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NATIONAL RESEARCH COUNCIL OF CANADA

RADIO AND ELECTRICAL ENGINEERING DIVISION

AN I.F.F. ANTENNA FOR USE WITH GROUND RADAR AN/CPS-6B

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OTTAWA

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ABSTRACT

An IFF antenna for use in conjunction with Ground Radar AN/CPS-6B is described. The antenna, a combination horn-reflector type commonly known as the "Hoghorn" was designed by personnel of the RCAF Air Material Command, in collaboration with the Radio and Electrical Engineering Division, National Research Council. One unit was constructed at the RCAF Number 6 Repair Depot, and has recently been tested at the National Research Council. The results of these tests, which are tabulated below, indicate that the antenna may be expected to perform satisfactorily.

SUMMARY OF ANTENNA PERFORMANCE

H-Plane Beamwidth (3-db points)

8° at 950 mc/s.

6.5° at 1155 mc/s.

E-Plane Beamwidth (3-db points)

62° at 950 mc/s.

53° at 1155 mc/s.

Level of Side Lobes and Rear-Radiation

- 25 db, or less, from 950-1155 mc/s.

V.S.W.R. on 50-Ohm Cable

1.2 at 1030 mc/s.

1.6 at 1090 mc/s.

1.8, or less, from 950-1150 mc/s.

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FIGURES

AN I.F.F. ANTENNA FOR USE WITH GROUND RADAR AN/CPS-6B

INTRODUCTION

In an attempt to satisfy an urgent requirement by the RCAF for an IFF antenna to be used in conjunction with Ground Radar AN/CPS-6B, discussions were held between personnel of the RCAF Air Material Command and the Radio and Electrical Engineering Division, National Research Council, with a view to designing an antenna which could be quickly constructed in the shops of the RCAF Number 6 Repair Depot. At these discussions it was agreed that the detailed design of the antenna would be carried out by the RCAF, and that the design of the co-axial line to waveguide transition and complete testing of the antenna would be done by the National Research Council.

ANTENNA DESIGN

Since it was desirable that the antenna be designed and constructed in a minimum of time, it was felt that the type chosen must be inherently broad-band, and as free of critical dimensions as possible. Therefore, an antenna of the horn-reflector type was decided upon, known commonly as the "Hoghorn". A study of the electrical requirements led to a design having an 8-foot aperture, and approximately a 5-foot focal length. A parallel-plate spacing of 4 inches was chosen, flaring at the aperture into a horn with a width of 10 inches. The feed design consisted of a short length of waveguide, 4 inches by 8 inches in cross section, closed at the end by a shorting plate and excited by means of a probe fed by RG-17/U coaxial cable. A photograph of the completed antenna is shown in Figure 1.

ANTENNA PERFORMANCE

The match curve of the antenna and transition is shown in Figure 2. Since a slotted waveguide section was not available, the matching was carried out by adjusting the probe depth and shorting plate spacing for minimum V.S.W.R. on the co-axial feed lines, with the transition connected to the antenna. To carry out these tests it was necessary to construct an adapter from RG-17/U cable to RG-8/U cable, as shown in Figure 3. Trial and error adjustments of the transition resulted in the final match curve of Figure 2, as measured at section A-A, Figure 3. The mismatch of the adapter itself was subsequently checked and found to be of the order of 1.1 to 1, and thus no serious change in the overall V.S.W.R. is anticipated when the antenna is fed directly from RG-17/U cable. As will be noted, an attempt was made to obtain the best match at the challenging frequency of 1030 mc/s. While an improvement in the impedance characteristic could be obtained by constructing a slotted waveguide measuring line and placing additional matching devices in the waveguide feed, it was felt that the improvement so gained would not warrant the time and effort required.

Radiation patterns in the E and H planes at three frequencies in the band 950-1155 mc/s. are shown in Figures 4 to 9. Earlier patterns showed that the quarter-wave chokes placed on the outside of the horn were ineffective in reducing rear-radiation, which rose to -15 db at 950 mc/s. This was subsequently reduced to -25 db by means of 4-inch flanges fastened at right angles to the chokes, as shown in Figure 1. In order that the antenna be mounted correctly on the AN/CPS-6B reflector, measurements were made to determine if there was a tilt of the main beam in the H-plane. These tests showed the main beam to be directed normally from the aperture, as expected. No further comment on the radiation patterns is necessary; it is sufficient to say that the patterns are satisfactory for IFF operations.

CONCLUSIONS

The mechanical design and construction of the antenna leaves nothing to be desired. Indeed, the tolerances maintained and the ruggedness achieved by the shops of No. 6 Repair Depot are more than adequate. Electrically, the radiation patterns appear to be entirely satisfactory, and while the impedance characteristic could be improved, it is felt that unless a large number of these antennas are to be built, the cost of such improvements,both in time and money, is not warranted.

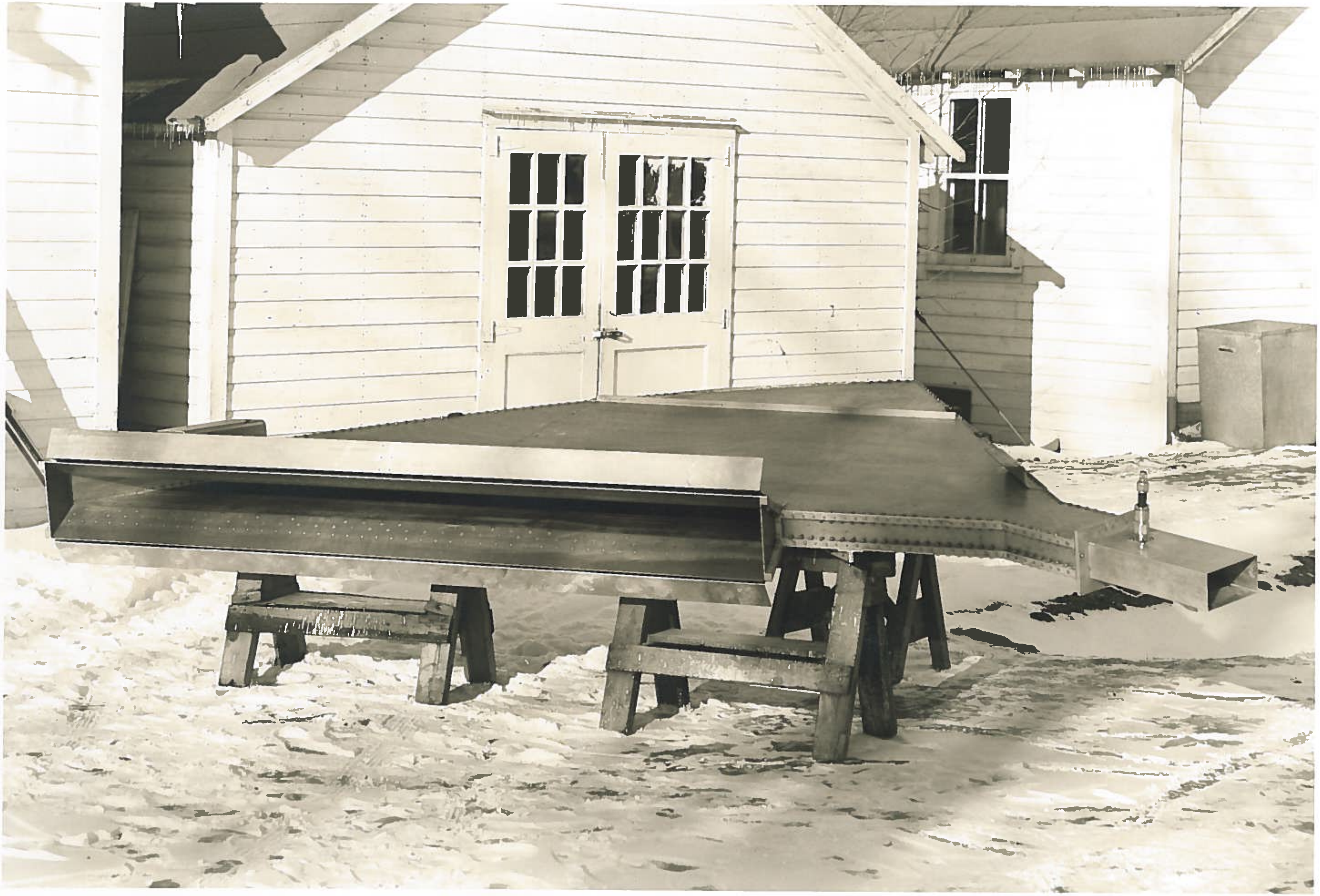

FIG. 1 "HOGHORN" IFF ANTENNA

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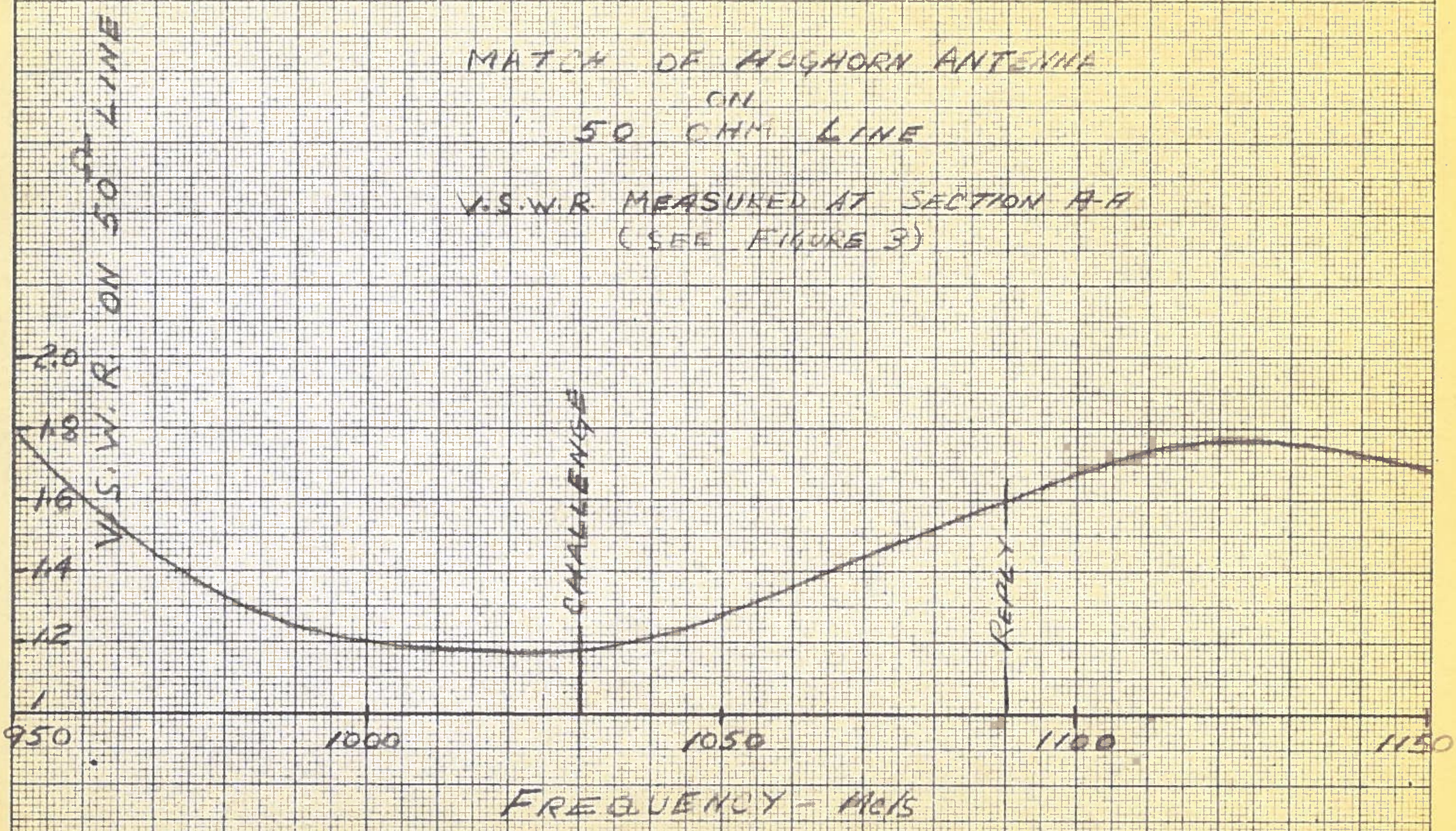

FIGURE 2

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CO-AX TO WAVEGUIDE TRANSFORMER AND ADAPTOR FROM RG-17/U TO RG-8/U CABLE

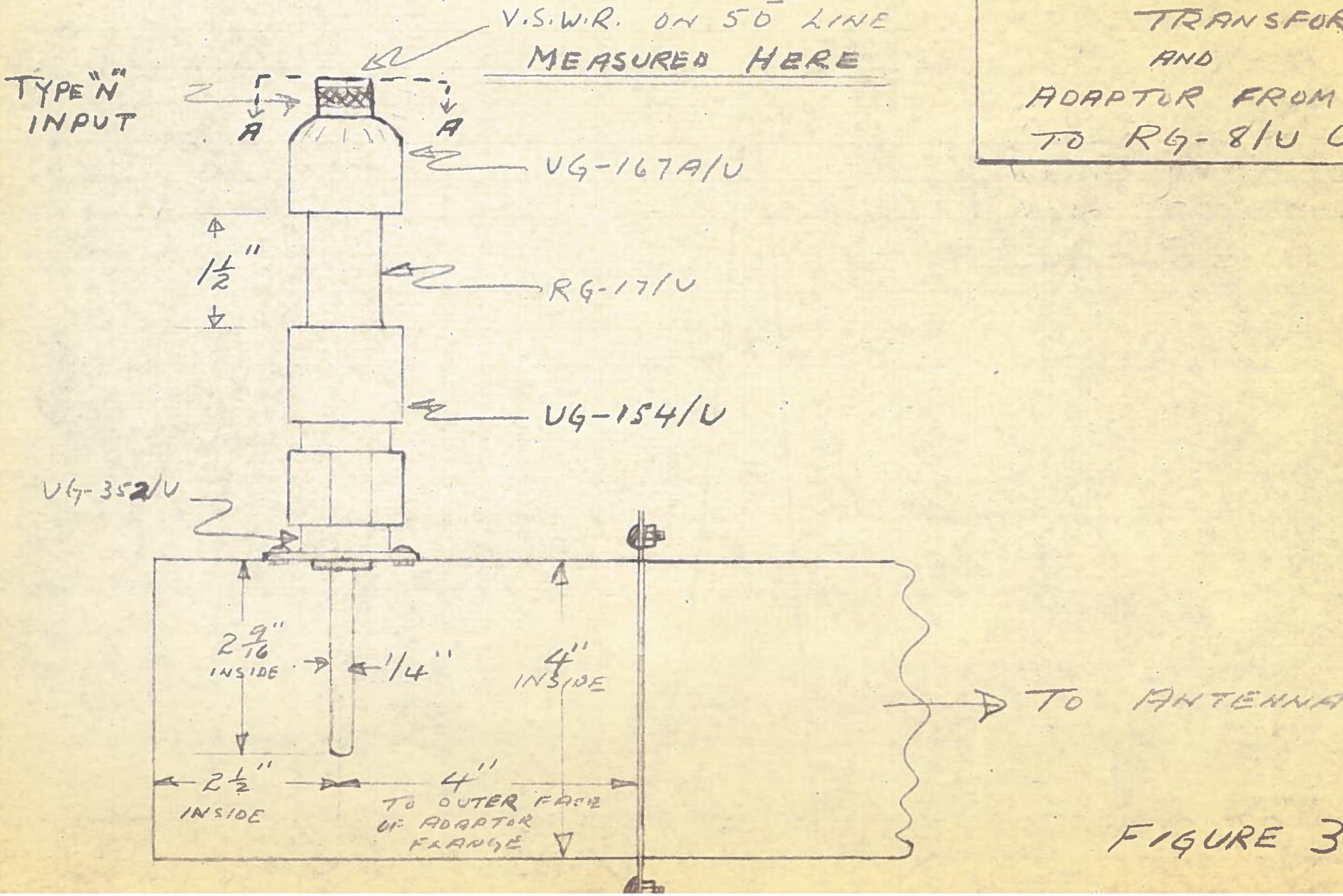

FIGURE 3

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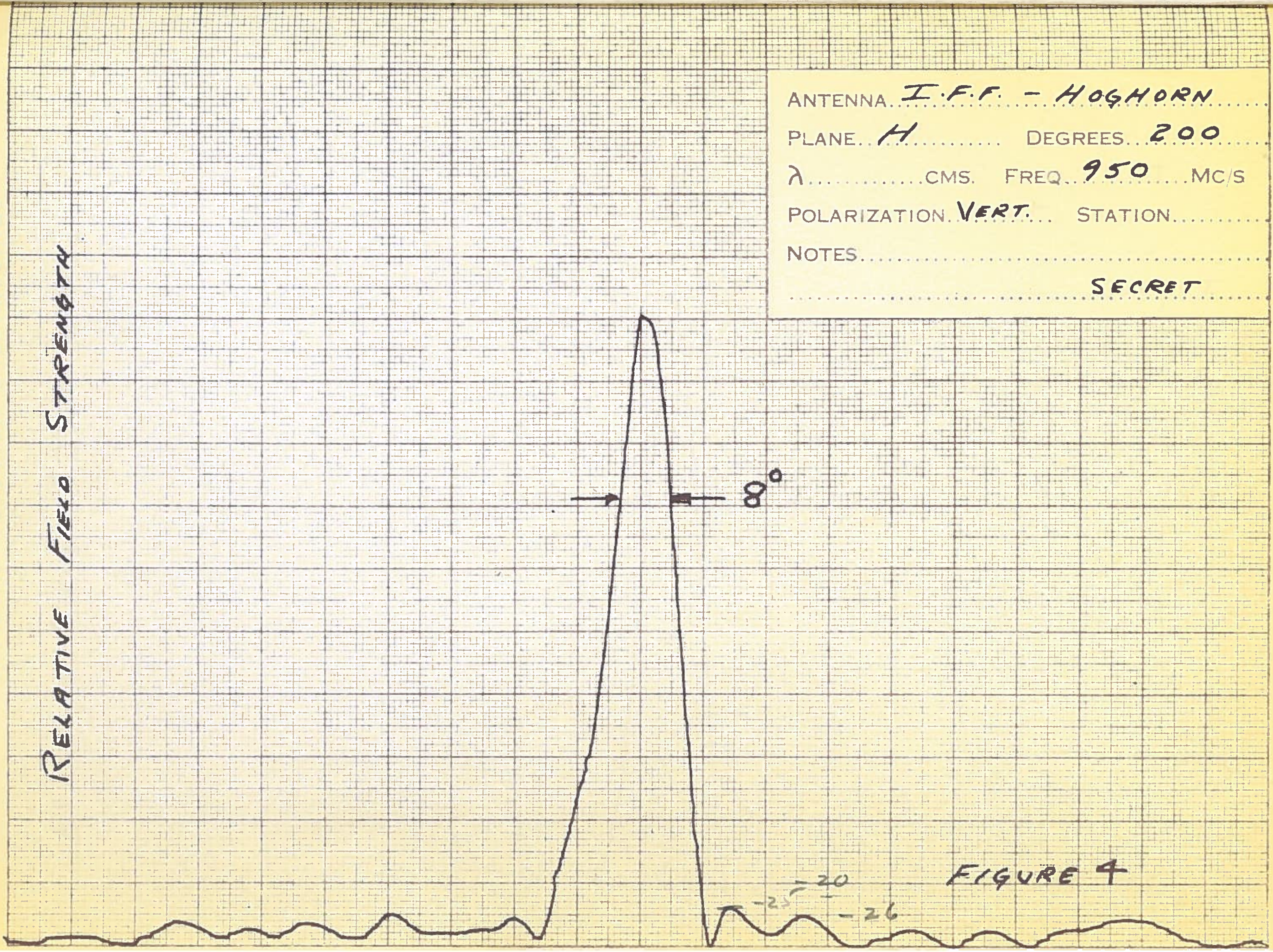

FIGURE 4

DATE 24-1-

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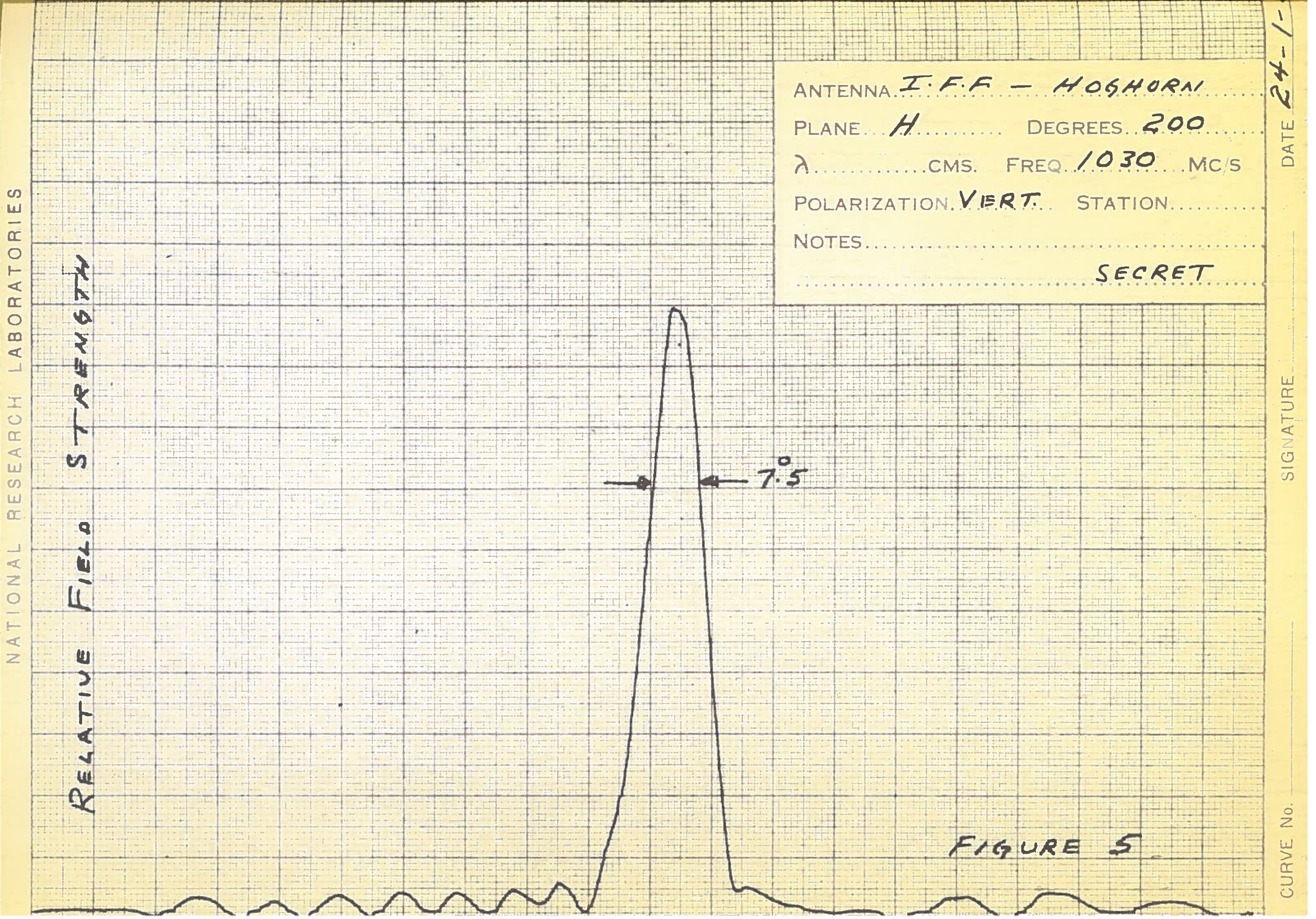
ANTENNA I.F.F — HOGHORN
PLANE H DEGREES 200
λ CMS. FREQ 1030 MC/S
POLARIZATION VERT. STATION
NOTES
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DATE 24-1-
SIGNATURE
CURVE No.
NATIONAL RESEARCH LABORATORIES
RELATIVE FIELD STRENGTH
7.5°

FIGURE 5

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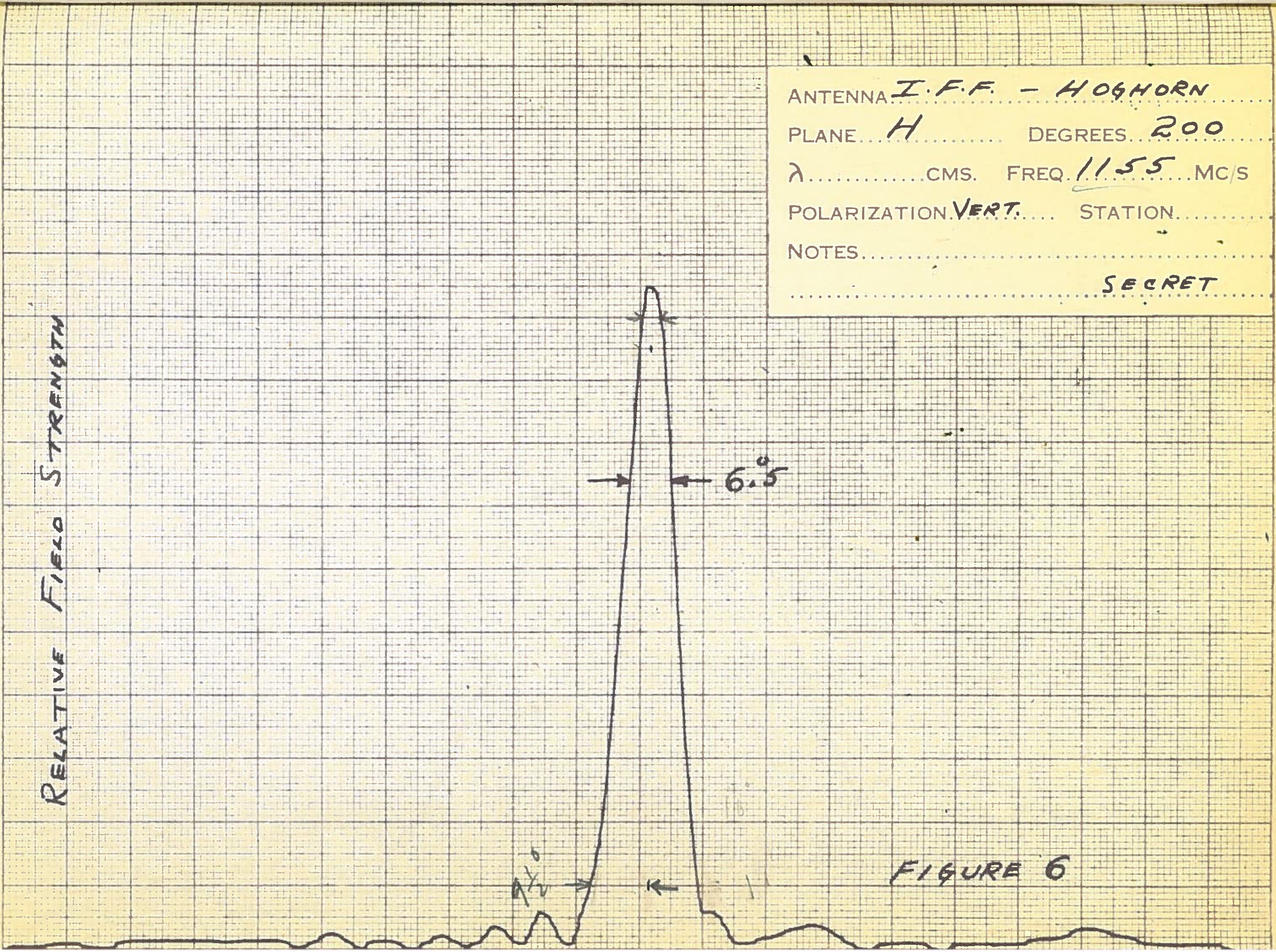

FIGURE 6

DATE 24-1-

SIGNATURE

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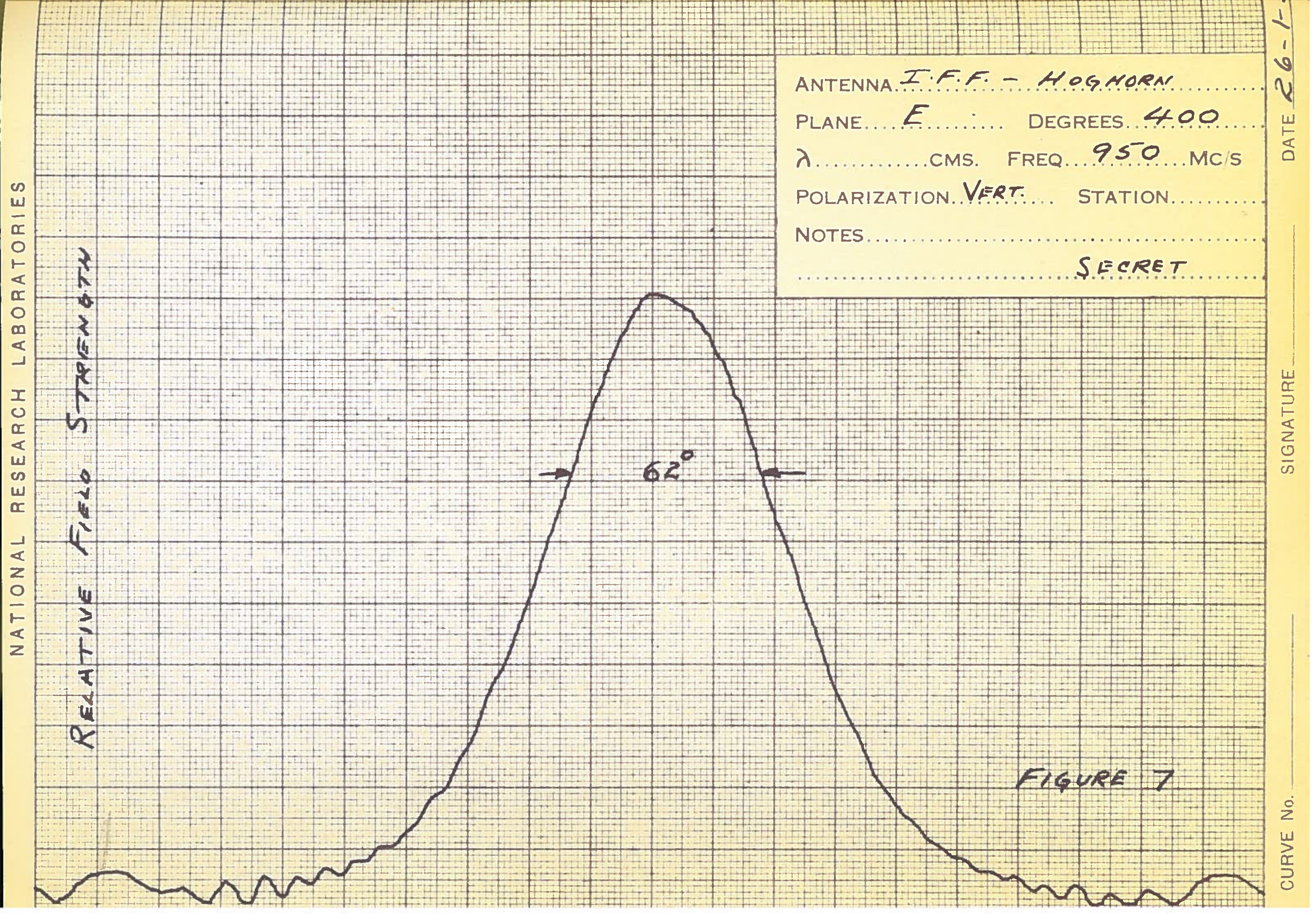
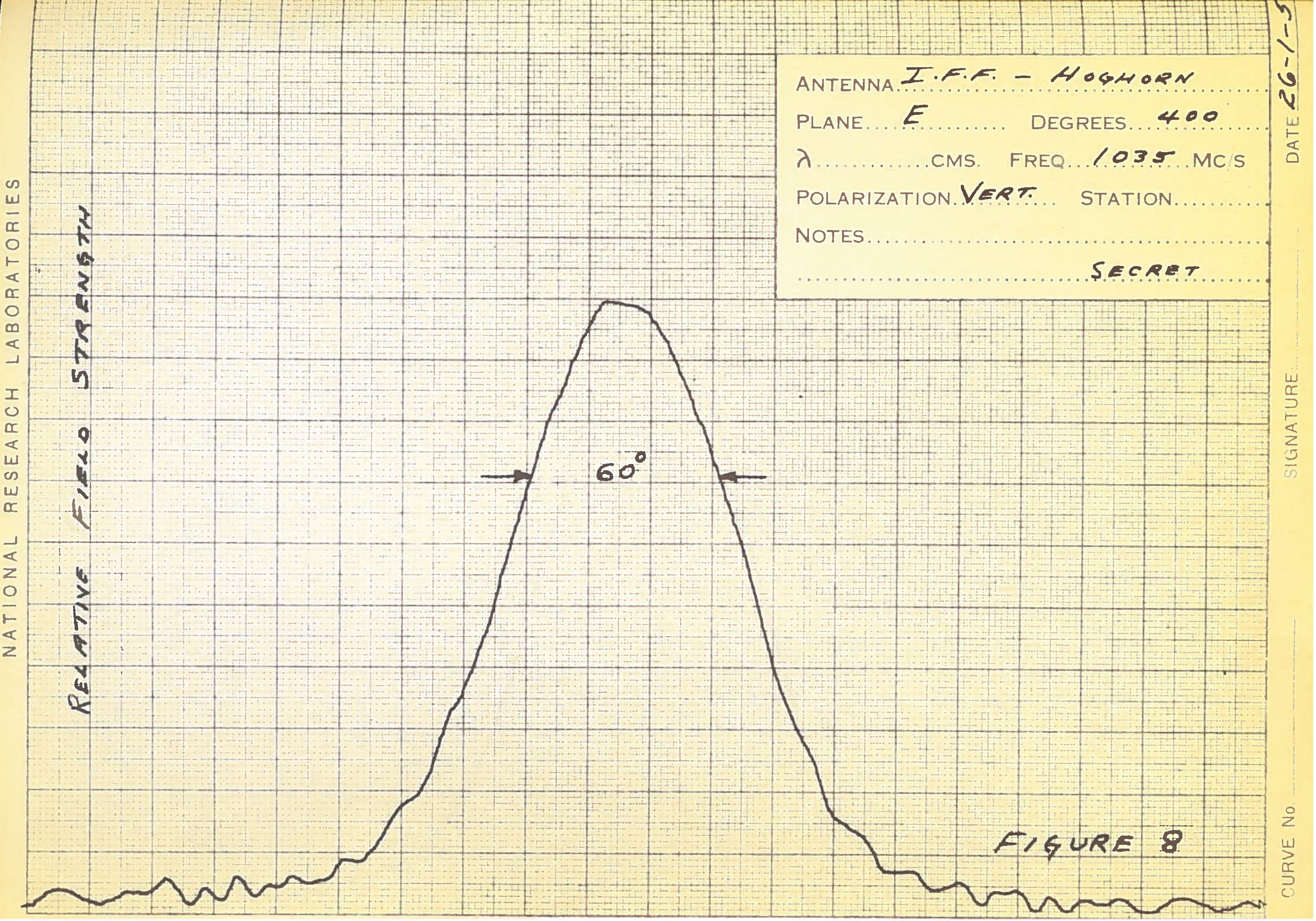

NATIONAL RESEARCH LABORATORIES
ANTENNA I.F.F. - HOGHORN
PLANE E
DEGREES 400
λ CMS.
FREQ 950 MC/S
POLARIZATION VERT.
STATION
NOTES
SECRET
DATE 26-1-
SIGNATURE
CURVE No.
RELATIVE FIELD STRENGTH
62°

FIGURE 7


NATIONAL RESEARCH LABORATORIES
ANTENNA I.F.F. – HOGHORN
PLANE E
DEGREES 400
λ CMS.
FREQ. 1035 MC/S
POLARIZATION VERT.
STATION
NOTES
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DATE 26-1-5
SIGNATURE
CURVE No.
RELATIVE FIELD STRENGTH
60°

FIGURE 8

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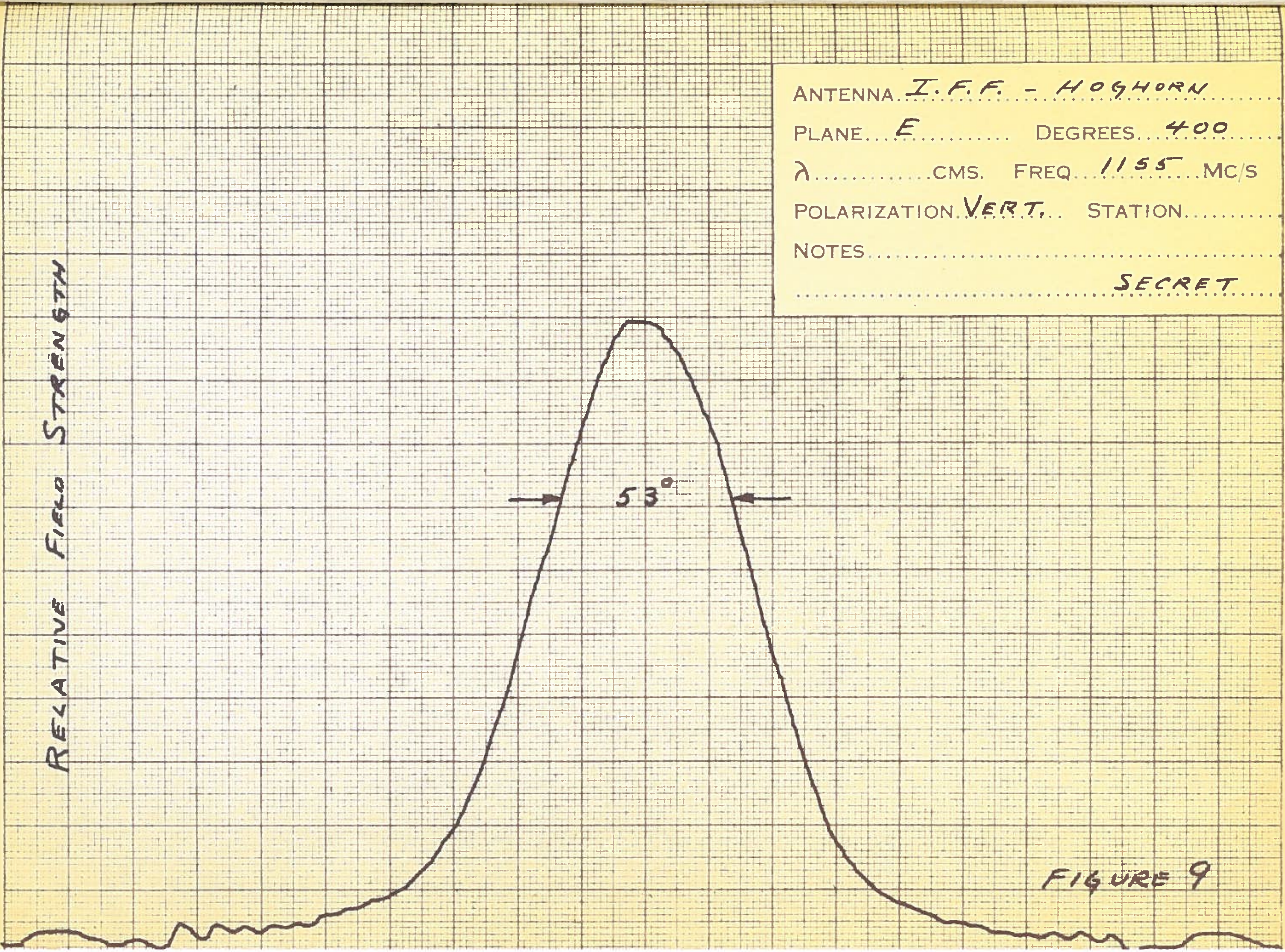

FIGURE 9

DATE 26-1-5

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