GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION

# PROJECT INITIATION

Date: February 9, 1976

Project Title: 95 GHz, One-Quarter Size, Flat-Plate Feed

Project No.: A-1799

Project Director: Mr. R. M. Goodman

Sponsor: Applied Physics Laboratory, The Johns Hopkins University

Agreement Period: From Dec. 12, 1975 Until Jan. 11, 1976

Type Agreement: Contract 600449 (Fixed-Price)

Amount: $3,000

Reports Required: None

Sponsor Contact Person:

| Technical Matters | Contractual Matters |
|---|---|
| Mr. R. B. Hester | Mr. R. M. Stevens |

Johns Hopkins University
Applied Physics Laboratory
Johns Hopkins Road
Laurel, Maryland 20810
Phone: (301) 953-7100, X-2062

Defense Priority Rating: DO-A2 under DMS Reg. 1

Assigned to: Systems & Techniques Laboratory

COPIES TO:

- Project Director
- Director, EES
- Assistant Director
- Division Chief
- EES Accounting
- Patent Coordinator
- EES Supply Services
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- General Office Services
- Library, Technical Reports Section
- Office of Computing Services
- Project File
- Other Sue Corbin; Jim Donovan

RA-3 (8-75)

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

# SPONSORED PROJECT TERMINATION

Date: April 1, 1976

Project Title: 95 GHZ, One-Quarter Size, Flat-Plate Feed

Project No: A-1799

Project Director: Mr. R. M. Goodman

Sponsor: Applied Physics Laboratory; Johns Hopkins University

Effective Termination Date: 1/11/76

Clearance of Accounting Charges: N/A – fixed price agreement

Grant/Contract Closeout Actions Remaining: NONE

- _ Final Invoice and Closing Documents
- _ Final Fiscal Report
- _ Final Report of Inventions
- _ Govt. Property Inventory & Related Certificate
- _ Classified Material Certificate
- _ Other ______

Assigned to: Systems & Techniques (School/Laboratory)

COPIES TO:

Project Director
Division Chief (EES)
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Library, Technical Reports Section
Office of Computing Services
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EES Information Office
Project File (OCA)
Project Code (GTRI)
Other ______

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H-1111

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

April 29, 1976

The Johns Hopkins University
Applied Physics Laboratory
Johns Hopkins Road
Laurel, Maryland 20810

Attention: Mr. R. M. Stevens

Reference: APL Contract No. 600449

Subject: 95 GHz, One Quarter Size, Flat Plate Feed Antenna

Gentlemen:

Accompanying this letter is the final report describing the refurbishing and testing of the 95 GHz, one quarter size, flat plate feed antenna and summarizing the results of the antenna tests.

These tests show that the performance of the antenna with the new feed is as good as that of the antenna with the original feed. There is some difference in the patterns due to greater aperture blockage caused by the waveguide support structure, the harmonic mixer, and the coaxial cable used in testing.

After completion of testing, the feed was mounted rigidly in place and the antenna was then crated and shipped to you on March 30, 1976.

Sincerely,

R. M. Goodman, Jr.
Head, Systems & Techniques Laboratory

RMG/mh

Enclosures

Engineering Experiment Station
Georgia Institute of Technology
Atlanta, Georgia 30332

# 95 GHz, ONE QUARTER SIZE, FLAT-PLATE FEED ANTENNA

Final Technical Report
EES/GIT Project A-1799

by

L. E. Cail, Sr.
H. P. Cotten
R. M. Goodman, Jr.

Prepared for

The Johns Hopkins University
Applied Physics Laboratory
Johns Hopkins Road
Laurel, Maryland 20810

under

APL/JHU Subcontract No. 600449

95 GHz, ONE QUARTER SIZE, FLAT-PLATE FEED
FINAL LETTER REPORT

The purpose of this report is to describe the refurbishing and testing of the 95 GHz, one quarter size, flat-plate feed antenna originally built as the scale model of the 94 GHz fixed fan beam antenna for APL under Contract No. N00017-72-C-4401, and to summarize the test results of the antenna.

The parallel plate assembly was cleaned to remove any accumulations of dirt, chips, etc. All fasteners were replaced with corrosion resistant types.

The feedhorn for the antenna had to be remade. Existing electroform mandrels from the previous 95 GHz project were used. The main feedhorn had to be electroformed three times before an acceptable horn was produced. Problems such as warped mandrel, machinist error, and poor electroform deposits caused the delay in producing a good feedhorn.

Figure 1 shows the final feedhorn and mounting bracket. Figures 2 and 3 show the antenna with the feedhorn installed and Figure 4 shows the shield designed to protect the feedhorn waveguide in transit and while not in use.

In order to properly locate the new feedhorn of the 95 GHz antenna and determine the antenna characteristics with the new feedhorn, it was necessary to make far-field radiation pattern and gain measurements of the antenna. This was done on the EES 1000 ft. antenna range.

The antenna range was set up as shown in Figure 5. The signal source used was the EES 95 GHz radar with a 12 in. Cassegrain antenna. The measurements were taken using a precision amplitude phase locked receiver which required a reference signal to maintain frequency lock. This signal was obtained by using a 5 foot parabolic reflector. After aligning the transmitting antenna with the reference and test antennas, it was then possible to make accurate measurements of the test antennas.

The feedhorn was installed at the calculated focal point of the antenna and preliminary E- and H-plane patterns were recorded using a rectangular antenna pattern recorder. As the antenna was not focused, it was necessary to move the feedhorn in and out in small increments, taking patterns each time, until gain and sidelobe structure were optimized. After this was accomplished, the final far-field radiation patterns were taken.

The required final patterns were principal E- and H-plane cuts through the peak of the beam at 95 GHz. A gain measurement at 95 GHz was also taken. As the transmit and receive antennas were vertically polarized, the E-plane pattern was taken in the elevation plane and the H-plane patterns were taken in the azimuth plane. The E-plane pattern and one H-plane pattern were taken on the 60° chart scale, with the other H-plane pattern taken on the 10° expanded chart scale.

The H-plane patterns, Figures 6 and 7, indicated a half-power beamwidth of 0.42° with a highest sidelobe level at -13.25 dB below the peak of the main beam. The E-plane pattern, Figure 8, had a half-power beamwidth of 6.9° with a highest sidelobe level of -8.5 dB below the peak of the main beam.

The gain measurement was made using the standard gain horn substitution method. The peak of the test antenna was plotted, the receiver was then connected to the standard gain horn and plots were made through the peak of the beam of the standard gain horn. The standard gain horn has a gain of 25.05 dB at 95 GHz as determined by calibration data taken from NRL Report 4433. The test antenna measured 11.25 dB above the standard gain horn giving a total gain of the test antenna of 36.3 dB. The gain measurement is shown in Figure 9.

Figures 10 and 11 are E- and H-plane patterns of the antenna with the original feed and are included here for comparison with the patterns of the antenna with the new feed.

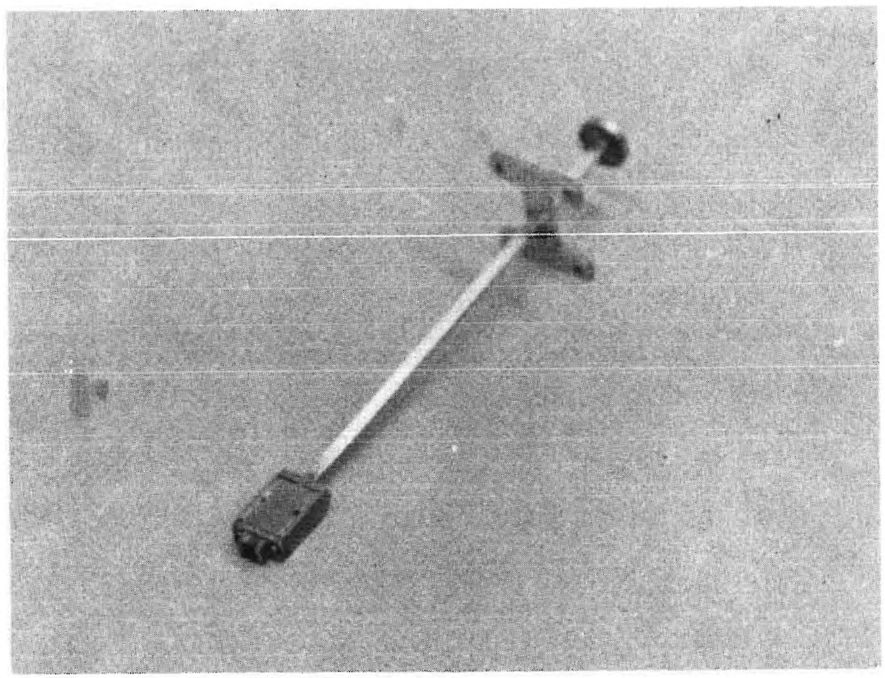

Figure 1. Feedhorn and mounting bracket.

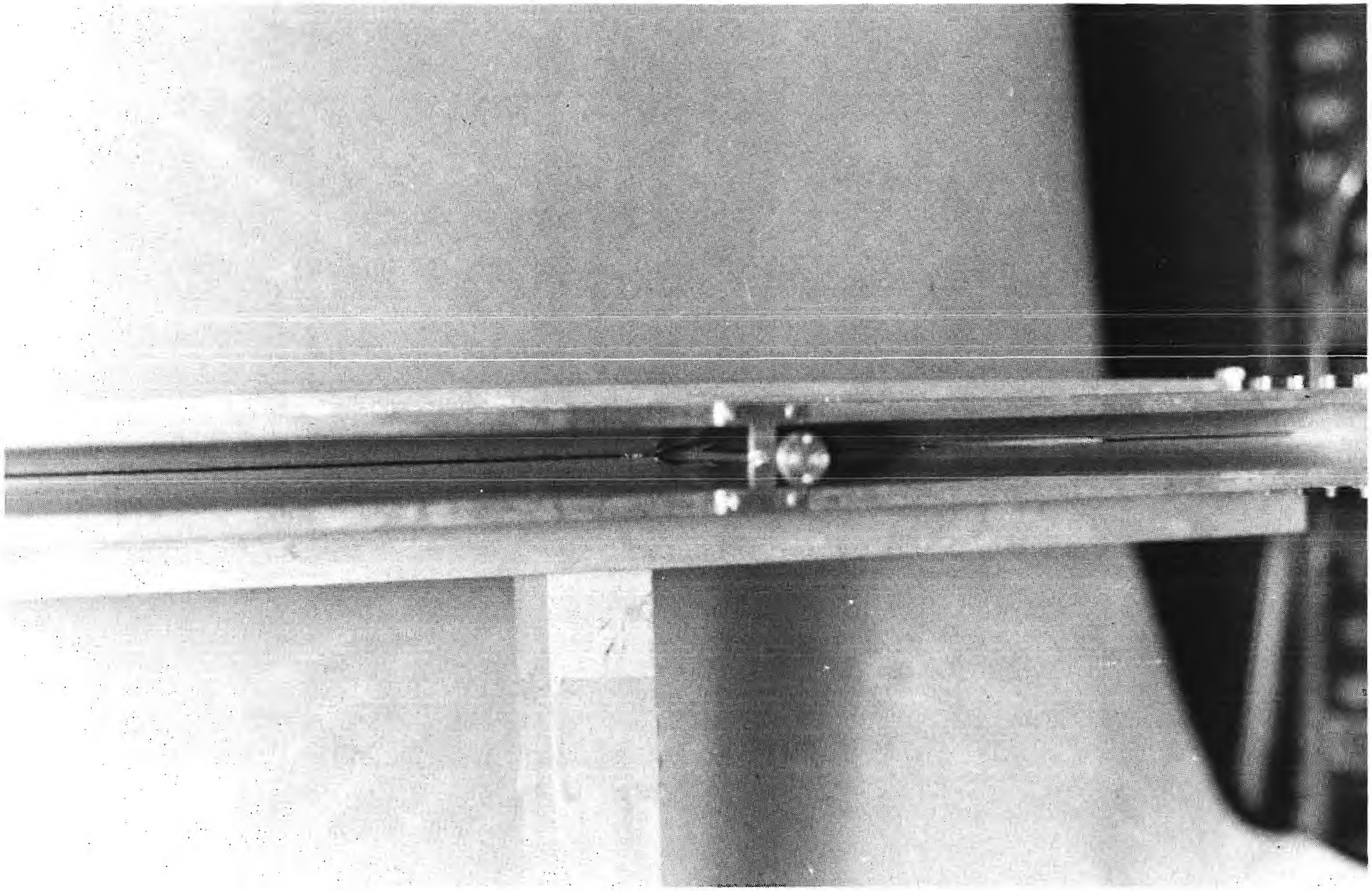

Figure 2.  Antenna with feedhorn.

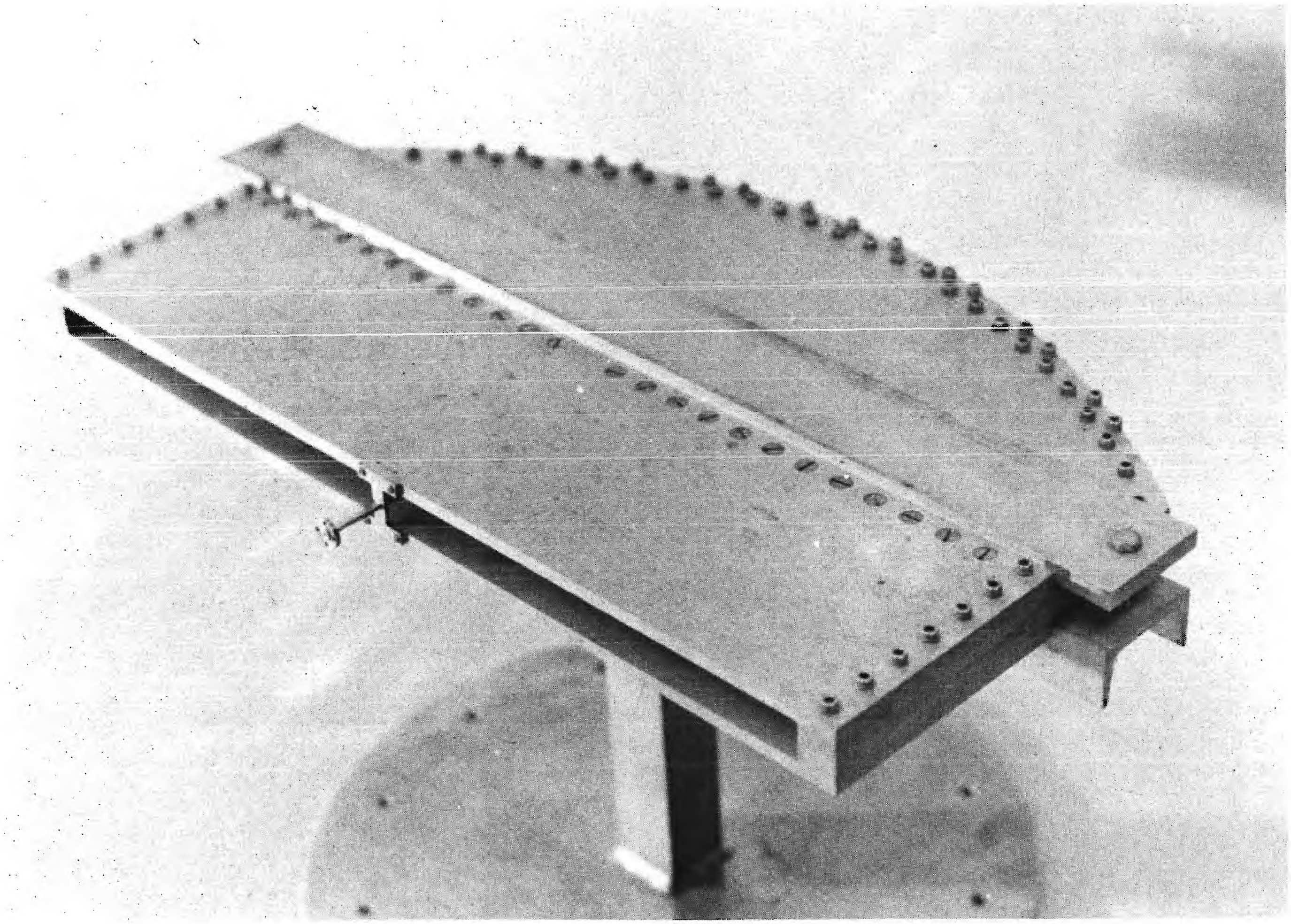

Figure 3. Antenna with feedhorn.

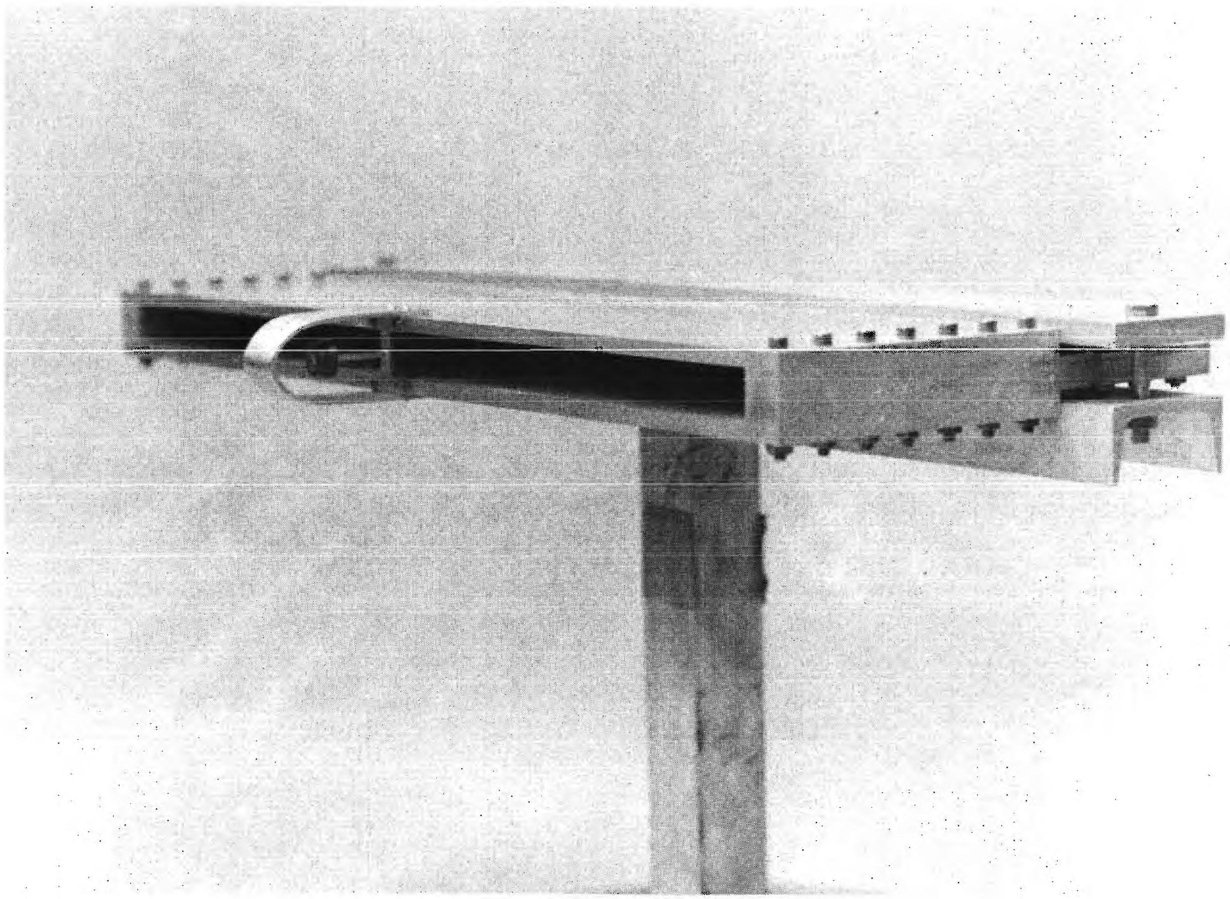

Figure 4. Antenna with feedhorn and feedhorn protective shield.

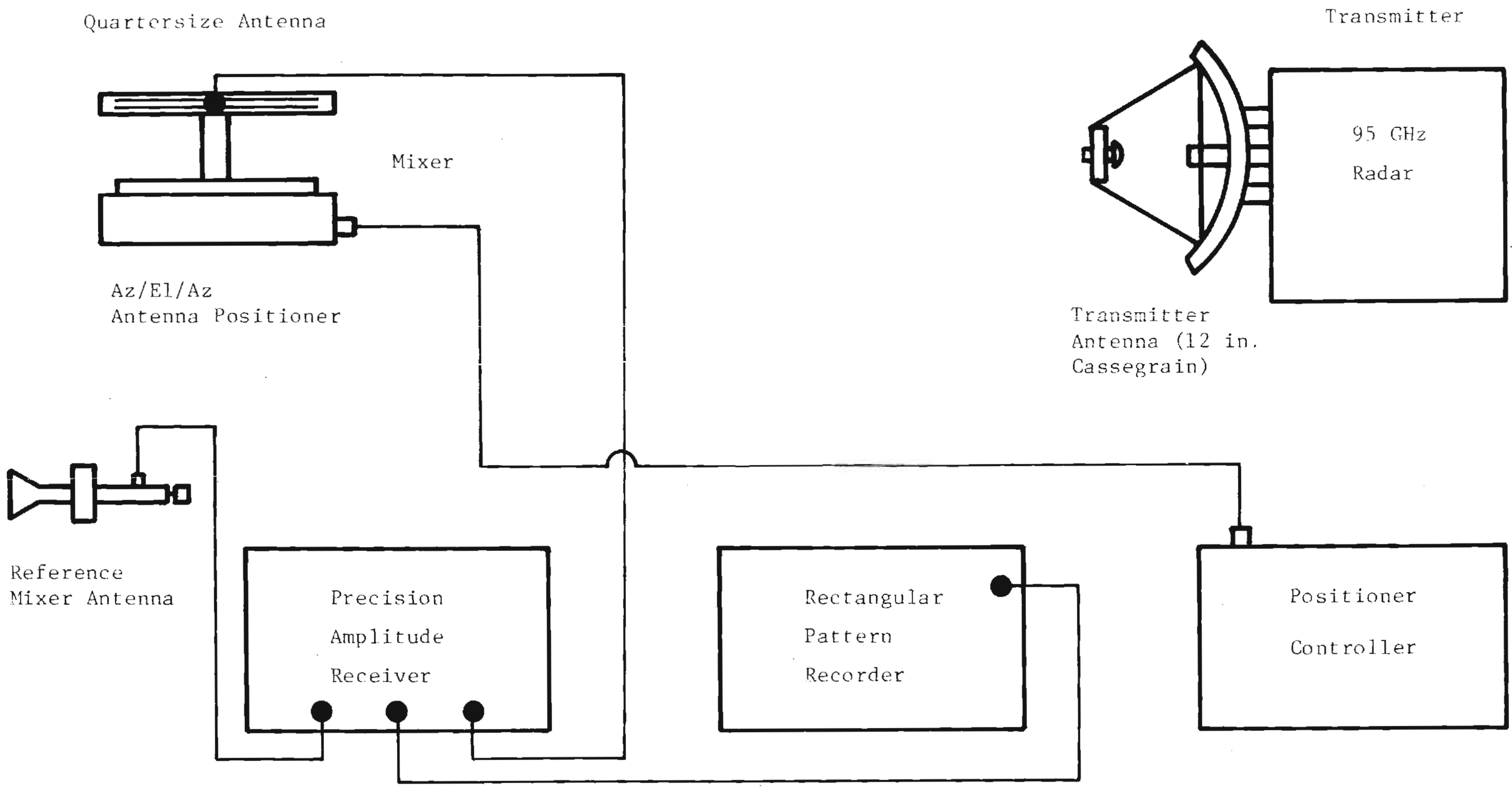


Figure 5. Antenna range diagram.

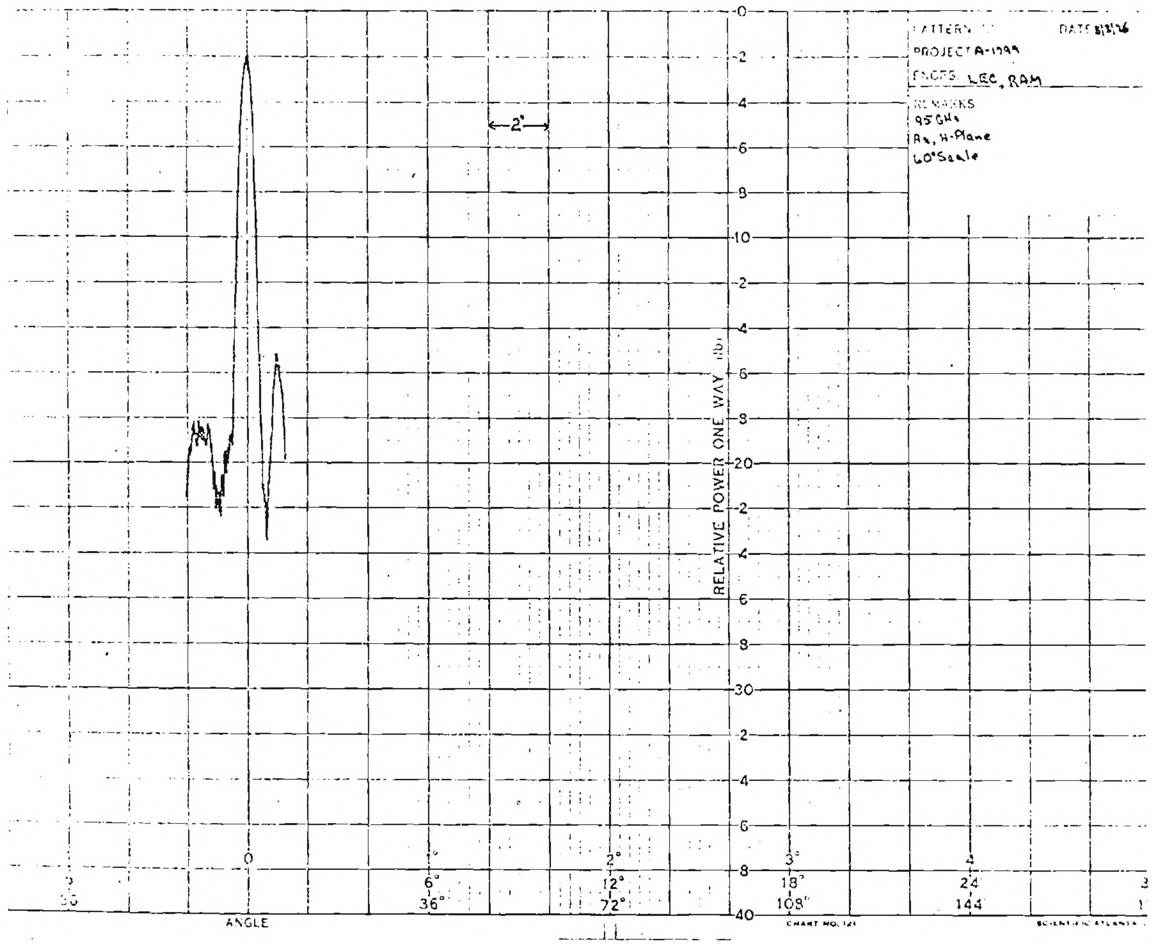


Figure 6. Far-field antenna radiation pattern, H-plane cut at 95 GHz, 60° chart scale.

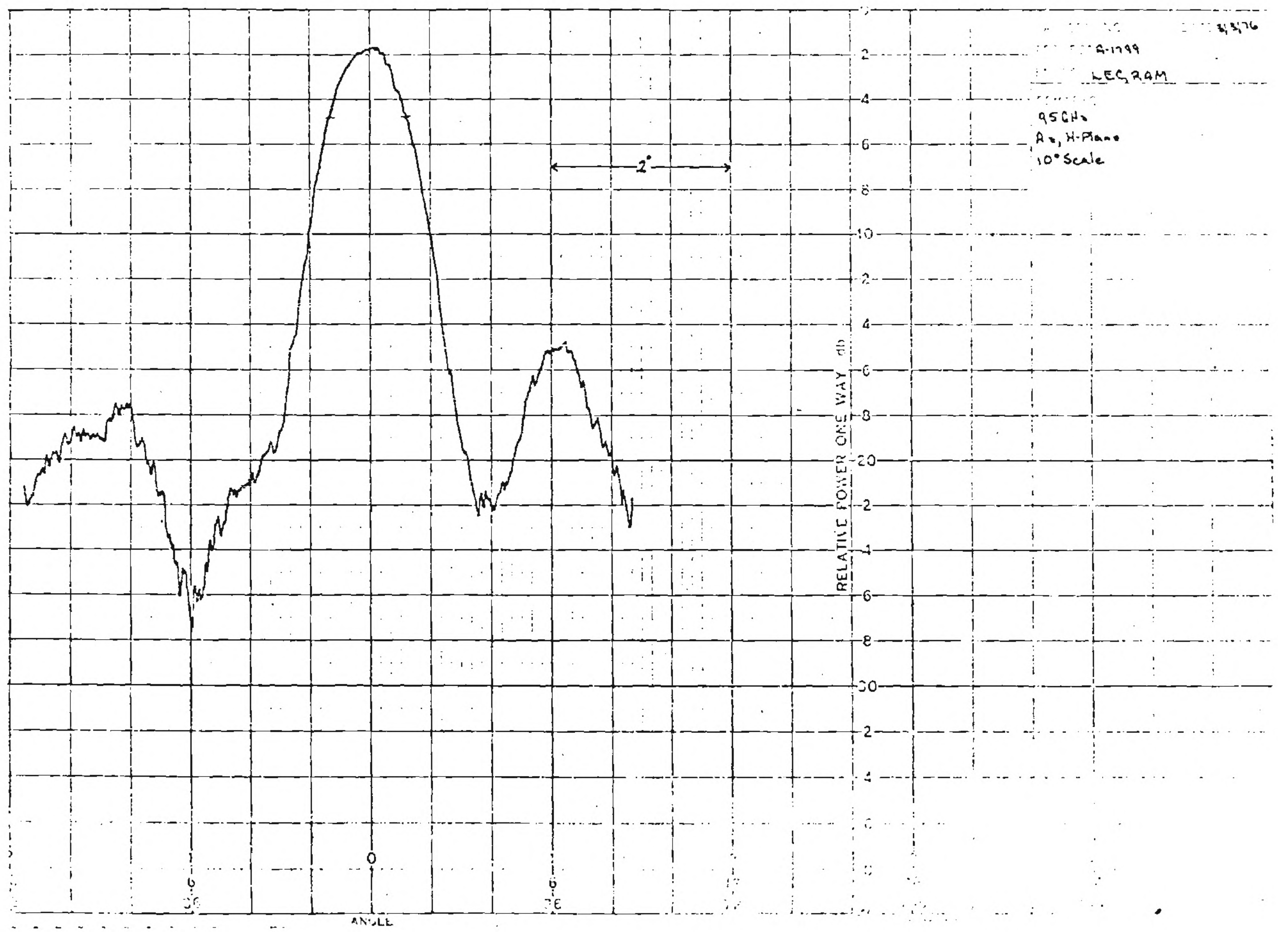


Figure 7. Far-field antenna radiation pattern, expanded H-plane cut at 95 GHz, 10° chart scale.

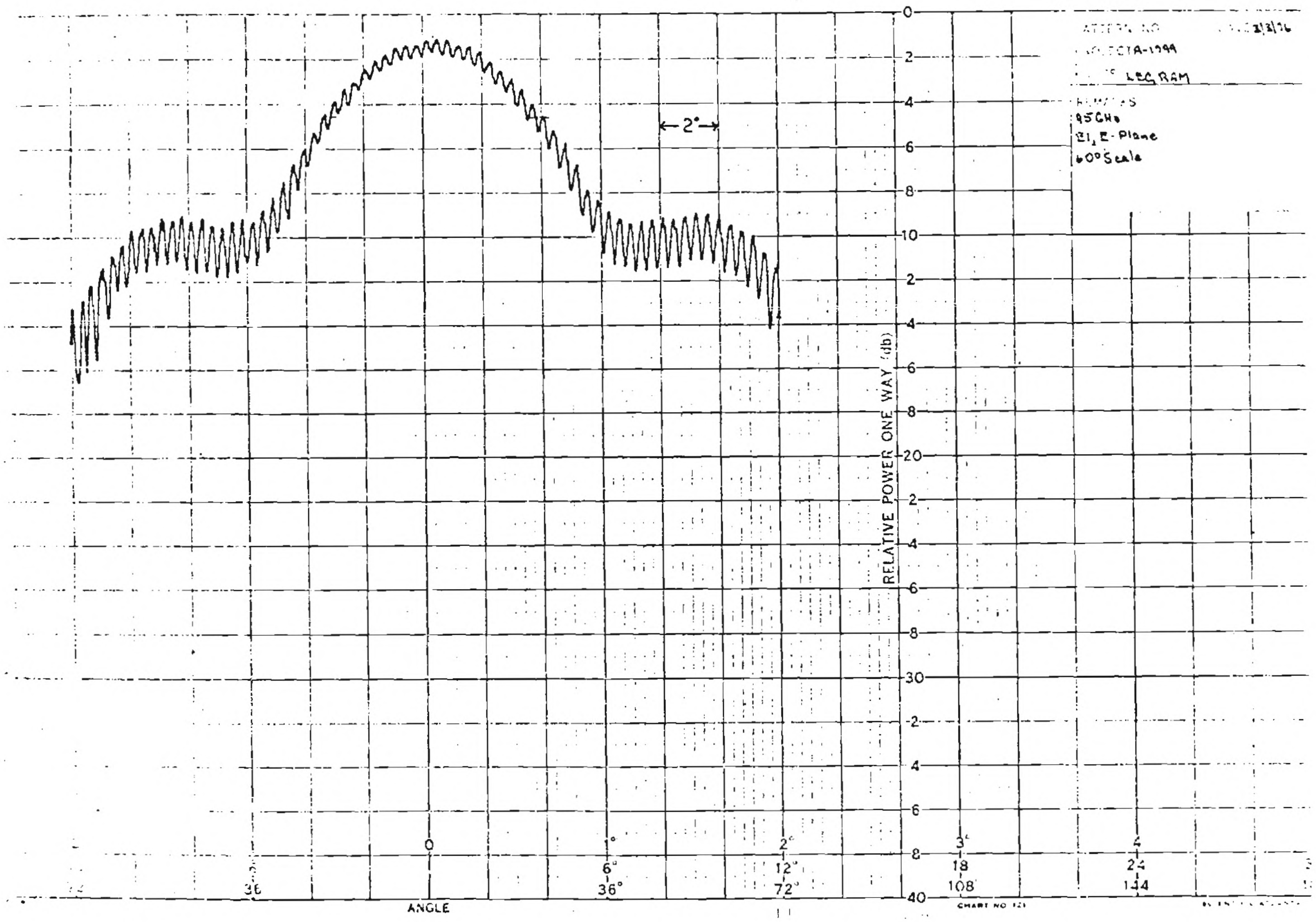


Figure 8. Far-field antenna radiation pattern, E-plane cut at 95 GHz, 60° chart scale.

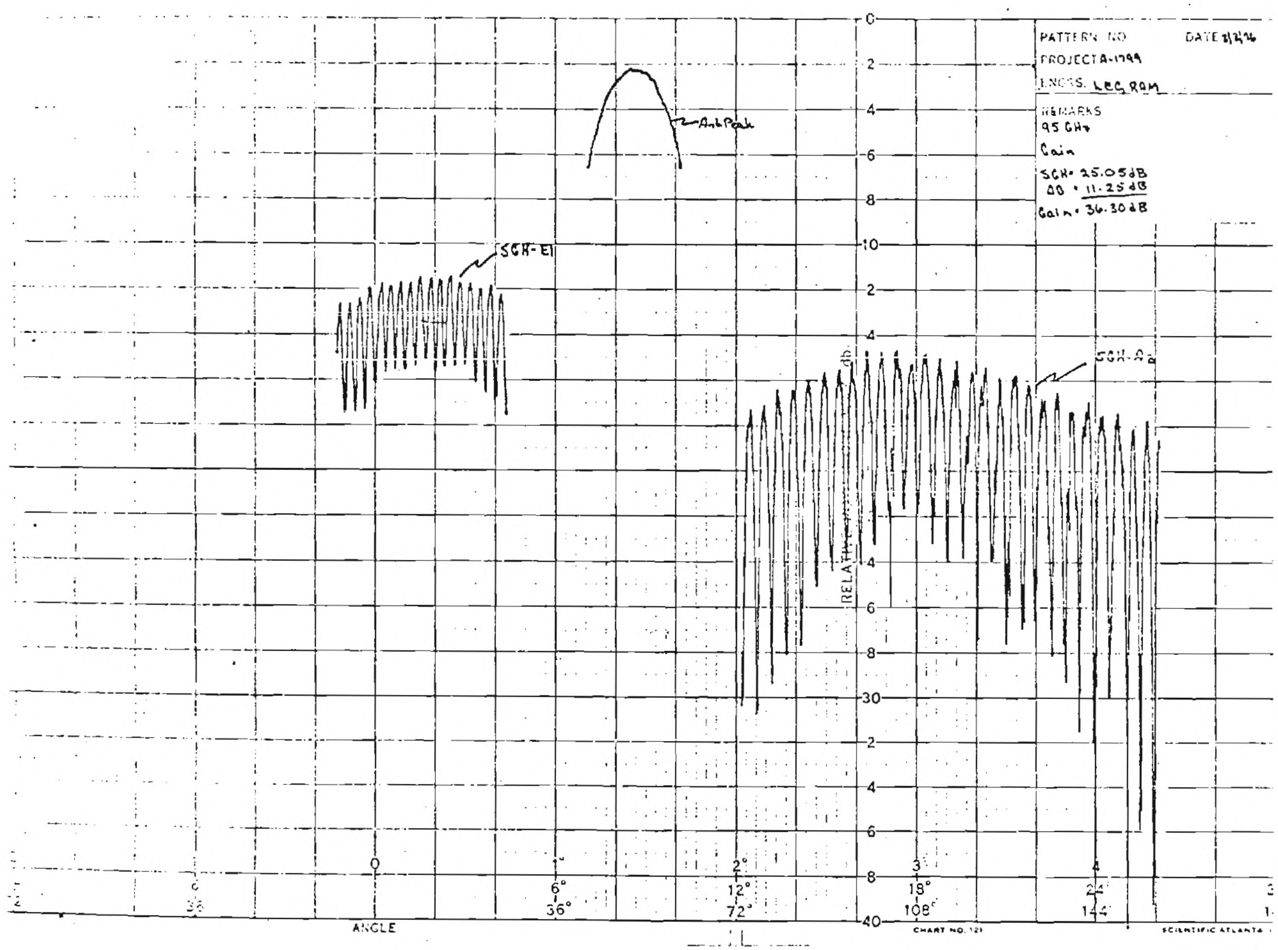


Figure 9. Antenna Gain Measurement at 95 GHz.

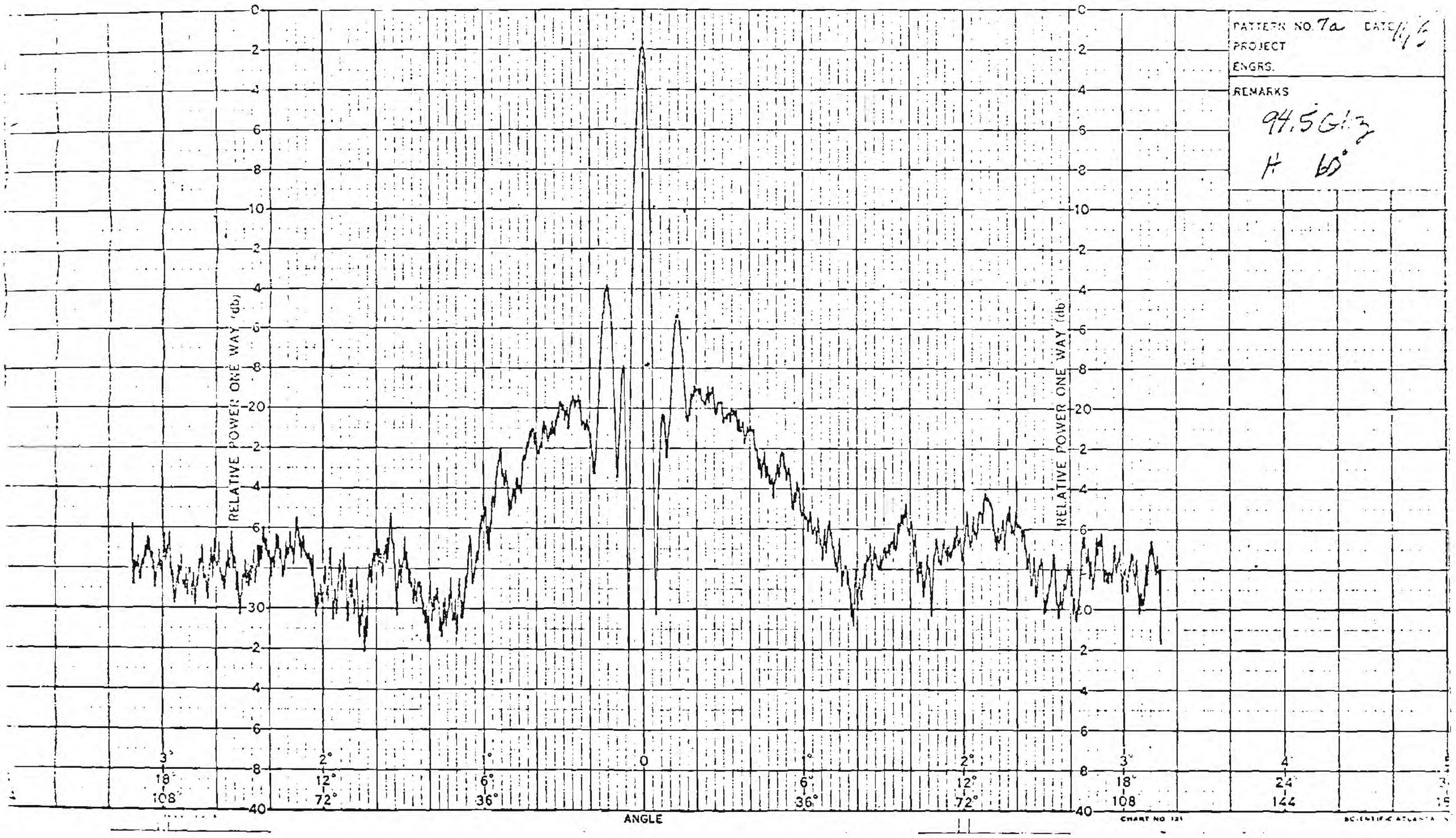


Figure 10. Far-field antenna radiation pattern with original feed, H-plane cut at 94.5 GHz, 60° chart scale.

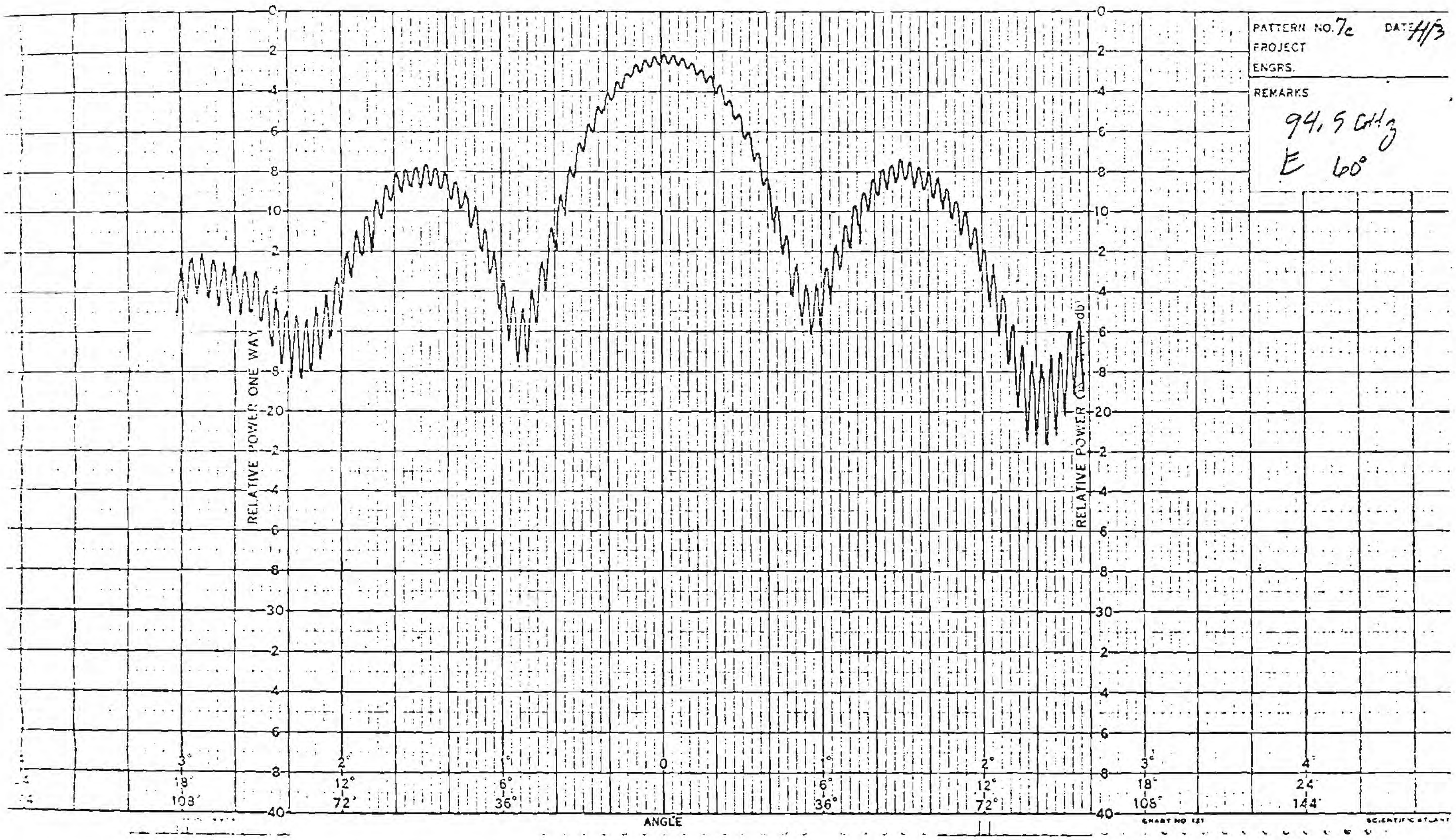


Figure 11. Far-field antenna radiation pattern with original feed, E-plane cut at 94.5 GHz, 60° chart scale.