A FEEDING TECHNIQUE FOR BROADBANDING AND DUAL-BANDING MICROSTRIP ANTENNAS

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INTRODUCTION

Microstrip antennas (MSA) are useful as an antenna mounting on a moving vehicle such as a car, a plane, a rocket, or a satellite, because of their small size, light weight and low profile. But there are difficulties with regard to their practical use because of the MSA's narrow band characteristic. Many works have been done on the broadband and the dual-band MSA's [1][2].

In the case of the above techniques, it was necessary to re-shape the radiating element itself. So there are some problems with these techniques such as: the difficulty of applying these to an MSA which has a patch of arbitrary shape; a distortion to radiation patterns; and complicated designing.

In this paper, a feeding technique for broadbanding and dual-banding MSAs using a transformer consisting of three distributed elements is presented. Because the transformer in a microstrip line it is independent of a radiating patch, it does not distort the inherent radiation patterns of an MSA.

PRINCIPLE

It is well known that the variation of susceptance component of admittance of any load with frequency is compensated by connecting a shunt stub which has the variation of susceptance opposite to frequency.

The principle of the feeding technique for broadbanding and dual-banding MSA's has three steps as follows: first rotating an admittance locus of an MSA to the symmetric position with respect to the axis jB=0 on the Smith chart as shown in Fig.1a, second compensating the susceptive component of the original admittance locus as shown in Fig.1b, and third moving the knotted admittance locus into the circle of VSWR $\leq$ 2 for broadband use, or the knotted point of the locus to the center for dual-band use, as shown in Fig.1c. The equivalent circuit of the transformer is also shown in the bottom of Fig.1. The transmission line of the characteristic admittance Y_0 and of length "ℓ_1" works as a rotating element of admittance locus of an MSA, the open stub having the characteristic admittance Y_S and of length "$\ell_2=5\lambda/2$" (λ:wavelength) works as a compensating element of the variation of susceptance with frequency, and the quarter-wave transformer of the characteristic admittance Y_T works as a moving element for the admittance locus.

A practical configuration of an MSA with a transformer is shown in Fig.2.

RESULTS

Fig.3 shows the original admittance locus of an MSA. The antenna has a resonant frequency (f_0) of 2.265GHz and a bandwidth of 1.3% with VSWR ≦ 2.

Fig.4 shows the transformed admittance locus of the antenna for broadband use. The sizes of the parameters are also shown in Fig.4. The antenna has a bandwidth of 4.4% with VSWR ≦ 2. This is about three times of the original bandwidth of the MSA.

The input admittance locus of a dual-band MSA is also shown in Fig.5. Also sizes of parameters are shown in this figure. The resonant frequencies are $0.98f_0$ and $1.02f_0$, respectively.

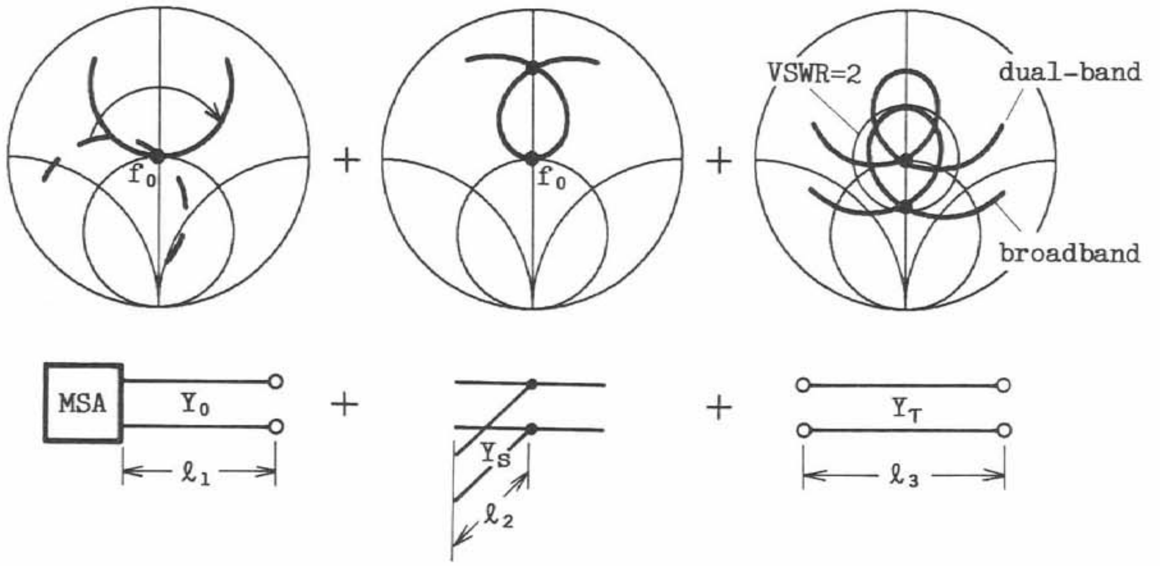
CONCLUSION

A feeding technique for broadbanding and dual-banding MSAs is presented. The antenna yields a bandwidth of 4.4% with VSWR ≦ 2 for broadband use, and has resonant frequencies of $0.98f_0$ and $1.02f_0$ for dual-band use.

REFERENCES

[1] W.F.Richards, S.E.Davidson and S.A.Long:"Dual-band microstrip antennas with monolithic reactive loading",Electron. Lett., 21, 20, pp.936-937, Sep.1985.

[2] S.S.Zhong:"A broadband feeding technique for microstrip antenna elements",IEE International Conference on Antennas and Propag.,ICAP87, pp.300-303.



(a) Rotation of locus. (b) Compensation of variation. (c) Transformed admittance for broadband and dual-band use.

Fig.1 Principle of three stage transformer.

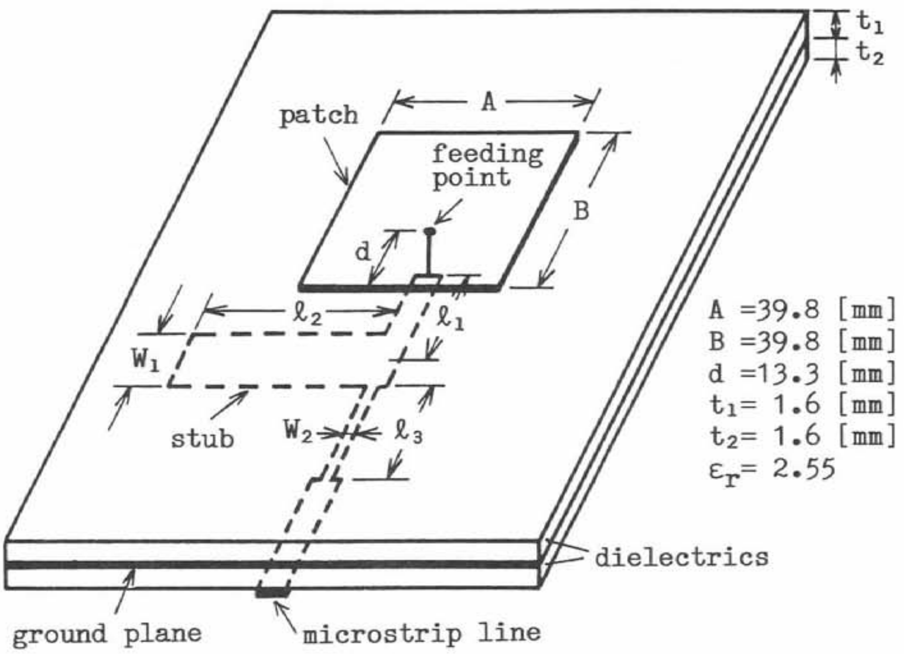


Fig.2 Configuration of a stub loaded microstrip antenna.

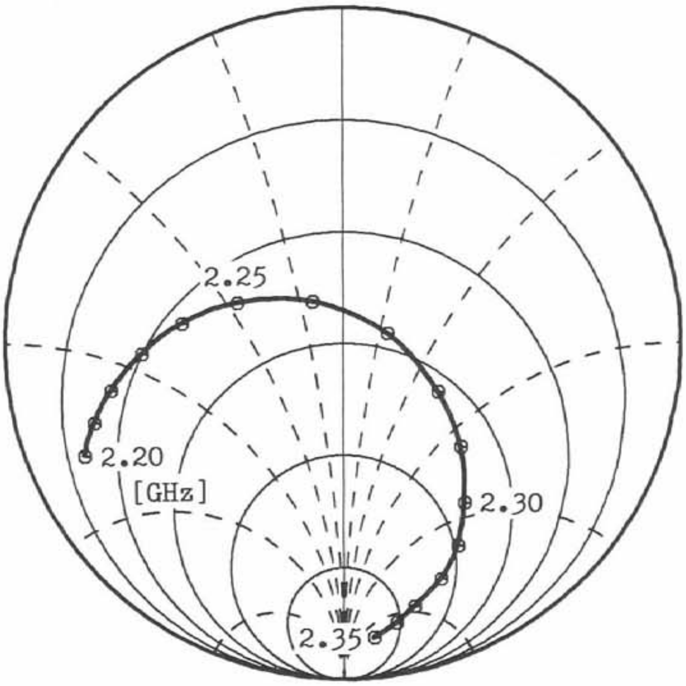


Fig.3 Measured input admittance of a microstrip antenna without transformer.

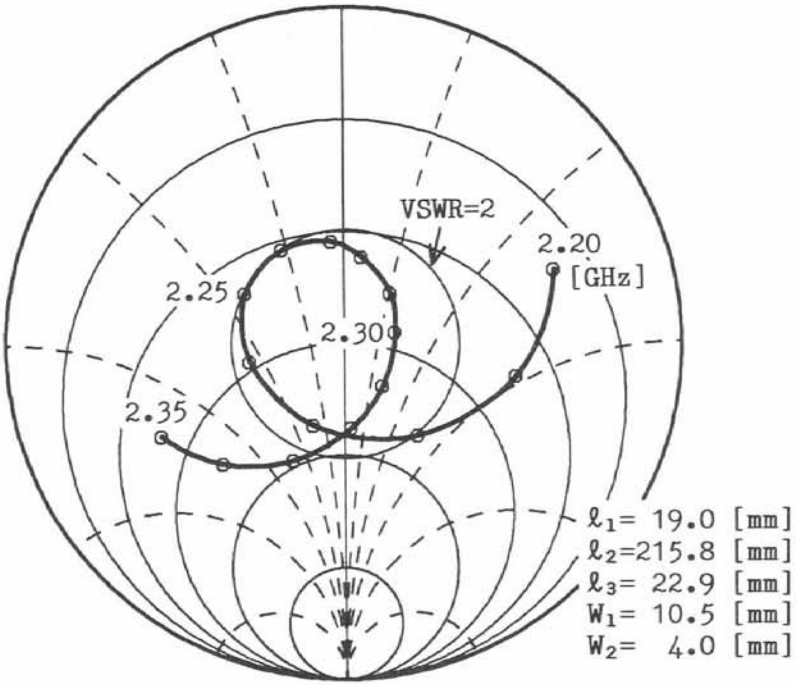


Fig.4 Measured input admittance of a microstrip antenna with transformer for broadband use.

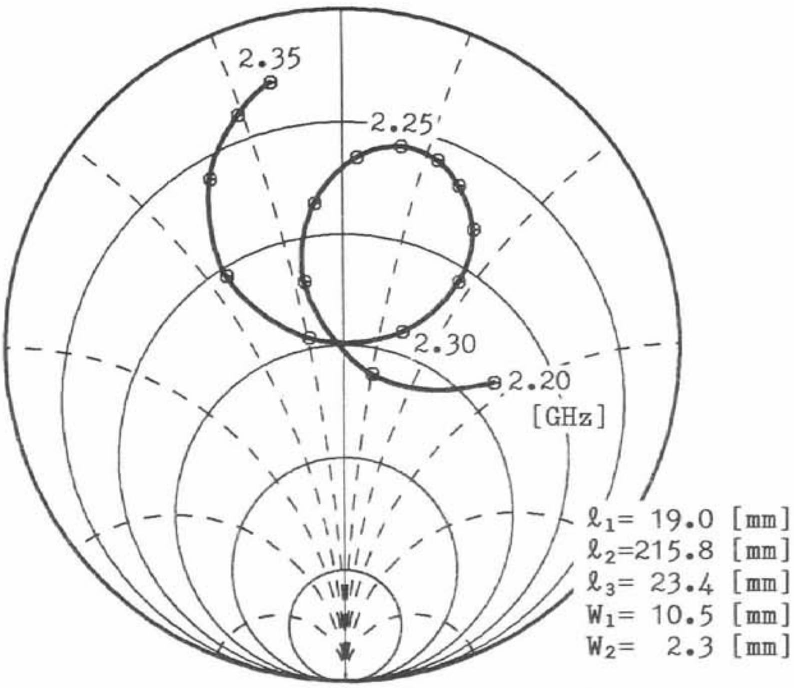


Fig.5 Measured input admittance of a microstrip antenna with transformer for dual-band use.