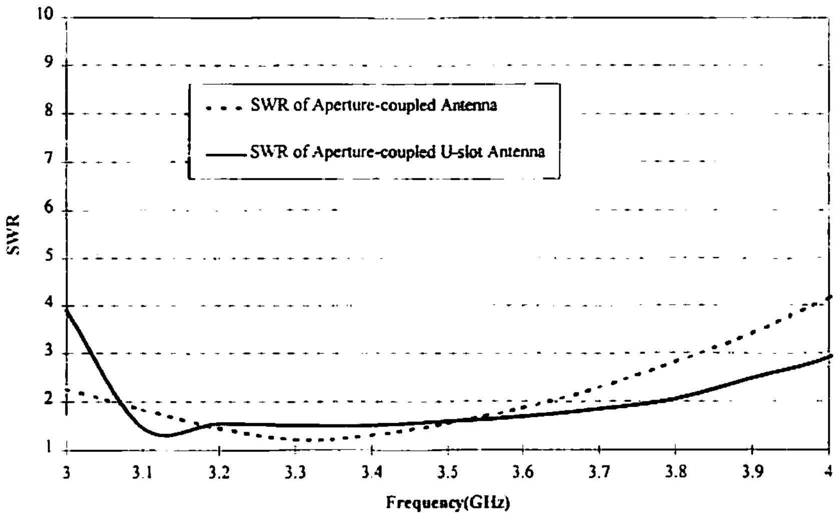
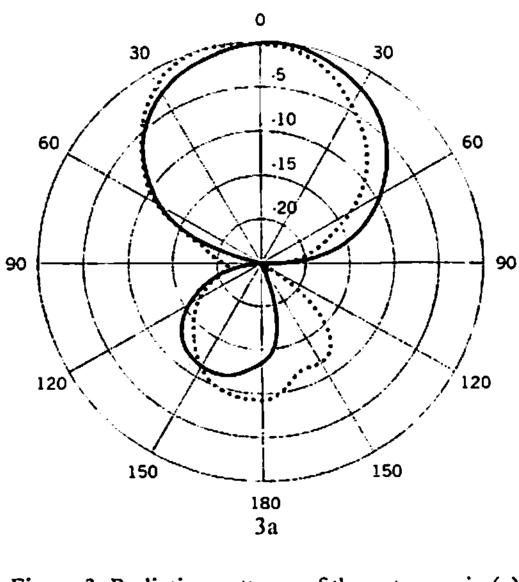


Figure 2. Comparison in VSWR between the antennas with and without U-slot

Figure 3 showed the measured radiation patterns in the E and H planes at frequencies 3.08, 3.43 and 3.78 GHz. From figure 3, we could see that the differences in radiation patterns of the two antennas were small. The 3 dB beamwidths of the antennas in H plane at 3.08, 3.43 and 3.78 GHz were 71°, 67° and 67° respectively. In E plane, the 3 dB beamwidths of the antennas at those frequencies were 74°, 62° and 58°. We could see that the U-slot antenna had a lower back lobe level at lower frequencies. Though out the passband, the cross polarization levels were below 20dB in both E and H plane.



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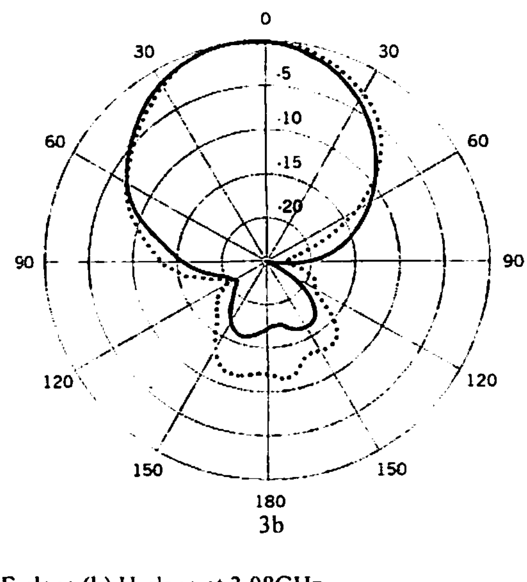
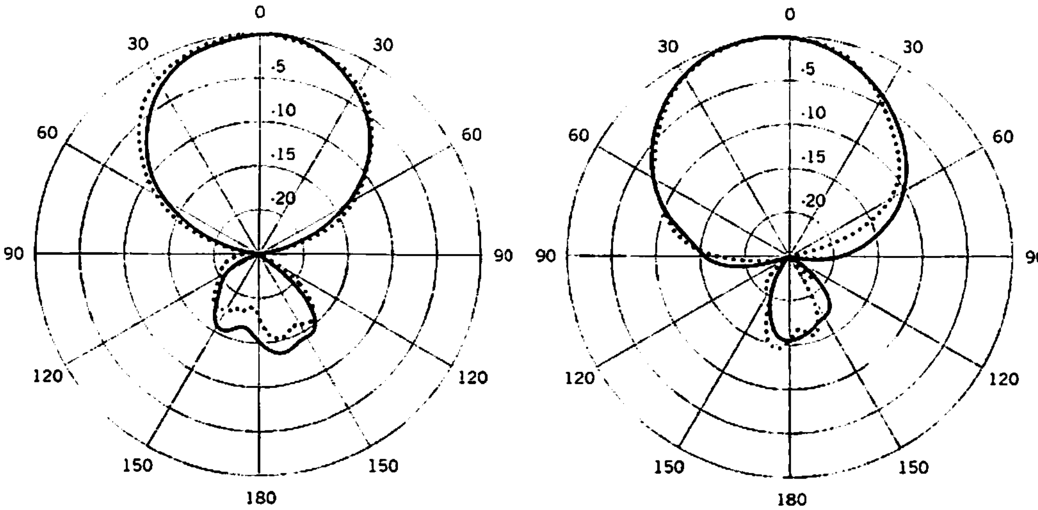


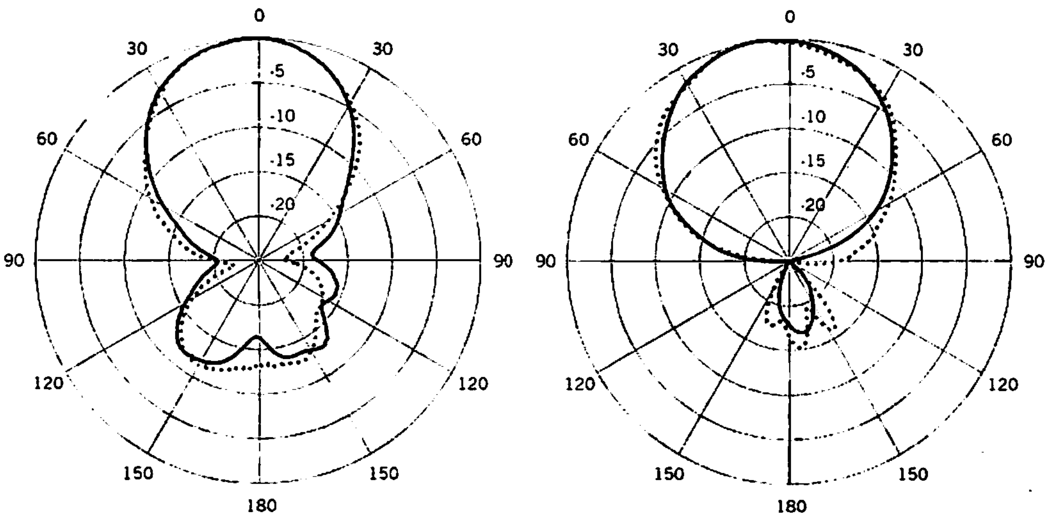
3b

Figure 3. Radiation patterns of the antennas in (a) E plane (b) H plane at 3.08GHz



3c 3d

Figure 3. Radiation patterns of the antennas in (c) E plane (d) H plane at 3.43 GHz



3e 3f

Figure 3. Radiation patterns of the antennas in (e) E plane (f) H plane at 3.78 GHz

The measured gain versus frequencies curves of the both antennas were shown in figure 4. The gains of both antennas had similar trend within the passband. The aperture coupled microstrip antenna with U-slot at frequencies below 3.2 GHz and higher than3.65 GHz has a higher gain. At other frequencies within the passband, there was only a maximum 0.5 dB difference between both antennas.

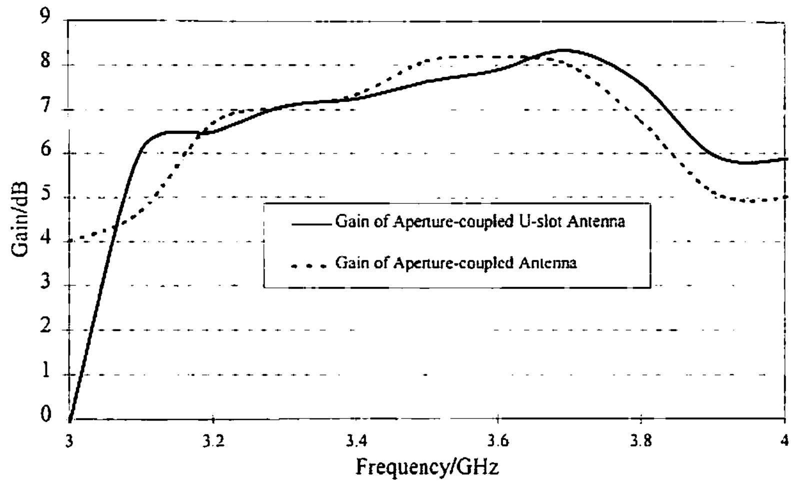


Figure 4. Measured gain of the antennas versus frequency

3. Conclusions

In this paper, experimental results of an aperture coupled microstrip antenna with a U-slot have been presented. Wider bandwidth (20%) and lower back lobe level were reported. The gain of the antennas was about 7.5 dB. A comparison was made between the antennas with and without a U-slot. The numerical analysis of the antenna will be presented in the conference.

4. Acknowledgement

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5. References

1. T. M. Au, K. F. Tong and K. M. Luk, 'Analysis of offset dual-patch microstrip antenna'. IEE Proceedings Microwave, Antenna and Propagation, Vol.141, No.6, December 1994, pp. 523-526.
2. T.Huynh and K.F. Lee, "Single-layer single-patch wideband microstrip antenna," Electronics Letters, Vol. 31, No. 16, pp. 1310-1312, 1995.