CPW FED ACTIVE LOOP ANTENNA FOR TELEVISION RECEIVERS

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1. Introduction

Authors have proposed a new type of active dipole antenna for television receiver[1], [2]. This antenna is fabricated on a thin dielectric film by using photoetching techniques. A coplanar waveguide (CPW) is printed as a feeder on the film[3], [4], so a planar active antenna is realized. In the reference [1], a silicon transistor amplifier is integrated between the feed point of dipole and the CPW. Although the impedances between dipole and transistor amplifier are tolerably matched, the amplifier and the CPW are not matched. When the total length of dipole is 24cm, actual gains more than 8dBd (relative gain to halfwave dipole antenna) are obtaind at the frequencies for television channels 13 − 62, from 470 − 770MHz in Japan. In the reference [2], a deformed circular loop and a GaAs FET FHC30LG are used as an antenna element and an amplifier, respectively, for improving the impedance matching between antenna, amplifier and the CPW at wider frequency bandwidth. When the size of loop is 288x88cm^2, actual gains more than 8dBd are obtained at the frequencies for television channels 1 − 62, from 90 to 770MHz. However, this high gain may be due to the fact that the CPW operates as an antenna.

In this paper, an active loop antenna for television receiver is presented and its broadband operation is reported. This antenna is fabricated on a thin dielectric film in the same manner as the active antenna in references [1] and [2]. In order to suppress the contribution from the CPW, the plane of loop antenna is located perpendicurlarly to the CPW. A chip inductor is loaded between loop and ground plane of CPW to improve the impedance matching between loop and amplifier. The antenna is numerically analyzed by using AWAS program[5]. The input impedance characteristics, the receiving patterns and the actual gains are measured at Japanese television channel frequencies from 90 to 770MHz.

2. Structure of active antenna

Fig.1 shows the structure of active loop antenna and GaAs FET amplifier circuit. The loop antenna and the CPW are printed on a polyimide film of thickness 45μm. The relative permittivity of film is 3.5. The length of straight portion between the feed point and the arc of loop antenna is L, the radius of circular arc is R, and the width of antenna W is 2mm. The characteristic impedance of CPW is chosen as 75Ω for impedance matching to the coaxial feeder of the television receiver[6]. This antenna is covered by the same film of thickness 50μm. The GaAs FET FHC30LG is integrated between the feed point of

loop antenna and the CPW. The CPW also serves as a bias supply line to the FET circuit. The available power gains of this FET are 17 to 18dB at frequencies from 100 to 500MHz. The nominal value of noise figure of this FET is about 0.35dB at 4GHz.

3. Experimental results

Fig.2 show the measured input impedances at the feed point of loop antenna and the nominal values of S parameters of GaAs FET FHC30LG. FHC30LG and the CPW are moderately matched. Fig.3 show the examples of the electric field receiving patterns of the active loop antenna in the xy−plane. Fig.4 shows the measured actual gains of the active antenna in its main lobe direction. The gains are expressed by relative values to the halfwave dipole antenna. In the figures, the actual gains with and without chip inductor loaded between the loop and the ground plane of CPW are compared. When an inductor of 100nH is loaded on the antenna of L=7cm and R=4cm, actual gains more than 3dBd are obtained at the frequencies for television channels 1 − 12, from 90 − 222MHz and more than 6dBd for channels 13 − 62, from 470 − 770MHz in Japan.

4. Conclusion

A CPW fed active loop antenna for television receivers has been proposed. This antenna has broader bandwidth compared with the active dipole antenna proposed by the authors[1]. The active loop antenna presented here is suitable as the automobile television receiving antenna.

Acknowledgement

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References

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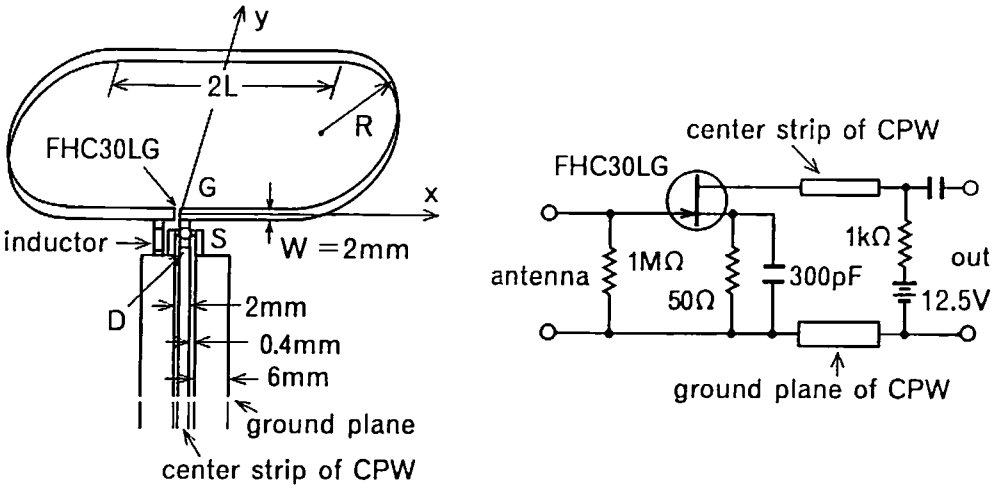
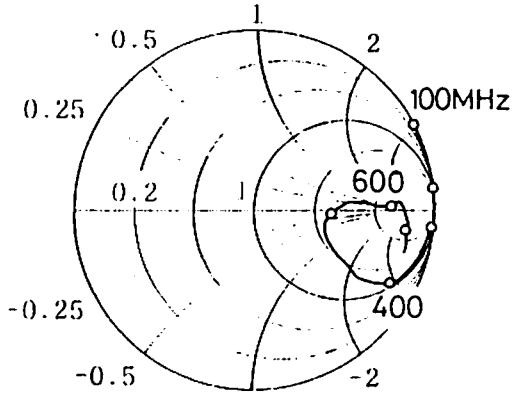
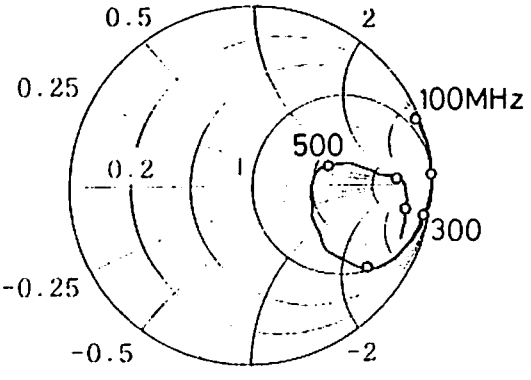


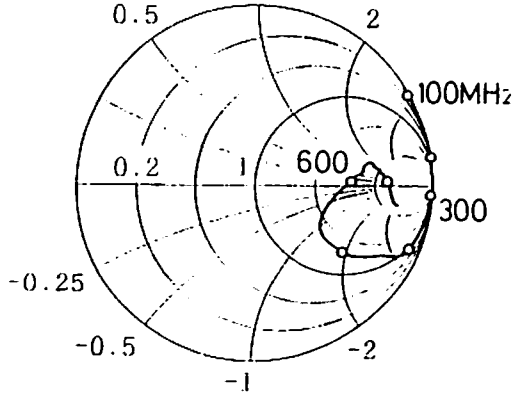
Fig. 1 CPW fed Active loop antenna



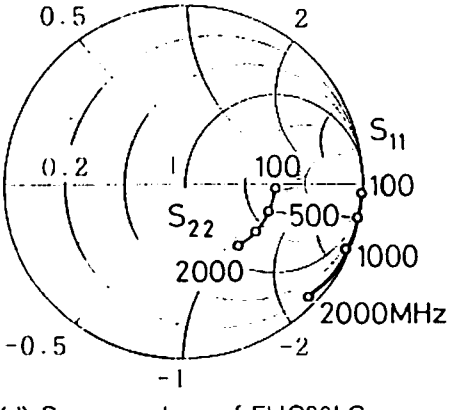
(a) Input impedance L=10cm, R=3cm



(b) Input impedance L=4cm, R=7cm

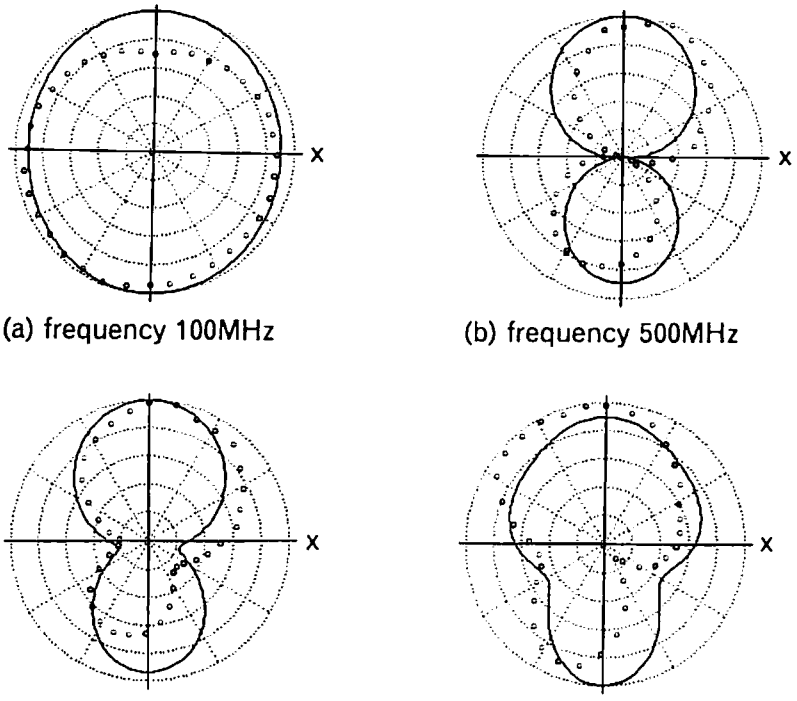


(c) Input impedance L=7cm, R=4cm



(d) S parameters of FHC30LG

Fig.2 Measured input impedances at feed point of loop antenna and S parameters of GaAs FET FHC30LG



(a) frequency 100MHz (b) frequency 500MHz

(c) frequency 600MHz (d) frequency 700MHz

Fig.3 Electric field receiving patterns in xy−plane L=4cm, R=7cm
—— calculated by AWAS, ooo measured

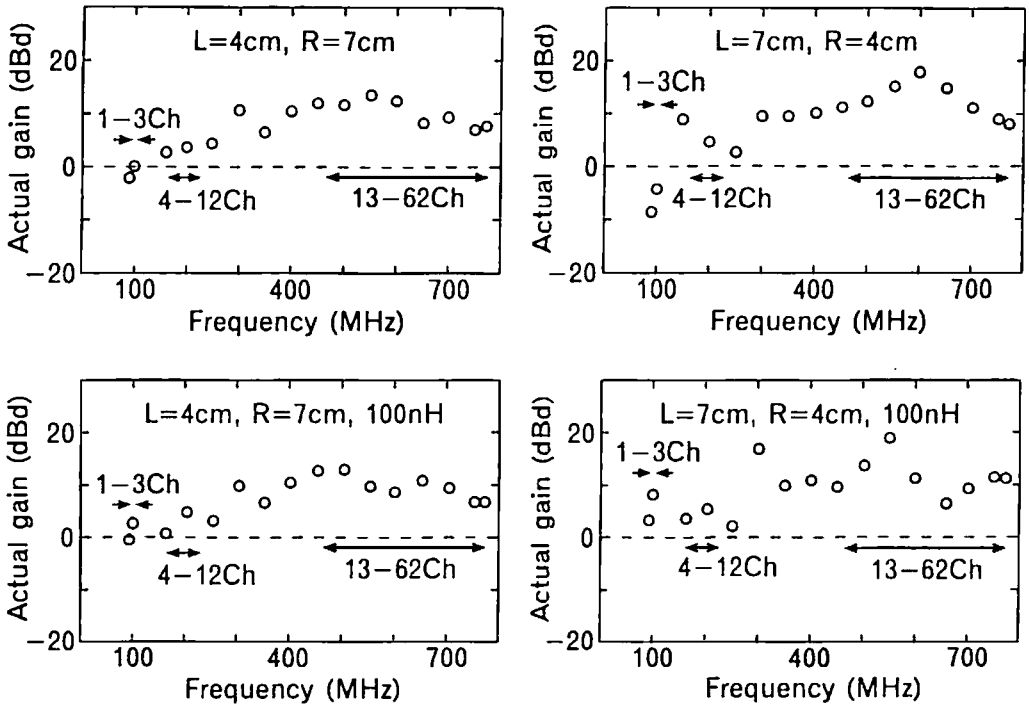


Fig.4 Measured actual gains in the main lobe direction