Shively Labs
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S.O. 28636

Report of Test 6810-3R-SS-V/H-DA

for

VERMONT PUBLIC RADIO

WRVT 88.7 MHz Rutland, VT

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-3R-SS-V/H-DA to meet the needs of WRVT and to comply with the requirements of the FCC construction permit, file number BMPED-20091120ABB.

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-20091120ABB indicates that the Vertical radiation component shall not exceed 4.8 kW at any azimuth and is restricted to the following values at the azimuths specified:

0 Degrees T: 0.799 kW

From Figure 1A, the maximum radiation of the Vertical component occurs at 130 Degrees T. At the restricted azimuth of 0 Degrees T the Horizontal component is 9.12 dB down from the maximum of 4.8 kW, or 0.588 kW.

The R.M.S. of the Horizontal component is 0.705. The total Horizontal power gain is 1.616. The R.M.S. of the Vertical component is 0.739. The total Vertical power gain is 1.939. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.932. The R.M.S. of the measured composite pattern is 0.793. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.792. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6810-3R-SS-V/H-DA was mounted on a tower of precise scale to the Stainless G7 tower at the WRVT site. The spacing of the antenna to the tower was varied to achieve the horizontal and vertical patterns shown in Figure 1A. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BMPED-20091120ABB, a single level of the 6810-3R-SS-V/H-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 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

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 399.15 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 28636
November 22, 2010

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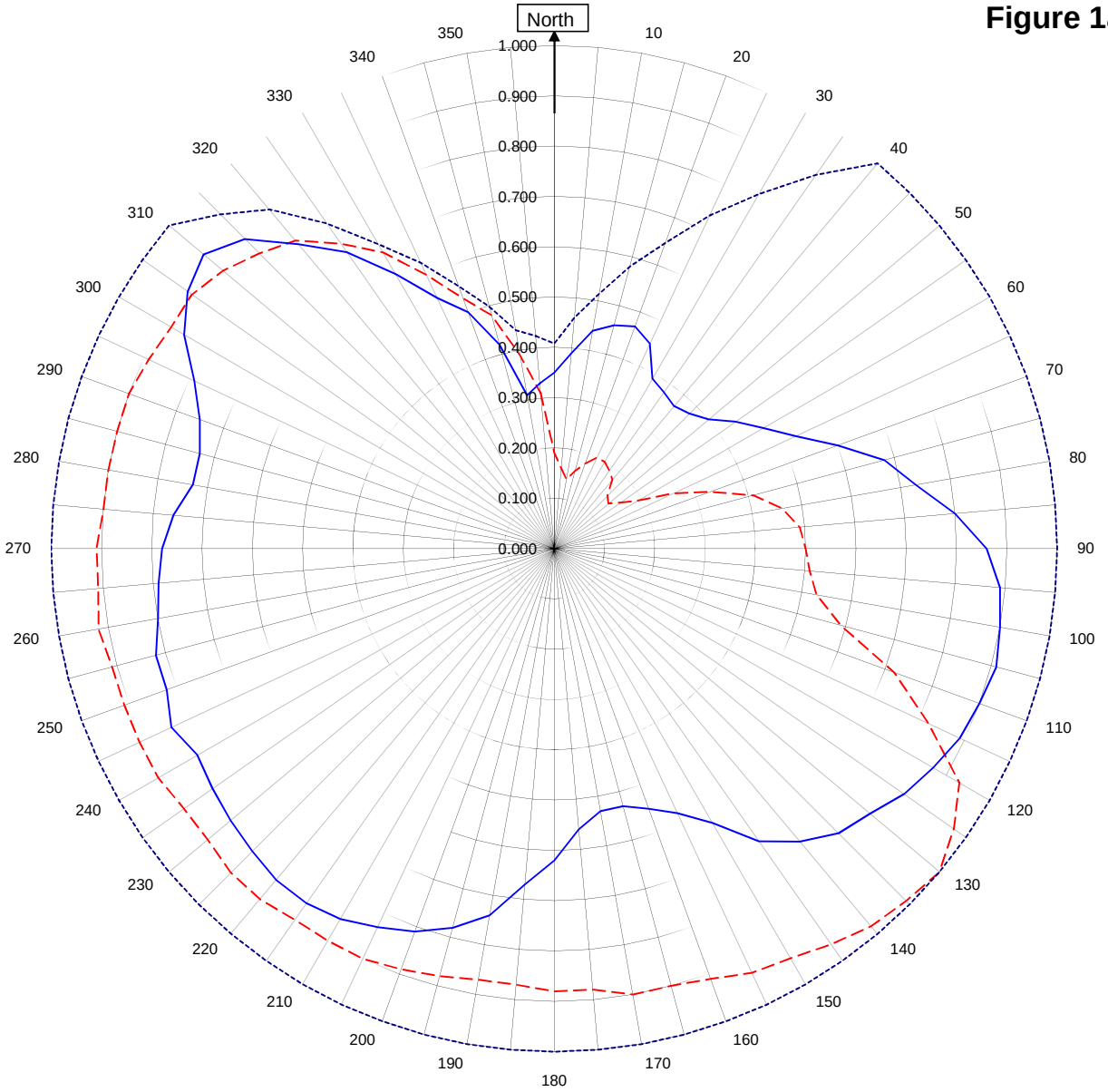
Figure 1a



WRVT Rutland, VT

28636

November 22, 2010

Horizontal RMS	0.705
Vertical RMS	0.739
H/V Composite RMS	0.793
FCC Composite RMS	0.932

Frequency	88.7 / 399.15 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6810-3R-SS-V/H-DA
Pattern Type	Directional Azimuth

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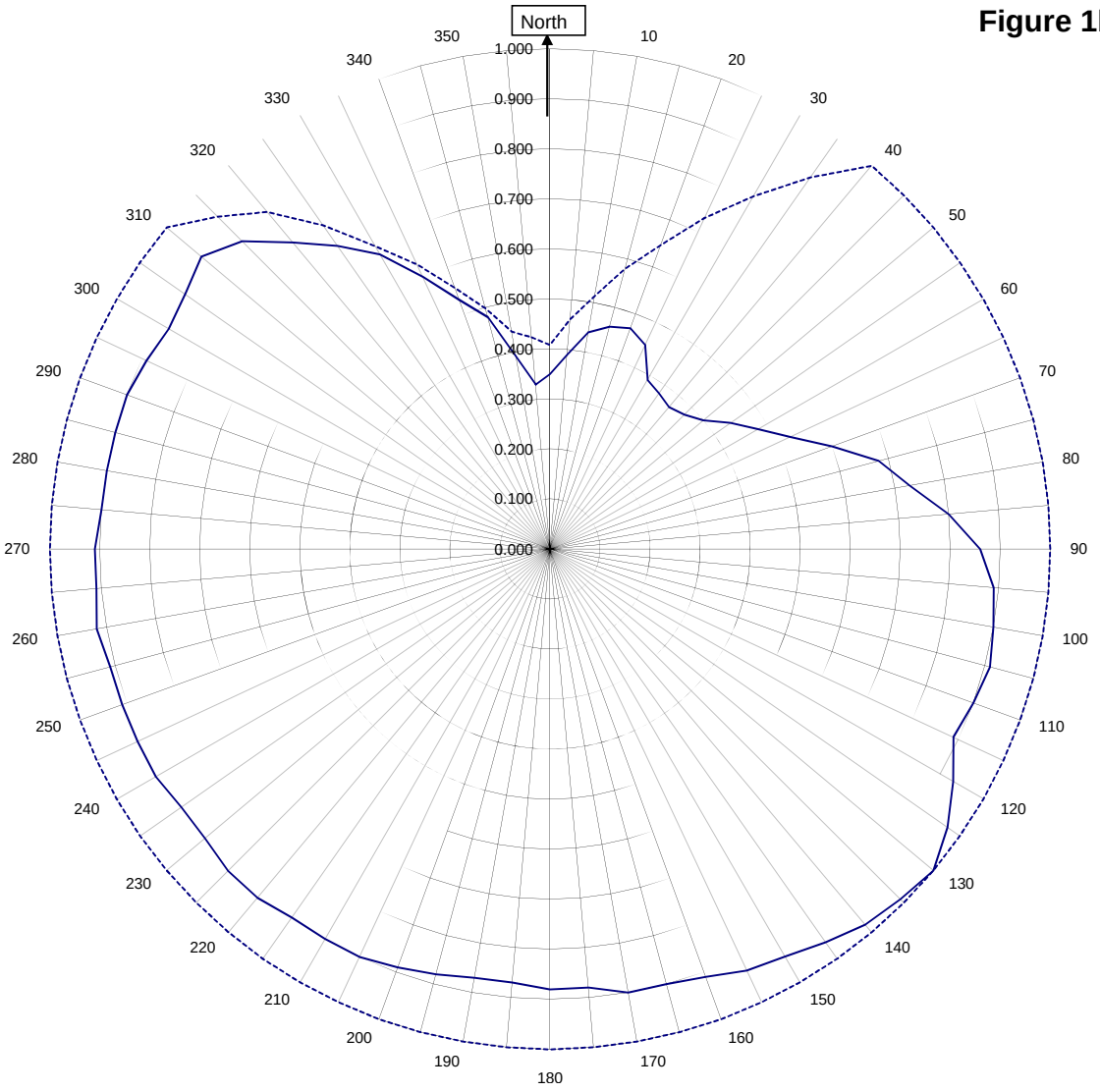
Figure 1b



WRVT Rutland, VT

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November 22, 2010

_____H/VComposite RMS	0.793
……FCC Composite RMS	0.932

Frequency	88.7 / 399.15 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6810-3R-SS-V/H-DA
Pattern Type	Directional H/V Composite

Figure 1C

Tabulation of Horizontal Azimuth Pattern
WRVT Rutland, VT

Azimuth	Rel Field	Azimuth	Rel Field
0	0.350	180	0.620
10	0.440	190	0.740
20	0.470	200	0.810
30	0.390	210	0.850
40	0.370	220	0.860
45	0.380	225	0.850
50	0.400	230	0.840
60	0.480	240	0.820
70	0.600	250	0.820
80	0.730	260	0.800
90	0.860	270	0.780
100	0.900	280	0.730
110	0.900	290	0.750
120	0.870	300	0.850
130	0.820	310	0.910
135	0.800	315	0.870
140	0.760	320	0.790
150	0.630	330	0.630
160	0.550	340	0.500
170	0.530	350	0.310

Additional Azimuth:

105	0.913

Figure 1D

Tabulation of Vertical Azimuth Pattern
WRVT Rutland, VT

Azimuth	Rel Field	Azimuth	Rel Field
0	0.190	180	0.880
10	0.140	190	0.870
20	0.180	200	0.890
30	0.200	210	0.900
40	0.180	220	0.910
45	0.150	225	0.910
50	0.140	230	0.900
60	0.190	240	0.910
70	0.330	250	0.910
80	0.460	260	0.920
90	0.500	270	0.910
100	0.530	280	0.900
110	0.720	290	0.900
120	0.930	300	0.880
130	1.000	310	0.860
135	0.990	315	0.830
140	0.980	320	0.800
150	0.940	330	0.680
160	0.910	340	0.530
170	0.900	350	0.390

Figure 1E

Tabulation of Composite Azimuth Pattern
WRVT Rutland, VT

Azimuth	Rel Field	Azimuth	Rel Field
0	0.350	180	0.880
10	0.440	190	0.870
20	0.470	200	0.890
30	0.390	210	0.900
40	0.370	220	0.910
45	0.380	225	0.910
50	0.400	230	0.900
60	0.480	240	0.910
70	0.600	250	0.910
80	0.730	260	0.920
90	0.860	270	0.910
100	0.900	280	0.900
110	0.900	290	0.900
120	0.930	300	0.880
130	1.000	310	0.910
135	0.990	315	0.870
140	0.980	320	0.800
150	0.940	330	0.680
160	0.910	340	0.530
170	0.900	350	0.390

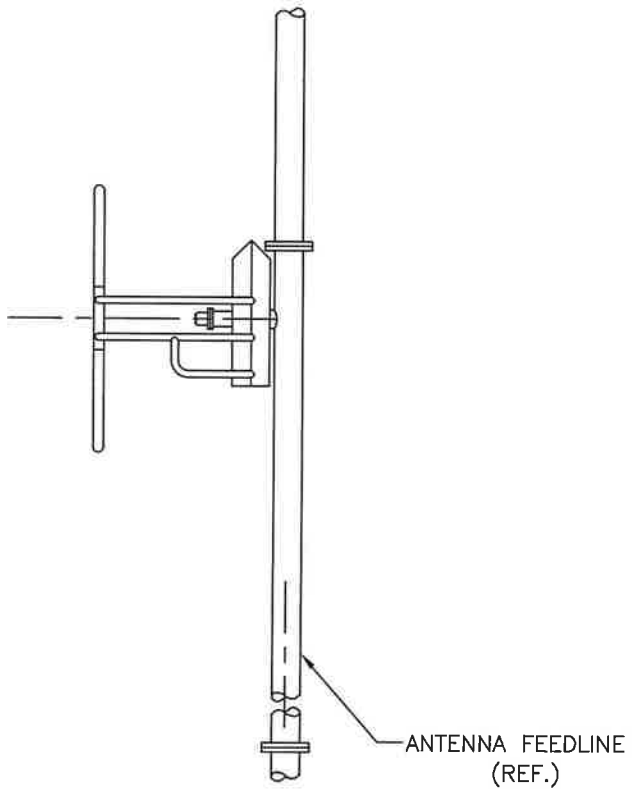
Figure 1F

Tabulation of FCC Directional Composite
WRVT Rutland, VT

Azimuth	Rel Field	Azimuth	Rel Field
0	0.408	180	1.000
10	0.514	190	1.000
20	0.647	200	1.000
30	0.814	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	1.000
100	1.000	280	1.000
110	1.000	290	1.000
120	1.000	300	1.000
130	1.000	310	1.000
140	1.000	320	0.880
150	1.000	330	0.699
160	1.000	340	0.555
170	1.000	350	0.441

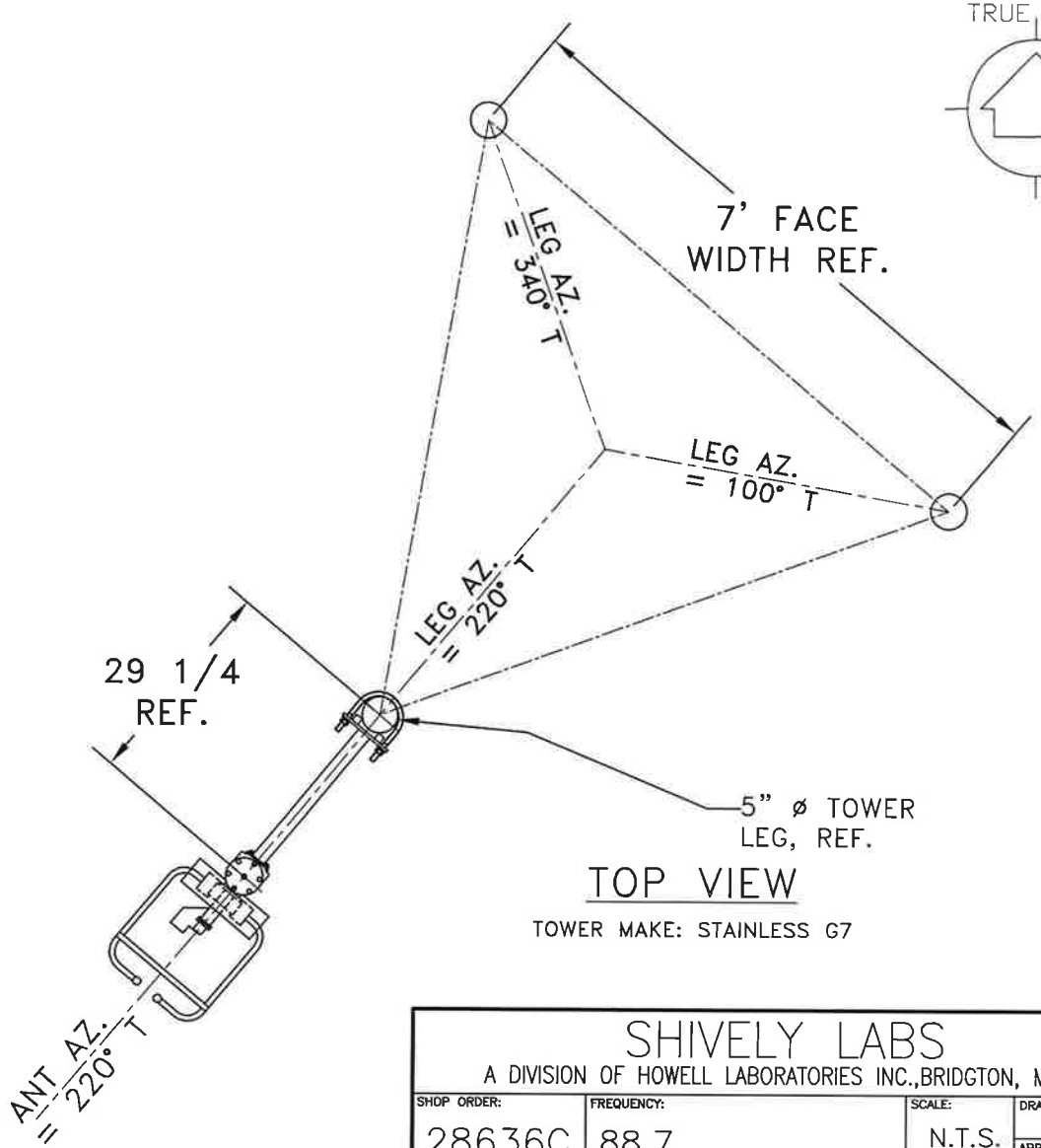
Additional Azimuths:

39	1.000	314	1.000



SIDE VIEW

ANTENNA HEADING 220° TRUE NORTH



TOP VIEW

TOWER MAKE: STAINLESS G7

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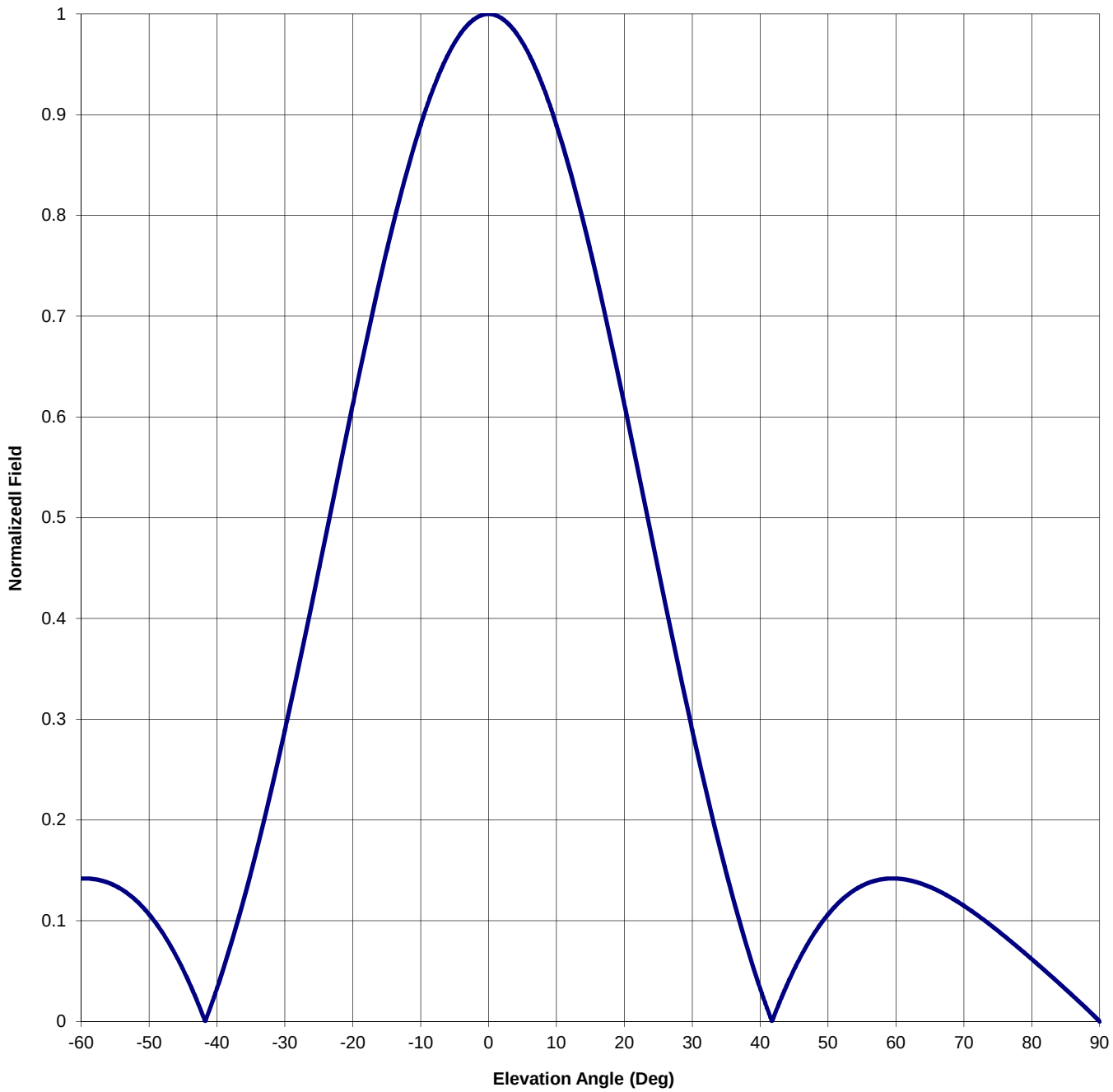
SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY:
28636C	88.7	N.T.S.	ASP
			APPROVED BY: DAB

TITLE: MODEL-6810-3R-SS-H/V-DIRECTIONAL ANTENNA

DATE: 11/12/10

FIGURE 2

Antenna Mfg.:	**Shively Labs**			**Date: 11/22/2010**
Antenna Type:	**6810-3R-SS-V/H-DA**			
Station:	**WRVT**	**Beam Tilt**	**0**	
Frequency:	**88.7**	**Gain (Max)**	**1.616**	**2.085 dB**
Channel #:	**204**	**Gain (Horizon)**	**1.616**	**2.085 dB**
Figure:	**3**			



Antenna Mfg.: Shively Labs
Antenna Type: 6810-3R-SS-V/H-DA
Station: WRVT
Frequency: 88.7
Channel #: 204
Figure: 3

Date: 11/22/2010

Beam Tilt	**0**	
Gain (Max)	**1.616**	**2.085 dB**
Gain (Horizon)	**1.616**	**2.085 dB**

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	0.037	0	1.000	46	0.065
-89	0.007	-43	0.022	1	0.999	47	0.077
-88	0.013	-42	0.005	2	0.995	48	0.088
-87	0.020	-41	0.014	3	0.990	49	0.098
-86	0.026	-40	0.033	4	0.982	50	0.106
-85	0.032	-39	0.054	5	0.972	51	0.114
-84	0.038	-38	0.075	6	0.959	52	0.121
-83	0.044	-37	0.098	7	0.945	53	0.126
-82	0.050	-36	0.123	8	0.928	54	0.131
-81	0.056	-35	0.148	9	0.910	55	0.135
-80	0.062	-34	0.174	10	0.890	56	0.138
-79	0.068	-33	0.202	11	0.868	57	0.140
-78	0.073	-32	0.230	12	0.844	58	0.141
-77	0.079	-31	0.259	13	0.819	59	0.142
-76	0.085	-30	0.289	14	0.793	60	0.142
-75	0.090	-29	0.320	15	0.765	61	0.141
-74	0.095	-28	0.351	16	0.736	62	0.140
-73	0.101	-27	0.383	17	0.706	63	0.138
-72	0.106	-26	0.416	18	0.676	64	0.136
-71	0.110	-25	0.448	19	0.644	65	0.134
-70	0.115	-24	0.481	20	0.612	66	0.131
-69	0.119	-23	0.514	21	0.580	67	0.127
-68	0.123	-22	0.547	22	0.547	68	0.123
-67	0.127	-21	0.580	23	0.514	69	0.119
-66	0.131	-20	0.612	24	0.481	70	0.115
-65	0.134	-19	0.644	25	0.448	71	0.110
-64	0.136	-18	0.676	26	0.416	72	0.106
-63	0.138	-17	0.706	27	0.383	73	0.101
-62	0.140	-16	0.736	28	0.351	74	0.095
-61	0.141	-15	0.765	29	0.320	75	0.090
-60	0.142	-14	0.793	30	0.289	76	0.085
-59	0.142	-13	0.819	31	0.259	77	0.079
-58	0.141	-12	0.844	32	0.230	78	0.073
-57	0.140	-11	0.868	33	0.202	79	0.068
-56	0.138	-10	0.890	34	0.174	80	0.062
-55	0.135	-9	0.910	35	0.148	81	0.056
-54	0.131	-8	0.928	36	0.123	82	0.050
-53	0.126	-7	0.945	37	0.098	83	0.044
-52	0.121	-6	0.959	38	0.075	84	0.038
-51	0.114	-5	0.972	39	0.054	85	0.032
-50	0.106	-4	0.982	40	0.033	86	0.026
-49	0.098	-3	0.990	41	0.014	87	0.020
-48	0.088	-2	0.995	42	0.005	88	0.013
-47	0.077	-1	0.999	43	0.022	89	0.007
-46	0.065	0	1.000	44	0.037	90	0.000
-45	0.052			45	0.052		

S.O. 28636 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WRVT Rutland, VT

Model 6810-3R-SS-V/H-DA

Elevation Gain of Antenna 1.01

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

V RMS 0.739 H RMS 0.705 V/H Ratio 1.048

Elevation Gain of Vertical Component 1.059

Elevation Gain of Horizontal Component 0.964

Vertical Azimuth Gain equals $1/(RMS)^2$. 1.831

Horizontal Azimuth Gain equals $1/(RMS/Max\ Horiz)^2$. 1.677
Max. Horizontal 0.913

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

Total Vertical Power Gain = **1.939**

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

Total Horizontal Power Gain = **1.616**

==========

ERP divided by Verical Power Gain equals Antenna Input Power

4.8 kW ERP Divided by V Gain 1.939 equals 2.48 kW V Antenna Input Power

Antenna Input Power times Horizontal Power Gain equals Horizontal ERP

2.48 kW Times H Gain 1.616 equals 4.00 kW H ERP

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

(0.913)^2 Times 4.80 Equals 4.00 kW Horizontal ERP

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