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S.O. 24612

Report of Test 6810-2D-SS-DA

for

GREAT NORTHERN RADIO, LLC

WBEC-FM 105.5 MHz EASTHAMPTON, MA

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-2D-SS-DA to meet the needs of WBEC-FM and to comply with the requirements of the FCC construction permit, file number BMPH-20051104AAZ.

RESULTS:

The measured azimuth pattern for the 6810-2D-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 BMPH-20051104AAZ indicates that the Horizontal radiation component shall not exceed 0.72 kW at any azimuth and is restricted to the following values at the azimuths specified:

135 - 140 Degrees T: 0.135 kW

From Figure 1, the maximum radiation of the Horizontal component occurs at 216 Degrees T to 257 Degrees T. At the restricted azimuth of 135 - 140 Degrees T the Vertical component is 7.639 dB down from the maximum of 0.72 kW, or 0.124 kW.

The R.M.S. of the Horizontal component is 0.822. The total Horizontal power gain is 1.049. The R.M.S. of the Vertical component is 0.822. The total Vertical power gain is 1.028. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.922. The R.M.S. of the measured composite pattern is 0.840. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.784. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6810-2D-SS-DA was mounted on a pole of exact scale to a 4.5″ pole used at the WBEC-FM transmitter 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 BMPH-20051104AAZ, a single level of the 6810-2D-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 9^{th} 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 474.75 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.

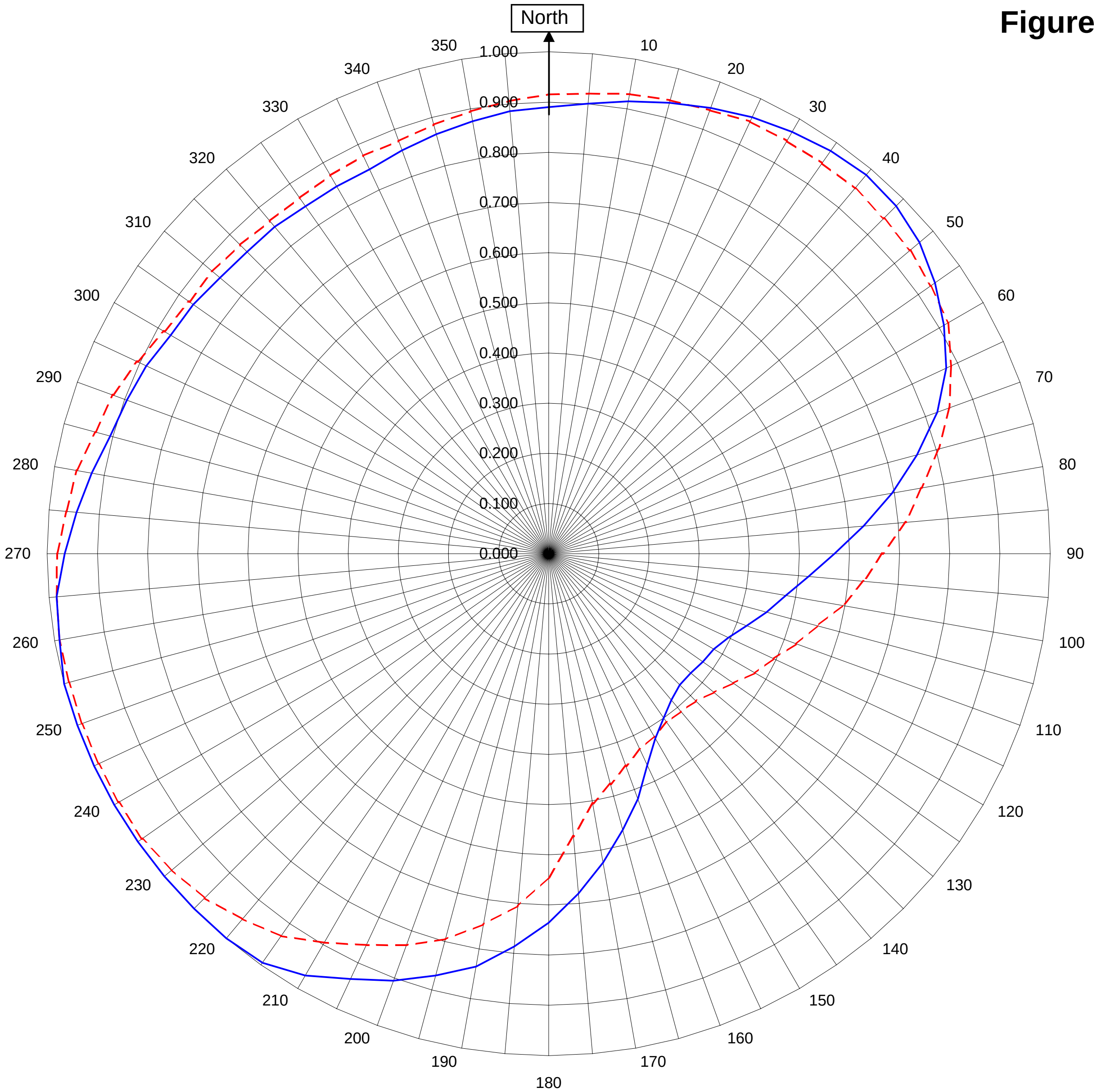
Respectfully submitted by:

Robert A. Surette
Manager of RF Engineering
S/O 24612
March 6, 2006

Shively Labs

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

Figure 1



WBEC-FM
Easthampton, MA

24612

March 6, 2006

Horizontal RMS	0.822
Vertical RMS	0.822
H/V Composite RMS	0.840

Frequency	105.5 / 474.75 mHz
Plot	Relative Field
Scale	4.5 : 1

Antenna Model	6810-2D-SS-DA
Pattern Type	Directional Azimuth

See Figure 2 for Mechanical Details

Figure 1a

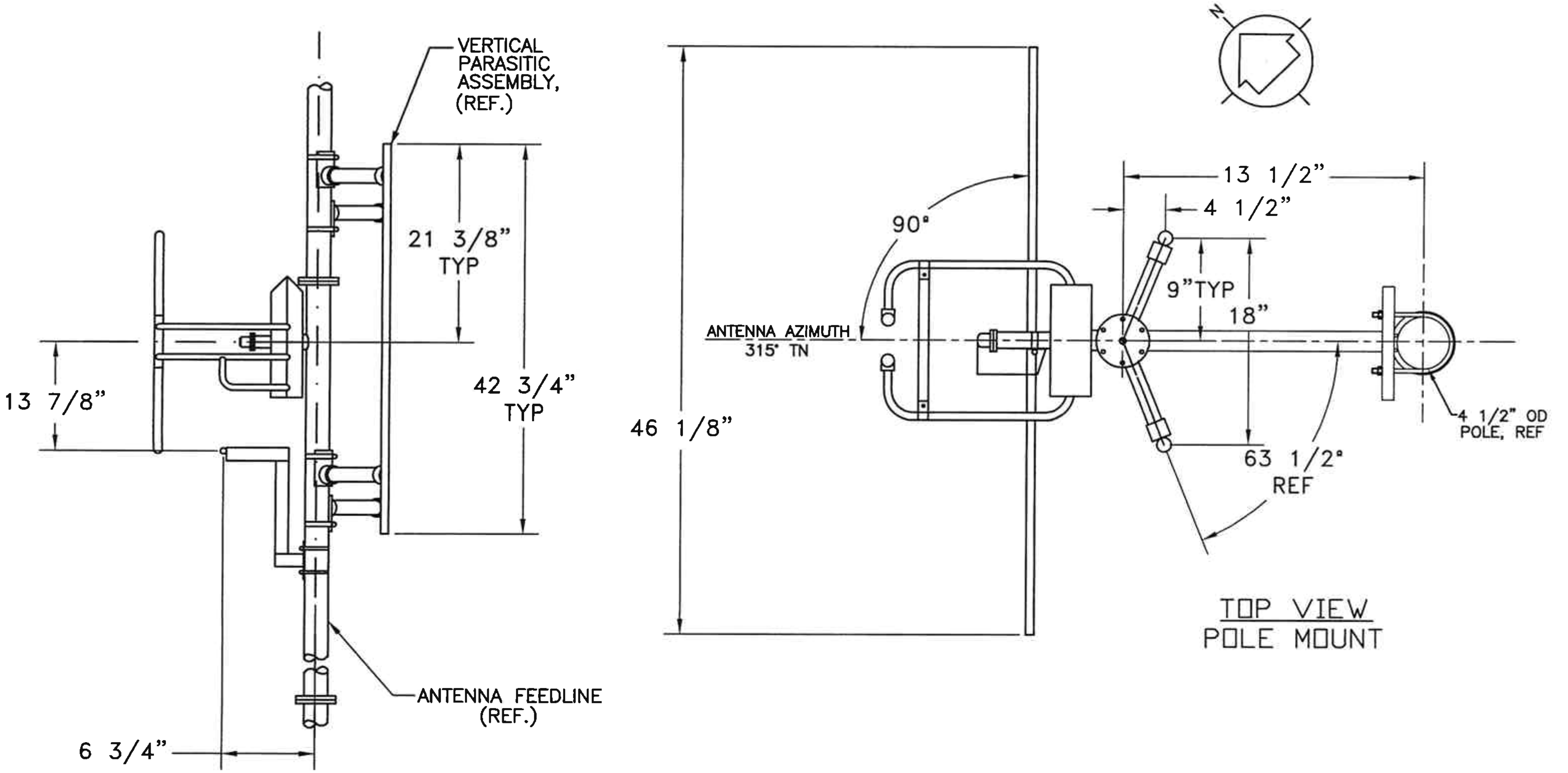
Tabulation of Horizontal Azimuth Pattern
WBEC-FM Easthampton, MA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.890	180	0.735
10	0.915	190	0.835
20	0.945	200	0.905
30	0.970	210	0.970
40	0.985	220	1.000
45	0.980	225	1.000
50	0.965	230	1.000
60	0.910	240	1.000
70	0.825	250	1.000
80	0.695	260	0.990
90	0.570	270	0.965
100	0.480	280	0.925
110	0.420	290	0.895
120	0.380	300	0.870
130	0.370	310	0.855
135	0.370	315	0.850
140	0.380	320	0.850
150	0.425	330	0.845
160	0.520	340	0.855
170	0.625	350	0.875

Figure 1b

Tabulation of Vertical Azimuth Pattern
WBEC-FM Easthampton, MA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.915	180	0.645
10	0.930	190	0.750
20	0.940	200	0.830
30	0.950	210	0.895
40	0.950	220	0.950
45	0.945	225	0.970
50	0.940	230	0.980
60	0.920	240	0.990
70	0.850	250	0.990
80	0.755	260	0.990
90	0.665	270	0.980
100	0.595	280	0.955
110	0.525	290	0.925
120	0.475	300	0.885
130	0.430	310	0.875
135	0.415	315	0.870
140	0.410	320	0.865
150	0.420	330	0.870
160	0.450	340	0.875
170	0.505	350	0.895



SIDE VIEW

TOP VIEW
POLE MOUNT

ANTENNA HEADING 315° TRUE NORTH

SHIVELY LABS A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE			
SHOP ORDER: 24612	FREQUENCY: 105.5	SCALE: N.T.S.	DRAWN BY: LRA APPROVED BY: ASP
TITLE: MODEL-6810-2D-SS-DIRECTIONAL ANTENNA			
DATE: 03/01/06	FIGURE 2		

Antenna Mfg.:	**Shively Labs**			**Date:**	**3/6/2006**
Antenna Type:	**6810-2D-SS-DA**				
Station:	**WBEC-FM**	**Beam Tilt**	**0**		
Frequency:	**105.5**	**Gain (Max)**	**1.049**	**0.206**	**dB**
Channel #:	**288**	**Gain (Horizon)**	**1.049**	**0.206**	**dB**
Figure:	**3**				

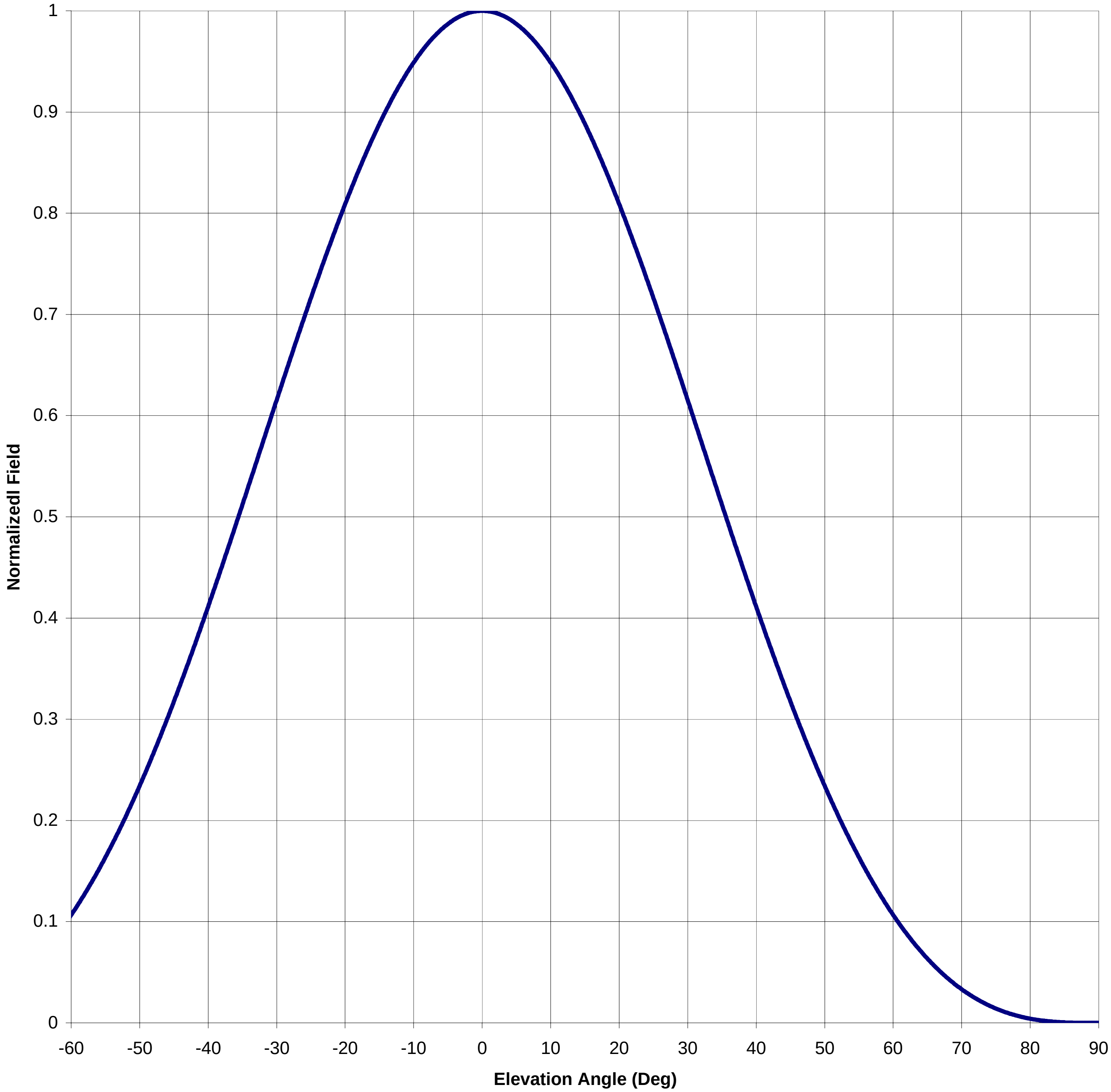


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Figure:	**3**			

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	0.336	0	1.000	46	0.300
-89	0.000	-43	0.354	1	0.999	47	0.283
-88	0.000	-42	0.373	2	0.998	48	0.266
-87	0.000	-41	0.392	3	0.995	49	0.250
-86	0.000	-40	0.411	4	0.992	50	0.234
-85	0.000	-39	0.431	5	0.987	51	0.219
-84	0.001	-38	0.451	6	0.981	52	0.204
-83	0.001	-37	0.471	7	0.975	53	0.190
-82	0.002	-36	0.491	8	0.967	54	0.177
-81	0.003	-35	0.512	9	0.958	55	0.164
-80	0.004	-34	0.533	10	0.949	56	0.151
-79	0.006	-33	0.553	11	0.938	57	0.139
-78	0.007	-32	0.574	12	0.927	58	0.128
-77	0.009	-31	0.595	13	0.915	59	0.117
-76	0.012	-30	0.615	14	0.902	60	0.107
-75	0.014	-29	0.636	15	0.888	61	0.097
-74	0.017	-28	0.656	16	0.874	62	0.088
-73	0.021	-27	0.677	17	0.859	63	0.079
-72	0.024	-26	0.697	18	0.843	64	0.071
-71	0.029	-25	0.716	19	0.826	65	0.063
-70	0.033	-24	0.736	20	0.809	66	0.056
-69	0.038	-23	0.755	21	0.791	67	0.050
-68	0.044	-22	0.773	22	0.773	68	0.044
-67	0.050	-21	0.791	23	0.755	69	0.038
-66	0.056	-20	0.809	24	0.736	70	0.033
-65	0.063	-19	0.826	25	0.716	71	0.029
-64	0.071	-18	0.843	26	0.697	72	0.024
-63	0.079	-17	0.859	27	0.677	73	0.021
-62	0.088	-16	0.874	28	0.656	74	0.017
-61	0.097	-15	0.888	29	0.636	75	0.014
-60	0.107	-14	0.902	30	0.615	76	0.012
-59	0.117	-13	0.915	31	0.595	77	0.009
-58	0.128	-12	0.927	32	0.574	78	0.007
-57	0.139	-11	0.938	33	0.553	79	0.006
-56	0.151	-10	0.949	34	0.533	80	0.004
-55	0.164	-9	0.958	35	0.512	81	0.003
-54	0.177	-8	0.967	36	0.491	82	0.002
-53	0.190	-7	0.975	37	0.471	83	0.001
-52	0.204	-6	0.981	38	0.451	84	0.001
-51	0.219	-5	0.987	39	0.431	85	0.000
-50	0.234	-4	0.992	40	0.411	86	0.000
-49	0.250	-3	0.995	41	0.392	87	0.000
-48	0.266	-2	0.998	42	0.373	88	0.000
-47	0.283	-1	0.999	43	0.354	89	0.000
-46	0.300	0	1.000	44	0.336	90	0.000
-45	0.318			45	0.318		

S.O. 24612 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WBEC-FM 105.5 MHz EASTHAMPTON, MA

MODEL 6810-2D-SS-DA

Elevation Gain of Antenna 0.709

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 0.822 V RMS 0.822 H/V Ratio 1.000

Elevation Gain of Horizontal Component 0.709

Elevation Gain of Vertical Component 0.709

Horizontal Azimuth Gain equals 1/(RMS)SQ. 1.480

Vertical Azimuth Gain equals 1/(RMS/Max Vert)SQ. 1.451
Max. Vertical 0.99

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

Total Horizontal Power Gain = **1.049**

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

Total Vertical Power Gain = **1.028**

==

ERP divided by Horizontal Power Gain equals Antenna Input Power

0.72 KW ERP Equals 0.686 KW Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

0.686 KW Times 1.028 KW Equals 0.706 KW ERP

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

0.99 Equals 0.706 KW Vertical ERP

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