Shively Labs
a division of Howell Laboratories,Inc.
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S.O. 25492
Report of Test 6513-3-DA
for
AMERICAN FAMILY ASSOCIATION
WDLL 90.5 MHz DILLON, SC

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6513-3-DA to meet the needs of WDLL and to comply with the requirements of the FCC construction permit, file number BMPED-20061206ACJ.

RESULTS:

The measured azimuth pattern for the 6513-3-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-20061206ACJ indicates that the Vertical radiation component shall not exceed 25 kW at any azimuth and is restricted to the following values at the azimuths specified:

100 Degrees T: 13.5 kW

From Figure 1, the maximum radiation of the Vertical component occurs at 35 Degrees T to 55 Degrees T and at 284 Degrees T to 326 Degrees T. At the restricted azimuth of 100 Degrees T the Vertical component is 6.11 dB down from the maximum of 25 kW, or 6.1 kW.

The R.M.S. of the Vertical component is 0.828. The total Vertical power gain is 4.548. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.974. The R.M.S. of the measured composite pattern is 0.828. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.8279. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6513-3-DA was mounted on a tower of precise scale to the Pirod 48M tower at the WDLL site. The spacing of the antenna to the tower was varied and vertical parasitic elements were attached to the interbay feedline 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-20061206ACJ, a single level of the 6513-3-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 9th 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 unpadded 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 25492
April 10, 2007

Shively Labs

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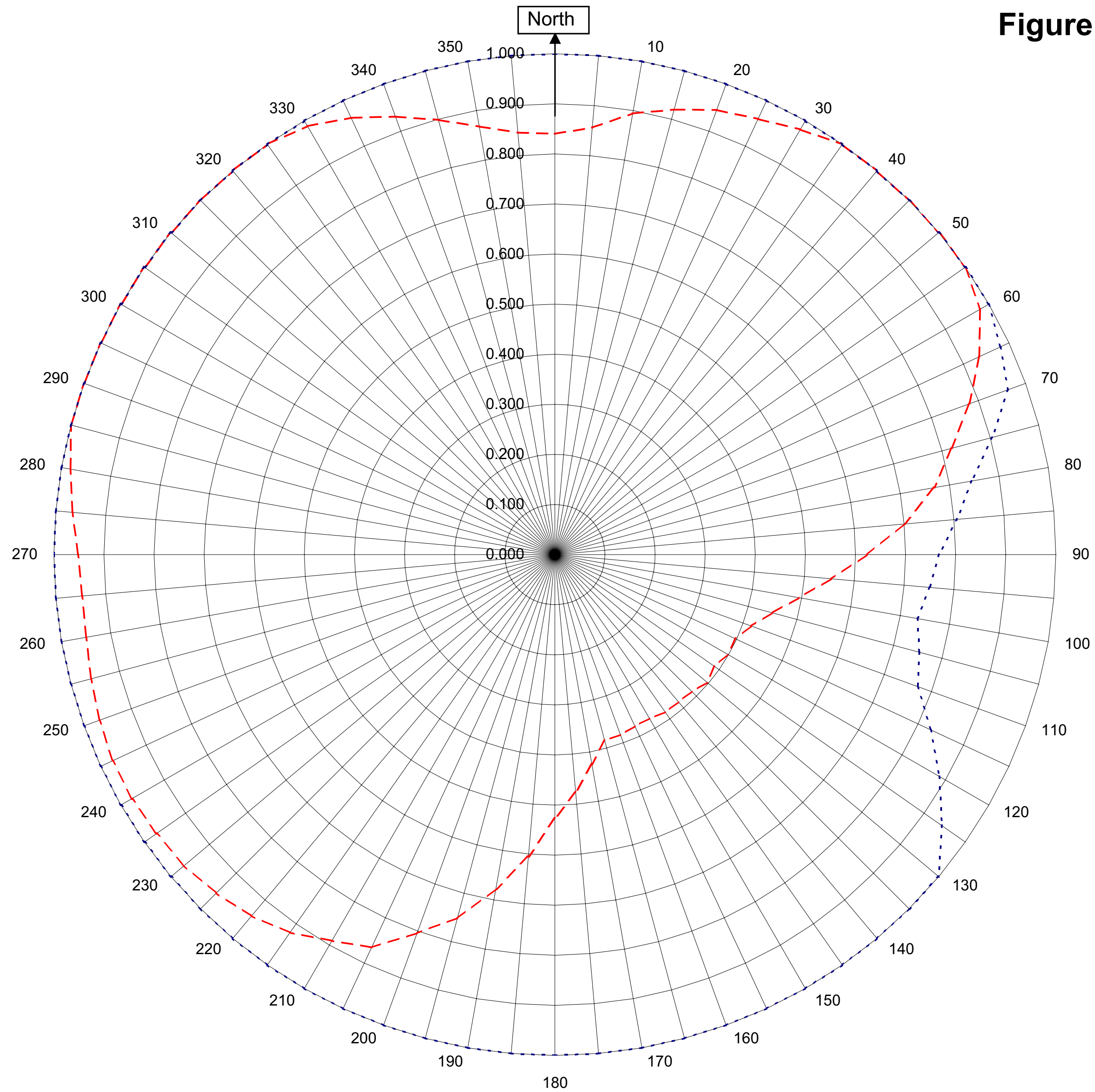
Figure 1



WDLL Dillon, SC

25492

April 10, 2007

____________Horizontal RMS	0.000
_ _ _ _ _ _ _ _ _ Vertical RMS	0.828
H/V Composite RMS	0.828
...............FCC Composite RMS	0.974

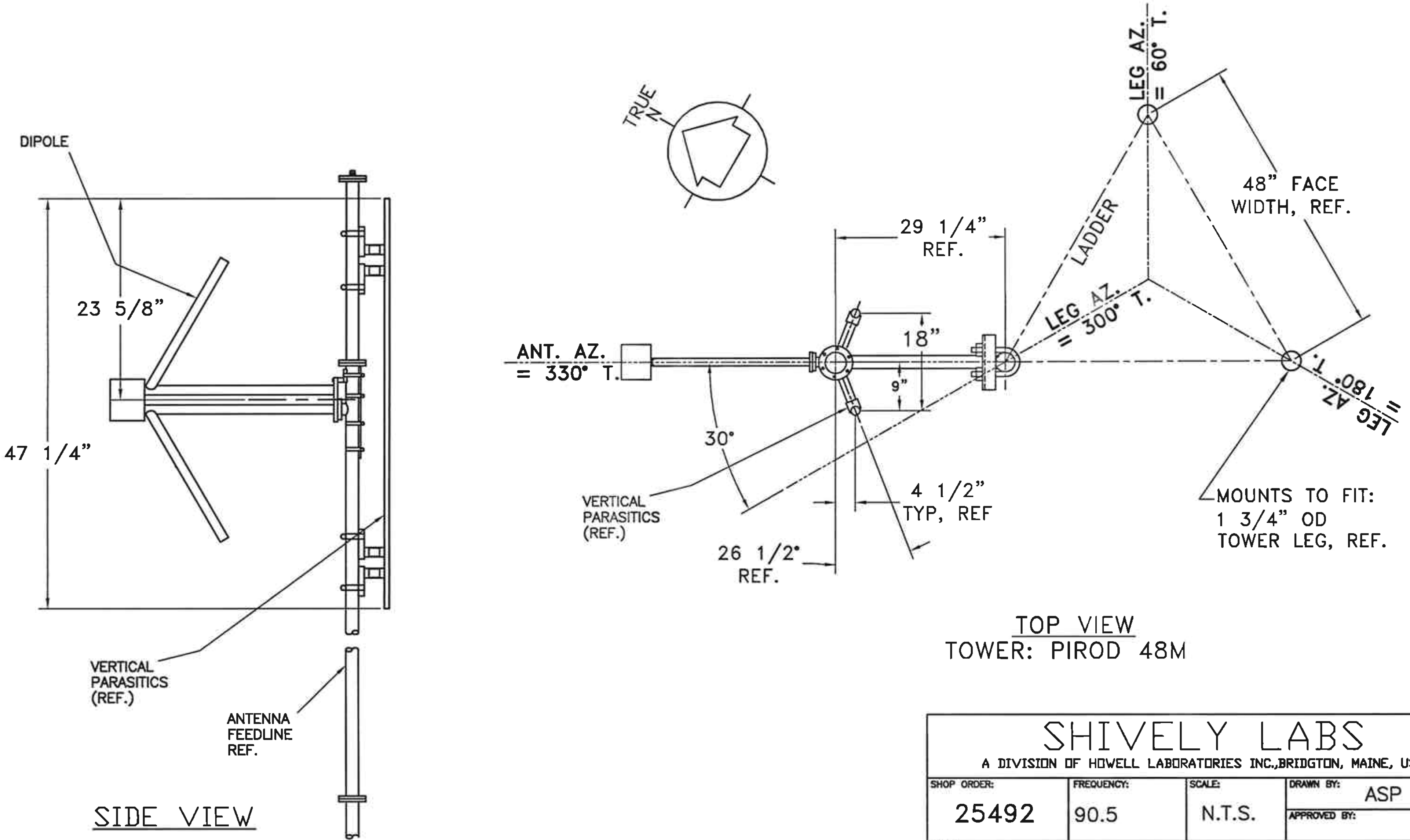
Frequency	90.5 / 407.25 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6513-3-DA
Pattern Type	Directional Azimuth

Figure 1a

Tabulation of Vertical Azimuth Pattern
WDLL Dillon, SC

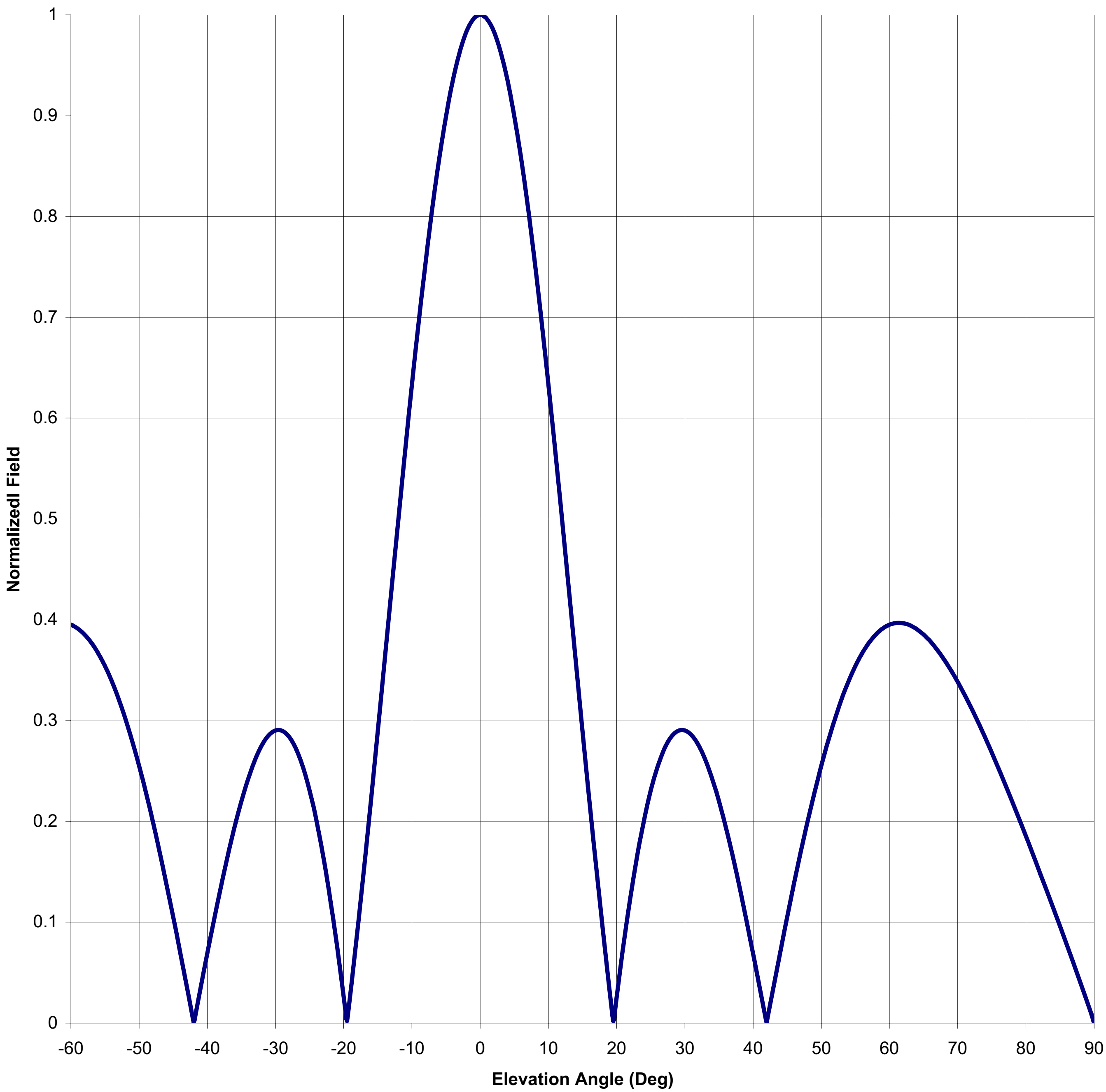
Azimuth	Rel Field	Azimuth	Rel Field
0	0.840	180	0.527
10	0.894	190	0.678
20	0.945	200	0.804
30	0.980	210	0.890
40	1.000	220	0.942
45	1.000	225	0.955
50	1.000	230	0.966
60	0.980	240	0.975
70	0.880	250	0.967
80	0.769	260	0.950
90	0.623	270	0.952
100	0.495	280	0.982
110	0.417	290	1.000
120	0.398	300	1.000
130	0.397	310	1.000
135	0.386	315	1.000
140	0.384	320	1.000
150	0.378	330	0.988
160	0.383	340	0.931
170	0.425	350	0.868



ANTENNA HEADING: 330° TRUE NORTH

SHIVELY LABS A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE, USA			
SHOP ORDER: 25492	FREQUENCY: 90.5	SCALE: N.T.S.	DRAWN BY: ASP APPROVED BY:
TITLE: MODEL 6513-3-DIRECTIONAL ANTENNA FM STATION			
DATE: 4/4/07	FIGURE 2		

Antenna Mfg.:	Shively Labs			Date:	4/10/2007
Antenna Type:	6513-3-DA				
Station:	WDLL	Beam Tilt	0		
Frequency:	90.5	Gain (Max)	4.548	6.578	dB
Channel #:	213	Gain (Horizon)	4.548	6.578	dB
Figure:	3				



Antenna Mfg.: Shively Labs **Date:** 4/10/2007
Antenna Type: 6513-3-DA
Station: WDLL **Beam Tilt** 0
Frequency: 90.5 **Gain (Max)** 4.548 6.578 dB
Channel #: 213 **Gain (Horizon)** 4.548 6.578 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	0.071	0	1.000	46	0.138
-89	0.021	-43	0.036	1	0.996	47	0.170
-88	0.040	-42	0.001	2	0.984	48	0.200
-87	0.059	-41	0.034	3	0.963	49	0.229
-86	0.078	-40	0.069	4	0.935	50	0.255
-85	0.096	-39	0.103	5	0.900	51	0.280
-84	0.114	-38	0.136	6	0.858	52	0.302
-83	0.132	-37	0.166	7	0.809	53	0.322
-82	0.150	-36	0.195	8	0.755	54	0.339
-81	0.168	-35	0.220	9	0.696	55	0.354
-80	0.185	-34	0.243	10	0.634	56	0.367
-79	0.203	-33	0.261	11	0.568	57	0.377
-78	0.220	-32	0.276	12	0.500	58	0.385
-77	0.236	-31	0.285	13	0.430	59	0.391
-76	0.252	-30	0.290	14	0.360	60	0.395
-75	0.268	-29	0.290	15	0.290	61	0.397
-74	0.284	-28	0.284	16	0.222	62	0.397
-73	0.298	-27	0.272	17	0.155	63	0.395
-72	0.312	-26	0.254	18	0.091	64	0.391
-71	0.326	-25	0.231	19	0.031	65	0.385
-70	0.338	-24	0.201	20	0.026	66	0.378
-69	0.350	-23	0.165	21	0.077	67	0.370
-68	0.361	-22	0.124	22	0.124	68	0.361
-67	0.370	-21	0.077	23	0.165	69	0.350
-66	0.378	-20	0.026	24	0.201	70	0.338
-65	0.385	-19	0.031	25	0.231	71	0.326
-64	0.391	-18	0.091	26	0.254	72	0.312
-63	0.395	-17	0.155	27	0.272	73	0.298
-62	0.397	-16	0.222	28	0.284	74	0.284
-61	0.397	-15	0.290	29	0.290	75	0.268
-60	0.395	-14	0.360	30	0.290	76	0.252
-59	0.391	-13	0.430	31	0.285	77	0.236
-58	0.385	-12	0.500	32	0.276	78	0.220
-57	0.377	-11	0.568	33	0.261	79	0.203
-56	0.367	-10	0.634	34	0.243	80	0.185
-55	0.354	-9	0.696	35	0.220	81	0.168
-54	0.339	-8	0.755	36	0.195	82	0.150
-53	0.322	-7	0.809	37	0.166	83	0.132
-52	0.302	-6	0.858	38	0.136	84	0.114
-51	0.280	-5	0.900	39	0.103	85	0.096
-50	0.255	-4	0.935	40	0.069	86	0.078
-49	0.229	-3	0.963	41	0.034	87	0.059
-48	0.200	-2	0.984	42	0.001	88	0.040
-47	0.170	-1	0.996	43	0.036	89	0.021
-46	0.138	0	1.000	44	0.071	90	0.000
-45	0.105			45	0.105		

FIGURE 4

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VALIDATION OF GAIN CALCULATION

WDLL 90.5 MHz Dillon, SC

MODEL 6513-3-DA

Elevation Gain of 6513-3-DA equals 3.118

Vertical Azimuth Gain equals $1/(\text{RMS})^2$
$1/(.828)^2 = 1.4586$

*** Total Vertical Gain is Elevation Gain times Azimuth Gain**
3.118 x 1.4586 = 4.548

ERP divided by Vertical Gain equals Antenna Input Power

25 kW ÷ 4.548 = 5.497 kW