Shively Labs
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S.O. 24574

Report of Test - 2 x CL-FM/VRM/50N

for

CHURCH PLANTERS OF AMERICA

WGHW 88.1 MHz LOCKWOODS FOLLY TOWN, NC

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a Scala 2 x CL-FM/VRM/50N to meet the needs of WGHW and to comply with the requirements of the FCC construction permit, file number BMPED-20070821ADK.

RESULTS:

The measured azimuth pattern for the Scala 2 x CL-FM/VRM/50N 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-20070821ADK 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:

140 Degrees T: 0.5 kW
310 - 330 Degrees T: 2.0 kW

From Figure 1, the maximum radiation of the Vertical component occurs at 050 Degrees T to 052 Degrees T and at 228 Degrees to 231 Degrees T. At the restricted azimuth of 140 Degrees T the Vertical component is 17.7 dB down from the maximum of 10 kW, or 0.2 kW. At the restricted azimuth of 310 - 330 Degrees T the Vertical component is 8.0 dB down from the maximum of 10 kW, or 1.6 kW.

The R.M.S. of the Vertical component is 0.674. The total Vertical power gain is 2.280. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.731. The R.M.S. of the measured composite pattern is 0.674. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.621. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

The Scala 2 x CL-FM/VRM/50N was mounted on a tower of exact scale to a Cellxion tower at the WGHW site. The spacing and rotation 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-20070821ADK, a single level of the Scala 2 x CL-FM/VRM/50N 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 396.45 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 1.

Respectfully submitted by:

Robert A. Surette
Manager of RF Engineering
S/O 24574
February 1, 2008

Shively Labs

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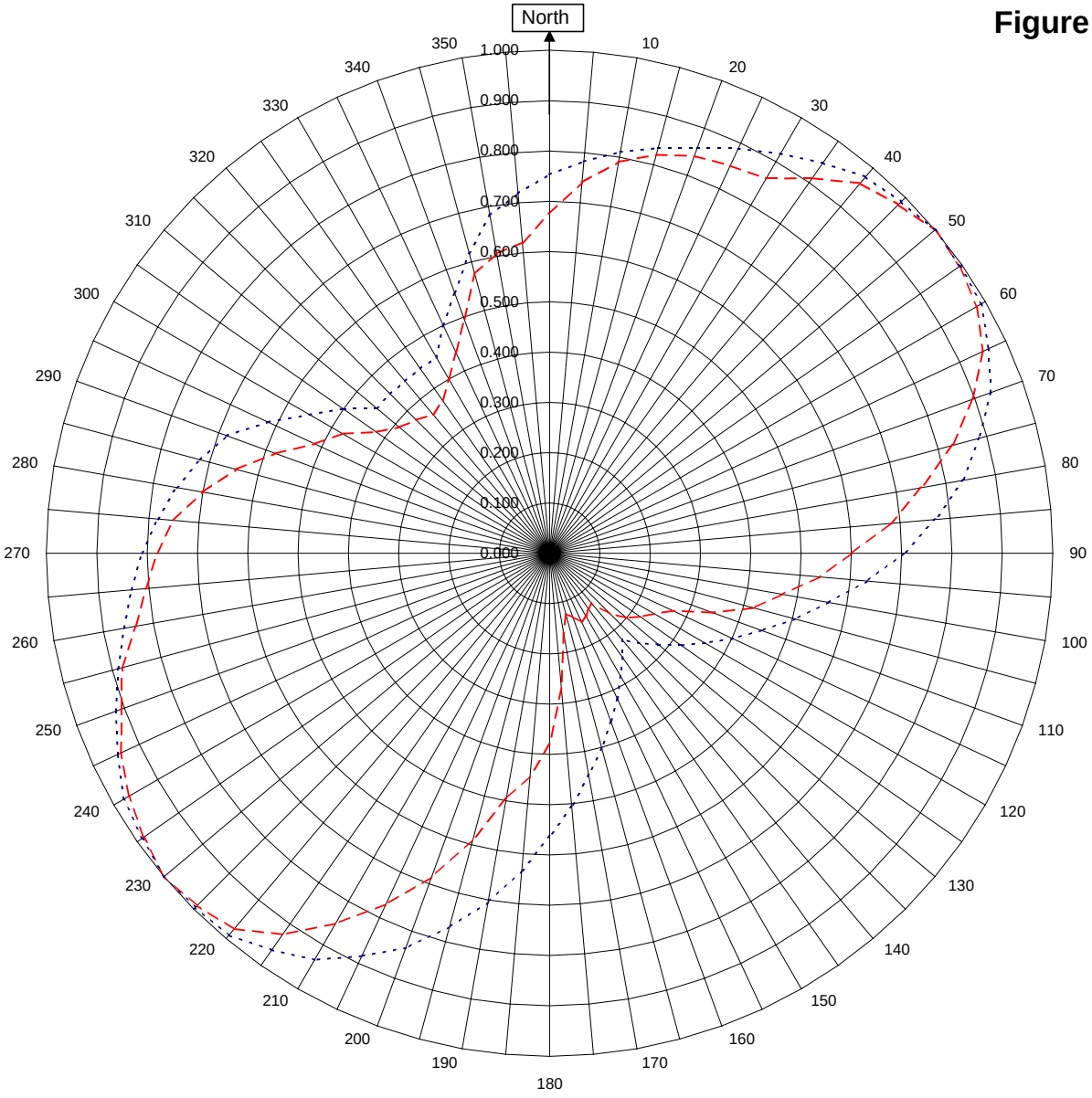
Figure 1



WGHW Lockwoods Folly Town

24574

February 1, 2008

Horizontal RMS	0.000
Vertical RMS	0.674
H/V Composite RMS	0.674
FCC Composite RMS	0.731

Frequency	88.1 / 396.45 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	Scala 2xCL-FM/VRM/50N
Pattern Type	Directional Azimuth

Figure 1a

Tabulation of Vertical Azimuth Pattern
WGHW Lockwoods Folly Town, NC

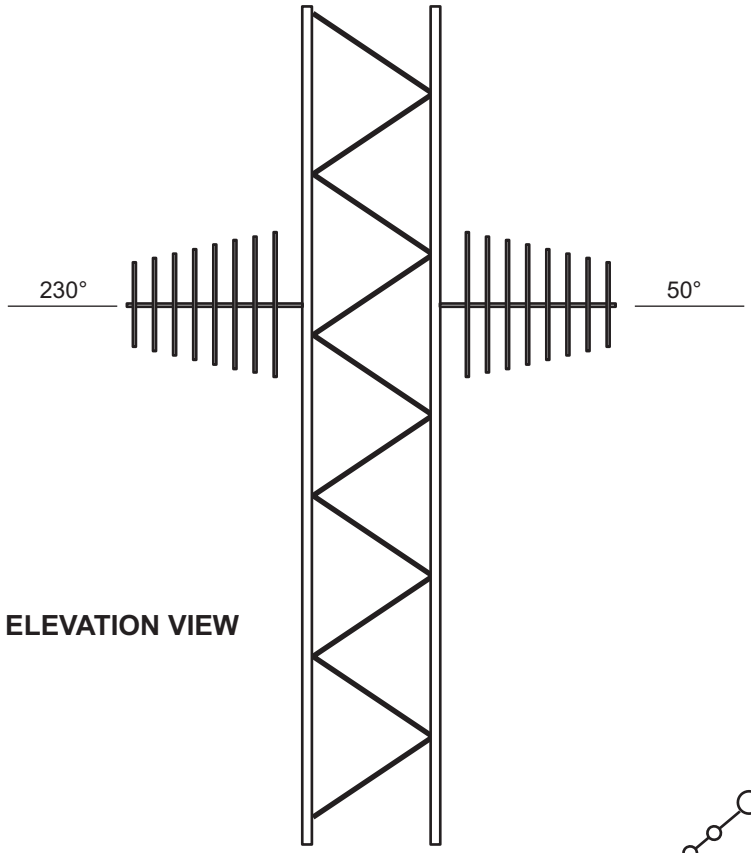
Azimuth	Rel Field	Azimuth	Rel Field
0	0.675	180	0.380
10	0.790	190	0.495
20	0.840	200	0.685
30	0.860	210	0.850
40	0.960	220	0.975
45	0.980	225	0.990
50	1.000	230	1.000
60	0.980	240	0.965
70	0.895	250	0.905
80	0.750	260	0.835
90	0.600	270	0.780
100	0.470	280	0.700
110	0.345	290	0.580
120	0.240	300	0.475
130	0.200	310	0.390
135	0.170	315	0.375
140	0.130	320	0.360
150	0.145	330	0.400
160	0.135	340	0.495
170	0.160	350	0.605

Figure 1b

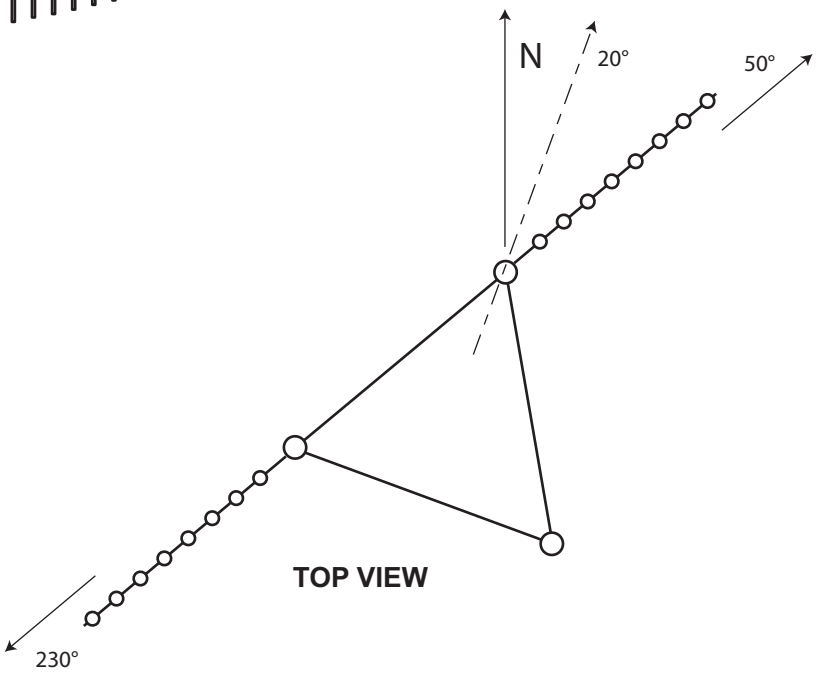
Tabulation of FCC Directional Composite
WGHW Lockwoods Folly Town, NC

Azimuth	Rel Field	Azimuth	Rel Field
0	0.753	180	0.563
10	0.810	190	0.704
20	0.858	200	0.835
30	0.917	210	0.933
40	0.977	220	0.991
50	1.000	230	1.000
60	0.991	240	0.977
70	0.933	250	0.917
80	0.835	260	0.858
90	0.704	270	0.810
100	0.563	280	0.753
110	0.448	290	0.683
120	0.356	300	0.551
130	0.282	310	0.449
140	0.224	320	0.447
150	0.282	330	0.449
160	0.356	340	0.551
170	0.448	350	0.683

REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED
A	DELETED 2ND SET OF YAGIS, 116-1/2” BELOW EXISTING SET	01/31/08	



ELEVATION VIEW



TOP VIEW

PART NO.

DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED.
TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONAL: ± 1/32
ANGLES: ± 1/2
2 PL DECIMAL: ± .02
3 PL DECIMAL: ± .005
SURFACE FINISH 63
FILLETS .015 MAX

ANGLE PROJECTION

MATERIAL

	APPROVED BY	DATE
MFG. APPROVAL		
ENG. APPROVAL		
CHECKED		
DRAWN BY		

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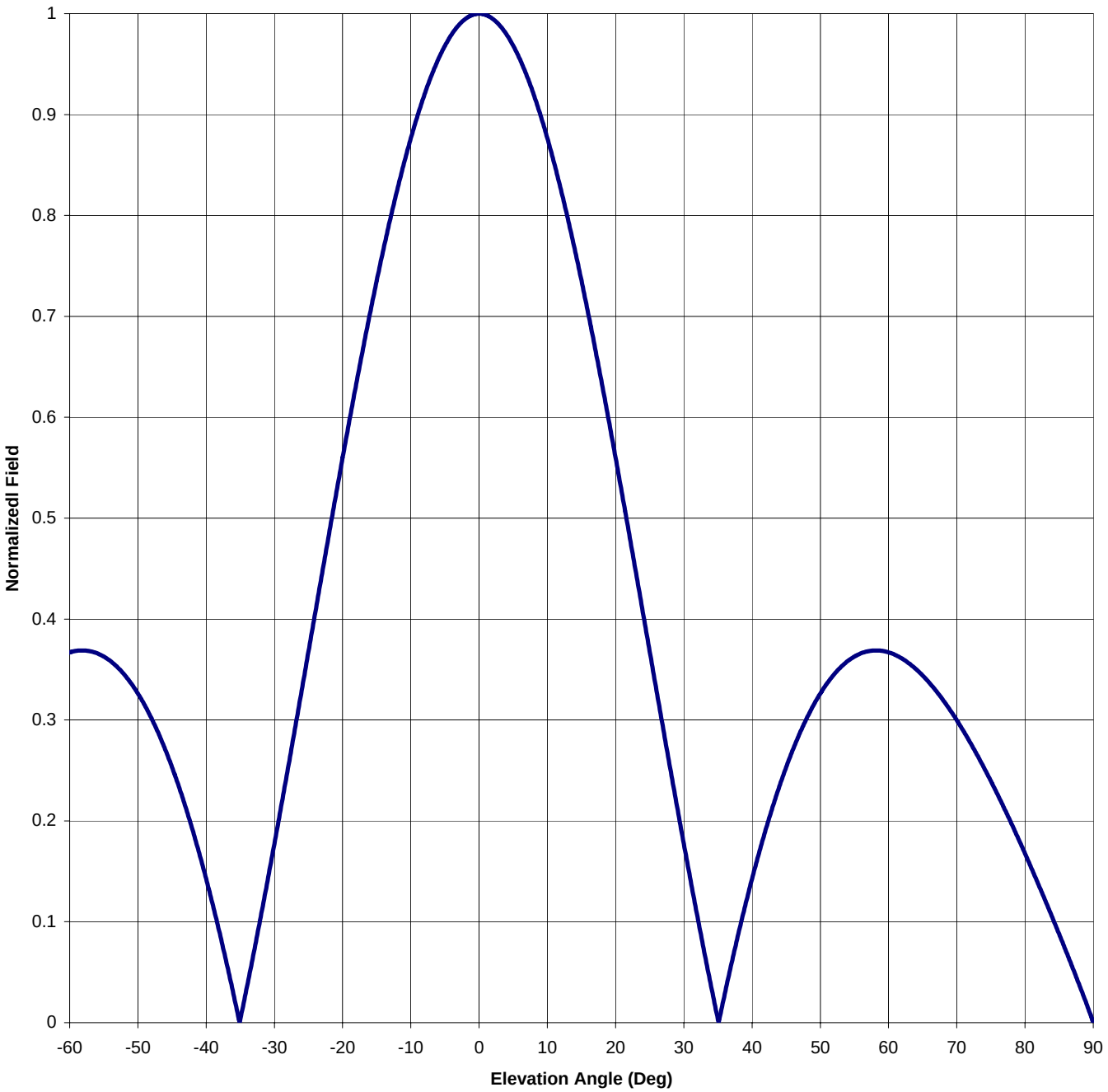
BRIDGTON, MAINE USA

Figure 2
WGHW YAGI

SIZE	CAGE CODE	DWG NO	REV
A	26750	AGF071207-001	A

SCALE		SHEET
NONE	24574 88.1 MHz	1 OF 1

Antenna Mfg.:	**Shively Labs**			**Date: 2/1/2008**
Antenna Type:	**Scala 2xCL-FM/VRM/50N**			
Station:	**WGHW**	**Beam Tilt**	**0**	
Frequency:	**88.1**	**Gain (Max)**	**2.280**	**3.579 dB**
Channel #:	**201**	**Gain (Horizon)**	**2.280**	**3.579 dB**
Figure:	**3**			



Antenna Mfg.: Shively Labs — **Date:** 2/1/2008

Antenna Type: Scala 2xCL-FM/VRM/50N

Station: WGHW — **Beam Tilt** 0

Frequency: 88.1 — **Gain (Max)** 2.280 — 3.579 dB

Channel #: 201 — **Gain (Horizon)** 2.280 — 3.579 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	0.234	0	1.000	46	0.271
-89	0.019	-43	0.213	1	0.999	47	0.287
-88	0.037	-42	0.191	2	0.995	48	0.302
-87	0.054	-41	0.168	3	0.988	49	0.315
-86	0.071	-40	0.143	4	0.980	50	0.326
-85	0.088	-39	0.116	5	0.968	51	0.336
-84	0.104	-38	0.088	6	0.954	52	0.345
-83	0.121	-37	0.059	7	0.938	53	0.352
-82	0.136	-36	0.029	8	0.920	54	0.358
-81	0.152	-35	0.003	9	0.899	55	0.363
-80	0.168	-34	0.036	10	0.877	56	0.366
-79	0.183	-33	0.070	11	0.852	57	0.368
-78	0.197	-32	0.105	12	0.825	58	0.369
-77	0.212	-31	0.141	13	0.797	59	0.369
-76	0.226	-30	0.177	14	0.767	60	0.367
-75	0.239	-29	0.214	15	0.735	61	0.364
-74	0.253	-28	0.252	16	0.702	62	0.361
-73	0.265	-27	0.291	17	0.668	63	0.356
-72	0.277	-26	0.329	18	0.633	64	0.351
-71	0.289	-25	0.368	19	0.597	65	0.344
-70	0.300	-24	0.407	20	0.560	66	0.337
-69	0.310	-23	0.445	21	0.522	67	0.329
-68	0.320	-22	0.484	22	0.484	68	0.320
-67	0.329	-21	0.522	23	0.445	69	0.310
-66	0.337	-20	0.560	24	0.407	70	0.300
-65	0.344	-19	0.597	25	0.368	71	0.289
-64	0.351	-18	0.633	26	0.329	72	0.277
-63	0.356	-17	0.668	27	0.291	73	0.265
-62	0.361	-16	0.702	28	0.252	74	0.253
-61	0.364	-15	0.735	29	0.214	75	0.239
-60	0.367	-14	0.767	30	0.177	76	0.226
-59	0.369	-13	0.797	31	0.141	77	0.212
-58	0.369	-12	0.825	32	0.105	78	0.197
-57	0.368	-11	0.852	33	0.070	79	0.183
-56	0.366	-10	0.877	34	0.036	80	0.168
-55	0.363	-9	0.899	35	0.003	81	0.152
-54	0.358	-8	0.920	36	0.029	82	0.136
-53	0.352	-7	0.938	37	0.059	83	0.121
-52	0.345	-6	0.954	38	0.088	84	0.104
-51	0.336	-5	0.968	39	0.116	85	0.088
-50	0.326	-4	0.980	40	0.143	86	0.071
-49	0.315	-3	0.988	41	0.168	87	0.054
-48	0.302	-2	0.995	42	0.191	88	0.037
-47	0.287	-1	0.999	43	0.213	89	0.019
-46	0.271	0	1.000	44	0.234	90	0.000
-45	0.253			45	0.253		

FIGURE 4

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VALIDATION OF GAIN CALCULATION

WGHW 88.1 MHz LOCKWOODS FOLLY TOWN, NC

Scala 2 x CL-FM/VRM/50N

Elevation Gain of Scala 2 x CL-FM/VRM/50N equals 1.036

Vertical Azimuth Gain equals $1/(RMS)^2$
$1/(0.674)^2 = 2.201$

*** Total Vertical Gain is Elevation Gain times Azimuth Gain**
1.036 x 2.201 = 2.280

ERP divided by Vertical Gain equals Antenna Input Power
10 kW ÷ 2.280 = 4.386 kW