Electrical

Test Report

3.7M Weather

Radar Antenna

5.4 – 5.7 GHz

Model No. AS 146-54

Prepared for:

Baron Services, Inc.

4930 Research Dr.

Huntsville, AL 35805

Report 0303-700

June, 2003

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Seavey Engineering 0303-800 Drawing
Antenna Test Procedures ANSI/IEEE STD 149 - 1979

INTRODUCTION

This report summarizes the results of gain and sidelobes of Seavey Engineering Model 0303-800, a high performance 16-panel 3.7 Meter C-Band weather radar antenna.

This effort was conducted under authorization of Baron Purchase Number 6794. Pertinent specifications are referred to in Table 1, Final Test Data 3.7 M C-Band Radar Antenna.

DESCRIPTION OF ANTENNA

Appendix A shows the antenna drawing, SEA 0303-800. The specifications are as follows:

Specification - Model AS146-54

	3.7 M C-Band Weather Radar Antenna
Item	3.7 M Low Sidelobe C-Band Weather Radar Antenna
Antenna Type	Prime Focus, Circular Paraboloid, 16-Panel
Frequency	5.40 - 5.70 GHz
Polarization	Horizontal Linear
Gain	43 dBi nominal
Beamwidth, 3 dB	1.1 degree, nominal
Sidelobes, co-pol,	-25 dB +/- 0.5 dB
Power Handling	550 KW peak, 1% duty cycle
VSWR	1.25, maximum
Reflector Diameter	151 inches nominal
RF Ports	(1) WR-187 choke flange (round style) at reflectors edge
Pressurization	7.5 psig desiccated air thru feeders Pressure leak tested thru waveguide & feed assembly @ 15 psig
Mechanical Data	a) Alodine (or equal), primed and white paint b) Mounting holes, 4x) 1.062 dia on 36 inch square

Antenna System

This antenna is a precision, 16-panel, 3.7 meter painted aluminum reflector with a 57.6-inch focal length. The quadra-pod feed support structure is a slender and symmetrical metal design. The C-band feed is a specially optimized scalar feed. The braced feeder WR-159 waveguide functions as a minimum blockage strut. The waveguide has a transition to a WR-187 choke flange at the edge of the reflector.

Test Procedures

Please refer to the List of Illustrations for the test results. Co-polarized radiation patterns were measured at the designated test frequencies of 5.400, 5.550 and 5.700 GHz. Patterns were measured in two planes (0 and 90 degrees of axial rotation). Gain data was measured using a Narda 643 horn and calibrated rotary vane attenuator. Swept return loss (VSWR) was measured using a scalar network analyzer.

The source antenna was a 6-foot parabolic antenna located 850 feet away. The feed system of the antenna under test was shimmed outward axially by 0.45 inches in accordance with the recommendations of IEEE Standard Test Procedures for Antennas, IEEE Standard 149-1979. Following the tests, the feed system shims were removed and the antenna was shipped in this condition.

Additional tests and inspections were done as follows:

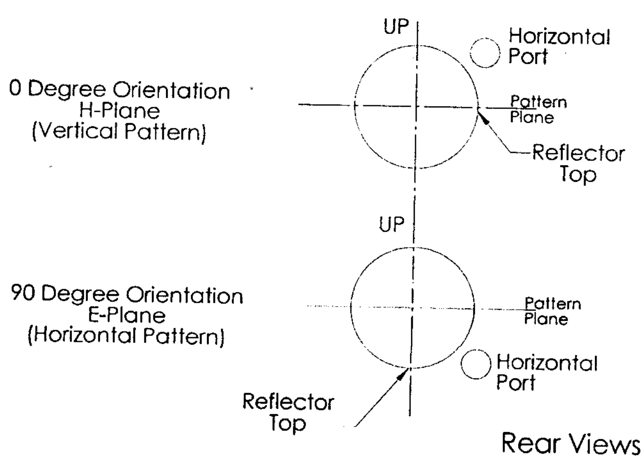
* 10 minute 15 psig waveguide pressure test

Test Results

Table I summarizes the results of these tests. The antenna complies with all specifications.

Table 1

FINAL TEST DATA 3.7 M C-BAND RADAR ANTENNA				
Frequency	**5.400 GHz**	**5.550 GHz**	**5.700 GHz**	**Spec'n**
Gain	44.0 dBil	44.6 dBil	44.55 dBil	43.0 dBi Nom
3 dB Beamwidth				
Vertical, H-Plane (ϕ=0°)	1.1 °	1.0 °	1.0 °	1.10 ° Nom
Horizontal, E-Plane (ϕ=90°)	1.1 °	1.0 °	1.0 °	1.10 ° Nom
Sidelobes				
Vertical, H-Plane (ϕ=0°)	28.0 dB	27.0 dB	28.4 dB	25.0 dB ± .5 dB
Horizontal, E-Plane (ϕ=90°)	27.4 dB	28.3 dB	26.8 dB	25.0 dB ± .5 dB



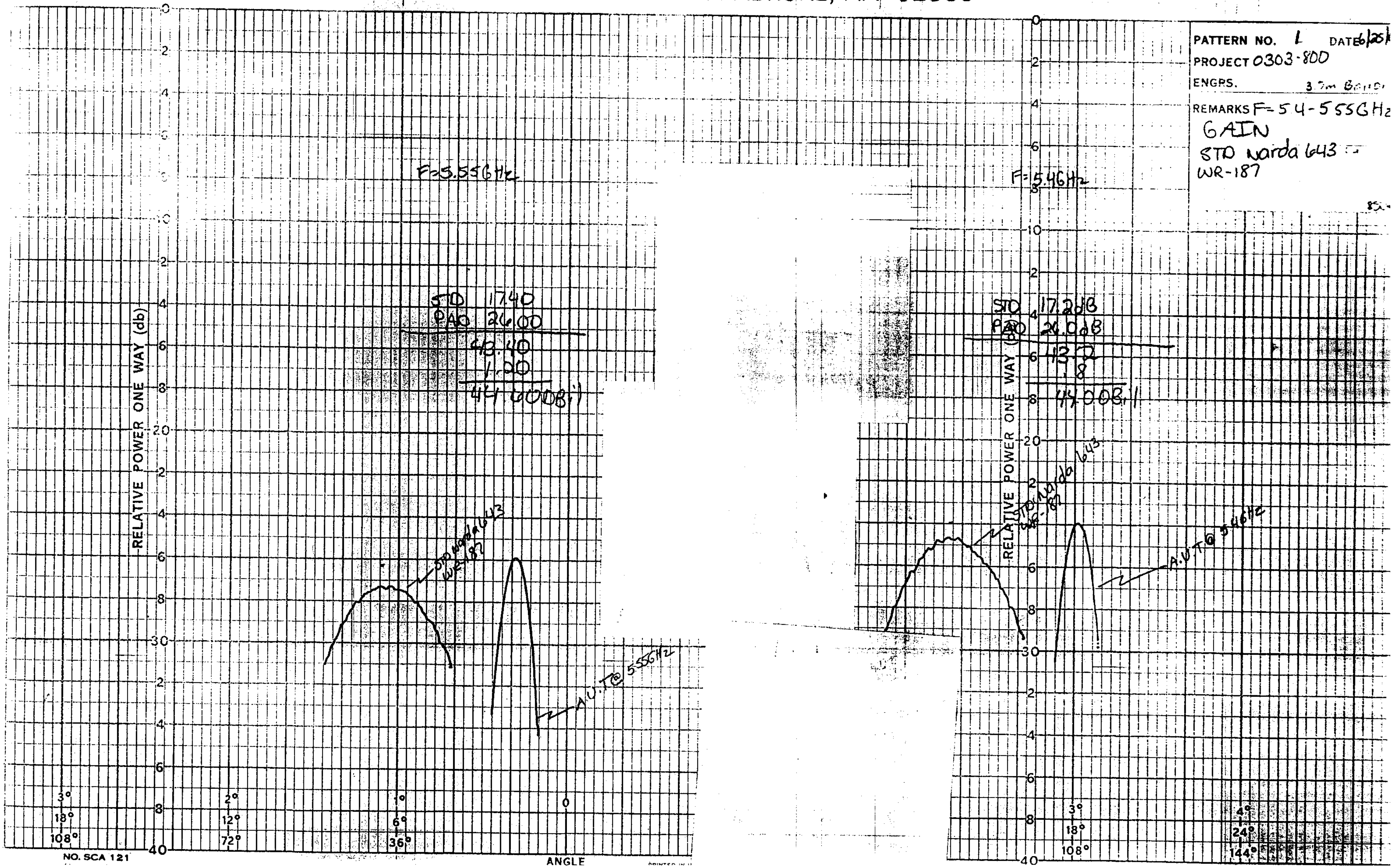
SEAVEY ENGINEERING
ASSOCIATES, INC.
28 RIVERSIDE DRIVE
PEMBROKE, MA 02359

PATTERN NO. 1 DATE 6/28

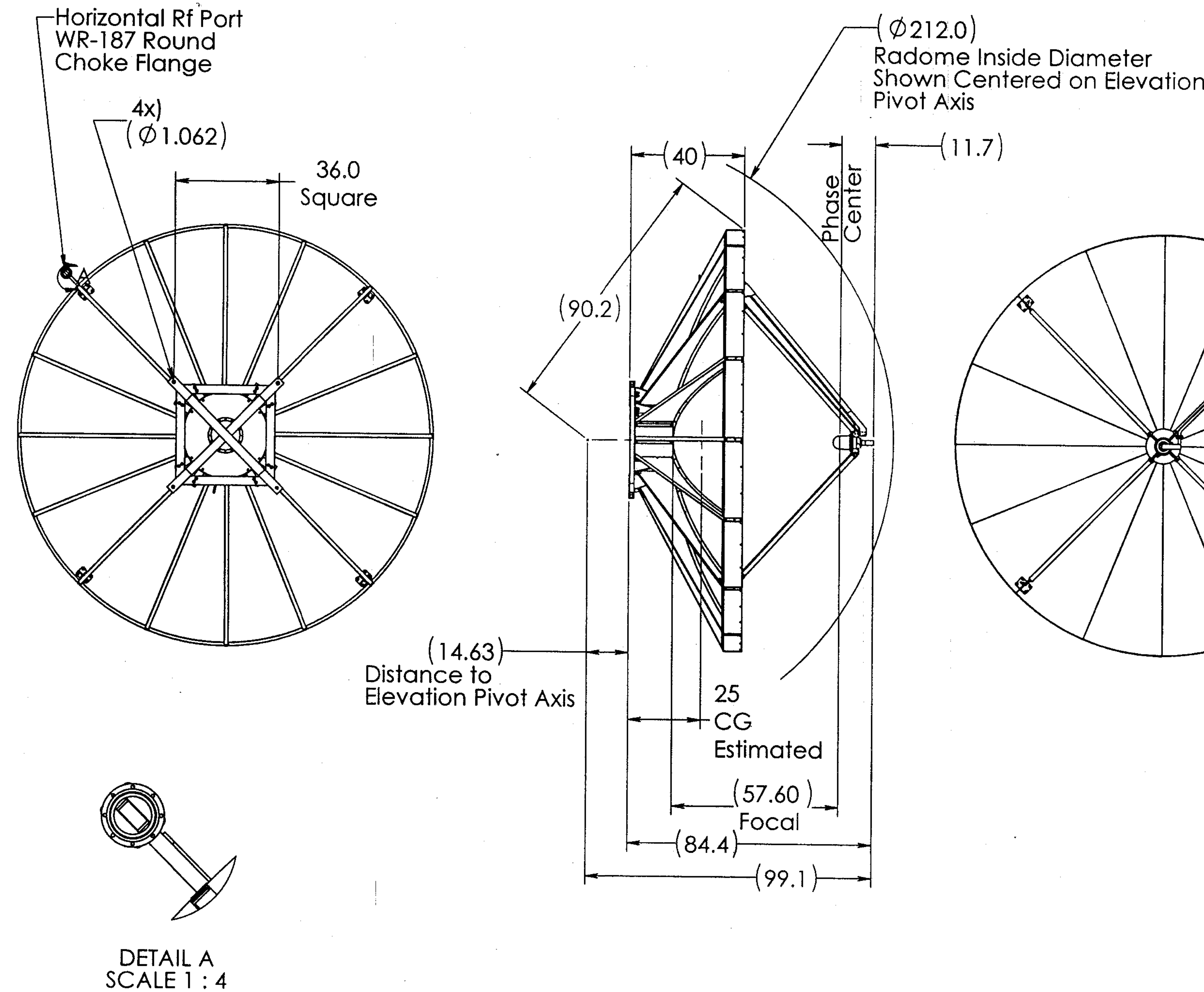
PROJECT 0303-800

ENGRS. 3.7m Band

REMARKS F=5.4-5.55GHz
GAIN
STD Narda 643
WR-187



ECO#	REV	DESCRIPTION	DONE BY	DATE	APPROVED
—	B	ORIGINAL ISSUE	PSR	06/27/03	



NEXT ASSY.	USED ON
	—

FINISH
White Paint

MATERIAL
Aluminum 6061-T6

REMOVE ALL BURRS AND SHARP EDGES
DO NOT SCALE DRAWING
WORKMANSHIP SHALL BE IN ACCORDANCE WITH MIL-STD-454, REQT 9.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

ANGLES	HOLE DIA.	TOLERANCES	LINEAR
±1°	.0135-.250	+.005 -.001	.X = ±.06
	.251-.500	+.006 -.001	.XX = ±.02
	.501-1.000	+.010 -.001	.XXX = ±.010

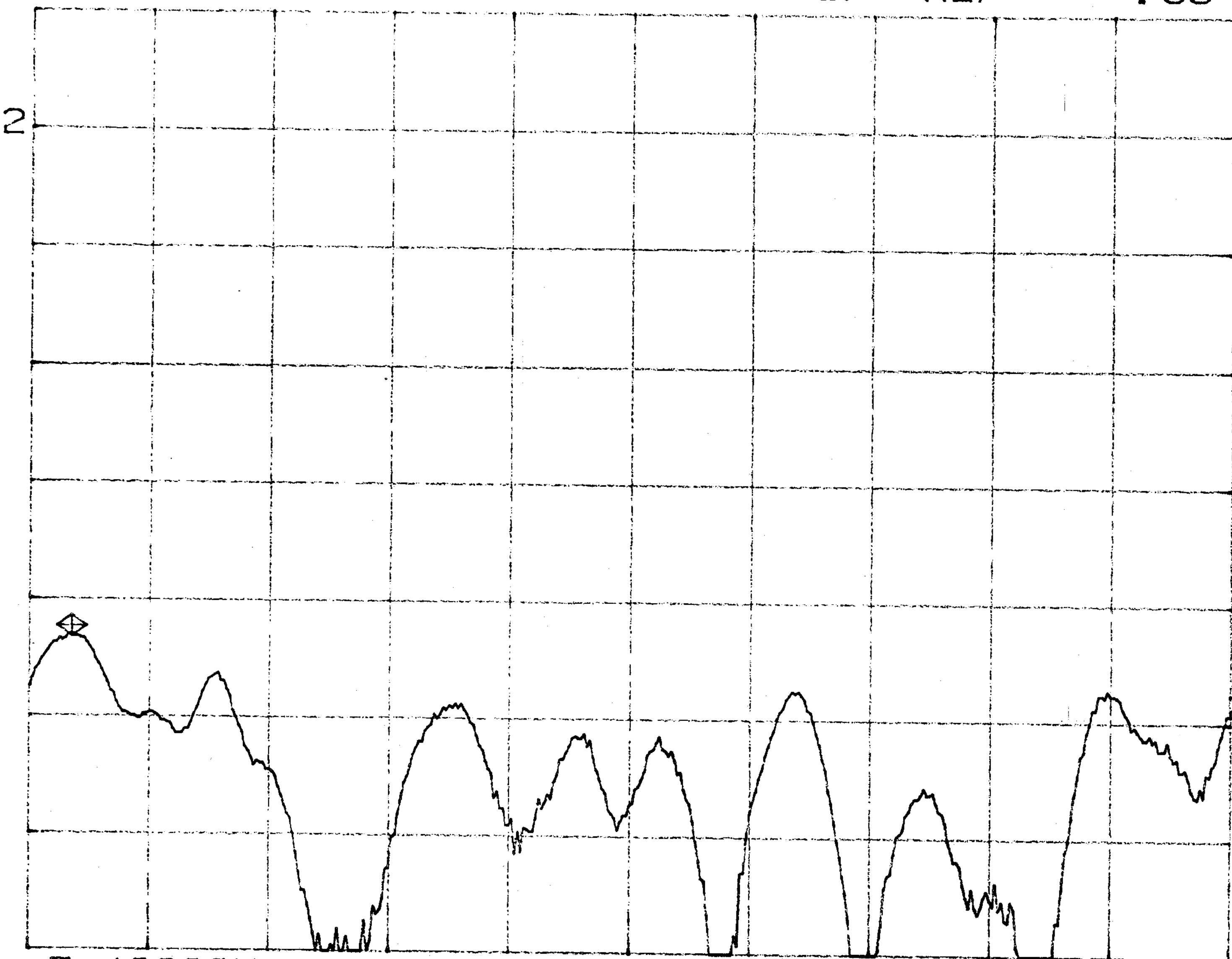
DRAWN:	PSR	DATE 01/24/03
CHECKED:		DATE
PROJ. ENG:		DATE
ENG. DEPT:		DATE
MFG. DEPT:		DATE
Q.A. DEPT:		DATE

SEAVEY ENGINEERING ASSOCIATES, INC.
Pembroke, MA 02359

DRAWING TITLE
Outline
AS146-54

SIZE	CAGE CODE	DWG NO.	REV
C	60173	0303-800	B

Test Conditions Return Loss



HEWLETT-PACKARD SCALAR NETWORK ANALYZER SYSTEM 8756A/S

Return Loss ✓ at Waveguide port Axial Ratio ____ Cross Polarization ____ Swept Gain ____

Isolation ____ between ports ____ and ____ Insertion Loss between ports ____ and ____

Customer Name Barron

W.O. ~~P.O.~~ ____

Sales Order No. ____

Seavey P/N ____

Model No. ____

S/N 001

Date 6/26/03

Tech. m.W.L.

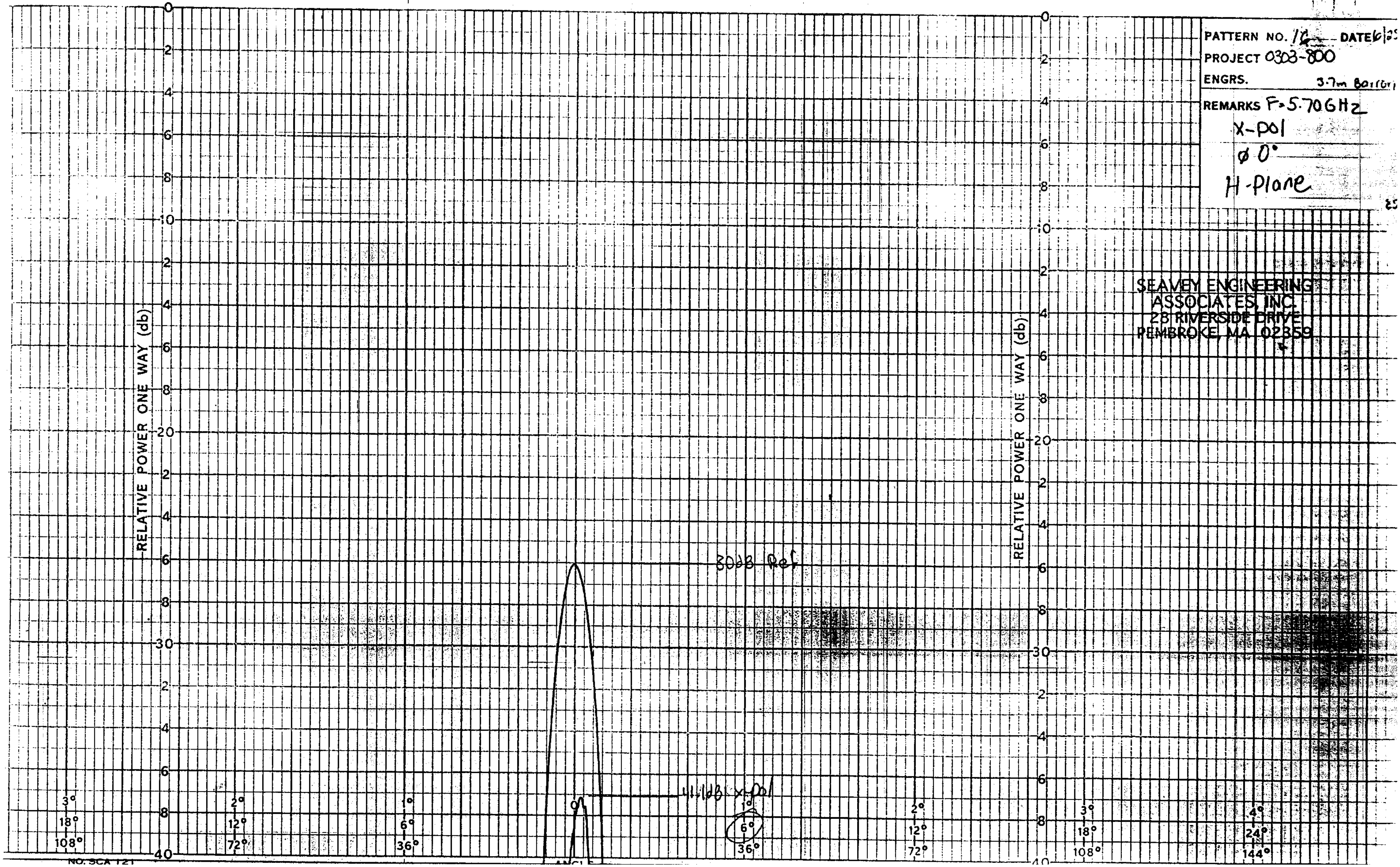
Specification ____

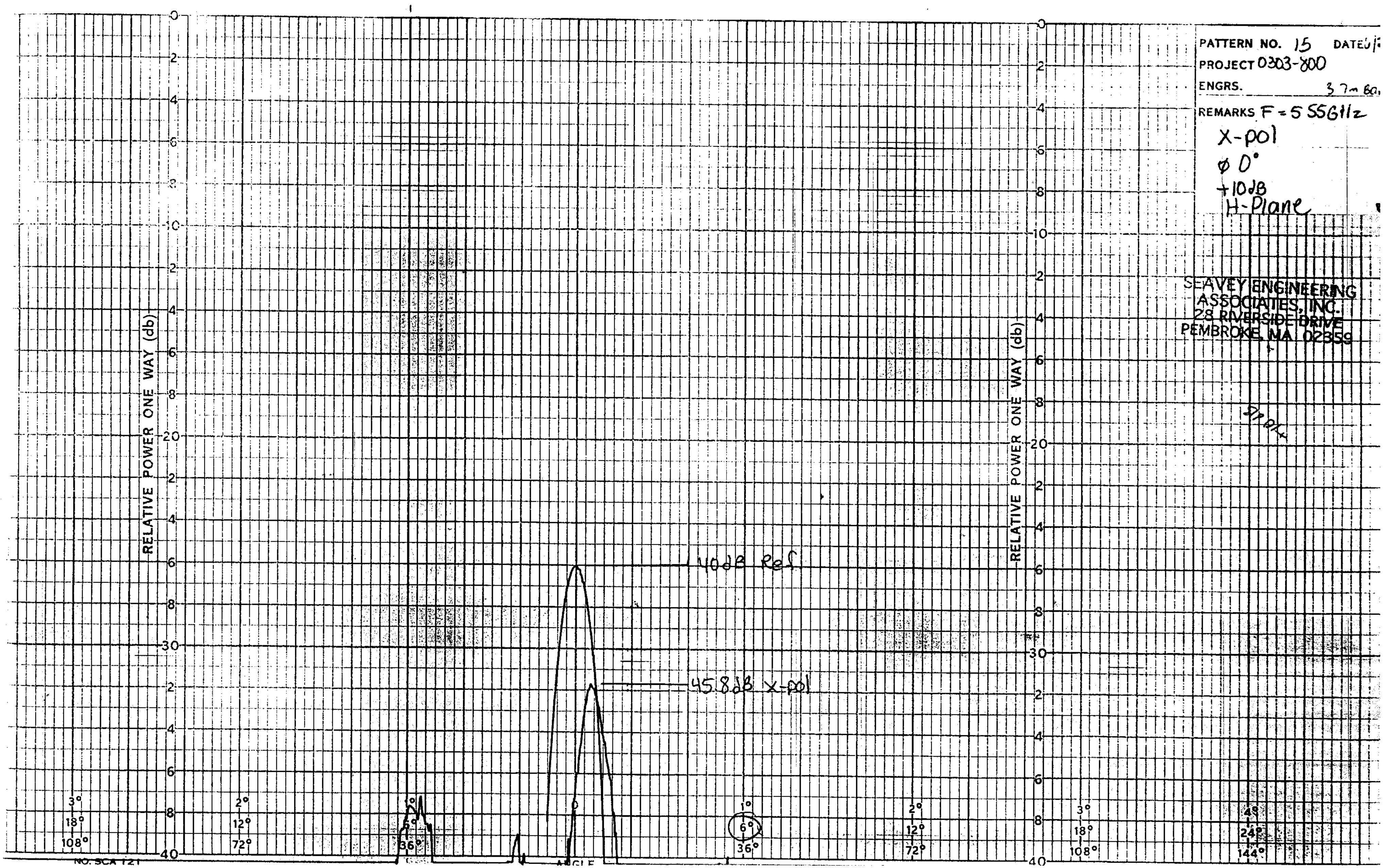
Inspector ____

Report No. 0303-700

Figure No. 18

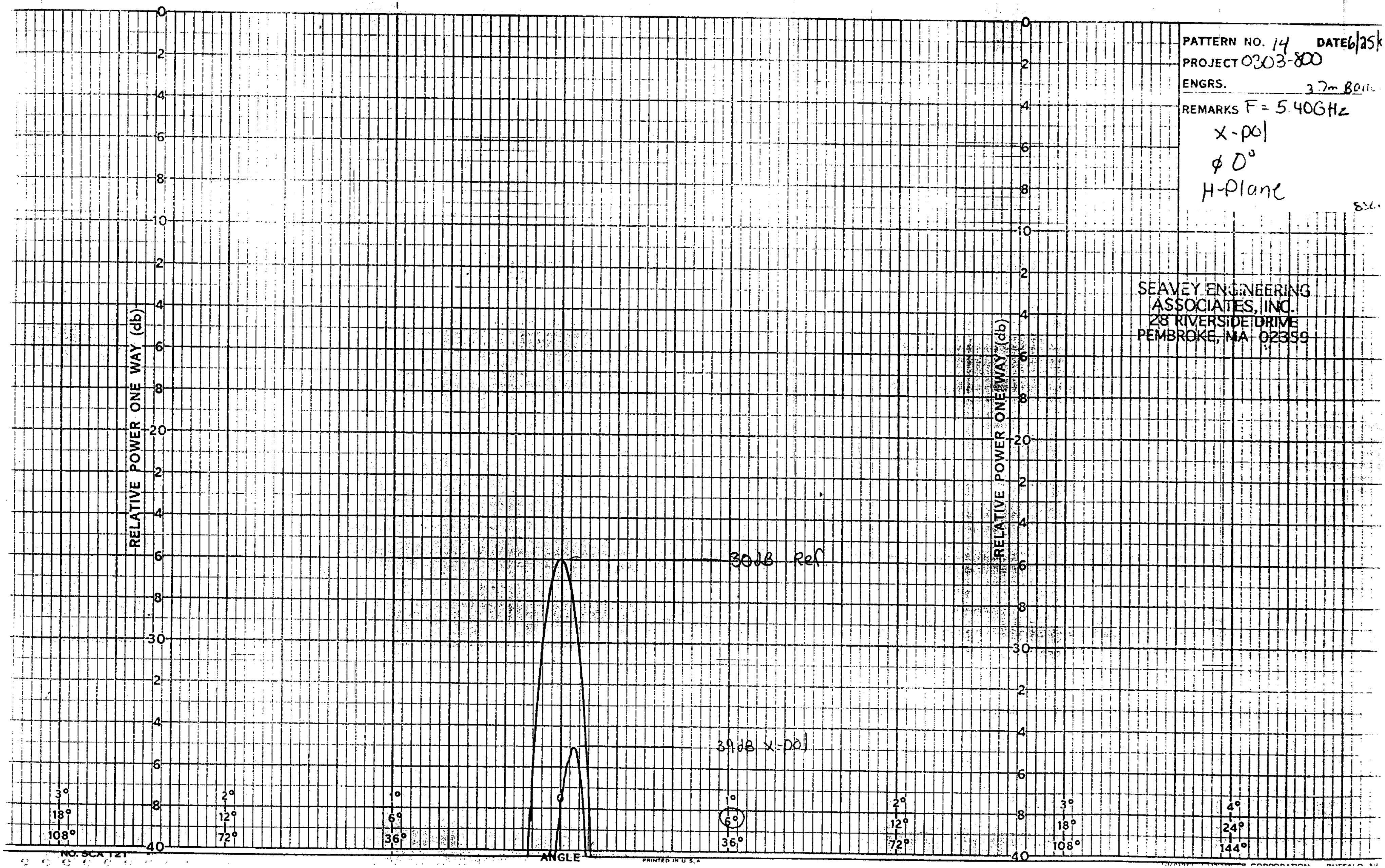
SEAVEY ENGINEERING ASSOCIATES, INC.
ANTENNA DESIGN AND DEVELOPMENT

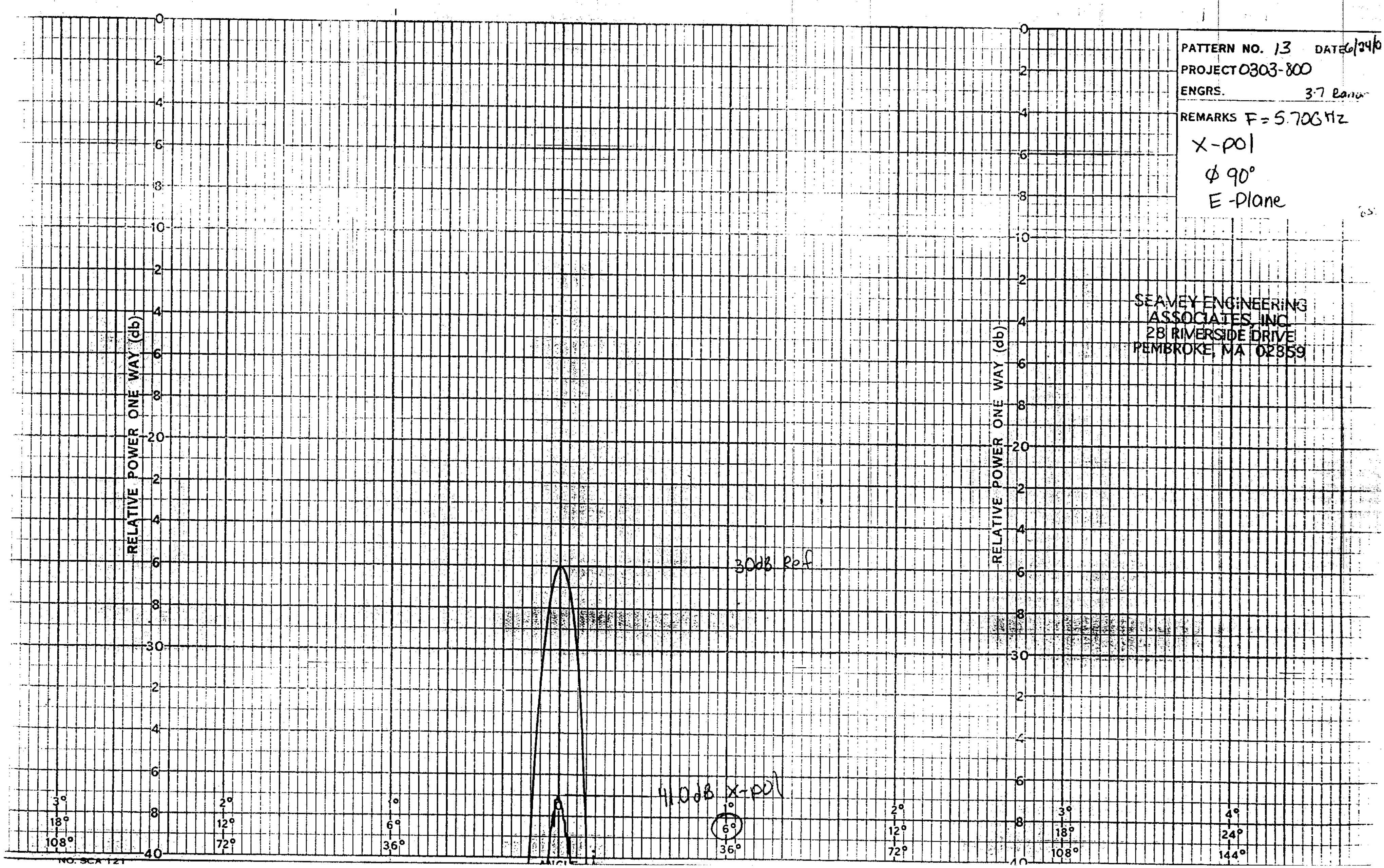

PATTERN NO. 16 DATE 6/25
PROJECT 0303-800
ENGRS. 3.7m Boi(Gr)
REMARKS F=5.70GHz
X-Pol
φ 0°
H-Plane
SEAVEY ENGINEERING ASSOCIATES, INC.
28 RIVERSIDE DRIVE
PEMBROKE, MA 02359
RELATIVE POWER ONE WAY (db)
30dB Ref
41.1dB X-Pol
NO. SCA 121



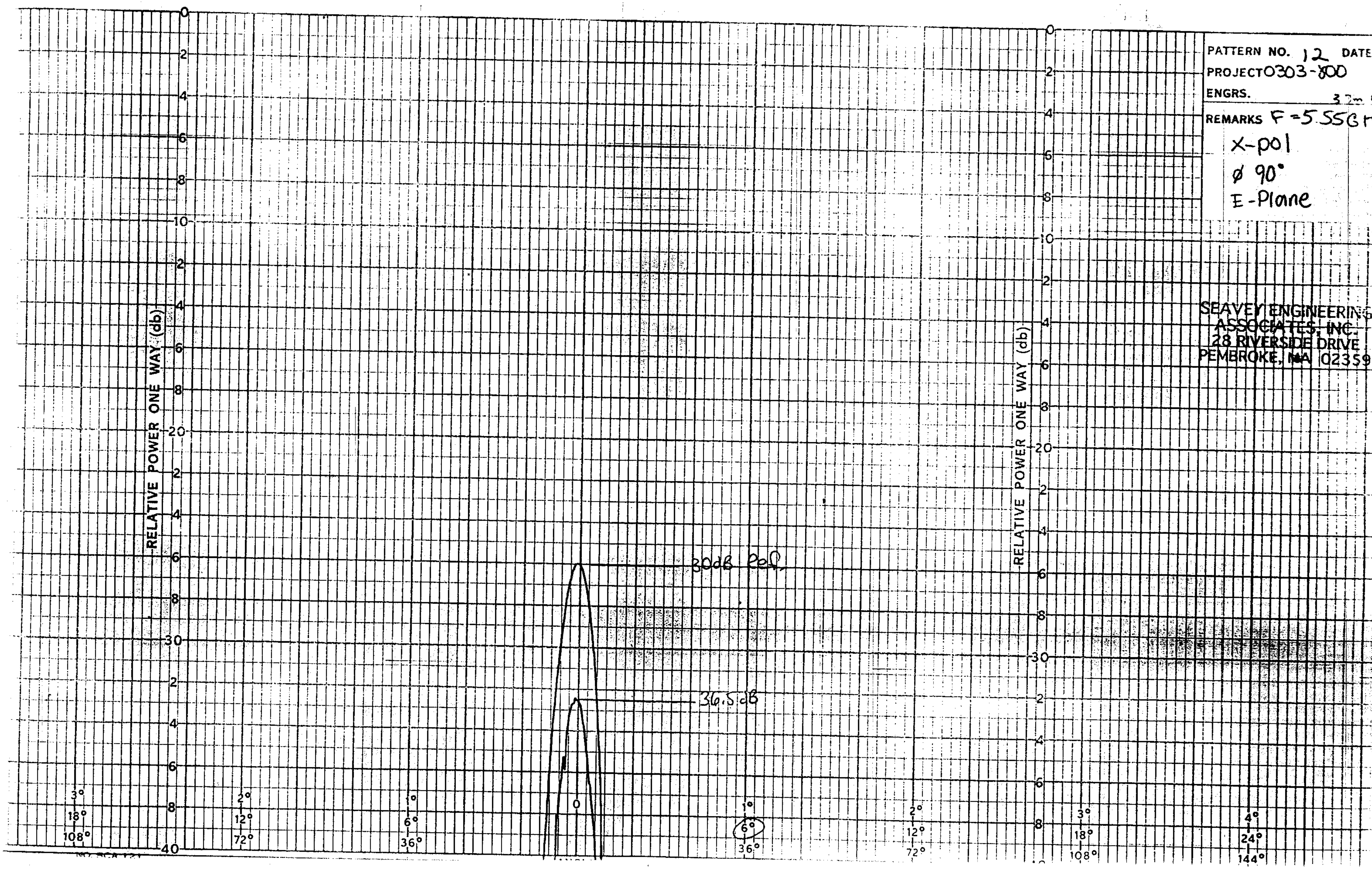
PATTERN NO. 15
DATE
PROJECT 0303-800
ENGRS.
3-7-80
REMARKS F = 5.55GHz
X-pol
φ 0°
+10dB
H-Plane
SEAVEY ENGINEERING
ASSOCIATES, INC.
28 RIVERSIDE DRIVE
PEMBROKE, MA 02359
RELATIVE POWER ONE WAY (db)
40dB Ref
45.8dB X-pol
ANGLE
NO. SCA 121

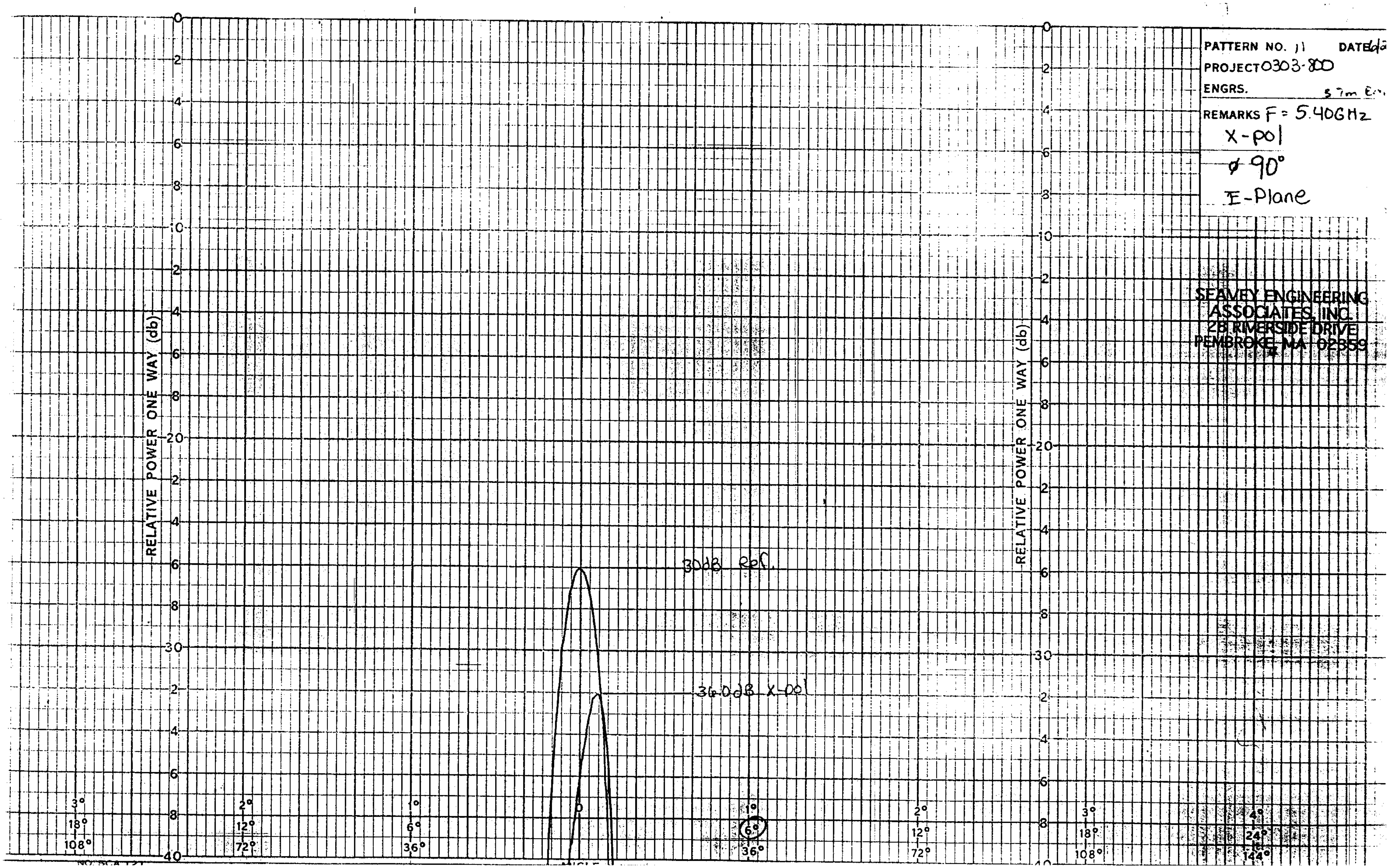
PATTERN NO. 14 DATE 6/25/k
PROJECT 0303-800
ENGRS. 3.7m 800
REMARKS F = 5.40GHz
X-pol
φ 0°
H-Plane

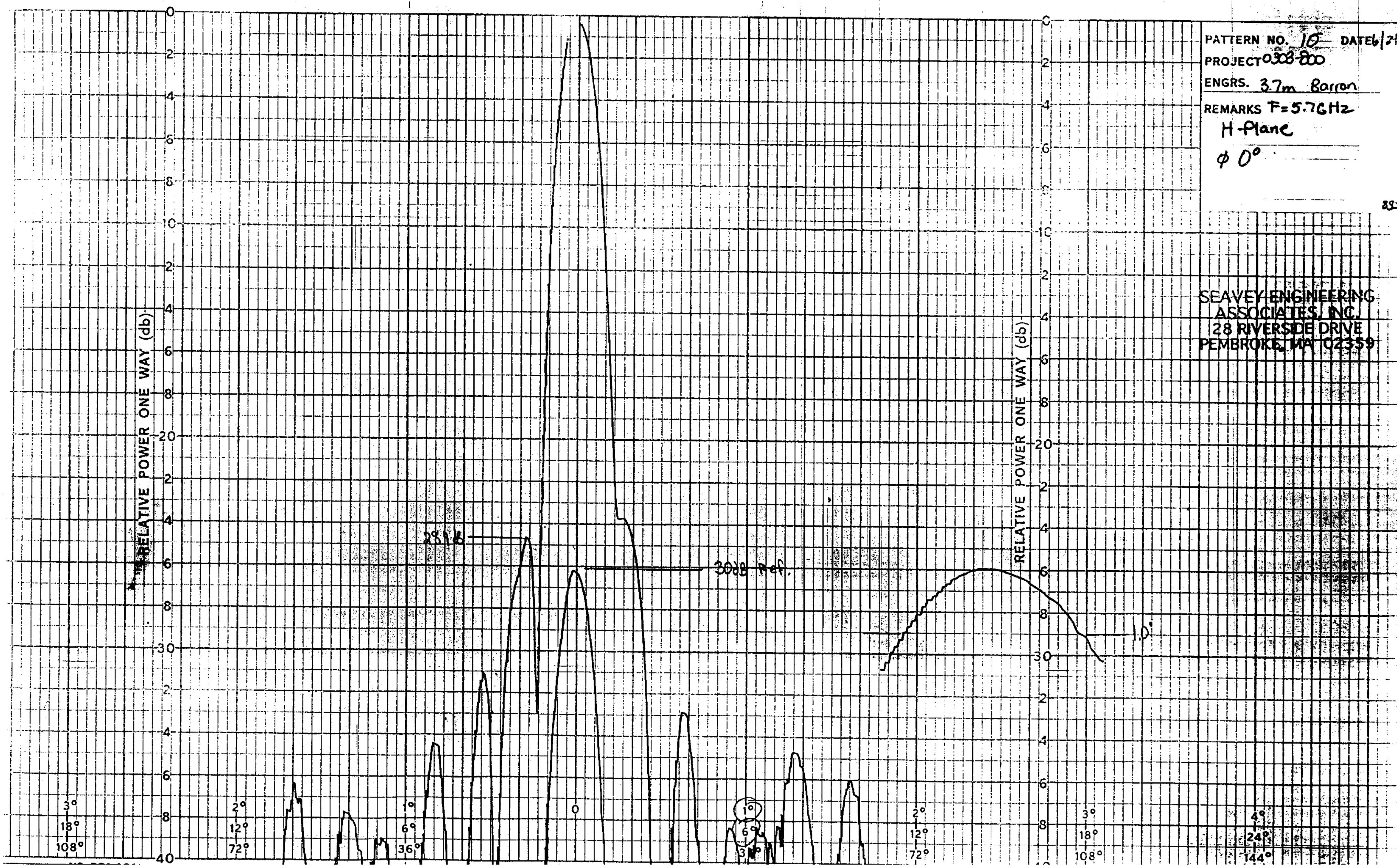




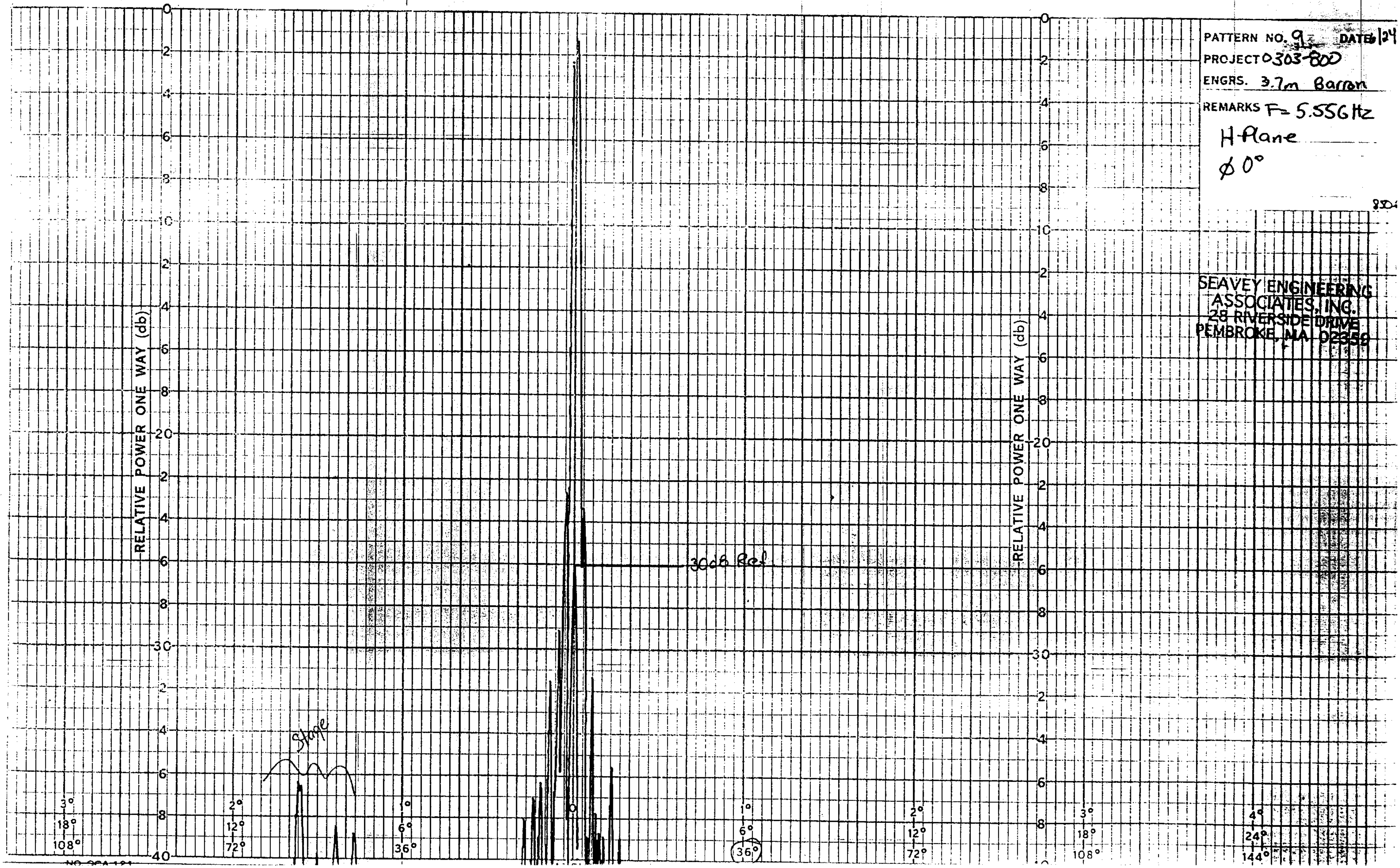
PATTERN NO. 13 DATE 6/24/0
PROJECT 0303-800
ENGRS. 3-7 Band
REMARKS F = 5.7GHz
X-pol
φ 90°
E-Plane
SEAVEY ENGINEERING ASSOCIATES, INC. 28 RIVERSIDE DRIVE PEMBROKE, MA 02359
RELATIVE POWER ONE WAY (db)
30dB Ref
41.0dB X-pol
NO. SCA 121

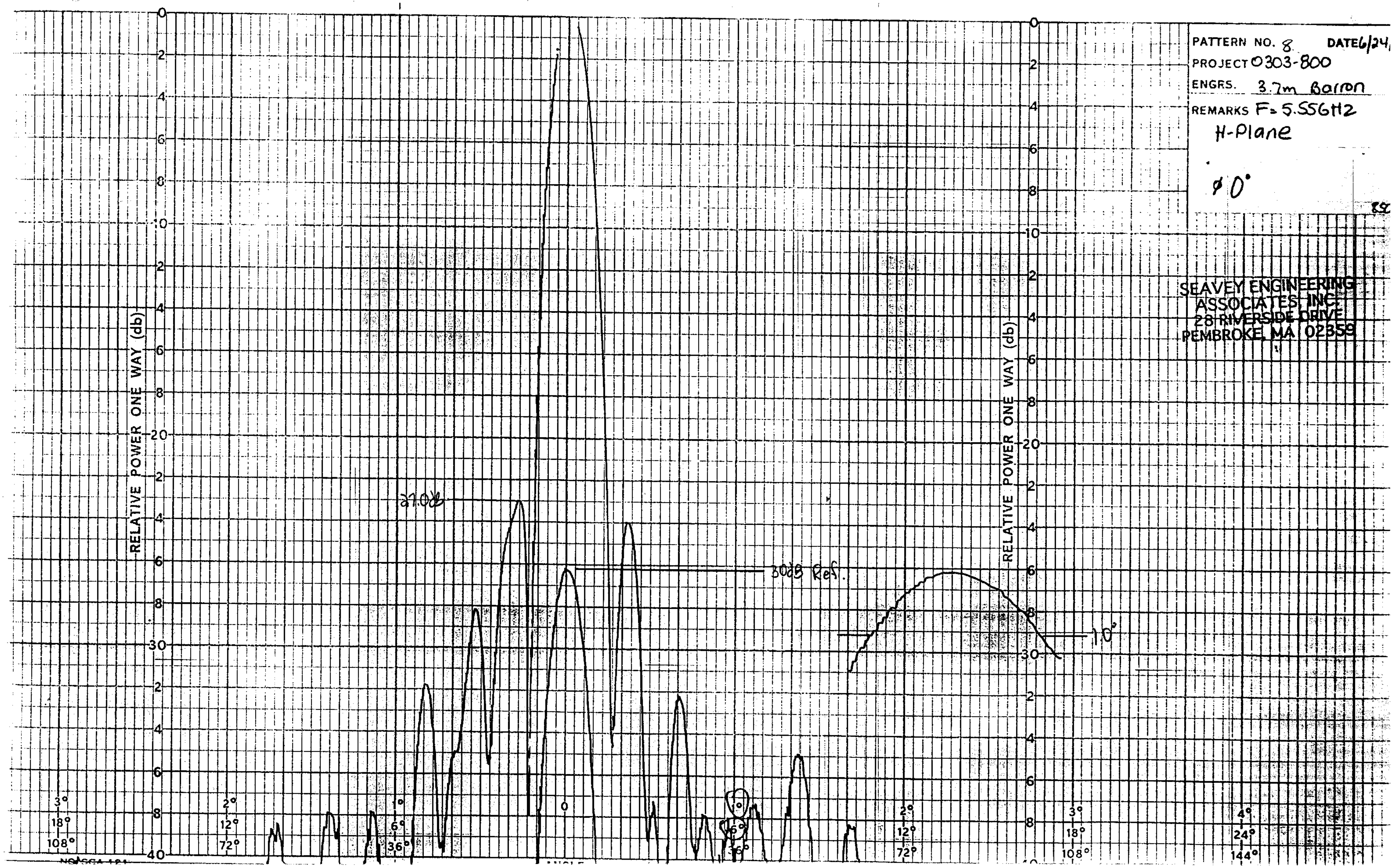

PATTERN NO. 12 DATE
PROJECT 0303-800
ENGRS.
REMARKS F = 5.55 GHz
X-pol
ø 90°
E-Plane
SEAVEY ENGINEERING ASSOCIATES, INC.
28 RIVERSIDE DRIVE
PEMBROKE, MA 02359
RELATIVE POWER ONE WAY (db)
30dB Ref.
36.5dB
0
1° 6° 36°
2° 12° 72°
3° 18° 108°
4° 24° 144°


PATTERN NO. 11
DATE
PROJECT 0303-800
ENGRS.
REMARKS F = 5.40GHz
X-pol
ϕ 90°
E-Plane
SEAVEY ENGINEERING ASSOCIATES, INC.
28 RIVERSIDE DRIVE
PEMBROKE, MA 02359
RELATIVE POWER ONE WAY (db)
30dB Ref.
36.0dB X-pol



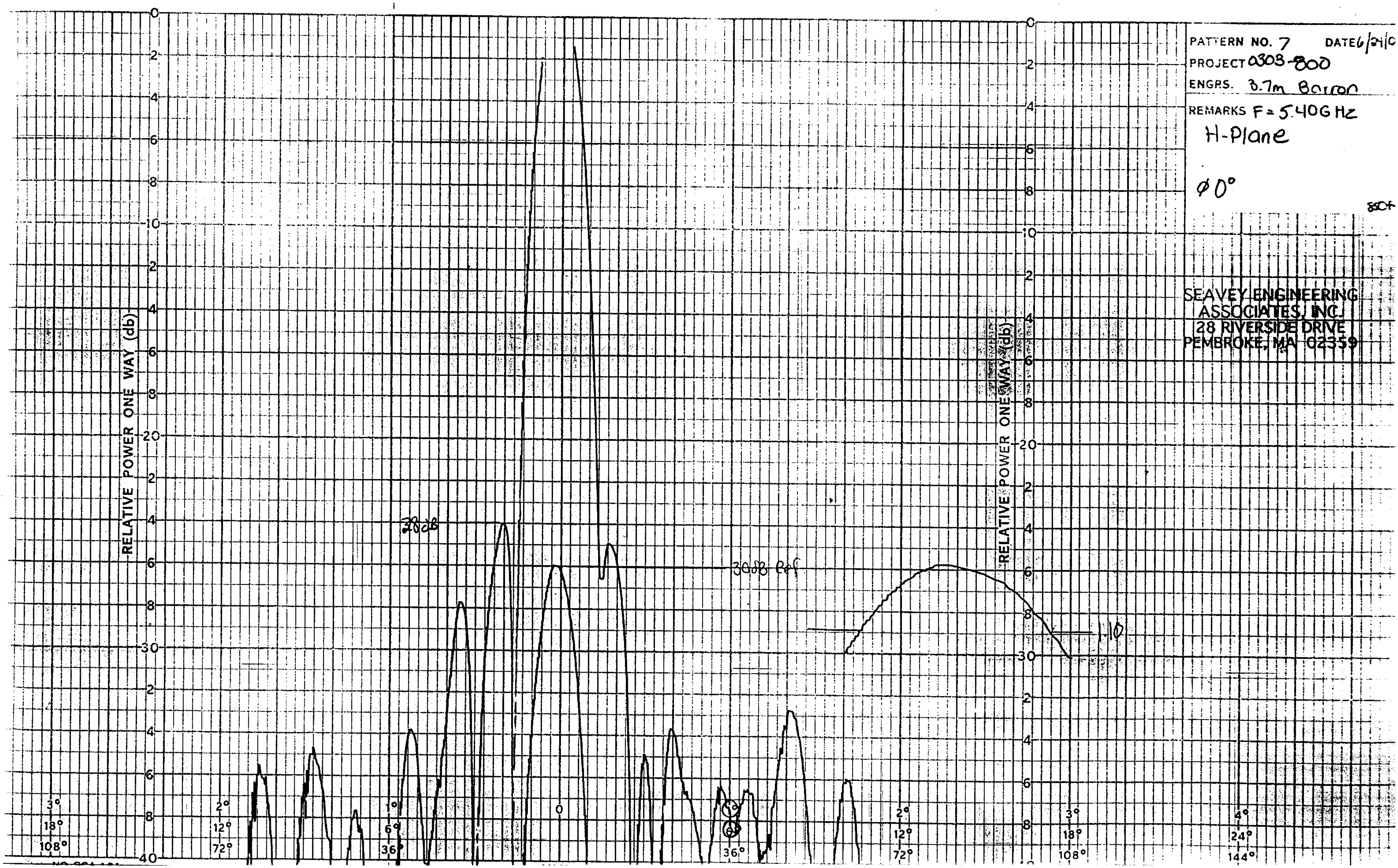
PATTERN NO. 10 DATE 6/21
PROJECT 0308-800
ENGRS. 3.7m Barron
REMARKS F=5.7GHz
H-Plane
φ 0°
SEAVEY ENGINEERING ASSOCIATES, INC.
28 RIVERSIDE DRIVE
PEMBROKE, MA 02359
RELATIVE POWER ONE WAY (db)
28 dB
30dB Ref.
1.0°


PATTERN NO. 9 DATE 6/24
PROJECT 0303-800
ENGRS. 3.7m Barron
REMARKS F= 5.55GHz
H-Plane
ϕ 0°
SEAVEY ENGINEERING ASSOCIATES, INC.
28 RIVERSIDE DRIVE
PEMBROKE, MA 02359
RELATIVE POWER ONE WAY (db)
30dB Ref
Stage
NO. SEA-121

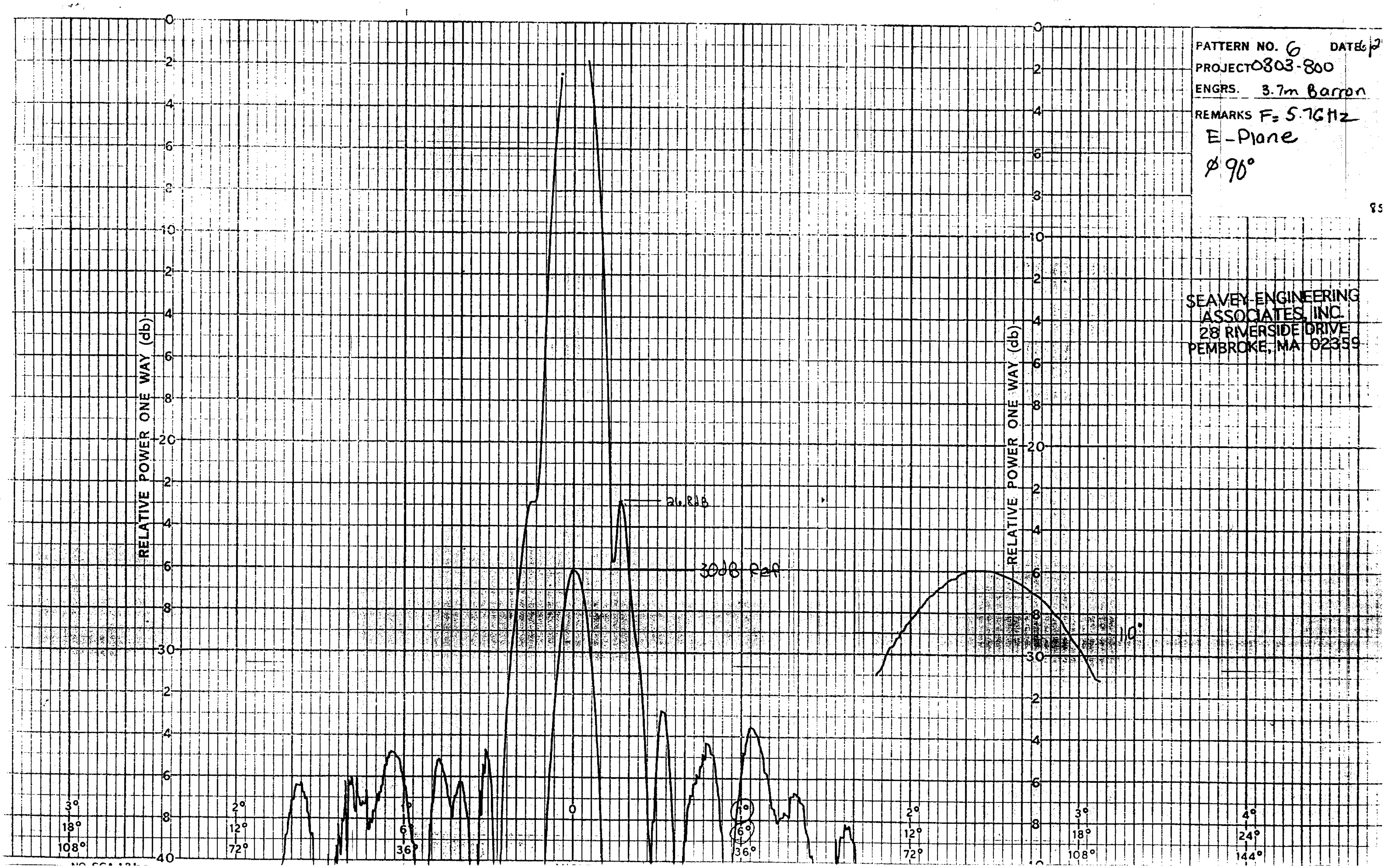


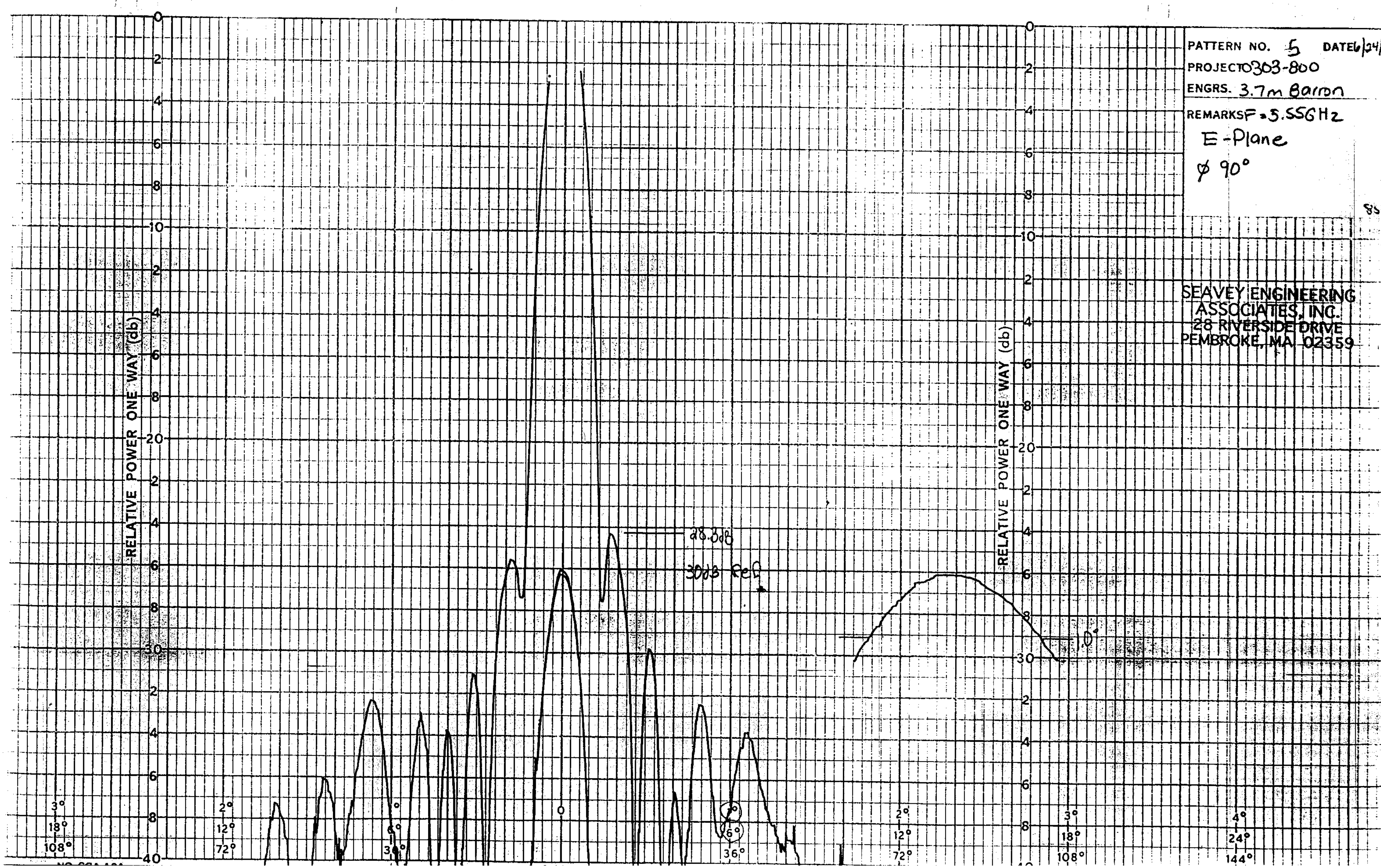
PATTERN NO. 8 DATE 6/24
PROJECT 0303-800
ENGRS. 3.7m Barron
REMARKS F= 5.5GHz
H-Plane
φ 0°

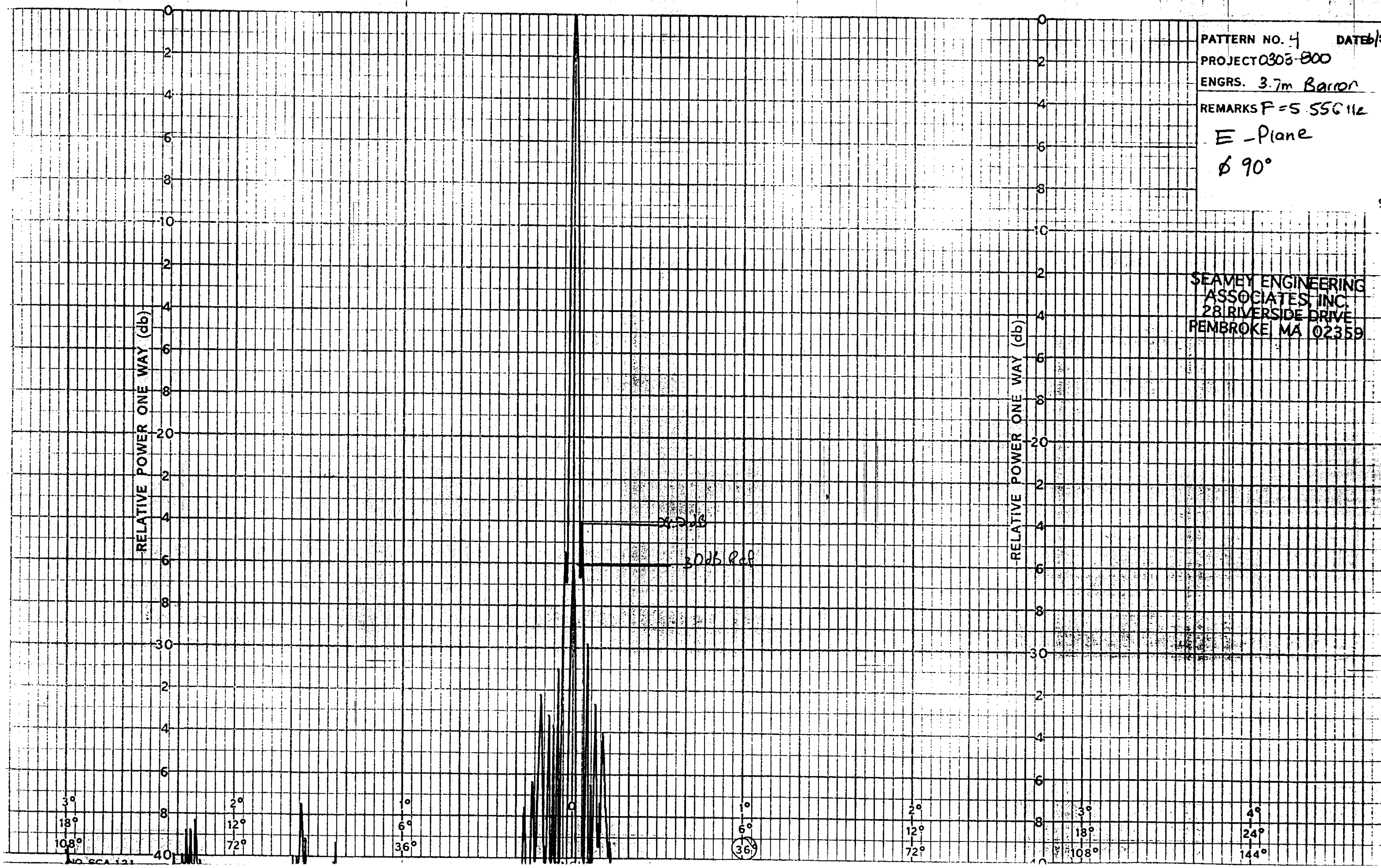
SEAVEY ENGINEERING
ASSOCIATES, INC.
28 RIVERSIDE DRIVE
PEMBROKE, MA 02359

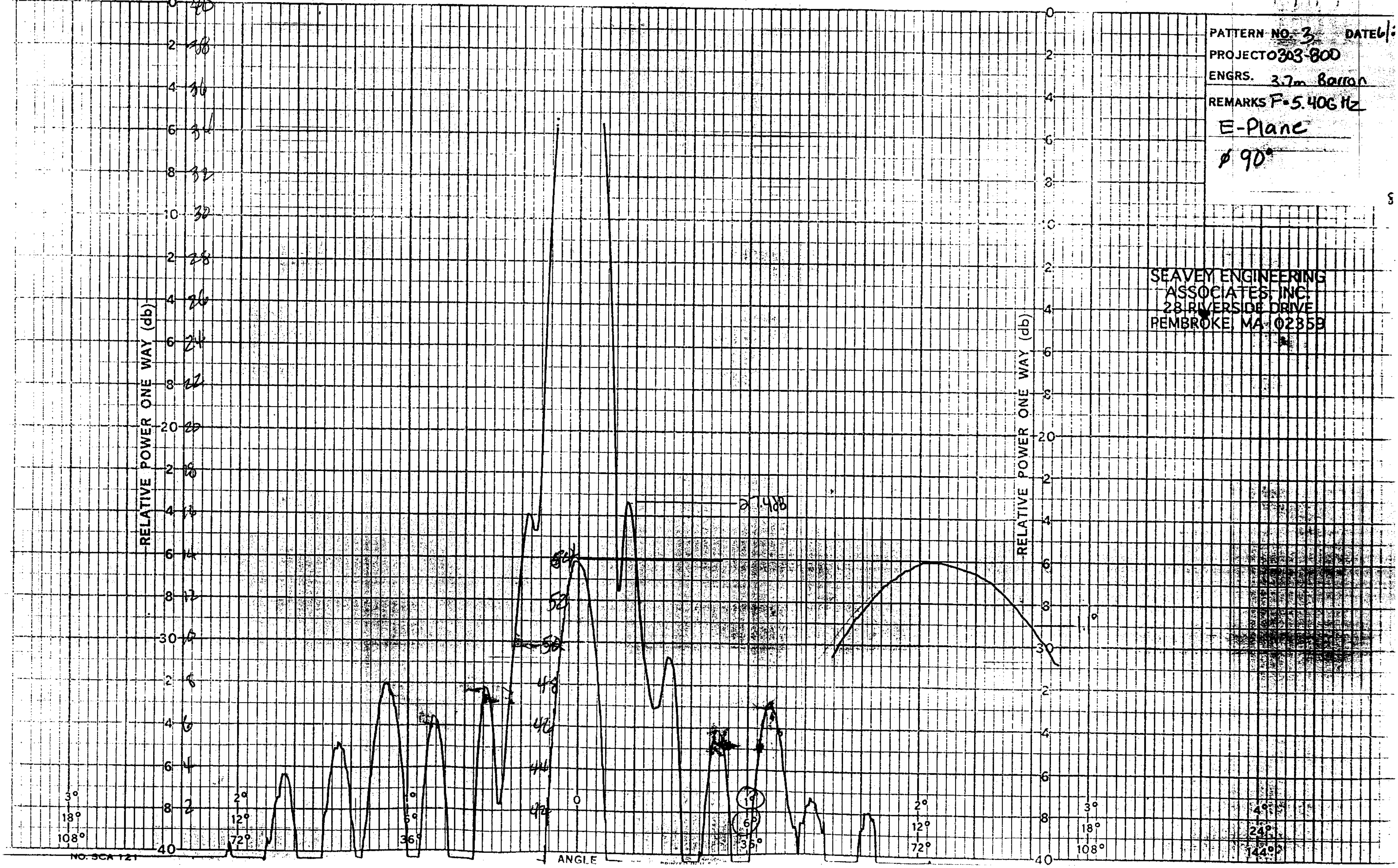


PATTERN NO. 7
DATE 6/24/10
PROJECT 0303-800
ENGRS. 3.7m Barron
REMARKS F = 5.40GHz
H-Plane
ϕ 0°
SEAVEY ENGINEERING ASSOCIATES, INC.
28 RIVERSIDE DRIVE
PEMBROKE, MA 02359
RELATIVE POWER ONE WAY (db)
RELATIVE POWER ONE WAY (db)
28dB
30dB Ref
1.10


PATTERN NO. 6
DATE 6/2
PROJECT 0803-800
ENGRS. 3.7m Barron
REMARKS F= 5.76Hz
E-Plane
ø 90°
SEAVEY ENGINEERING ASSOCIATES, INC.
28 RIVERSIDE DRIVE
PEMBROKE, MA 02359
RELATIVE POWER ONE WAY (db)
26.8dB
30dB Ref
10°


PATTERN NO. 5 DATE 6/24/0
PROJECT 0303-800
ENGRS. 3.7m Barron
REMARKS F = 3.55GHz
E-Plane
ϕ 90°
SEAVEY ENGINEERING ASSOCIATES, INC.
28 RIVERSIDE DRIVE
PEMBROKE, MA 02359
RELATIVE POWER ONE WAY (db)
28.3dB
30dB Ref
0°
36°
72°
108°
144°


PATTERN NO. 4
DATE 6/04
PROJECT 0303-800
ENGRS. 3.7m Barron
REMARKS F=5.556Hz
E-Plane
ϕ 90°
SEAVEY ENGINEERING ASSOCIATES, INC.
28 RIVERSIDE DRIVE
PEMBROKE, MA 02359
RELATIVE POWER ONE WAY (db)
30db Ref


PATTERN NO. 3 DATE 6/
PROJECT 0303-800
ENGRS. 3.7m Barron
REMARKS F=5.40GHz
E-Plane
ϕ 90°
SEAVEY ENGINEERING
ASSOCIATES, INC.
28 RIVERSIDE DRIVE
PEMBROKE, MA 02359
RELATIVE POWER ONE WAY (db)
ANGLE
27.4dB
NO. SCA 121


PATTERN NO. 2
PROJECT 0303-800
ENGRS.
REMARKS F=5.60-5.75
GAIN
STD Narda 643
WR-187
F=5.70GHz
STD 17.65
PAD 26.00
43.65
.90
44.55 DBil
STD Narda 643
WR-187
AUT@ 5.70GHz
F=5.60GHz
STD 17.50
PAD 26.00
43.50
1.00
44.50 DBil
STD Narda 643
WR-187
AUT@ 5.60GHz
RELATIVE POWER ONE WAY (db)
NO. SCA 121

7.2 Antenna-Focusing Technique

For some test situations it is difficult or impractical to measure antenna characteristics using far-field-range techniques. A technique that can be used to measure the far-field antenna pattern at reduced ranges is that of focusing the test antenna at the range at which the measurement will be made [16], [31]. This approach is limited to those test antennas which are provided with a means of changing their focus from infinity to a finite distance. This can usually be accomplished with phased arrays and reflector-type antennas. Considerable work has been done with paraboloidal reflector antennas, since they are the most common of the large antennas. The geometry for the use of ray optics in establishing the focusing of a parabola is shown in Fig 30. When the feed antenna is located at point F, the antenna is focused at infinity. By moving the feed to position F', the rays are brought into a quasi-focus at F''. It is not a true focus since the reflector shape is paraboloidal rather than ellipsoidal, which is required for two finite foci.

The required distance ε that the feed shall be moved can be determined by ray tracing and is expressed approximately as

$$\varepsilon \cong \frac{1}{R}\ f^2 + \left(\frac{D}{4}\right)^2$$

where R is the distance $0F''$, f is the distance $0F$ and ϵ is the distance FF' as shown in Fig 30. Once the feed is moved to point F', the antenna's radiation pattern is measured at a range R. After testing the feed is returned to its original position at point F. For ranges as short as $D^2/8\lambda$ the measurement will yield a fairly accurate description of the main lobe of the far-field pattern of the antenna focused at infinity; however, the side lobe description will be in error. An improvement can be made by making a fine adjustment of the feed about point F'. One approach is to adjust the position of the feed for a maximum depth of the first null. This yields a better description of the main lobe. However, if the power gain is measured on the focused antenna at range R, it will be low by several tenths of a decibel as compared to a far-field measurement. Another approach is to adjust the feed for the maximum power gain in the direction of the peak of the main lobe of the focused test antenna as measured at a range R. This will yield a slight improvement in the measurement of power gain over that which would be obtained using the maximum depth of the first null criterion. Despite these shortcomings this method has been found to be very useful.

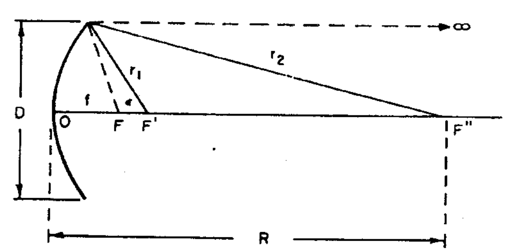


Figure 30