

**S.O. 27800**

**Report of Test 6513-2-DA**

**for**

**EDUCATIONAL MEDIA FOUNDATION**

**WZKL 91.7 MHz Woodstock, IL**

**OBJECTIVE:**

The objective of this test was to demonstrate the directional characteristics of a 6513-2-DA to meet the needs of WZKL and to comply with the requirements of the FCC construction permit, file number BMPED-20080717AND.

**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 Vertical Polarization for the Measured Azimuth Pattern

Figure 1D - Tabulation of the Measured Composite Azimuth Pattern

Figure 1E - Tabulation of the FCC Composite

The calculated elevation pattern of the antenna is shown in Figure 3.

Construction permit file number BMPED-20080717AND indicates that the Vertical radiation component shall not exceed 6.5 kW at any azimuth and is restricted to the following values at the azimuths specified:

130 Degrees T: 0.210 kW

From Figure 1A, the maximum radiation of the Vertical component occurs at 243 Degrees T to 251 Degrees T. At the restricted azimuth of 130 Degrees T the Vertical component is 15.14 dB down from the maximum of 6.5 kW, or 0.199 kW.

The R.M.S. of the Vertical component is 0.559. The total Vertical power gain is 6.349. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.614. The R.M.S. of the measured composite pattern is 0.559. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.522. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

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

One bay of the 6513-2-DA was mounted on a tower of precise scale to the 6-ft. 4-in. facewidth tower at the WZKL site. The spacing of the antenna to the tower was varied and a vertical parasitic element was attached to the interbay feedline to achieve the vertical pattern shown in Figure 1A. See Figure 2 for mechanical details.

#### **METHOD OF MEASUREMENT:**

As allowed by the construction permit, file number BMPED-20080717AND, a single level of the 6513-2-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 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 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:

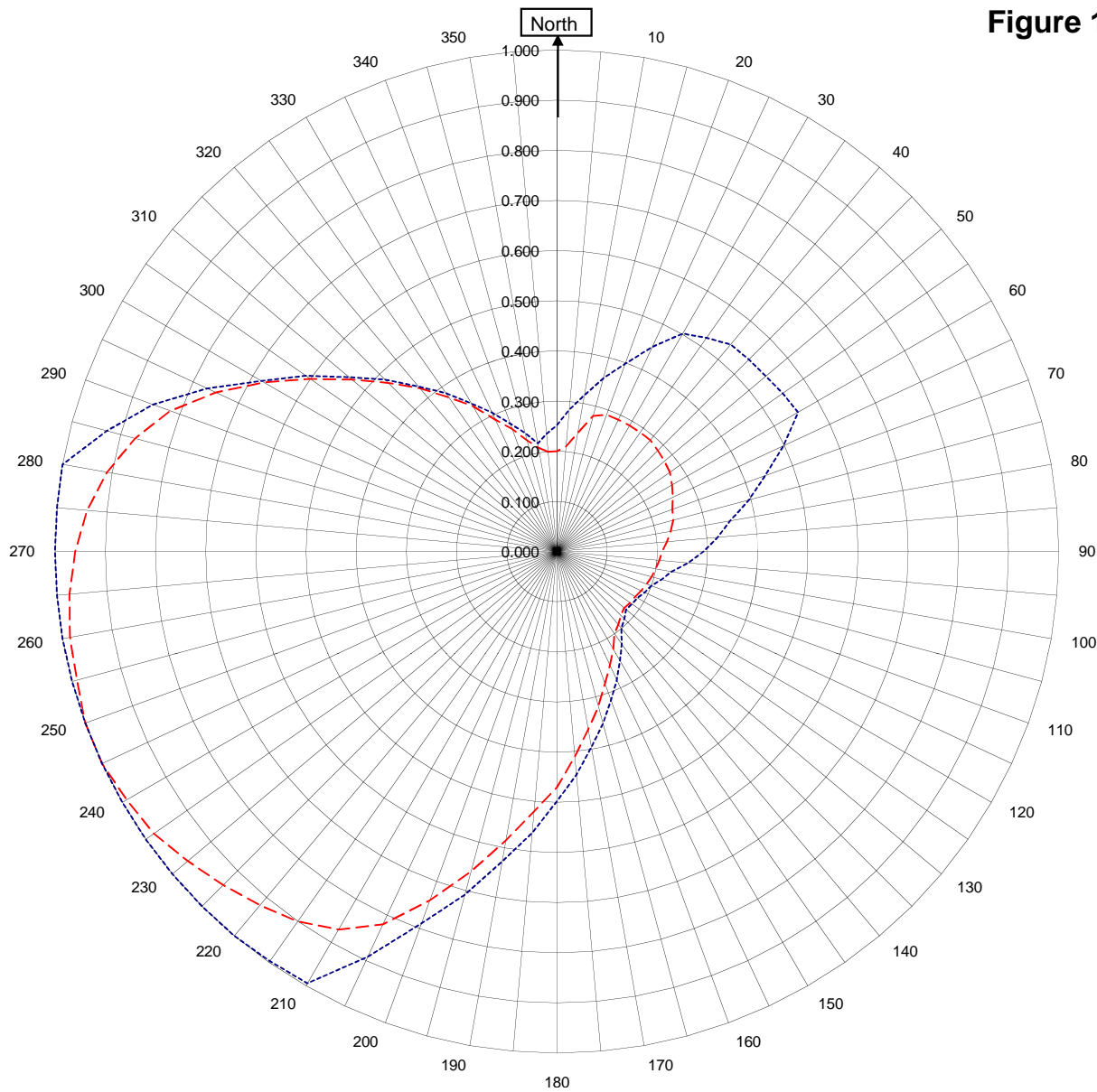


Robert A. Surette  
Director of Sales Engineering  
S/O 27800  
October 2, 2009

# Shively Labs

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

Figure 1A



## WZKL Woodstock, IL

27800

October 2, 2009

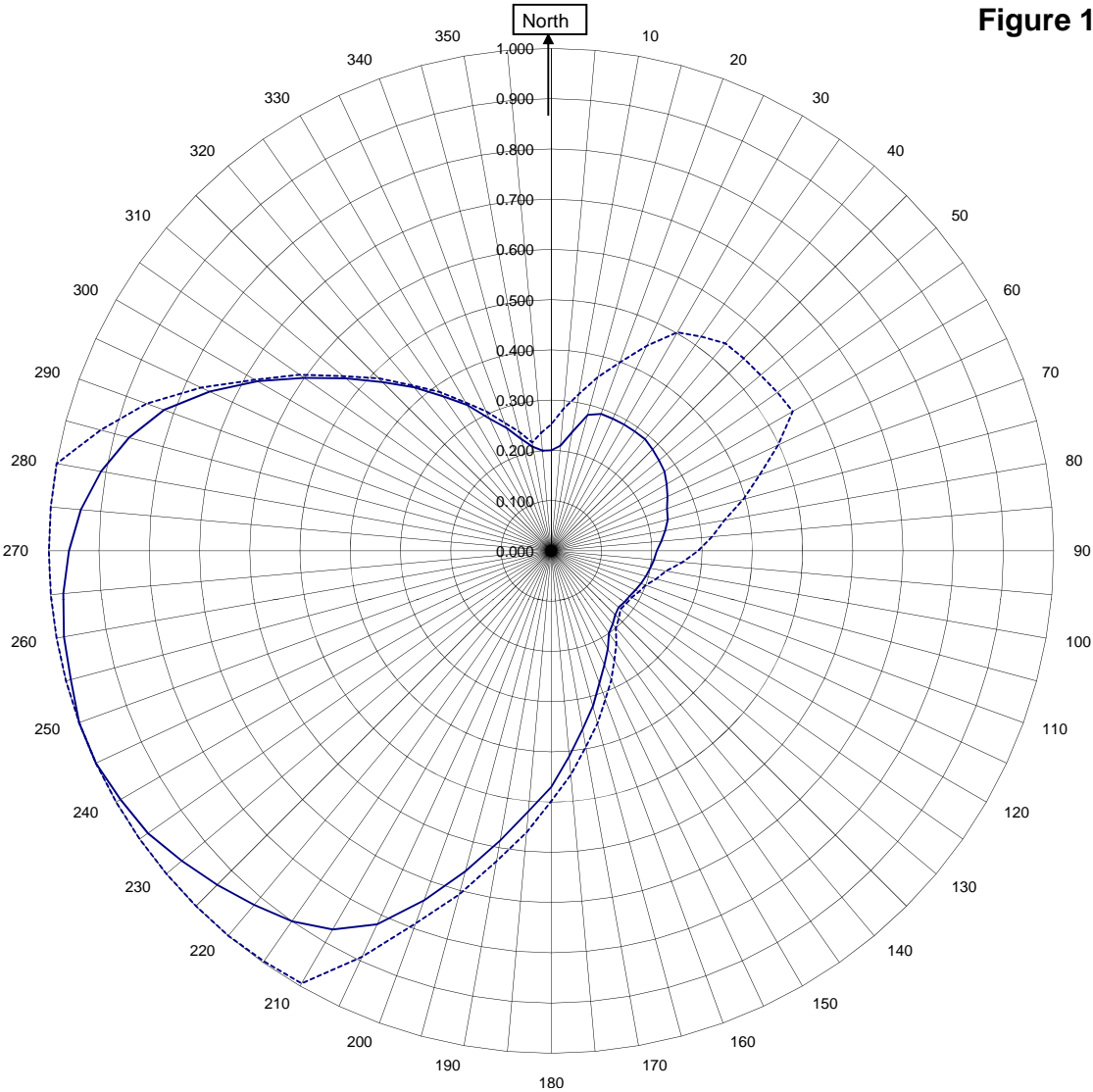
Horizontal RMS	0.000	Frequency	91.7 / 412.65 MHz
Vertical RMS	0.559	Plot	Relative Field
H/V Composite RMS	0.559	Scale	4.5 : 1
FCC Composite RMS	0.614	See Figure 2 for Mechanical Details	

Antenna Model	6513-2-DA Patt 11-B
Pattern Type	Directional Azimuth

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Figure 1B



WZKL Woodstock, IL

27800  
October 2, 2009

—————H/V Composite RMS	0.559
.....FCC Composite RMS	0.614

Frequency	91.7 / 412.65 MHz
Plot	Relative Field
Scale	4.5 : 1
See Figure 2 for Mechanical Details	

Antenna Model	6513-2-DA Patt 11-B
Pattern Type	Directional H/V Composite

Figure 1C

Tabulation of Vertical Azimuth Pattern  
WZKL Woodstock, IL

Azimuth	Rel Field	Azimuth	Rel Field
0	0.200	180	0.470
10	0.240	190	0.585
20	0.290	200	0.740
30	0.290	210	0.870
40	0.290	220	0.920
45	0.285	225	0.940
50	0.280	230	0.960
60	0.265	240	0.990
70	0.245	250	1.000
80	0.230	260	0.985
90	0.210	270	0.960
100	0.200	280	0.910
110	0.190	290	0.820
120	0.180	300	0.675
130	0.175	310	0.534
135	0.180	315	0.475
140	0.190	320	0.425
150	0.225	330	0.335
160	0.280	340	0.260
170	0.360	350	0.210

Figure 1D

Tabulation of Composite Azimuth Pattern  
WZKL Woodstock, IL

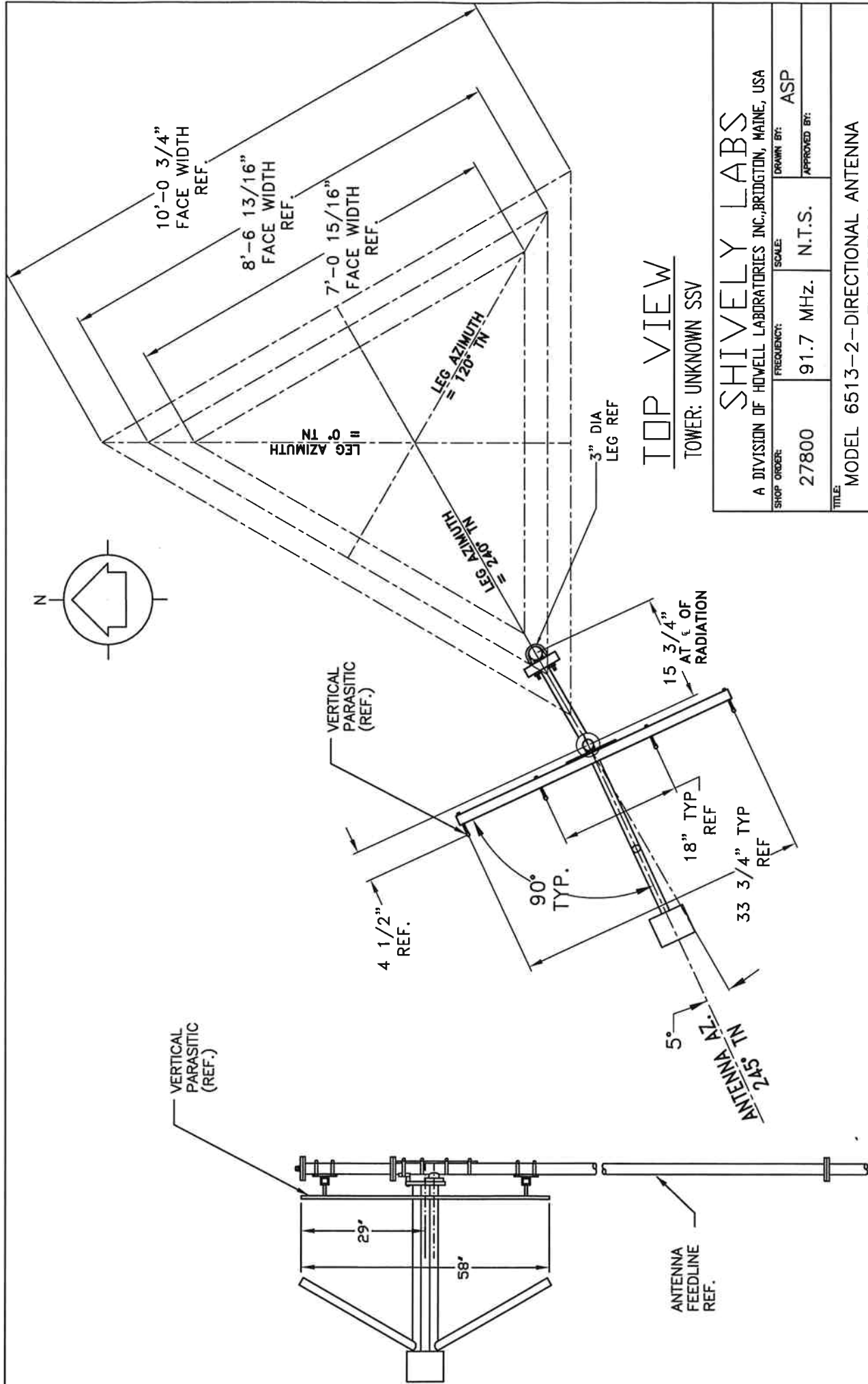
Azimuth	Rel Field	Azimuth	Rel Field
0	0.200	180	0.470
10	0.240	190	0.585
20	0.290	200	0.740
30	0.290	210	0.870
40	0.290	220	0.920
45	0.285	225	0.940
50	0.280	230	0.960
60	0.265	240	0.990
70	0.245	250	1.000
80	0.230	260	0.985
90	0.210	270	0.960
100	0.200	280	0.910
110	0.190	290	0.820
120	0.180	300	0.675
130	0.175	310	0.534
135	0.180	315	0.475
140	0.190	320	0.425
150	0.225	330	0.335
160	0.280	340	0.260
170	0.360	350	0.210

Figure 1E

Tabulation of FCC Directional Composite  
WZKL Woodstock, IL

Azimuth	Rel Field	Azimuth	Rel Field
0	0.252	180	0.498
10	0.317	190	0.627
20	0.399	200	0.789
30	0.502	210	0.994
40	0.539	220	1.000
50	0.544	230	1.000
60	0.555	240	1.000
70	0.441	250	1.000
80	0.350	260	1.000
90	0.292	270	1.000
100	0.232	280	1.000
110	0.200	290	0.857
120	0.185	300	0.681
130	0.180	310	0.541
140	0.200	320	0.430
150	0.251	330	0.341
160	0.315	340	0.271
170	0.396	350	0.219





SIDE VIEW

DATE: 10/23/09

FIGURE 2

Antenna Mfg.: Shively Labs

Antenna Type: 6513-2-DA

Station: WZKL

Frequency: 91.7

Channel #: 219

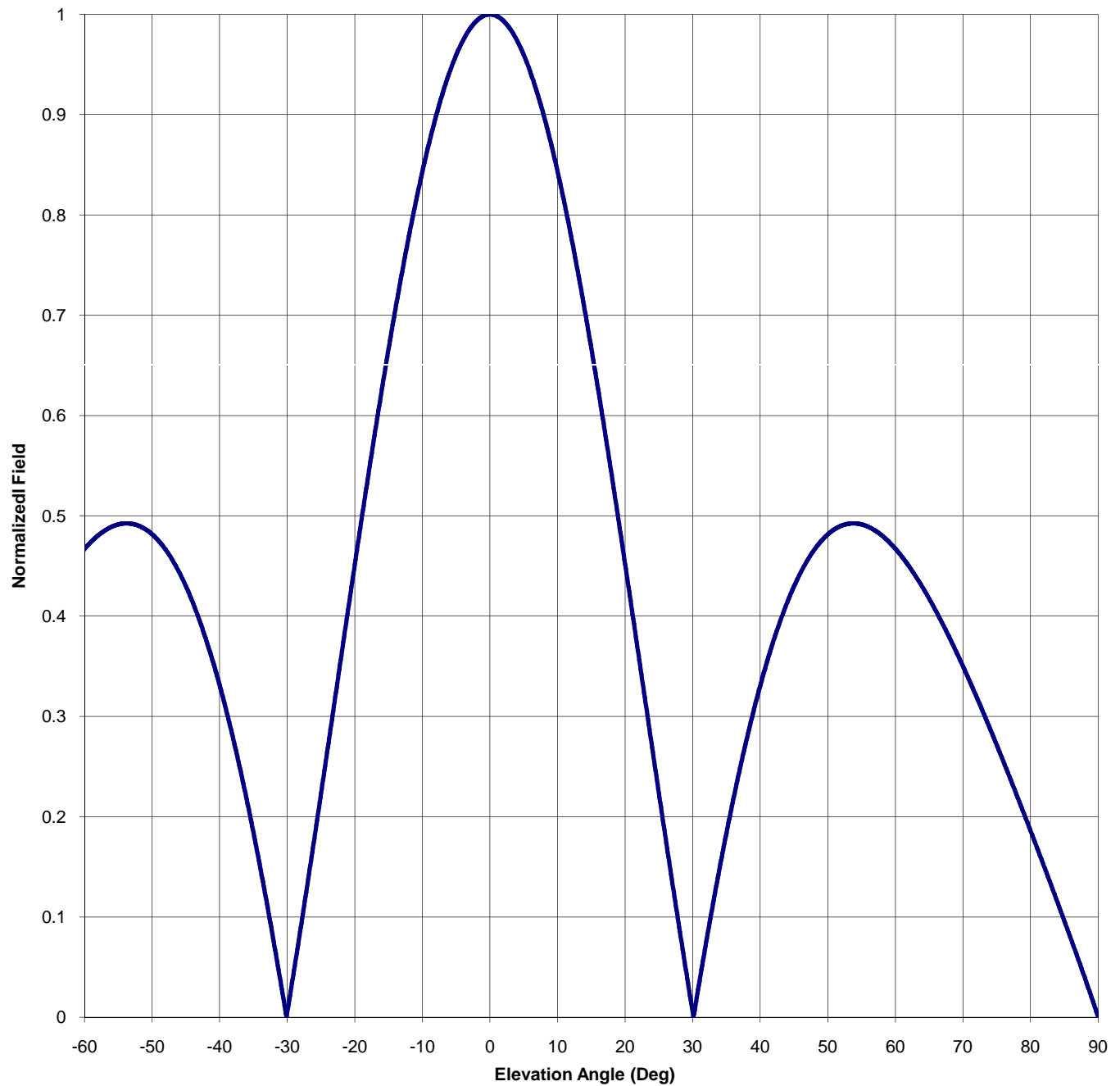
Figure: 3

Date: 10/27/2009

Beam Tilt 0

Gain (Max) 6.349 8.027 dB

Gain (Horizon) 6.349 8.027 dB



Antenna Mfg.: Shively Labs

Date: 10/27/2009

Antenna Type: 6513-2-DA

Station: WZKL

Beam Tilt 0

Frequency: 91.7

Gain (Max) 6.349

8.027 dB

Channel #: 219

Gain (Horizon) 6.349

8.027 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	0.414	0	1.000	46	0.444
-89	0.021	-43	0.396	1	0.998	47	0.456
-88	0.040	-42	0.376	2	0.993	48	0.466
-87	0.059	-41	0.354	3	0.985	49	0.475
-86	0.078	-40	0.331	4	0.974	50	0.482
-85	0.096	-39	0.305	5	0.959	51	0.487
-84	0.114	-38	0.278	6	0.942	52	0.490
-83	0.132	-37	0.248	7	0.921	53	0.492
-82	0.150	-36	0.217	8	0.898	54	0.492
-81	0.168	-35	0.184	9	0.872	55	0.491
-80	0.186	-34	0.149	10	0.843	56	0.489
-79	0.203	-33	0.113	11	0.812	57	0.485
-78	0.221	-32	0.075	12	0.779	58	0.480
-77	0.238	-31	0.036	13	0.743	59	0.474
-76	0.255	-30	0.005	14	0.706	60	0.467
-75	0.271	-29	0.047	15	0.667	61	0.459
-74	0.288	-28	0.090	16	0.626	62	0.450
-73	0.304	-27	0.133	17	0.584	63	0.440
-72	0.320	-26	0.178	18	0.541	64	0.429
-71	0.335	-25	0.223	19	0.497	65	0.417
-70	0.350	-24	0.269	20	0.452	66	0.405
-69	0.364	-23	0.315	21	0.406	67	0.392
-68	0.379	-22	0.361	22	0.361	68	0.379
-67	0.392	-21	0.406	23	0.315	69	0.364
-66	0.405	-20	0.452	24	0.269	70	0.350
-65	0.417	-19	0.497	25	0.223	71	0.335
-64	0.429	-18	0.541	26	0.178	72	0.320
-63	0.440	-17	0.584	27	0.133	73	0.304
-62	0.450	-16	0.626	28	0.090	74	0.288
-61	0.459	-15	0.667	29	0.047	75	0.271
-60	0.467	-14	0.706	30	0.005	76	0.255
-59	0.474	-13	0.743	31	0.036	77	0.238
-58	0.480	-12	0.779	32	0.075	78	0.221
-57	0.485	-11	0.812	33	0.113	79	0.203
-56	0.489	-10	0.843	34	0.149	80	0.186
-55	0.491	-9	0.872	35	0.184	81	0.168
-54	0.492	-8	0.898	36	0.217	82	0.150
-53	0.492	-7	0.921	37	0.248	83	0.132
-52	0.490	-6	0.942	38	0.278	84	0.114
-51	0.487	-5	0.959	39	0.305	85	0.096
-50	0.482	-4	0.974	40	0.331	86	0.078
-49	0.475	-3	0.985	41	0.354	87	0.059
-48	0.466	-2	0.993	42	0.376	88	0.040
-47	0.456	-1	0.998	43	0.396	89	0.021
-46	0.444	0	1.000	44	0.414	90	0.000
-45	0.430			45	0.430		

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Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WZKL 91.7 MHz Woodstock, IL

MODEL 6513-2-DA

Elevation Gain of Antenna 1.984

V RMS 0.559

Vertical Azimuth Gain equals  $1/(\text{RMS})^2$  3.200

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

Total Vertical Power Gain 6.349

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ERP divided by Vertical Power Gain equals Antenna Input Power

6.5 kW ERP Divided by V Gain 6.349 Equals 1.024 kW Antenna Input Power