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S.O. 30550

Report of Test 6810-1D-V/H Special-DA

for

Lehigh University

WLVR-FM 91.3 MHz Bethlehem, PA

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-1D-V/H Special-DA to meet the needs of WLVR-FM and to comply with the requirements of the FCC construction permit, file number BPED-20120921ADL. 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-20120921ADL indicates that the Vertical radiation component shall not exceed 0.200 kW at any azimuth and is restricted to the following values at the azimuths specified:

050 Degrees T: 0.094 kW

240 Degrees T: 0.011 kW

310 - 330 Degrees T: 0.0125 kW

From Figure 1A, the maximum radiation of the Vertical component occurs at 85 Degrees T and 113 to 125 Degrees T. At the restricted azimuth of 050 Degrees T the Vertical component is 3.836 dB down from the maximum of 0.200 kW, or 0.083 kW, at the restricted azimuth of 240 Degrees T the Horizontal component is 13.556 dB down from the maximum of 0.200 kW, or 0.009kW and at the restricted azimuth of 310 - 330 Degrees T the Vertical component is 12.396 dB down from the maximum of 0.200 kW, or 0.011 kW.
The R.M.S. of the Horizontal component is 0.313. The total Horizontal power gain is 0.431. The R.M.S. of the Vertical component is 0.617. The total Vertical power gain is 2.383. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.684. The R.M.S. of the measured composite pattern is 0.619. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.581. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6810-1D-V/H Special-DA was mounted Rohn 65-G tower of precise scale to the Rohn 65-G at the WLVR-FM site. The spacing of the antenna to the pole was varied and vertical parasitic elements where 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-20120921ADL, a single level of the 6810-1D-V/H Special-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 4395A 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 410.85 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
30550
October 31, 2014

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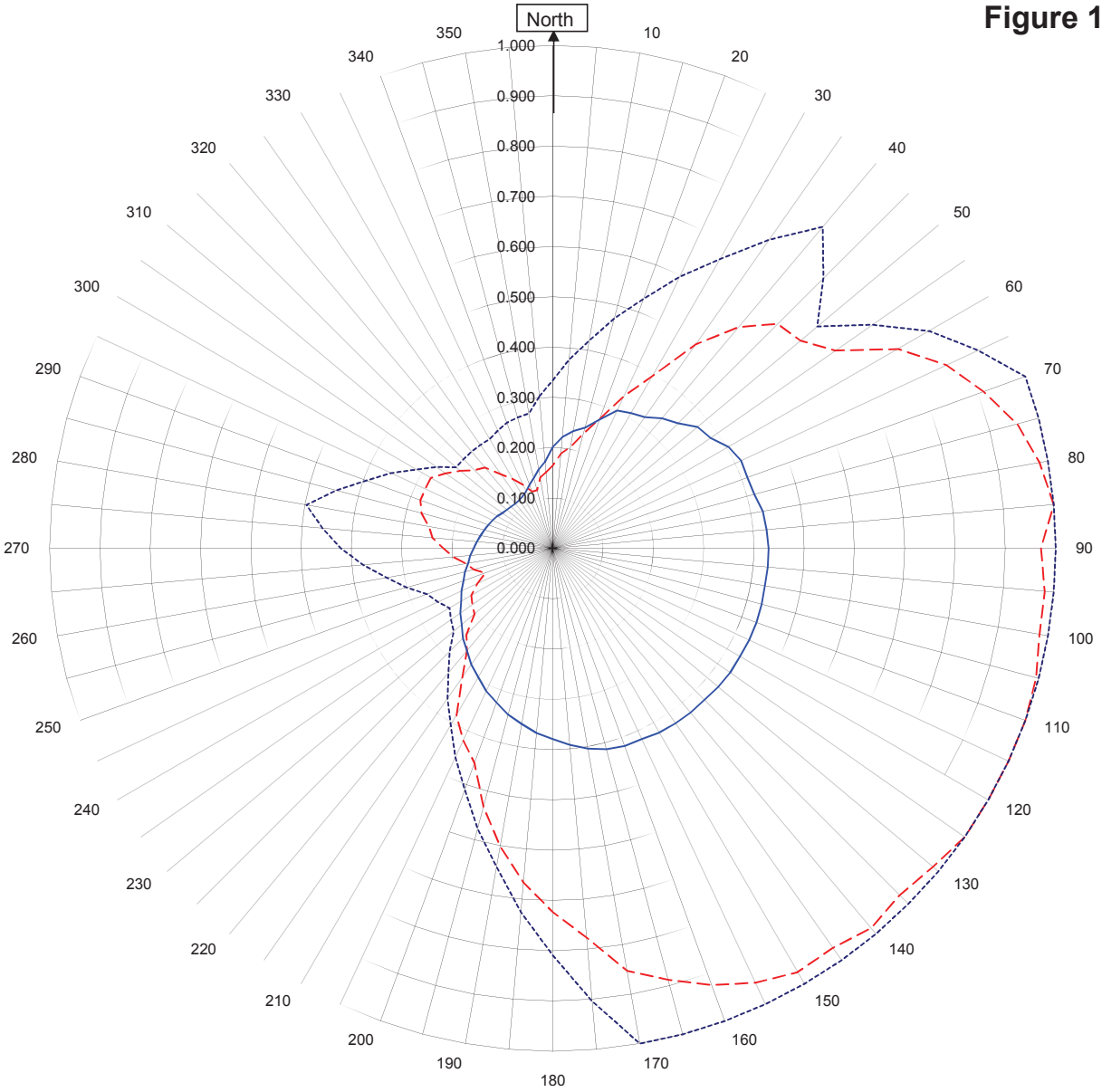
Figure 1A



WLVR BETHLEHEM, PA.

30550

October 31, 2014

Horizontal RMS	0.313
Vertical RMS	0.617
H/V Composite RMS	0.619
FCC Composite RMS	0.684

Frequency	91.3 / 410.85 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6810-1D-V/H Special-DA
Pattern Type	Directional Azimuth

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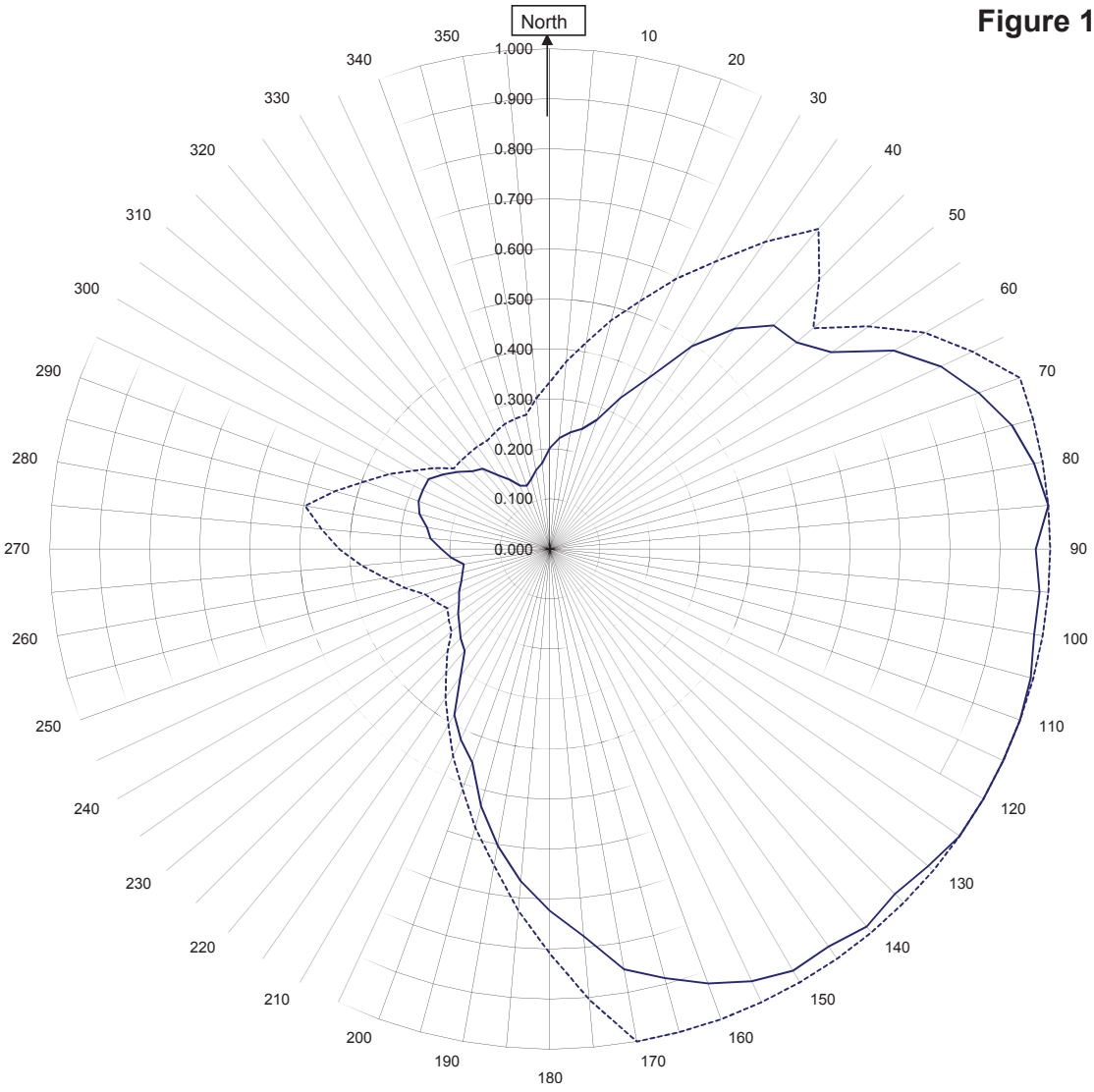
Figure 1B



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October 31, 2014

_____H/VComposite RMS	0.619
……FCC Composite RMS	0.684

Frequency	91.3 / 410.85 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6810-1D-V/H Special-DA
Pattern Type	Directional H/V Composite

Figure 1C

Tabulation of Horizontal Azimuth Pattern
WLVR BETHLEHEM, PA.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.202	180	0.379
10	0.237	190	0.355
20	0.273	200	0.326
30	0.311	210	0.296
40	0.338	220	0.266
45	0.352	225	0.252
50	0.376	230	0.236
60	0.404	240	0.210
70	0.412	250	0.189
80	0.424	260	0.171
90	0.429	270	0.157
100	0.428	280	0.145
110	0.431	290	0.136
120	0.430	300	0.128
130	0.429	310	0.120
135	0.426	315	0.117
140	0.426	320	0.116
150	0.423	330	0.120
160	0.418	340	0.135
170	0.404	350	0.160

Figure 1D

Tabulation of Vertical Azimuth Pattern
WLVR BETHLEHEM, PA.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.165	180	0.723
10	0.206	190	0.602
20	0.275	200	0.454
30	0.396	210	0.383
40	0.575	220	0.265
45	0.632	225	0.243
50	0.643	230	0.203
60	0.794	240	0.187
70	0.912	250	0.143
80	0.983	260	0.175
90	0.971	270	0.217
100	0.983	280	0.250
110	1.000	290	0.280
120	1.000	300	0.280
130	0.986	310	0.240
135	0.975	315	0.220
140	0.985	320	0.210
150	0.973	330	0.160
160	0.924	340	0.120
170	0.853	350	0.144

Figure 1E

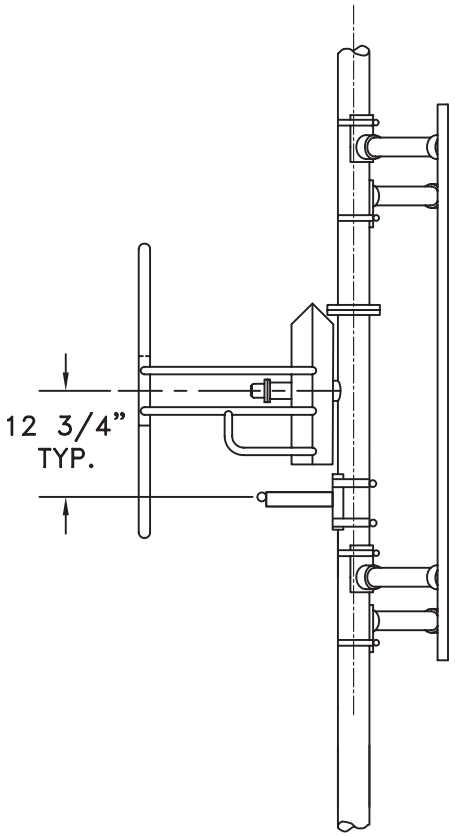
Tabulation of Composite Azimuth Pattern
WLVR BETHLEHEM, PA.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.202	180	0.723
10	0.237	190	0.602
20	0.275	200	0.454
30	0.396	210	0.383
40	0.575	220	0.266
45	0.632	225	0.252
50	0.643	230	0.236
60	0.794	240	0.210
70	0.912	250	0.189
80	0.983	260	0.175
90	0.971	270	0.217
100	0.983	280	0.250
110	1.000	290	0.280
120	1.000	300	0.280
130	0.986	310	0.240
135	0.975	315	0.220
140	0.985	320	0.210
150	0.973	330	0.160
160	0.924	340	0.135
170	0.853	350	0.160

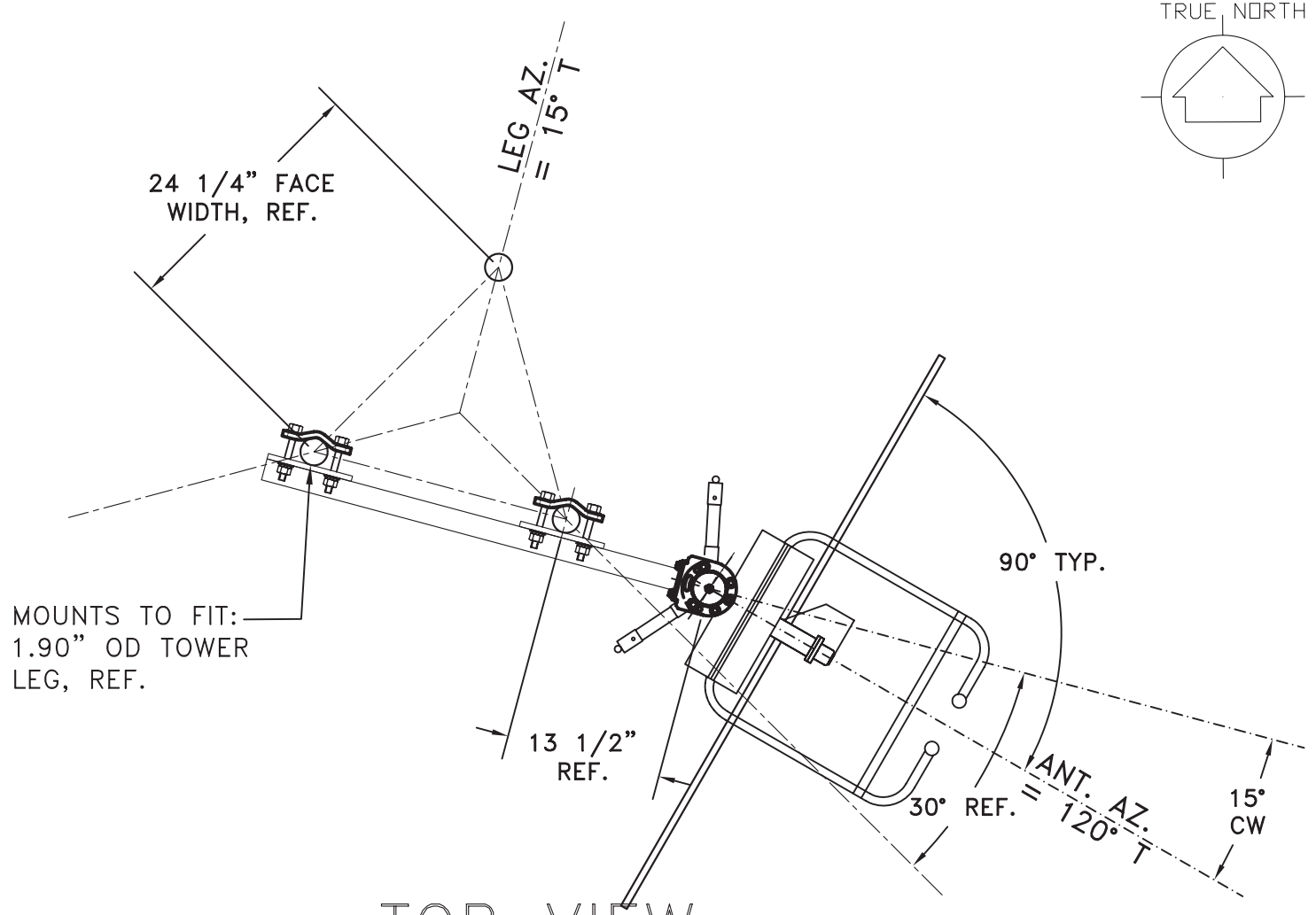
Figure 1F

Tabulation of FCC Directional Composite
WLVR BETHLEHEM, PA.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.334	180	0.809
10	0.420	190	0.643
20	0.528	200	0.511
30	0.664	210	0.406
40	0.835	220	0.323
50	0.687	230	0.257
60	0.865	240	0.237
70	1.000	250	0.266
80	1.000	260	0.335
90	1.000	270	0.421
100	1.000	280	0.497
110	1.000	290	0.395
120	1.000	300	0.314
130	1.000	310	0.251
140	1.000	320	0.251
150	1.000	330	0.251
160	1.000	340	0.266
170	1.000	350	0.273



SIDE VIEW



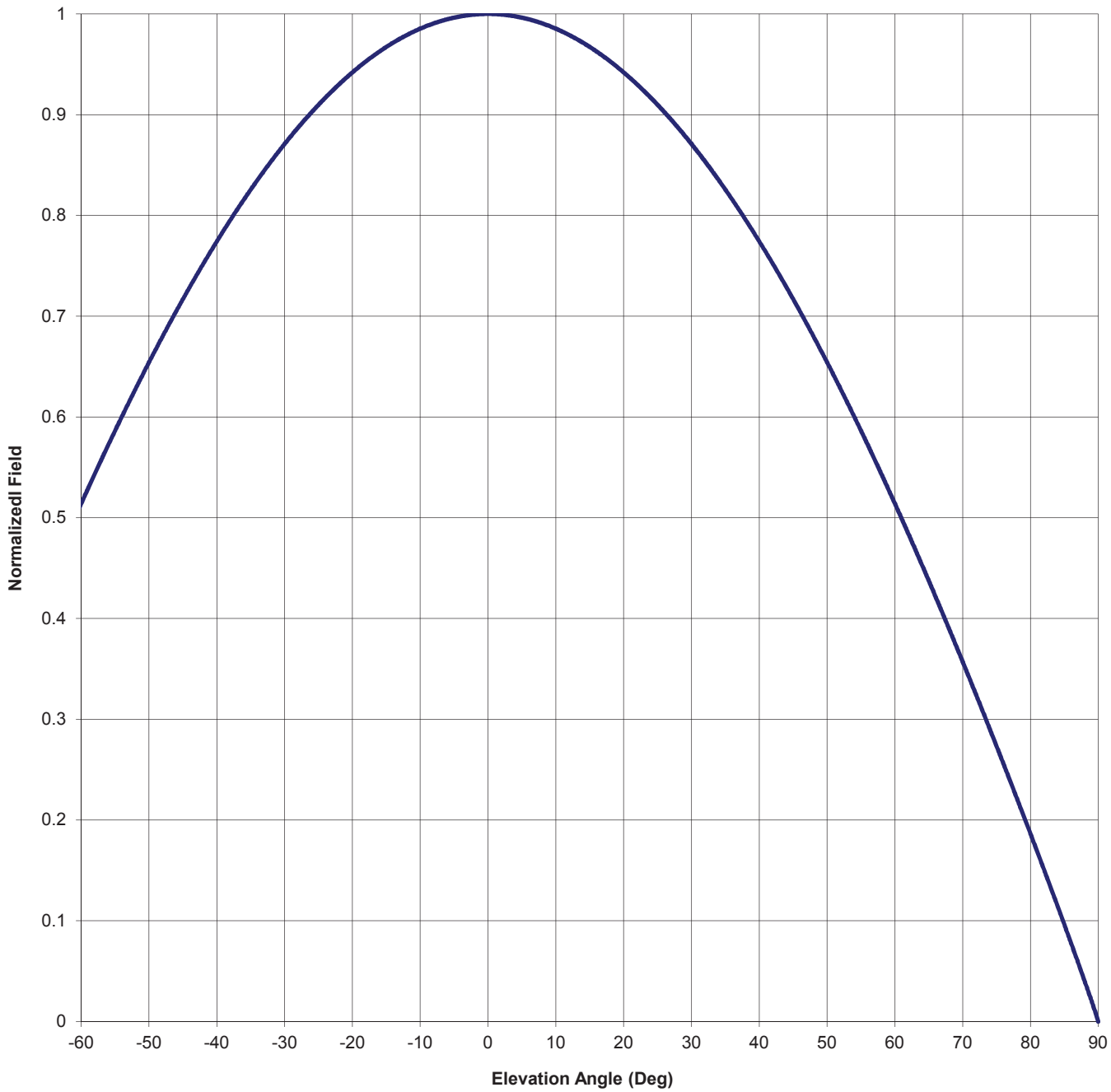
TOP VIEW

TOWER: ROHN 65

ANTENNA HEADING 120° TRUE NORTH

SHIVELY LABS A DIVISION OF HOWELL LABORATORIES INC.,BRIDGTON, MAINE			
SHOP ORDER: 30550	FREQUENCY: 91.3	SCALE: N.T.S.	DRAWN BY: ASP APPROVED BY: DAB
TITLE: MODEL-6810-1D-H/V-DIRECTIONAL ANTENNA			
DATE: 11-26-14	FIGURE 2		

Antenna Mfg.:	**Shively Labs**			**Date: 10/30/2014**
Antenna Type:	**6810-1D-H/V-DA**			
Station:	**WLVR**	**Beam Tilt**	**0**	
Frequency:	**91.3**	**Gain (Max)**	**2.383**	**3.772 dB**
Channel #:	**217**	**Gain (Horizon)**	**2.383**	**3.772 dB**
Figure:	**Figure 3**			



Antenna Mfg.: Shively Labs **Date:** 10/30/2014

Antenna Type: 6810-1D-H/V-DA

Station: WLVR **Beam Tilt** 0

Frequency: 91.3 **Gain (Max)** 2.383 3.772 dB

Channel #: 217 **Gain (Horizon)** 2.383 3.772 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	0.729	0	1.000	46	0.705
-89	0.021	-43	0.741	1	1.000	47	0.693
-88	0.040	-42	0.752	2	0.999	48	0.680
-87	0.059	-41	0.763	3	0.999	49	0.667
-86	0.078	-40	0.774	4	0.998	50	0.654
-85	0.096	-39	0.785	5	0.996	51	0.641
-84	0.114	-38	0.796	6	0.995	52	0.628
-83	0.133	-37	0.806	7	0.993	53	0.614
-82	0.151	-36	0.816	8	0.991	54	0.600
-81	0.168	-35	0.826	9	0.988	55	0.586
-80	0.186	-34	0.835	10	0.985	56	0.572
-79	0.204	-33	0.845	11	0.982	57	0.558
-78	0.221	-32	0.854	12	0.979	58	0.544
-77	0.239	-31	0.862	13	0.975	59	0.529
-76	0.256	-30	0.871	14	0.971	60	0.514
-75	0.273	-29	0.879	15	0.967	61	0.499
-74	0.290	-28	0.887	16	0.963	62	0.484
-73	0.307	-27	0.895	17	0.958	63	0.469
-72	0.324	-26	0.903	18	0.953	64	0.453
-71	0.341	-25	0.910	19	0.948	65	0.437
-70	0.357	-24	0.917	20	0.942	66	0.422
-69	0.373	-23	0.924	21	0.936	67	0.406
-68	0.390	-22	0.930	22	0.930	68	0.390
-67	0.406	-21	0.936	23	0.924	69	0.373
-66	0.422	-20	0.942	24	0.917	70	0.357
-65	0.437	-19	0.948	25	0.910	71	0.341
-64	0.453	-18	0.953	26	0.903	72	0.324
-63	0.469	-17	0.958	27	0.895	73	0.307
-62	0.484	-16	0.963	28	0.887	74	0.290
-61	0.499	-15	0.967	29	0.879	75	0.273
-60	0.514	-14	0.971	30	0.871	76	0.256
-59	0.529	-13	0.975	31	0.862	77	0.239
-58	0.544	-12	0.979	32	0.854	78	0.221
-57	0.558	-11	0.982	33	0.845	79	0.204
-56	0.572	-10	0.985	34	0.835	80	0.186
-55	0.586	-9	0.988	35	0.826	81	0.168
-54	0.600	-8	0.991	36	0.816	82	0.151
-53	0.614	-7	0.993	37	0.806	83	0.133
-52	0.628	-6	0.995	38	0.796	84	0.114
-51	0.641	-5	0.996	39	0.785	85	0.096
-50	0.654	-4	0.998	40	0.774	86	0.078
-49	0.667	-3	0.999	41	0.763	87	0.059
-48	0.680	-2	0.999	42	0.752	88	0.040
-47	0.693	-1	1.000	43	0.741	89	0.021
-46	0.705	0	1.000	44	0.729	90	0.000
-45	0.717			45	0.717		

S.O. 30550 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WLVR BETHLEHEM, PA.

MODEL 6810-1D-V/H Special-DA

Elevation Gain of Antenna 0.46

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

V RMS 0.61743 H RMS 0.312635 V/H Ratio 1.975

Elevation Gain of Vertical Component 0.908

Elevation Gain of Horizontal Component 0.233

Vertical Azimuth Gain equals $1/(RMS)^2$. 2.623

Horizontal Azimuth Gain equals $1/(RMS/Max\ Horz)^2$. 1.901
Max. Horizontal 0.431

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

Total Vertical Power Gain = **2.383**

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

Total Horizontal Power Gain = **0.443**

==========

ERP divided by Vertical Power Gain equals Antenna Input Power

0.2 kW ERP Divided by V Gain 2.383 equals 0.084 kW V Antenna Input Power

Antenna Input Power times Horizontal Power Gain equals Horizontal ERP

0.084 kW Times H Gain 0.443 equals 0.037 kW H ERP

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

(0.431)^2 Times 0.20 Equals 0.037 kW Horizontal ERP

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