

## **S.O. 28043**

### **Report of Test Aldena Log Periodic Array**

**for**

**Calvary Chapel of Omaha**

**New FM 90.1 MHz Gretna, NE**

#### **OBJECTIVE:**

The objective of this test was to demonstrate the directional characteristics of an Aldena Log Periodic Array to meet the needs of the New FM and to comply with the requirements of the FCC construction permit, file number BMPED-20090928AFA.

#### **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-20090928AFA indicates that the Horizontal radiation component shall not exceed 100 kW at any azimuth and is restricted to the following values at the azimuths specified:

190 thru 350 Degrees T: 4.0 kW

From Figure 1A, the maximum radiation of the Horizontal component occurs at 88 Degrees T to 91 Degrees T. At the restricted azimuths of 190 thru 350 Degrees T the Horizontal component is 15.92 dB down from the maximum of 100 kW, or 2.560 kW. At the restricted azimuths of 190 thru 350 Degrees T the Vertical component does not exceed the maximum Horizontal component and therefore complies with the requirements of the construction permit.

The R.M.S. of the Horizontal component is 0.399. The total Horizontal power gain is 10.136. The R.M.S. of the Vertical component is 0.408. The total Vertical power gain is 9. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.459. The R.M.S. of the measured composite pattern is 0.417. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.390. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

#### **METHOD OF DIRECTIONALIZATION:**

One level of the Aldena Log Periodic Array was mounted on a tower of precise scale to the Allied 36SR tower at the New FM site. The alignment of the antenna to the tower was varied and the horizontal spacing between the elements 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-20090928AFA, a single level of the Aldena Log Periodic 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 9<sup>th</sup> and 10<sup>th</sup> 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 405.45 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:

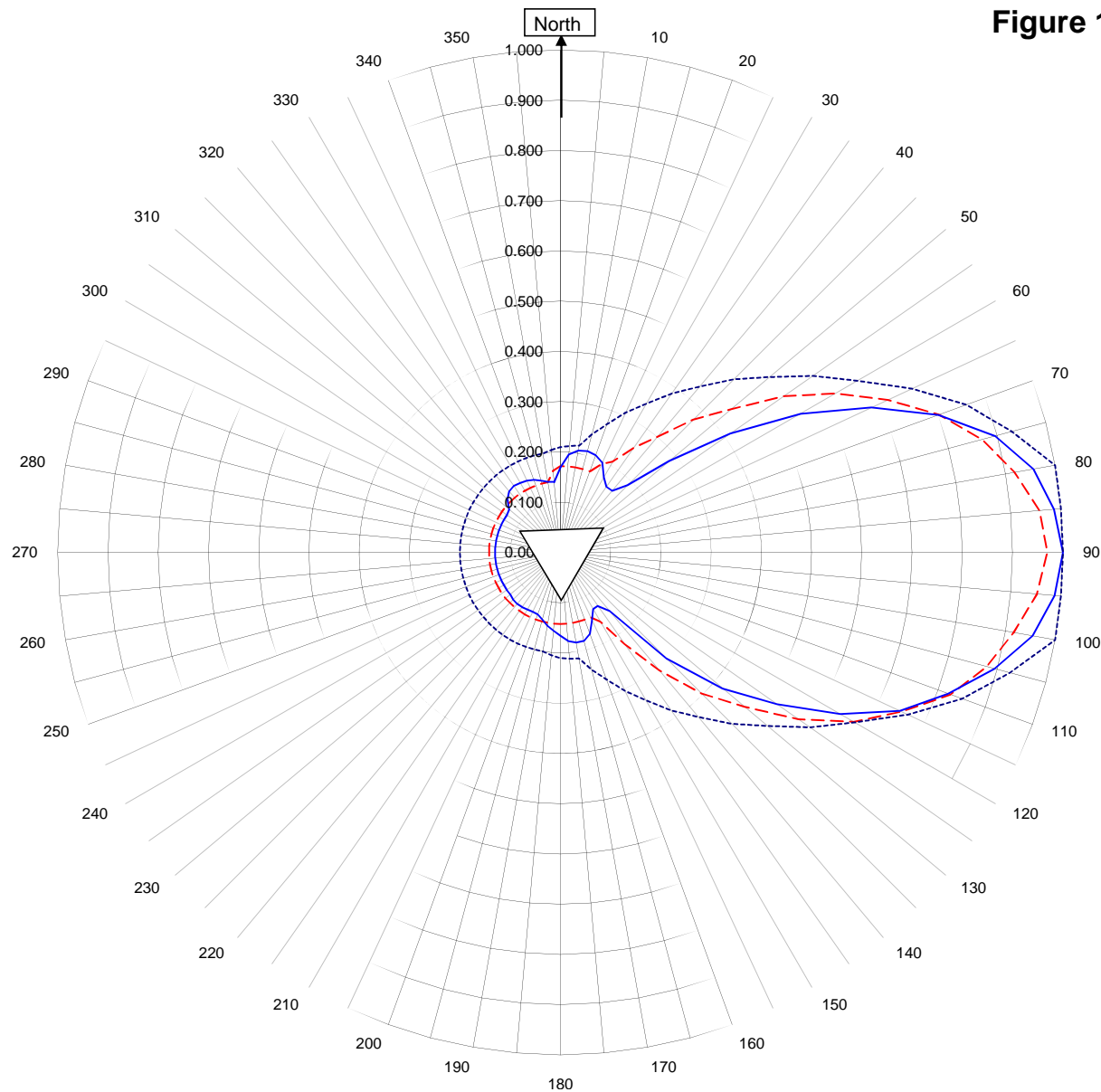


Robert A. Surette  
Director of Sales Engineering  
S/O 28043  
Date: January 6, 2011

# Shively Labs

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

Figure 1a



## KZLW Gretna, NE

28043

January 7, 2011

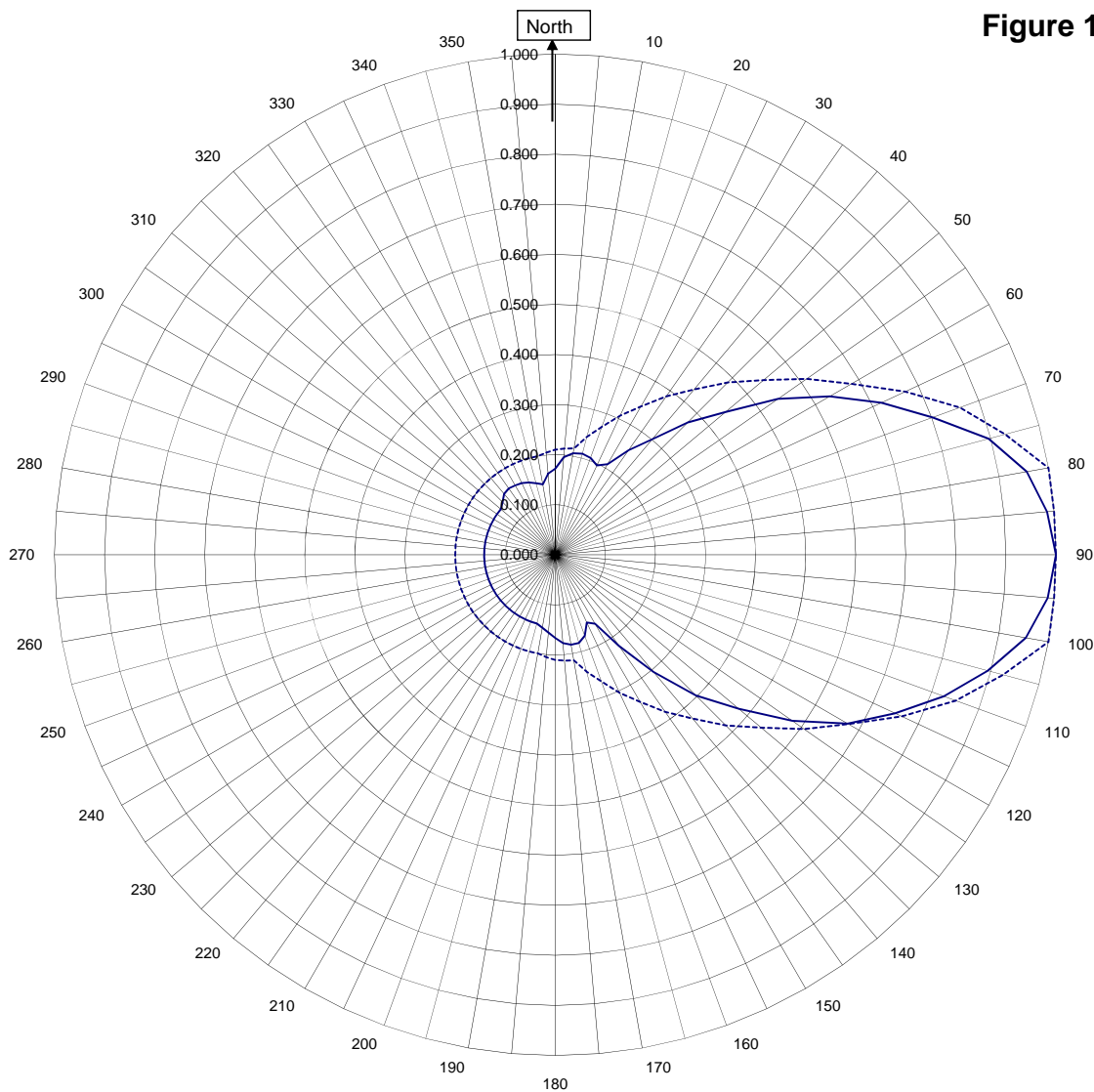
Horizontal RMS	0.399	Frequency	90.1 / 405.45 MHz
Vertical RMS	0.408	Plot	Relative Field
H/V Composite RMS	0.417	Scale	4.5 : 1
FCC Composite RMS	0.459	See Figure 2 for Mechanical Details	

Antenna Model	Aldena Log Periodic Array-Slant
Pattern Type	Directional Azimuth

# Shively Labs

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

Figure 1b



## KZLW Gretna, NE

28043  
January 7, 2011

 H/V Composite RMS	0.417
 FCC Composite RMS	0.459

Frequency	90.1 / 405.45 MHz
Plot	Relative Field
Scale	4.5 : 1
See Figure 2 for Mechanical Details	

Antenna Model	Aldena Log Periodic Array-Slant
Pattern Type	Directional H/V Composite

Figure 1c

Tabulation of Horizontal Azimuth Pattern  
KZLW Gretna, NE

Azimuth	Rel Field	Azimuth	Rel Field
0	0.169	180	0.166
10	0.206	190	0.148
20	0.206	200	0.131
30	0.173	210	0.131
40	0.160	220	0.134
45	0.190	225	0.133
50	0.283	230	0.130
60	0.552	240	0.130
70	0.801	250	0.130
80	0.956	260	0.130
90	1.000	270	0.130
100	0.954	280	0.130
110	0.821	290	0.130
120	0.643	300	0.130
130	0.421	310	0.133
135	0.298	315	0.149
140	0.152	320	0.159
150	0.130	330	0.160
160	0.172	340	0.154
170	0.182	350	0.143

Figure 1d

Tabulation of Vertical Azimuth Pattern  
KZLW Gretna, NE

Azimuth	Rel Field	Azimuth	Rel Field
0	0.172	180	0.142
10	0.172	190	0.142
20	0.172	200	0.142
30	0.209	210	0.142
40	0.301	220	0.142
45	0.374	225	0.142
50	0.444	230	0.142
60	0.633	240	0.142
70	0.802	250	0.142
80	0.918	260	0.142
90	0.969	270	0.142
100	0.916	280	0.142
110	0.826	290	0.142
120	0.674	300	0.142
130	0.478	310	0.142
135	0.397	315	0.142
140	0.305	320	0.142
150	0.159	330	0.142
160	0.142	340	0.142
170	0.142	350	0.142

Figure 1e

Tabulation of Composite Azimuth Pattern  
KZLW Gretna, NE

Azimuth	Rel Field	Azimuth	Rel Field
0	0.172	180	0.166
10	0.206	190	0.148
20	0.206	200	0.142
30	0.209	210	0.142
40	0.301	220	0.142
45	0.374	225	0.142
50	0.444	230	0.142
60	0.633	240	0.142
70	0.802	250	0.142
80	0.956	260	0.142
90	1.000	270	0.142
100	0.954	280	0.142
110	0.826	290	0.142
120	0.674	300	0.142
130	0.478	310	0.142
135	0.397	315	0.149
140	0.305	320	0.159
150	0.159	330	0.160
160	0.172	340	0.154
170	0.182	350	0.143

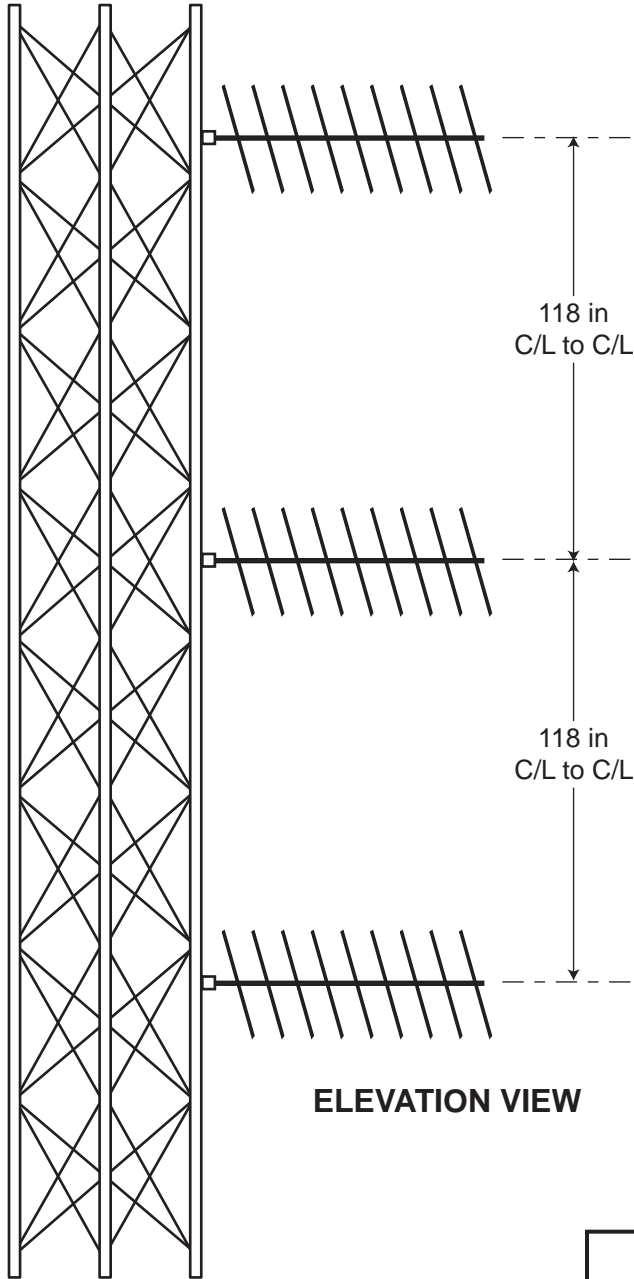


Figure 1f

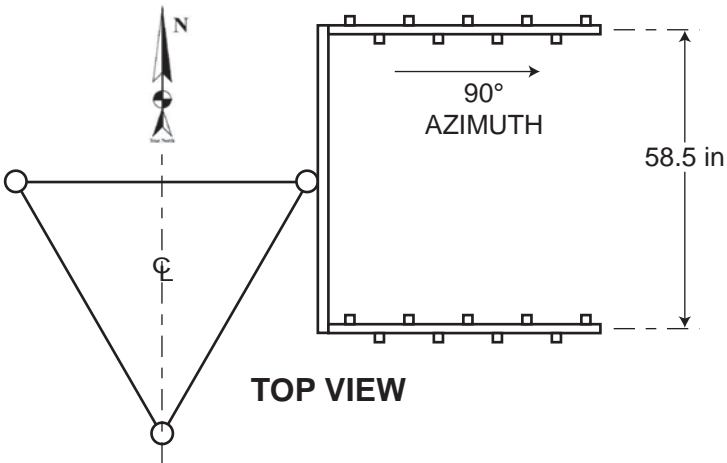
Tabulation of FCC Directional Composite  
KZLW Gretna, NE

Azimuth	Rel Field	Azimuth	Rel Field
0	0.210	180	0.210
10	0.216	190	0.200
20	0.272	200	0.200
30	0.342	210	0.200
40	0.431	220	0.200
50	0.543	230	0.200
60	0.683	240	0.200
70	0.860	250	0.200
80	1.000	260	0.200
90	1.000	270	0.200
100	1.000	280	0.200
110	0.851	290	0.200
120	0.676	300	0.200
130	0.537	310	0.200
140	0.427	320	0.200
150	0.339	330	0.200
160	0.269	340	0.200
170	0.214	350	0.200

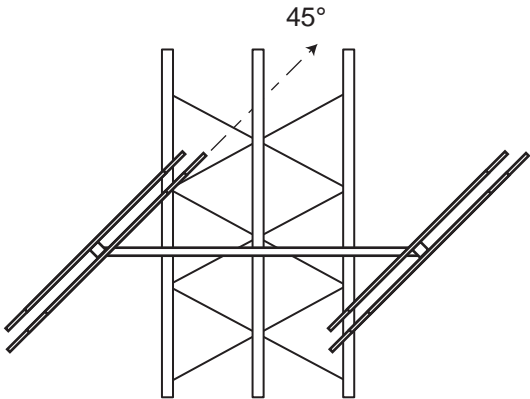
REV NO.	REVISION	DATE	APP'D
A	REDRAWN. ADDED THIRD LEVEL.	1/6/11	
B	DELETED COR ELEVATION	2/10/11	



ELEVATION VIEW



TOP VIEW



FRONT VIEW  
ONE PAIR ONLY SHOWN

The designs, constructions, arrangements, disclosures, and devices shown or described in the proposals, drawings, or sketches bearing this legend are the property of Howell Laboratories, Inc./Shively Labs and are submitted in confidence with the understanding that such designs, constructions, arrangements, disclosures, and devices shall not be utilized in whole or in part by any person, firm, or corporation, or disclosed to anyone other than the submittee, without the prior written permission of Howell Laboratories, Inc.

<b>SHIVELY LABS</b>			
DIV. HOWELL LABS		BRIDGTON, MAINE USA	
<b>FIGURE 2, NEW GREтна, NE ALDENА LOG PERIODIC ARRAY</b>			
SIZE <b>A</b>	CODE IDENT. NO. <b>26750</b>	DRAWING NO. <b>012210-BJR</b>	REV <b>B</b>
SCALE NONE	S/O 28043	SHEET 1 OF 1	

Antenna Mfg.: Shively Labs  
Antenna Type: Aldena Log Periodic Array

Date: 1/6/2011

Station: New FM

Beam Ti 0

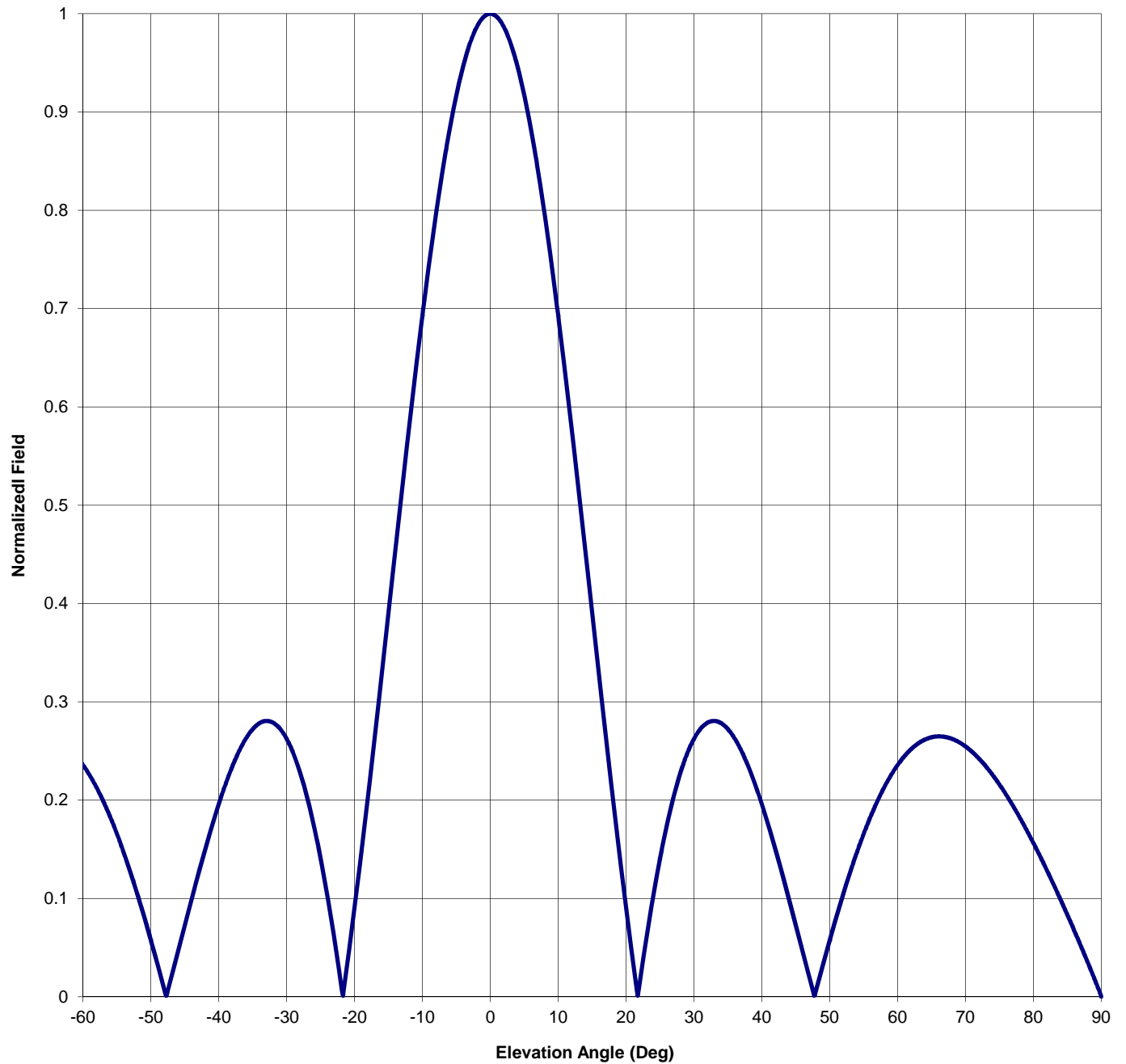
Frequency: 90.1

Gain (Max) 10.136 10.059 dB

Channel #: 211

Gain (Horizon) 10.136 10.059 dB

Figure: FIGURE 3



Antenna Mfg.: Shively Labs

Date: 1/6/2011

Antenna Type: Aldena Log Periodic Array

Station: New FM

Beam Tilt 0

Frequency: 90.1

Gain (Max) 10.136

10.059 dB

Channel #: 211

Gain (Horizon) 10.136

10.059 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	0.099	0	1.000	46	0.046
-89	0.018	-43	0.125	1	0.997	47	0.019
-88	0.035	-42	0.150	2	0.986	48	0.007
-87	0.051	-41	0.174	3	0.970	49	0.033
-86	0.067	-40	0.196	4	0.946	50	0.058
-85	0.083	-39	0.216	5	0.917	51	0.082
-84	0.099	-38	0.234	6	0.882	52	0.105
-83	0.114	-37	0.250	7	0.842	53	0.126
-82	0.128	-36	0.263	8	0.796	54	0.147
-81	0.143	-35	0.272	9	0.746	55	0.166
-80	0.156	-34	0.278	10	0.693	56	0.183
-79	0.169	-33	0.281	11	0.636	57	0.199
-78	0.182	-32	0.279	12	0.577	58	0.213
-77	0.194	-31	0.273	13	0.516	59	0.225
-76	0.205	-30	0.262	14	0.453	60	0.236
-75	0.216	-29	0.247	15	0.391	61	0.245
-74	0.225	-28	0.228	16	0.328	62	0.252
-73	0.234	-27	0.203	17	0.266	63	0.258
-72	0.242	-26	0.174	18	0.205	64	0.262
-71	0.249	-25	0.141	19	0.146	65	0.264
-70	0.255	-24	0.103	20	0.090	66	0.265
-69	0.259	-23	0.060	21	0.036	67	0.264
-68	0.262	-22	0.014	22	0.014	68	0.262
-67	0.264	-21	0.036	23	0.060	69	0.259
-66	0.265	-20	0.090	24	0.103	70	0.255
-65	0.264	-19	0.146	25	0.141	71	0.249
-64	0.262	-18	0.205	26	0.174	72	0.242
-63	0.258	-17	0.266	27	0.203	73	0.234
-62	0.252	-16	0.328	28	0.228	74	0.225
-61	0.245	-15	0.391	29	0.247	75	0.216
-60	0.236	-14	0.453	30	0.262	76	0.205
-59	0.225	-13	0.516	31	0.273	77	0.194
-58	0.213	-12	0.577	32	0.279	78	0.182
-57	0.199	-11	0.636	33	0.281	79	0.169
-56	0.183	-10	0.693	34	0.278	80	0.156
-55	0.166	-9	0.746	35	0.272	81	0.143
-54	0.147	-8	0.796	36	0.263	82	0.128
-53	0.126	-7	0.842	37	0.250	83	0.114
-52	0.105	-6	0.882	38	0.234	84	0.099
-51	0.082	-5	0.917	39	0.216	85	0.083
-50	0.058	-4	0.946	40	0.196	86	0.067
-49	0.033	-3	0.970	41	0.174	87	0.051
-48	0.007	-2	0.986	42	0.150	88	0.035
-47	0.019	-1	0.997	43	0.125	89	0.018
-46	0.046	0	1.000	44	0.099	90	0.000
-45	0.073			45	0.073		

## VALIDATION OF TOTAL POWER GAIN CALCULATION

New FM Gretna, NE

Aldena Log Periodic Array - Slant Polarization

Elevation Gain of Antenna

1.650

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

H RMS 0.399

V RMS 0.408

H/V Ratio 0.978

Elevation Gain of Horizontal Component 1.614

Elevation Gain of Vertical Component 1.687

Horizontal Azimuth Gain equals  $1/(\text{RMS})^2$ . 6.281Vertical Azimuth Gain equals  $1/(\text{RMS}/\text{Max Vert})^2$ . 5.641

Max. Vertical

0.969

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

Total Horizontal Power Gain = 10.136

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

Total Vertical Power Gain = 9.517

ERP divided by Horizontal Power Gain equals Antenna Input Power

100 kW ERP Divided by H Gain 10.136 equals 9.87 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

9.87 kW Times V Gain 9.517 equals 93.90 kW V ERP

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

 $(0.969)^2$  Times 100.00 Equals 93.90 kW Vertical ERP

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