

S.O. 24878

Report of Test 6513-4-DA

for

AMERICAN FAMILY ASSOCIATION

WCSO 90.5 MHz COLUMBUS, MS

## **OBJECTIVE:**

The objective of this test was to demonstrate the directional characteristics of a 6513-4-DA to meet the needs of WCSO and to comply with the requirements of the FCC construction permit, file number BMPED-20060216AFQ.

## **RESULTS:**

The measured azimuth pattern for the 6513-4-DA is shown in Figure 1. Figure 1A shows the Tabulation of the Vertical Polarization. The calculated elevation pattern of the antenna is shown in Figure 3. Construction permit file number BMPED-20060216AFQ indicates that the Vertical radiation component shall not exceed 10 kW at any azimuth and is restricted to the following values at the azimuths specified:

80 Degrees T: 4.5 kW

From Figure 1, the maximum radiation of the Vertical component occurs at 223 Degrees T to 020 Degrees T. At the restricted azimuth of 80 Degrees T the Vertical component is 4.88 dB down from the maximum of 10 kW, or 3.25 kW.

The R.M.S. of the Vertical component is 0.829. The total Vertical power gain is 6.231. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.966. The R.M.S. of the measured composite pattern is 0.829. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.821. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

**METHOD OF DIRECTIONALIZATION:**

One bay of the 6513-4-DA was mounted on a tower of exact scale to the Allied 24SR tower at the WCSO site. The spacing of the antenna to the tower was varied to achieve the vertical pattern shown in Figure 1. See Figure 2 for mechanical details.

**METHOD OF MEASUREMENT:**

As allowed by the construction permit, file number BMPED-20060216AFQ, a single level of the 6513-4-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> Edition 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 407.25 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 unpadding reading of 100 in voltage. From the recorded patterns, the R.M.S. values are calculated and recorded as shown in Figure 1.

Respectfully submitted by:

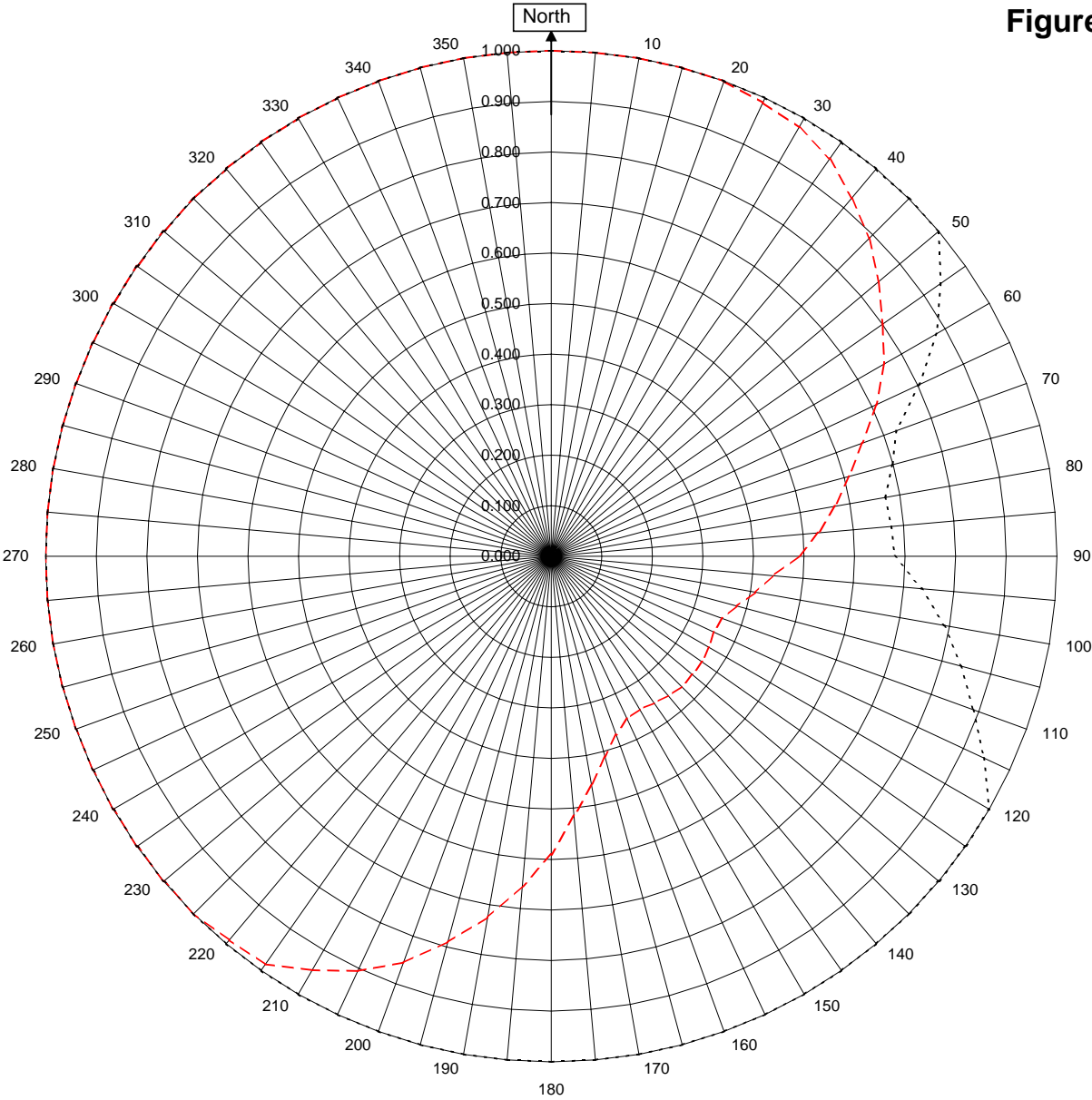


Robert A. Surette  
Director of Sales Engineering  
S/O 24878  
August 4, 2006

# Shively Labs

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

Figure 1



## WCSO Columbus, MS

24878  
August 4, 2006

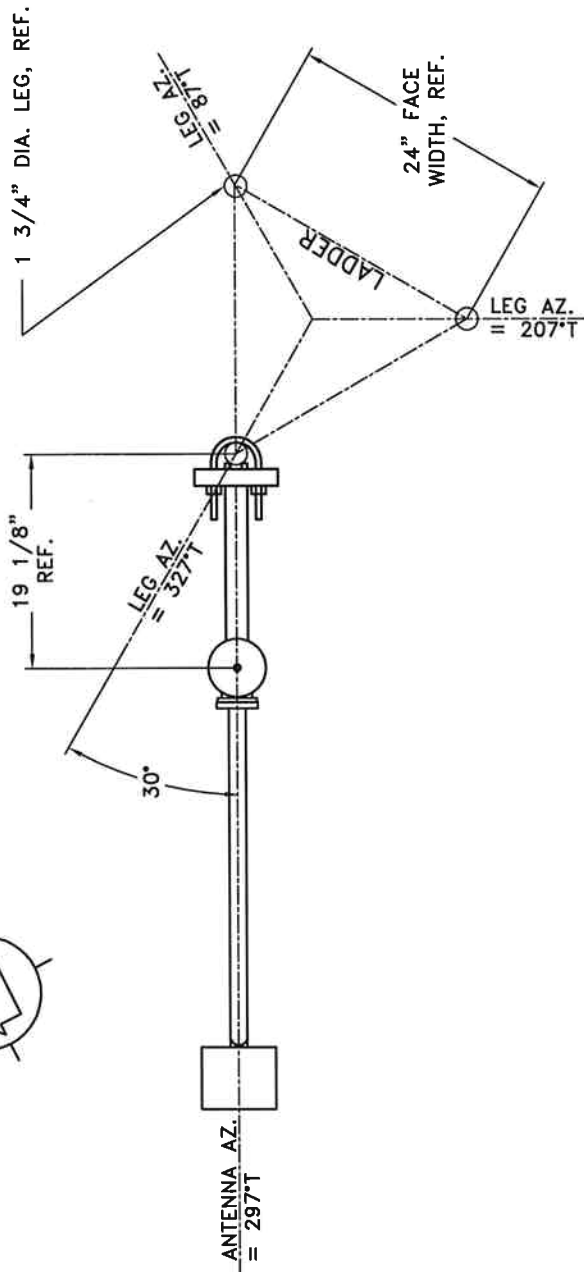
Horizontal RMS	0.000	Frequency	90.5 / 407.25 mHz
Vertical RMS	0.829	Plot	Relative Field
H/V Composite RMS	0.829	Scale	4.5 : 1
FCC Composite RMS	0.966	See Figure 2 for Mechanical Details	

Antenna Model	6513-4-DA
Pattern Type	Directional Azimuth

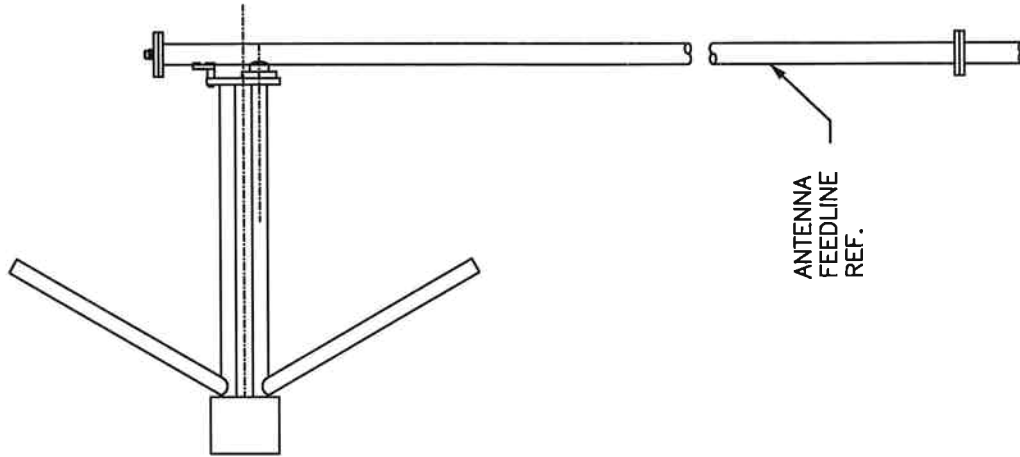
Figure 1a

Tabulation of Vertical Azimuth Pattern  
WCSO Columbus, MS

Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	0.590
10	1.000	190	0.725
20	1.000	200	0.855
30	0.980	210	0.945
40	0.925	220	0.990
45	0.890	225	1.000
50	0.845	230	1.000
60	0.760	240	1.000
70	0.655	250	1.000
80	0.570	260	1.000
90	0.490	270	1.000
100	0.410	280	1.000
110	0.360	290	1.000
120	0.360	300	1.000
130	0.365	310	1.000
135	0.365	315	1.000
140	0.360	320	1.000
150	0.350	330	1.000
160	0.375	340	1.000
170	0.460	350	1.000



TOP VIEW  
TOWER: ALLIED TOWER  
MODEL: 24SR SERIES



SIDE VIEW

ANTENNA HEADING: 297° TRUE NORTH

SHIVELY LABS			
A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE, USA			
SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY:
24878	90.5 MHZ.	N.T.S.	ASP
TITLE:			
MODEL 6513-4-DIRECTIONAL ANTENNA			
FM STATION			
DATE:	APPROVED BY:		
7/27/06	FIGURE 2		

Antenna Mfg.: Shively Labs

Antenna Type: 6513-4-DA

Station: WCSO

Frequency: 90.5

Channel #: 213

Figure: 3

Date: 8/4/2006

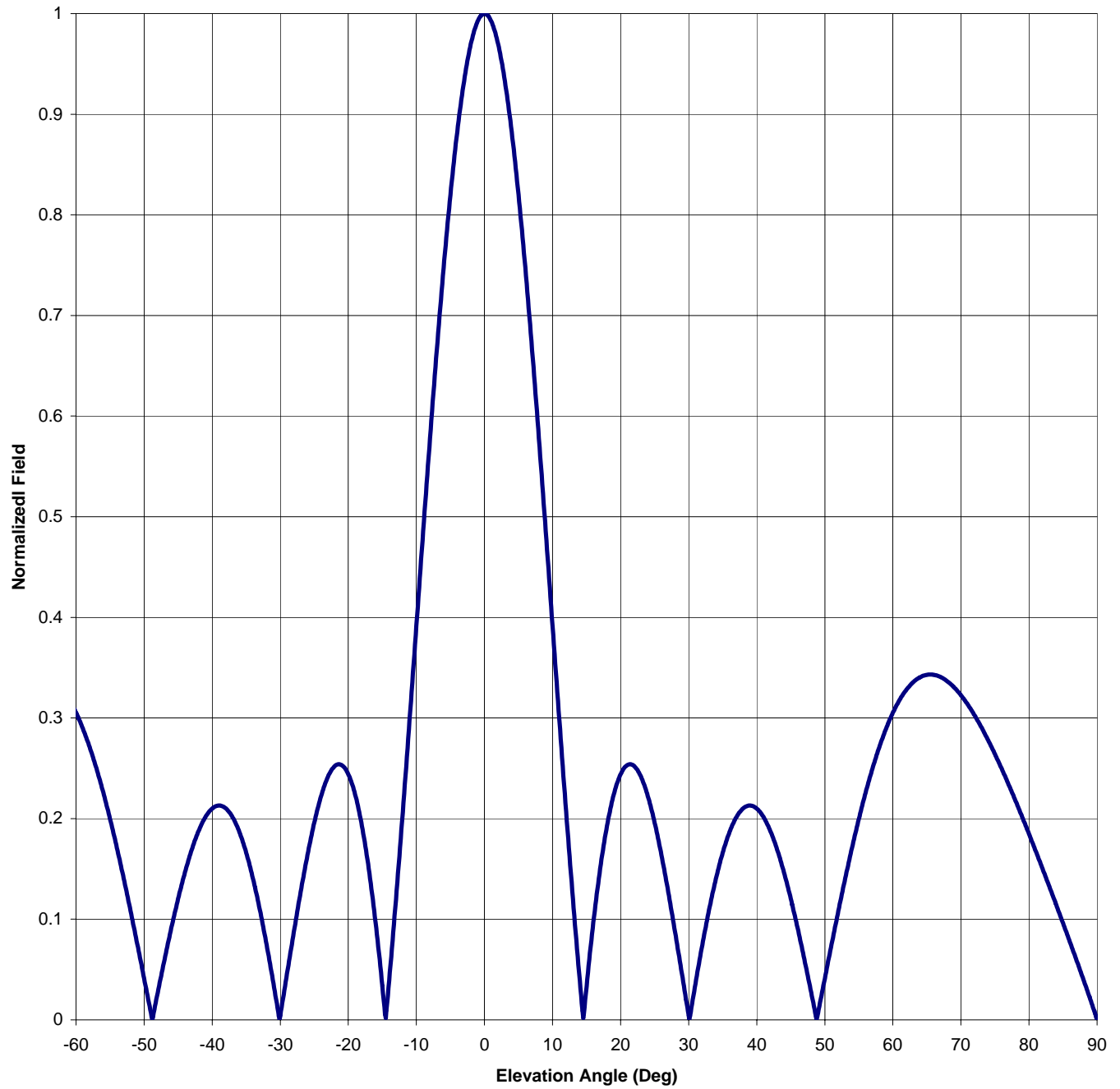
Beam Tilt 0

Gain (Max) 6.231

Gain (Horizon) 6.231

7.946 dB

7.946 dB



Antenna Mfg.: Shively Labs

Date: 8/4/2006

Antenna Type: 6513-4-DA

Station: WCSO

Beam Tilt 0

Frequency: 90.5

Gain (Max) 6.231

7.946 dB

Channel #: 213

Gain (Horizon) 6.231

7.946 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	0.147	0	1.000	46	0.091
-89	0.021	-43	0.169	1	0.992	47	0.060
-88	0.040	-42	0.188	2	0.970	48	0.027
-87	0.059	-41	0.201	3	0.933	49	0.007
-86	0.078	-40	0.210	4	0.882	50	0.041
-85	0.096	-39	0.213	5	0.820	51	0.075
-84	0.114	-38	0.210	6	0.747	52	0.108
-83	0.132	-37	0.201	7	0.666	53	0.141
-82	0.150	-36	0.187	8	0.578	54	0.171
-81	0.167	-35	0.166	9	0.486	55	0.200
-80	0.185	-34	0.140	10	0.392	56	0.226
-79	0.202	-33	0.109	11	0.298	57	0.250
-78	0.218	-32	0.074	12	0.207	58	0.271
-77	0.234	-31	0.036	13	0.120	59	0.289
-76	0.249	-30	0.004	14	0.039	60	0.305
-75	0.264	-29	0.046	15	0.033	61	0.318
-74	0.278	-28	0.087	16	0.097	62	0.328
-73	0.291	-27	0.127	17	0.150	63	0.336
-72	0.303	-26	0.164	18	0.193	64	0.341
-71	0.313	-25	0.196	19	0.224	65	0.343
-70	0.323	-24	0.222	20	0.244	66	0.343
-69	0.330	-23	0.241	21	0.253	67	0.341
-68	0.336	-22	0.252	22	0.252	68	0.336
-67	0.341	-21	0.253	23	0.241	69	0.330
-66	0.343	-20	0.244	24	0.222	70	0.323
-65	0.343	-19	0.224	25	0.196	71	0.313
-64	0.341	-18	0.193	26	0.164	72	0.303
-63	0.336	-17	0.150	27	0.127	73	0.291
-62	0.328	-16	0.097	28	0.087	74	0.278
-61	0.318	-15	0.033	29	0.046	75	0.264
-60	0.305	-14	0.039	30	0.004	76	0.249
-59	0.289	-13	0.120	31	0.036	77	0.234
-58	0.271	-12	0.207	32	0.074	78	0.218
-57	0.250	-11	0.298	33	0.109	79	0.202
-56	0.226	-10	0.392	34	0.140	80	0.185
-55	0.200	-9	0.486	35	0.166	81	0.167
-54	0.171	-8	0.578	36	0.187	82	0.150
-53	0.141	-7	0.666	37	0.201	83	0.132
-52	0.108	-6	0.747	38	0.210	84	0.114
-51	0.075	-5	0.820	39	0.213	85	0.096
-50	0.041	-4	0.882	40	0.210	86	0.078
-49	0.007	-3	0.933	41	0.201	87	0.059
-48	0.027	-2	0.970	42	0.188	88	0.040
-47	0.060	-1	0.992	43	0.169	89	0.021
-46	0.091	0	1.000	44	0.147	90	0.000
-45	0.120			45	0.120		



S.O. 24878

VALIDATION OF GAIN CALCULATION

WCSO 90.5 MHz COLUMBUS, MS

MODEL 6513-4-DA

Elevation Gain of 6513-4-DA equals 4.282

Vertical Azimuth Gain equals  $1/(\text{RMS})^2$   
 $1/(0.829)^2 = 1.4551$

**\* Total Vertical Gain is Elevation Gain times Azimuth Gain**  
**4.282 x 1.4551 = 6.231**

---

---

ERP divided by Vertical Gain equals Antenna Input Power  
 $10 \text{ kW} \div 6.231 = 1.605 \text{ kW}$