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**S.O. 22679**

**Report of Test 6810-2R-SS-DA**

**for**

**INFINITY RADIO OPERATIONS INC.**

**WAQZ 97.3 MHZ FORT THOMAS, KY**

## OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-2R-SS-DA to meet the needs of WAQZ and to comply with the requirements of the FCC construction permit, file number BPH-20020322AAG.

## 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 BPH-20020322AAG indicates that the Horizontal radiation component shall not exceed 2.55 kW at any azimuth and is restricted to the following values at the azimuths specified:

200 Degrees T: 1.15 kW

From Figure 1, the maximum radiation of the Horizontal component occurs at 109 Degrees T to 125 Degrees T. At the restricted azimuth of 200 Degrees T the Horizontal component is 3.81 dB down from the maximum of 2.55 kW, or 1.06 kW.

The R.M.S. of the Horizontal component is 0.710. The total Horizontal power gain is 1.565. The R.M.S. of the Vertical component is 0.630. The total Vertical power gain is 1.469. See Figure Four for calculations. The R.M.S. of the FCC composite pattern is 0.98.

**AMENDED FCC COMPOSITE PATTERN:**

The R.M.S. of the measured pattern is 0.71. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.83. Therefore the measured pattern does not comply with the FCC requirement of 73.316(c)(ix)(A). In accordance with 73.1690(c)(2)(ii) an amended composite pattern is attached as Figure 5 that will allow the above measured pattern to comply with the FCC requirement of 73.316(c)(ix)(A). Figure 5A shows the tabulations of the amended composite Figure 5. Eighty five percent (85%) of the amended FCC composite pattern is 0.71. Therefore the RMS of the measured pattern will comply with the requirement of 73.316(c)(ix)(A).

**METHOD OF DIRECTIONALIZATION:**

One bay of the 6810-2R-SS-DA was mounted on an outrigged pole which is attached to an exact scale of one leg of a Landmark self-supported tower. In the aperture of the antenna, the legs of the tower are approximately 60 feet apart and have no measurable effect on the directional pattern. The spacing of the antenna to the outrigged pole and the spacing of the outrigged pole to the tower were varied to achieve the vertical pattern shown in Figure 1. A horizontal parasitic element was placed directly under the bay to achieve the horizontal pattern shown in Figure 1. See Figure 2 for mechanical details.

**METHOD OF MEASUREMENT:**

As allowed by the construction permit, file number BPH-20020322AAG, 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.

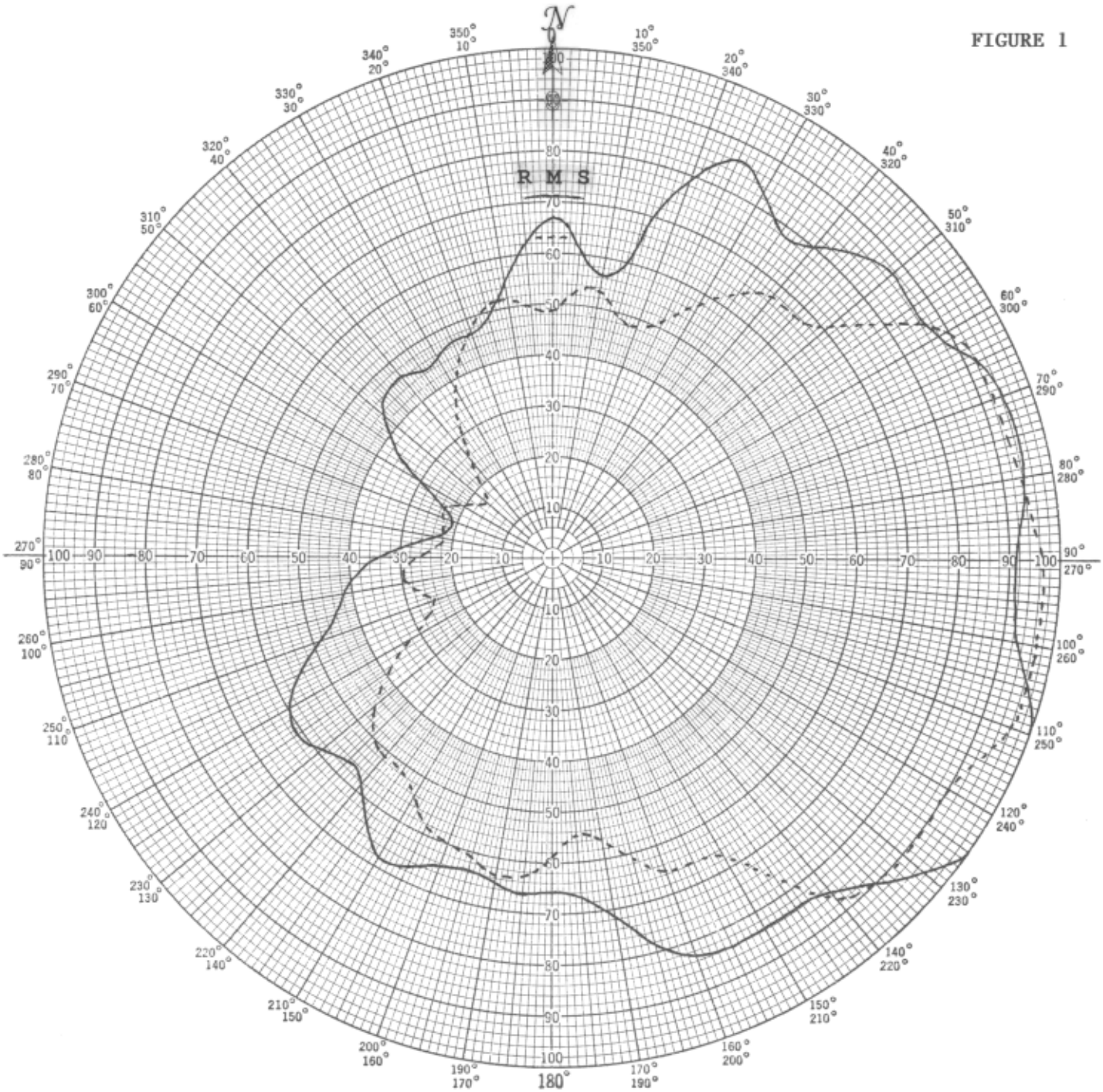
**TEST PROCEDURES:**

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 437.85 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 22679
October 1, 2002

FIGURE 1




# Shively Labs

PROJECT NAME WAQZ FORT THOMAS, KY

PROJECT NUMBER 22679 DATE 9/19/02

MODEL ( X ) FULL SCALE ( ) FREQUENCY 437.85/97.3 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**

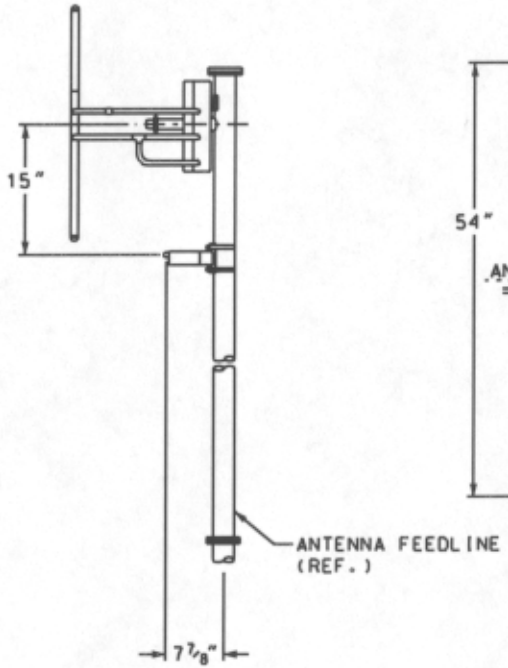
**S/O 22679**
**TABULATION OF HORIZONTAL POLARIZATION**
**WAQZ FORT THOMAS, KY**

| DEGREE | RELATIVE FIELD | DEGREE | RELATIVE FIELD |
|---|---|---|---|
| 0 | 0.670 | 180 | 0.660 |
| 10 | 0.565 | 190 | 0.650 |
| 20 | 0.790 | 200 | 0.645 |
| 30 | 0.830 | 210 | 0.680 |
| 40 | 0.800 | 220 | 0.590 |
| 45 | 0.850 | 225 | 0.570 |
| 50 | 0.875 | 230 | 0.590 |
| 60 | 0.880 | 240 | 0.595 |
| 70 | 0.945 | 250 | 0.490 |
| 80 | 0.945 | 260 | 0.415 |
| 90 | 0.915 | 270 | 0.340 |
| 100 | 0.930 | 280 | 0.230 |
| 110 | 1.000 | 290 | 0.210 |
| 120 | 1.000 | 300 | 0.300 |
| 130 | 0.955 | 310 | 0.430 |
| 135 | 0.900 | 315 | 0.460 |
| 140 | 0.855 | 320 | 0.465 |
| 150 | 0.840 | 330 | 0.450 |
| 160 | 0.830 | 340 | 0.470 |
| 170 | 0.710 | 350 | 0.550 |

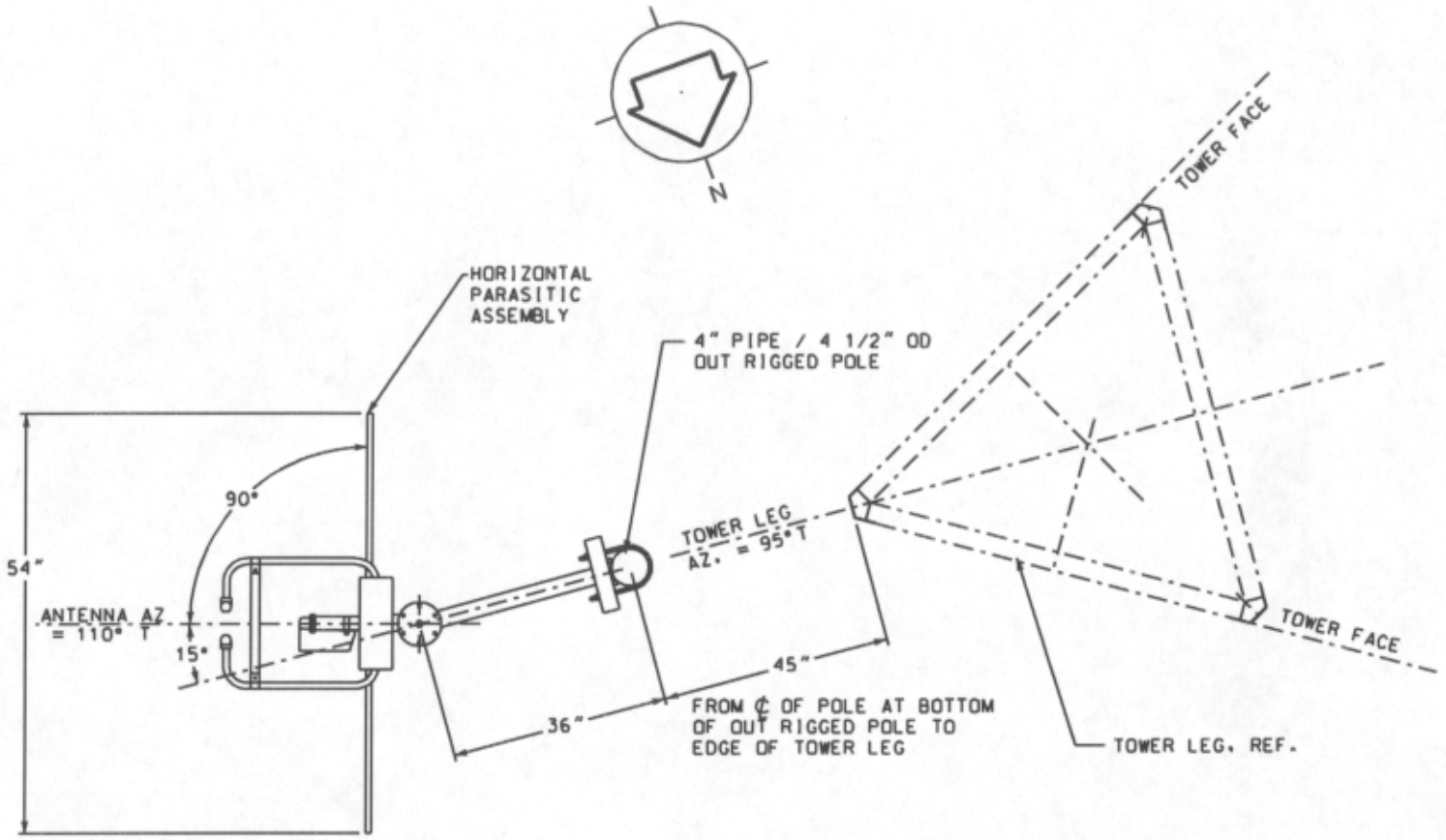
**Figure 1B**

**S/O 22679**
**TABULATION OF VERTICAL POLARIZATION**
**WAQZ FORT THOMAS, KY**

| DEGREE | RELATIVE FIELD | DEGREE | RELATIVE FIELD |
|---|---|---|---|
| 0 | 0.490 | 180 | 0.590 |
| 10 | 0.535 | 190 | 0.635 |
| 20 | 0.480 | 200 | 0.600 |
| 30 | 0.575 | 210 | 0.545 |
| 40 | 0.670 | 220 | 0.510 |
| 45 | 0.675 | 225 | 0.500 |
| 50 | 0.710 | 230 | 0.450 |
| 60 | 0.900 | 240 | 0.320 |
| 70 | 0.925 | 250 | 0.250 |
| 80 | 0.935 | 260 | 0.290 |
| 90 | 0.970 | 270 | 0.270 |
| 100 | 0.970 | 280 | 0.220 |
| 110 | 0.960 | 290 | 0.230 |
| 120 | 0.900 | 300 | 0.210 |
| 130 | 0.905 | 310 | 0.170 |
| 135 | 0.900 | 315 | 0.200 |
| 140 | 0.870 | 320 | 0.250 |
| 150 | 0.670 | 330 | 0.385 |
| 160 | 0.655 | 340 | 0.475 |
| 170 | 0.560 | 350 | 0.515 |




SIDE VIEW




TOP VIEW

TOWER: LANDMARK
SELF-SUPPORTING

| SHIVELY LABS<br>A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE USA | | | |
|---|---|---|---|
| SHOP ORDER: 22679 | FREQUENCY: 97.3 MHz | SCALE: N.T.S. | DRAWN BY: ASP<br>APPROVED BY: |
| MODEL: MODEL-6810-2R-SS-DIRECTIONAL ANTENNA | | | |
| DATE: 9-30-02 | FIGURE 2 | | |

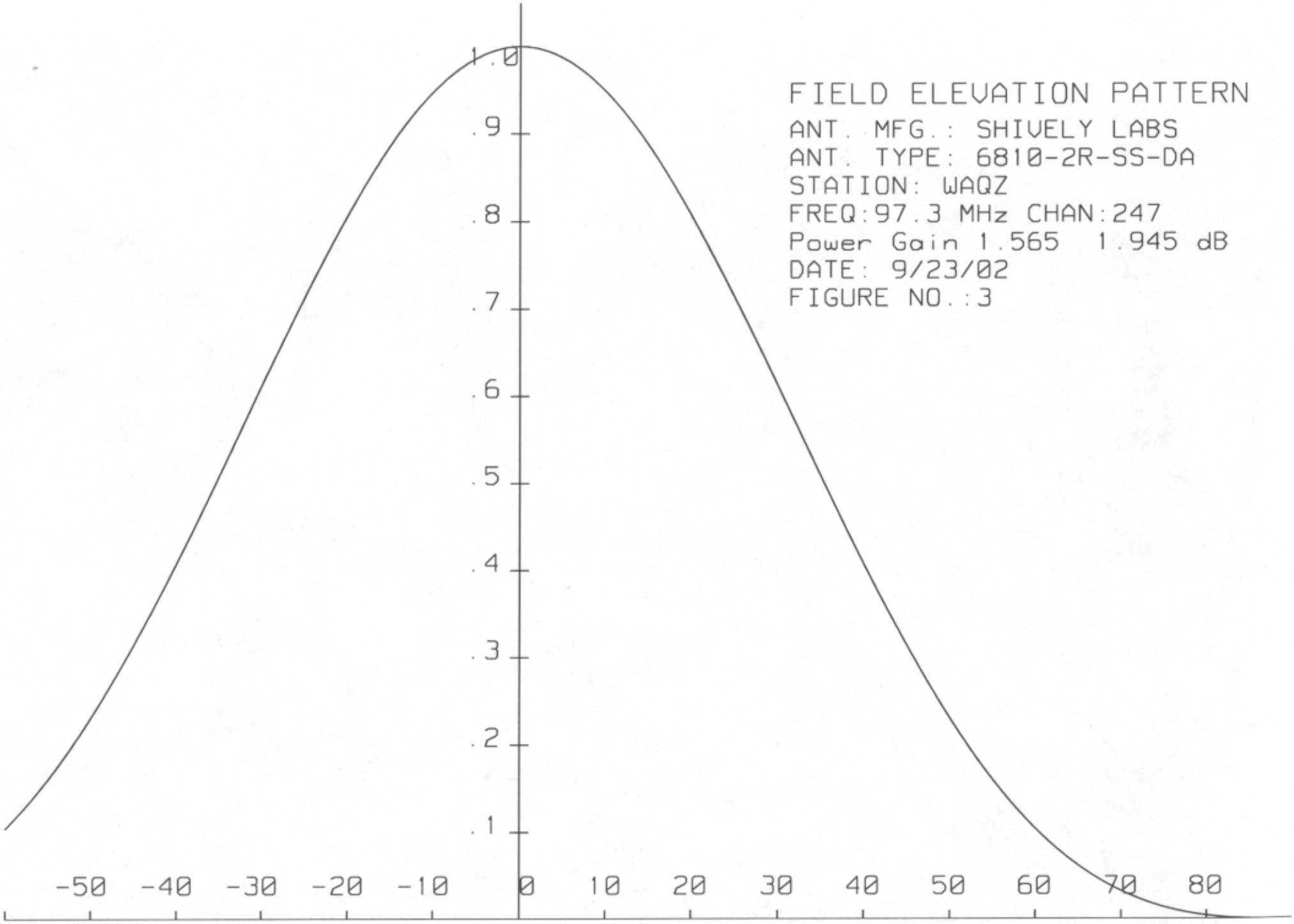

FIELD ELEVATION PATTERN
ANT. MFG.: SHIVELY LABS
ANT. TYPE: 6810-2R-SS-DA
STATION: WAQZ
FREQ:97.3 MHz CHAN:247
Power Gain 1.565 1.945 dB
DATE: 9/23/02
FIGURE NO.:3
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
-50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80

**FIGURE 4**

**S.O. 22679**

**VALIDATION OF GAIN CALCULATION**

**WAQZ FORT THOMAS, KY**

**MODEL 6810-2R-SS-DA**

Elevation Gain of 6810-2R-SS-DA equals 0.70

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

Horizontal RMS divided by Vertical RMS equals
$0.71 \div 0.63 = 1.127$

Elevation Gain of Horizontal Component equals
$0.70 \times 1.127 = 0.789$

Elevation Gain of Vertical Component equals
$0.70 \times 0.887 = 0.62$

Horizontal Azimuth Gain equals $1/(RMS)^2$
$1/(0.71)^2 = 1.984$

Vertical Azimuth Gain equals $1/(RMS \div Max\ Vert)^2$
$1/(0.63 \div 0.97)^2 = 2.37$

*** Total Horizontal Gain is Elevation Gain times Azimuth Gain**
**$0.789 \times 1.984 = 1.565$**

*** Total Vertical Gain is Elevation Gain times Azimuth Gain**
**$0.62 \times 2.37 = 1.469$**

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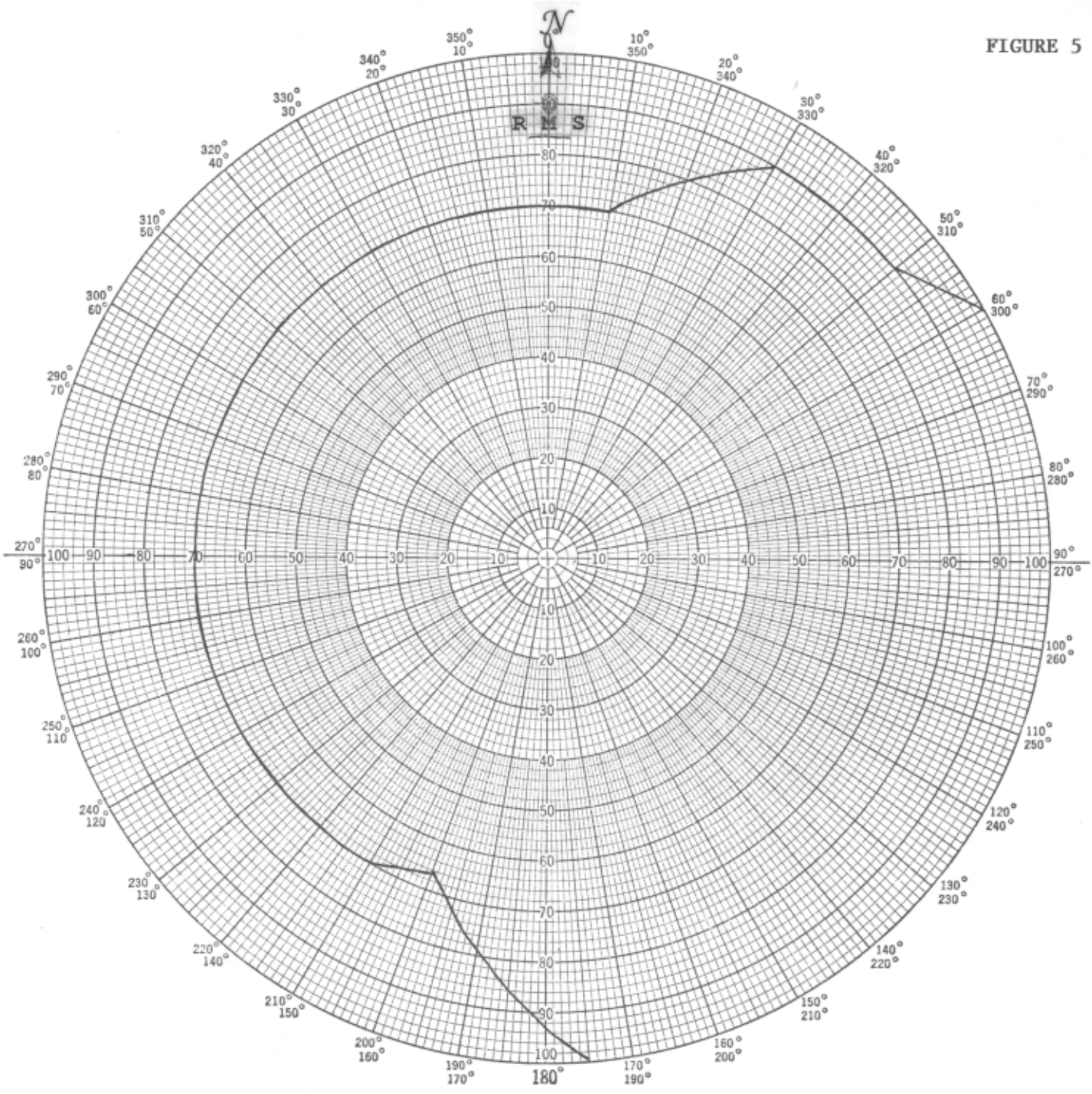
ERP divided by Horizontal Gain equals Antenna Input Power
$2.55\ kW \div 1.565 = 1.629\ kW$

Antenna Input Power times Vertical Gain equals Vertical ERP
$1.629 \times 1.469 = 2.393\ kW$

Maximum Value of the Vertical Component squared times the Maximum ERP equals the Vertical ERP
$(0.97)^2 \times 2.55\ kW = 2.399\ kW$

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

FIGURE 5




# Shively Labs

PROJECT NAME WAQZ FORT THOMAS, KY

PROJECT NUMBER 22679 DATE 9/25/02

MODEL ( X ) FULL SCALE ( ) FREQUENCY 437.85/97.3 MHz

POLARIZATION COMPOSITE

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

OBSERVER RAS

ANTENNA TYPE 6810-2R-SS-DA

PATTERN TYPE DIRECTIONAL AZIMUTH

REMARKS:

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**Figure 5A**

**S/O 22679**
**TABULATION OF COMPOSITE PATTERN**
**WAQZ FORT THOMAS, KY**

| DEGREE | RELATIVE FIELD | DEGREE | RELATIVE FIELD |
|---|---|---|---|
| 0 | 0.700 | 180 | 0.930 |
| 10 | 0.700 | 190 | 0.790 |
| 20 | 0.795 | 200 | 0.660 |
| 30 | 0.900 | 210 | 0.700 |
| 40 | 0.900 | 220 | 0.700 |
| 45 | 0.900 | 225 | 0.700 |
| 50 | 0.900 | 230 | 0.700 |
| 60 | 1.000 | 240 | 0.700 |
| 70 | 1.000 | 250 | 0.700 |
| 80 | 1.000 | 260 | 0.700 |
| 90 | 1.000 | 270 | 0.700 |
| 100 | 1.000 | 280 | 0.700 |
| 110 | 1.000 | 290 | 0.700 |
| 120 | 1.000 | 300 | 0.700 |
| 130 | 1.000 | 310 | 0.700 |
| 135 | 1.000 | 315 | 0.700 |
| 140 | 1.000 | 320 | 0.700 |
| 150 | 1.000 | 330 | 0.700 |
| 160 | 1.000 | 340 | 0.700 |
| 170 | 1.000 | 350 | 0.700 |