

S.O. 21380

Report of Test 6810-2R-DA-SPL-CF

for

ENTERCOM BOSTON LICENSE, LLC

WAAF 107.3 MHz WORCESTER, MA

## **OBJECTIVE:**

The objective of this test was to demonstrate the directional characteristics of a 6810-2R-DA-SPL-CF to meet the needs of WAAF and to comply with the requirements of the FCC construction permit, file number BPH-20030228AJE.

## **RESULTS:**

The measured azimuth pattern for the 6810-2R-DA-SPL-CF 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-20030228AJE indicates that the Horizontal radiation component shall not exceed 9.60 kW at any azimuth and is restricted to the following values at the azimuths specified:

40 Degrees T: 6.790 kW

120-140 Degrees T: 0.959 kW

From Figure 1, the maximum radiation of the Horizontal component occurs at 357 Degrees T to 024 Degrees T and at 247 Degrees T to 251 Degrees T. At the restricted azimuth of 40 Degrees T the Vertical component is 1.72 dB down from the maximum of 9.60 kW, or 6.455 kW. At the restricted azimuth of 120-140 Degrees T the Horizontal component is 11.37 dB down from the maximum of 9.60 kW, or 0.700 kW.

The R.M.S. of the Horizontal component is 0.746. The total Horizontal power gain is 1.849. The R.M.S. of the Vertical component is 0.719. The total Vertical power gain is 1.813. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.880. The R.M.S. of the measured composite pattern is 0.772. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.748. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

**METHOD OF DIRECTIONALIZATION:**

One bay of the 6810-2R-DA-SPL-CF was mounted on a tower of exact scale to a Stainless G-7. 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-20030228AJE, a single level of the 6810-2R-DA-SPL-CF 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 482.85 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 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:

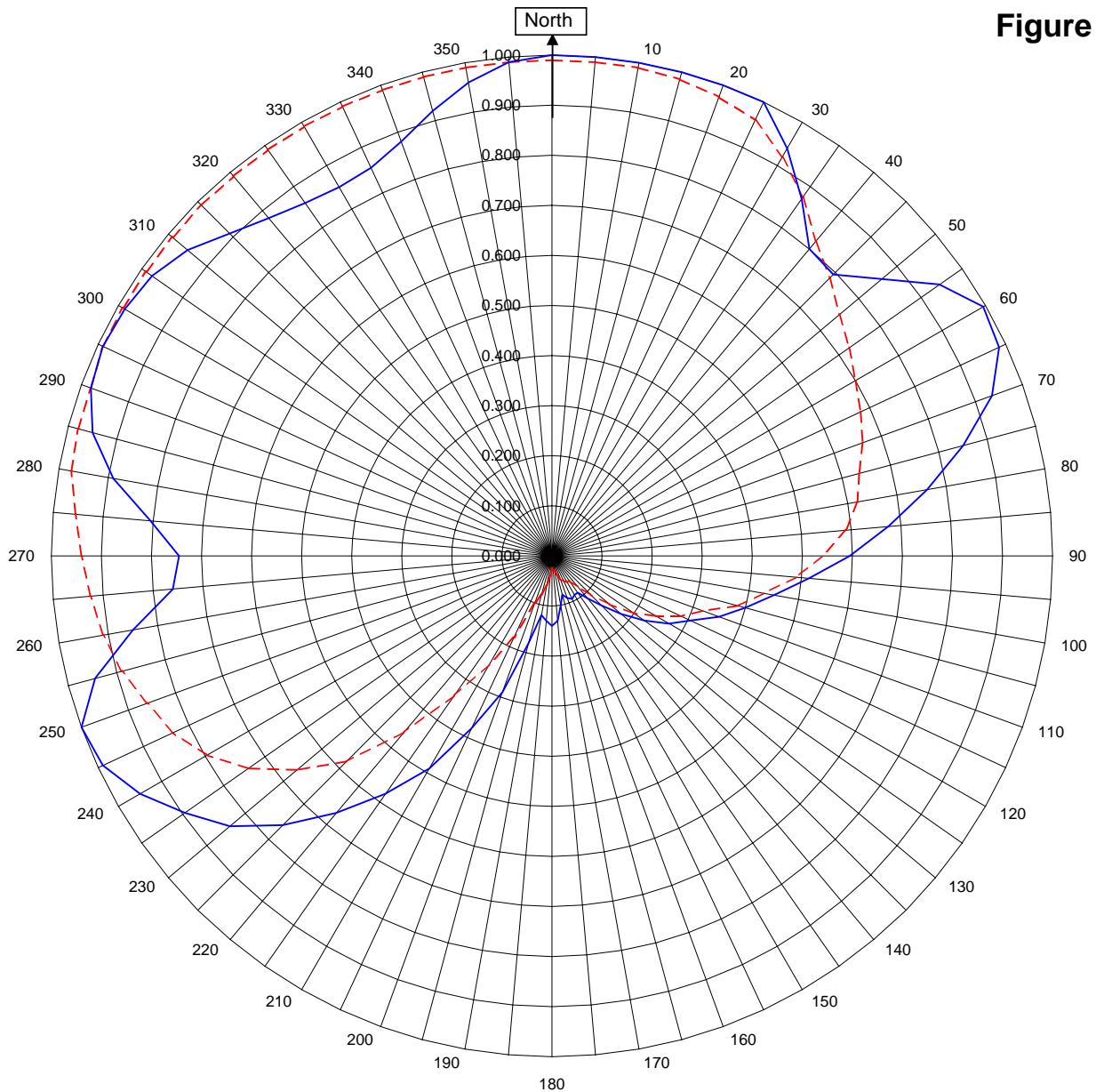


Robert A. Surette  
Manager of RF Engineering  
S/O 21380  
August 12, 2005

# Shively Labs

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

Figure 1



## WAAF Worcester, MA

21380  
August 10, 2005

Horizontal RMS	0.746
Vertical RMS	0.719
H/V Composite RMS	0.772

Frequency	107.3 / 482.85 mHz
Plot	Relative Field
Scale	4.5 : 1

Antenna Model	6810-2R-DA
Pattern Type	Directional Azimuth

See Figure 2 for Mechanical Details

Figure 1a

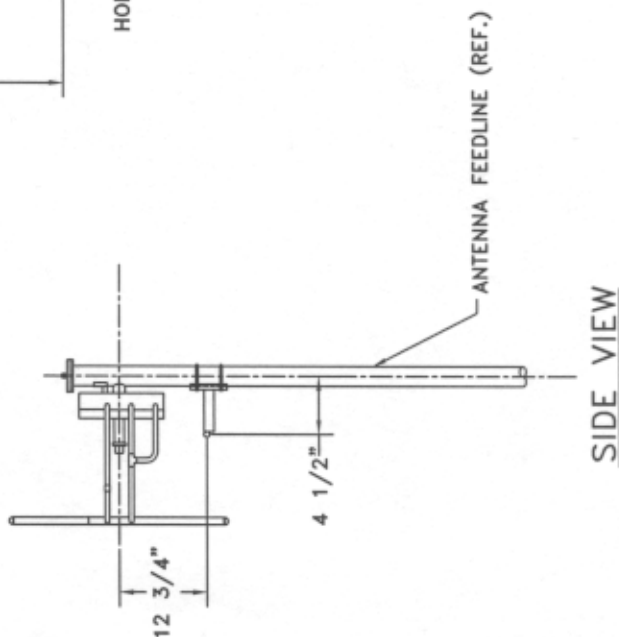
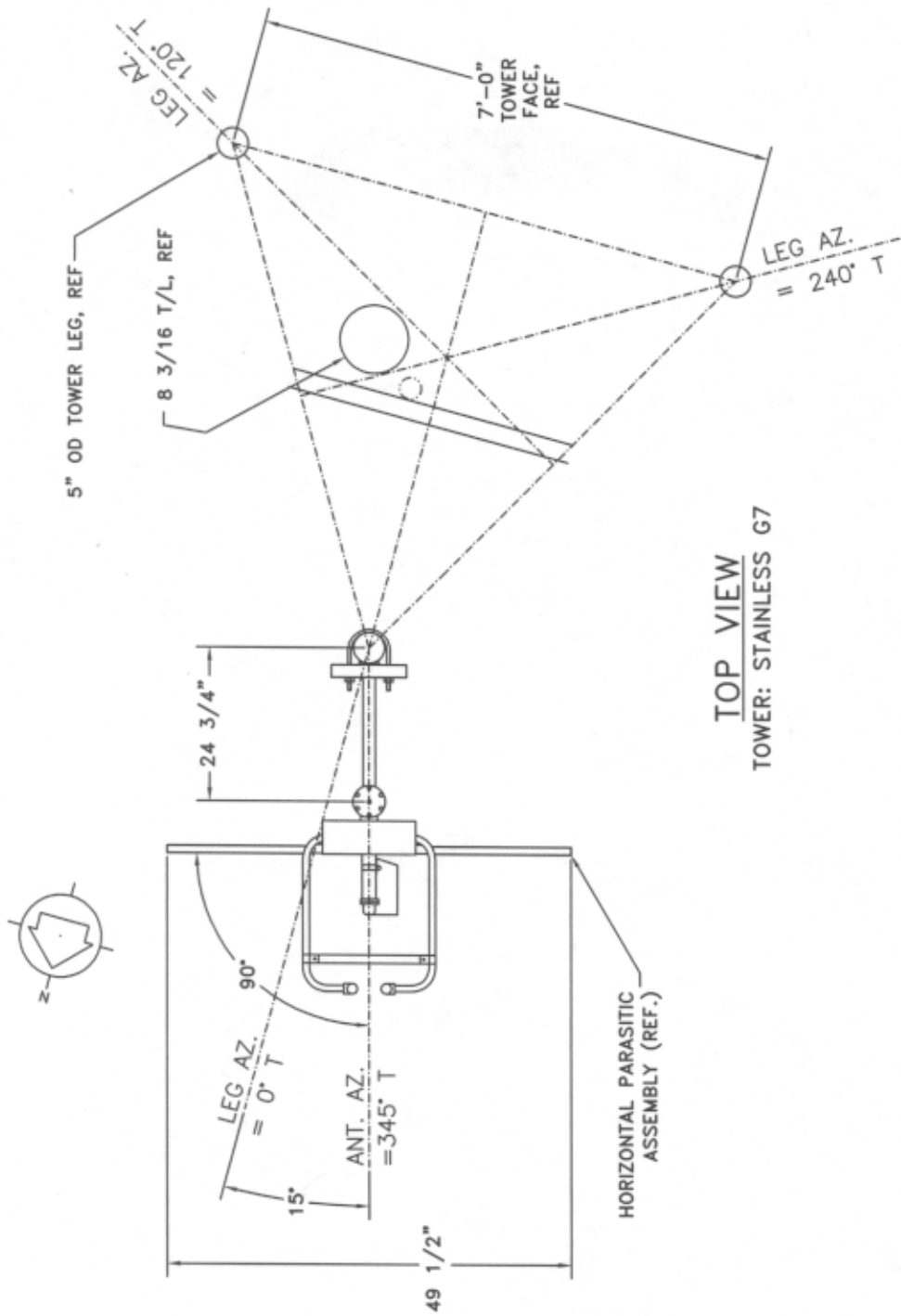
Tabulation of Horizontal Azimuth Pattern  
WAAF Worcester, MA

Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	0.140
10	1.000	190	0.120
20	1.000	200	0.290
30	0.940	210	0.490
40	0.800	220	0.670
45	0.795	225	0.760
50	0.860	230	0.840
60	0.995	240	0.950
70	0.935	250	1.000
80	0.760	260	0.850
90	0.595	270	0.745
100	0.450	280	0.890
110	0.355	290	0.980
120	0.270	300	0.985
130	0.180	310	0.950
135	0.140	315	0.910
140	0.110	320	0.880
150	0.090	330	0.850
160	0.090	340	0.880
170	0.100	350	0.960

Figure 1b

Tabulation of Vertical Azimuth Pattern  
WAAF Worcester, MA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.990	180	0.025
10	0.990	190	0.060
20	0.975	200	0.100
30	0.920	210	0.250
40	0.820	220	0.460
45	0.785	225	0.580
50	0.750	230	0.665
60	0.700	240	0.795
70	0.660	250	0.860
80	0.620	260	0.910
90	0.540	270	0.940
100	0.430	280	0.975
110	0.320	290	0.980
120	0.240	300	0.990
130	0.150	310	0.990
135	0.110	315	0.990
140	0.080	320	0.990
150	0.060	330	0.990
160	0.050	340	0.990
170	0.030	350	0.990



SHIVELY LABS			
A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE			
SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY:
21380	107.3 MHZ.	N.T.S.	ASP
APPROVED BY:			
TITLE:			
MODEL-6810-2R-CF-DIRECTIONAL ANTENNA			
DATE:			
7/29/03			

FIGURE 2

Antenna Mfg.: Shively Labs  
Antenna Type: 6810-2R-DA

Date: 8/10/2005

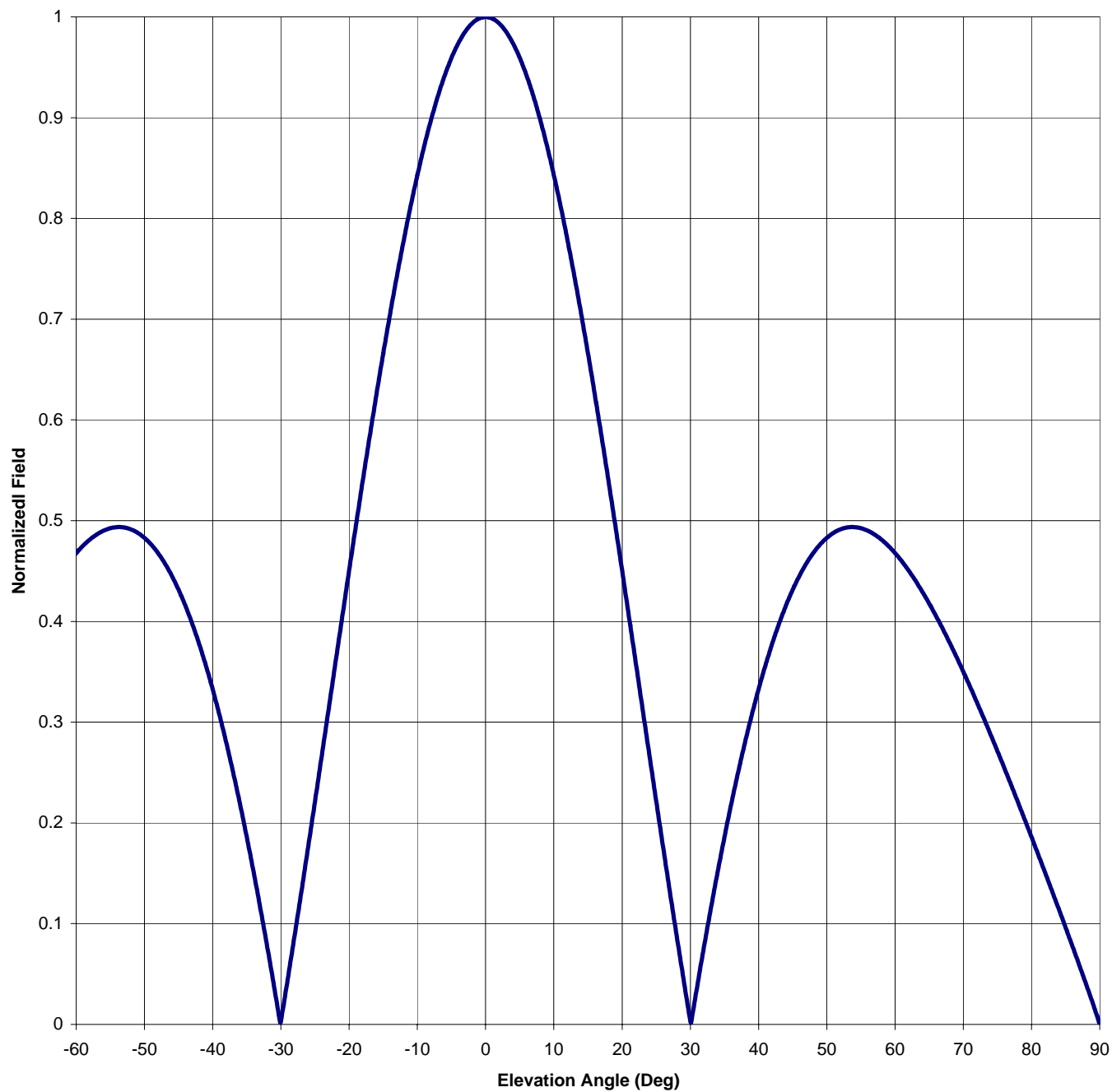
Station: WAAF

Frequency: 107.3

Channel #: 297

Figure: 3

Beam Tilt	0	
Gain (Max)	1.849	2.670 dB
Gain (Horizon)	1.849	2.670 dB





Antenna Mfg.: Shively Labs

Date: 8/10/2005

Antenna Type: 6810-2R-DA

Station: WAAF

Beam Tilt 0

Frequency: 107.3

Gain (Max) 1.849

2.670 dB

Channel #: 297

Gain (Horizon) 1.849

2.670 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	0.416	0	1.000	46	0.445
-89	0.021	-43	0.398	1	0.998	47	0.457
-88	0.040	-42	0.378	2	0.993	48	0.468
-87	0.059	-41	0.356	3	0.985	49	0.476
-86	0.078	-40	0.333	4	0.974	50	0.483
-85	0.096	-39	0.307	5	0.959	51	0.488
-84	0.114	-38	0.280	6	0.942	52	0.491
-83	0.133	-37	0.250	7	0.921	53	0.493
-82	0.150	-36	0.219	8	0.898	54	0.494
-81	0.168	-35	0.186	9	0.872	55	0.492
-80	0.186	-34	0.151	10	0.843	56	0.490
-79	0.203	-33	0.115	11	0.812	57	0.486
-78	0.221	-32	0.077	12	0.778	58	0.481
-77	0.238	-31	0.038	13	0.743	59	0.475
-76	0.255	-30	0.003	14	0.705	60	0.468
-75	0.271	-29	0.045	15	0.666	61	0.460
-74	0.288	-28	0.088	16	0.625	62	0.450
-73	0.304	-27	0.132	17	0.583	63	0.440
-72	0.320	-26	0.176	18	0.540	64	0.429
-71	0.335	-25	0.222	19	0.496	65	0.418
-70	0.350	-24	0.267	20	0.451	66	0.405
-69	0.365	-23	0.313	21	0.405	67	0.392
-68	0.379	-22	0.359	22	0.359	68	0.379
-67	0.392	-21	0.405	23	0.313	69	0.365
-66	0.405	-20	0.451	24	0.267	70	0.350
-65	0.418	-19	0.496	25	0.222	71	0.335
-64	0.429	-18	0.540	26	0.176	72	0.320
-63	0.440	-17	0.583	27	0.132	73	0.304
-62	0.450	-16	0.625	28	0.088	74	0.288
-61	0.460	-15	0.666	29	0.045	75	0.271
-60	0.468	-14	0.705	30	0.003	76	0.255
-59	0.475	-13	0.743	31	0.038	77	0.238
-58	0.481	-12	0.778	32	0.077	78	0.221
-57	0.486	-11	0.812	33	0.115	79	0.203
-56	0.490	-10	0.843	34	0.151	80	0.186
-55	0.492	-9	0.872	35	0.186	81	0.168
-54	0.494	-8	0.898	36	0.219	82	0.150
-53	0.493	-7	0.921	37	0.250	83	0.133
-52	0.491	-6	0.942	38	0.280	84	0.114
-51	0.488	-5	0.959	39	0.307	85	0.096
-50	0.483	-4	0.974	40	0.333	86	0.078
-49	0.476	-3	0.985	41	0.356	87	0.059
-48	0.468	-2	0.993	42	0.378	88	0.040
-47	0.457	-1	0.998	43	0.398	89	0.021
-46	0.445	0	1.000	44	0.416	90	0.000
-45	0.431			45	0.431		

## VALIDATION OF TOTAL POWER GAIN CALCULATION

WAAF Worcester, MA

6810-2R-DA

Elevation Gain of Antenna 0.992

**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 0.746 V RMS 0.719 H/V Ratio 1.038

Elevation Gain of Horizontal Component 1.029

Elevation Gain of Vertical Component 0.956

Horizontal Azimuth Gain equals 1/(RMS)SQ. 1.797

Vertical Azimuth Gain equals 1/(RMS/Max Vert)SQ. 1.896

Max. Vertical 0.99

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

Total Horizontal Power Gain = 1.849

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

Total Vertical Power Gain = 1.813

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ERP divided by Horizontal Power Gain equals Antenna Input Power

9.6 KW ERP Equals 5.191 KW Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

5.191 KW Times 1.813 KW Equals 9.409 KW ERP

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

0.99 Equals 9.409 KW Vertical ERP

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