Shively Labs
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S.O. 29912

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

for

Vermont Public Radio

WVBA 88.9MHz Brattleboro, VT

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-2R-SS(0.5)-DA to meet the needs of WVBA and to comply with the requirements of the FCC construction permit, file number BMPED-20110922ACG. 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 BMPED-20110922ACG indicates that the Horizontal radiation component shall not exceed 8.9 kW at any azimuth and is restricted to the following values at the azimuths specified:

20 Degrees T: 2.15 kW
320 Degrees T: 1.600 kW
350 Degrees T: 1.450 kW

From Figure 1A, the maximum radiation of the Horizontal component occurs at 155 Degrees T to 161 Degrees T. At the restricted azimuth of 20 Degrees T the Horizontal component is 11.701 dB down from the maximum of 8.9 kW, or 0.602 kW, at the restricted azimuth of 320 Degrees T the horizontal component is 8.826 dB down from the maximum of 8.9 kW, or 1.166 kW. and at the restricted azimuth of 350 Degrees T the horizontal component is 16.832 dB down from the maximum of 8.9 kW, or 0.185 kW.

The R.M.S. of the Horizontal component is 0.665. The total Horizontal power gain is 1.712. The R.M.S. of the Vertical component is 0.615. The total Vertical power gain is 1.641. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.801. The R.M.S. of the measured composite pattern is 0.694. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.681. 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 was mounted on a tower of precise scale to the Pirod SSV tower at the WVBA 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 BMPED-20110922ACG, a single level of the 6810-2R-SS(0.5)-DA 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 400.05 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 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 29912
May 25, 2012

Shively Labs

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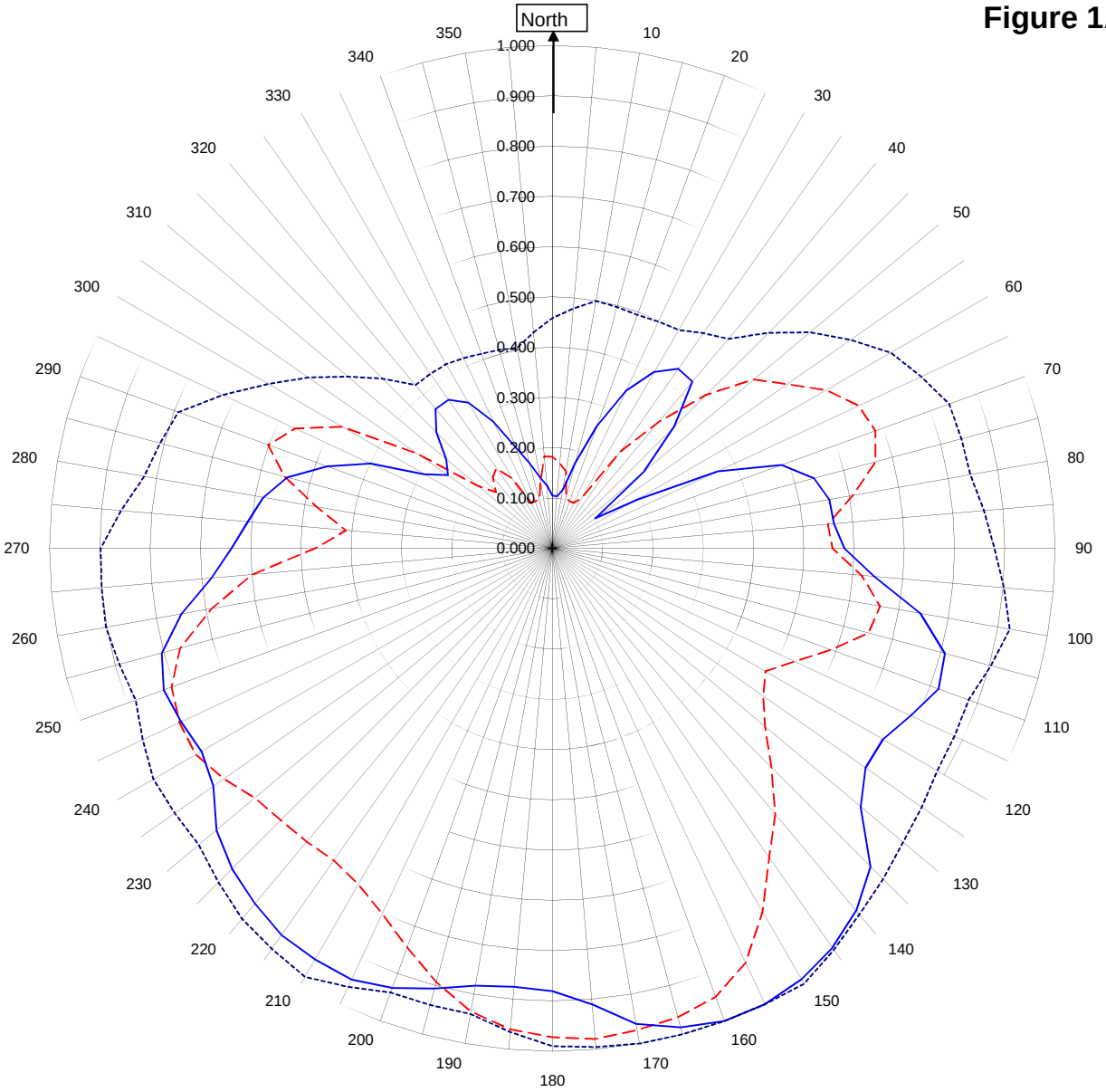
Figure 1A



WVBA BRATTLEBORO,VT

29912

May 25, 2012

Horizontal RMS	0.665
Vertical RMS	0.615
H/V Composite RMS	0.694
FCC Composite RMS	0.801

Frequency	88.9 / 400.05 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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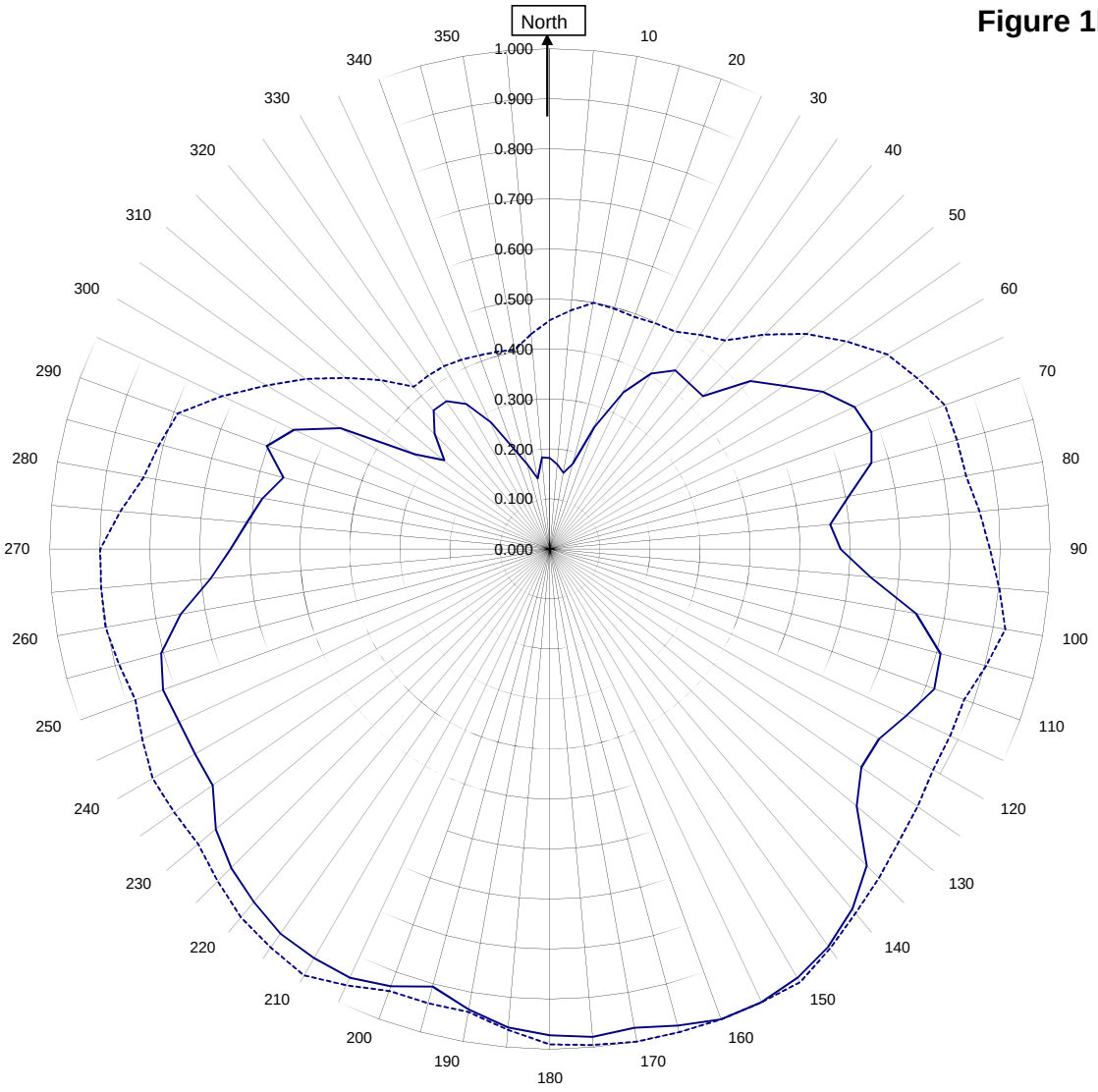
Figure 1B



WVBA BRATTLEBORO,VT

29912

May 25, 2012

_____H/VComposite RMS	0.694
……FCC Composite RMS	0.801

Frequency	88.9 / 400.05 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
WVBA BRATTLEBORO,VT

Azimuth	Rel Field	Azimuth	Rel Field
0	0.105	180	0.880
10	0.119	190	0.883
20	0.260	200	0.930
30	0.405	210	0.944
40	0.433	220	0.921
45	0.342	225	0.901
50	0.237	230	0.872
60	0.194	240	0.806
70	0.485	250	0.823
80	0.559	260	0.750
90	0.581	270	0.638
100	0.743	280	0.584
110	0.817	290	0.477
120	0.759	300	0.296
130	0.800	310	0.276
135	0.895	315	0.327
140	0.940	320	0.362
150	0.990	330	0.335
160	1.000	340	0.215
170	0.960	350	0.144

Figure 1D

Tabulation of Vertical Azimuth Pattern
WVBA BRATTLEBORO,VT

Azimuth	Rel Field	Azimuth	Rel Field
0	0.182	180	0.972
10	0.155	190	0.935
20	0.100	200	0.845
30	0.115	210	0.772
40	0.328	220	0.761
45	0.432	225	0.764
50	0.523	230	0.772
60	0.629	240	0.819
70	0.684	250	0.806
80	0.607	260	0.689
90	0.557	270	0.472
100	0.662	280	0.477
110	0.590	290	0.602
120	0.489	300	0.484
130	0.552	310	0.194
135	0.616	315	0.159
140	0.689	320	0.185
150	0.835	330	0.161
160	0.949	340	0.100
170	0.972	350	0.137

Figure 1E

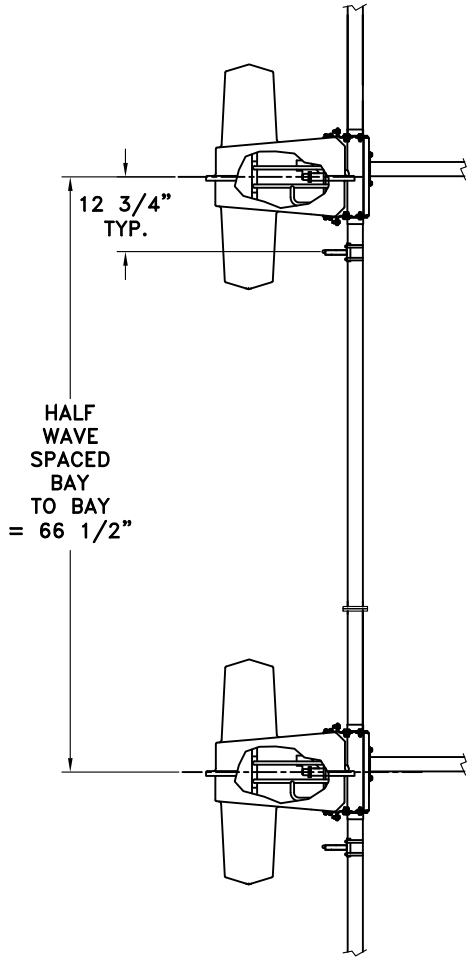
Tabulation of Composite Azimuth Pattern
WVBA BRATTLEBORO,VT

Azimuth	Rel Field	Azimuth	Rel Field
0	0.182	180	0.972
10	0.155	190	0.935
20	0.260	200	0.930
30	0.405	210	0.944
40	0.433	220	0.921
45	0.432	225	0.901
50	0.523	230	0.872
60	0.629	240	0.819
70	0.684	250	0.823
80	0.607	260	0.750
90	0.581	270	0.638
100	0.743	280	0.584
110	0.817	290	0.602
120	0.759	300	0.484
130	0.800	310	0.276
135	0.895	315	0.327
140	0.940	320	0.362
150	0.990	330	0.335
160	1.000	340	0.215
170	0.972	350	0.144

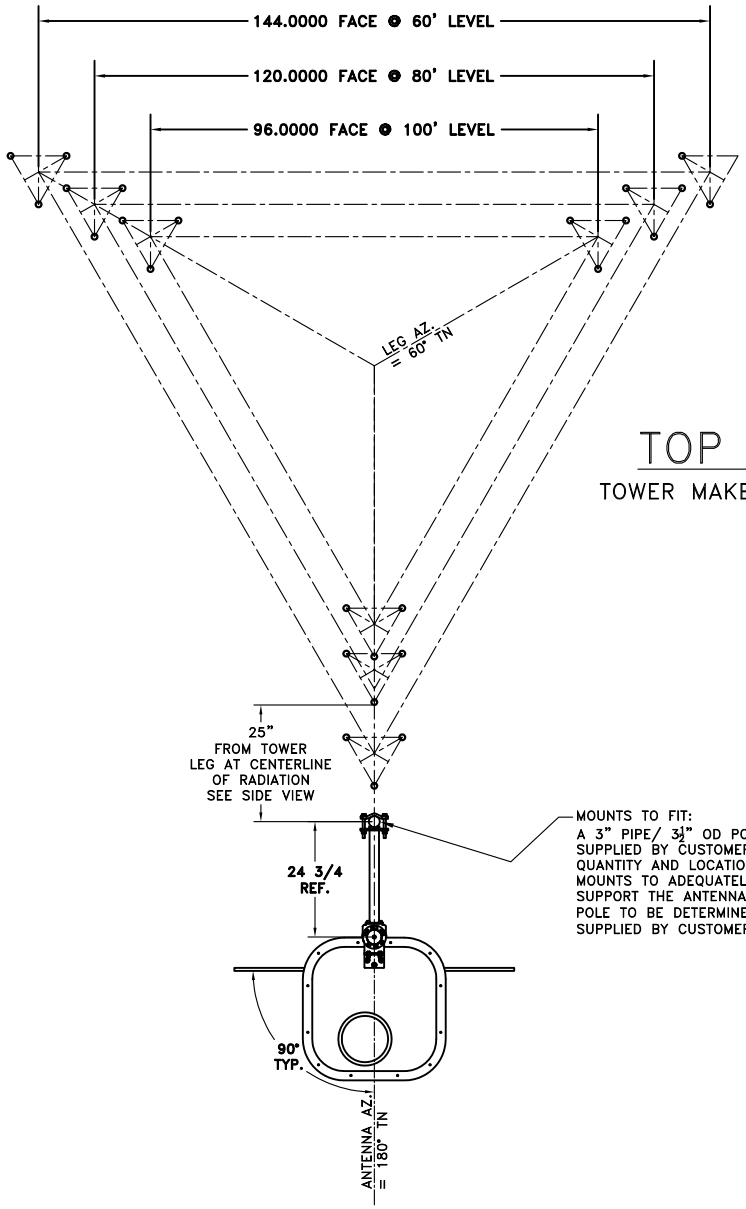
Figure 1F

Tabulation of FCC Directional Composite
WVBA BRATTLEBORO,VT

Azimuth	Rel Field	Azimuth	Rel Field
0	0.458	180	0.990
10	0.500	190	0.940
20	0.494	200	0.940
30	0.502	210	0.984
40	0.544	220	0.961
50	0.669	230	0.918
60	0.778	240	0.917
70	0.840	250	0.882
80	0.844	260	0.902
90	0.879	270	0.899
100	0.924	280	0.825
110	0.881	290	0.792
120	0.884	300	0.654
130	0.910	310	0.532
140	0.950	320	0.424
150	1.000	330	0.423
160	1.000	340	0.412
170	1.000	350	0.405

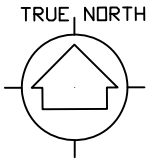


SIDE VIEW



TOP VIEW

TOWER MAKE: PIROD SSV



ANTENNA HEADING 180° TRUE NORTH

SHIVELY LABS
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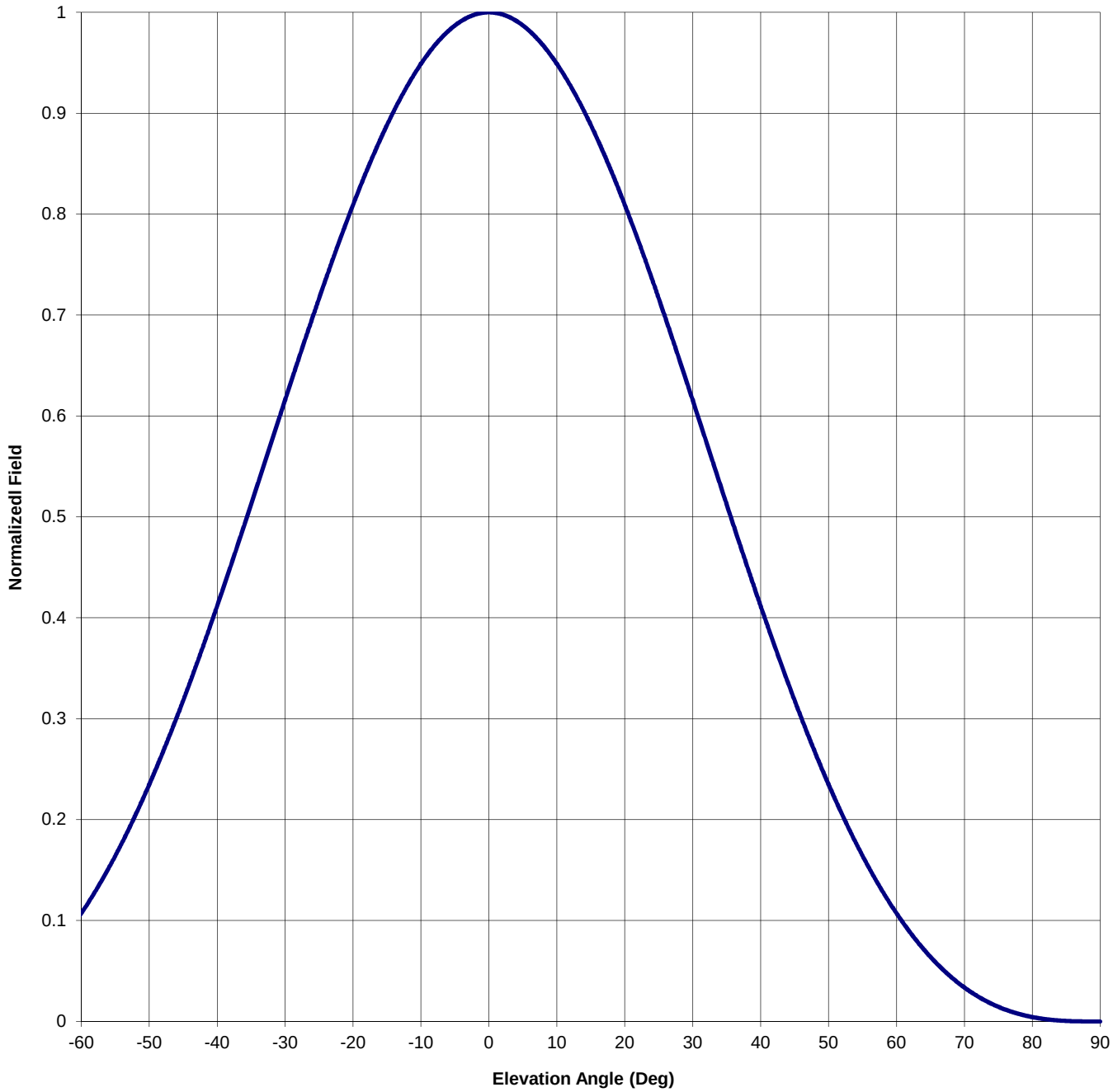
SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY:
29912	88.9	N.T.S.	ASP
			APPROVED BY: DAB

TITLE: MODEL-6810-2R-SS-DIRECTIONAL ANTENNA

DATE: 4-18-12

FIGURE 2

Antenna Mfg.:	**Shively Labs**			**Date:**	**5/22/2012**
Antenna Type:	**6810-2R-SS(0.5)-DA**				
Station:	**WVBA**	**Beam Tilt**	**0**		
Frequency:	**88.9**	**Gain (Max)**	**1.712**	**2.335**	**dB**
Channel #:	**205**	**Gain (Horizon)**	**1.712**	**2.335**	**dB**
Figure:	**Figure 3**				



Antenna Mfg.: Shively Labs **Date:** 5/22/2012

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

Station: WVBA **Beam Tilt** 0

Frequency: 88.9 **Gain (Max)** 1.712 2.335 dB

Channel #: 205 **Gain (Horizon)** 1.712 2.335 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	0.301
-89	0.000	-43	0.355	1	0.999	47	0.283
-88	0.000	-42	0.373	2	0.998	48	0.267
-87	0.000	-41	0.392	3	0.995	49	0.251
-86	0.000	-40	0.412	4	0.992	50	0.235
-85	0.001	-39	0.432	5	0.987	51	0.220
-84	0.001	-38	0.451	6	0.981	52	0.205
-83	0.001	-37	0.472	7	0.975	53	0.191
-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	0.152
-79	0.006	-33	0.554	11	0.939	57	0.140
-78	0.008	-32	0.574	12	0.927	58	0.128
-77	0.010	-31	0.595	13	0.915	59	0.117
-76	0.012	-30	0.616	14	0.902	60	0.107
-75	0.015	-29	0.636	15	0.888	61	0.097
-74	0.018	-28	0.657	16	0.874	62	0.088
-73	0.021	-27	0.677	17	0.859	63	0.080
-72	0.025	-26	0.697	18	0.843	64	0.072
-71	0.029	-25	0.717	19	0.826	65	0.064
-70	0.034	-24	0.736	20	0.809	66	0.057
-69	0.039	-23	0.755	21	0.792	67	0.050
-68	0.044	-22	0.774	22	0.774	68	0.044
-67	0.050	-21	0.792	23	0.755	69	0.039
-66	0.057	-20	0.809	24	0.736	70	0.034
-65	0.064	-19	0.826	25	0.717	71	0.029
-64	0.072	-18	0.843	26	0.697	72	0.025
-63	0.080	-17	0.859	27	0.677	73	0.021
-62	0.088	-16	0.874	28	0.657	74	0.018
-61	0.097	-15	0.888	29	0.636	75	0.015
-60	0.107	-14	0.902	30	0.616	76	0.012
-59	0.117	-13	0.915	31	0.595	77	0.010
-58	0.128	-12	0.927	32	0.574	78	0.008
-57	0.140	-11	0.939	33	0.554	79	0.006
-56	0.152	-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	0.191	-7	0.975	37	0.472	83	0.001
-52	0.205	-6	0.981	38	0.451	84	0.001
-51	0.220	-5	0.987	39	0.432	85	0.001
-50	0.235	-4	0.992	40	0.412	86	0.000
-49	0.251	-3	0.995	41	0.392	87	0.000
-48	0.267	-2	0.998	42	0.373	88	0.000
-47	0.283	-1	0.999	43	0.355	89	0.000
-46	0.301	0	1.000	44	0.336	90	0.000
-45	0.318			45	0.318		

S.O. 29912 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WVBA BRATTLEBORO, 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 0.664642 V RMS 0.615076 H/V Ratio 1.081

Elevation Gain of Horizontal Component 0.756

Elevation Gain of Vertical Component 0.648

Horizontal Azimuth Gain equals $1/(RMS)^2$. 2.264

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 2.533

Max. Vertical 0.979

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

Total Horizontal Power Gain = **1.712**

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

Total Vertical Power Gain = **1.641**

==========

ERP divided by Horizontal Power Gain equals Antenna Input Power

8.9 kW ERP Divided by H Gain 1.712 equals 5.198 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

5.198 kW Times V Gain 1.641 equals 8.530 kW V ERP

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

(0.979)^2 Times 8.90 Equals 8.530 kW Vertical ERP

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