

AD-A134 281

A WIDEBAND CORNER-REFLECTOR ANTENNA FOR 240 TO 400 MHZ

1/1

(U) AEROSPACE CORP EL SEGUNDO CA ELECTRONICS RESEARCH

LAB J L WONG ET AL 19 SEP 83 TR-0083(3925-06)-3

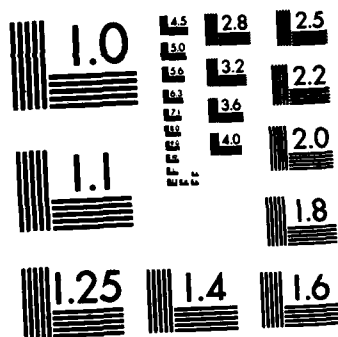
UNCLASSIFIED

SD-TR-83-68 F04701-82-C-0083

F/G 9/5

NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

12

AD-A134281

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

NOV 3 1983
A

DTIC FILE COPY

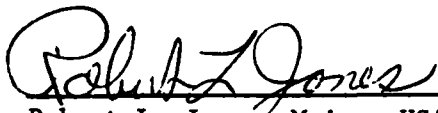
Prepared for
SPACE DIVISION
AIR FORCE SYSTEMS COMMAND
Los Angeles Air Force Station
P.O. Box 92960, Worldway Postal Center
Los Angeles, Calif. 90009

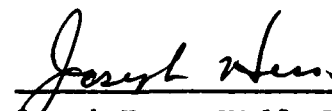
83 11 03 010

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

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER SD-TR-83-68	2. GOVT ACCESSION NO. AD A134281	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A WIDEBAND CORNER-REFLECTOR ANTENNA FOR 240 TO 400 MHz		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER TR-0083(3925-06)-3
7. AUTHOR(s) Jimmy L. Wong and H. E. King		8. CONTRACT OR GRANT NUMBER(s) F04701-82-C-0083
		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
9. PERFORMING ORGANIZATION NAME AND ADDRESS The Aerospace Corporation El Segundo, Calif. 90245		12. REPORT DATE 19 September 1983
11. CONTROLLING OFFICE NAME AND ADDRESS Space Division Air Force Systems Command Los Angeles, Calif. 90009		13. NUMBER OF PAGES 11
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Corner Reflectors Open Sleeve Dipoles		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) 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.		

DD FORM 1473
(IF ACQUISITION)

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

CONTENTS

INTRODUCTION.....	5
DESIGN DESCRIPTION.....	7
ELECTRICAL CHARACTERISTICS.....	9
REFERENCES.....	11

[illegible]

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 \times 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 0.291λ at 240 MHz and 0.484λ at 400 MHz.

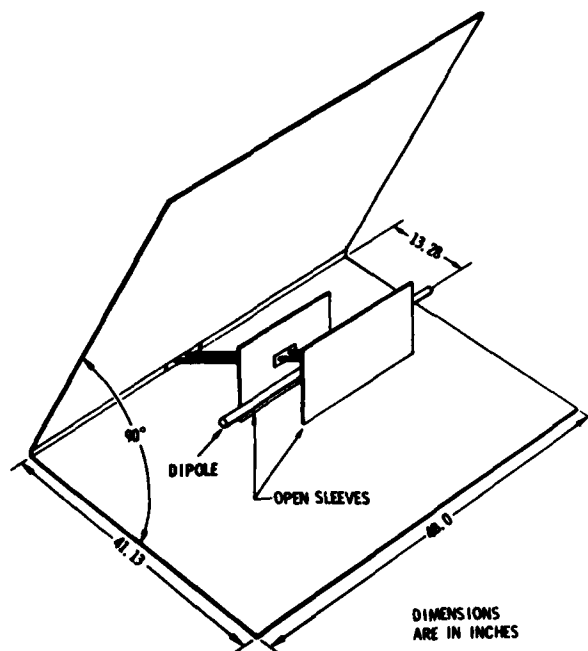


Fig. 1. Corner Reflector with Open-Sleeve Dipole Feed

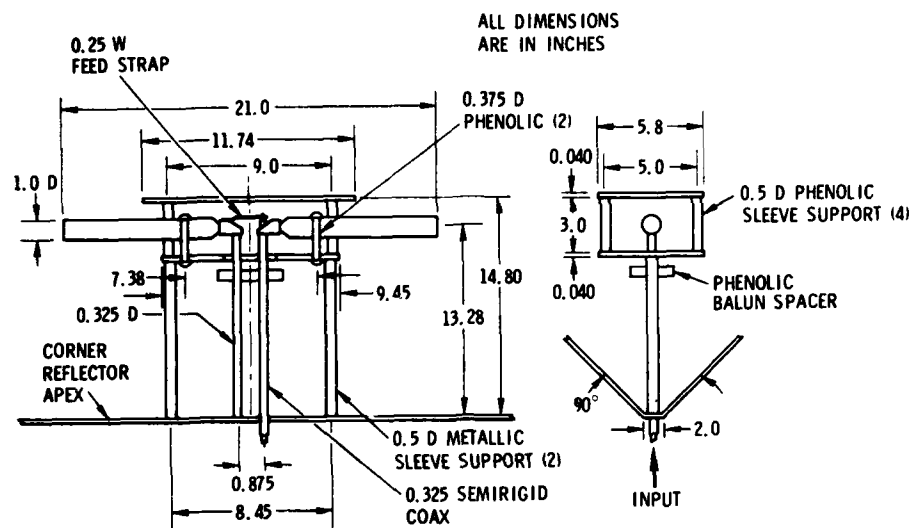


Fig. 2. Open-Sleeve Dipole Feed for Corner Reflector, 240 to 400 MHz

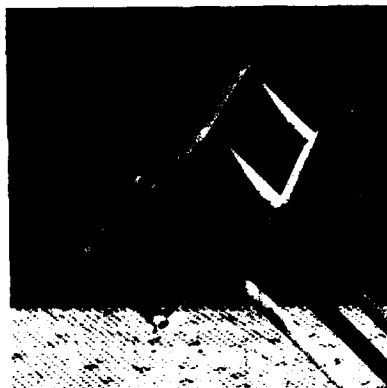


Fig. 3. Close-up Photo of Open-Sleeve Dipole

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.

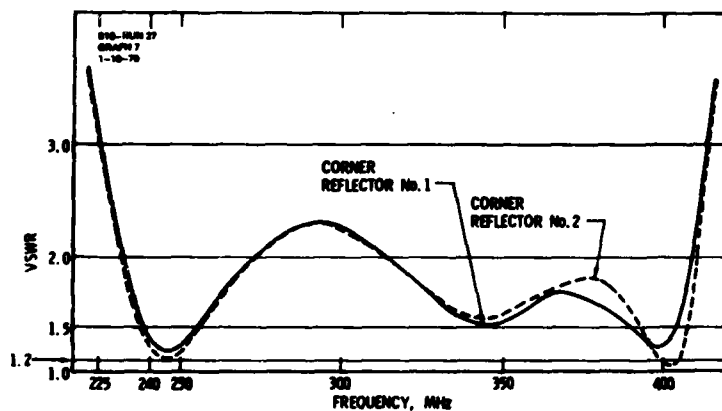


Fig. 4. VSWR of 4-ft Corner Reflector,
Open-Sleeve Dipole Feed

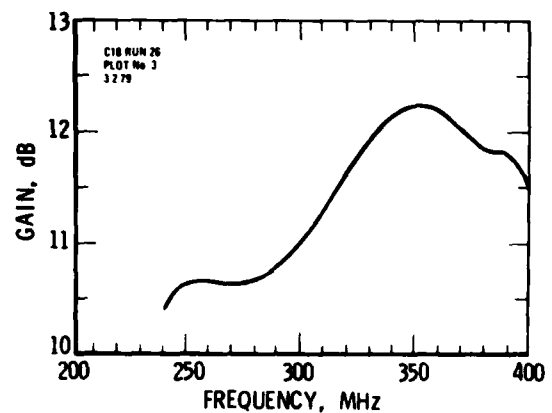


Fig. 5. Gain of Corner Reflector

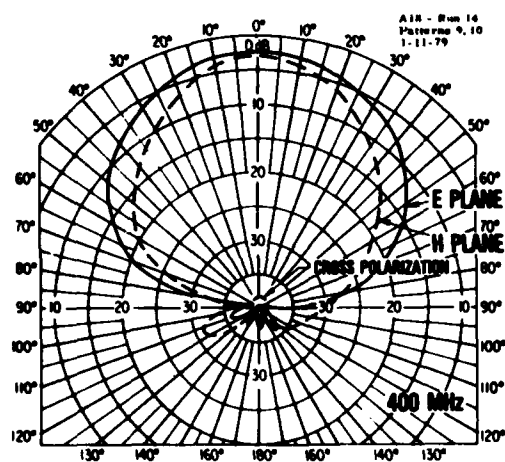
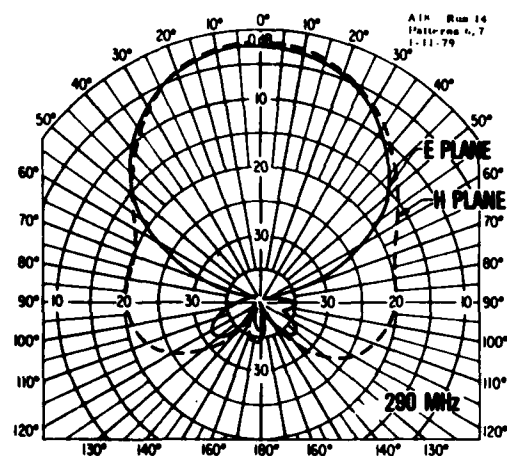
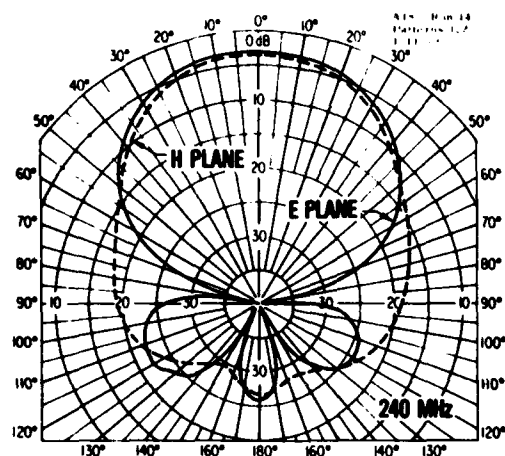


Fig. 6. Measured E- and H-Plane Patterns at 240, 290, and 400 MHz

REFERENCES

1. J. D. Kraus, "The Corner Reflector Antenna," Proc. IRE, November 1940, pp. 513-519.
2. E. F. Harris, "An Experimental Investigation of the Corner Reflector Antenna," Proc. IRE, May 1953, pp. 645-651.
3. O. M. Woodward, Jr., "A Circularly-Polarized Corner Reflector Antenna," IRE Trans. AP-6, July 1958, pp. 290-297.
4. R. W. Kiopfenstein, "Corner Reflector Antennas with Arbitrary Dipole Orientation and Apex Angle," IRE Trans., AP-5, July 1957, pp. 297-305.
5. H. V. Cottony and A. C. Wilson, "Gain of Finite-Size Corner Reflector Antennas," IRE Trans., AP-6, October 1958, pp. 366-369.
6. A. C. Wilson and H. V. Cottony, "Radiation Patterns of Finite-Size Corner Reflector Antennas," IRE Trans., AP-8, March 1960, pp. 144-157.
7. S. P. Kosta, M. D. Singh, and N. K. Agarwal, "A Wideband Circularly Polarized Corner Reflector Antenna," Proc. IEEE, September 1969, pp. 1662-1663; also, S. P. Kosta and S. R. Nath, Proc. IEEE, May 1970, p. 852 for corrections.
8. D. T. Stephenson and S. K. Finley, "Use of Log-Periodic Feeds in Corner Reflectors," IEEE Trans., AP-20, November 1972, pp. 770-772.
9. H. E. King and J. L. Wong, "An Experimental Study of a Balun-Fed Open-Sleeve Dipole in Front of a Metallic Reflector," IEEE Trans., AP-20, March 1972, pp. 201-204.
10. J. L. Wong and H. E. King, "Design Variations and Performance Characteristics of the Open-Sleeve Dipole," The Aerospace Corporation, TR-0073(3404)-2, 15 January 1973; SAMSO TR-73-133.

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.

END

FILMED

1983

1983