

S.O. 22739

Report of Test 6016-3/2-DA

for

BOARD OF TRUSTEES OF THE UNIV. OF NC

WUND-FM 88.9 MHZ MANTEO, NC

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6016-3/2-DA to meet the needs of WUND-FM and to comply with the requirements of the FCC construction permit, file number BMPED-20011102ABW.

RESULTS:

The measured azimuth pattern for the 6016-3/2-DA is shown in Figure 1. Figure 1A shows the Tabulation of the Horizontal Polarization. Figure 1B shows the Tabulation of the Vertical Polarization. The calculated elevation pattern of the antenna is shown in Figure 3. Construction permit file number BMPED-20011102ABW indicates that the Horizontal radiation component shall not exceed 50 kW at any azimuth and is restricted to the following values at the azimuths specified:

10 Degrees T: 1.60 kW

170 Degrees T: 2.80 kW

From Figure 1, the maximum radiation of the Horizontal component occurs at 100 Degrees T to 108 Degrees T. At the restricted azimuth of 10 Degrees T the Horizontal component is 17.08 dB down from the maximum of 50 kW, or 1.0 kW. At the restricted azimuth of 170 Degrees T the Horizontal component is 12.58 dB down from the maximum of 50 kW, or 2.76 kW.

The R.M.S. of the Horizontal component is 0.560. The total Horizontal power gain is 5.574. The R.M.S. of the Vertical component is 0.530. The total Vertical power gain is 5.246. See Figure Four for calculations. The R.M.S. of the FCC composite pattern is 0.660. Therefore this Pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6016-3/2-DA was mounted on a tower of exact scale to a Stainless G-10 tower. The spacing of the antenna to the tower was varied to achieve both the horizontal and vertical pattern shown in Figure 1. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BMPED-20011102ABW, a single level of the 6016-3/2-DA was set up on the Howell Laboratories scale model antenna pattern measuring range. A scale of 4.5:1 was used.

SUPERVISION:

Mr. Surette was graduated from Lowell Technological Institute, Lowell, Massachusetts in 1973 with the degree of Bachelor of Science in Electrical Engineering. He has been directly involved with design and development of broadcast antennas, filter systems and RF transmission components since 1974, as an RF Engineer for six years with the original Shively Labs in Raymond, ME and for a short period of time with Dielectric Communications. He is currently an Associate Member of the AFCCE and a Senior Member of IEEE. He has authored a chapter on filters and combining systems for the latest edition of the CRC Electronics Handbook and for the 9th Edition of the NAB Handbook.

EQUIPMENT:

The scale model pattern range consists of a wooden rotating pedestal equipped with a position indicator. The scale model bay is placed on the top of this pedestal and is used in the transmission mode at approximately 20 feet above ground level. The receiving corner reflector is spaced 50 feet away from the rotating pedestal at the same level above ground as the transmitting model. The transmitting and receiving signals are carried to a control building by means of RG-9/U double shielded coax cable.

The control building is equipped with:

Hewlett Packard Model 8753 Network Analyzer

PC Based Controller

Hewlett Packard 7550A Graphics Plotter

The test equipment is calibrated to ANSI/NCSL Z540-1-1994.

TEST PROCEDURES:

The corner reflector is mounted so that the horizontal and vertical azimuth patterns are measured independently by rotating the corner reflector by 90 degrees. The network analyzer was set to 400.05 MHz. Calibrated pads are used to check the linearity of the measuring system. For example, 6 dB padding yields a scale reading of 50 from an unpadded reading of 100 in voltage. From the recorded patterns, the R.M.S. values are calculated and recorded as shown in Figure 1.

Respectfully submitted by:



Robert A. Surette
Manager of RF Engineering
S/O 22739
May 21, 2003

Figure 1A

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TABULATION OF HORIZONTAL POLARIZATION
WUND-FM MANTEO, NC

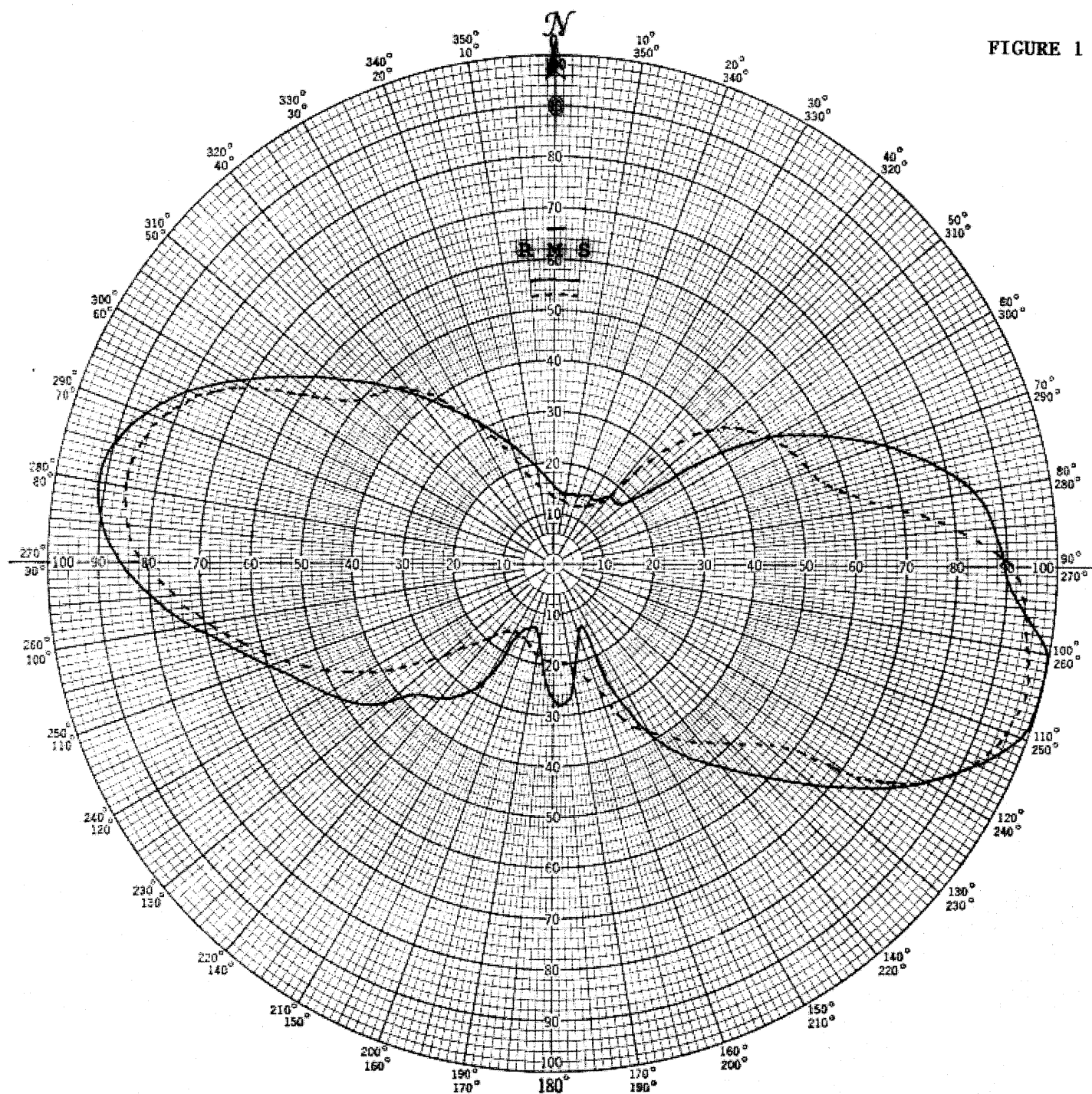
DEGREE	RELATIVE FIELD	DEGREE	RELATIVE FIELD
0	0.155	180	0.270
10	0.140	190	0.150
20	0.145	200	0.130
30	0.150	210	0.260
40	0.175	220	0.350
45	0.175	225	0.370
50	0.180	230	0.430
60	0.505	240	0.515
70	0.690	250	0.600
80	0.845	260	0.730
90	0.890	270	0.855
100	1.000	280	0.915
110	0.990	290	0.860
120	0.850	300	0.715
130	0.680	310	0.565
135	0.595	315	0.500
140	0.525	320	0.430
150	0.390	330	0.330
160	0.135	340	0.250
170	0.235	350	0.195

Figure 1B

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TABULATION OF VERTICAL POLARIZATION
WUND-FM MANTEO, NC

DEGREE	RELATIVE FIELD	DEGREE	RELATIVE FIELD
0	0.135	180	0.190
10	0.125	190	0.180
20	0.120	200	0.160
30	0.130	210	0.155
40	0.180	220	0.190
45	0.330	225	0.235
50	0.405	230	0.295
60	0.495	240	0.430
70	0.540	250	0.565
80	0.670	260	0.690
90	0.915	270	0.810
100	0.955	280	0.860
110	0.960	290	0.825
120	0.850	300	0.690
130	0.550	310	0.500
135	0.495	315	0.475
140	0.460	320	0.450
150	0.380	330	0.330
160	0.270	340	0.215
170	0.205	350	0.160

FIGURE 1



Shively Labs

PROJECT NAME WUND-FM MANTEO, NC

PROJECT NUMBER 22739 DATE 11/6/02

MODEL (X) FULL SCALE () FREQUENCY 400.05/88.9 MHz

POLARIZATION HORIZ (—); VERT (----)

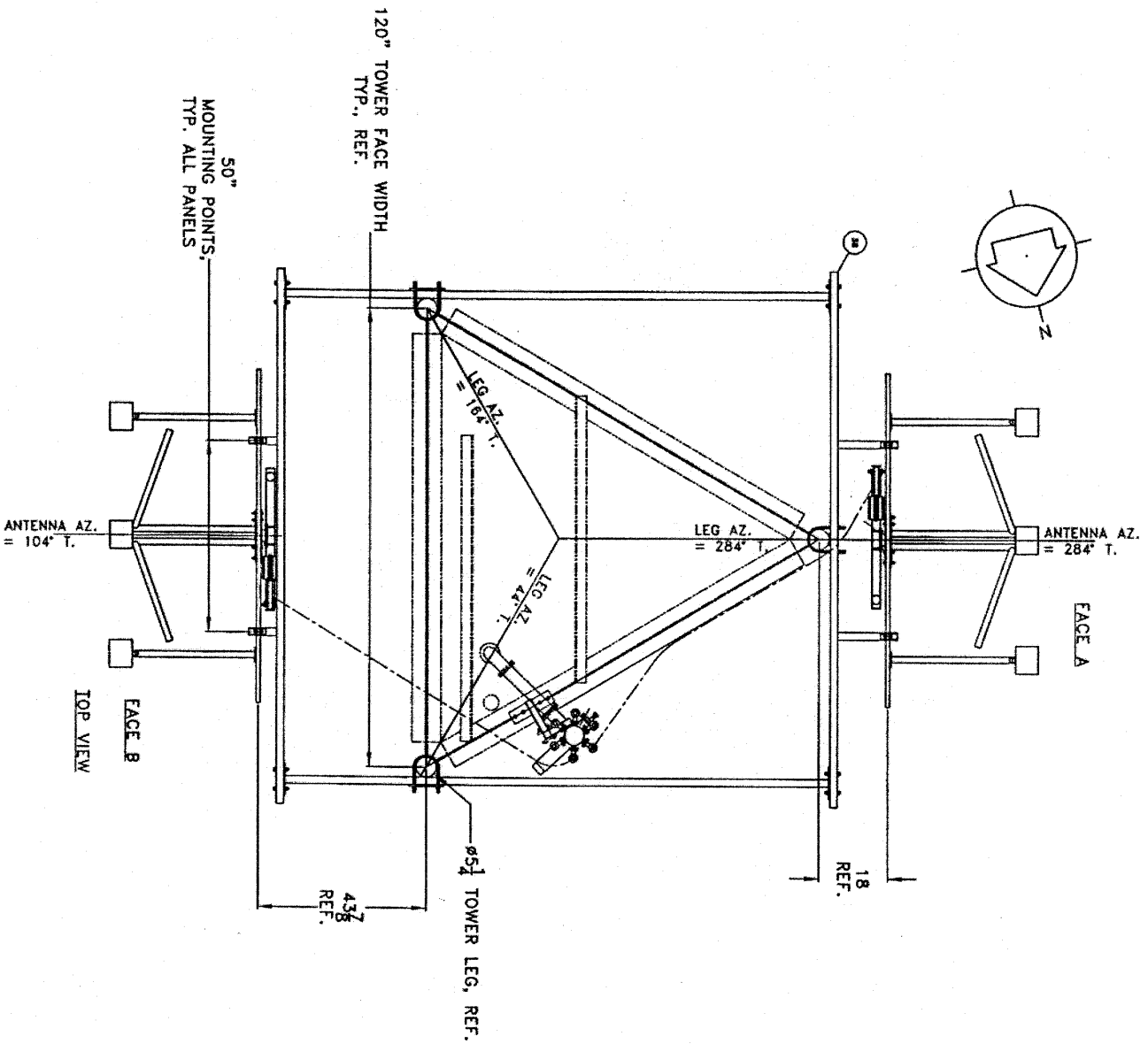
CURVE PLOTTED IN: VOLTAGE (X) POWER () DB ()

OBSERVER RAS

ANTENNA TYPE 6016-3/2-DA

PATTERN TYPE DIRECTIONAL AZIMUTH

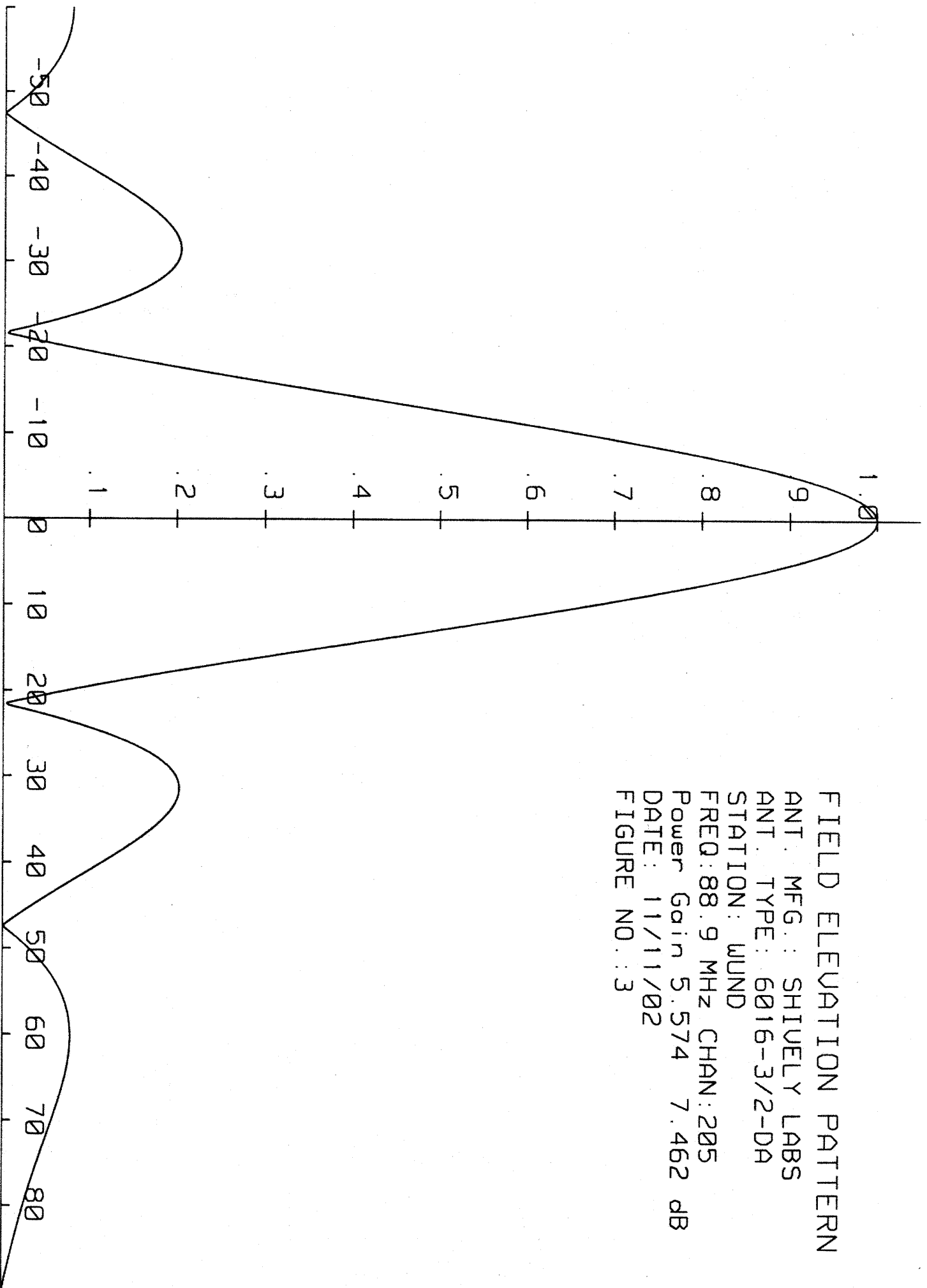
REMARKS: SEE FIGURE 2 FOR MECHANICAL
DETAILS



SIDE VIEW OF PANEL

SHIVELY LABS			
A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE			
SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY:
22739	88.9 MHz	N.T.S.	ASP
TITLED:			
MODEL-6016-3/2-DIRECTIONAL ANTENNA			
DATE:			
5/20/03	FIGURE 2		

FIELD ELEVATION PATTERN
ANT. MFG.: SHIVELY LABS
ANT. TYPE: 6016-3/2-DA
STATION: WUND
FREQ: 88.9 MHz CHAN: 205
Power Gain 5.574 7.462 dB
DATE: 11/11/02
FIGURE NO.: 3



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VALIDATION OF GAIN CALCULATION

WUND-FM MANTEO, NC
MODEL 6016-3/2-DA

The RMS values are calculated utilizing the data of a planimeter.

Elevation Gain of Horizontal Component equals 1.755

Elevation Gain of Vertical Component equals 1.560

Input Power Divider Ratio:
Horizontal 49.8% / Vertical 50.2%

Elevation Gain H = $2 \times 1.755 \times 0.498 = 1.748$

Elevation Gain V = $2 \times 1.56 \times 0.502 = 1.566$

Horizontal Azimuth Gain equals $1/(\text{RMS})^2$
 $1/(0.560)^2 = 3.189$

Vertical Azimuth Gain equals $1/(\text{RMS} + \text{Max Vert})^2$
 $1/(0.530 + 0.970)^2 = 3.350$

*** Total Horizontal Gain is Proportioned Elevation Gain times Azimuth Gain**

$1.748 \times 3.189 = 5.574$

*** Total Vertical Gain is Proportioned Elevation Gain times Azimuth Gain**

$1.566 \times 3.350 = 5.246$

ERP divided by Horizontal Gain equals Antenna Input Power
 $50 \text{ kW} \div 5.574 = 8.97 \text{ kW}$

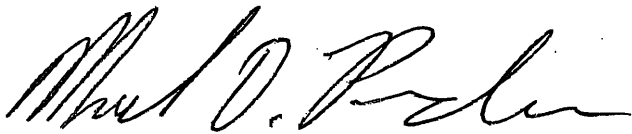
Antenna Input Power times Vertical Gain equals Vertical ERP
 $8.97 \times 5.246 = 47.05 \text{ kW}$

Maximum Value of the Vertical Component squared times the Maximum ERP equals the Vertical ERP
 $(0.970)^2 \times 50 \text{ kW} = 47.04 \text{ kW}$

NOTE: Calculating the ERP of the Vertical Component by two methods validates the total antenna gain calculations

Antenna Orientation Certification

I certify that I am a Professional Land Surveyor licensed in the State of North Carolina, and that I have verified the antenna orientation for WUND-FM. Based on a survey performed by me on 7-16-03 I certify that the WUND-FM antenna is oriented with radiators at bearings of 104 degrees East of True North and 284 degrees East of True North. The orientation conforms to the installation drawings from Shively Labs, shop order 22739, Figure 2.



MARK D. PRUDEN
PROF. LAND SURVEYOR

7-16-03



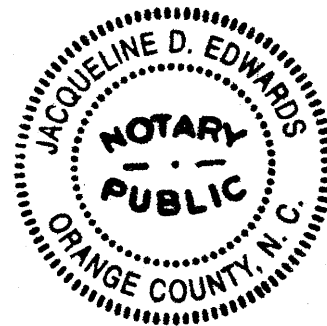
Directional Antenna Installation Certification

In compliance with FCC Regulations, this is to certify that the Shively Labs Model 6016-3/2-DA SN# 1010 directional antenna for Radio Station WUND-FM, Permit No. : BPED-19971120MM, operating at 88.9 Mhz, has been erected according to the design and installation instructions provided by Shively Labs, of Bridgeton Maine.

I David C. Wright, Associate Director of WUNC Radio, supervised the installation of the antenna. I hold FCC license P1-5-17327 and North Carolina General Contractor license with Communications Endorsement #25782. I have been employed by WUNC radio for 21 years and have supervised numerous antenna installations.

By: David C. Wright
David C. Wright

Date: 7/17/03



My Commission Expires May 31, 2004

STATE OF NORTH CAROLINA

COUNTY OF ORANGE

I, Jacqueline D. Edwards, a Notary Public for said County and State, certify that David C. Wright personally came before me this day and acknowledged the execution of the foregoing instrument.

WITNESS my hand and official seal this 17th day of July, 2003.

Jacqueline D. Edwards
Notary Public