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INTEGRATED ACTIVE SLOT DIPOLE ANTENNA AMPLIFIER

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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 quasi-optical power combining is not limited by size or modeling 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 microstrips 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 Fujiitsu 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 (εr = 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 L1 of the slot dipole antenna is 20 mm. The CPW was terminated in a short circuit at a distance L2 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 S1 of the CPW is 0.2 mm and the slot width S2 of the slot line is 1.5 mm. L2 was
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 NARIDA standard horn antenna is also shown in Figure 4 for comparison.

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.

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