ShivelyLabs
a division of Howell Laboratories,Inc.
- An Employee-Owned Company -

P. O. Box 389 Harrison Rd.,
Bridgton, Maine 04009 USA
(207) 647-3327
888-SHIVELY
Fax: (207) 647-8273
E-mail: sales@shively.com
Web site: www.shively.com

S.O. 27430

Report of Test - Aldena Yagi Array

for

Saint Ambrose College

KALA 88.5 MHz Davenport, IA

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of an Aldena Yagi Array to meet the needs of KALA and to comply with the requirements of the FCC construction permit, file number BPED-20070907ADL.

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-20070907ADL indicates that the Horizontal radiation component shall not exceed 10 kW at any azimuth and is restricted to the following values at the azimuths specified:

0 - 20 Degrees T: 2.304 kW

150 - 160 Degrees T: 0.552 kW

From Figure 1A, the maximum radiation of the Horizontal component occurs at 235 Degrees T. At the restricted azimuth of 0 - 20 Degrees T the Vertical component is 6.84 dB down from the maximum of 10 kW, or 2.070 kW.

At the restricted azimuth of 150 - 160 Degrees T the Horizontal component is 12.88 dB down from the maximum of 10 kW, or 0.515 kW.

The R.M.S. of the Horizontal component is 0.649. The total Horizontal power gain is 2.811. The R.M.S. of the Vertical component is 0.603. The total Vertical power gain is 2.623. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.761. The R.M.S. of the measured composite pattern is 0.692. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.647. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One level of the Aldena Yagi Array was mounted on a tower of precise scale to the 36 inch face tower at the KALA site. The angle of the antenna elements to the tower was varied and phasing was applied to achieve the horizontal azimuth pattern shown in Figure 1A. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BPED-20070907ADL, a single level of the Aldena 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 398.25 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.

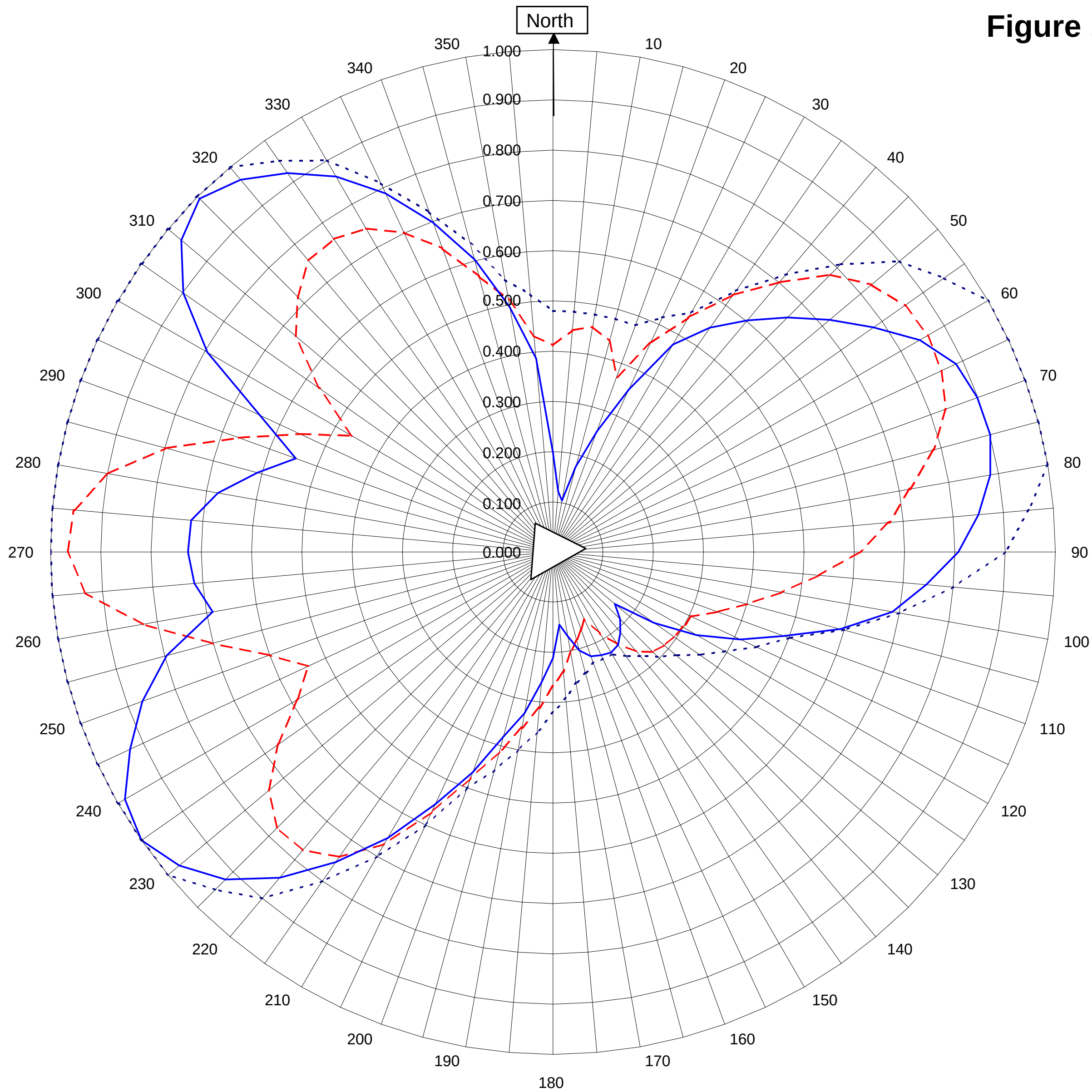
Respectfully submitted by:

Robert A. Surette
Director of Sales Engineering
S/O 27430
Date: April 14, 2009

Shively Labs

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

Figure 1a



KALA Davenport, IA

27430

April 8, 2009

____________Horizontal RMS	0.649
_ _ _ _ _ _ _ _ _ Vertical RMS	0.603
H/V Composite RMS	0.692
...............FCC Composite RMS	0.761

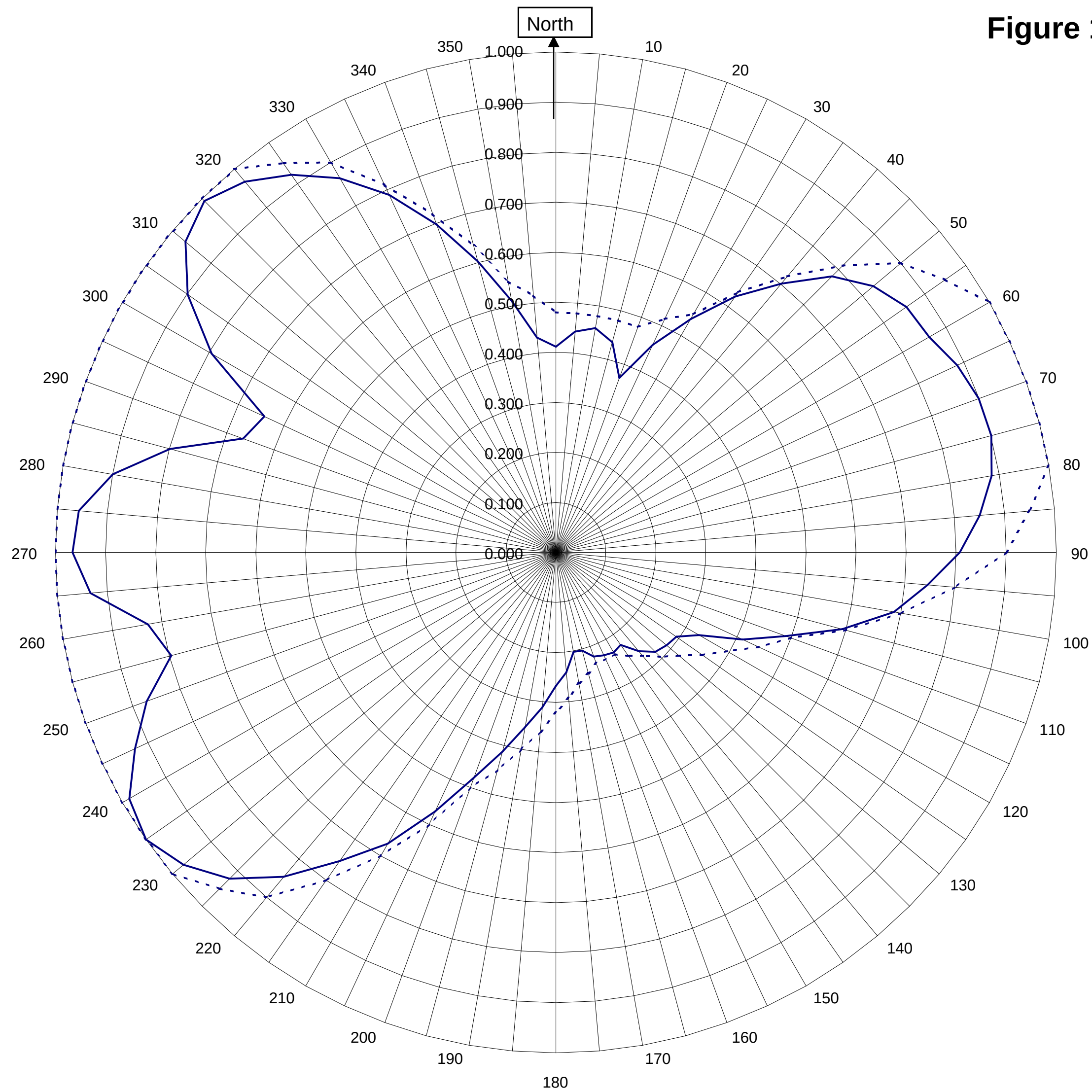
Frequency	88.5 / 398.25 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	Aldena Yagi Array
Pattern Type	Directional Azimuth

Shively Labs

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

Figure 1b



KALA Davenport, IA

27430
April 8, 2009

__________H/VComposite RMS	0.692
……………FCC Composite RMS	0.761

Frequency	88.5 / 398.25 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	Aldena Yagi Array
Pattern Type	Directional H/V Composite

Figure 1c

Tabulation of Horizontal Azimuth Pattern
KALA Davenport, IA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.198	180	0.211
10	0.104	190	0.326
20	0.256	200	0.467
30	0.477	210	0.657
40	0.602	220	0.846
45	0.660	225	0.922
50	0.719	230	0.971
60	0.843	240	0.984
70	0.899	250	0.870
80	0.884	260	0.688
90	0.807	270	0.727
100	0.686	280	0.677
110	0.489	290	0.545
120	0.330	300	0.794
130	0.161	310	0.966
135	0.189	315	0.994
140	0.209	320	0.967
150	0.231	330	0.863
160	0.221	340	0.698
170	0.170	350	0.495

Figure 1d

Tabulation of Vertical Azimuth Pattern
KALA Davenport, IA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.411	180	0.267
10	0.455	190	0.355
20	0.371	200	0.479
30	0.539	210	0.672
40	0.701	220	0.775
45	0.780	225	0.776
50	0.828	230	0.739
60	0.861	240	0.587
70	0.832	250	0.601
80	0.721	260	0.828
90	0.610	270	0.966
100	0.462	280	0.899
110	0.349	290	0.665
120	0.299	300	0.462
130	0.289	310	0.668
135	0.281	315	0.718
140	0.258	320	0.757
150	0.187	330	0.743
160	0.164	340	0.643
170	0.202	350	0.510

Figure 1e

Tabulation of Composite Azimuth Pattern
KALA Davenport, IA

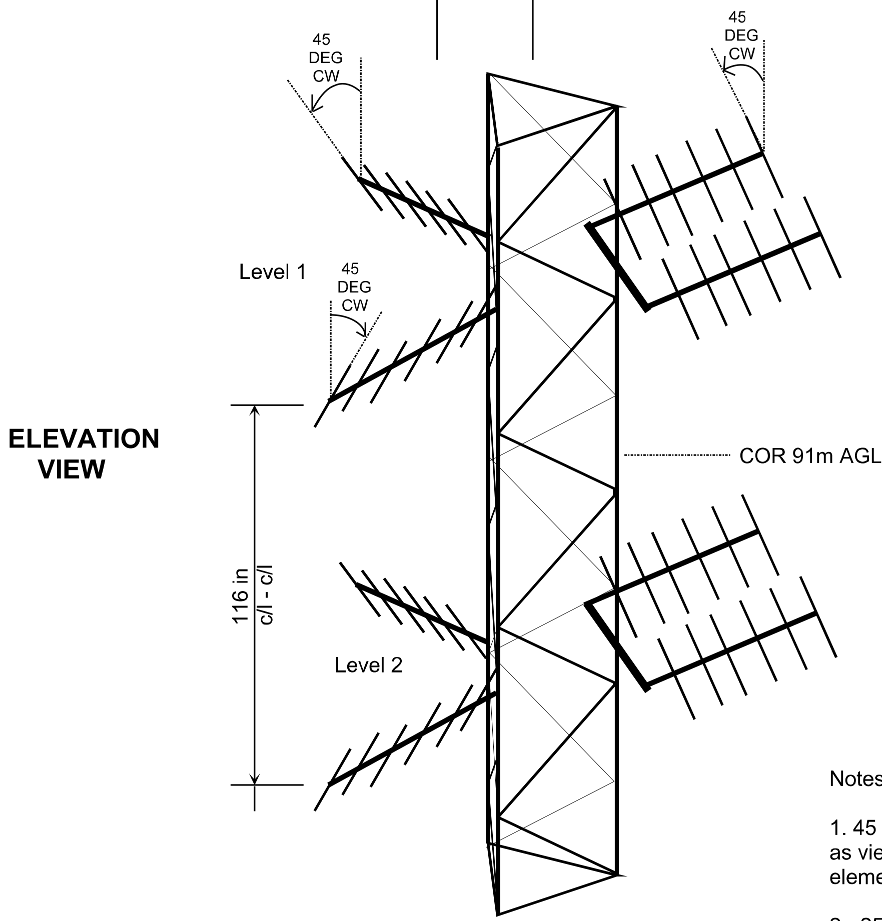
Azimuth	Rel Field	Azimuth	Rel Field
0	0.411	180	0.267
10	0.455	190	0.355
20	0.371	200	0.479
30	0.539	210	0.672
40	0.701	220	0.846
45	0.780	225	0.922
50	0.828	230	0.971
60	0.861	240	0.984
70	0.899	250	0.870
80	0.884	260	0.828
90	0.807	270	0.966
100	0.686	280	0.899
110	0.489	290	0.665
120	0.330	300	0.794
130	0.289	310	0.966
135	0.281	315	0.994
140	0.258	320	0.967
150	0.231	330	0.863
160	0.221	340	0.698
170	0.202	350	0.510

Figure 1f

Tabulation of FCC Directional Composite
KALA Davenport, IA

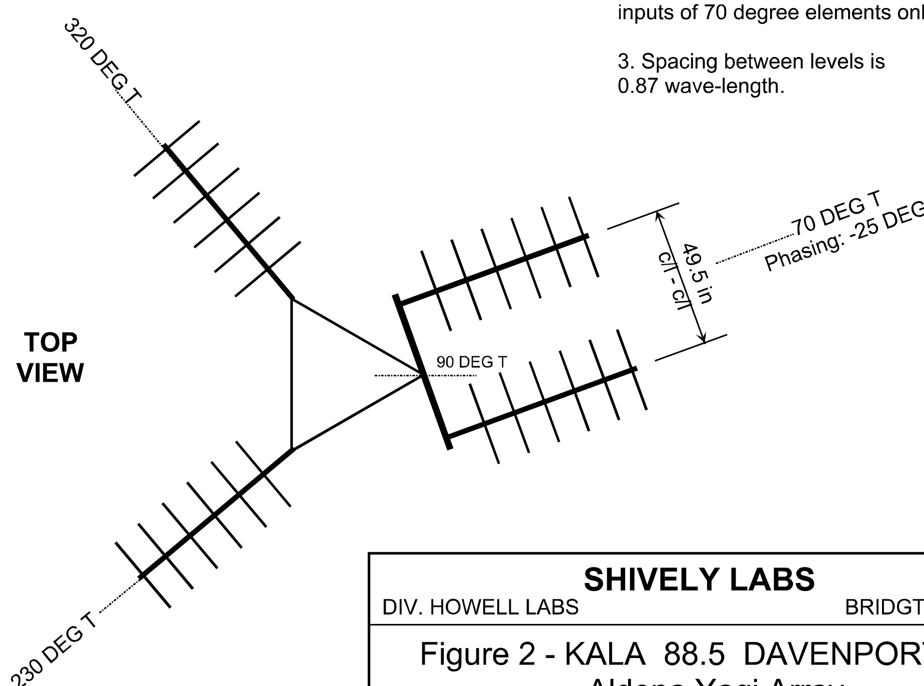
Azimuth	Rel Field	Azimuth	Rel Field
0	0.480	180	0.320
10	0.480	190	0.400
20	0.480	200	0.500
30	0.550	210	0.700
40	0.720	220	0.900
50	0.900	230	1.000
60	1.000	240	1.000
70	1.000	250	1.000
80	1.000	260	1.000
90	0.900	270	1.000
100	0.700	280	1.000
110	0.500	290	1.000
120	0.395	300	1.000
130	0.320	310	1.000
140	0.270	320	1.000
150	0.235	330	0.900
160	0.235	340	0.720
170	0.265	350	0.550

REV NO	REVISON	DATE	APP'D



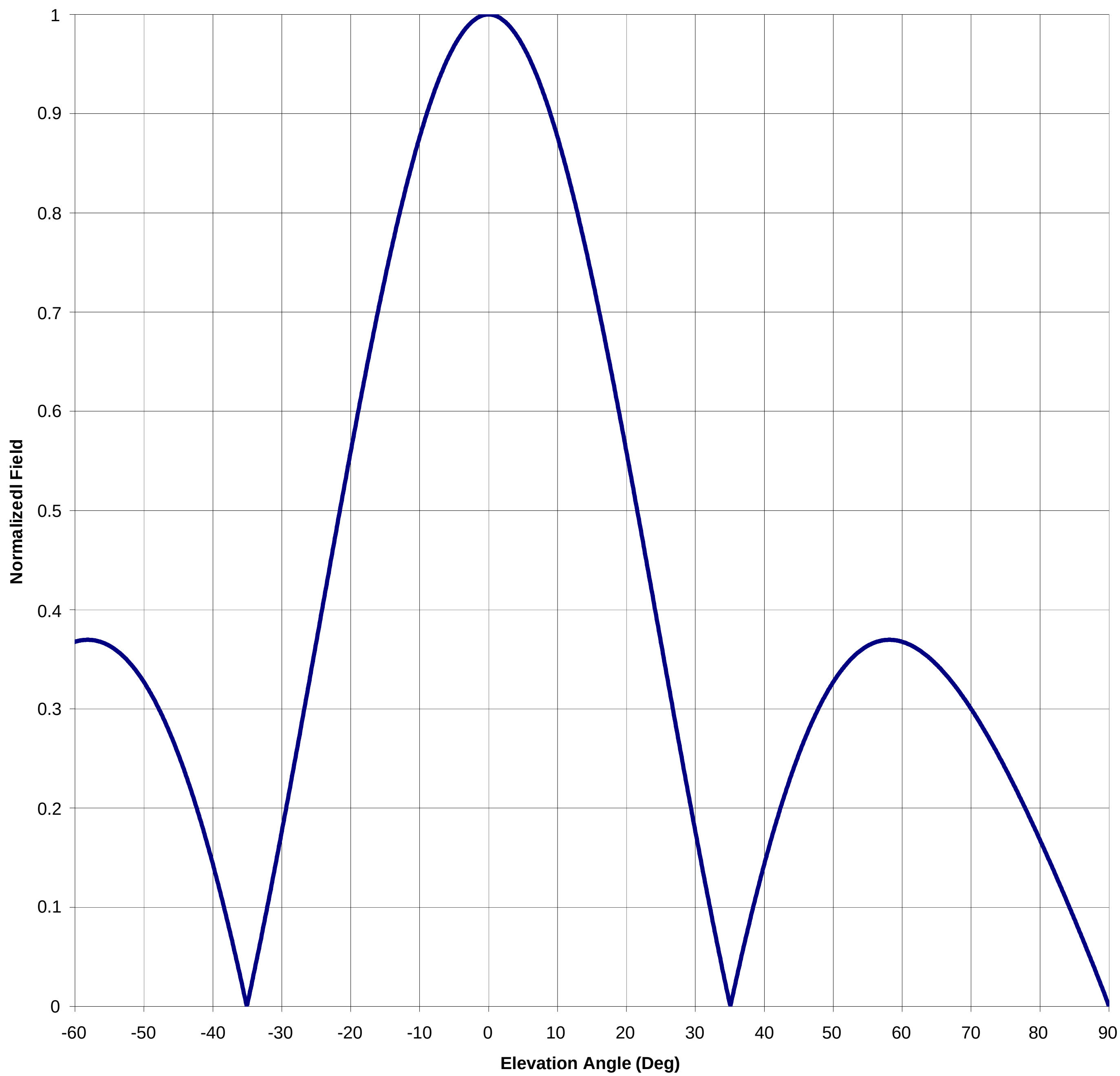
Notes:

1. 45 degree CW slant polarization as viewed looking into tower on all elements in array.
2. -25 degrees phasing applied at inputs of 70 degree elements only.
3. Spacing between levels is 0.87 wave-length.



SHIVELY LABS			
DIV. HOWELL LABS		BRIDGTON, ME USA	
Figure 2 - KALA 88.5 DAVENPORT, IA Aldena Yagi Array			
SIZE A	CODE IDENT NO 22501	DRAWING NO BJR 090415	REV
SCALE NONE	SO 27430	SHEET 1 of 1	

Antenna Mfg.:	Shively Labs			Date:	4/15/2009
Antenna Type:	Aldena Yagi Array				
Station:	KALA	Beam Til	0		
Frequency:	88.5	Gain (Max)	2.811	4.488	dB
Channel #:	203	Gain (Horizon)	2.811	4.488	dB
Figure:	3				



Antenna Mfg.:	**Shively Labs**			**Date:**	**4/15/2009**
Antenna Type:	**Aldena Yagi Array**				
Station:	**KALA**	**Beam Tilt**	**0**		
Frequency:	**88.5**	**Gain (Max)**	**2.811**	**4.488**	**dB**
Channel #:	**203**	**Gain (Horizon)**	**2.811**	**4.488**	**dB**
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	0.235	0	1.000	46	0.272
-89	0.019	-43	0.214	1	0.999	47	0.288
-88	0.037	-42	0.192	2	0.995	48	0.302
-87	0.054	-41	0.169	3	0.988	49	0.315
-86	0.071	-40	0.144	4	0.980	50	0.327
-85	0.088	-39	0.117	5	0.968	51	0.337
-84	0.104	-38	0.089	6	0.954	52	0.346
-83	0.121	-37	0.060	7	0.938	53	0.353
-82	0.137	-36	0.029	8	0.920	54	0.359
-81	0.152	-35	0.002	9	0.899	55	0.364
-80	0.168	-34	0.035	10	0.876	56	0.367
-79	0.183	-33	0.069	11	0.852	57	0.369
-78	0.198	-32	0.104	12	0.825	58	0.370
-77	0.212	-31	0.140	13	0.797	59	0.369
-76	0.226	-30	0.176	14	0.767	60	0.368
-75	0.240	-29	0.214	15	0.735	61	0.365
-74	0.253	-28	0.251	16	0.702	62	0.361
-73	0.265	-27	0.290	17	0.668	63	0.357
-72	0.278	-26	0.328	18	0.633	64	0.351
-71	0.289	-25	0.367	19	0.596	65	0.345
-70	0.300	-24	0.406	20	0.559	66	0.337
-69	0.310	-23	0.445	21	0.522	67	0.329
-68	0.320	-22	0.483	22	0.483	68	0.320
-67	0.329	-21	0.522	23	0.445	69	0.310
-66	0.337	-20	0.559	24	0.406	70	0.300
-65	0.345	-19	0.596	25	0.367	71	0.289
-64	0.351	-18	0.633	26	0.328	72	0.278
-63	0.357	-17	0.668	27	0.290	73	0.265
-62	0.361	-16	0.702	28	0.251	74	0.253
-61	0.365	-15	0.735	29	0.214	75	0.240
-60	0.368	-14	0.767	30	0.176	76	0.226
-59	0.369	-13	0.797	31	0.140	77	0.212
-58	0.370	-12	0.825	32	0.104	78	0.198
-57	0.369	-11	0.852	33	0.069	79	0.183
-56	0.367	-10	0.876	34	0.035	80	0.168
-55	0.364	-9	0.899	35	0.002	81	0.152
-54	0.359	-8	0.920	36	0.029	82	0.137
-53	0.353	-7	0.938	37	0.060	83	0.121
-52	0.346	-6	0.954	38	0.089	84	0.104
-51	0.337	-5	0.968	39	0.117	85	0.088
-50	0.327	-4	0.980	40	0.144	86	0.071
-49	0.315	-3	0.988	41	0.169	87	0.054
-48	0.302	-2	0.995	42	0.192	88	0.037
-47	0.288	-1	0.999	43	0.214	89	0.019
-46	0.272	0	1.000	44	0.235	90	0.000
-45	0.254			45	0.254		

S.O. 27430 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

KALA Davenport, IA

Aldena Array 1 level , four around - slant polarization

Elevation Gain of Antenna 1.100

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

H RMS 0.649 V RMS 0.603 H/V Ratio 1.076

Elevation Gain of Horizontal Component 1.184

Elevation Gain of Vertical Component 1.022

Horizontal Azimuth Gain equals $1/(RMS)^2$. 2.374

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 2.566
Max. Vertical 0.966

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

Total Horizontal Power Gain = **2.811**

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

Total Vertical Power Gain = **2.623**

==

ERP divided by Horizontal Power Gain equals Antenna Input Power

10 kW ERP Divided by H Gain 2.811 equals 3.56 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

3.56 kW Times V Gain 2.623 equals 9.33 kW V ERP

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

(0.966)^2 Times 10.00 Equals 9.33 kW Vertical ERP

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