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A Log-Spiral, Radiating-Line Antenna

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INTRODUCTION

The log-spiral, radiating-line antenna has low-profile geometry similar to that of microstrip patch antennas, but has the potential for operating over much wider bandwidths. To achieve this result, a mode of operation that is fundamentally different from that of conventional cavity-backed spirals has been investigated.

ANTENNA STRUCTURE

The log-spiral, radiating-line antenna is a traveling wave structure in which one or more logarithmic spiral arms are excited against a closely spaced conical ground surface. Side and top views of a one-arm antenna are shown in Figure 1. The space between the flat spiral and the conical conductor contains just enough foam dielectric to support the spiral. The center conductor of a small-diameter coaxial cable is attached to the spiral through a transition region and the shield of the cable is attached to the cone.

ANTENNA PERFORMANCE

Near-field measurements have been made by probing through the conical conducting surface underneath the edges of the arm. These data correspond closely to a wave traveling faster than the free-space phase velocity along the outside edge and slower than the free-space phase velocity along the inside edge. As a result there is appreciable radiation from the wave as it travels along the spiral arm.

The near-field measurements have also shown that the amplitude of the wave decays rapidly with distance away from the feed point. Since very little energy reaches the outer radius of the structure, the truncation at that point has little influence upon the behavior of the input impedance. Measurements of input impedance over the band of 1-12 GHz form a relatively compact locus, as shown in Figure 2. In order to obtain this result it is important to construct the feed-point and transition regions with great care.

So far, radiation patterns have been measured for only a few

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antennas. The degree of rotational symmetry in the patterns of one-arm antennas is dependent upon the rate of spiral. The radiation tends to be circularly polarized over much of the pattern. Figure 3 shows four polar cuts measured using a spinning dipole to illustrate the variation of polarization with polar angle.

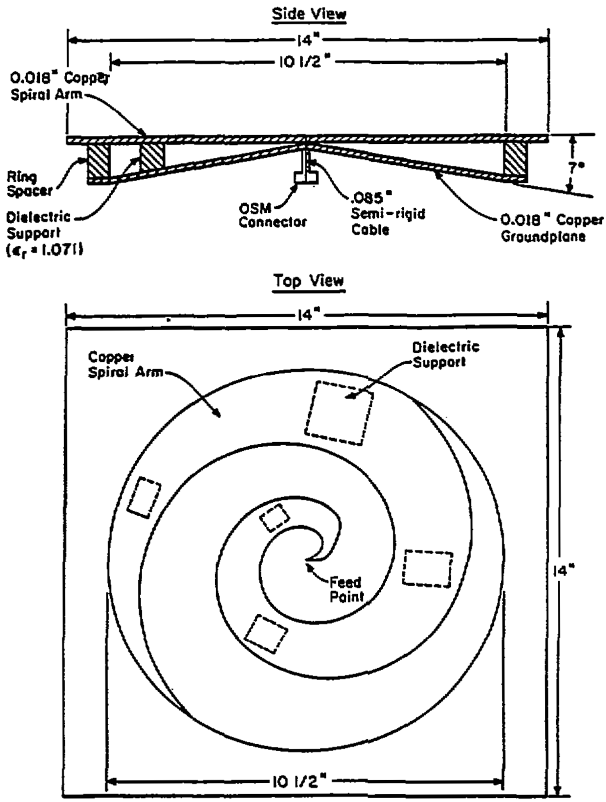

Figure 1. A one-arm log-spiral fed against a closely spaced conical ground surface.

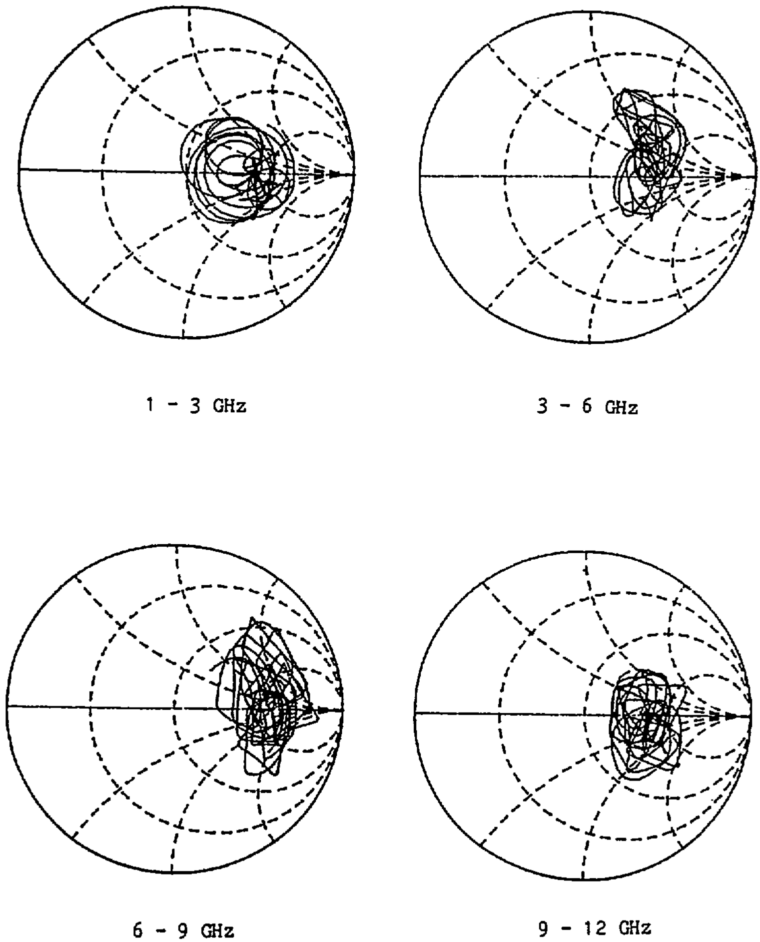

Figure 2. Measured S_{11} versus frequency for a one-arm, log-spiral, radiating line antenna.

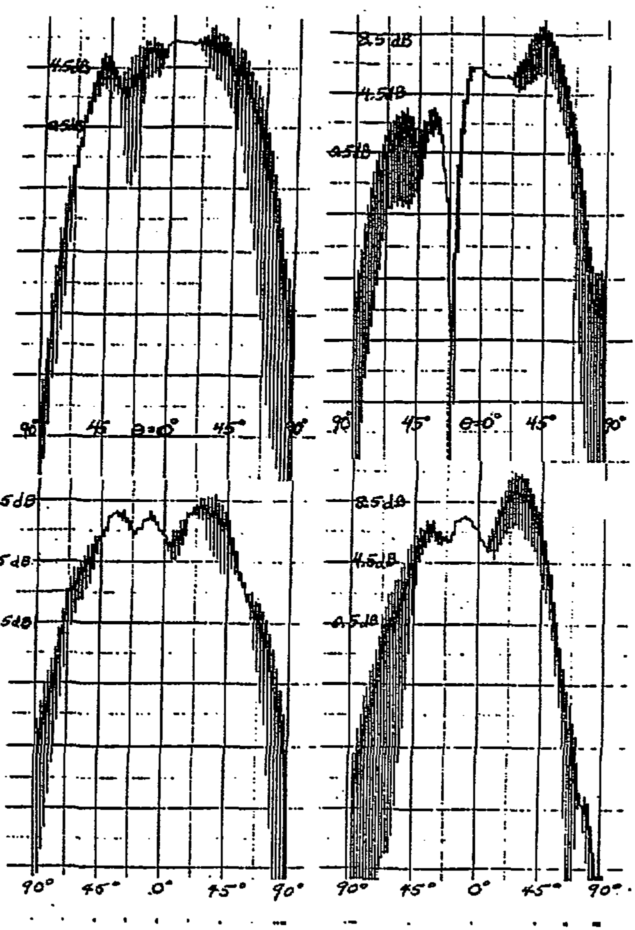

Figure 3. Polar radiation patterns at four cuts (ϕ=0, 45,90,135 degrees) of a one-arm, log-spiral, radiating-line antenna, f=5 GHz.