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S.O. 29524

Report of Test 6810-2R-SS(0.5)-DA

For

VERMONT PUBLIC RADIO

WVPA 88.5 MHz ST. JOHNSBURY, VT.

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-2R-SS(0.5)-DA half waved spaced antenna to meet the needs of WVPA and to comply with the requirements of the FCC construction permit, file number BPED-20070821AAA. This test characterizes only the radiation characteristics of the antenna when mounted on the tower as described. It does not represent or imply any guarantee of specific coverage which can be influenced by factors beyond the scope of this test.

RESULTS:

The following Figures are the results of the measurements from our pattern range:

Figure 1A - Measured Azimuth Pattern with the FCC Composite
Figure 1B - Measured Composite Azimuth Pattern with the FCC Composite
Figure 1C - Tabulation of the Horizontal Polarization for the Measured Azimuth Pattern
Figure 1D - Tabulation of the Vertical Polarization for the Measured Azimuth Pattern
Figure 1E - Tabulation of the Measured Composite Azimuth Pattern
Figure 1F - Tabulation of the FCC Composite

The calculated elevation pattern of the antenna is shown in Figure 3.

Construction permit file number BPED-20070821AAA indicates that the Horizontal radiation component shall not exceed 0.85 kW at any azimuth and is restricted to the following values at the azimuths specified:

290 - 300 Degrees T: 0.251 kW

310 - 350 Degrees T: 0.290 kW

From Figure 1A, the maximum radiation of the Horizontal component occurs at 195 Degrees T to 200 Degrees T. At the restricted azimuth of 290 - 300 Degrees T the Horizontal component is 7.23 dB down from the maximum of 0.85 kW, or 0.161 kW and at the restricted azimuth of 310 - 350 Degrees T the horizontal component is 9.42 dB down from the maximum of 0.85 kW, or 0.097 kW.

The R.M.S. of the Horizontal component is 0.758. The total Horizontal power gain is 1.340. The R.M.S. of the Vertical component is 0.689. The total Vertical power gain is 1.250. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.903. The R.M.S. of the measured composite pattern is 0.777. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.768. Therefore this pattern complies with the FCC requirement of 73.316(c) (2) (ix) (A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6810-2R-SS(0.5)-DA antenna was mounted on a tower of precise scale to the Mirco-Flect tower at the WVPA site. The spacing of the antenna to the tower was varied to achieve the vertical pattern shown in Figure 1A. 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 1A was achieved. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BPED-20070821AAA, a single level of the 6810-2R-SS(0.5)-DA antenna was set up on the Shively Labs 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 9th and 10th Editions 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

All testing is carried out in strict accordance with approved procedures under our ISO9001:2008.

TEST PROCEDURES:

The receiving antenna system is mounted so that the horizontal and vertical azimuth patterns are measured independently. The network analyzer was set to 398.25 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 1A.

Respectfully submitted by:

Robert A. Surette
Director of Sales Engineering
S/O 29524
Date May 4, 2012

Shively Labs

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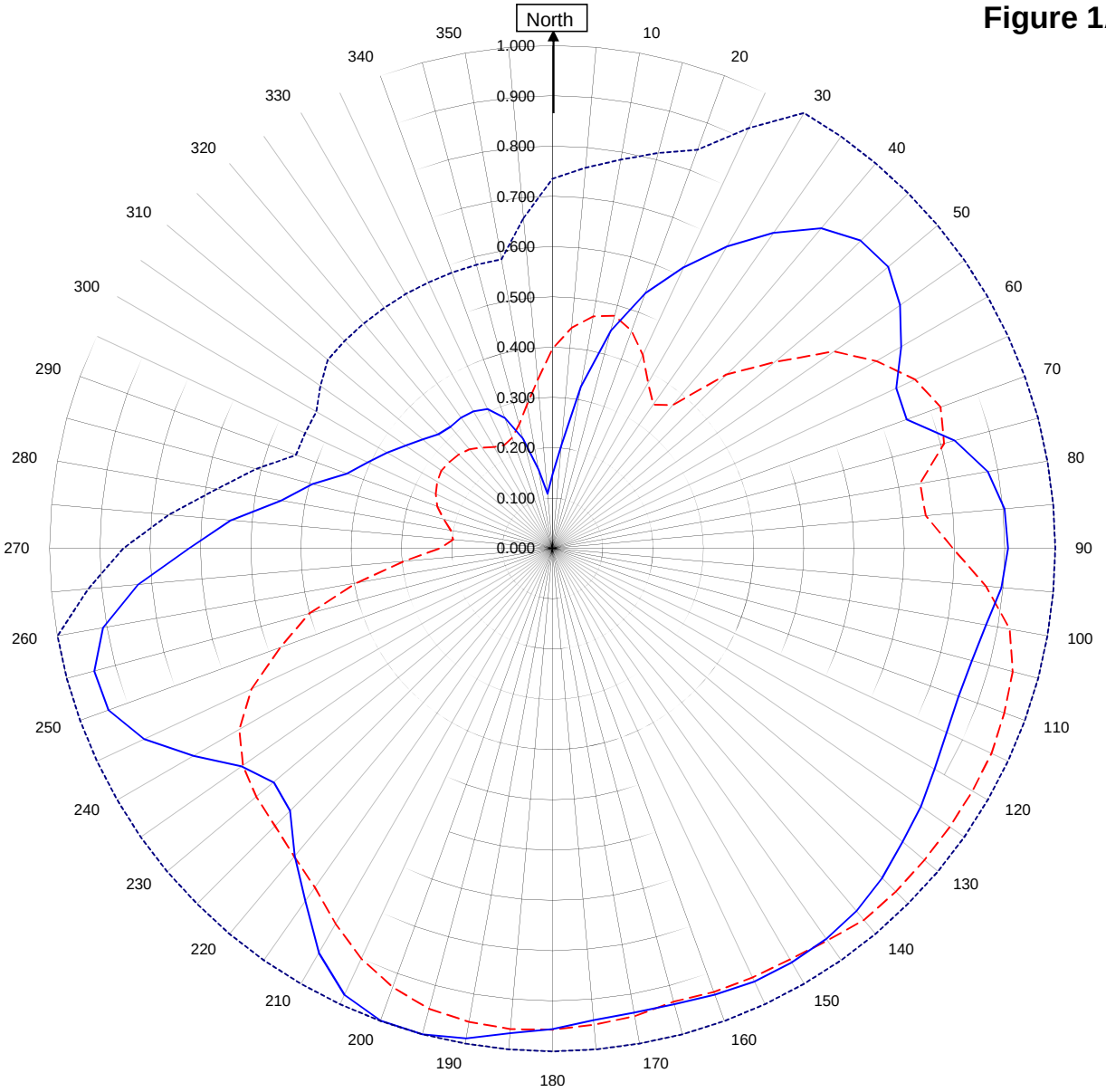
Figure 1A



WVPA ST. JOHNSBURY, VT.

29524

May 4, 2012

Horizontal RMS	0.758
Vertical RMS	0.689
H/V Composite RMS	0.777
FCC Composite RMS	0.903

Frequency	88.5 / 398.25 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

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

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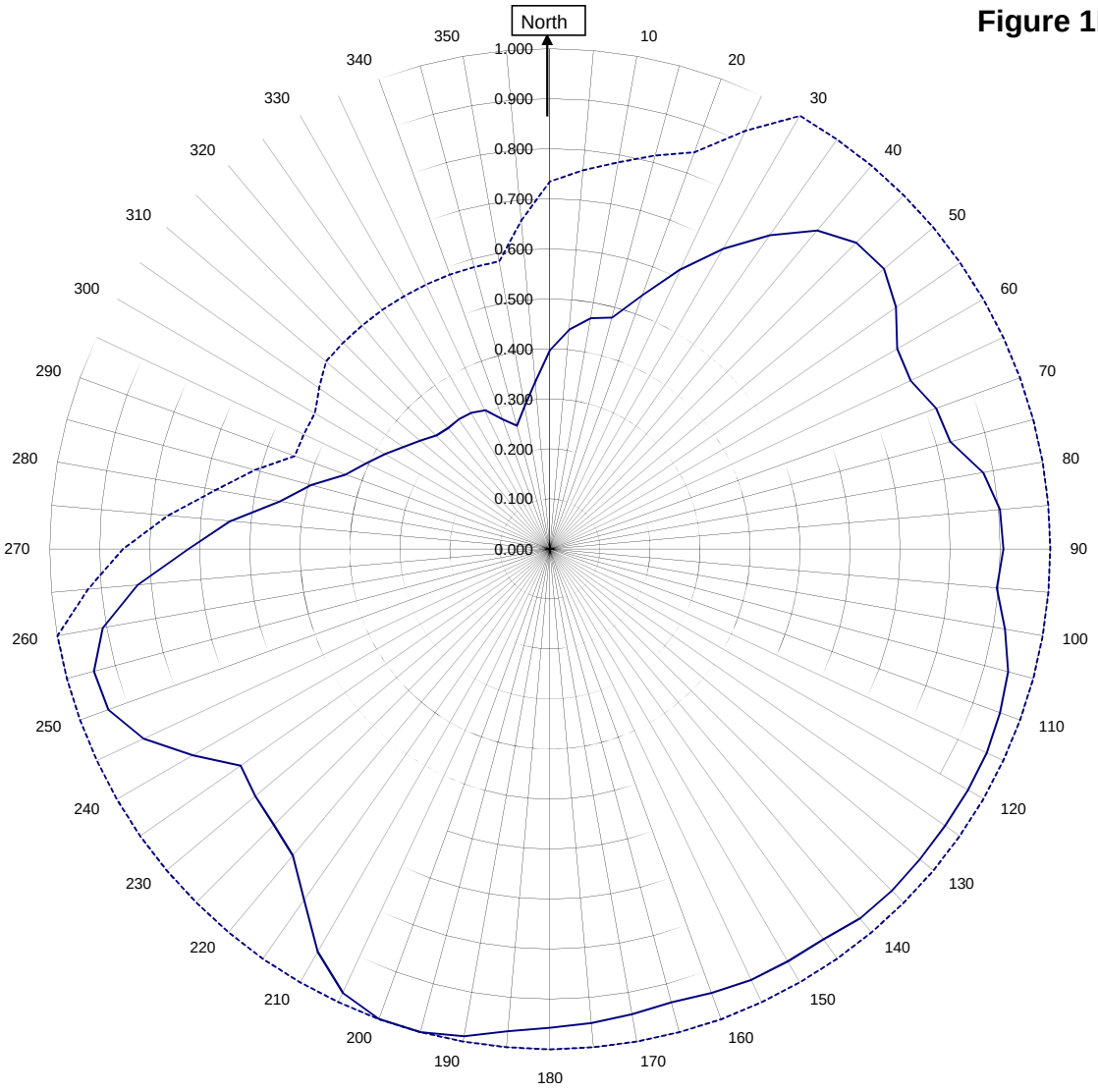
Figure 1B



WVPA ST. JOHNSBURY, VT.

29524

May 4, 2012

_____H/VComposite RMS	0.777
……FCC Composite RMS	0.903

Frequency	88.5 / 398.25 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6810-2R-SS-DA
Pattern Type	Directional H/V Composite

Figure 1C

Tabulation of Horizontal Azimuth Pattern
WVPA ST. JOHNSBURY, VT.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.147	180	0.956
10	0.327	190	0.989
20	0.540	200	1.000
30	0.694	210	0.929
40	0.832	220	0.798
45	0.866	225	0.738
50	0.872	230	0.724
60	0.801	240	0.825
70	0.750	250	0.940
80	0.879	260	0.908
90	0.906	270	0.723
100	0.876	280	0.548
110	0.860	290	0.435
120	0.878	300	0.381
130	0.909	310	0.338
135	0.927	315	0.321
140	0.941	320	0.316
150	0.951	330	0.315
160	0.944	340	0.276
170	0.937	350	0.159

Figure 1D

Tabulation of Vertical Azimuth Pattern
WVPA ST. JOHNSBURY, VT.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.397	180	0.957
10	0.469	190	0.956
20	0.461	200	0.929
30	0.380	210	0.863
40	0.371	220	0.800
45	0.489	225	0.780
50	0.577	230	0.769
60	0.745	240	0.719
70	0.822	250	0.576
80	0.743	260	0.397
90	0.797	270	0.225
100	0.924	280	0.205
110	0.957	290	0.244
120	0.965	300	0.265
130	0.965	310	0.267
135	0.966	315	0.264
140	0.964	320	0.257
150	0.944	330	0.233
160	0.939	340	0.234
170	0.944	350	0.290

Figure 1E

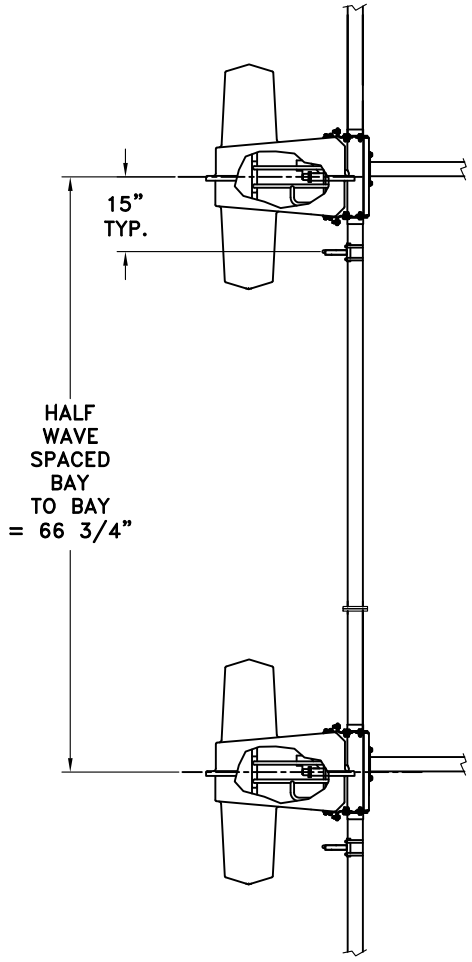
Tabulation of Composite Azimuth Pattern
WVPA ST. JOHNSBURY, VT.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.397	180	0.957
10	0.469	190	0.989
20	0.540	200	1.000
30	0.694	210	0.929
40	0.832	220	0.800
45	0.866	225	0.780
50	0.872	230	0.769
60	0.801	240	0.825
70	0.822	250	0.940
80	0.879	260	0.908
90	0.906	270	0.723
100	0.924	280	0.548
110	0.957	290	0.435
120	0.965	300	0.381
130	0.965	310	0.338
135	0.966	315	0.321
140	0.964	320	0.316
150	0.951	330	0.315
160	0.944	340	0.276
170	0.944	350	0.290

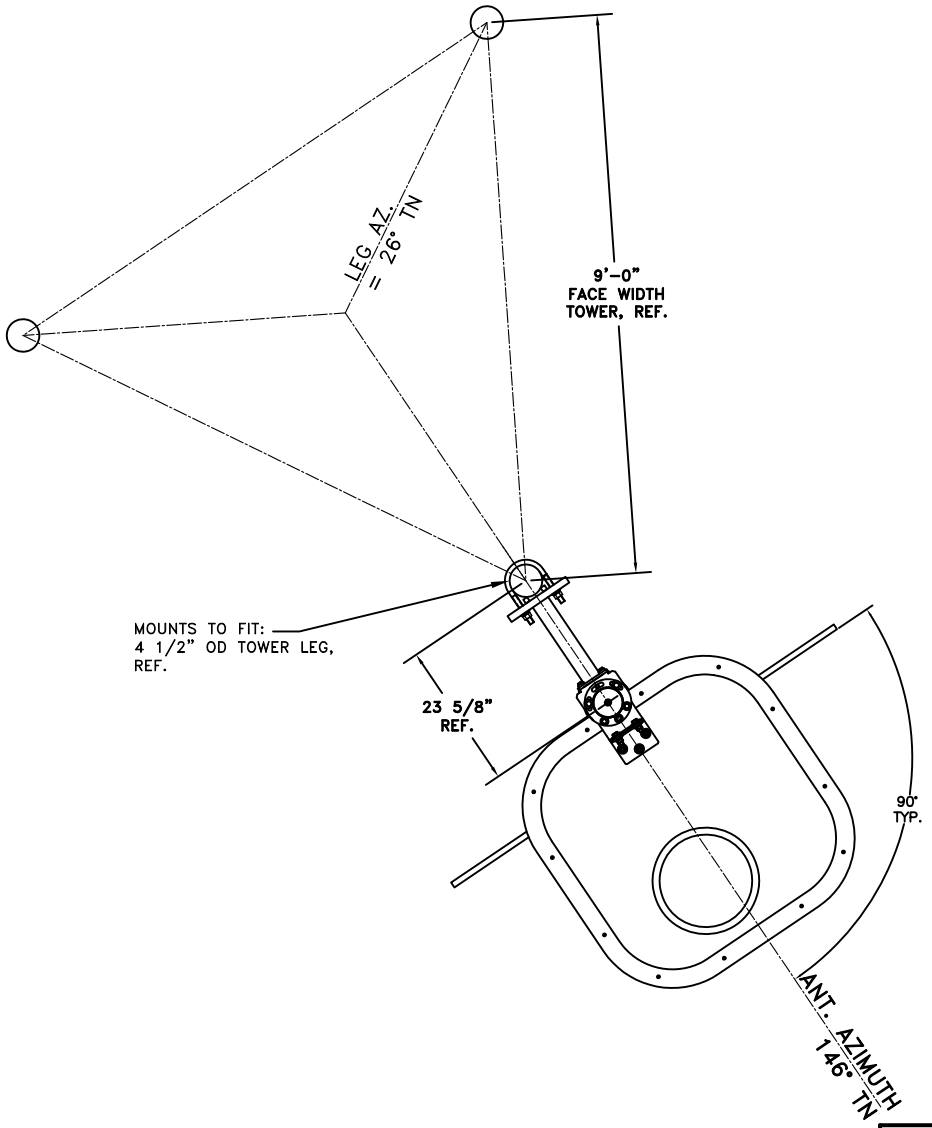
Figure 1F

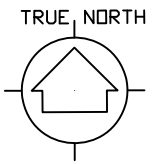
Tabulation of FCC Directional Composite
WVPA ST. JOHNSBURY, VT.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.735	180	1.000
10	0.785	190	1.000
20	0.844	200	1.000
30	1.000	210	1.000
40	1.000	220	1.000
50	1.000	230	1.000
60	1.000	240	1.000
70	1.000	250	1.000
80	1.000	260	1.000
90	1.000	270	0.854
100	1.000	280	0.679
110	1.000	290	0.543
120	1.000	300	0.543
130	1.000	310	0.584
140	1.000	320	0.584
150	1.000	330	0.584
160	1.000	340	0.584
170	1.000	350	0.584



SIDE VIEW





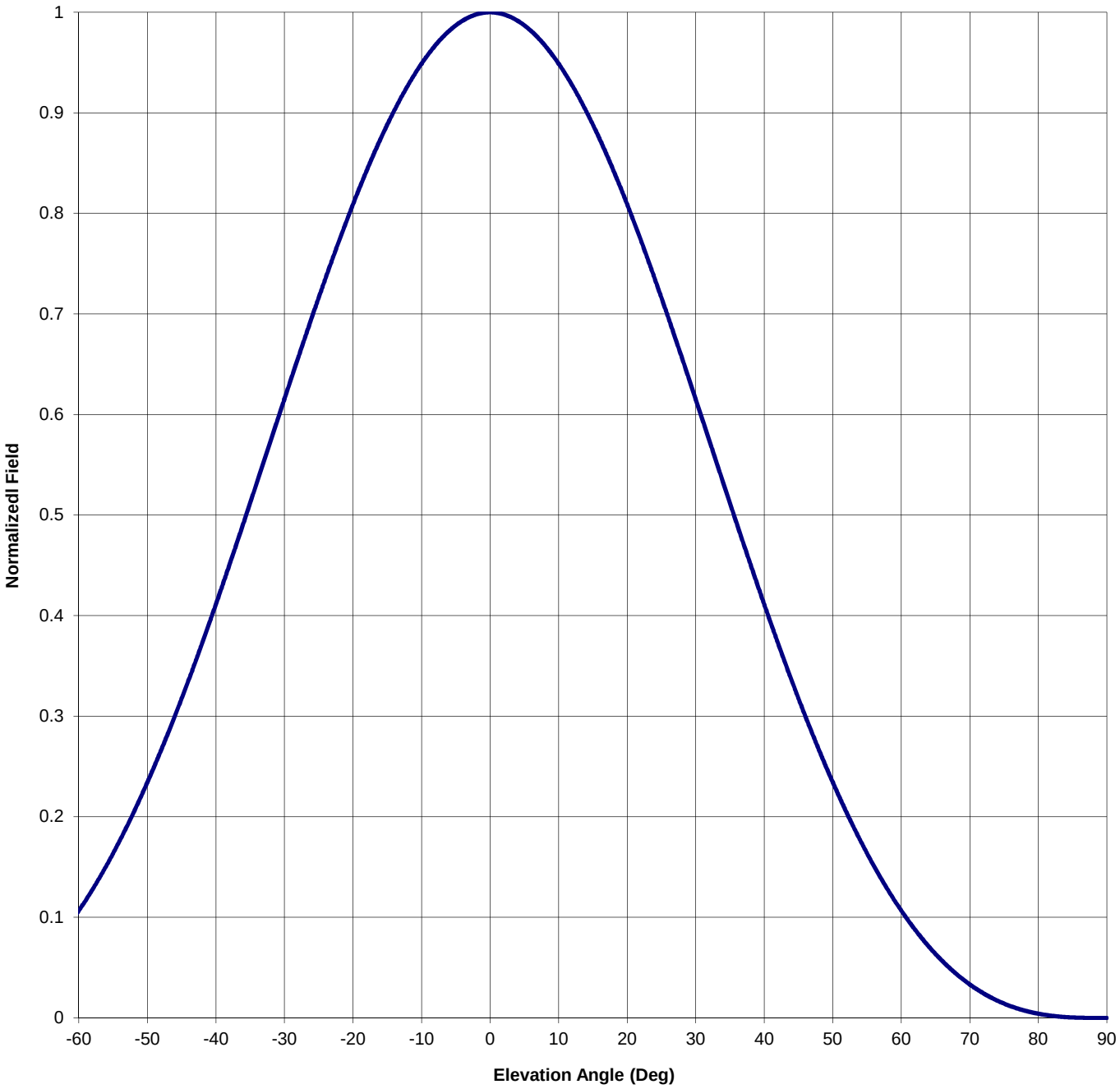
TOP VIEW

TOWER MAKE: MICROFLECT
3ST

ANTENNA HEADING 146° TRUE NORTH

SHIVELY LABS A DIVISION OF HOWELL LABORATORIES INC.,BRIDGTON, MAINE			
SHOP ORDER: 29524	FREQUENCY: 88.5	SCALE: N.T.S.	DRAWN BY: ASP APPROVED BY: DAB
TITLE: MODEL-6810-2R-SS-DIRECTIONAL ANTENNA			
DATE: 4-13-12	FIGURE 2		

Antenna Mfg.:	**Shively Labs**			**Date: 5/4/2012**
Antenna Type:	**6810-2R-SS(0.5)-DA**			
Station:	**WVPA**	**Beam Tilt**	**0**	
Frequency:	**88.5**	**Gain (Max)**	**1.340**	**1.340 dB**
Channel #:	**203**	**Gain (Horizon)**	**1.340**	**1.340 dB**
Figure:	**Figure 3**			



Antenna Mfg.: Shively Labs **Date:** 5/4/2012

Antenna Type: 6810-2R-SS(0.5)-DA

Station: WVPA **Beam Tilt** 0

Frequency: 88.5 **Gain (Max)** 1.340 1.340 dB

Channel #: 203 **Gain (Horizon)** 1.340 1.340 dB

Figure: 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	0.492	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	0.064
-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	0.064	-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	0.492	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. 29524 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WVPA ST. JOHNSBURY, VT.

MODEL 6810-2R-SS-DA

Elevation Gain of Antenna 0.7

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

H RMS 0.758197 V RMS 0.689112 H/V Ratio 1.100

Elevation Gain of Horizontal Component 0.770

Elevation Gain of Vertical Component 0.636

Horizontal Azimuth Gain equals $1/(RMS)^2$. 1.740

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 1.965

Max. Vertical 0.966

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

Total Horizontal Power Gain = **1.340**

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

Total Vertical Power Gain = **1.250**

==========

ERP divided by Horizontal Power Gain equals Antenna Input Power

0.85 kW ERP Divided by H Gain 1.340 equals 0.634 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

0.634 kW Times V Gain 1.250 equals 0.793 kW V ERP

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

(0.966)^2 Times 0.85 Equals 0.793 kW Vertical ERP

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