

S.O. 32707

Report of Test 6810-2R-SPCLW(0.8)-DA

for

PENFOLD COMMUNICATIONS, INC.

WTPG 88.9 MHz WHITEHOUSE, OH.

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-2R-SPCLW(0.8)-DA to meet the needs of WTPG and to comply with the requirements of the FCC construction permit, file number BPED-20140310ADP. 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-20140310ADP indicates that the Horizontal radiation component shall not exceed 12.5 kW at any azimuth and is restricted to the following values at the azimuths specified:

220 - 230 Degrees True: 0.40 kilowatts

From Figure 1A, the maximum radiation of the Horizontal component occurs at 350 Degrees True to 10 Degrees True. At the restricted azimuth of 220 Degrees True to 230 Degrees True the Horizontal component is 16.71 dB down from the maximum of 12.5 kW, or 0.266 kW.

The R.M.S. of the Horizontal component is 0.603. The total Horizontal power gain is 2.958. The R.M.S. of the Vertical component is 0.552. The total Vertical power gain is 2.592. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.657. The R.M.S. of the measured composite pattern is 0.604. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.558. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6810-2R-SPCLW(0.8)-DA was mounted on a tower of precise scale to the Valmont tower at the WTPG site. The spacing of the antenna to the tower was varied and vertical parasitic elements were added 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-20140310ADP, a single level of the 6810-2R-SPCLW(0.8)-DA was set up on the Shively Labs scale model antenna pattern measuring range. A scale of 4.5:1 was used.

EQUIPMENT:

The 4.5:1 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 4395-A Network Analyzer

PC Based Controller

Output Standard Printer or 'pdf'

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:

A handwritten signature in blue ink, appearing to read 'Martyn Gregory', with a stylized flourish at the end.

Martyn Gregory

Vice President, Shively Labs

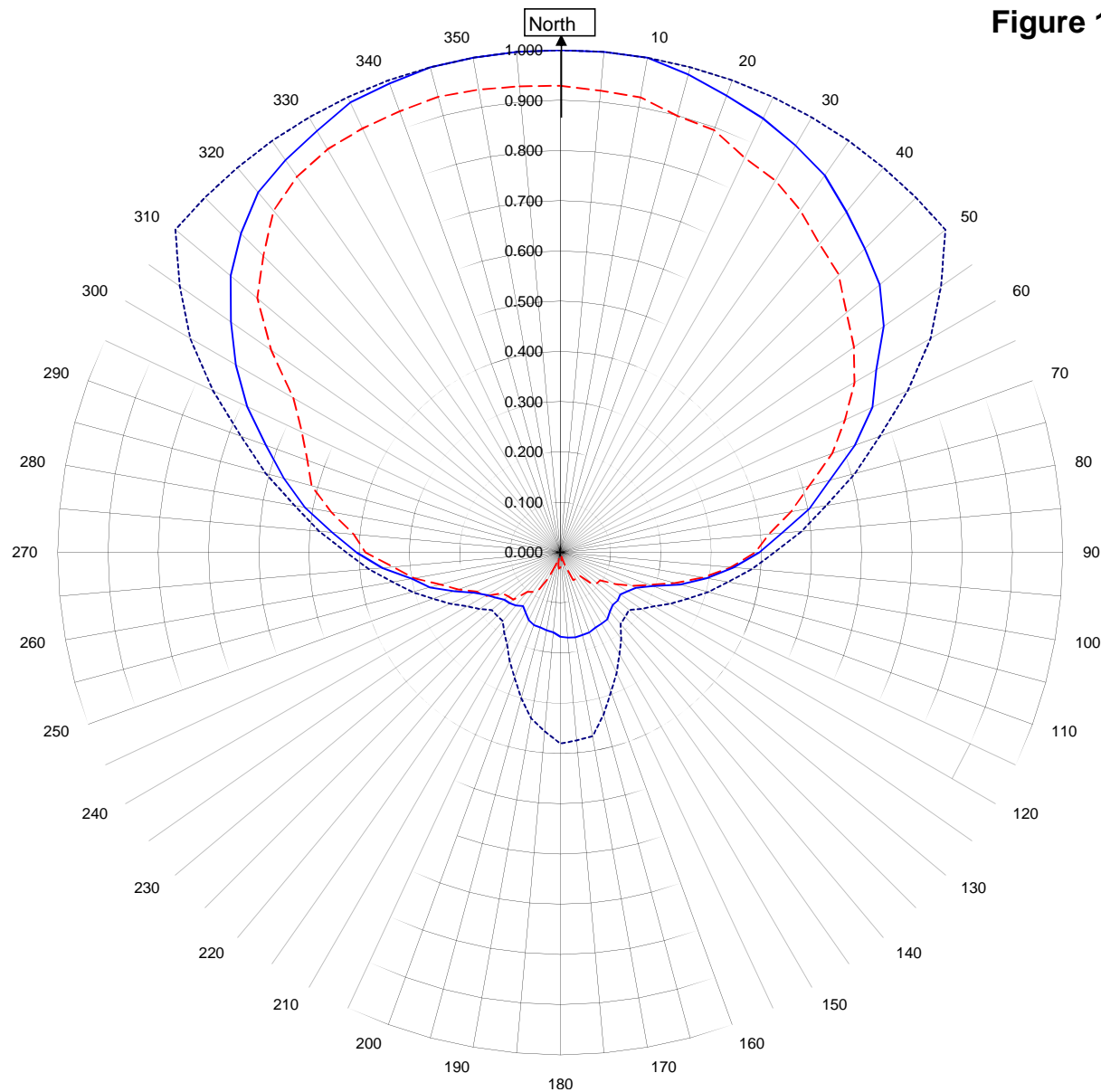
S/O 32707

Date July 16, 2015

Shively Labs

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

Figure 1A



WTPG WHITEHOUSE, OH.
32707
July 15, 2015

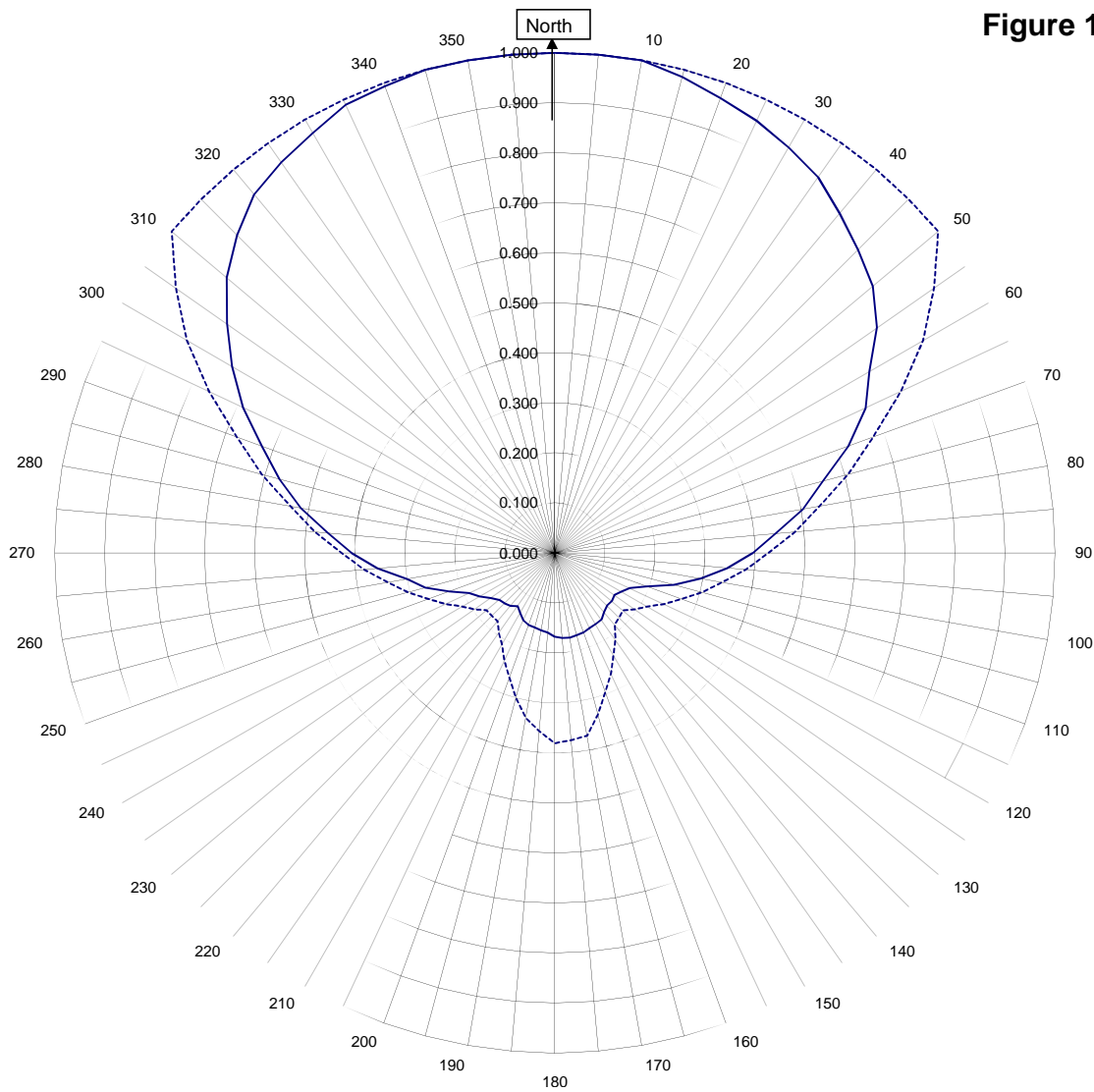
Horizontal RMS	0.603	Frequency	88.9 / 400.05 mHz
Vertical RMS	0.552	Plot	Relative Field
H/V Composite RMS	0.604	Scale	4.5 : 1
FCC Composite RMS	0.657	See Figure 2 for Mechanical Details	

Antenna Model	6810-2R-SPCLW(.8)-DA
Pattern Type	Directional Azimuth

Shively Labs

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Figure 1B



WTPG WHITEHOUSE, OH.
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July 15, 2015

—————H/V Composite RMS	0.604
.....FCC Composite RMS	0.657

Frequency	88.9 / 400.05 mHz
Plot	Relative Field
Scale	4.5 : 1
See Figure 2 for Mechanical Details	

Antenna Model	6810-2R-SPCLW(.8)-DA
Pattern Type	Directional H/V Composite

Figure 1C

Tabulation of Horizontal Azimuth Pattern
WTPG WHITEHOUSE, OH.

Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	0.168
10	1.000	190	0.157
20	0.968	200	0.154
30	0.936	210	0.139
40	0.886	220	0.138
45	0.857	225	0.143
50	0.830	230	0.146
60	0.726	240	0.169
70	0.624	250	0.225
80	0.503	260	0.300
90	0.396	270	0.406
100	0.296	280	0.516
110	0.196	290	0.624
120	0.154	300	0.746
130	0.149	310	0.857
135	0.148	315	0.899
140	0.154	320	0.936
150	0.164	330	0.969
160	0.169	340	0.994
170	0.172	350	1.000

Figure 1D

Tabulation of Vertical Azimuth Pattern
WTPG WHITEHOUSE, OH.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.929	180	0.030
10	0.920	190	0.022
20	0.895	200	0.026
30	0.855	210	0.084
40	0.802	220	0.102
45	0.783	225	0.133
50	0.743	230	0.136
60	0.676	240	0.174
70	0.576	250	0.216
80	0.466	260	0.296
90	0.388	270	0.388
100	0.288	280	0.464
110	0.188	290	0.536
120	0.126	300	0.614
130	0.095	310	0.788
135	0.087	315	0.836
140	0.061	320	0.888
150	0.061	330	0.927
160	0.027	340	0.935
170	0.015	350	0.936

Figure 1E

Tabulation of Composite Azimuth Pattern
WTPG WHITEHOUSE, OH.

Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	0.168
10	1.000	190	0.157
20	0.968	200	0.154
30	0.936	210	0.139
40	0.886	220	0.138
45	0.857	225	0.143
50	0.830	230	0.146
60	0.726	240	0.174
70	0.624	250	0.225
80	0.503	260	0.300
90	0.396	270	0.406
100	0.296	280	0.516
110	0.196	290	0.624
120	0.154	300	0.746
130	0.149	310	0.857
135	0.148	315	0.899
140	0.154	320	0.936
150	0.164	330	0.969
160	0.169	340	0.994
170	0.172	350	1.000

Figure 1F

Tabulation of FCC Directional Composite
WTPG WHITEHOUSE, OH.

Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	0.380
10	1.000	190	0.335
20	1.000	200	0.266
30	1.000	210	0.212
40	1.000	220	0.178
50	1.000	230	0.178
60	0.850	240	0.214
70	0.676	250	0.269
80	0.537	260	0.339
90	0.426	270	0.426
100	0.339	280	0.537
110	0.269	290	0.676
120	0.214	300	0.850
130	0.178	310	1.000
140	0.186	320	1.000
150	0.235	330	1.000
160	0.295	340	1.000
170	0.371	350	1.000

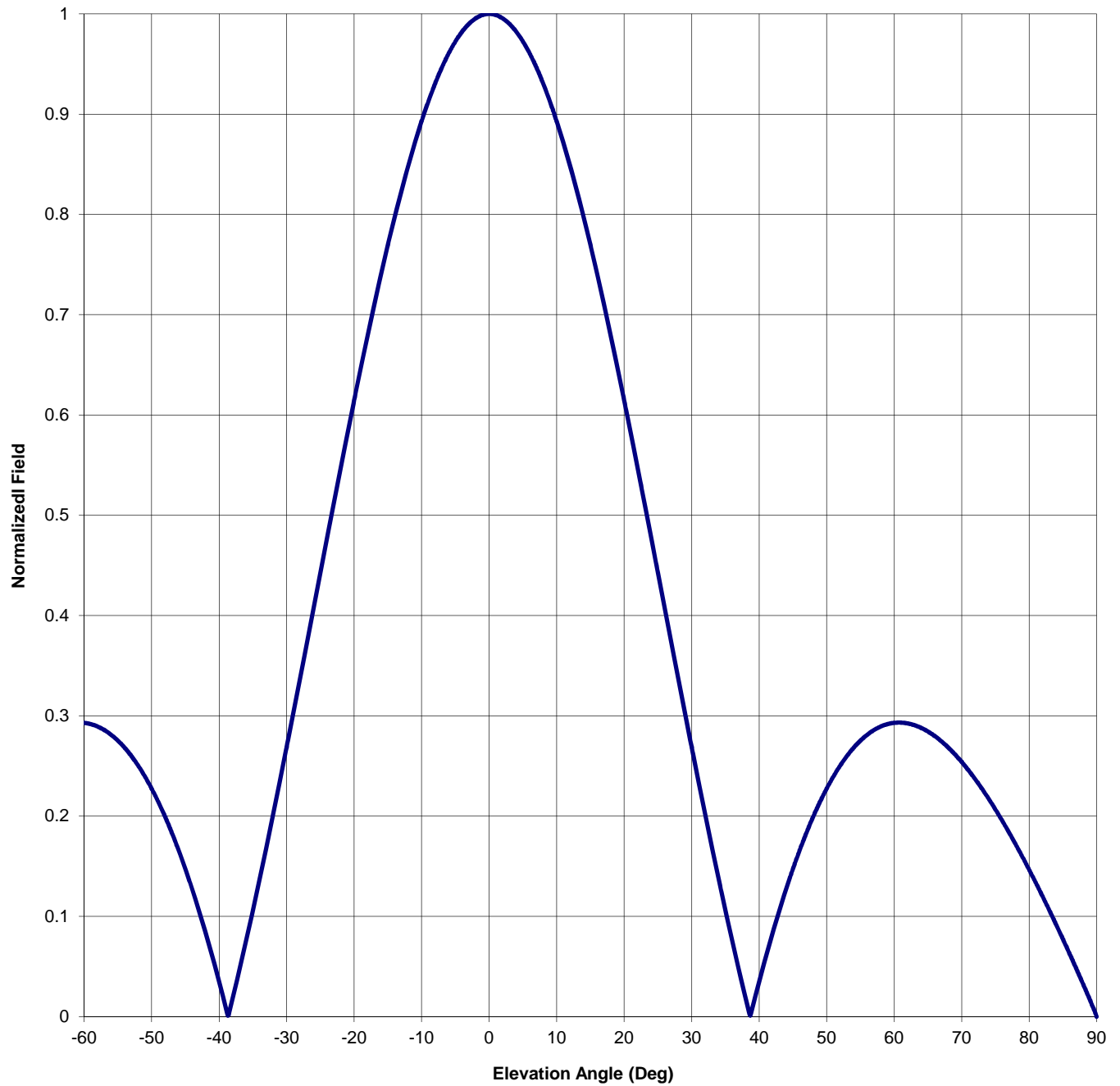
Antenna Mfg.: Shively Labs
Antenna Type: 6810-2R-SPCLW(.8)

Date: 7/20/2015

Station: WTPG
Frequency: 88.9
Channel #: 205

Beam Tilt	0	
Gain (Max)	2.958	4.710 dB
Gain (Horizon)	2.958	4.710 dB

Figure: Figure 3



Antenna Mfg.: Shively Labs
Antenna Type: 6810-2R-SPCLW(.8)

Date: 7/20/2015

Station: WTPG

Beam Tilt 0

Frequency: 88.9

Gain (Max) 2.958

4.710 dB

Channel #: 205

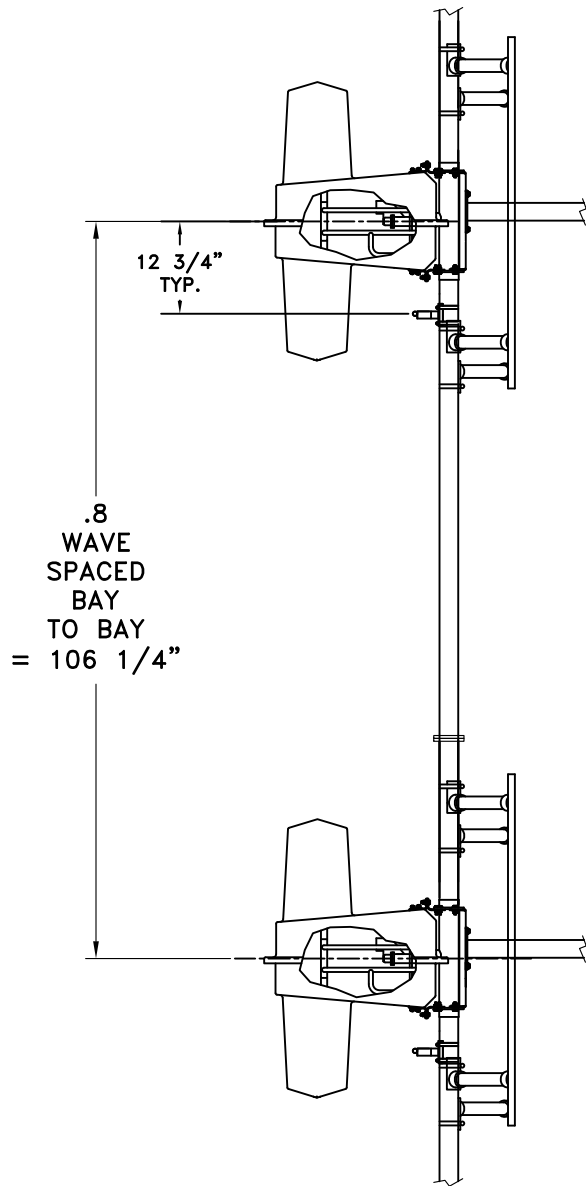
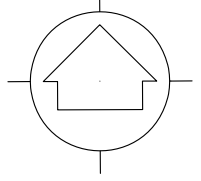
Gain (Horizon) 2.958

4.710 dB

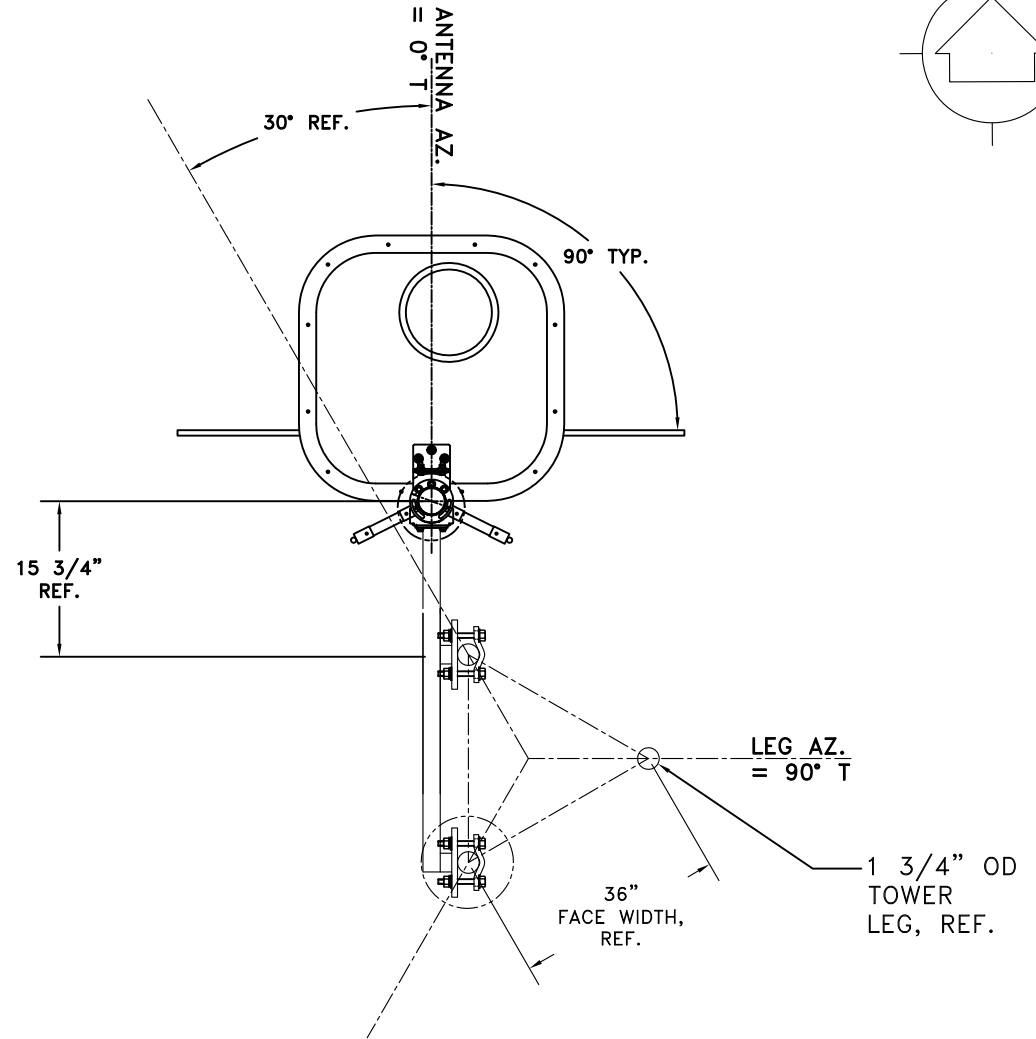
Figure: Figure 3

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	0.127	0	1.000	46	0.166
-89	0.017	-43	0.106	1	0.999	47	0.183
-88	0.032	-42	0.084	2	0.996	48	0.199
-87	0.048	-41	0.060	3	0.990	49	0.214
-86	0.063	-40	0.035	4	0.982	50	0.228
-85	0.077	-39	0.009	5	0.973	51	0.240
-84	0.092	-38	0.018	6	0.961	52	0.250
-83	0.106	-37	0.046	7	0.947	53	0.260
-82	0.120	-36	0.076	8	0.931	54	0.268
-81	0.133	-35	0.106	9	0.913	55	0.275
-80	0.146	-34	0.137	10	0.893	56	0.281
-79	0.159	-33	0.169	11	0.871	57	0.286
-78	0.172	-32	0.202	12	0.848	58	0.289
-77	0.184	-31	0.235	13	0.824	59	0.292
-76	0.195	-30	0.269	14	0.797	60	0.293
-75	0.207	-29	0.303	15	0.770	61	0.293
-74	0.217	-28	0.338	16	0.741	62	0.292
-73	0.227	-27	0.373	17	0.711	63	0.291
-72	0.237	-26	0.408	18	0.680	64	0.288
-71	0.246	-25	0.443	19	0.648	65	0.284
-70	0.254	-24	0.478	20	0.615	66	0.280
-69	0.262	-23	0.513	21	0.581	67	0.275
-68	0.268	-22	0.547	22	0.547	68	0.268
-67	0.275	-21	0.581	23	0.513	69	0.262
-66	0.280	-20	0.615	24	0.478	70	0.254
-65	0.284	-19	0.648	25	0.443	71	0.246
-64	0.288	-18	0.680	26	0.408	72	0.237
-63	0.291	-17	0.711	27	0.373	73	0.227
-62	0.292	-16	0.741	28	0.338	74	0.217
-61	0.293	-15	0.770	29	0.303	75	0.207
-60	0.293	-14	0.797	30	0.269	76	0.195
-59	0.292	-13	0.824	31	0.235	77	0.184
-58	0.289	-12	0.848	32	0.202	78	0.172
-57	0.286	-11	0.871	33	0.169	79	0.159
-56	0.281	-10	0.893	34	0.137	80	0.146
-55	0.275	-9	0.913	35	0.106	81	0.133
-54	0.268	-8	0.931	36	0.076	82	0.120
-53	0.260	-7	0.947	37	0.046	83	0.106
-52	0.250	-6	0.961	38	0.018	84	0.092
-51	0.240	-5	0.973	39	0.009	85	0.077
-50	0.228	-4	0.982	40	0.035	86	0.063
-49	0.214	-3	0.990	41	0.060	87	0.048
-48	0.199	-2	0.996	42	0.084	88	0.032
-47	0.183	-1	0.999	43	0.106	89	0.017
-46	0.166	0	1.000	44	0.127	90	0.000
-45	0.147			45	0.147		

TRUE NORTH



SIDE VIEW



TOP VIEW

TOWER MAKE:
VALMONT 36" FACE

ANTENNA HEADING 0° TRUE NORTH

SHIVELY LABS			
A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE			
SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY:
32707	88.9	N.T.S.	ASP
TITLE:			APPROVED BY:
MODEL-6810-2R-.8SS-DIRECTIONAL ANTENNA			DAB
DATE:		FIGURE 2	
7-20-15			

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Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WTPG WHITEHOUSE, OH.

MODEL 6810-2R-SPCLW(.8)-DA

Elevation Gain of Antenna 0.985

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

H RMS 0.603456 V RMS 0.551736 H/V Ratio 1.094

Elevation Gain of Horizontal Component 1.077

Elevation Gain of Vertical Component 0.901

Horizontal Azimuth Gain equals $1/(\text{RMS})^2$. 2.746

Vertical Azimuth Gain equals $1/(\text{RMS}/\text{Max Vert})^2$. 2.878

Max. Vertical 0.936

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

Total Horizontal Power Gain = 2.958

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

Total Vertical Power Gain = 2.592

=====

ERP divided by Horizontal Power Gain equals Antenna Input Power

12.5 kW ERP Divided by H Gain 2.958 equals 4.225 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

4.225 kW Times V Gain 2.592 equals 10.951 kW V ERP

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

$(0.936)^2$ Times 12.50 Equals 10.951 kW Vertical ERP

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