Shively Labs®
a division of Howell Laboratories, Inc.

P. O. Box 389, 188 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. 33946

Report of Test 6014-3/3-SS-DA

for

SAGA COMMUNICATIONS OF NORTH CAROLINA, LLC

WOXL-FM 96.5 MHz BILTMORE FOREST, NC.

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6014-3/3-SS-DA to meet the needs of WOXL-FM and to comply with the requirements of the FCC construction permit, file number BPH-20131220HHF. 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 - Tabulation of the Horizontal Polarization for the Measured Azimuth Pattern
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 BPH-20131220HHF indicates that the Horizontal radiation component shall not exceed 9.5 kW at any azimuth and is restricted to the following values at the azimuths specified:

0 - 20 Degrees True: 8.574 kilowatts

290 – 300 Degrees True: 6.864 kilowatts

From Figure 1A, the maximum radiation of the Horizontal component occurs at 48 Degrees True to 62 Degrees True and 174 Degrees True to 478 Degrees True. At the restricted azimuth of 0 Degrees True to 20 degrees true clockwise the Vertical component is 0.762 dB down from the maximum of 9.5 kW, or 7.971 kW and at the restricted azimuth of 290 Degrees True to 300 degrees true clockwise the Vertical component is 1.566 dB down from the maximum of 9.5 kW, or 6.624 kW.

The R.M.S. of the Horizontal component is 0.834. The total Horizontal power gain is 1.463. The R.M.S. of the Vertical component is 0.824. The total Vertical power gain is 1.332. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.988. The R.M.S. of the measured composite pattern is 0.876. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.839. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One level of the 6014-3/3-SS-DA was mounted on a tower of precise scale to the self-supported Sabre tower at the WOXL-FM site. The spacing of the antenna to the tower was varied and the addition of a 3-way unequal power split was used to achieve the horizontal and vertical pattern shown in Figure 1A. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BPH-20131220HHF, a single level of the 6014-3/3-SS-DA was set up on the Shively Labs scale model antenna pattern measuring range. A scale of 4.5:1 was used.

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:

Hewlett Packard Model 4395-A Network Analyzer

PC Based Controller

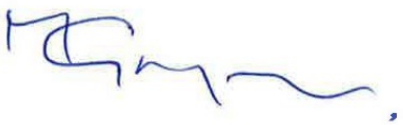
Output Standard Printer or 'pdf'

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 434.25 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 1A.

Respectfully submitted by:



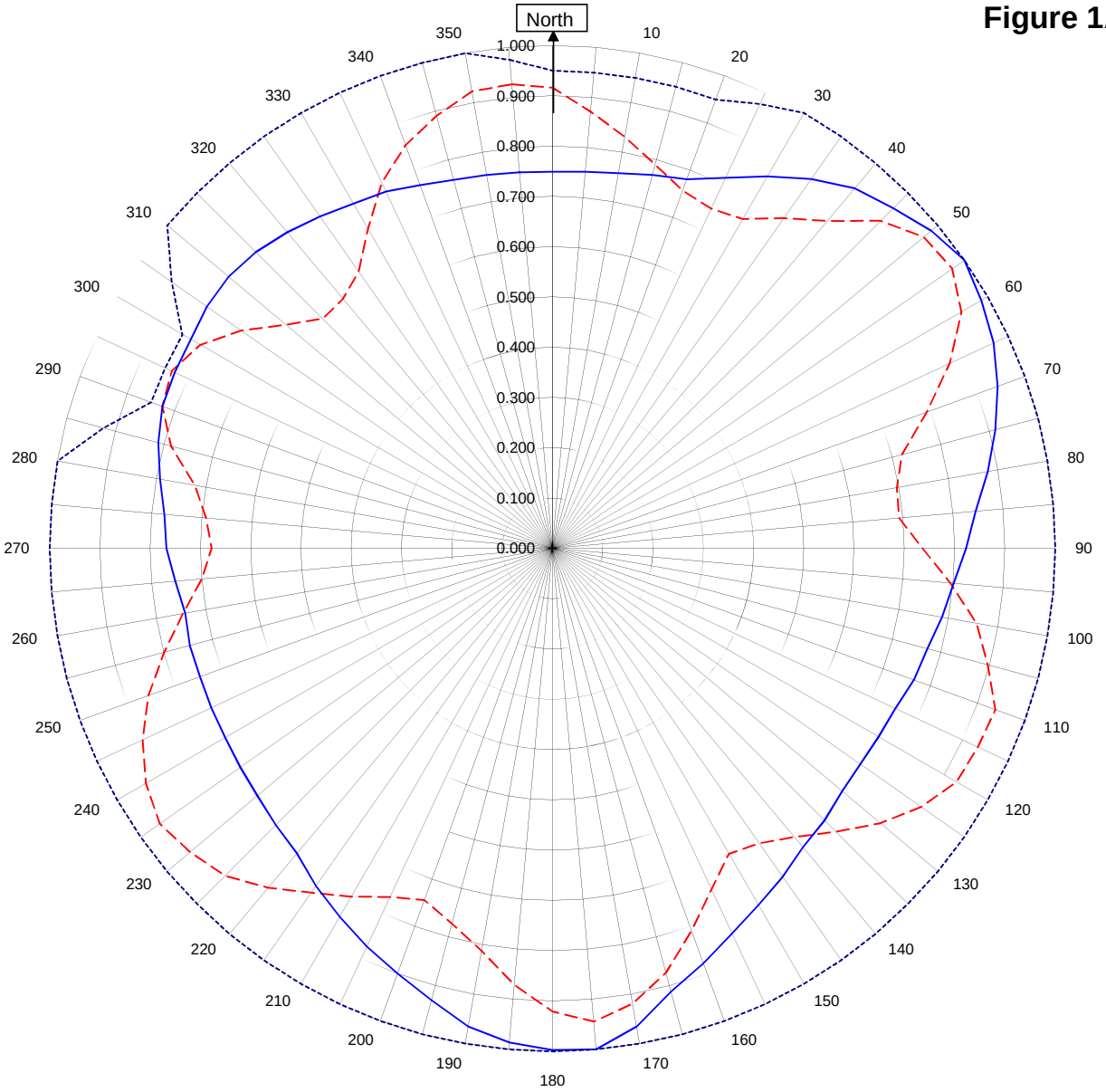
Martyn Gregory

Vice President, Shively Labs
S/O 33946
Date September 12, 2016

Shively Labs

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

Figure 1A



WOXL-FM BILTMORE FOREST, NC.

33946

September 12, 2016

Horizontal RMS	0.834
Vertical RMS	0.824
H/V Composite RMS	0.876
FCC Composite RMS	0.988

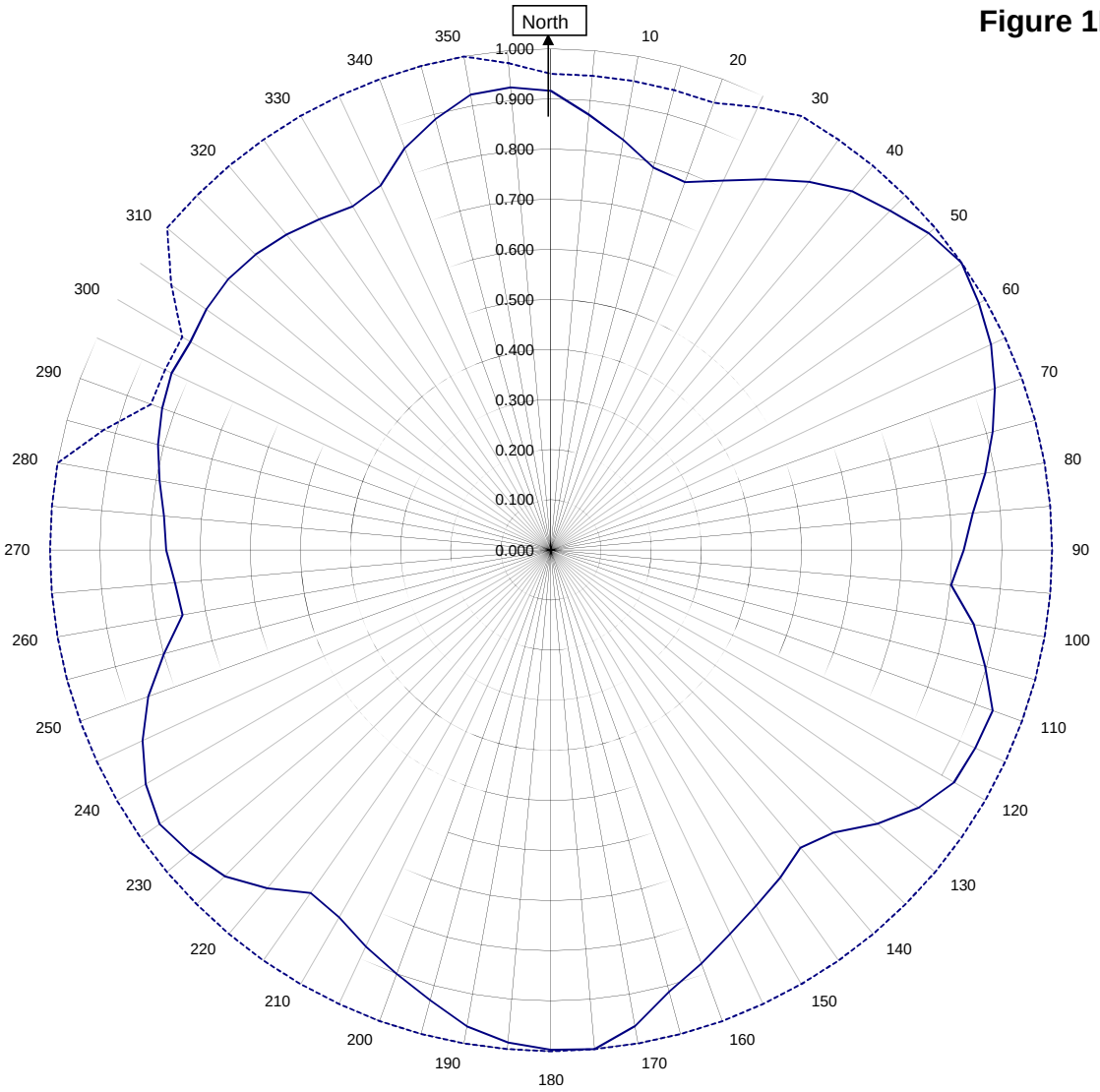
Frequency	96.5 / 434.25 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6014-3/3-SS-DA
Pattern Type	Directional Azimuth

Shively Labs

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

Figure 1B



WOXL-FM LTMORE FOREST, N

33946

September 12, 2016

_____H/VComposite RMS	0.876
……FCC Composite RMS	0.988

Frequency	96.5 / 434.25 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6014-3/3-SS-DA
Pattern Type	Directional H/V Composite

Figure 1C

Tabulation of Horizontal Azimuth Pattern
WOXL-FM BILTMORE FOREST, NC.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.749	180	0.997
10	0.758	190	0.965
20	0.781	200	0.900
30	0.854	210	0.846
40	0.935	220	0.791
45	0.957	225	0.778
50	0.983	230	0.766
60	0.985	240	0.752
70	0.942	250	0.746
80	0.879	260	0.742
90	0.823	270	0.768
100	0.787	280	0.793
110	0.765	290	0.826
120	0.749	300	0.831
130	0.752	310	0.841
135	0.765	315	0.834
140	0.775	320	0.821
150	0.819	330	0.792
160	0.878	340	0.769
170	0.965	350	0.754

Figure 1D

Tabulation of Vertical Azimuth Pattern
WOXL-FM BILTMORE FOREST, NC.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.916	180	0.921
10	0.831	190	0.812
20	0.757	200	0.744
30	0.756	210	0.800
40	0.850	220	0.881
45	0.922	225	0.921
50	0.964	230	0.940
60	0.939	240	0.934
70	0.792	250	0.855
80	0.695	260	0.746
90	0.736	270	0.678
100	0.856	280	0.722
110	0.938	290	0.826
120	0.928	300	0.809
130	0.850	310	0.692
135	0.797	315	0.646
140	0.749	320	0.648
150	0.701	330	0.734
160	0.809	340	0.854
170	0.919	350	0.923

Figure 1E

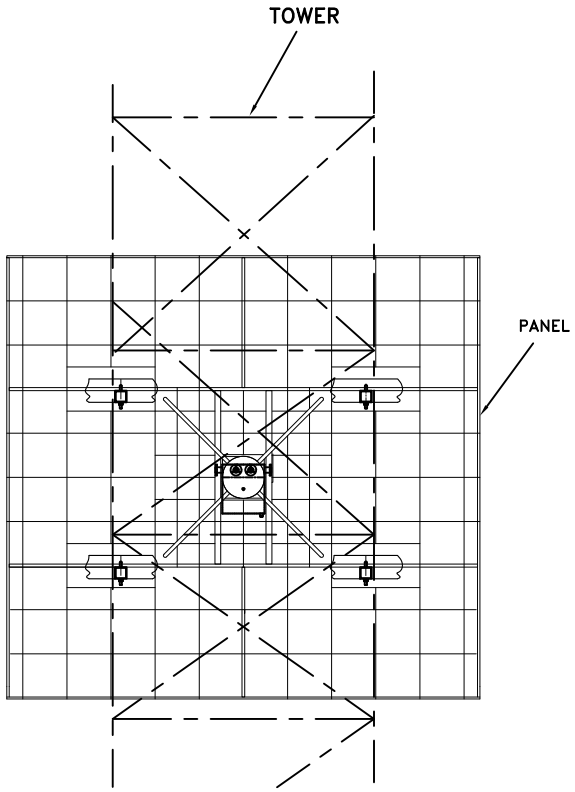
Tabulation of Composite Azimuth Pattern
WOXL-FM BILTMORE FOREST, NC.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.916	180	0.997
10	0.831	190	0.965
20	0.781	200	0.900
30	0.854	210	0.846
40	0.935	220	0.881
45	0.957	225	0.921
50	0.983	230	0.940
60	0.985	240	0.934
70	0.942	250	0.855
80	0.879	260	0.746
90	0.823	270	0.768
100	0.856	280	0.793
110	0.938	290	0.826
120	0.928	300	0.831
130	0.850	310	0.841
135	0.797	315	0.834
140	0.775	320	0.821
150	0.819	330	0.792
160	0.878	340	0.854
170	0.965	350	0.923

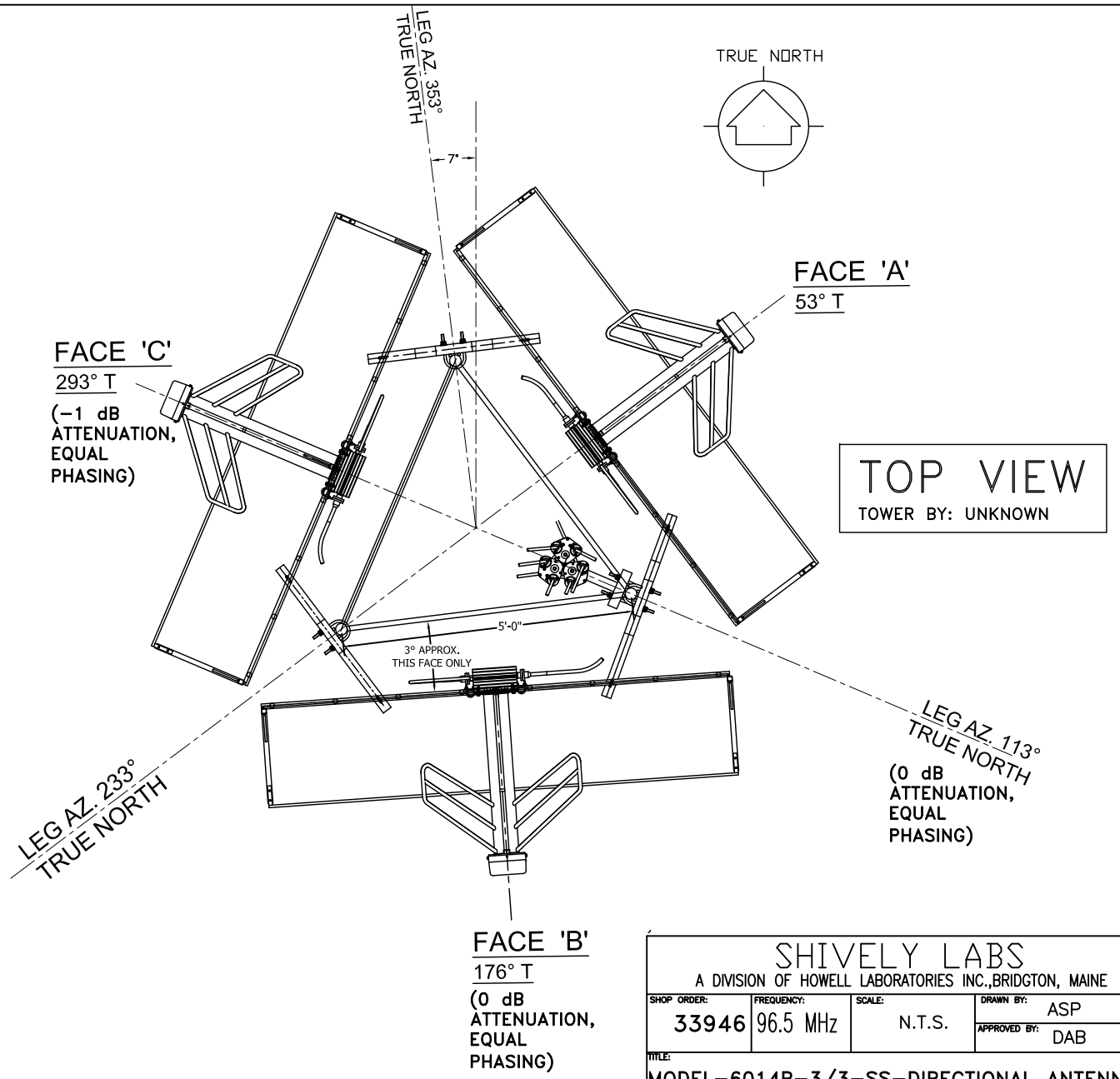
Figure 1F

Tabulation of FCC Directional Composite
WOXL-FM BILTMORE FOREST, NC.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.950	180	1.000
10	0.950	190	1.000
20	0.950	200	1.000
30	1.000	210	1.000
40	1.000	220	1.000
50	1.000	230	1.000
60	1.000	240	1.000
70	1.000	250	1.000
80	1.000	260	1.000
90	1.000	270	1.000
100	1.000	280	1.000
110	1.000	290	0.850
120	1.000	300	0.850
130	1.000	310	1.000
140	1.000	320	1.000
150	1.000	330	1.000
160	1.000	340	1.000
170	1.000	350	1.000



SIDE VIEW



TOP VIEW
TOWER BY: UNKNOWN

FACE 'A' ANTENNA HEADING 53° T
FACE 'B' ANTENNA HEADING 176° T
FACE 'C' ANTENNA HEADING 293° T

SHIVELY LABS
A DIVISION OF HOWELL LABORATORIES INC.,BRIDGTON, MAINE

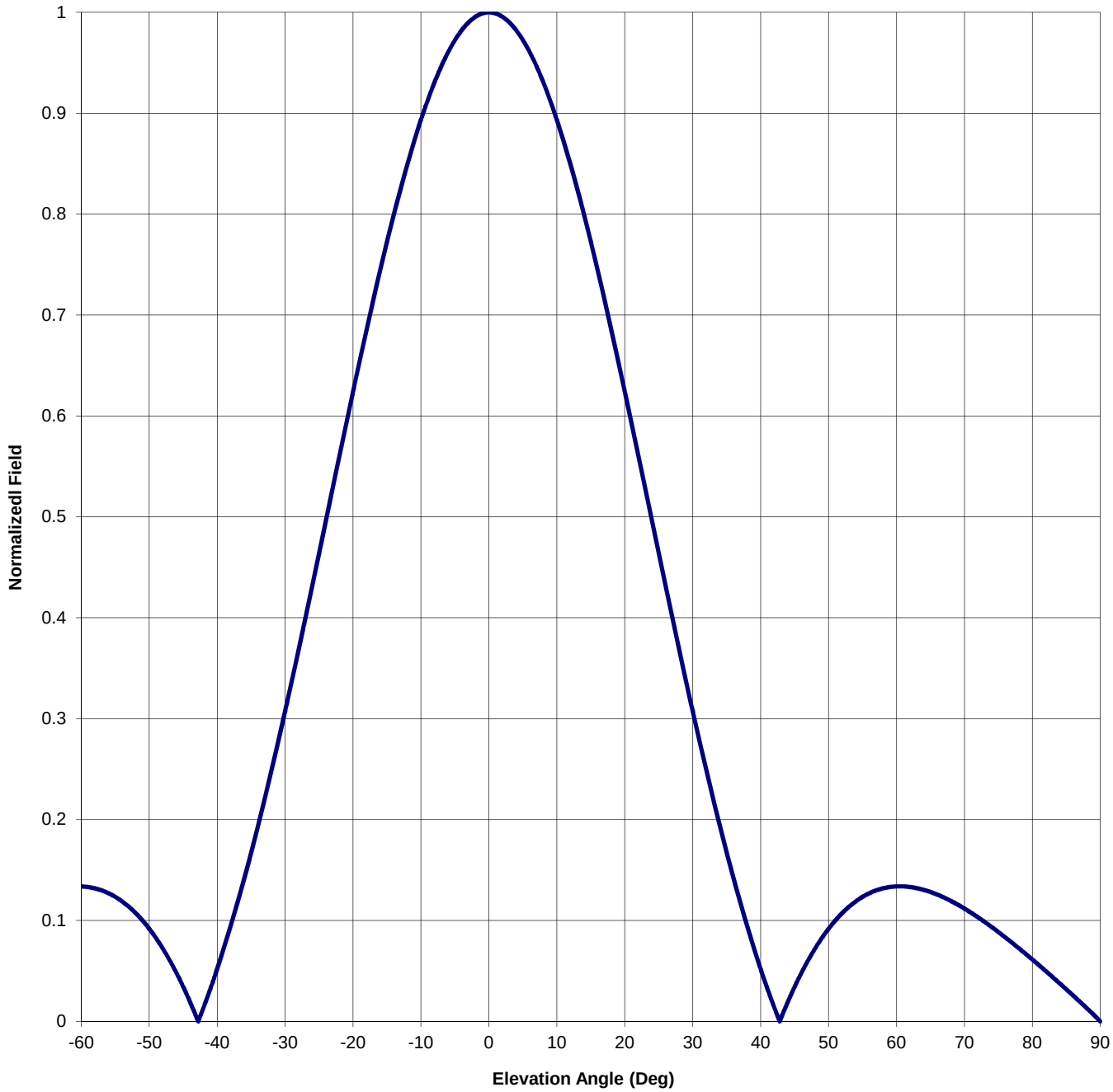
SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY:
33946	96.5 MHz	N.T.S.	ASP
			APPROVED BY: DAB

TITLE: MODEL−6014B−3/3−SS−DIRECTIONAL ANTENNA

DATE: 9−12−16

FIGURE 2

Antenna Mfg.:	**Shively Labs**			**Date:**	**9/14/2016**
Antenna Type:	**6014-3/3-SS-DA**				
Station:	**WOXL**	**Beam Tilt**	**0**		
Frequency:	**96.5**	**Gain (Max)**	**1.463**	**1.652**	**dB**
Channel #:	**243**	**Gain (Horizon)**	**1.463**	**1.652**	**dB**
Figure:	**Figure 3**				



Antenna Mfg.: Shively Labs **Date:** 9/14/2016

Antenna Type: 6014-3/3-SS-DA

Station: WOXL **Beam Tilt** 0

Frequency: 96.5 **Gain (Max)** 1.463 1.652 dB

Channel #: 243 **Gain (Horizon)** 1.463 1.652 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	0.019	0	1.000	46	0.048
-89	0.007	-43	0.003	1	0.999	47	0.061
-88	0.013	-42	0.014	2	0.996	48	0.072
-87	0.020	-41	0.032	3	0.990	49	0.083
-86	0.026	-40	0.052	4	0.982	50	0.092
-85	0.032	-39	0.073	5	0.973	51	0.100
-84	0.038	-38	0.095	6	0.961	52	0.107
-83	0.044	-37	0.118	7	0.947	53	0.114
-82	0.050	-36	0.142	8	0.931	54	0.119
-81	0.056	-35	0.167	9	0.913	55	0.123
-80	0.061	-34	0.194	10	0.894	56	0.127
-79	0.067	-33	0.221	11	0.872	57	0.130
-78	0.073	-32	0.249	12	0.850	58	0.132
-77	0.078	-31	0.278	13	0.825	59	0.133
-76	0.083	-30	0.308	14	0.800	60	0.134
-75	0.089	-29	0.338	15	0.773	61	0.134
-74	0.094	-28	0.369	16	0.745	62	0.133
-73	0.099	-27	0.400	17	0.716	63	0.132
-72	0.103	-26	0.432	18	0.686	64	0.130
-71	0.108	-25	0.464	19	0.655	65	0.128
-70	0.112	-24	0.496	20	0.624	66	0.126
-69	0.116	-23	0.528	21	0.593	67	0.123
-68	0.119	-22	0.561	22	0.561	68	0.119
-67	0.123	-21	0.593	23	0.528	69	0.116
-66	0.126	-20	0.624	24	0.496	70	0.112
-65	0.128	-19	0.655	25	0.464	71	0.108
-64	0.130	-18	0.686	26	0.432	72	0.103
-63	0.132	-17	0.716	27	0.400	73	0.099
-62	0.133	-16	0.745	28	0.369	74	0.094
-61	0.134	-15	0.773	29	0.338	75	0.089
-60	0.134	-14	0.800	30	0.308	76	0.083
-59	0.133	-13	0.825	31	0.278	77	0.078
-58	0.132	-12	0.850	32	0.249	78	0.073
-57	0.130	-11	0.872	33	0.221	79	0.067
-56	0.127	-10	0.894	34	0.194	80	0.061
-55	0.123	-9	0.913	35	0.167	81	0.056
-54	0.119	-8	0.931	36	0.142	82	0.050
-53	0.114	-7	0.947	37	0.118	83	0.044
-52	0.107	-6	0.961	38	0.095	84	0.038
-51	0.100	-5	0.973	39	0.073	85	0.032
-50	0.092	-4	0.982	40	0.052	86	0.026
-49	0.083	-3	0.990	41	0.032	87	0.020
-48	0.072	-2	0.996	42	0.014	88	0.013
-47	0.061	-1	0.999	43	0.003	89	0.007
-46	0.048	0	1.000	44	0.019	90	0.000
-45	0.034			45	0.034		

S.O. 33946 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WOXL-FM BILTMORE FOREST, NC.

MODEL 6014-3/3-SS-DA

Elevation Gain of Antenna 1.006

Horizontal RMS value divided by the Vertical RMS value equals the Horiz. - Vert. Ratio

H RMS 0.833934 V RMS 0.82446 H/V Ratio 1.011

Elevation Gain of Horizontal Component 1.018

Elevation Gain of Vertical Component 0.995

Horizontal Azimuth Gain equals $1/(RMS)^2$. 1.438

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 1.339

Max. Vertical 0.954

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

Total Horizontal Power Gain = **1.463**

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

Total Vertical Power Gain = **1.332**

==========

ERP divided by Horizontal Power Gain equals Antenna Input Power

9.5 kW ERP Divided by H Gain 1.463 equals 6.493 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

6.493 kW Times V Gain 1.332 equals 8.646 kW V ERP

Maximum Value of the Vertical Component squared times the Maximum ERP equals the Vertical ERP

(0.954)^2 Times 9.50 Equals 8.646 kW Vertical ERP

NOTE: Calculating the ERP of the Vertical Component by two methods validates the total power gain calculations