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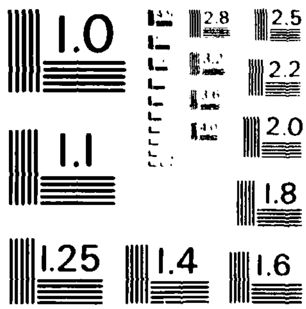

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A Wideband Low-Sidelobe Disc-O-Cone Antenna

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Robert L. Jones

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The electrical characteristics of a combined horn/cigar antenna are described. The antenna consists of a disc-on-rod (cigar) housed in a conical horn. This antenna combination produces broadband radiation characteristics with very low sidelobes. Measured VSWR, gain and pattern characteristics ae presented.

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PREFACE

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CONTENTS

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FIGURES

I. INTRODUCTION

A disc-on-rod or cigar antenna is an endfire antenna, composed of a series of concentric metallic discs on a rod.[1] When the disc diameter and spacing are properly chosen, the antenna produces an endfire pattern similar to a helix and the sidelobe level varies typically from -10 to -15 dB. To improve the sidelobe characteristics, the disc diameters may be tapered along the rod and a short axial-length funnel may be used in conjunction with the feed or launcher. Sidelobe levels of -15 to -20 dB have been reported.[1,2]

The present antenna design consists of a disc-on-rod housed in a conical horn with a relatively large flare angle. The combined antenna configuration provides broadband gain and pattern characteristics with peak sidelobe levels of ~ -30 dB, and it is referred to as "disc-o-cone." The operation of this antenna is similar to that of a helicone antenna.[3,4] However, the use of a disc-on-rod, instead of a helix, offers additional flexibilities for a low-sidelobe antenna design. The disc diameters are made nonuniform along the rod and the design parameters such as the axial length, disc diameters, number of discs and spacing between discs can be varied easily. Furthermore, variable-polarization operation can be achieved by appropriate design of the feed or launcher. The disc-o-cone antenna was designed for possible application with the Global Positioning System (GPS) operating within the 1200 to 1600 MHz band. Thus, most of the measurements were made in this frequency range.

II. DESIGN DESCRIPTION

Figure 1 shows a typical disc-o-cone antenna geometry. Except in the feed region, the discs are uniformly spaced at 2.04 in. and the disc diameter tapers from 3 in. to 2 in. at the end. For experimental purposes, a 24.75 in. diameter × 21.73 in. length horn with a 45° flare angle was chosen. These horn dimensions are slightly less than those of an optimum-horn design. It should be mentioned that an isolated conical optimum horn generally has a peak sidelobe level of ~ −12 dB.

To provide broadband operations, the disc-o-cone antenna was fed with a cavity-backed, open-sleeve crossed dipole[5] as depicted in Fig. 1. Two 2.75-in. diameter open sleeves (not part of disc-on-rod) spaced 0.40 in. from the dipoles are employed. These circular open sleeves provide a natural transition to the disc-on-rod antenna. For circular polarization, the orthogonal dipoles are connected to a 90° hybrid. The measured VSWR characteristics of the individual dipoles (linear polarization) are shown in Fig. 2. The presence of the horn has relatively little effect of the VSWR performance. Typically, the VSWR is <1.8:1 from 1.2 to 1.6 GHz.

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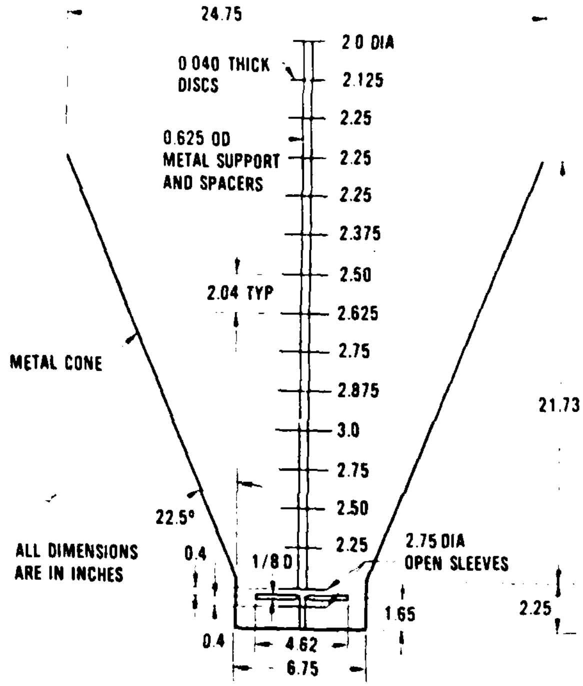

Figure 1 Typical Disc-O-Cone Antenna Geometry

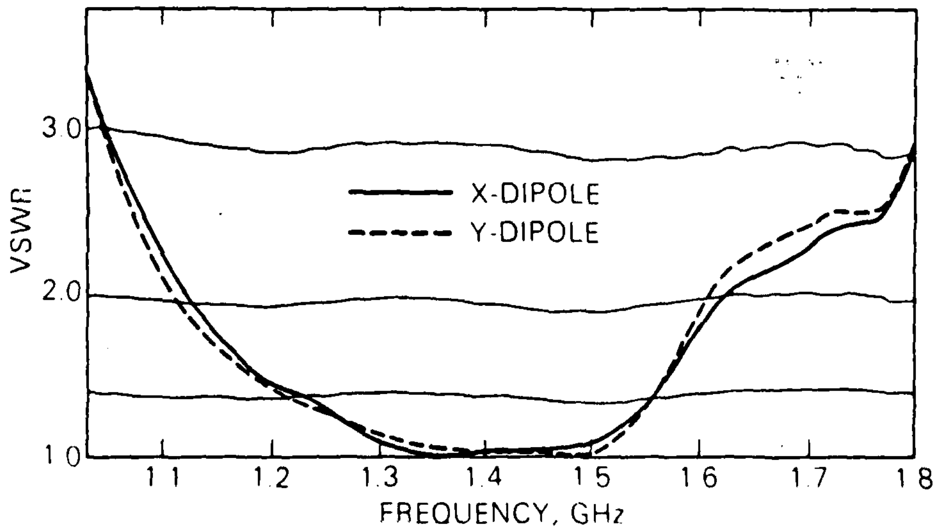

Figure 2 VSWR of Disc-O-Cone

III. GAIN AND PATTERNS

The measured gain and typical patterns of the disc-o-cone antenna are shown in Figures 3 and 4, respectively. The gain response is relatively flat (± 1 dB) from 1.1 to 1.7 GHz. The patterns were taken with a rotating linearly-polarized source. The axial ratio is $<$ 1 dB, and the sidelobes and backlobes are generally $<$ -27 dB over the measurement frequency range, providing substantial improvement over an isolated disc-on-rod or horn antenna.

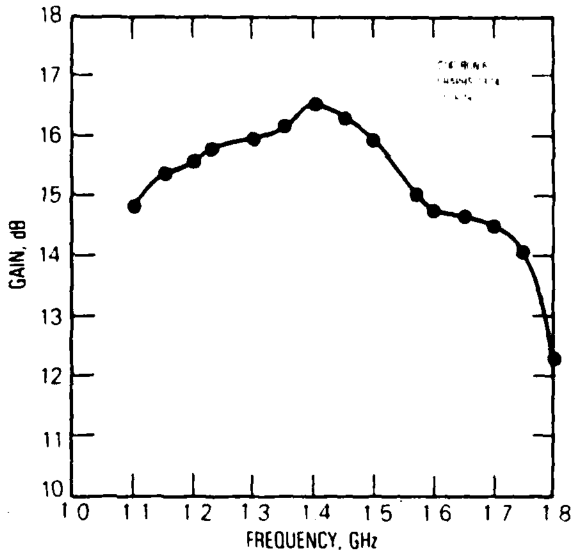

Figure 3 Gain of Disc-O-Cone

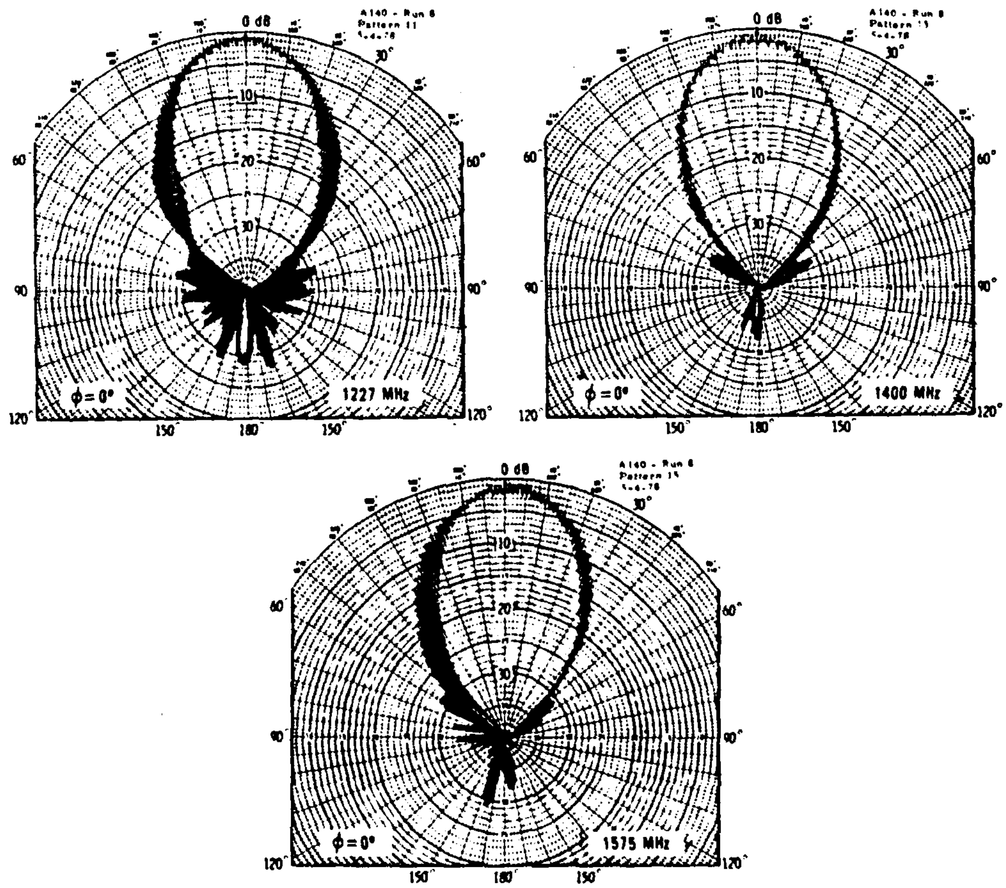

Figure 4 Typical Measured Patterns

IV. CONCLUSIONS

A combination of a conical horn and a disc-on-rod antenna has been shown to yield extremely low sidelobe levels (peak sidelobe ~ -30 dB) over a 1200 to 1600 MHz bandwidth. The combination eliminates the poor sidelobe characteristics of the individual isolated antennas. The disc-o-cone has the flexibility of varying the disc diameters, the disc spacing, and the number of discs to optimize the sidelobe performance over a wide bandwidth.

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