

S.O. 25462

Report of Test 6810-8-DA

for

AMERICAN FAMILY ASSOCIATION

WATP 90.9 MHz Laurel, MS

## **OBJECTIVE:**

The objective of this test was to demonstrate the directional characteristics of a 6810-8-DA to meet the needs of WATP and to comply with the requirements of the FCC construction permit, file number BMPED-20051122AAZ.

## **RESULTS:**

The measured azimuth pattern for the 6810-8-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-20051122AAZ indicates that the Horizontal radiation component shall not exceed 69 kW at any azimuth and is restricted to the following values at the azimuths specified:

100 Degrees T: 9.243 kW

From Figure 1, the maximum radiation of the Horizontal component occurs at 305 Degrees T to 310 Degrees T. At the restricted azimuth of 100 Degrees T the Horizontal component is 10.458 dB down from the maximum of 69 kW, or 6.210 kW.

The R.M.S. of the Horizontal component is 0.780. The total Horizontal power gain is 7.745. The R.M.S. of the Vertical component is 0.752. The total Vertical power gain is 7.591. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.889. The R.M.S. of the measured composite pattern is 0.805. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.756. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

**METHOD OF DIRECTIONALIZATION:**

One bay of the 6810-8-DA was mounted on a tower of precise scale to the Allied 24-inch face tower at the WATP 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 BMPED-20051122AAZ, a single level of the 6810-8-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 409.05 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 unpadding 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:

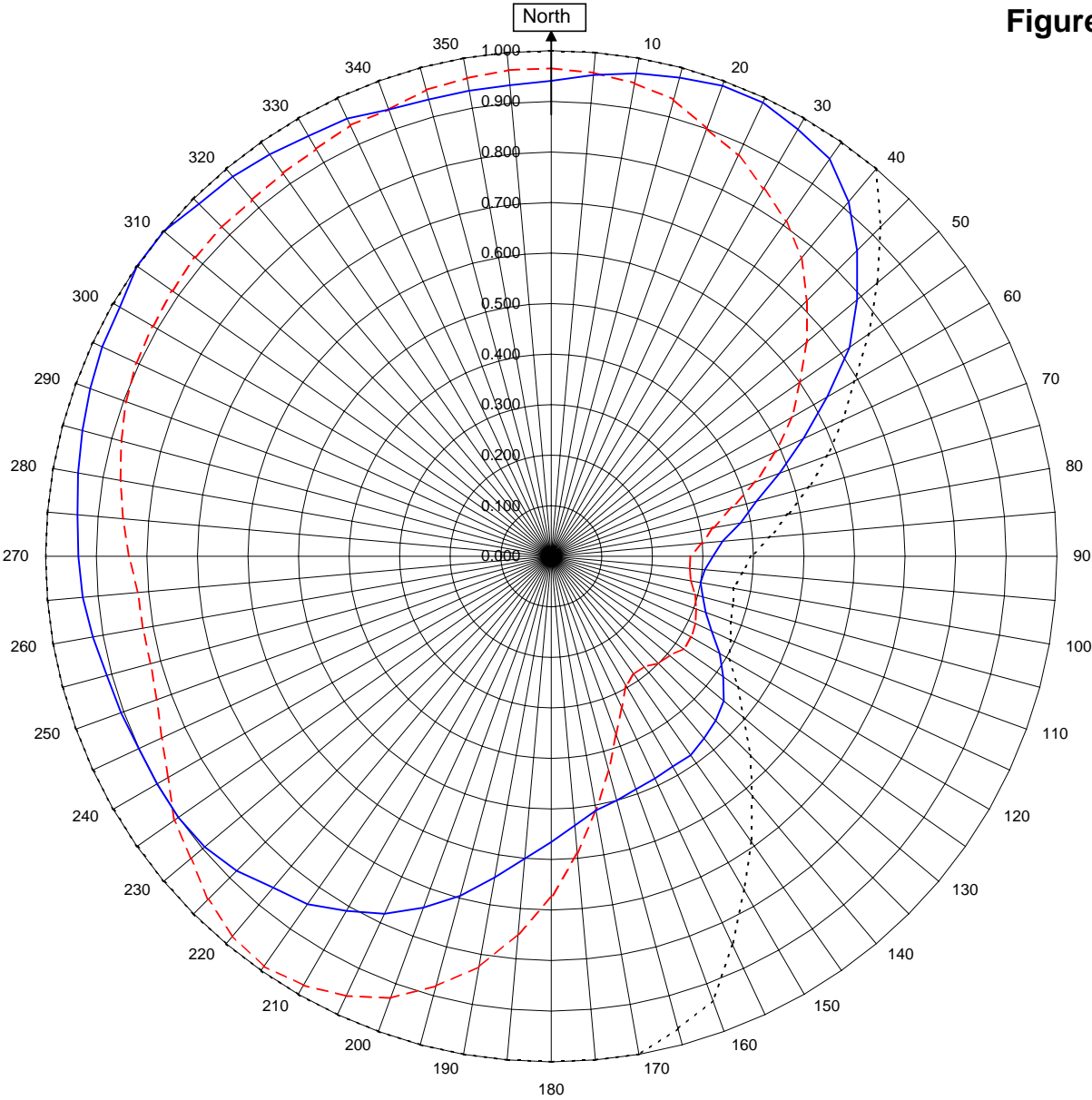


Robert A. Surette  
Director of Sales Engineering  
S/O 25462  
April 10, 2007

# Shively Labs

Shively Labs, a division of Howell Laboratories, Inc. Bridgton, ME (207)647-3327

Figure 1



## WATP Laurel, MS

25462  
April 10, 2007

Horizontal RMS	0.780	Frequency	90.9 / 409.05 mHz
Vertical RMS	0.752	Plot	Relative Field
H/V Composite RMS	0.805	Scale	4.5 : 1
FCC Composite RMS	0.889	See Figure 2 for Mechanical Details	

Antenna Model	6810-8-DA
Pattern Type	Directional Azimuth

Figure 1a

Tabulation of Horizontal Azimuth Pattern  
WATP Laurel, MS

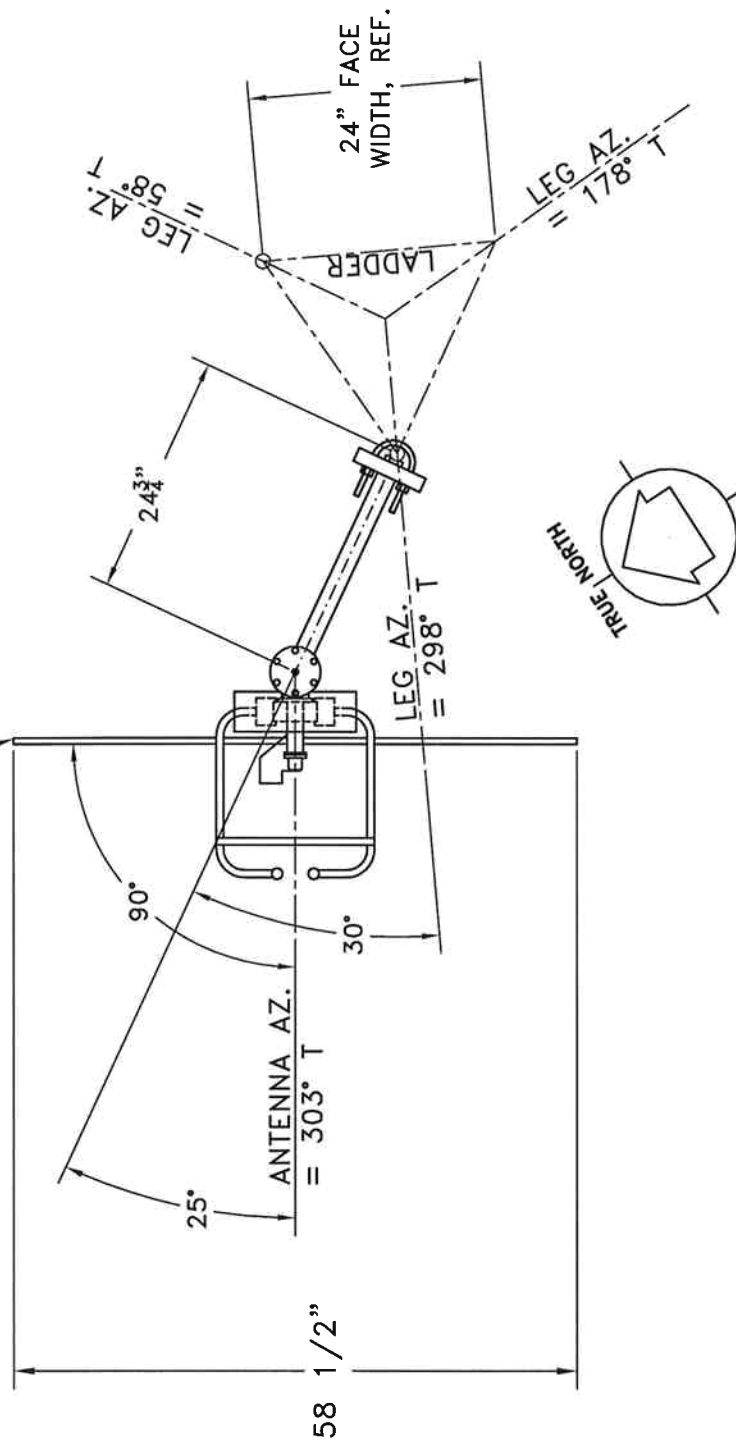
Azimuth	Rel Field	Azimuth	Rel Field
0	0.940	180	0.565
10	0.970	190	0.645
20	0.990	200	0.740
30	0.975	210	0.810
40	0.915	220	0.855
45	0.855	225	0.880
50	0.790	230	0.895
60	0.630	240	0.900
70	0.480	250	0.905
80	0.380	260	0.920
90	0.320	270	0.935
100	0.300	280	0.950
110	0.325	290	0.970
120	0.385	300	0.985
130	0.445	310	1.000
135	0.460	315	0.985
140	0.470	320	0.980
150	0.480	330	0.960
160	0.490	340	0.940
170	0.510	350	0.935

Figure 1b

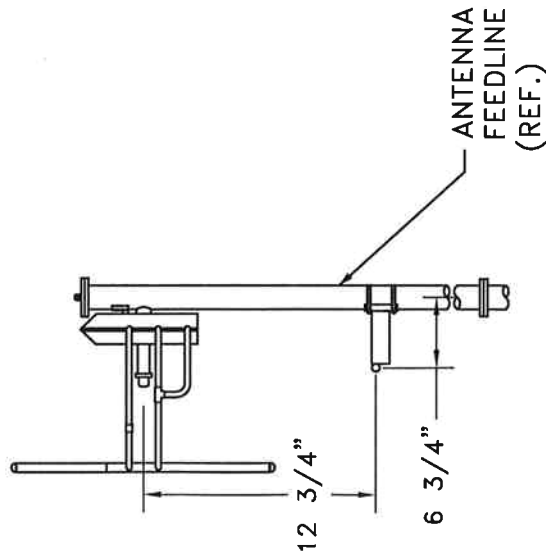
Tabulation of Vertical Azimuth Pattern  
WATP Laurel, MS

Azimuth	Rel Field	Azimuth	Rel Field
0	0.965	180	0.675
10	0.950	190	0.825
20	0.900	200	0.930
30	0.840	210	0.980
40	0.770	220	0.980
45	0.715	225	0.960
50	0.660	230	0.930
60	0.550	240	0.875
70	0.430	250	0.830
80	0.325	260	0.820
90	0.275	270	0.835
100	0.280	280	0.865
110	0.305	290	0.895
120	0.320	300	0.910
130	0.305	310	0.920
135	0.300	315	0.920
140	0.285	320	0.920
150	0.295	330	0.930
160	0.375	340	0.940
170	0.510	350	0.960

HORIZONTAL  
PARASITIC  
REF.



TOP VIEW  
TOWER: ALLIED 2400



SIDE VIEW

SHIVELY LABS			
A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE			
SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY:
25462	90.9	N.T.S.	DAB
TITLE:		APPROVED BY:	
MODEL-6810-8-DIRECTIONAL ANTENNA		ASP	
DATE:		3/1/07	

ANTENNA HEADING: 303° TRUE NORTH

FIGURE 2

Antenna Mfg.: Shively Labs

Antenna Type: 6810-8-DA

Station: WATP

Frequency: 90.9

Channel #: 215

Figure: 3

Date: 4/10/2007

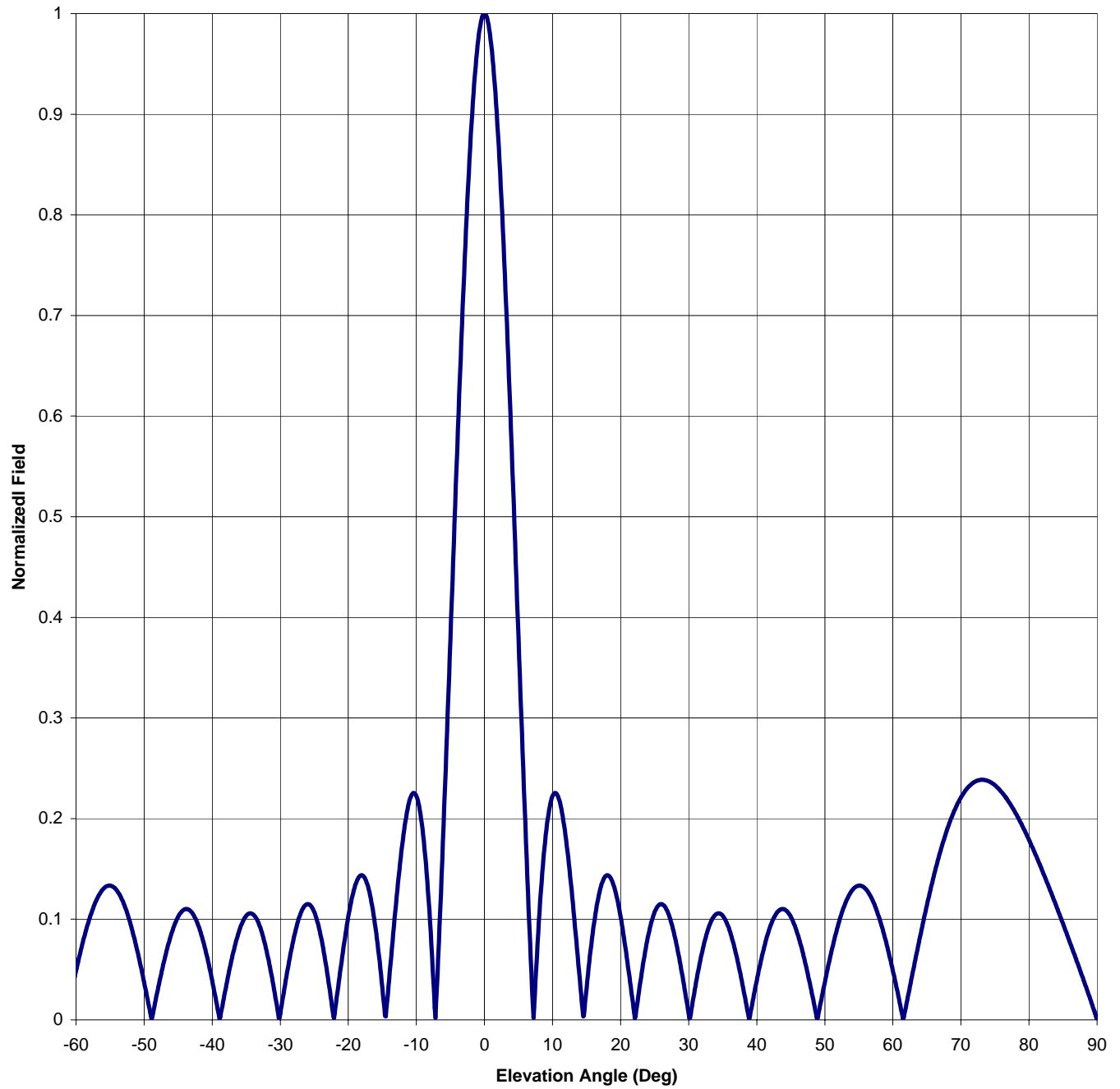
Beam Tilt 0

Gain (Max) 7.745

Gain (Horizon) 7.745

8.890 dB

8.890 dB





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Station: WATP

Beam Tilt 0

Frequency: 90.9

Gain (Max) 7.745

8.890 dB

Channel #: 215

Gain (Horizon) 7.745

8.890 dB

Figure: 3

Angle of Depression (Deg)	Relative Field	Angle of Depression (Deg)	Relative Field	Angle of Depression (Deg)	Relative Field	Angle of Depression (Deg)	Relative Field
-90	0.000	-44	0.110	0	1.000	46	0.085
-89	0.020	-43	0.107	1	0.969	47	0.060
-88	0.040	-42	0.093	2	0.879	48	0.030
-87	0.059	-41	0.070	3	0.740	49	0.004
-86	0.077	-40	0.039	4	0.568	50	0.037
-85	0.095	-39	0.004	5	0.379	51	0.069
-84	0.113	-38	0.032	6	0.195	52	0.095
-83	0.131	-37	0.064	7	0.031	53	0.116
-82	0.147	-36	0.089	8	0.098	54	0.129
-81	0.164	-35	0.103	9	0.183	55	0.133
-80	0.179	-34	0.105	10	0.222	56	0.130
-79	0.193	-33	0.093	11	0.218	57	0.119
-78	0.206	-32	0.068	12	0.178	58	0.101
-77	0.217	-31	0.034	13	0.115	59	0.077
-76	0.226	-30	0.006	14	0.040	60	0.049
-75	0.233	-29	0.047	15	0.032	61	0.017
-74	0.237	-28	0.082	16	0.091	62	0.016
-73	0.239	-27	0.106	17	0.130	63	0.050
-72	0.236	-26	0.115	18	0.144	64	0.083
-71	0.231	-25	0.107	19	0.133	65	0.114
-70	0.221	-24	0.082	20	0.102	66	0.143
-69	0.207	-23	0.042	21	0.058	67	0.168
-68	0.190	-22	0.007	22	0.007	68	0.190
-67	0.168	-21	0.058	23	0.042	69	0.207
-66	0.143	-20	0.102	24	0.082	70	0.221
-65	0.114	-19	0.133	25	0.107	71	0.231
-64	0.083	-18	0.144	26	0.115	72	0.236
-63	0.050	-17	0.130	27	0.106	73	0.239
-62	0.016	-16	0.091	28	0.082	74	0.237
-61	0.017	-15	0.032	29	0.047	75	0.233
-60	0.049	-14	0.040	30	0.006	76	0.226
-59	0.077	-13	0.115	31	0.034	77	0.217
-58	0.101	-12	0.178	32	0.068	78	0.206
-57	0.119	-11	0.218	33	0.093	79	0.193
-56	0.130	-10	0.222	34	0.105	80	0.179
-55	0.133	-9	0.183	35	0.103	81	0.164
-54	0.129	-8	0.098	36	0.089	82	0.147
-53	0.116	-7	0.031	37	0.064	83	0.131
-52	0.095	-6	0.195	38	0.032	84	0.113
-51	0.069	-5	0.379	39	0.004	85	0.095
-50	0.037	-4	0.568	40	0.039	86	0.077
-49	0.004	-3	0.740	41	0.070	87	0.059
-48	0.030	-2	0.879	42	0.093	88	0.040
-47	0.060	-1	0.969	43	0.107	89	0.020
-46	0.085	0	1.000	44	0.110	90	0.000
-45	0.102			45	0.102		

## VALIDATION OF TOTAL POWER GAIN CALCULATION

WATP 90.9 MHz LAUREL, MS

MODEL 6810-8-DA

Elevation Gain of Antenna 4.543

Horizontal RMS value divided by the Vertical RMS value equals the Horiz. - Vert. Ratio

H RMS	0.78	V RMS	0.752	H/V Ratio	1.037
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Elevation Gain of Horizontal Component 4.712

Elevation Gain of Vertical Component 4.380

Horizontal Azimuth Gain equals 1/(RMS)SQ. 1.644

Vertical Azimuth Gain equals 1/(RMS/Max Vert)SQ. 1.733

Max. Vertical 0.99

**\*Total Horizontal Power Gain is the Elevation Gain Times the Azimuth Gain**

Total Horizontal Power Gain = 7.745

**\*Total Vertical Power Gain is the Elevation Gain Times the Azimuth Gain**

Total Vertical Power Gain = 7.591

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ERP divided by Horizontal Power Gain equals Antenna Input Power

69 KW ERP Equals 8.909 KW Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

8.909 KW Times 7.591 KW Equals 67.627 KW ERP

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

0.99 Equals 67.627 KW Vertical ERP

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