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S.O. 28979

Report of Test Aldena Slant (45°) Yagi Array

for

The Power Foundation

WEGN 88.7 MHz Kankakee, IL

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of an Aldena Slant (45°) Yagi Array to meet the needs of WEGN and to comply with the requirements of the FCC construction permit, file number BMPED-20100819ABO.

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-20100819ABO indicates that the Horizontal radiation component shall not exceed 5.0 kW at any azimuth and is restricted to the following values at the azimuths specified:

200 Degrees T: 1.30 kW

340 - 350 Degrees T: 0.160 kW

MEMBER: NAB BROADCASTERS · SOCIETY OF BROADCAST ENGINEERS · NRB NATIONAL RELIGIOUS BROADCASTERS · TAB TEXAS ASSOCIATION OF BROADCASTERS · NTA NATIONAL TRANSLATOR ASSOCIATION

From Figure 1A, the maximum radiation of the Horizontal component occurs at 100 Degrees T to 130 Degrees T. At the restricted azimuth of 200 Degrees T the Horizontal component is 13.15 dB down from the maximum of 5.0 kW, or 0.242 kW. At the restricted azimuth of 340 - 350 Degrees T the Vertical component is 17.924 dB down from the maximum of 5.0 kW, or 0.081 kW.

The R.M.S. of the Horizontal component is 0.557. The total Horizontal power gain is 1.779. The R.M.S. of the Vertical component is 0.555. The total Vertical power gain is 1.744. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.668. The R.M.S. of the measured composite pattern is 0.582. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.568. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the Aldena Slant (45°) Yagi Array was mounted on a tower of precise scale to the Sabre tower at the WEGN 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-20100819ABO, a single level of the Aldena Slant (45°) Yagi Array 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 28979
March 28, 2011

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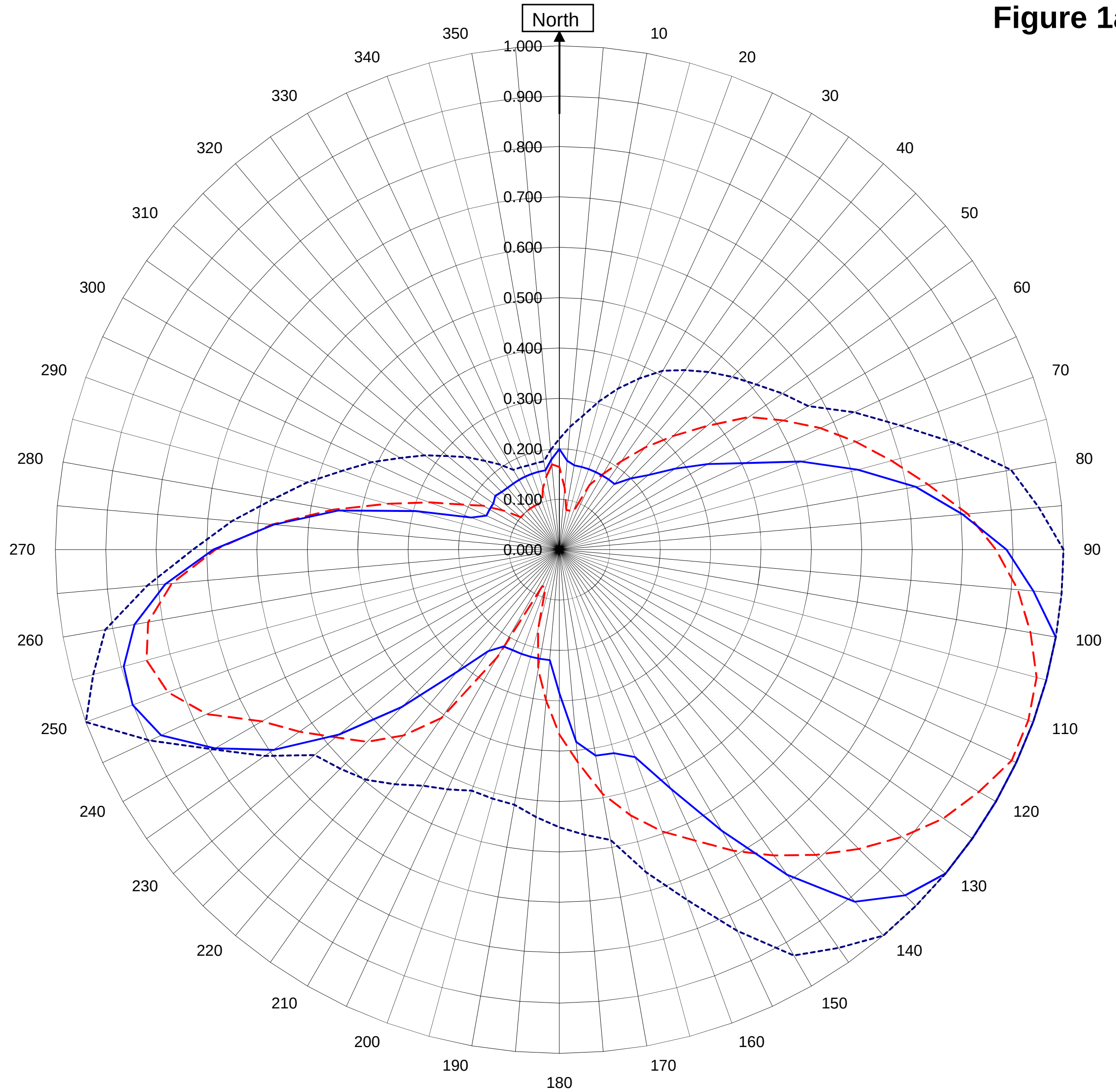
Figure 1a



WEGN Kankakee, IL

28979

March 28, 2011

____________Horizontal RMS	0.557
_ _ _ _ _ _ _ _ _ Vertical RMS	0.555
H/V Composite RMS	0.582
……………FCC Composite RMS	0.668

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

Antenna Model	Aldena Slant (45°)Yagi Array
Pattern Type	Directional Azimuth

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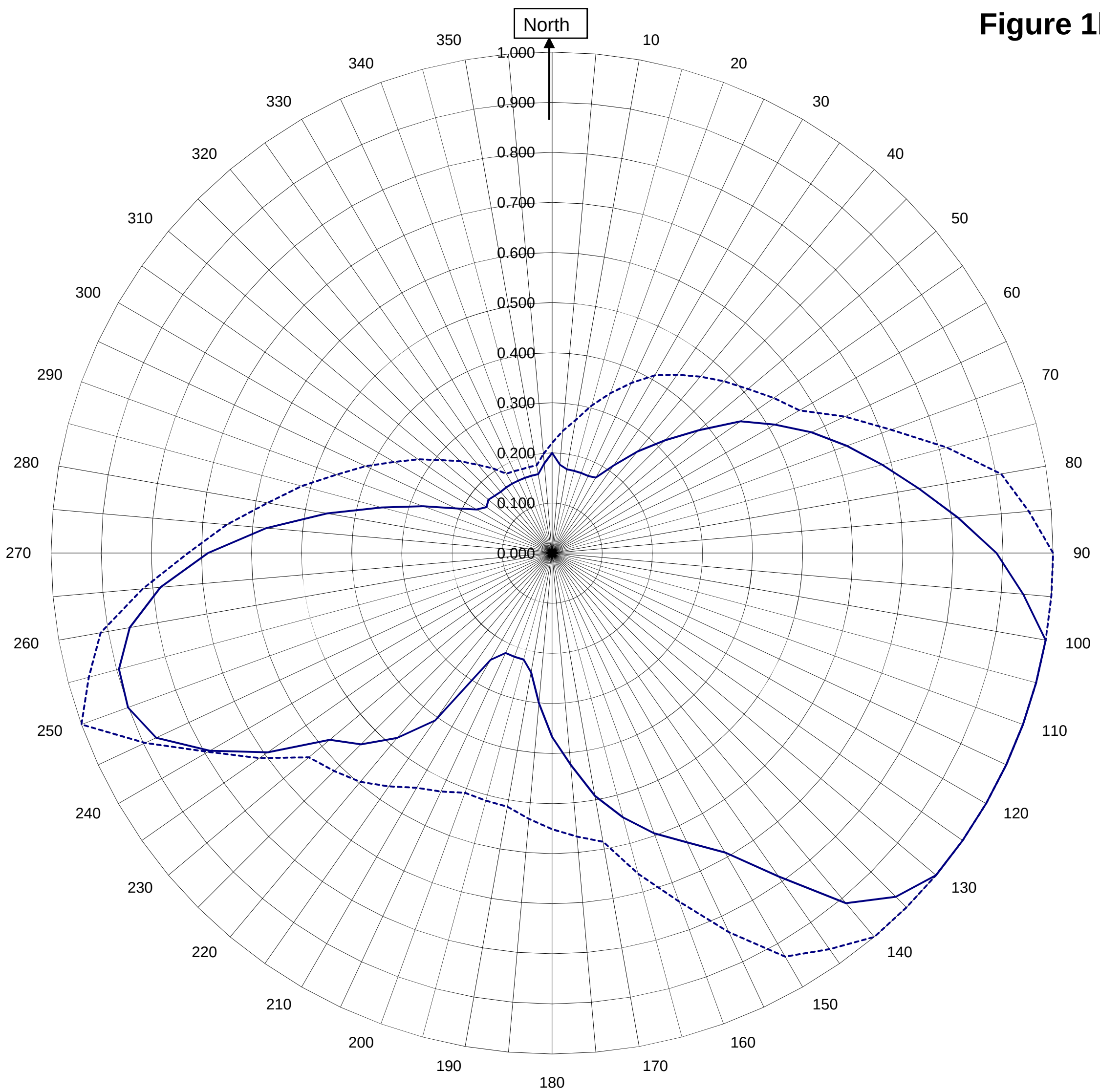
Figure 1b



WEGN Kankakee, IL

28979

March 28, 2011

___________H/VComposite RMS	0.582
……………FCC Composite RMS	0.668

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

Antenna Model	Aldena Slant (45°)Yagi Array
Pattern Type	Directional H/V Composite

Figure 1c

Tabulation of Horizontal Azimuth Pattern
WEGN Kankakee, IL

Azimuth	Rel Field	Azimuth	Rel Field
0	0.200	180	0.285
10	0.170	190	0.220
20	0.170	200	0.220
30	0.170	210	0.222
40	0.170	220	0.317
45	0.200	225	0.441
50	0.230	230	0.571
60	0.340	240	0.789
70	0.511	250	0.901
80	0.718	260	0.856
90	0.887	270	0.687
100	1.000	280	0.446
110	1.000	290	0.186
120	1.000	300	0.160
130	1.000	310	0.166
135	0.970	315	0.162
140	0.912	320	0.160
150	0.644	330	0.160
160	0.438	340	0.160
170	0.415	350	0.160

Figure 1d

Tabulation of Vertical Azimuth Pattern
WEGN Kankakee, IL

Azimuth	Rel Field	Azimuth	Rel Field
0	0.164	180	0.367
10	0.080	190	0.242
20	0.080	200	0.080
30	0.174	210	0.246
40	0.265	220	0.481
45	0.319	225	0.540
50	0.382	230	0.580
60	0.513	240	0.682
70	0.626	250	0.827
80	0.743	260	0.828
90	0.866	270	0.683
100	0.949	280	0.456
110	0.990	290	0.274
120	0.961	300	0.174
130	0.887	310	0.100
135	0.840	315	0.100
140	0.791	320	0.100
150	0.690	330	0.100
160	0.595	340	0.100
170	0.492	350	0.148

Figure 1e

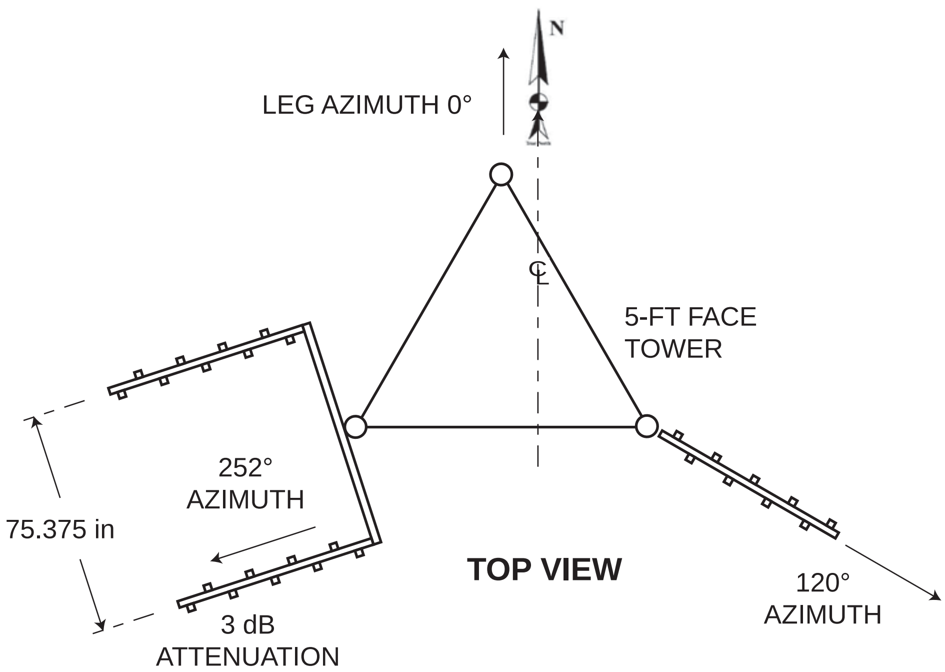
Tabulation of Composite Azimuth Pattern
WEGN Kankakee, IL

Azimuth	Rel Field	Azimuth	Rel Field
0	0.200	180	0.367
10	0.170	190	0.242
20	0.170	200	0.220
30	0.174	210	0.246
40	0.265	220	0.481
45	0.319	225	0.540
50	0.382	230	0.580
60	0.513	240	0.789
70	0.626	250	0.901
80	0.743	260	0.856
90	0.887	270	0.687
100	1.000	280	0.456
110	1.000	290	0.274
120	1.000	300	0.174
130	1.000	310	0.166
135	0.970	315	0.162
140	0.912	320	0.160
150	0.690	330	0.160
160	0.595	340	0.160
170	0.492	350	0.160

Figure 1f

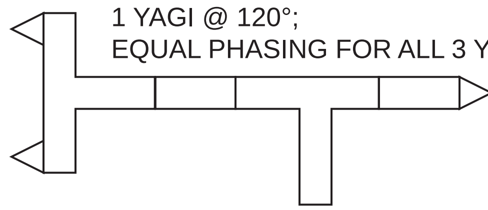
Tabulation of FCC Directional Composite
WEGN Kankakee, IL

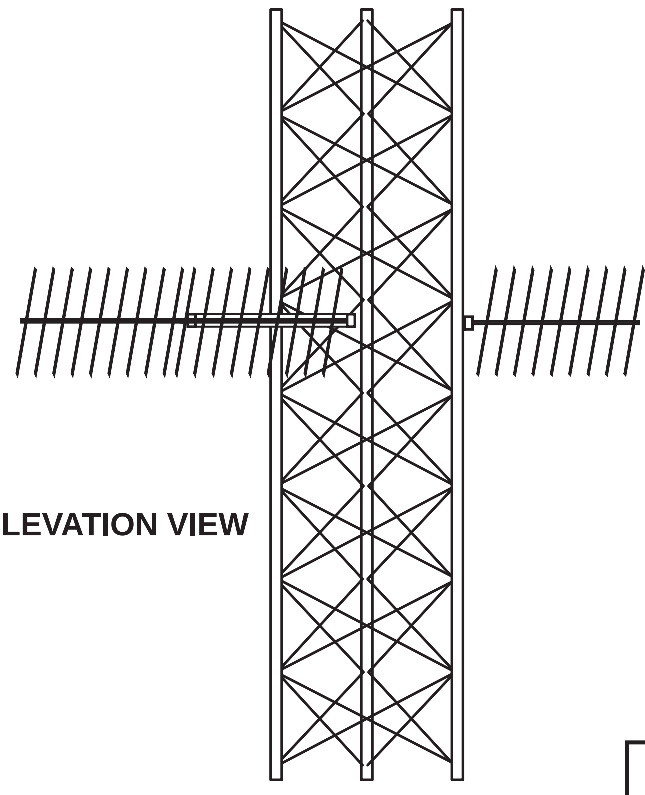
Azimuth	Rel Field	Azimuth	Rel Field
0	0.220	180	0.551
10	0.270	190	0.514
20	0.340	200	0.509
30	0.410	210	0.541
40	0.460	220	0.596
50	0.510	230	0.634
60	0.570	240	0.793
70	0.720	250	1.000
80	0.910	260	0.915
90	1.000	270	0.727
100	1.000	280	0.577
110	1.000	290	0.458
120	1.000	300	0.364
130	1.000	310	0.289
140	1.000	320	0.230
150	0.930	330	0.183
160	0.740	340	0.178
170	0.585	350	0.178



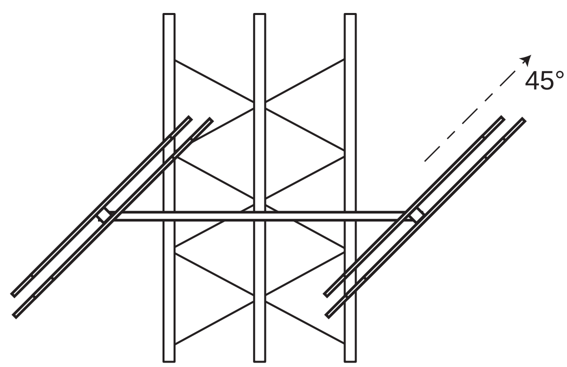
TOP VIEW

COAX SYSTEM FOR
2 YAGIS @ 252°, 3 dB ATTENUATION;
1 YAGI @ 120°;
EQUAL PHASING FOR ALL 3 YAGIS





ELEVATION VIEW



PARTIAL FRONT VIEW

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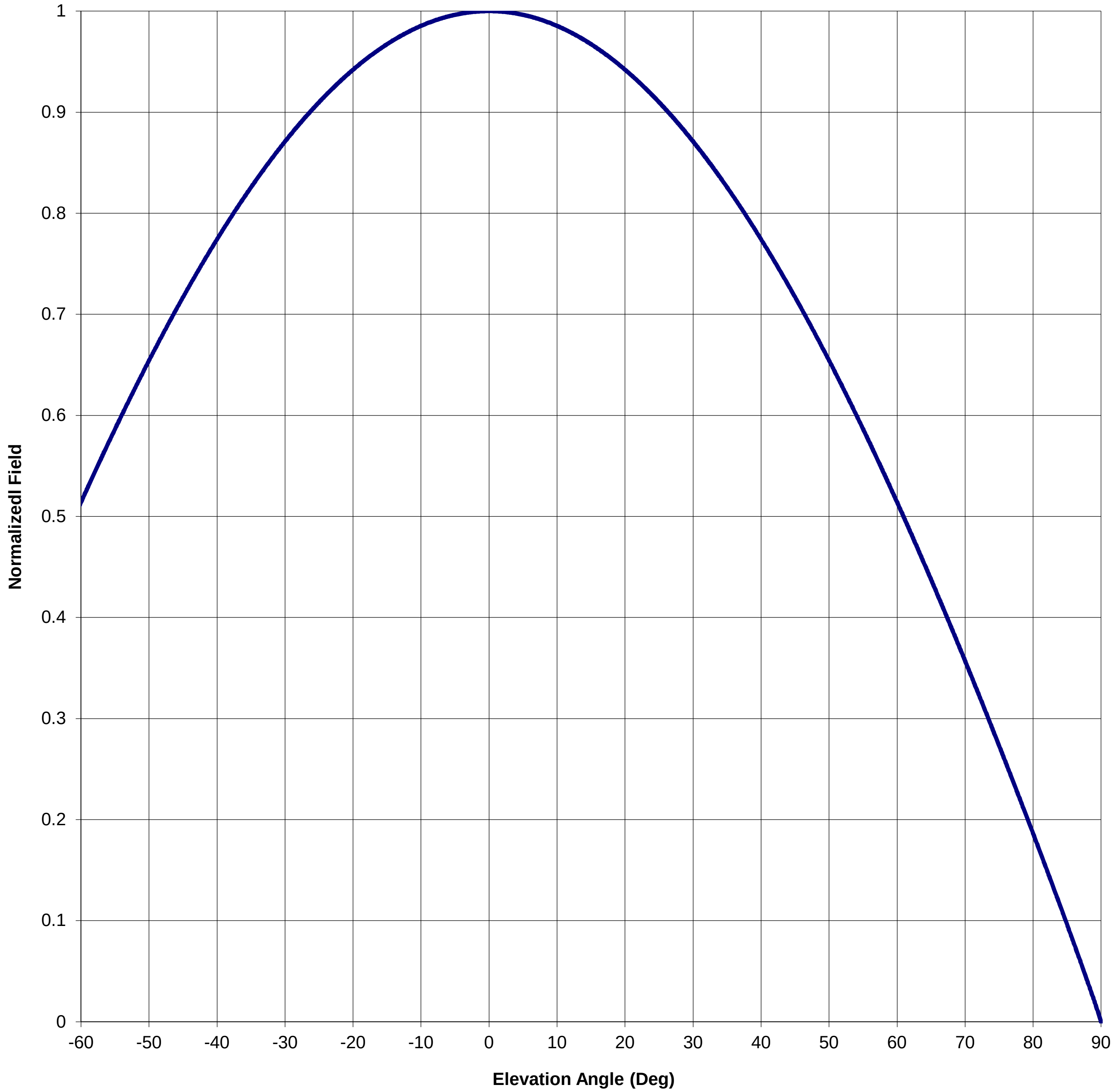
FIGURE 2, WEGN, 88.7 MHz
KANKAKEE, IL
ALDENA SLANT YAGI ARRAY

SIZE	CODE IDENT. NO.	DRAWING NO.	REV
A	26750	AGF110324-001	—
SCALE NONE	S/O 28979	SHEET 1 OF 1	

Antenna Mfg.:	**Shively Labs**			**Date: 3/27/2011**
Antenna Type:	**Aldena Slant (45) Yagi Array**			
Station:	**WEGN**	**Beam Tilt**	**0**	
Frequency:	**88.7**	**Gain (Max)**	**1.779**	**2.501 dB**
Channel #:	**204**	**Gain (Horizon)**	**1.779**	**2.501 dB**
Figure:	**Figure 3**			



Antenna Mfg.:	Shively Labs			Date: 3/27/2011
Antenna Type:	Aldena Slant (45) Yagi Array			
Station:	WEGN	Beam Tilt	0	
Frequency:	88.7	Gain (Max)	1.779	2.501 dB
Channel #:	204	Gain (Horizon)	1.779	2.501 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. 28979 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WEGN 88.7 MHz Kankakee, IL

Aldena Slant (45°) Yagi Array

Elevation Gain of Antenna 0.55

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

H RMS 0.557 V RMS 0.555 H/V Ratio 1.004

Elevation Gain of Horizontal Component 0.552

Elevation Gain of Vertical Component 0.548

Horizontal Azimuth Gain equals $1/(RMS)^2$. 3.223

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 3.182

Max. Vertical 0.99

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

Total Horizontal Power Gain = **1.779**

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

Total Vertical Power Gain = **1.744**

==

ERP divided by Horizontal Power Gain equals Antenna Input Power

5 kW ERP Divided by H Gain 1.779 equals 2.81 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

2.81 kW Times V Gain 1.744 equals 4.90 kW V ERP

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

(0.99)^2 Times 5.00 Equals 4.90 kW Vertical ERP

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