A WIDEBAND CORNER-REFLECTOR ANTENNA FOR 240 TO 400 MHZ

(A) AEROSPACE CORP EL SEGUNDO CA ELECTRONICS RESEARCH
LAB J L WONG ET AL. 19 SEP 83 TR-0083(3925-06)-3

UNCLASSIFIED 5D-TR-83-68 F04701-82-C-0003

F/G 9/5
A Wideband Corner-Reflector Antenna for 240 to 400 MHz

J. L. WONG and H. E. KING
Electronics Research Laboratory
Laboratory Operations
The Aerospace Corporation
El Segundo, Calif. 90245

19 September 1983

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED

Prepared for
SPACE DIVISION
AIR FORCE SYSTEMS COMMAND
Los Angeles Air Force Station
P.O. Box 92960, Worldway Postal Center
Los Angeles, Calif. 90009
This report was submitted by The Aerospace Corporation, El Segundo, CA 90245, under Contract No F04701-82-C-0083 with the Space Division, P. O. Box 92960, Worldway Postal Center, Los Angeles, CA 90009. It was reviewed and approved for The Aerospace Corporation by Dr. D. H. Phillips, Director, Electronics Research Laboratory. Major Robert L. Jones, SD/YASM, was the project officer for the Mission-Oriented Investigation and Experimentation program.

This report has been reviewed by the Public Affairs Office (PAS) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nationals.

This technical report has been reviewed and is approved for publication. Publication of this report does not constitute Air Force approval of the report's findings or conclusions. It is published only for the exchange and stimulation of ideas.

Robert L. Jones, Major, USAF  
Project Officer

Joseph Hess, GM-15, Director  
West Coast Office, AF Space Technology Center
A WIDEBAND CORNER-REFLECTOR ANTENNA FOR 240 TO 400 MHZ

Jimmy L. Wong and H. E. King

The Aerospace Corporation
El Segundo, Calif. 90245

Space Division
Air Force Systems Command
Los Angeles, Calif. 90009

Approved for public release; distribution unlimited.

Corner Reflectors
Open Sleeve Dipoles

The design and performance characteristics of a corner-reflector antenna capable of operation in the 240- to 400-MHz frequency range are described. The corner reflector is suitable for use as a standard reference antenna for wideband swept-frequency gain measurements. Measured VSWR, gain and patterns are presented.
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>5</td>
</tr>
<tr>
<td>DESIGN DESCRIPTION</td>
<td>7</td>
</tr>
<tr>
<td>ELECTRICAL CHARACTERISTICS</td>
<td>9</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>11</td>
</tr>
</tbody>
</table>
FIGURES

1. Corner Reflector with Open-Sleeve Dipole Feed.......................... 7
2. Open-Sleeve Dipole Feed for Corner Reflector, 240-400 MHz............. 8
3. Closeup Photo of Open-Sleeve Dipole........................................ 8
4. VSWR of 4-ft Corner Reflector, Open-Sleeve Dipole Feed............... 9
5. Gain of Corner Reflector....................................................... 9
6. Measured E- and H-Plane Patterns at 240, 290, and 400 MHz.......... 10
I. INTRODUCTION

In the VHF/UHF frequency region, a corner reflector provides a simple means of acquiring a unidirectional antenna with moderate gain [Refs. 1-6]. Generally, a corner reflector is fed with a half-wave dipole, and its operating bandwidth is restricted to about 15 percent. In an attempt to achieve broadband performance, the use of a log-periodic dipole array feed has been investigated with limited success [Refs. 7-8]. In this report, a corner reflector which employs an open-sleeve feed to provide broadband operation from 240 to 400 MHz is described.
II. DESIGN DESCRIPTION

For experimental purposes, two identical 90° corner reflectors were constructed with perforated aluminum sheets, 48 in. W × 41.13 in. L. The apex was slightly truncated to facilitate the construction and mounting of the feed as illustrated in Figures 1 and 2. To achieve broadband performance, an open-sleeve dipole was used as the corner-reflector feed. It consists of a conventional dipole with two closely-spaced parasitic elements (open-sleeves) as shown in Figure 2. The addition of these parasites extends the bandwidth of a conventional dipole from about 1.25:1 to 1.8:1. The broadband characteristics of the open-sleeve dipole have been reported in the literature [Refs. 9-10]. The sleeves were constructed with flat strips rather than cylindrical rods, although they should yield equivalent results [Ref. 10]. A close-up photograph of the feed is shown in Figure 3. Since the corner reflector is truncated with a 2-in. wide strip, the effective distance between the dipole and the true apex is 14.28" which corresponds to 0.291\(\lambda\) at 240 MHz and 0.484\(\lambda\) at 400 MHz.

Fig. 1. Corner Reflector with Open-Sleeve Dipole Feed
Fig. 2. Open-Sleeve Dipole Feed for Corner Reflector, 240 to 400 MHz

Fig. 3. Close-up Photo of Open-Sleeve Dipole
III. ELECTRICAL CHARACTERISTICS

The impedance or VSWR characteristics of the corner reflector were optimized over the 240 to 400 MHz band by varying the various parameters of the open-sleeve dipole feed; e.g., dipole and sleeve dimensions, sleeve-to-dipole spacing, and dipole-to-apex distance. Figure 4 shows the measured VSWRs of the two corner reflectors. The difference was caused by construction tolerances. The gain of the corner reflector was calibrated by using a swept-frequency, two-antenna method, and the results are depicted in Figure 5. To minimize the uncertainty caused by multipath and other instrumentation errors, the gain measurements were performed under various test conditions including variable range distance, different antenna orientations, etc. The swept-frequency data were sampled at 10 MHz intervals, and over 95 data points were obtained for each frequency. The maximum standard deviation is 0.13 dB, and the average is 0.095 dB. Typical measured E- and H-plane patterns of the corner reflector at 240, 290 and 400 MHz are shown in Figure 6. Generally, the patterns exhibit good front-to-back ratio characteristics with the worst case being ~23 dB at the lower edge of the band. The on-axis crossed polarization level was measured at 400 MHz and it was found to be ~35 dB.

![Fig. 4. VSWR of 4-ft Corner Reflector, Open-Sleeve Dipole Feed](image1)

![Fig. 5. Gain of Corner Reflector](image2)
Fig. 6. Measured E- and H-Plane Patterns at 240, 290, and 400 MHz
REFERENCES


LABORATORY OPERATIONS

The Laboratory Operations of The Aerospace Corporation is conducting experimental and theoretical investigations necessary for the evaluation and application of scientific advances to new military space systems. Versatility and flexibility have been developed to a high degree by the laboratory personnel in dealing with the many problems encountered in the nation's rapidly developing space systems. Expertise in the latest scientific developments is vital to the accomplishment of tasks related to these problems. The laboratories that contribute to this research are:

Aerophysics Laboratory: Launch vehicle and reentry aerodynamics and heat transfer, propulsion chemistry and fluid mechanics, structural mechanics, flight dynamics; high-temperature thermomechanics, gas kinetics and radiation; research in environmental chemistry and contamination; cw and pulsed chemical laser development including chemical kinetics, spectroscopy, optical resonators and beam pointing, atmospheric propagation, laser effects and countermeasures.

Chemistry and Physics Laboratory: Atmospheric chemical reactions, atmospheric optics, light scattering, state-specific chemical reactions and radiation transport in rocket plumes, applied laser spectroscopy, laser chemistry, battery electrochemistry, space vacuum and radiation effects on materials, lubrication and surface phenomena, thermionic emission, photosensitive materials and detectors, atomic frequency standards, and bioenvironmental research and monitoring.

Electronics Research Laboratory: Microelectronics, GaAs low-noise and power devices, semiconductor lasers, electromagnetic and optical propagation phenomena, quantum electronics, laser communications, lidar, and electro-optics; communication sciences, applied electronics, semiconductor crystal and device physics, radiometric imaging; millimeter-wave and microwave technology.

Information Sciences Research Office: Program verification, program translation, performance-sensitive system design, distributed architectures for spaceborne computers, fault-tolerant computer systems, artificial intelligence, and microelectronics applications.

Materials Sciences Laboratory: Development of new materials: metal matrix composites, polymers, and new forms of carbon; component failure analysis and reliability; fracture mechanics and stress corrosion; evaluation of materials in space environment; materials performance in space transportation systems; analysis of systems vulnerability and survivability in enemy-induced environments.

Space Sciences Laboratory: Atmospheric and ionospheric physics, radiation from the atmosphere, density and composition of the upper atmosphere, aurorae and airglow; magnetospheric physics, cosmic rays, generation and propagation of plasma waves in the magnetosphere; solar physics, infrared astronomy; the effects of nuclear explosions, magnetic storms, and solar activity on the earth's atmosphere, ionosphere, and magnetosphere; the effects of optical, electromagnetic, and particulate radiations in space on space systems.