

S.O. 29447
Report of Test 6810-3R-DA
for
Capstar Tx Limited Partnership
WZZO 95.1 MHz Bethlehem, PA

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-3R-DA to meet the needs of WZZO and to comply with the requirements of the FCC construction permit, file number BLH-19890830KD. 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 BLH-19890830KD indicates that the Horizontal radiation component shall not exceed 30.0 kW at any azimuth and is restricted to the following values at the azimuths specified:

218 Degrees T: 12.0 kW

From Figure 1A, the maximum radiation of the Horizontal component occurs at 129 Degrees T to 156 Degrees T and 315 Degrees T to 342 Degrees T. At the restricted azimuth of 218 Degrees T the Horizontal component is 4.013 dB down from the maximum of 30.0 kW, or 11.907 kW.

The R.M.S. of the Horizontal component is 0.823. The total Horizontal power gain is 2.340. The R.M.S. of the Vertical component is 0.805. The total Vertical power gain is 2.293. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.930. The R.M.S. of the measured composite pattern is 0.823. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.791. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6810-3R-DA was mounted on a pole of precise scale to the pole tower at the WZZO 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 BLH-19890830KD, a single level of the 6810-3R-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

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 427.95 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:

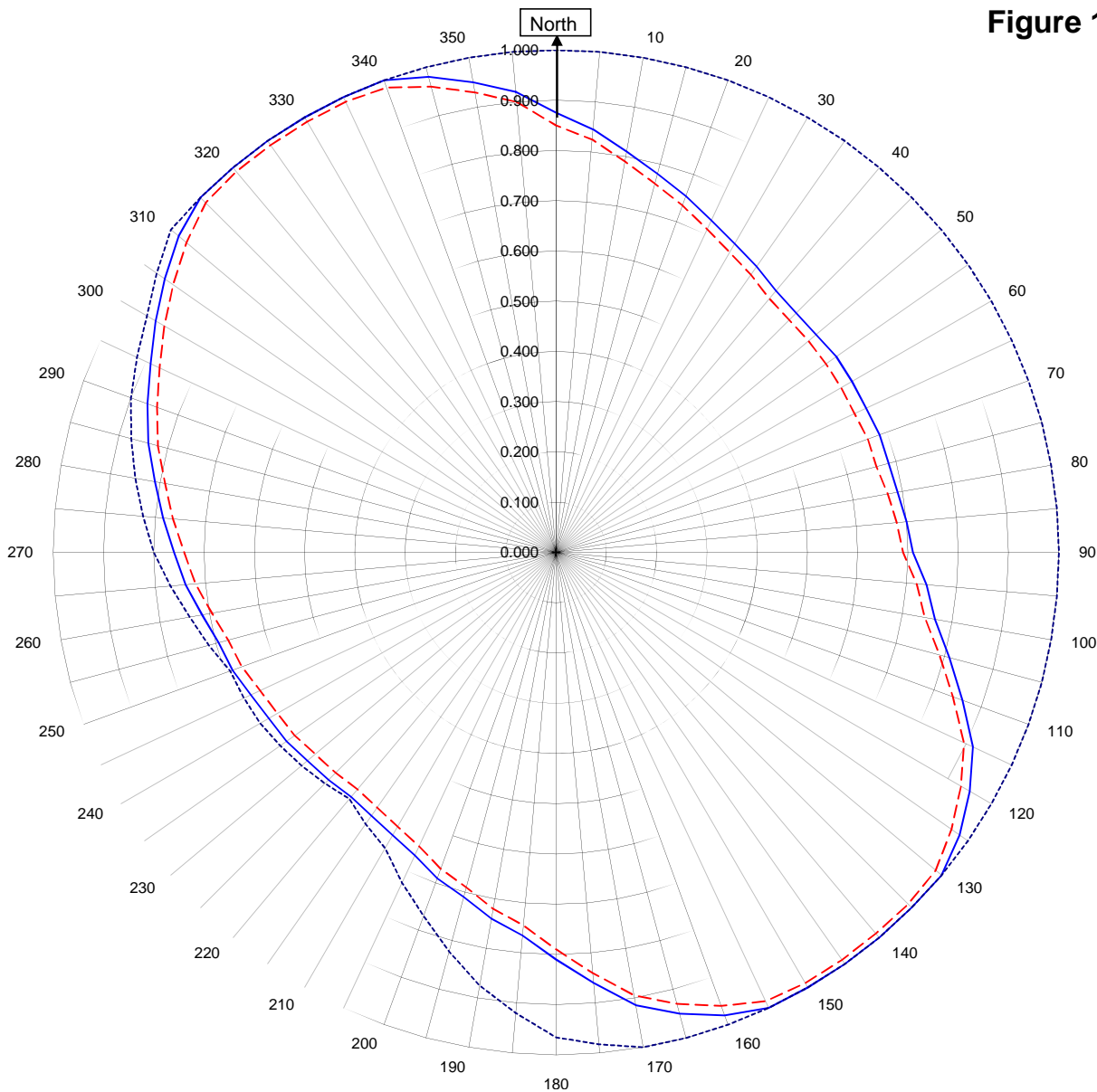


Robert A. Surette
Director of Sales Engineering
S/O 2944
October 20, 2011

Shively Labs

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

Figure 1A



WZZO **Bethlehem, PA**
29447
October 20, 2011

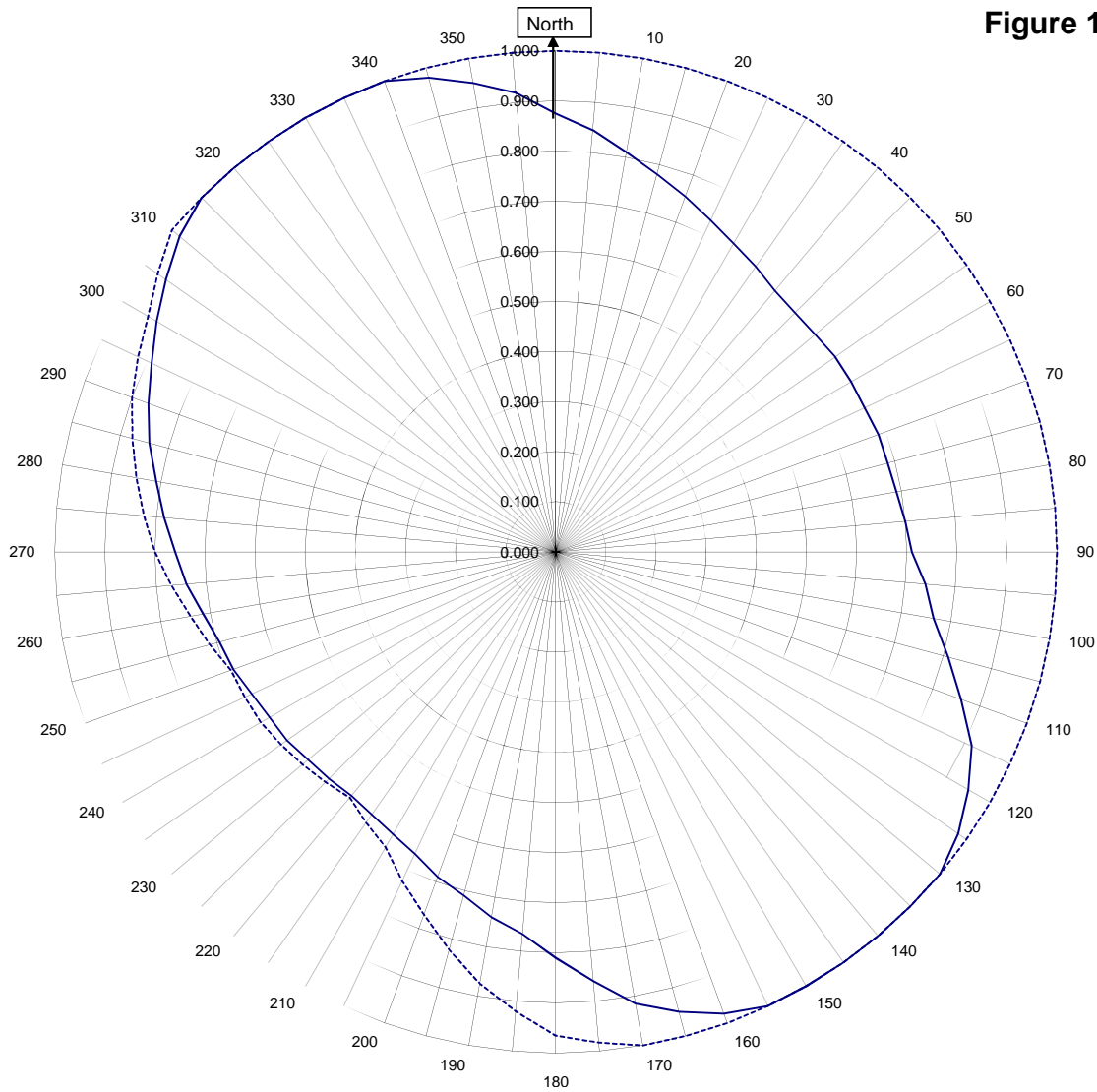
Horizontal RMS	0.823	Frequency	95.1 / 427.95 MHz
Vertical RMS	0.805	Plot	Relative Field
H/V Composite RMS	0.823	Scale	4.5 : 1
FCC Composite RMS	0.930	See Figure 2 for Mechanical Details	

Antenna Model	6810-3R-DA
Pattern Type	Directional Azimuth

Shively Labs

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

Figure 1B



WZZO **Bethlehem, PA**
29447
October 20, 2011

—————H/V Composite RMS	0.823
.....FCC Composite RMS	0.930

Frequency	95.1 / 427.95 mHz
Plot	Relative Field
Scale	4.5 : 1
See Figure 2 for Mechanical Details	

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

Figure 1C

Tabulation of Horizontal Azimuth Pattern
WZZO Bethlehem, PA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.875	180	0.810
10	0.810	190	0.740
20	0.755	200	0.690
30	0.710	210	0.650
40	0.680	220	0.635
45	0.675	225	0.640
50	0.675	230	0.645
60	0.680	240	0.660
70	0.685	250	0.685
80	0.690	260	0.715
90	0.710	270	0.760
100	0.765	280	0.810
110	0.860	290	0.865
120	0.950	300	0.920
130	1.000	310	0.980
135	1.000	315	1.000
140	1.000	320	1.000
150	1.000	330	1.000
160	0.980	340	1.000
170	0.915	350	0.950
218	0.630		

Figure 1D

Tabulation of Vertical Azimuth Pattern
WZZO Bethlehem, PA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.850	180	0.790
10	0.790	190	0.720
20	0.735	200	0.670
30	0.690	210	0.630
40	0.660	220	0.615
45	0.655	225	0.620
50	0.655	230	0.625
60	0.655	240	0.640
70	0.660	250	0.665
80	0.670	260	0.695
90	0.690	270	0.740
100	0.745	280	0.790
110	0.840	290	0.845
120	0.930	300	0.900
130	0.985	310	0.960
135	0.990	315	0.985
140	0.990	320	0.990
150	0.990	330	0.990
160	0.960	340	0.985
170	0.895	350	0.930

Figure 1E

Tabulation of Composite Azimuth Pattern
WZZO Bethlehem, PA

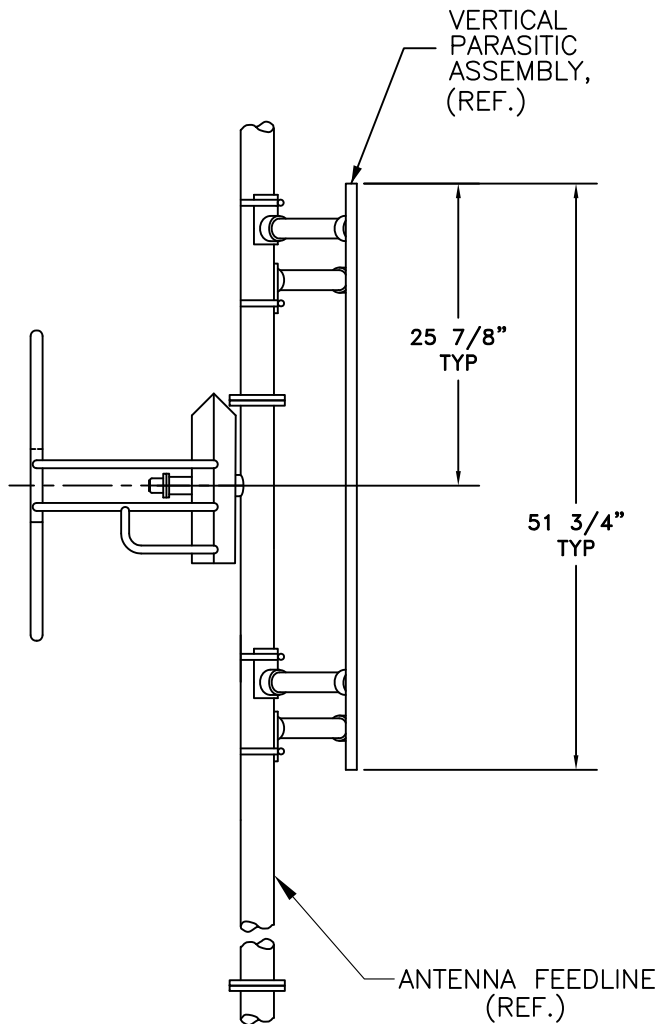
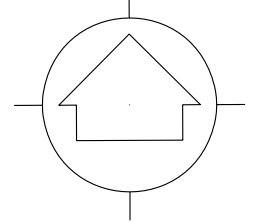
Azimuth	Rel Field	Azimuth	Rel Field
0	0.875	180	0.810
10	0.810	190	0.740
20	0.755	200	0.690
30	0.710	210	0.650
40	0.680	220	0.635
45	0.675	225	0.640
50	0.675	230	0.645
60	0.680	240	0.660
70	0.685	250	0.685
80	0.690	260	0.715
90	0.710	270	0.760
100	0.765	280	0.810
110	0.860	290	0.865
120	0.950	300	0.920
130	1.000	310	0.980
135	1.000	315	1.000
140	1.000	320	1.000
150	1.000	330	1.000
160	0.980	340	1.000
170	0.915	350	0.950

Figure 1F

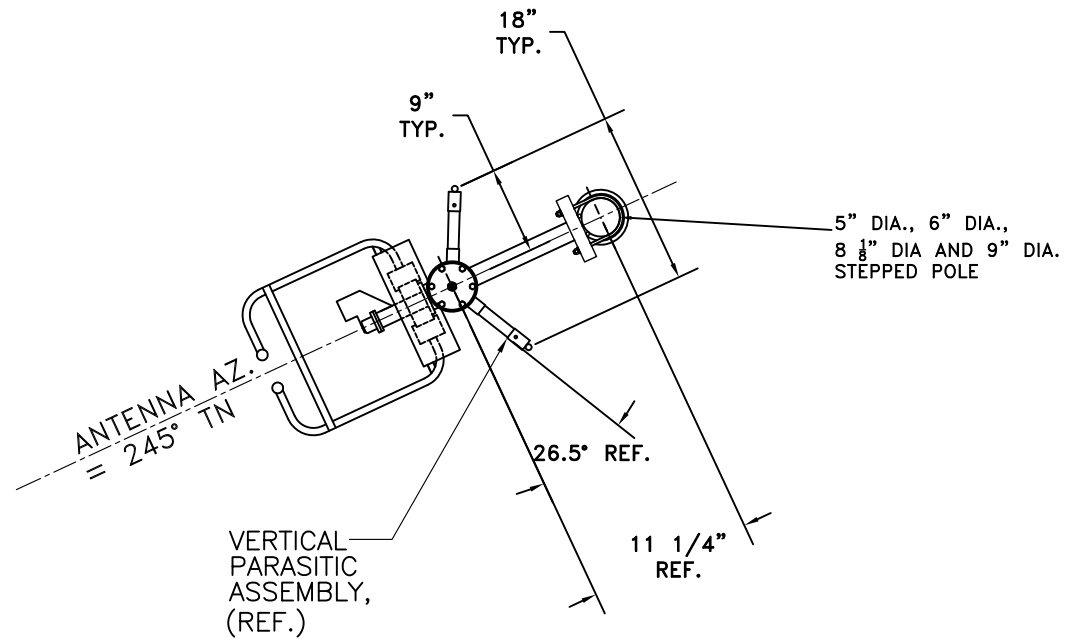
Tabulation of FCC Directional Composite
WZZO Bethlehem, PA

Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	0.965
10	1.000	190	0.875
20	1.000	200	0.770
30	1.000	210	0.680
40	1.000	220	0.640
50	1.000	230	0.660
60	1.000	240	0.680
70	1.000	250	0.690
80	1.000	260	0.740
90	1.000	270	0.800
100	1.000	280	0.850
110	1.000	290	0.900
120	1.000	300	0.940
130	1.000	310	1.000
140	1.000	320	1.000
150	1.000	330	1.000
160	1.000	340	1.000
170	1.000	350	1.000
218	0.632		

TRUE NORTH



SIDE VIEW



TOP VIEW
STEPPED POLE
5", 6", $8 \frac{1}{8}$ " & 9" DIA.

ANTENNA HEADING 245° TRUE NORTH

SHIVELY LABS			
A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE			
SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY:
29447	95.1	N.T.S.	ASP
TITLE:		APPROVED BY:	
MODEL-6810-3R-DIRECTIONAL ANTENNA		DAB	
DATE:			
9-29-11	FIGURE 2		

Antenna Mfg.: Shively Labs

Antenna Type: 6810-3R-DA

Station: WZZO

Frequency: 95.1

Channel #: 236

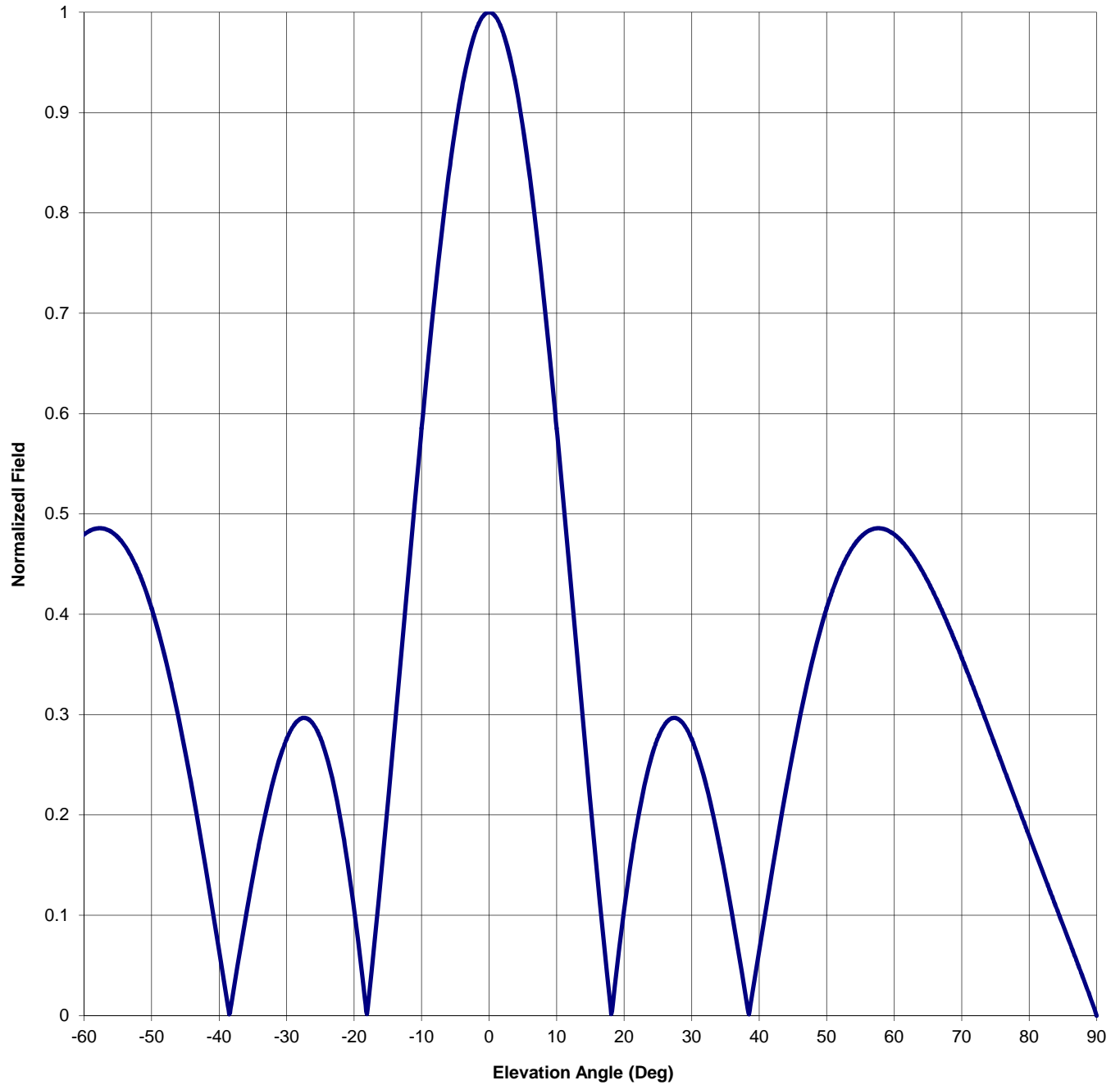
Figure: Figure 3

Date: 9/29/2011

Beam Tilt 0

Gain (Max) 2.340 3.692 dB

Gain (Horizon) 2.340 3.692 dB



Antenna Mfg.: Shively Labs

Date: 9/29/2011

Antenna Type: 6810-3R-DA

Station: WZZO

Beam Tilt 0

Frequency: 95.1

Gain (Max) 2.340

3.692 dB

Channel #: 236

Gain (Horizon) 2.340

3.692 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	0.226	0	1.000	46	0.296
-89	0.019	-43	0.188	1	0.995	47	0.328
-88	0.037	-42	0.148	2	0.981	48	0.357
-87	0.055	-41	0.106	3	0.958	49	0.383
-86	0.073	-40	0.065	4	0.926	50	0.406
-85	0.090	-39	0.022	5	0.885	51	0.426
-84	0.108	-38	0.020	6	0.837	52	0.443
-83	0.126	-37	0.061	7	0.782	53	0.457
-82	0.143	-36	0.101	8	0.721	54	0.469
-81	0.161	-35	0.138	9	0.655	55	0.477
-80	0.179	-34	0.174	10	0.585	56	0.482
-79	0.197	-33	0.206	11	0.512	57	0.485
-78	0.215	-32	0.234	12	0.437	58	0.486
-77	0.233	-31	0.257	13	0.362	59	0.484
-76	0.251	-30	0.276	14	0.286	60	0.480
-75	0.269	-29	0.289	15	0.212	61	0.474
-74	0.287	-28	0.296	16	0.140	62	0.466
-73	0.305	-27	0.296	17	0.072	63	0.456
-72	0.322	-26	0.290	18	0.008	64	0.445
-71	0.340	-25	0.277	19	0.052	65	0.433
-70	0.357	-24	0.257	20	0.106	66	0.419
-69	0.373	-23	0.229	21	0.154	67	0.405
-68	0.389	-22	0.195	22	0.195	68	0.389
-67	0.405	-21	0.154	23	0.229	69	0.373
-66	0.419	-20	0.106	24	0.257	70	0.357
-65	0.433	-19	0.052	25	0.277	71	0.340
-64	0.445	-18	0.008	26	0.290	72	0.322
-63	0.456	-17	0.072	27	0.296	73	0.305
-62	0.466	-16	0.140	28	0.296	74	0.287
-61	0.474	-15	0.212	29	0.289	75	0.269
-60	0.480	-14	0.286	30	0.276	76	0.251
-59	0.484	-13	0.362	31	0.257	77	0.233
-58	0.486	-12	0.437	32	0.234	78	0.215
-57	0.485	-11	0.512	33	0.206	79	0.197
-56	0.482	-10	0.585	34	0.174	80	0.179
-55	0.477	-9	0.655	35	0.138	81	0.161
-54	0.469	-8	0.721	36	0.101	82	0.143
-53	0.457	-7	0.782	37	0.061	83	0.126
-52	0.443	-6	0.837	38	0.020	84	0.108
-51	0.426	-5	0.885	39	0.022	85	0.090
-50	0.406	-4	0.926	40	0.065	86	0.073
-49	0.383	-3	0.958	41	0.106	87	0.055
-48	0.357	-2	0.981	42	0.148	88	0.037
-47	0.328	-1	0.995	43	0.188	89	0.019
-46	0.296	0	1.000	44	0.226	90	0.000
-45	0.262			45	0.262		

VALIDATION OF TOTAL POWER GAIN CALCULATION

WZZO Bethlehem, PA

MODEL 6810-3R-DA

Elevation Gain of Antenna

1.55

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

H RMS 0.82313278

V RMS 0.80473102

H/V Ratio 1.023

Elevation Gain of Horizontal Component 1.585

Elevation Gain of Vertical Component 1.515

Horizontal Azimuth Gain equals $1/(\text{RMS})^2$. 1.476

1.513

Max. Vertical

0.990

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

Total Horizontal Power Gain = 2.340

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

Total Vertical Power Gain = 2.293

ERP divided by Horizontal Power Gain equals Antenna Input Power

30.000 kW ERP Divided by H Gain 2.340 equals 12.821 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

12.821 kW Times V Gain 2.293 equals 29.403 kW V ERP

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

(0.99)^2 Times 30.00 Equals 29.403 kW Vertical ERP

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