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S.O. 28397
Report of Test Aldena Slant (45º) Yagi Array
for
Calvary Chapel of the Berkshires
WJNF 91.7 MHz Dalton, MA

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a Single level of an Aldena Slant (45º) Yagi Array to meet the needs of WJNF and to comply with the requirements of the FCC construction permit, file number BMPED-20110310AAE. 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 BMPED-20110310AAE indicates that the Horizontal radiation component shall not exceed 0.160 kW at any azimuth and is restricted to the following values at the azimuths specified:

070-080 Degrees T: 0.0052 kW

From Figure 1A, the maximum radiation of the Horizontal component occurs at 285 Degrees T to 290 Degrees T. At the restricted azimuth of 070-080 Degrees T the Horizontal component is 19.9 dB down from the maximum of 0.160 kW, or 0.0016 kW.

The R.M.S. of the Horizontal component is 0.51. The total Horizontal power gain is 2.14. The R.M.S. of the Vertical component is 0.504. The total Vertical power gain is 1.657. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.624. The R.M.S. of the measured composite pattern is 0.535. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.530. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the Aldena Slant (45º) Yagi Array was mounted on a pole of precise scale to the mounting pole at the WJNF site. The spacing of the antenna to the pole 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-20110310AAE a single level of the Aldena Slant (45º) 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.

<u>EQUIPMENT</u>:

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.

<u>TEST PROCEDURES</u>:

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 412.65 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 28397
April 27, 2011

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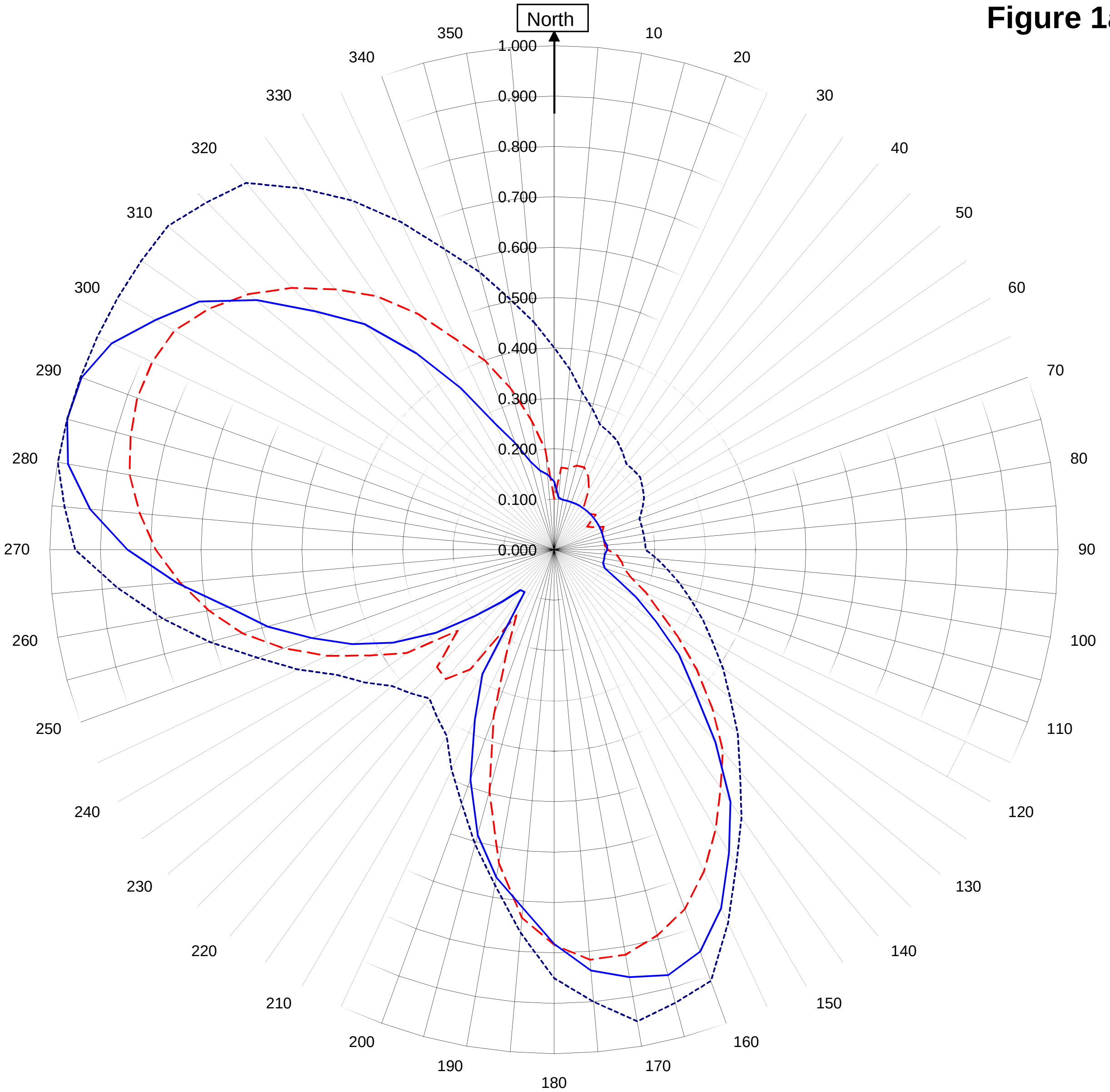
Figure 1a



WJNF Dalton, MA

28397

April 25, 2011

Horizontal RMS	0.510
Vertical RMS	0.504
H/V Composite RMS	0.535
...............FCC Composite RMS	0.624

Frequency	91.7 / 412.65 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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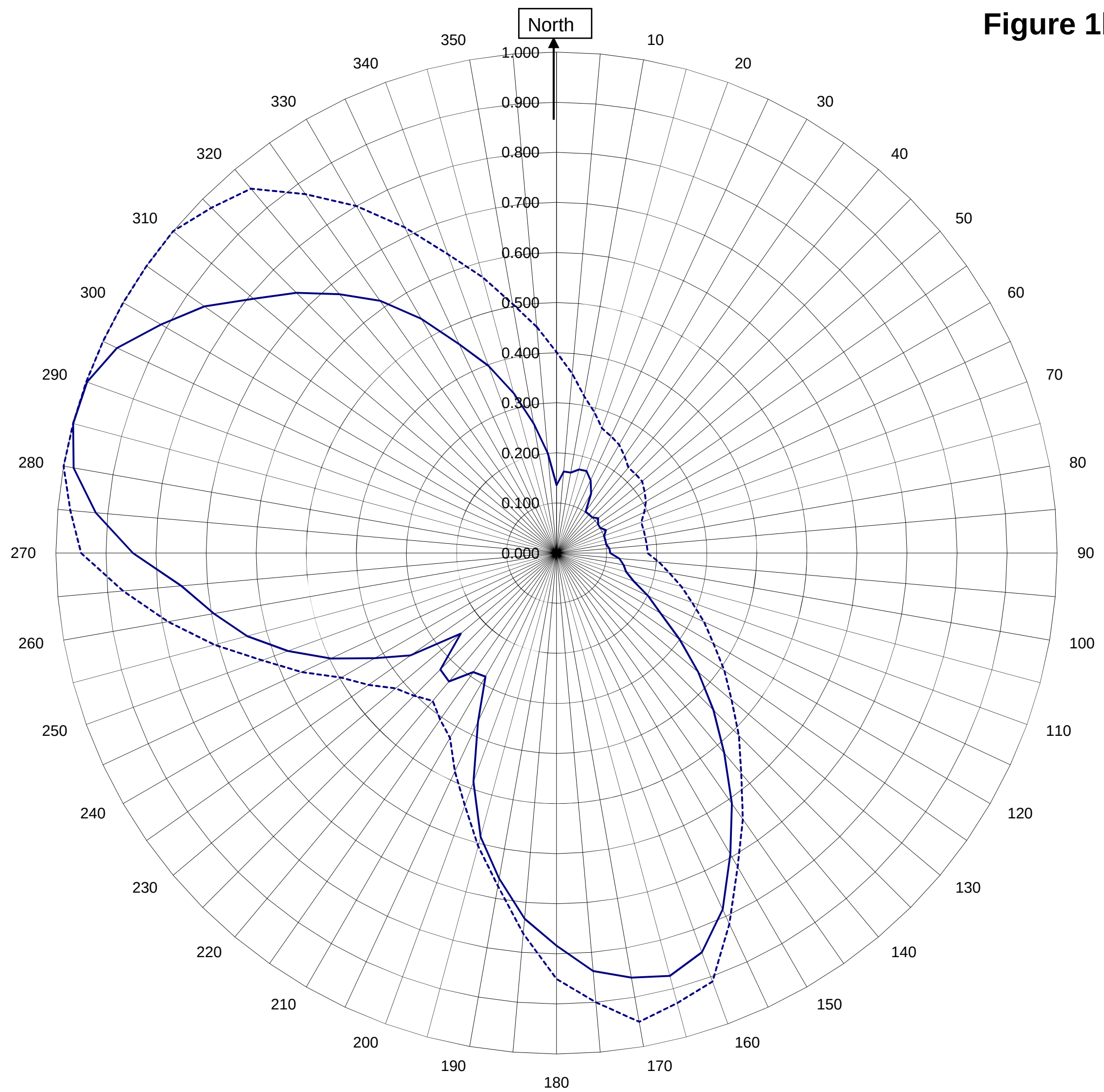
Figure 1b



WJNF Dalton, MA

28397

April 25, 2011

__________H/VComposite RMS	0.535
……………FCC Composite RMS	0.624

Frequency	91.7 / 412.65 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

WJNF Dalton, MA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.136	180	0.782
10	0.101	190	0.660
20	0.101	200	0.486
30	0.101	210	0.285
40	0.101	220	0.104
45	0.101	225	0.145
50	0.101	230	0.203
60	0.101	240	0.369
70	0.101	250	0.512
80	0.101	260	0.656
90	0.105	270	0.846
100	0.101	280	0.980
110	0.107	290	0.998
120	0.187	300	0.913
130	0.324	310	0.771
135	0.393	315	0.669
140	0.498	320	0.584
150	0.694	330	0.370
160	0.848	340	0.225
170	0.861	350	0.160

Figure 1d

Tabulation of Vertical Azimuth Pattern
WJNF Dalton, MA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.101	180	0.784
10	0.163	190	0.632
20	0.175	200	0.350
30	0.138	210	0.150
40	0.101	220	0.335
45	0.101	225	0.329
50	0.108	230	0.250
60	0.090	240	0.420
70	0.101	250	0.571
80	0.101	260	0.695
90	0.107	270	0.790
100	0.136	280	0.855
110	0.164	290	0.880
120	0.239	300	0.870
130	0.369	310	0.790
135	0.443	315	0.735
140	0.521	320	0.675
150	0.641	330	0.540
160	0.758	340	0.398
170	0.816	350	0.262

Figure 1e

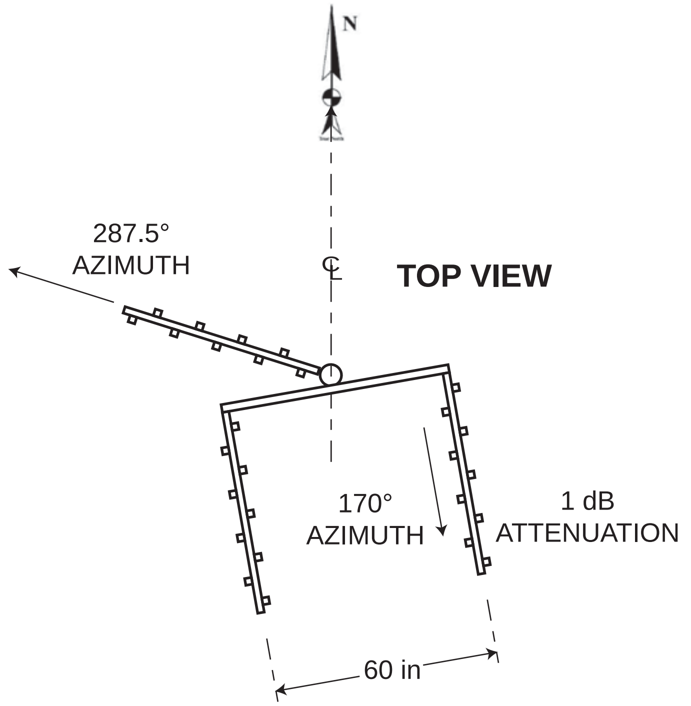
Tabulation of Composite Azimuth Pattern
WJNF Dalton, MA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.136	180	0.784
10	0.163	190	0.660
20	0.175	200	0.486
30	0.138	210	0.285
40	0.101	220	0.335
45	0.101	225	0.329
50	0.108	230	0.250
60	0.101	240	0.420
70	0.101	250	0.571
80	0.101	260	0.695
90	0.107	270	0.846
100	0.136	280	0.980
110	0.164	290	0.998
120	0.239	300	0.913
130	0.369	310	0.790
135	0.443	315	0.735
140	0.521	320	0.675
150	0.694	330	0.540
160	0.848	340	0.398
170	0.861	350	0.262

Figure 1f

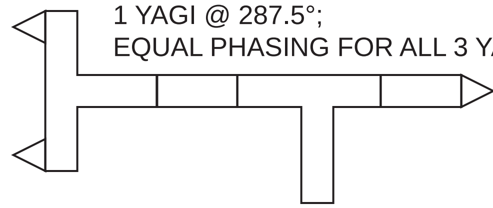
Tabulation of FCC Directional Composite
WJNF Dalton, MA

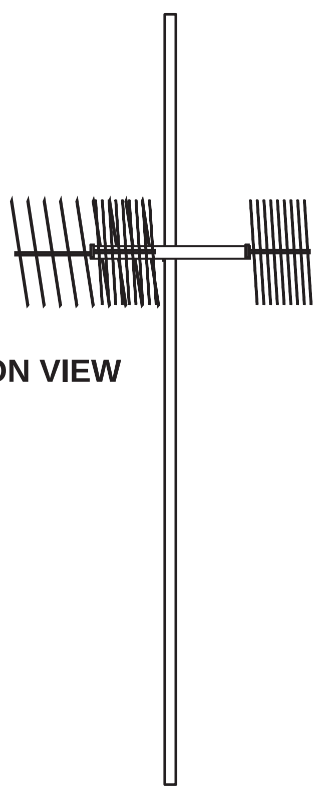
Azimuth	Rel Field	Azimuth	Rel Field
0	0.401	180	0.850
10	0.318	190	0.675
20	0.265	200	0.536
30	0.250	210	0.426
40	0.223	220	0.385
50	0.223	230	0.420
60	0.206	240	0.497
70	0.180	250	0.626
80	0.180	260	0.788
90	0.182	270	0.950
100	0.229	280	1.000
110	0.288	290	1.000
120	0.362	300	1.000
130	0.456	310	1.000
140	0.574	320	0.950
150	0.723	330	0.800
160	0.910	340	0.635
170	0.950	350	0.505



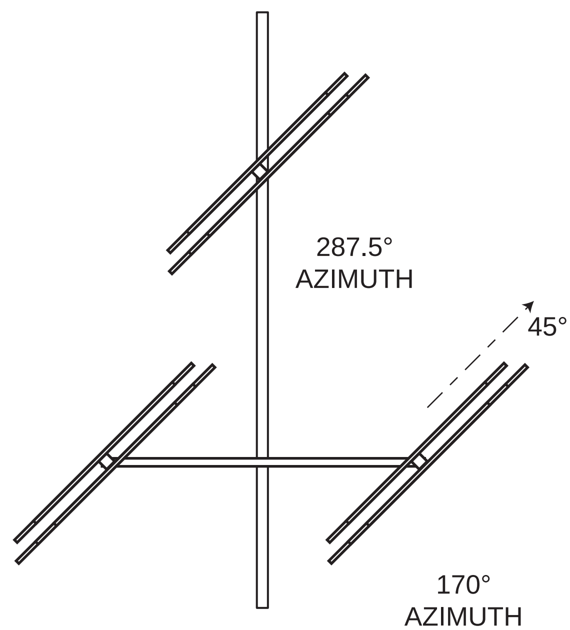
TOP VIEW

COAX SYSTEM FOR
2 YAGIS @ 170°, 1 dB ATTENUATION;
1 YAGI @ 287.5°;
EQUAL PHASING FOR ALL 3 YAGIS





ELEVATION VIEW



PARTIAL FRONT VIEW

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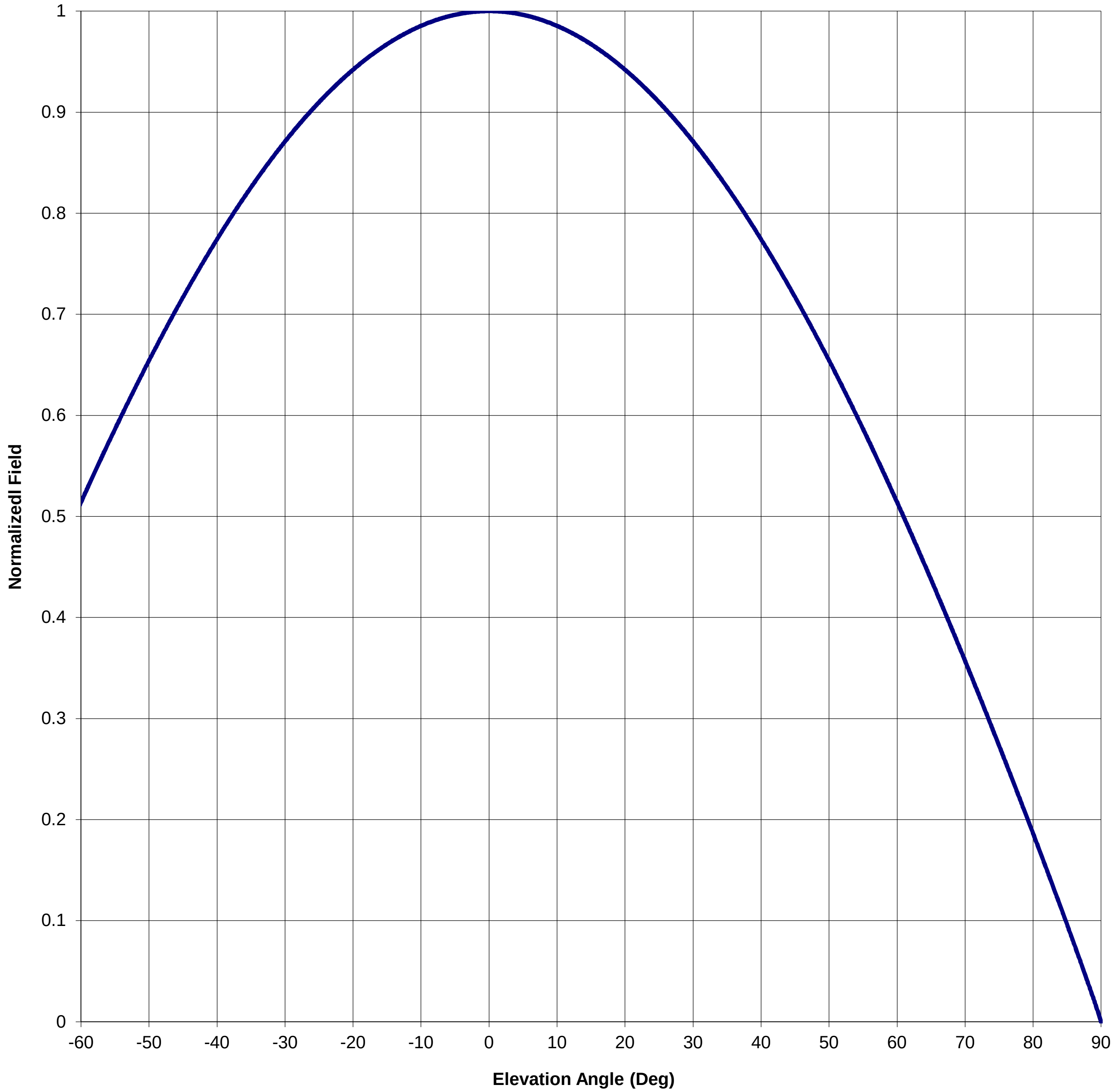
FIGURE 2, WJNF, 91.7 MHz ALDENA SLANT YAGI ARRAY

SIZE	CODE IDENT. NO.	DRAWING NO.	REV
A	26750	AGF110421-001	—

SCALE			SHEET
NONE	S/O 28397		1 OF 1

Antenna Mfg.:	**Shively Labs**			**Date:**	**4/21/2011**
Antenna Type:	**Aldena Slant (45º) Yagi Array**				
Station:	**WJNF**	**Beam Tilt**	**0**		
Frequency:	**91.7**	**Gain (Max)**	**2.140**	**3.304**	**dB**
Channel #:	**219**	**Gain (Horizon)**	**2.140**	**3.304**	**dB**
Figure:	**Figure 3**				



Antenna Mfg.: Shively Labs | Date: 4/21/2011

Antenna Type: Aldena Slant (45º) Yagi Array

Station:	WJNF	Beam Tilt	0	
Frequency:	91.7	Gain (Max)	2.140	3.304 dB
Channel #:	219	Gain (Horizon)	2.140	3.304 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. 28397 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WJNF Dalton, MA

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	0.51	V RMS	0.504	H/V Ratio	1.012

Elevation Gain of Horizontal Component	0.557
Elevation Gain of Vertical Component	0.544
Horizontal Azimuth Gain equals $1/(RMS)^2$.	3.845
Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$.	3.049

Max. Vertical 0.88

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

Total Horizontal Power Gain = **2.140**

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

Total Vertical Power Gain = **1.657**

===

ERP divided by Horizontal Power Gain equals Antenna Input Power

0.16 kW ERP Divided by H Gain 2.140 equals 0.07 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

0.07 kW Times V Gain 1.657 equals 0.12 kW V ERP

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

(0.88)^2 Times 0.16 Equals 0.12 kW Vertical ERP

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