

S.O. 23067  
Report of Test 6810-2D-DA  
for  
OHIO VALLEY COMMUNICATIONS, INC.  
WEEL 95.7 MHZ SHADYSIDE, OH

**OBJECTIVE:**

The objective of this test was to demonstrate the directional characteristics of a 6810-2D-DA to meet the needs of WEEL and to comply with the requirements of the FCC construction permit, file number BPH-20021003AAJ.

**RESULTS:**

The measured azimuth pattern for the 6810-2D-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-20021003AAJ indicates that the Horizontal radiation component shall not exceed 6.8 kW at any azimuth and is restricted to the following values at the azimuths specified:

290 - 300 Degrees T: 1.85 kW

From Figure 1, the maximum radiation of the Horizontal component occurs at 010 Degrees T to 046 Degrees T and at 117 Degrees T to 136 Degrees T. At the restricted azimuth of 290 - 300 Degrees T the Horizontal component is 6.196 dB down from the maximum of 6.8 kW, or 1.63 kW.

The R.M.S. of the Horizontal component is 0.790. The total Horizontal power gain is 1.681. The R.M.S. of the Vertical component is 0.745. The total Vertical power gain is 1.649. See Figure 4 for calculations. The measured composite pattern has an R.M.S. value of 0.810. The R.M.S. of the FCC composite pattern is 0.940. Therefore this Pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

**METHOD OF DIRECTIONALIZATION:**

One bay of the 6810-2D-DA was mounted on a tower of exact scale to a self-supported tower at the WEEL site. 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 BPH-20021003AAJ, a single level of the 6810-2D-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 9<sup>th</sup> 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 430.65 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.

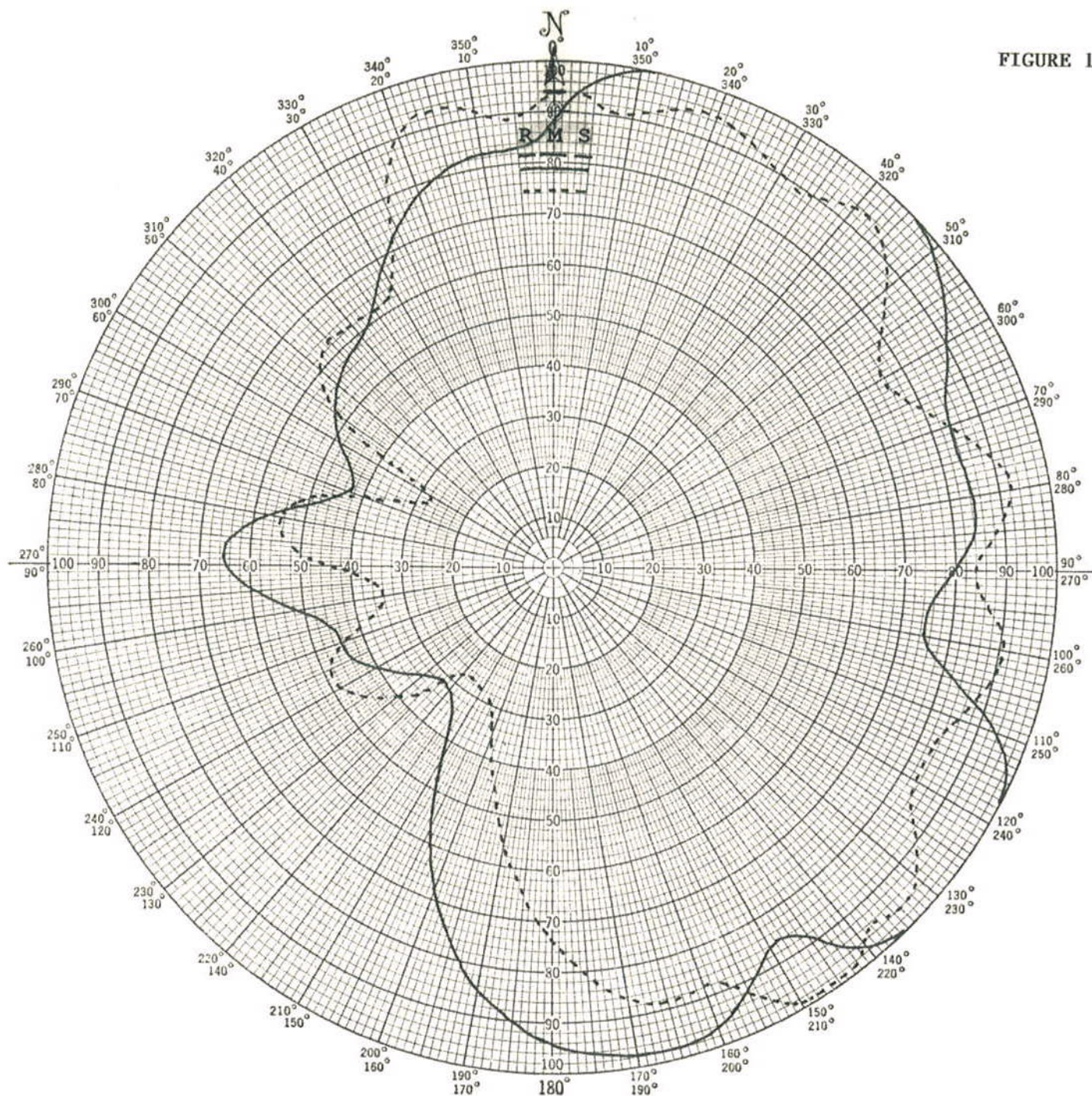
Respectfully submitted by:



Robert A. Surette  
Manager of RF Engineering  
S/O 23067  
September 29, 2003



FIGURE 1



## Shively Labs

PROJECT NAME WEEL SHADYSIDE, OH  
 PROJECT NUMBER 23067 DATE 9/10/03  
 MODEL ( ☒ ) FULL SCALE ( ) FREQUENCY 430.65/95.7 MHz  
 POLARIZATION HORIZ (—); VERT (----)  
 CURVE PLOTTED IN: VOLTAGE ( ☒ ) POWER ( ) DB ( )  
 OBSERVER RAS

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

Figure 1A

S/O 23067  
TABULATION OF HORIZONTAL POLARIZATION  
WHEEL SHADYSIDE, OH

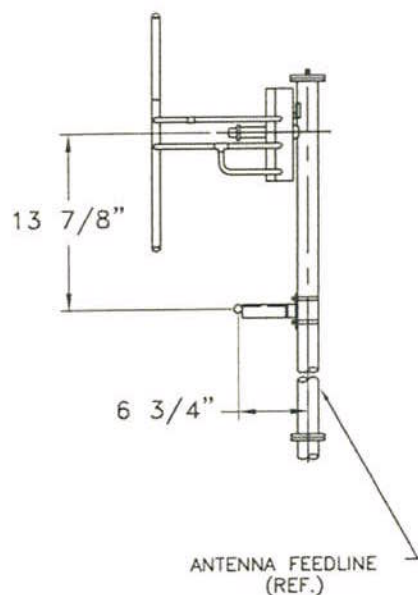
DEGREE	RELATIVE FIELD	DEGREE	RELATIVE FIELD
0	0.890	180	0.940
10	1.000	190	0.850
20	1.000	200	0.680
30	1.000	210	0.440
40	1.000	220	0.320
45	1.000	225	0.315
50	0.980	230	0.330
60	0.900	240	0.405
70	0.840	250	0.445
80	0.845	260	0.510
90	0.800	270	0.645
100	0.750	280	0.570
110	0.930	290	0.430
120	1.000	300	0.490
130	1.000	310	0.560
135	1.000	315	0.580
140	0.975	320	0.590
150	0.865	330	0.680
160	0.965	340	0.780
170	0.980	350	0.825



Figure 1B

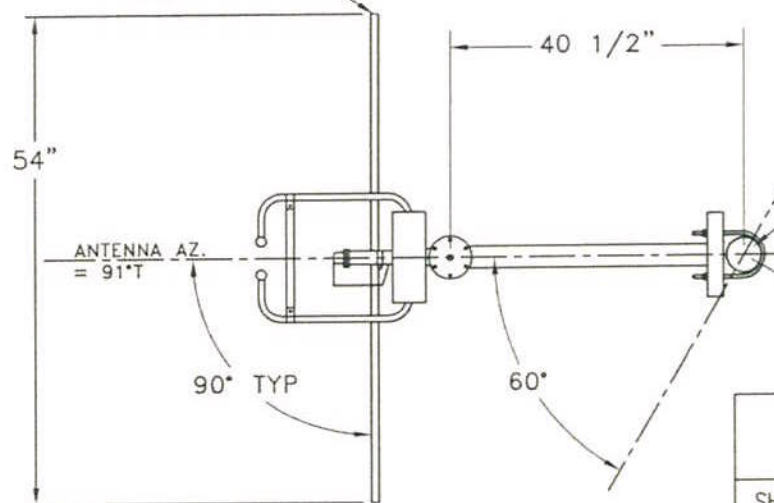
S/O 23067  
TABULATION OF VERTICAL POLARIZATION  
WHEEL SHADYSIDE, OH

DEGREE	RELATIVE FIELD	DEGREE	RELATIVE FIELD
0	0.940	180	0.740
10	0.910	190	0.560
20	0.950	200	0.350
30	0.900	210	0.280
40	0.930	220	0.280
45	0.920	225	0.350
50	0.865	230	0.400
60	0.755	240	0.485
70	0.840	250	0.440
80	0.920	260	0.340
90	0.840	270	0.440
100	0.905	280	0.545
110	0.860	290	0.400
120	0.830	300	0.290
130	0.940	310	0.605
135	0.960	315	0.630
140	0.960	320	0.620
150	0.990	330	0.640
160	0.880	340	0.905
170	0.865	350	0.910



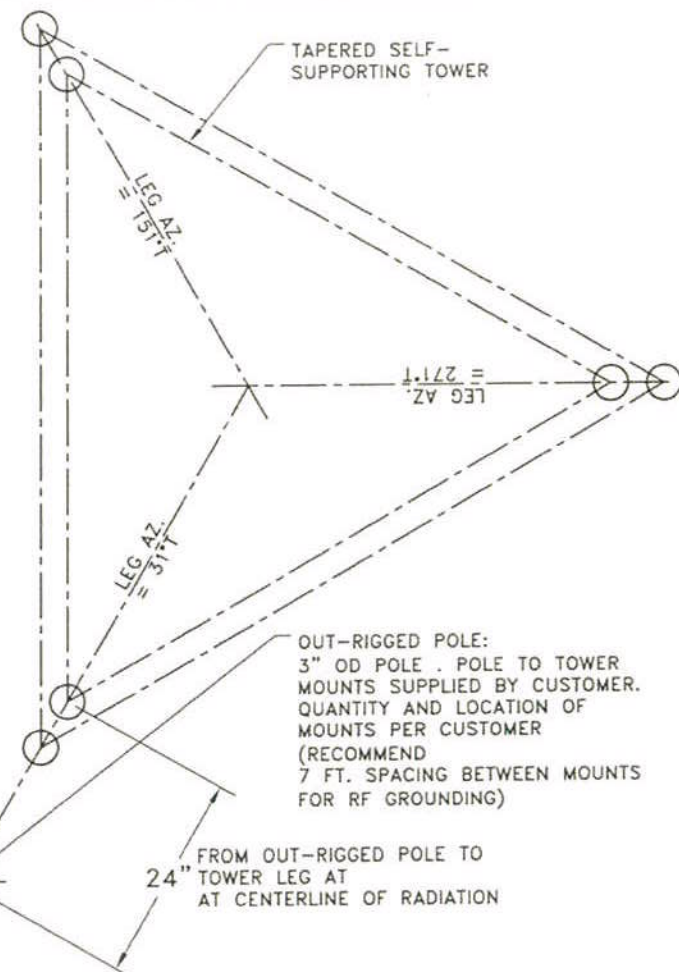
SIDE VIEW

HORIZONTAL PARASITIC ASSEMBLY, (REF.)



TOP VIEW

TOWER: 740' SELF-SUPPORTING



SHIVELY LABS

A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE

SHOP ORDER:  
23067

FREQUENCY:  
95.7 MHz.

SCALE:  
N.T.S.

DRAWN BY: ASP  
APPROVED BY:

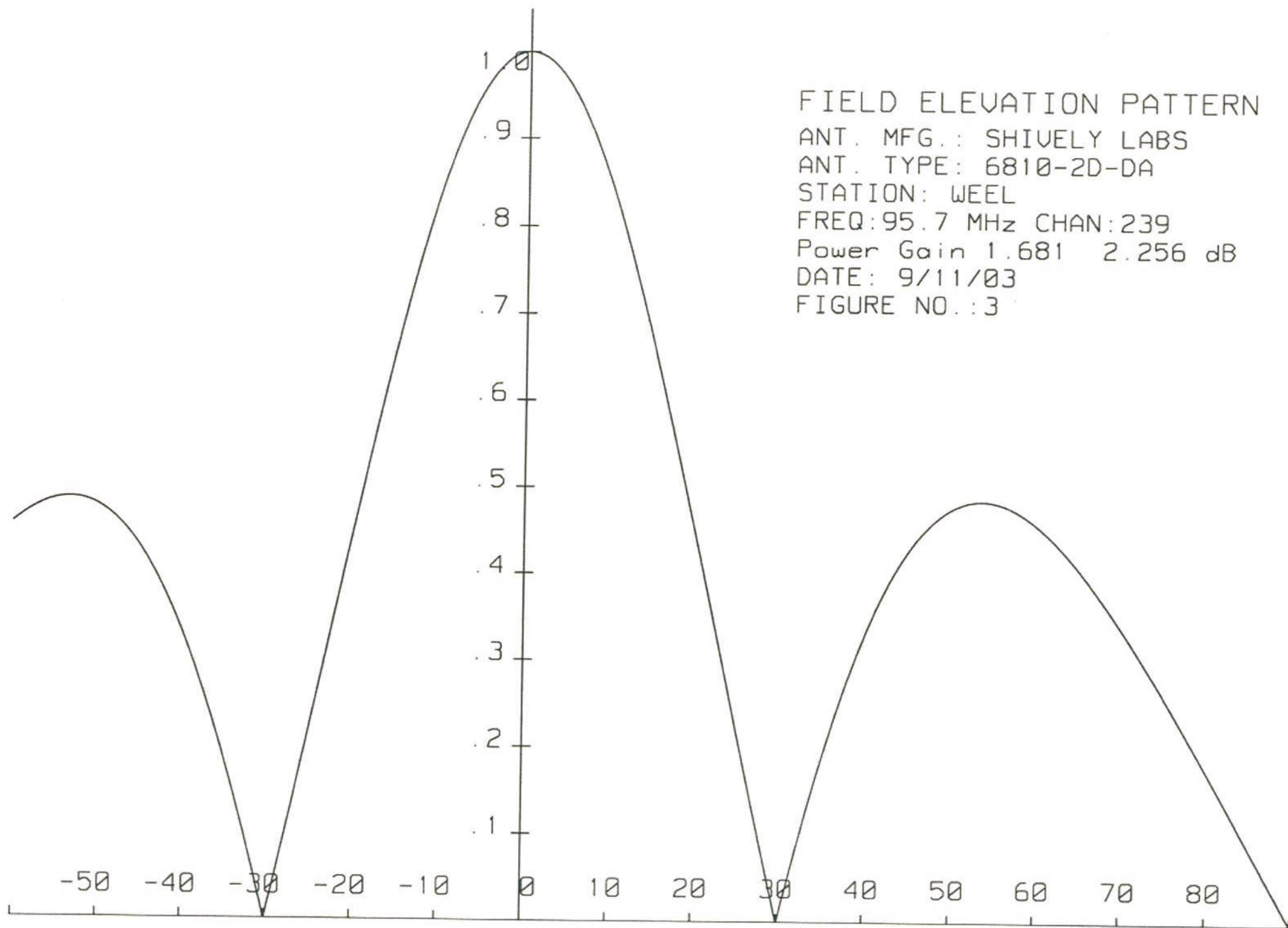
MODEL:

6810-2D-DIRECTIONAL ANTENNA

DATE:

9/23/03

FIGURE 2



# FIELD ELEVATION PATTERN

ANT. MFG.: SHIVELY LABS

ANT. TYPE: 6810-2D-DA

STATION: WEEL

FREQ: 95.7 MHz CHAN: 239

Power Gain 1.681 2.256 dB

DATE: 9/11/03

FIGURE NO.: 3



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## VALIDATION OF GAIN CALCULATION

WEEL SHADYSIDE, OH

MODEL 6810-2D-DA

Elevation Gain of 6810-2D-DA equals 0.99

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

Horizontal RMS divided by Vertical RMS equals  
 $0.790 \div 0.745 = 1.060$

Elevation Gain of Horizontal Component equals  
 $0.99 \times 1.060 = 1.049$

Elevation Gain of Vertical Component equals  
 $0.99 \times 0.943 = 0.934$

Horizontal Azimuth Gain equals  $1/(\text{RMS})^2$   
 $1/(0.790)^2 = 1.602$

Vertical Azimuth Gain equals  $1/(\text{RMS} \div \text{Max Vert})^2$   
 $1/(0.745 \div 0.990)^2 = 1.766$

\* Total Horizontal Gain is Elevation Gain times Azimuth Gain  
 $1.049 \times 1.602 = 1.681$

\* Total Vertical Gain is Elevation Gain times Azimuth Gain  
 $0.934 \times 1.766 = 1.649$

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ERP divided by Horizontal Gain equals Antenna Input Power  
 $6.8 \text{ kW} \div 1.681 = 4.045 \text{ kW}$

Antenna Input Power times Vertical Gain equals Vertical ERP  
 $4.045 \times 1.649 = 6.67 \text{ kW}$

Maximum Value of the Vertical Component squared times the  
Maximum ERP equals the Vertical ERP  
 $(0.990)^2 \times 6.8 \text{ kW} = 6.665 \text{ kW}$

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