

S.O. 22385

Report of Test 6810-5R-DA

for

RICHBURG EDUC. BROADCASTERS, INC.

WRBK Richburg, SC

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-5R-DA to meet the needs of WRBK and to comply with the requirements of the FCC construction permit, file number BPED-20040521ACQ.

RESULTS:

The measured azimuth pattern for the 6810-5R-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 BPED-20040521ACQ indicates that the Horizontal radiation component shall not exceed 7.5 kW at any azimuth and is restricted to the following values at the azimuths specified:

| | |
|--------------------|----------|
| 200 Degrees T: | 3.2 kW |
| 210 Degrees T: | 2.05 kW |
| 250 Degrees T: | 0.33 kW |
| 270-290 Degrees T: | 0.235 kW |
| 320 Degrees T: | 0.92 kW |

From Figure 1, the maximum radiation of the Horizontal component occurs at 069 Degrees T to 148 Degrees T. At the restricted azimuth of 200 Degrees T the Horizontal component is 4.882 dB down from the maximum of 7.5 kW, or 2.437 kW. At the restricted azimuth of 210 Degrees T the Horizontal component is 7.535 dB down from the maximum of 7.5 kW, or 1.323 kW. At the restricted azimuth of 250 Degrees T the Vertical component is 14.425 dB down from the maximum of 7.5 kW, or 0.271 kW. At the restricted azimuth of 270-290 Degrees T the Horizontal component

is 15.139 dB down from the maximum of 7.5 kW, or 0.230 kW. At the restricted azimuth of 320 Degrees T the Vertical component is 9.762 dB down from the maximum of 7.5 kW, or 0.792 kW.

The R.M.S. of the Horizontal component is 0.740. The total Horizontal power gain is 5.139. The R.M.S. of the Vertical component is 0.710. The total Vertical power gain is 5.036. See Figure Four for calculations. The R.M.S. of the FCC composite pattern is 0.790. Therefore this Pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6810-5R-DA was mounted on a tower of exact scale to a Pirod 24" face tower. The spacing of the antenna to the tower was varied 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 BPED-20040521ACQ, a single level of the 6810-5R-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:

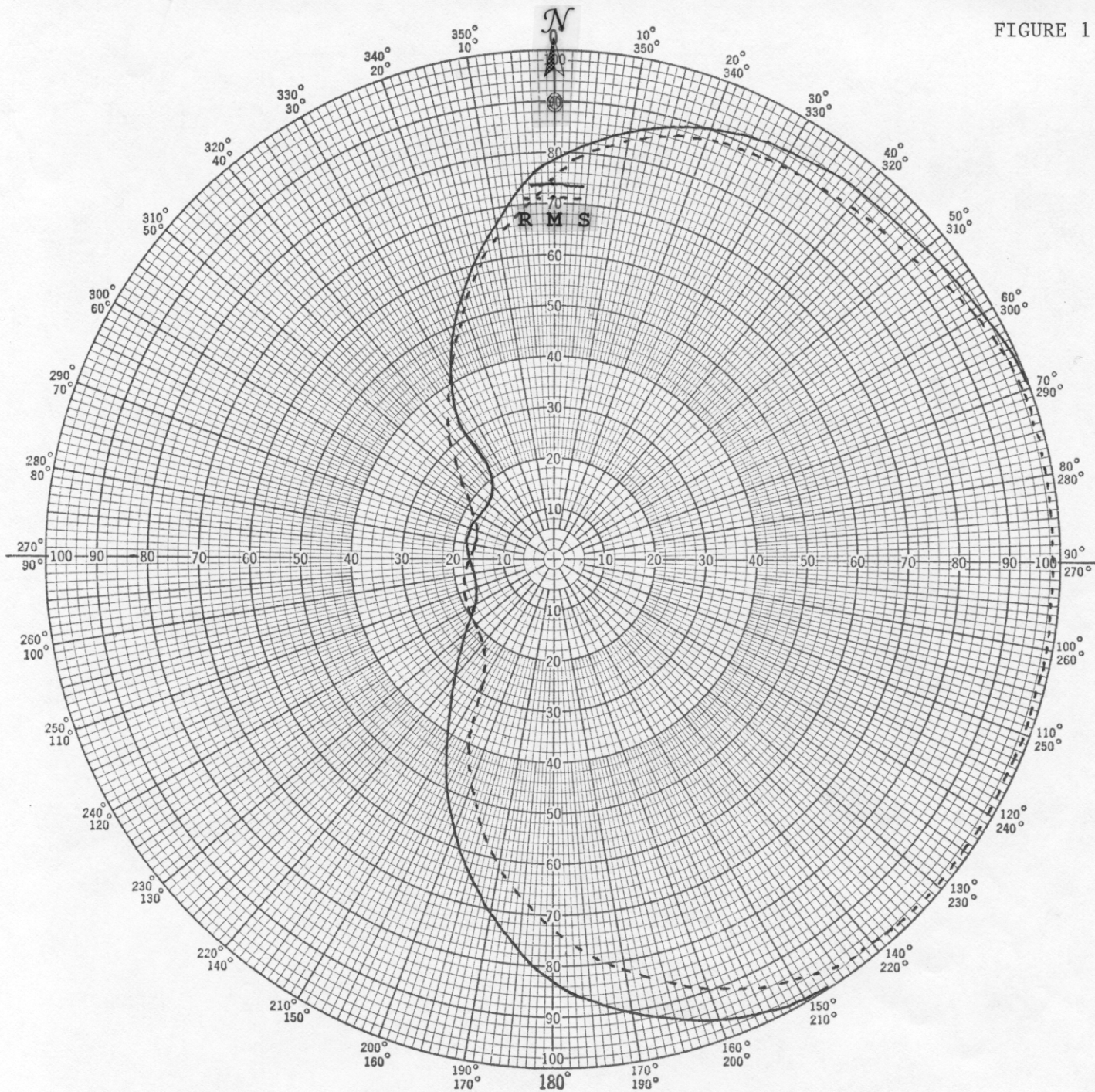
The corner reflector is mounted so that the horizontal and vertical azimuth patterns are measured independently by rotating the corner reflector by 90 degrees. The network analyzer was set to 406.35 MHz. Calibrated pads are used to check the linearity of the measuring system. For example, 6 dB padding 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 22385
September 30, 2004

FIGURE 1



Shively Labs

PROJECT NAME WRBK RICHBURG, SC
 PROJECT NUMBER 22385 DATE 3/1/02
 MODEL (X) FULL SCALE () FREQUENCY 406.35/90.3 MHz
 POLARIZATION HORIZ (—); VERT (----)
 CURVE PLOTTED IN: VOLTAGE (X) POWER () DB ()
 OBSERVER RAS

ANTENNA TYPE 6810-5R-DA
 PATTERN TYPE DIRECTIONAL AZIMUTH
 REMARKS: SEE FIGURE 2 FOR MECHANICAL
DETAILS

Figure 1A

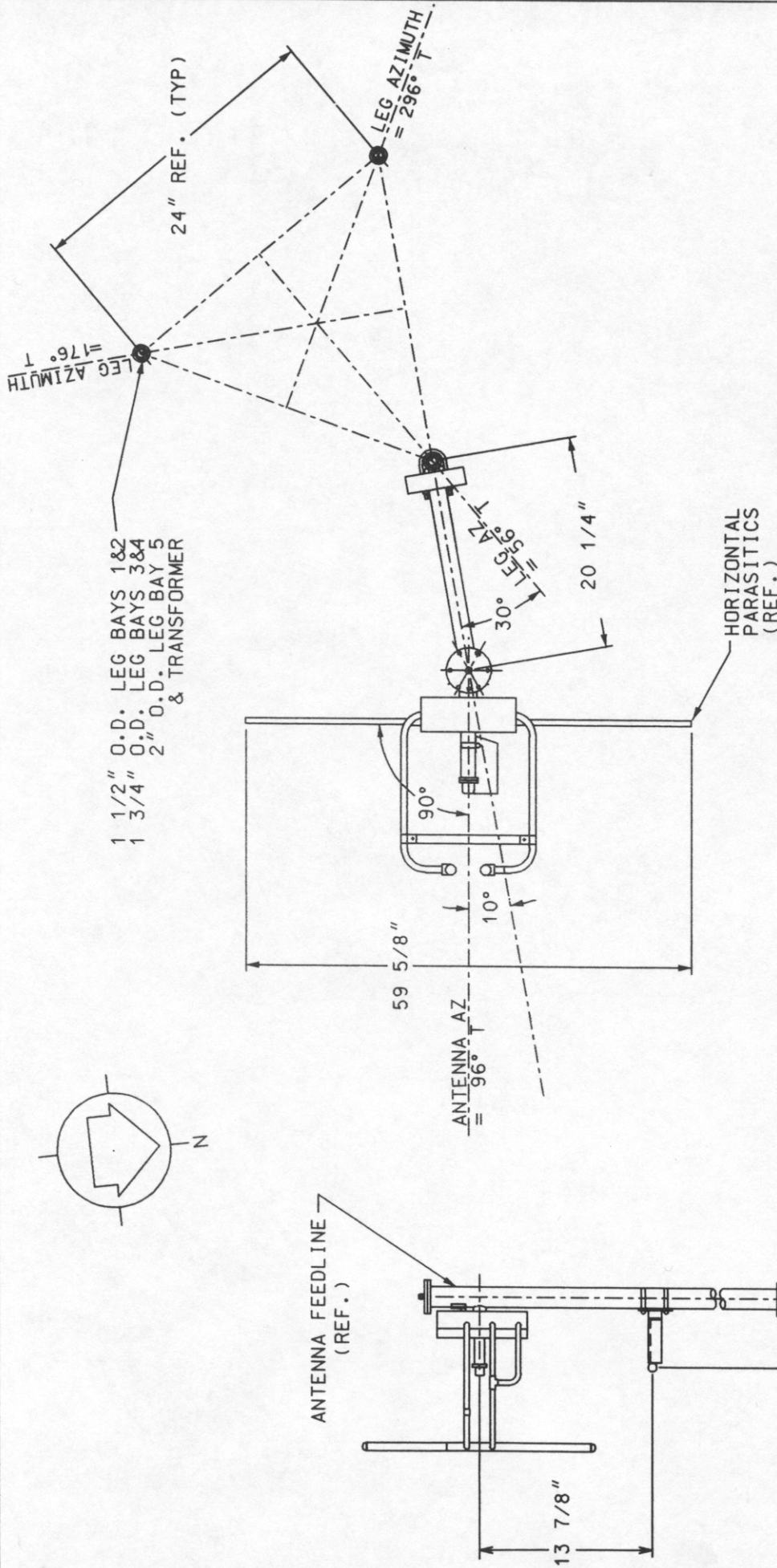
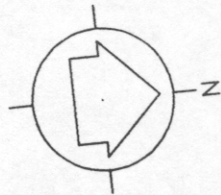
S/O 22385
TABULATION OF HORIZONTAL POLARIZATION
WRBK RICHBURG, SC

| DEGREE | RELATIVE FIELD | DEGREE | RELATIVE FIELD |
|--------|-------------------|--------|-------------------|
| 0 | 0.790 | 180 | 0.830 |
| 10 | 0.850 | 190 | 0.710 |
| 20 | 0.900 | 200 | 0.570 |
| 30 | 0.925 | 210 | 0.420 |
| 40 | 0.940 | 220 | 0.305 |
| 45 | 0.950 | 225 | 0.260 |
| 50 | 0.955 | 230 | 0.230 |
| 60 | 0.975 | 240 | 0.180 |
| 70 | 1.000 | 250 | 0.165 |
| 80 | 1.000 | 260 | 0.160 |
| 90 | 1.000 | 270 | 0.170 |
| 100 | 1.000 | 280 | 0.175 |
| 110 | 1.000 | 290 | 0.175 |
| 120 | 1.000 | 300 | 0.170 |
| 130 | 1.000 | 310 | 0.170 |
| 135 | 1.000 | 315 | 0.175 |
| 140 | 1.000 | 320 | 0.190 |
| 150 | 0.995 | 330 | 0.410 |
| 160 | 0.960 | 340 | 0.540 |
| 170 | 0.905 | 350 | 0.670 |

Figure 1B

S/O 22385
TABULATION OF VERTICAL POLARIZATION
WRBK RICHBURG, SC

| DEGREE | RELATIVE FIELD | DEGREE | RELATIVE FIELD |
|--------|-------------------|--------|-------------------|
| 0 | 0.750 | 180 | 0.730 |
| 10 | 0.835 | 190 | 0.620 |
| 20 | 0.880 | 200 | 0.480 |
| 30 | 0.895 | 210 | 0.280 |
| 40 | 0.910 | 220 | 0.215 |
| 45 | 0.920 | 225 | 0.210 |
| 50 | 0.925 | 230 | 0.200 |
| 60 | 0.960 | 240 | 0.200 |
| 70 | 0.985 | 250 | 0.190 |
| 80 | 0.990 | 260 | 0.180 |
| 90 | 0.990 | 270 | 0.170 |
| 100 | 0.990 | 280 | 0.160 |
| 110 | 0.990 | 290 | 0.160 |
| 120 | 0.990 | 300 | 0.190 |
| 130 | 0.990 | 310 | 0.240 |
| 135 | 0.990 | 315 | 0.280 |
| 140 | 0.980 | 320 | 0.325 |
| 150 | 0.950 | 330 | 0.410 |
| 160 | 0.895 | 340 | 0.530 |
| 170 | 0.820 | 350 | 0.640 |



SHIVELY LABS

A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE

| SHOP ORDER: | FREQUENCY: | SCALE: | DRAWN BY: | APPROVED BY: |
|-------------|------------|--------|-----------|--------------|
| 22,385 | 90.3 MHZ. | N.T.S. | KM | |

TITLE:

MODEL-6810-5R DIRECTIONAL ANTENNA

DATE:

2-28-02

FIGURE 2

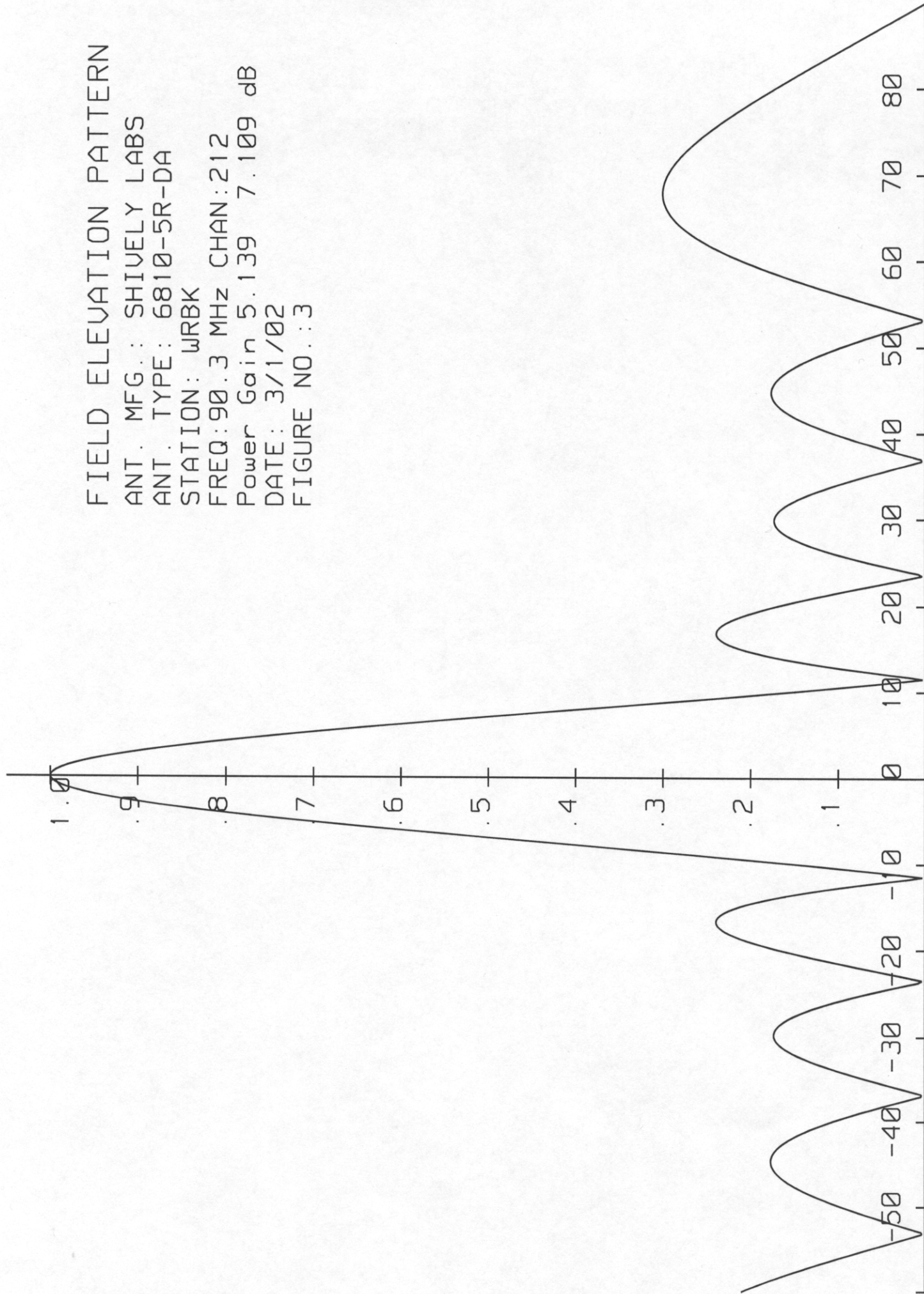
TOP VIEW

TOWER: PIROD; 24" FACE

SIDE VIEW

FIELD ELEVATION PATTERN

ANT. MFG.: SHIVELY LABS
ANT. TYPE: 6810-5R-DA
STATION: WRBK
FREQ: 90.3 MHz CHAN: 212
Power Gain 5.139 7.109 dB
DATE: 3/1/02
FIGURE NO.: 3



S.O. 22385

VALIDATION OF GAIN CALCULATION

WRBK RICHBURG, SC

MODEL 6810-5R-DA

Elevation Gain of 6810-5R-DA equals 2.70

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

Horizontal RMS divided by Vertical RMS equals

$$0.740 \div 0.710 = 1.0423$$

Elevation Gain of Horizontal Component equals

$$2.70 \times 1.0423 = 2.8142$$

Elevation Gain of Vertical Component equals

$$2.70 \times 1/1.0423 = 2.5904$$

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

$$1/(0.740)^2 = 1.8262$$

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

$$1/(0.710 \div 0.990)^2 = 1.9443$$

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

$$2.8142 \times 1.8262 = 5.139$$

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

$$2.5904 \times 1.9443 = 5.036$$

ERP divided by Horizontal Gain equals Antenna Input Power

$$7.5 \text{ kW} \div 5.139 = 1.459$$

Antenna Input Power times Vertical Gain equals Vertical ERP

$$1.459 \times 5.036 = 7.348$$

Maximum Value of the Vertical Component squared times the Maximum ERP equals the Vertical ERP

$$(0.990)^2 \times 7.5 \text{ kW} = 7.351$$

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