Shively Labs®
a division of Howell Laboratories, Inc.

P. O. Box 389 Harrison Rd.,
Bridgton, Maine 04009 USA
(207) 647-3327
888-SHIVELY
Fax: (207) 647-8273
E-mail: sales@shively.com
Web site: www.shively.com

S.O. 32630

Report of Test Scala CL-FM/VRM/50N-DA

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 CL-FM/VRM/50N-DA to meet the needs of WGHW and to comply with the requirements of the FCC construction permit, file number BMPED-20150402AAT.   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 - N/A
    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-20150402AAT indicates that the Vertical radiation component shall not exceed 52 kW at any azimuth and is restricted to the following values at the azimuths specified:

                    116 - 186   Degrees True: 1.65 kilowatts

From Figure 1A, the maximum radiation of the Vertical component occurs at 36 Degrees True. At the restricted azimuth of 116 - 186 Degrees True the Vertical component is 16.082 dB down from the maximum of 52 kW, or 1.282 kW.

The R.M.S. of the Vertical component is 0.554. The total Vertical power gain is 7.480. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.586. The R.M.S. of the measured composite pattern is 0.554. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.498. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:
One bay of the Scala CL-FM/VRM/50N-DA was mounted on a tower of precise scale to the Saber 44" tower at the WGHW site. The spacing of the antenna to the tower 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-20150402AAT, a single level of the Scala CL-FM/VRM/50N-DA was set up on the Shively Labs 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 a Life 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.

EQUIPMENT:

The 4.5:1 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:

<div align="center">

Hewlett Packard Model 4395A Network Analyzer

PC Based Controller

Output Standard Printer or 'pdf'

</div>

All testing is carried out in strict accordance with approved procedures under our ISO9001:2008.

TEST PROCEDURES:

The receiving antenna system is mounted so that the horizontal and vertical azimuth patterns are measured independently. 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 1A.
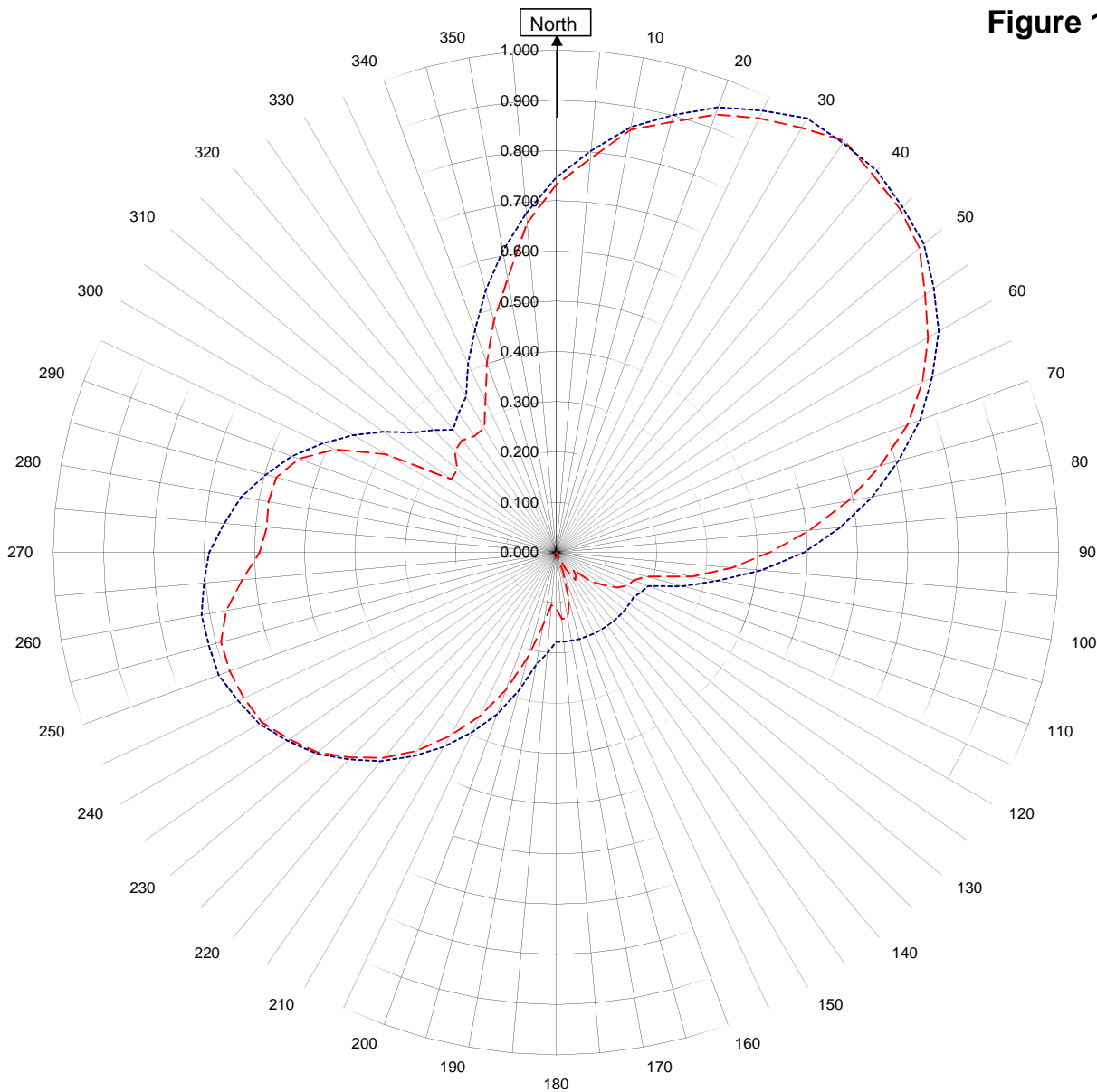
Respectfully submitted by:

Robert A. Surette
Director of Sales Engineering
S/O 32630
May 21, 2015

Shively Labs

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

Figure 1A

WGHW   **Lockwoods Folly Town, NC**

32630

May 21, 2015

Horizontal RMS	0.000		Frequency	88.1 / 396.45 mHz	
Vertical RMS	0.554		Plot	Relative Field	
H/V Composite RMS	0.554		Scale	4.5 : 1	
…………..FCC Composite RMS	0.586			See Figure 2 for Mechanical Details	

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

Shively Labs

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

Figure 1B
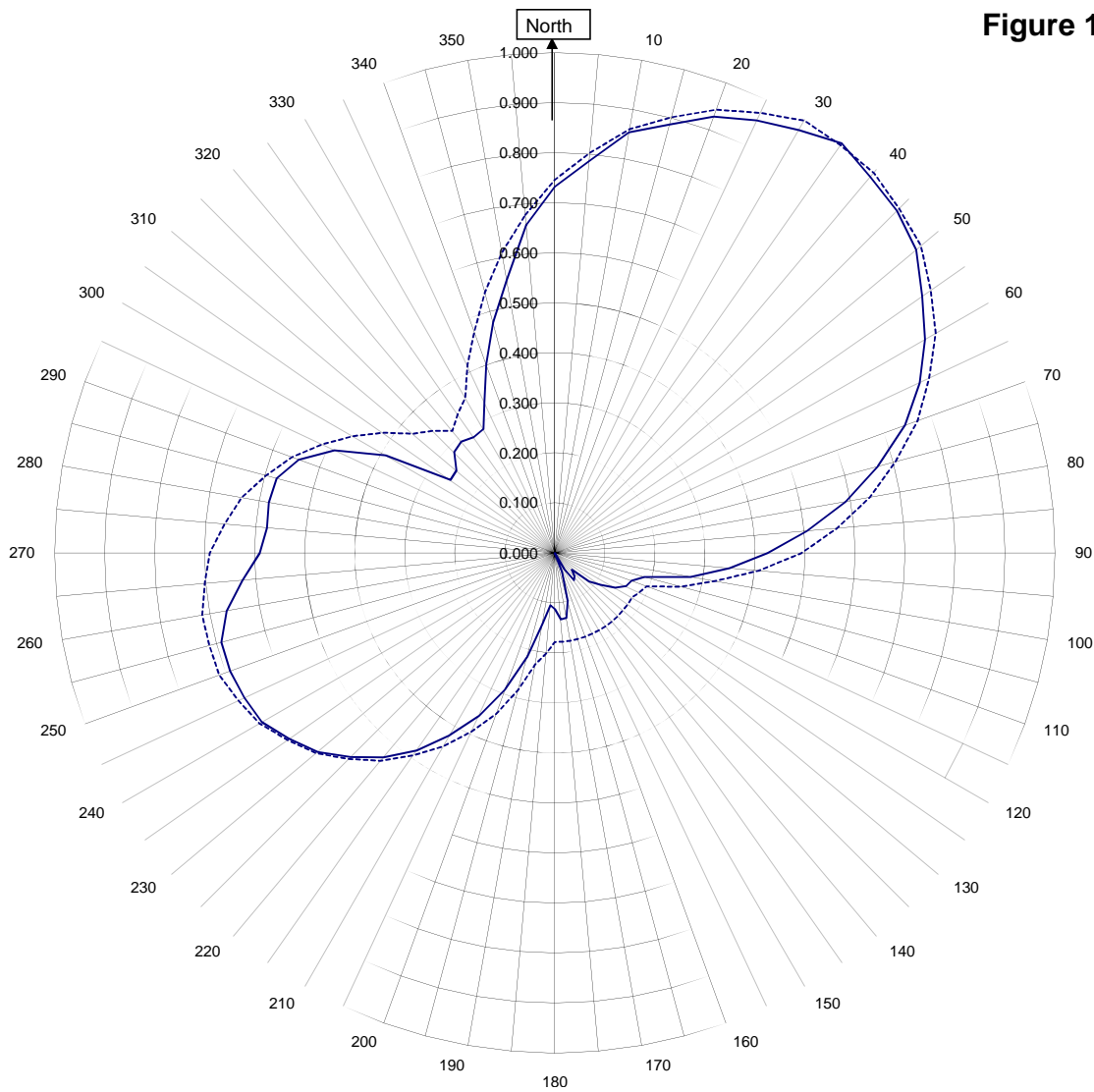
WGHW   :kwoods Folly Town,
32630
May 21, 2015

_____H/VComposite RMS	0.554	
…..………...FCC Composite RMS	0.586	

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

Antenna Model	Scala CL-FM/VRM/50N
Pattern Type	Directional H/V Composite

Tabulation of Vertical Azimuth Pattern
WGHW Lockwoods Folly Town, NC

Azimuth	Rel Field	Azimuth	Rel Field
0	0.732	180	0.112
10	0.854	190	0.145
20	0.928	200	0.290
30	0.976	210	0.421
40	0.981	220	0.533
45	0.967	225	0.577
50	0.943	230	0.619
60	0.854	240	0.676
70	0.744	250	0.691
80	0.590	260	0.666
90	0.425	270	0.590
100	0.275	280	0.581
110	0.163	290	0.545
120	0.139	300	0.391
130	0.088	310	0.257
135	0.048	315	0.285
140	0.061	320	0.291
150	0.037	330	0.286
160	0.041	340	0.402
170	0.132	350	0.554
36	1.000		

Tabulation of Composite Azimuth Pattern
WGHW Lockwoods Folly Town, NC

Azimuth	Rel Field	Azimuth	Rel Field
0	0.732	180	0.112
10	0.854	190	0.145
20	0.928	200	0.290
30	0.976	210	0.421
40	0.981	220	0.533
45	0.967	225	0.577
50	0.943	230	0.619
60	0.854	240	0.676
70	0.744	250	0.691
80	0.590	260	0.666
90	0.425	270	0.590
100	0.275	280	0.581
110	0.163	290	0.545
120	0.139	300	0.391
130	0.088	310	0.257
135	0.048	315	0.285
140	0.061	320	0.291
150	0.037	330	0.286
160	0.041	340	0.402
170	0.132	350	0.554
36	1.000		

Tabulation of FCC Directional Composite
WGHW Lockwoods Folly Town, NC

Azimuth	Rel Field	Azimuth	Rel Field
0	0.746	180	0.178
10	0.860	190	0.226
20	0.943	200	0.342
30	0.998	210	0.446
40	0.992	220	0.542
50	0.955	230	0.623
60	0.879	240	0.682
70	0.771	250	0.714
80	0.639	260	0.716
90	0.493	270	0.690
100	0.325	280	0.636
110	0.195	290	0.560
120	0.178	300	0.467
130	0.178	310	0.371
140	0.178	320	0.319
150	0.178	330	0.358
160	0.178	340	0.471
170	0.178	350	0.610
36	1.000		

COAX SYSTEM
30° ANTENNAS FULL POWER
252° Antenns -3 dB
all EQUAL PHASE

SCHEMATIC VIEW

36°
AZIMUTH

N

LEG AZIMUTH 62°

258°
AZIMUTH

2 to 3" Pipe

TOP VIEW

6"

258°
AZIMUTH

36°
AZIMUTH

134" Typ.

Center of
Radiation   101 Meters
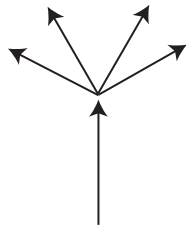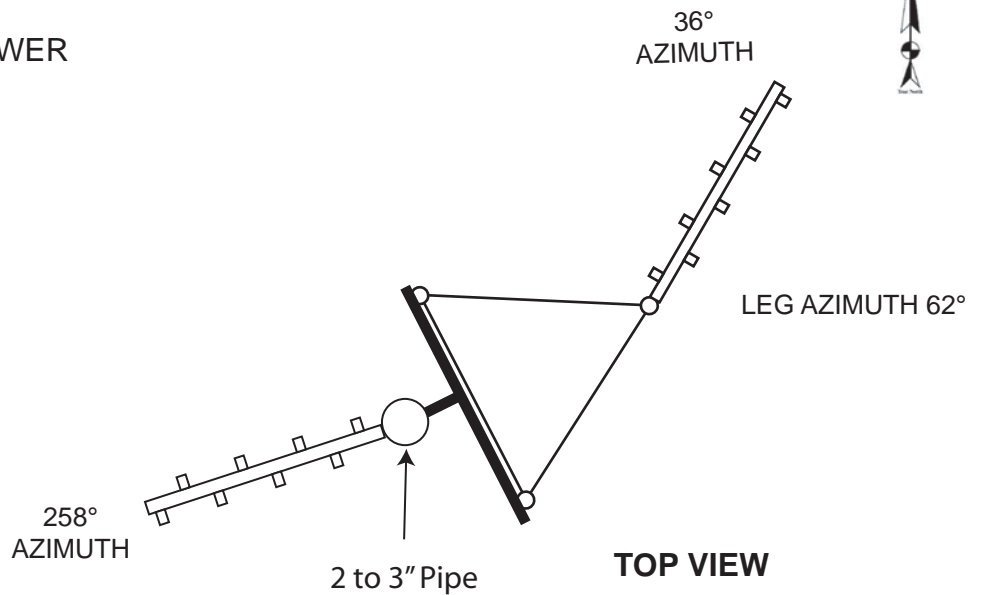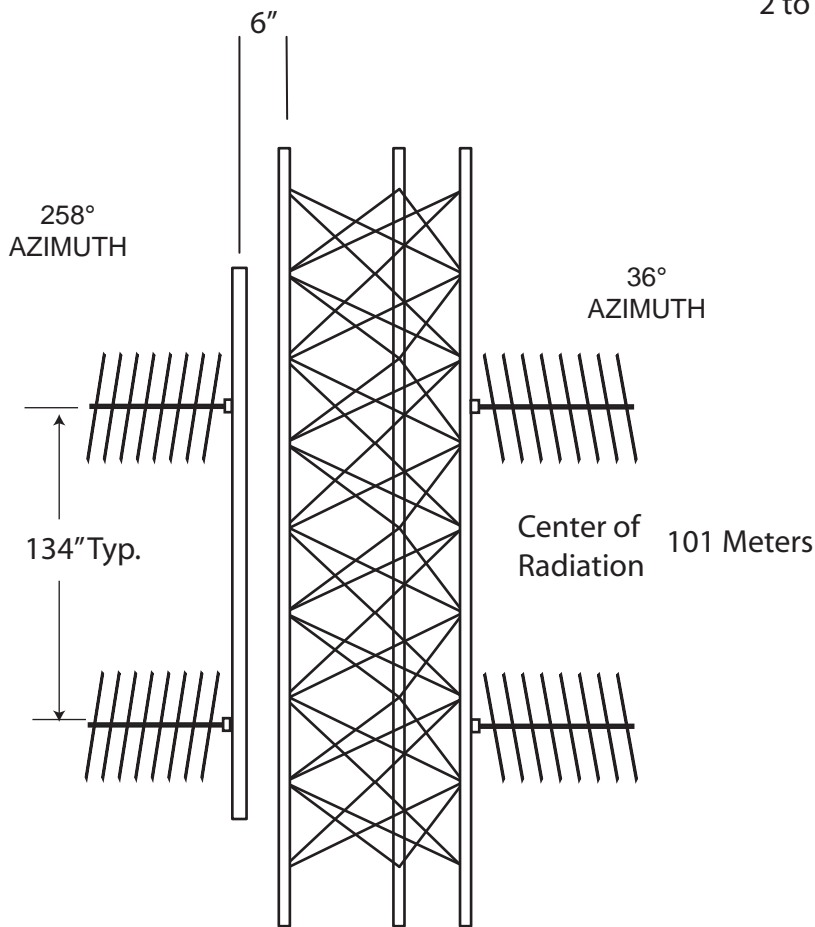
TOWER
Saber 44"
ELEVATION VIEW

SHIVELY LABS

DIV. HOWELL LABS   BRIDGTON, MAINE USA

FIGURE 2, 88.1 MHz
WGHW Lockwoods Folly Town, NC
Scala CL-FM/VRM/50N-2/2-DA

SIZE	CODE IDENT. NO.	DRAWING NO.		REV
A	26750	RAS5122015		A

SCALE				
NONE	S/O 32630	SHEET	1 OF 1	

Antenna Mfg.: Shively Labs **Date: 5/12/2015**
Antenna Type: Scala CL-FM/VRM/50N
Station: WGHW **Beam Tilt** **0**
Frequency: 88.1 **Gain (Max)** **7.480** **8.739 dB**
Channel #: 201 **Gain (Horizon)** **7.480** **8.739 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	0.419	0	1.000	46	0.448
-89	0.021	-43	0.401	1	0.998	47	0.460
-88	0.040	-42	0.381	2	0.993	48	0.471
-87	0.059	-41	0.360	3	0.985	49	0.479
-86	0.078	-40	0.336	4	0.974	50	0.486
-85	0.096	-39	0.311	5	0.959	51	0.490
-84	0.114	-38	0.283	6	0.942	52	0.494
-83	0.133	-37	0.254	7	0.921	53	0.496
-82	0.151	-36	0.222	8	0.897	54	0.496
-81	0.168	-35	0.189	9	0.871	55	0.495
-80	0.186	-34	0.155	10	0.842	56	0.492
-79	0.204	-33	0.118	11	0.811	57	0.488
-78	0.221	-32	0.080	12	0.777	58	0.483
-77	0.238	-31	0.041	13	0.742	59	0.477
-76	0.255	-30	0.000	14	0.704	60	0.469
-75	0.272	-29	0.042	15	0.665	61	0.461
-74	0.288	-28	0.085	16	0.624	62	0.452
-73	0.304	-27	0.129	17	0.581	63	0.441
-72	0.320	-26	0.173	18	0.538	64	0.430
-71	0.336	-25	0.219	19	0.494	65	0.419
-70	0.351	-24	0.265	20	0.448	66	0.406
-69	0.365	-23	0.311	21	0.403	67	0.393
-68	0.380	-22	0.357	22	0.357	68	0.380
-67	0.393	-21	0.403	23	0.311	69	0.365
-66	0.406	-20	0.448	24	0.265	70	0.351
-65	0.419	-19	0.494	25	0.219	71	0.336
-64	0.430	-18	0.538	26	0.173	72	0.320
-63	0.441	-17	0.581	27	0.129	73	0.304
-62	0.452	-16	0.624	28	0.085	74	0.288
-61	0.461	-15	0.665	29	0.042	75	0.272
-60	0.469	-14	0.704	30	0.000	76	0.255
-59	0.477	-13	0.742	31	0.041	77	0.238
-58	0.483	-12	0.777	32	0.080	78	0.221
-57	0.488	-11	0.811	33	0.118	79	0.204
-56	0.492	-10	0.842	34	0.155	80	0.186
-55	0.495	-9	0.871	35	0.189	81	0.168
-54	0.496	-8	0.897	36	0.222	82	0.151
-53	0.496	-7	0.921	37	0.254	83	0.133
-52	0.494	-6	0.942	38	0.283	84	0.114
-51	0.490	-5	0.959	39	0.311	85	0.096
-50	0.486	-4	0.974	40	0.336	86	0.078
-49	0.479	-3	0.985	41	0.360	87	0.059
-48	0.471	-2	0.993	42	0.381	88	0.040
-47	0.460	-1	0.998	43	0.401	89	0.021
-46	0.448	0	1.000	44	0.419	90	0.000
-45	0.435			45	0.435		

VALIDATION OF TOTAL POWER GAIN CALCULATION

<mark>WGHW   Lockwoods Folly Town, NC</mark>

<mark>MODEL   Scala CL-FM/VRM/50N</mark>

Elevation Gain of Antenna   <mark>2.3</mark>

V RMS   <mark>0.55452</mark>

Vertical Azimuth Gain equals $1/(RMS)^2$ 3.252

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

Total Vertical Power Gain   **7.480**

==

ERP divided by Vertical Power Gain equals Antenna Input Power

<mark>52</mark>   kW ERP   Divided by V Gain   7.480   Equals   **6.952**   kW Antenna Input Power