Shively Labs
a division of Howell Laboratories,Inc.

P. O. Box 389 Harrison Rd.,
Bridgton, Maine 04009 USA

- An Employee-Owned Company -

(207) 647-3327
888-SHIVELY
Fax: (207) 647-8273
E-mail: sales@shively.com
Web site: www.shively.com

S.O. 22680

Report of Test 6810-2R-SS-DA

for

HAMPSHIRE COUNTY BROADCASTING CO. LTD. PARTNERSHIP

WRNX-FM 100.9 MHZ AMHERST, MASSACHUSETTS

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-2R-SS-DA to meet the needs of WRNX-FM and to comply with the requirements of the FCC's license file number BLH-19930908KA which covers construction permit file number BPH930511ID.

RESULTS:

The measured azimuth pattern for the 6810-2R-SS-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 BPH930511ID indicates that the Horizontal radiation component shall not exceed 1.350 kW at any azimuth and is restricted to the following values at the azimuths specified:

140 Degrees T: 0.227 kW
150 Degrees T: 0.216 kW
160 Degrees T: 0.227 kW

From Figure 1, the maximum radiation of the Horizontal component occurs at 004 Degrees T to 057 Degrees T and at 219 Degrees T to 267 Degrees T. At the restricted azimuth of 140 Degrees T the Vertical component is 8.29 dB down from the maximum of 1.350 kW, or 0.200 kW.

At the restricted azimuth of 150 Degrees T the Vertical component is 8.40 dB down from the maximum of 1.350 kW, or 0.195 kW. At the restricted azimuth of 160 Degrees T the Vertical component is 8.18 dB down from the maximum of 1.350 kW, or 0.205 kW.

The R.M.S. of the Horizontal component is 0.820. The total Horizontal power gain is 1.08. The R.M.S. of the Vertical component is 0.790. The total Vertical power gain is 1.06. See Figure Four for calculations. The R.M.S. of the FCC composite pattern is 0.900. Therefore this Pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6810-2R-SS-DA was mounted on a pole of exact scale to a Prescott Tower 8" pole. The spacing of the antenna to the pole was varied and a vertical parasitic element was attached to the interbay feedline to achieve the vertical pattern shown in Figure 1. A horizontal parasitic element was placed directly under the bay. The position of this horizontal parasitic element was changed until the horizontal pattern shown in Figure 1 was achieved. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BPH930511ID, a single level of the 6810-2R-SS-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.

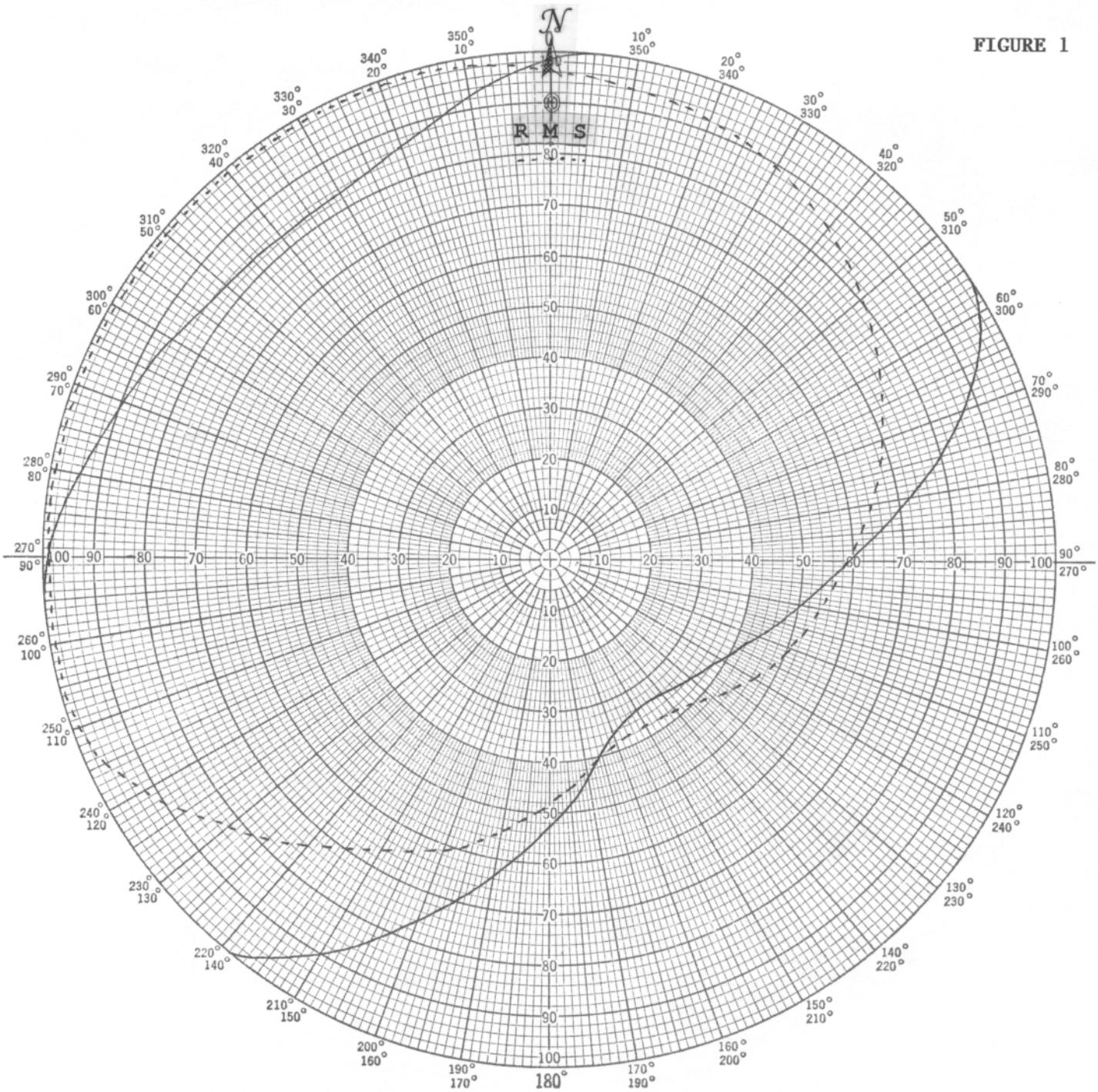
TEST PROCEDURES:

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 454.05 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 22680
October 29, 2002

FIGURE 1



Shively Labs

PROJECT NAME WRNX-FM AMHERST, MA

PROJECT NUMBER 22680 DATE 10/28/02

MODEL (X) FULL SCALE ( ) FREQUENCY 454.05/100.9 MHz

POLARIZATION HORIZ (———); VERT (----)

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

OBSERVER RAS

ANTENNA TYPE 6810-2R-SS-DA

PATTERN TYPE DIRECTIONAL AZIMUTH

REMARKS: SEE FIGURE 2 FOR MECHANICAL DETAILS

Figure 1A

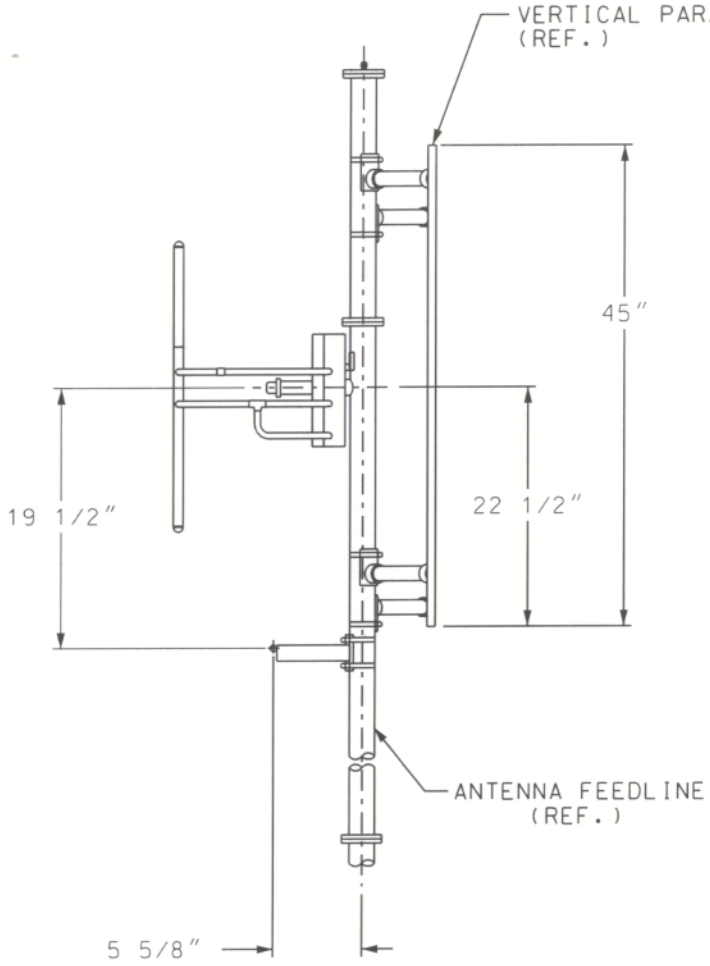
S/O 22680
TABULATION OF HORIZONTAL POLARIZATION
WRNX-FM AMHERST, MA

DEGREE	RELATIVE FIELD	DEGREE	RELATIVE FIELD
0	0.980	180	0.530
10	1.000	190	0.630
20	1.000	200	0.760
30	1.000	210	0.900
40	1.000	220	1.000
45	1.000	225	1.000
50	1.000	230	1.000
60	0.980	240	1.000
70	0.870	250	1.000
80	0.725	260	1.000
90	0.590	270	0.990
100	0.505	280	0.940
110	0.440	290	0.895
120	0.395	300	0.860
130	0.365	310	0.835
135	0.355	315	0.830
140	0.345	320	0.825
150	0.345	330	0.830
160	0.365	340	0.865
170	0.440	350	0.925

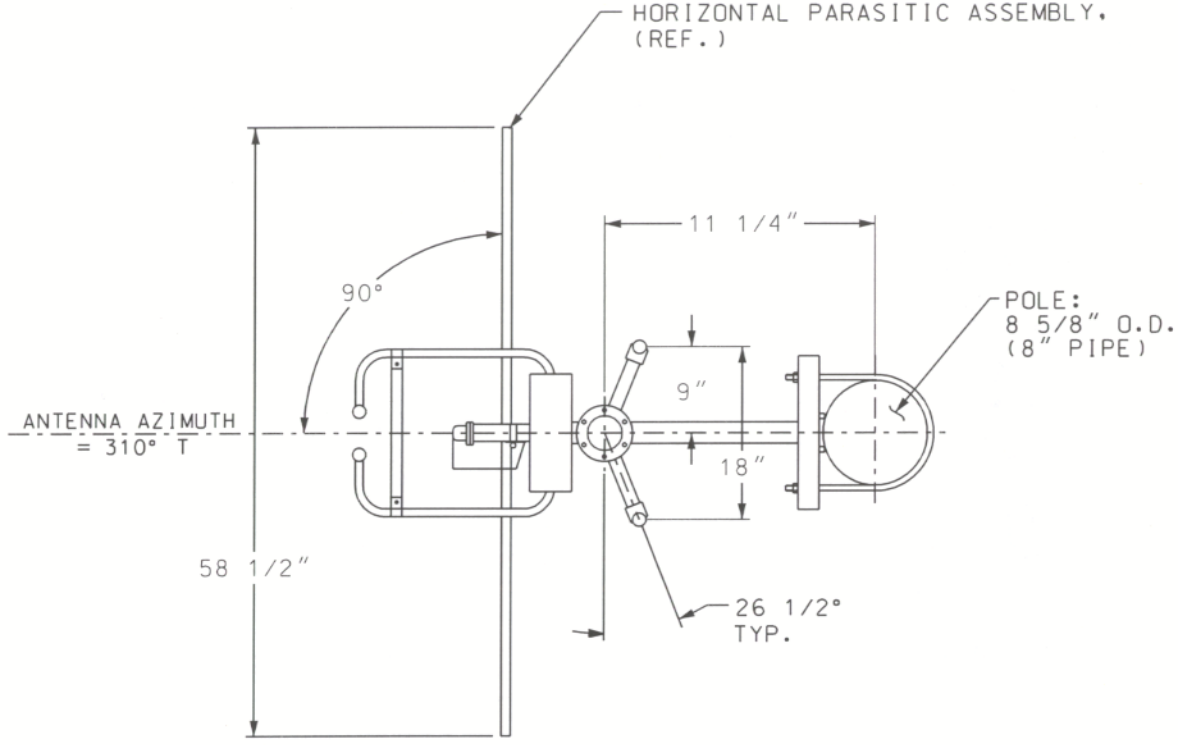
Figure 1B

S/O 22680
TABULATION OF VERTICAL POLARIZATION
WRNX-FM AMHERST, MA

DEGREE	RELATIVE FIELD	DEGREE	RELATIVE FIELD
0	0.965	180	0.480
10	0.940	190	0.545
20	0.920	200	0.610
30	0.895	210	0.660
40	0.855	220	0.740
45	0.830	225	0.785
50	0.805	230	0.825
60	0.750	240	0.920
70	0.700	250	0.985
80	0.645	260	0.990
90	0.590	270	0.990
100	0.545	280	0.990
110	0.505	290	0.990
120	0.470	300	0.990
130	0.420	310	0.990
135	0.400	315	0.990
140	0.385	320	0.990
150	0.380	330	0.990
160	0.390	340	0.990
170	0.420	350	0.985



SIDE VIEW



TOP VIEW

SHIVELY LABS A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE			
SHOP ORDER: 22,680	FREQUENCY: 100.9 MHz	SCALE: N.T.S.	DRAWN BY: ASP APPROVED BY:
TITLE: MODEL-6810-2R-SS DIRECTIONAL ANTENNA			
DATE: 10/10/02	**FIGURE 2**		

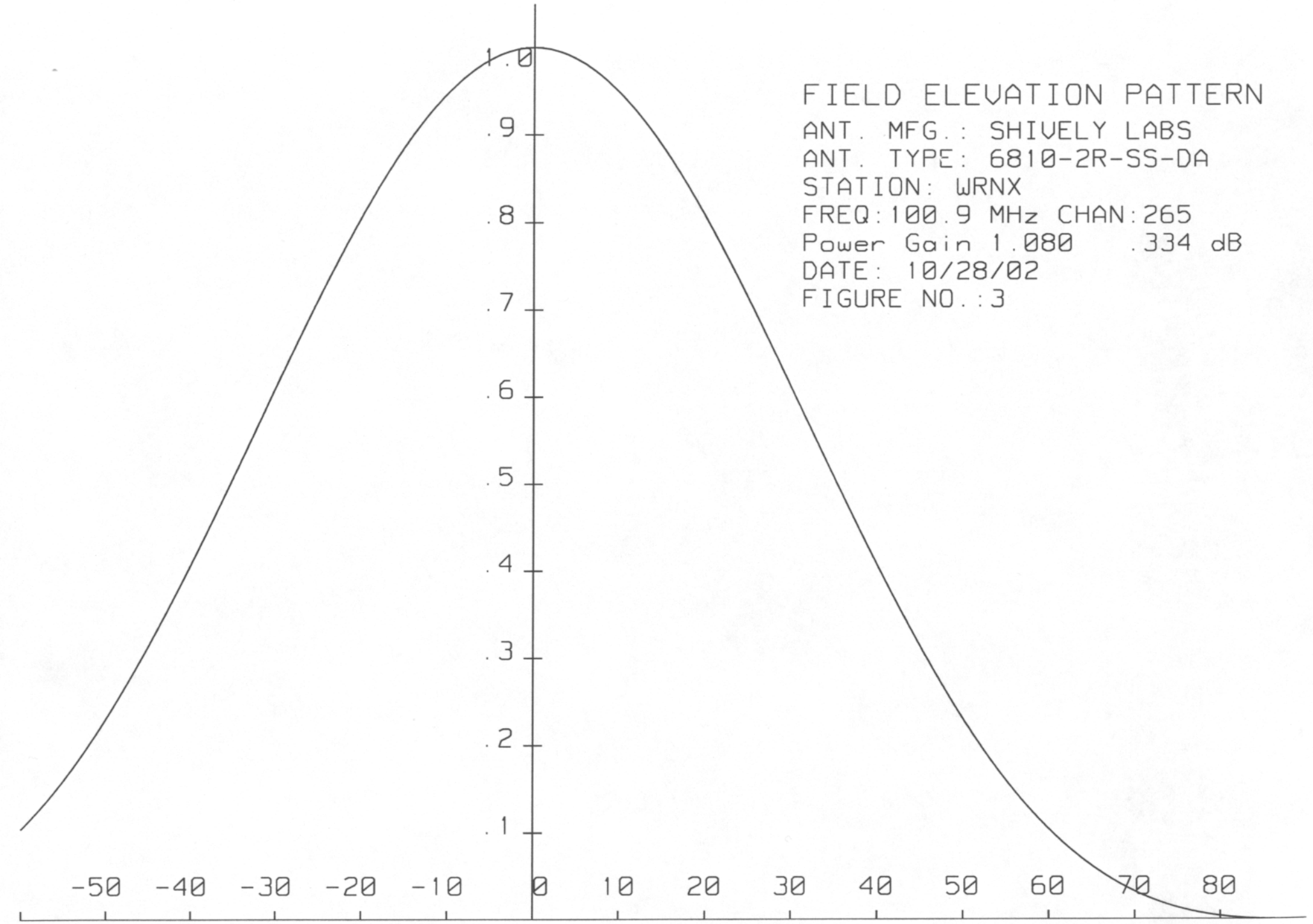

FIELD ELEVATION PATTERN
ANT. MFG.: SHIVELY LABS
ANT. TYPE: 6810-2R-SS-DA
STATION: WRNX
FREQ:100.9 MHz CHAN:265
Power Gain 1.080 .334 dB
DATE: 10/28/02
FIGURE NO.:3
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
-50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80

FIGURE 4

S.O. 22680

VALIDATION OF GAIN CALCULATION

WRNX-FM AMHERST, MA

MODEL 6810-2R-SS-DA

Elevation Gain of 6810-2R-SS-DA equals 0.700

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

Horizontal RMS divided by Vertical RMS equals
$0.820 \div 0.790 = 1.038$

Elevation Gain of Horizontal Component equals
$0.700 \times 1.038 = 0.727$

Elevation Gain of Vertical Component equals
$0.700 \times 0.963 = 0.674$

Horizontal Azimuth Gain equals $1/(\text{RMS})^2$
$1/(0.820)^2 = 1.487$

Vertical Azimuth Gain equals $1/(\text{RMS} \div \text{Max Vert})^2$
$1/(0.790 \div 0.990)^2 = 1.570$

*** Total Horizontal Gain is Elevation Gain times Azimuth Gain**
$0.727 \times 1.487 = 1.08$

*** Total Vertical Gain is Elevation Gain times Azimuth Gain**
$0.674 \times 1.570 = 1.06$

ERP divided by Horizontal Gain equals Antenna Input Power
$1.35 \text{ kW} \div 1.08 = 1.25 \text{ kW}$

Antenna Input Power times Vertical Gain equals Vertical ERP
$1.25 \text{ kW} \times 1.06 = 1.325 \text{ kW}$

Maximum Value of the Vertical Component squared times the Maximum ERP equals the Vertical ERP
$(0.990)^2 \times 1.350 \text{ kW} = 1.336 \text{ kW}$

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