

S.O. 24258

Report of Test 6810-4-DA

for

SSR COMMUNICATIONS, INC.

WYAB 93.1 MHz BENTON, MS

## **OBJECTIVE:**

The objective of this test was to demonstrate the directional characteristics of a 6810-4-DA to meet the needs of WYAB and to comply with the requirements of the FCC construction permit, file number BPH-20050131AIX.

## **RESULTS:**

The measured azimuth pattern for the 6810-4-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-20050131AIX indicates that the Horizontal radiation component shall not exceed 6.0 kW at any azimuth and is restricted to the following values at the azimuths specified:

230 Degrees T: 0.95 kW

From Figure 1, the maximum radiation of the Horizontal component occurs at 033 Degrees T to 043 Degrees T, at 98 Degrees T to 133 Degrees T and at 340 Degrees T to 005 Degrees T. At the restricted azimuth of 230 Degrees T the Horizontal component is 8.64 dB down from the maximum of 6.0 kW, or 0.82 kW.

The R.M.S. of the Horizontal component is 0.855. The total Horizontal power gain is 3.132. The R.M.S. of the Vertical component is 0.798. The total Vertical power gain is 3.070. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.910. The R.M.S. of the measured composite pattern is 0.857. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.774. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

**METHOD OF DIRECTIONALIZATION:**

One bay of the 6810-4-DA was mounted on a pole of exact scale to a 10 ¾ inch OD pole at the WYAB site. The spacing of the antenna to the pole was varied and vertical parasitic elements were 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 BPH-20050131AIX, a single level of the 6810-4-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 418.95 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:

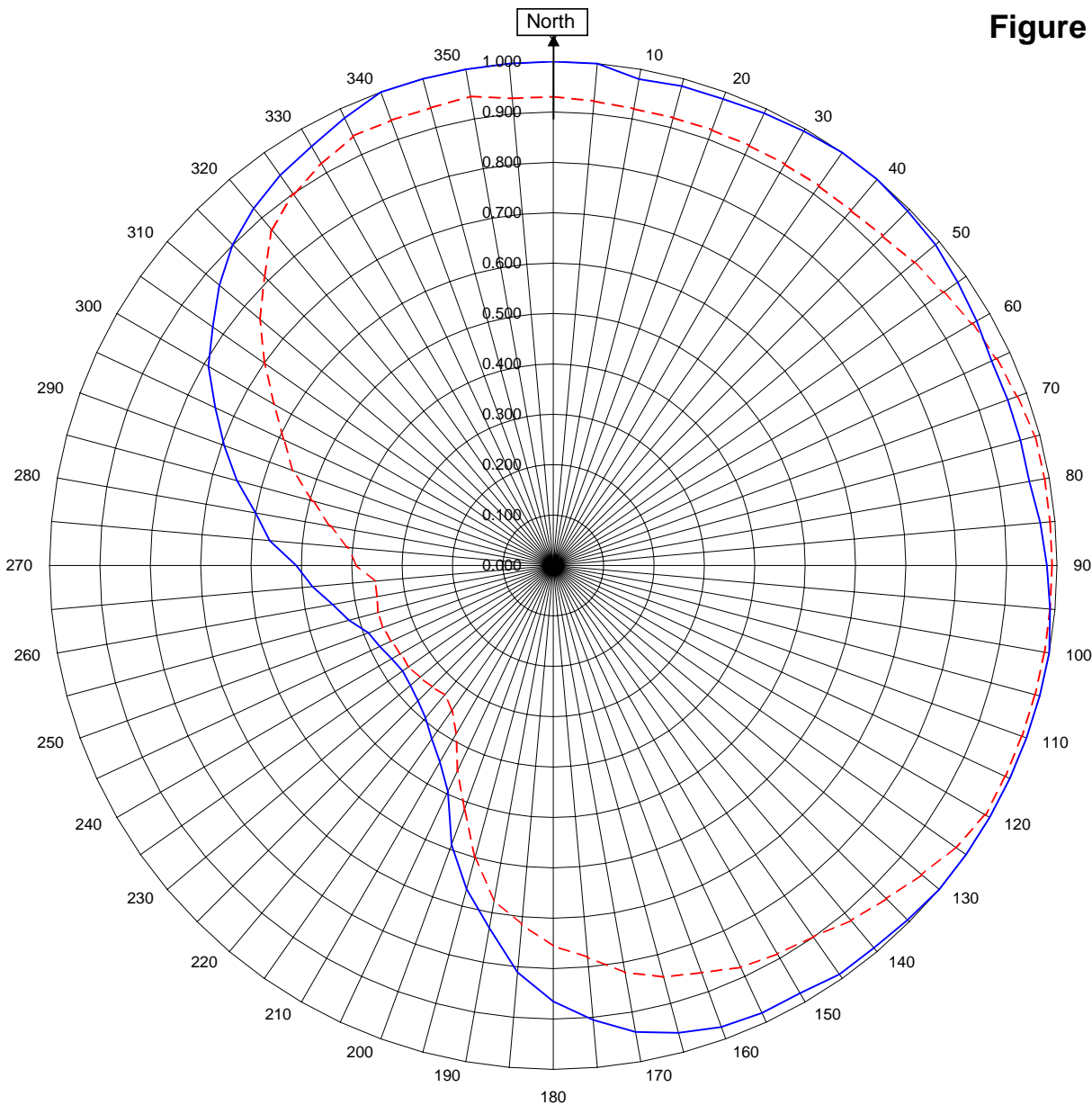
A handwritten signature in blue ink, appearing to read "Robert A. Surette", with a long horizontal flourish extending to the right.

Robert A. Surette  
Manager of RF Engineering  
S/O 24258  
October 3, 2005

# Shively Labs

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

Figure 1



## WYAB Benton, MS

24258  
October 3, 2005

Horizontal RMS	0.855
Vertical RMS	0.798
H/V Composite RMS	0.857

Frequency	93.1 / 418.95 mHz
Plot	Relative Field
Scale	4.5 : 1

Antenna Model	6810-4-DA
Pattern Type	Directional Azimuth

See Figure 2 for Mechanical Details

Figure 1a

Tabulation of Horizontal Azimuth Pattern  
WYAB Benton, MS

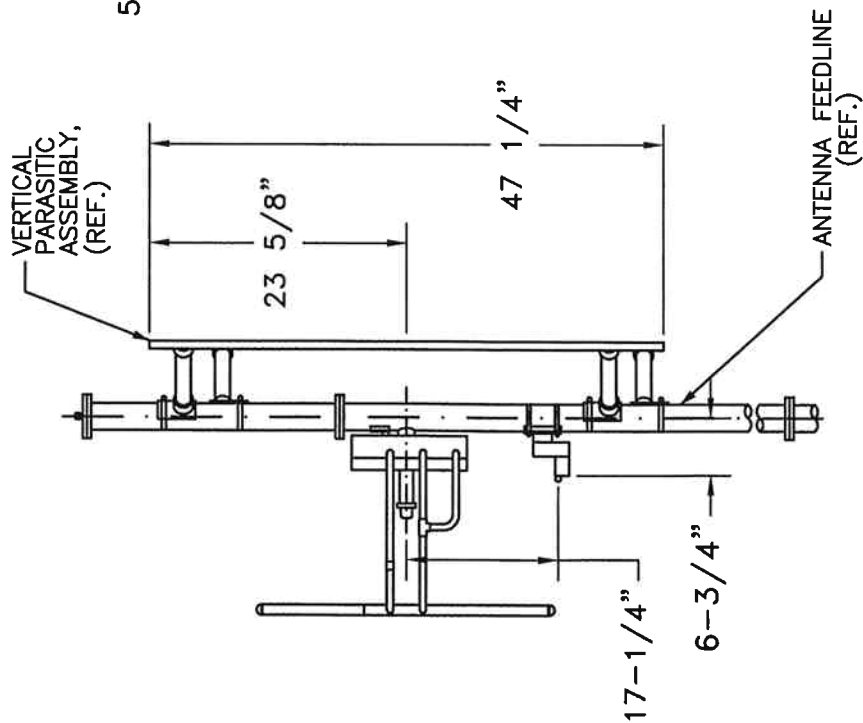
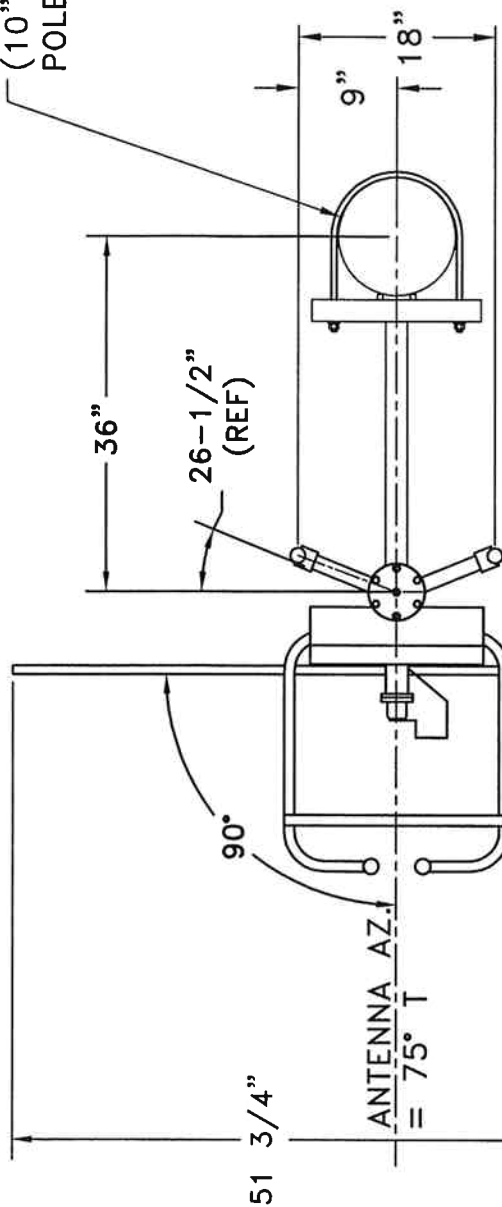
Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	0.865
10	0.980	190	0.730
20	0.985	200	0.590
30	0.995	210	0.450
40	1.000	220	0.395
45	0.995	225	0.380
50	0.990	230	0.370
60	0.970	240	0.370
70	0.960	250	0.390
80	0.960	260	0.445
90	0.980	270	0.510
100	1.000	280	0.600
110	1.000	290	0.695
120	1.000	300	0.790
130	1.000	310	0.865
135	0.995	315	0.900
140	0.990	320	0.925
150	0.980	330	0.960
160	0.975	340	1.000
170	0.940	350	1.000


Figure 1b

Tabulation of Vertical Azimuth Pattern  
WYAB Benton, MS

Azimuth	Rel Field	Azimuth	Rel Field
0	0.930	180	0.755
10	0.920	190	0.675
20	0.920	200	0.515
30	0.920	210	0.385
40	0.920	220	0.335
45	0.925	225	0.340
50	0.935	230	0.345
60	0.960	240	0.350
70	0.980	250	0.360
80	0.990	260	0.355
90	0.990	270	0.390
100	0.990	280	0.450
110	0.990	290	0.550
120	0.990	300	0.640
130	0.955	310	0.760
135	0.935	315	0.810
140	0.920	320	0.870
150	0.890	330	0.920
160	0.860	340	0.940
170	0.820	350	0.945

10 3/4" O.D.  
(10" PIPE)  
POLE, REF.



SHIVELY LABS			
A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE			
SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY:
24258	93.1 MHZ.	N.T.S.	LRA
TITLE:		APPROVED BY:	
MODEL-6810-4-DIRECTIONAL ANTENNA			
DATE:	FIGURE 2		
10/17/05			

Antenna Mfg.: Shively Labs

Antenna Type: 6810-4-DA

Station: WYAB

Frequency: 93.1

Channel #: 226

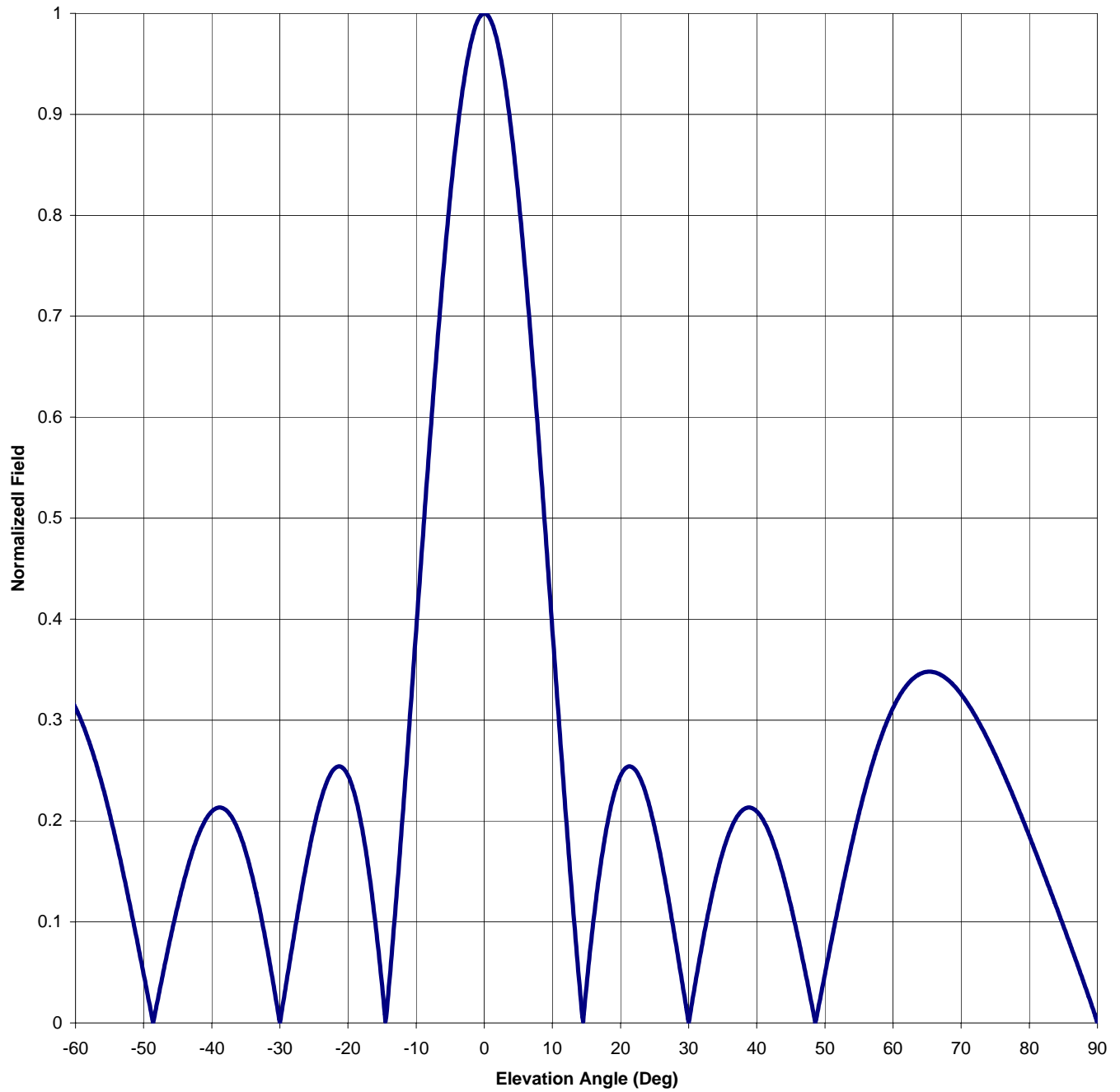
Figure: 3

Date: 10/19/2005

Beam Tilt 0

Gain (Max) 3.132 4.958 dB

Gain (Horizon) 3.132 4.958 dB





Antenna Mfg.: Shively Labs

Date: 10/19/2005

Antenna Type: 6810-4-DA

Station: WYAB

Beam Tilt 0

Frequency: 93.1

Gain (Max) 3.132

4.958 dB

Channel #: 226

Gain (Horizon) 3.132

4.958 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	0.143	0	1.000	46	0.086
-89	0.021	-43	0.166	1	0.992	47	0.054
-88	0.040	-42	0.186	2	0.970	48	0.021
-87	0.059	-41	0.200	3	0.932	49	0.014
-86	0.078	-40	0.210	4	0.882	50	0.048
-85	0.096	-39	0.213	5	0.819	51	0.083
-84	0.114	-38	0.211	6	0.746	52	0.116
-83	0.132	-37	0.203	7	0.664	53	0.148
-82	0.150	-36	0.189	8	0.576	54	0.179
-81	0.168	-35	0.169	9	0.483	55	0.208
-80	0.185	-34	0.144	10	0.389	56	0.234
-79	0.202	-33	0.113	11	0.295	57	0.257
-78	0.219	-32	0.078	12	0.203	58	0.278
-77	0.235	-31	0.040	13	0.116	59	0.297
-76	0.250	-30	0.000	14	0.036	60	0.312
-75	0.265	-29	0.042	15	0.037	61	0.325
-74	0.279	-28	0.084	16	0.100	62	0.334
-73	0.293	-27	0.124	17	0.153	63	0.341
-72	0.305	-26	0.161	18	0.195	64	0.346
-71	0.316	-25	0.194	19	0.226	65	0.348
-70	0.326	-24	0.221	20	0.245	66	0.347
-69	0.334	-23	0.240	21	0.254	67	0.345
-68	0.340	-22	0.252	22	0.252	68	0.340
-67	0.345	-21	0.254	23	0.240	69	0.334
-66	0.347	-20	0.245	24	0.221	70	0.326
-65	0.348	-19	0.226	25	0.194	71	0.316
-64	0.346	-18	0.195	26	0.161	72	0.305
-63	0.341	-17	0.153	27	0.124	73	0.293
-62	0.334	-16	0.100	28	0.084	74	0.279
-61	0.325	-15	0.037	29	0.042	75	0.265
-60	0.312	-14	0.036	30	0.000	76	0.250
-59	0.297	-13	0.116	31	0.040	77	0.235
-58	0.278	-12	0.203	32	0.078	78	0.219
-57	0.257	-11	0.295	33	0.113	79	0.202
-56	0.234	-10	0.389	34	0.144	80	0.185
-55	0.208	-9	0.483	35	0.169	81	0.168
-54	0.179	-8	0.576	36	0.189	82	0.150
-53	0.148	-7	0.664	37	0.203	83	0.132
-52	0.116	-6	0.746	38	0.211	84	0.114
-51	0.083	-5	0.819	39	0.213	85	0.096
-50	0.048	-4	0.882	40	0.210	86	0.078
-49	0.014	-3	0.932	41	0.200	87	0.059
-48	0.021	-2	0.970	42	0.186	88	0.040
-47	0.054	-1	0.992	43	0.166	89	0.021
-46	0.086	0	1.000	44	0.143	90	0.000
-45	0.116			45	0.116		

## VALIDATION OF TOTAL POWER GAIN CALCULATION

WYAB 93.1 MHz BENTON, MS

MODEL 6810-4-DA

Elevation Gain of Antenna 2.137

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

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

H RMS 0.855 V RMS 0.798 H/V Ratio 1.071

Elevation Gain of Horizontal Component 2.290

Elevation Gain of Vertical Component 1.995

Horizontal Azimuth Gain equals  $1/(\text{RMS})^2$ . 1.368Vertical Azimuth Gain equals  $1/(\text{RMS}/\text{Max Vert})^2$ . 1.539

Max. Vertical 0.99

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

Total Horizontal Power Gain = 3.132

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

Total Vertical Power Gain = 3.070

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ERP divided by Horizontal Power Gain equals Antenna Input Power

6 KW ERP Equals 1.916 KW Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

1.916 KW Times 3.070 KW Equals 5.881 KW ERP

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

0.99 Equals 5.881 KW Vertical ERP

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