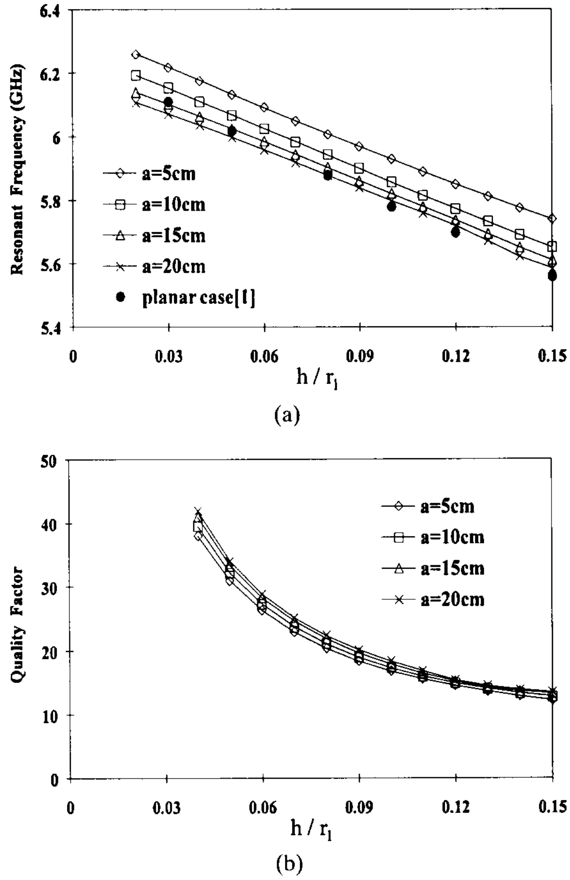

Figure 4 (a) Resonant frequency and (b) quality factor of TM_{12} mode versus substrate thickness for different curvature radii; ϵ_1 = 2.65, r_1 = 1.5 cm, r_2 = 3 cm. The solid circles are the resonant frequencies obtained in [1] (Galerkin's method solutions) for a corresponding planar annular-ring microstrip structure.

structure is only slightly varied with the curvature radius. However, as a radiator at TM_{12} mode, the quality factor decreases with decreasing curvature radius. That is, the spherical annular-ring microstrip structure, operated at TM_{12} mode, with smaller curvature radius is more suitable to be used as a radiator element.

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Received 7-9-93

Microwave and Optical Technology Letters, 6/15, 852–856
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CCC 0895-2477/93

INTEGRATED ACTIVE SLOT DIPOLE ANTENNA AMPLIFIER

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KEY TERMS

Active antennas, slot dipole antennas, integrated antenna amplifiers

ABSTRACT

This article presents the design and performance of a slop dipole antenna integrated directly with an FET amplifier. The measured radiation patterns of the antenna are linear with cross-polarization levels of 11 dB down in E plane and 17.5 dB down in H plane. The measured gain of the antenna is 10 dB at 7.1 GHz. Compared with a passive antenna, the active antenna has an extra gain of 7 dB.
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I. INTRODUCTION

Due to the power limitation of active solid-state radiating elements, considerable effort has been directed toward the development of quasi-optical technology. Recent developments have made it possible to combine active devices with planar antennas to create active radiating element arrays [1–5]. Furthermore, spatial or quasioptical power combining is not limited by size or moding problems, and allows use of a greater number of active radiating elements. However, most work has been concentrated on oscillator-type active antennas; little has been reported about active antenna amplifiers [6–8].

The geometry of coplanar waveguides is suitable for monolithic integration, and they do not require holes for mounting active devices as microstrip does. This article demonstrates a CPW feed slot dipole antenna integrated directly with an FET amplifier. The antenna has high gain with low cross polarization.

II. CIRCUIT CONFIGURATION

Figure 1 shows the CPW fed slot dipole active antenna. A Fujitsu FHX35LG general-purpose FET was integrated directly with the antenna. In order to match the FET with the slot antenna, the center strip conductor of the CPW extends across the slot line at a right angle. The circuit was fabricated on a 1.524-mm-thick RT/Duroid 5880 (ϵ_r = 2.2) substrate. A narrow slot was cut at each terminal of the slot line for dc block. The gate and drain were connected with the center strip of the CPW. The length L_1 of the slot dipole antenna is 20 mm. The CPW was terminated in a short circuit at a distance L_2 that is approximately 5 mm from the center of the slot. The width W of the center strip conductor of the coplanar waveguide is 1.4 mm. The slot width S_1 of the CPW is 0.2 mm and the slot width S_2 of the slot line is 1.5 mm. L_2 was

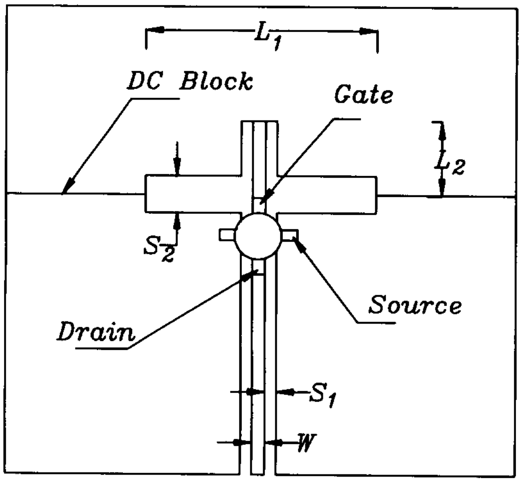

Figure 1 Circuit configuration of a CPW cross-fed slot dipole antenna amplifier

designed to accomplish the impedance matching to the antenna.

III. EXPERIMENT RESULTS

A passive antenna was first constructed with same dimensions but without FET to compare the gain with the active antenna. A return loss of greater than 18 dB was achieved over a bandwidth of 0.8 GHz. A gain (G_1) above isotropic of 3 dB was measured at 7.1 GHz for the passive antenna. The slot length of the active antenna is slightly shorter than the passive one to make it work at the same frequency. Figures 2 and 3 show the E- and H-plane patterns of the active antenna. The cross-polarization levels are 11 dB down in the E-plane pattern and 17.5 dB down in the H-plane pattern. Figure 4 shows the absolute or effective active antenna gain (G_2) above isotropic as a function of frequency. An extra gain ($G_3 = G_2 - G_1$) of 7 dB at 7.1 GHz was added by the amplifier as compared to the passive antenna. The gain of a NARDA standard horn antenna is also shown in Figure 4 for comparison.

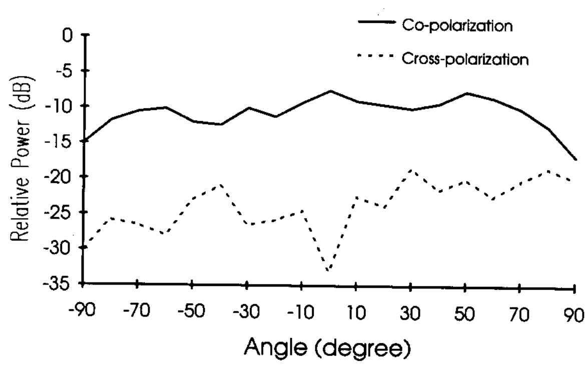

Figure 2 Measured E-plane pattern of the active antenna amplifier

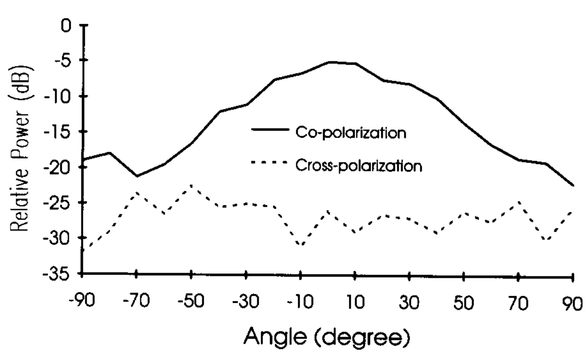

Figure 3 Measured H-plane pattern of the active antenna amplifier

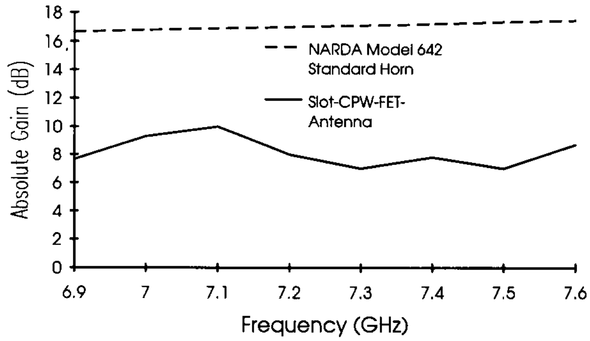

Figure 4 Absolute gain of the active antenna amplifier

IV. CONCLUSIONS

A novel integrated active antenna amplifier was developed. The antenna operated with high gain and low cross-polarization. This circuit should have applications in low-cost transmitters, receivers, and quasioptical power combiners. The circuit is planar and is suitable for monolithic implementation.

ACKNOWLEDGMENTS

The authors would like to thank Mr. L. Fan for his help in fabricating the circuits. This work was supported in part by the U.S. Army Research Office and the State of Texas Higher Education Coordinating Board's Advanced Technology Program.

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Received 7-8-93

Microwave and Optical Technology Letters, 6/15, 856–857
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CCC 0895-2477/93