ACTIVE DIPOLE ANTENNA FOR TELEVISION RECEIVER

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INTRODUCTION

The active antenna including a transistor amplifier integrated with a dipole antenna offeres advantages such as beam control, low noise and high gain[1]. If a dipole antenna and a transistor are matched at wider bandwidth, the operating bandwidth of active antenna will be extended. In this paper, an active dipole antenna for television reception is fabricated on a thin dielectric film by using the photoetching techniques. A coplanar waveguide (CPW) consisting of a center strip with two ground planes located parallel to strip is used as a feeder[2], [3]. A transistor amplifier is integrated between the feeding point of antenna and CPW. The bias voltage for transistor amplifier is supplied through CPW. In this antenna, the dipole antenna and the input of transistor amplifier is tolerably matched. The input impedance characteristics, the receiving patterns and the actual gain are measured at frequencies from 70 to 770MHz. The noise figure is an important parameter for describing the active antenna. Since the noise figure of coaxial feeder becomes larger compared with that of amplifier circuit in the application of television receiver, the noise figure of active antenna is not measured here.

STRUCTURE OF ACTIVE ANTENNA

Fig. 1 shows the structure of active dipole antenna and the transistor amplifier circuit. The dipole antenna and CPW are printed on a dielectric film of thickness u = 45 μm. The length of dipole antenna is L and its width W is 2mm. The charecteristic impedance of CPW is 75 Ω as described after. CPW also serves as a bias supply line to the transistor circuit. This antenna is covered by the same film of thickness u1 = 50 μm. The transistor 2SC2585 is integrated between the feeding point of antenna and CPW, where its two emmitor ports are connected to ground planes of CPW and the collector port to the center

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strip. The nominal value of noise figure of this transistor is around 1.6dB.

MEASURED RESULTS

Fig.2 shows the measured characteristic impedance of CPW as a function of the width of slot between the center strip and the ground plane[4]. The width of ground plane is 6mm. It may be observed that the characteristic impedance becomes larger for wider slot width. In the design of active antenna, the characteristic impedance of CPW is chosen as 75Ω for the impedance matching to the coaxial feeder of the television receiver. Then the widths of center strip and slot become 2mm and 0.4mm, respectively.

Fig.3 shows the measured input impedance at the feeding point of dipole antenna and the S parameters of transistor 2SC2585. At higher frequencies, the conjugate impedance matching between dipole antenna and transistor is achieved. Fig.4 shows the measured actual gains of the active antenna expressed by relative values to the halfwave dipole antenna. When the length of dipole antenna L is 12 to 16cm, the actual gains more than 8dBd are obtained at the UHF channel television frequencies from 470 to 770MHz in Japan. The lower gains at the VHF channel frequencies may be due to the impedance mismatching between transistor and CPW.

CONCLUSION

The new type of CPW fed active dipole antenna for television receiver has been presented. Although the physical length of this antenna is shorter than a free space half-wavelength, actual gains more than 8dBd are obtaind at frequencies from 470 to 770MHz. Improving the impedance matching between transistor and CPW will be left in the future. Although the receiving antenna has been investigated in this paper, the transmitting antenna is also fabricated by changing the geometry of CPW.

ACKNOWLEDGEMENT

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REFERENCES

[1] Y.Hiroi and K.Fujimoto: "Receiving pattern of a transistor-loaded active antenna", *Proc. 1971 Int. Symp. on Antennas and Propagat. Japan*, pp.69-70, Sept. 1971.

[2] C.P.Wen: "Coplanar waveguide: A surface strip transmission line sitable for nonreciprocal gyromagnetic device application", *IEEE Trans. Microwave Theory Tech.*, vol.17, no.12, pp.1087-1090, Dec. 1969.

[3] K.C.Gupta, R.Garg and I.J.Bahl: "Microstrip lines and slotlines", Ch.7, Artech House, 1979.

[4] Y.Nakashima, M.Taguchi and K.Tanaka: "Characteristic impedance of coplanar line printed on dielectric film", *Inst. Television Engineers of Japan, Technical Report*, ROFT'92−60, Oct. 1992.

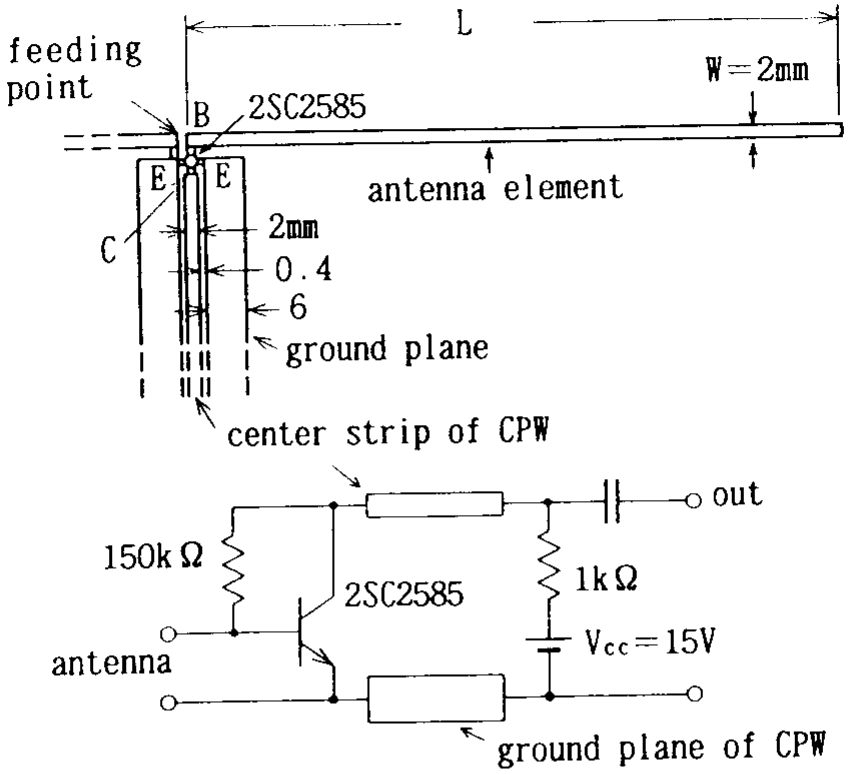


Fig.1 Active dipole antenna

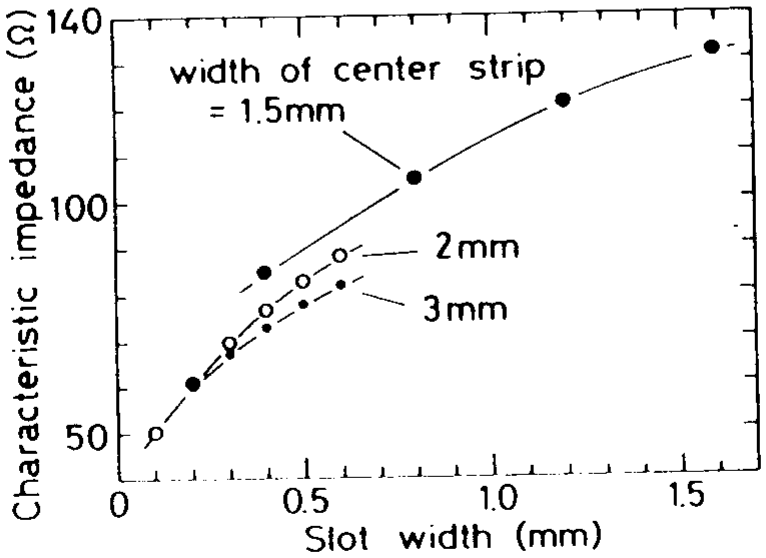
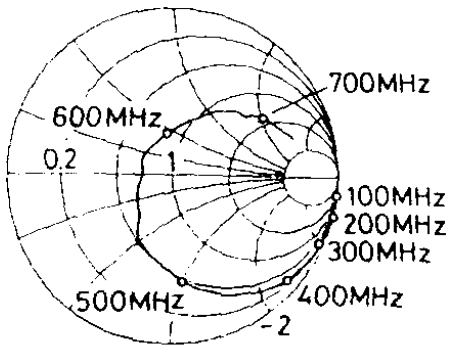
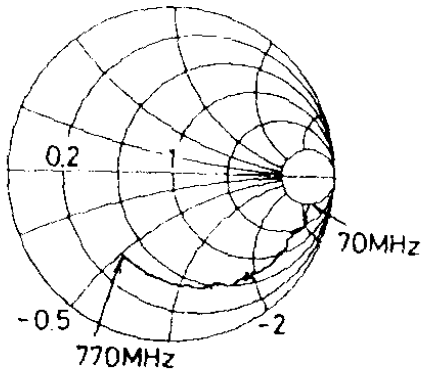


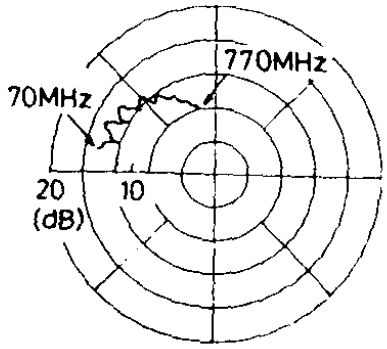
Fig.2 Measured characteristic impedance of CPW



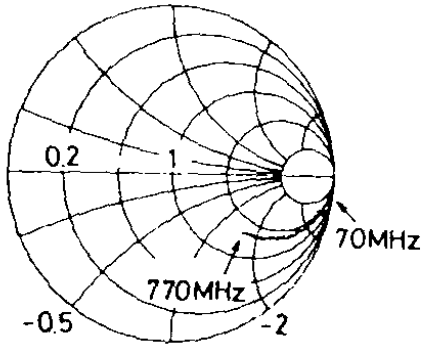
(a) Input impedance L = 12cm



(b) S_{11} parameter of 2SC2585



(c) S_{21} parameter



(d) S_{22} parameter

Fig.3 Measured input impedance at feeding point of dipole antenna and S parameters of transistor 2SC2585

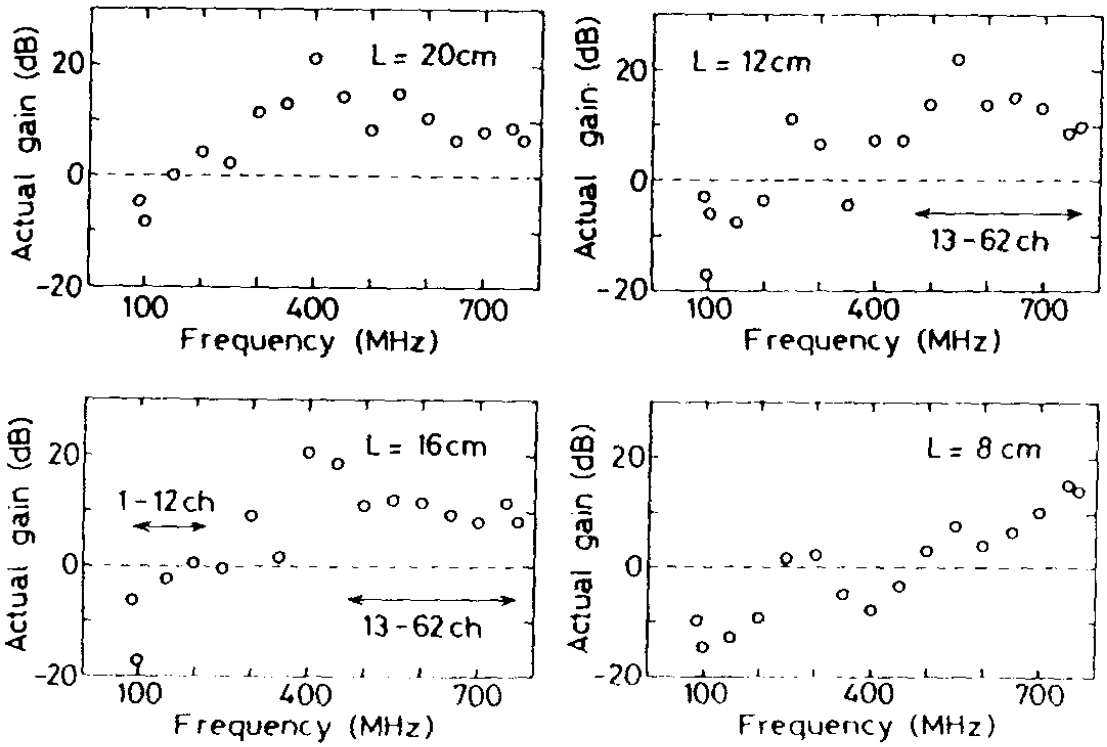


Fig.4 Measured actual gain