Shively Labs
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S.O. 30142

Report of Test 6016-1/3-DA

for

Delmarva Educational Association

WCRJ 88.1 MHz Jacksonville, FL

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6016-1/3-DA to meet the needs of WCRJ and to comply with the requirements of the FCC construction permit, file number BPED-20120504ABH. 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 BPED-20120504ABH indicates that the Horizontal radiation component shall not exceed 8.0 kW at any azimuth and is restricted to the following values at the azimuths specified:

220 - 230 Degrees T: 0.46 kW

From Figure 1A, the maximum radiation of the Horizontal component occurs at 004 Degrees T to 006 Degrees T. At the restricted azimuth of 220 - 230 Degrees T the Vertical component is 12.578 dB down from the maximum of 8.0 kW, or 0.44.

The R.M.S. of the Horizontal component is 0.721. The total Horizontal power gain is 1.287. The R.M.S. of the Vertical component is 0.708. The total Vertical power gain is 1.171. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.809. The R.M.S. of the measured composite pattern is 0.762. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.688. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:
One bay of the 6016-1/3-DA was mounted on a tower of precise scale to the tower at the WCRJ 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 BPED-20120504ABH a single level of the 6016-1/3-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 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 and 10th Editions 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

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 30142
September 8, 2012

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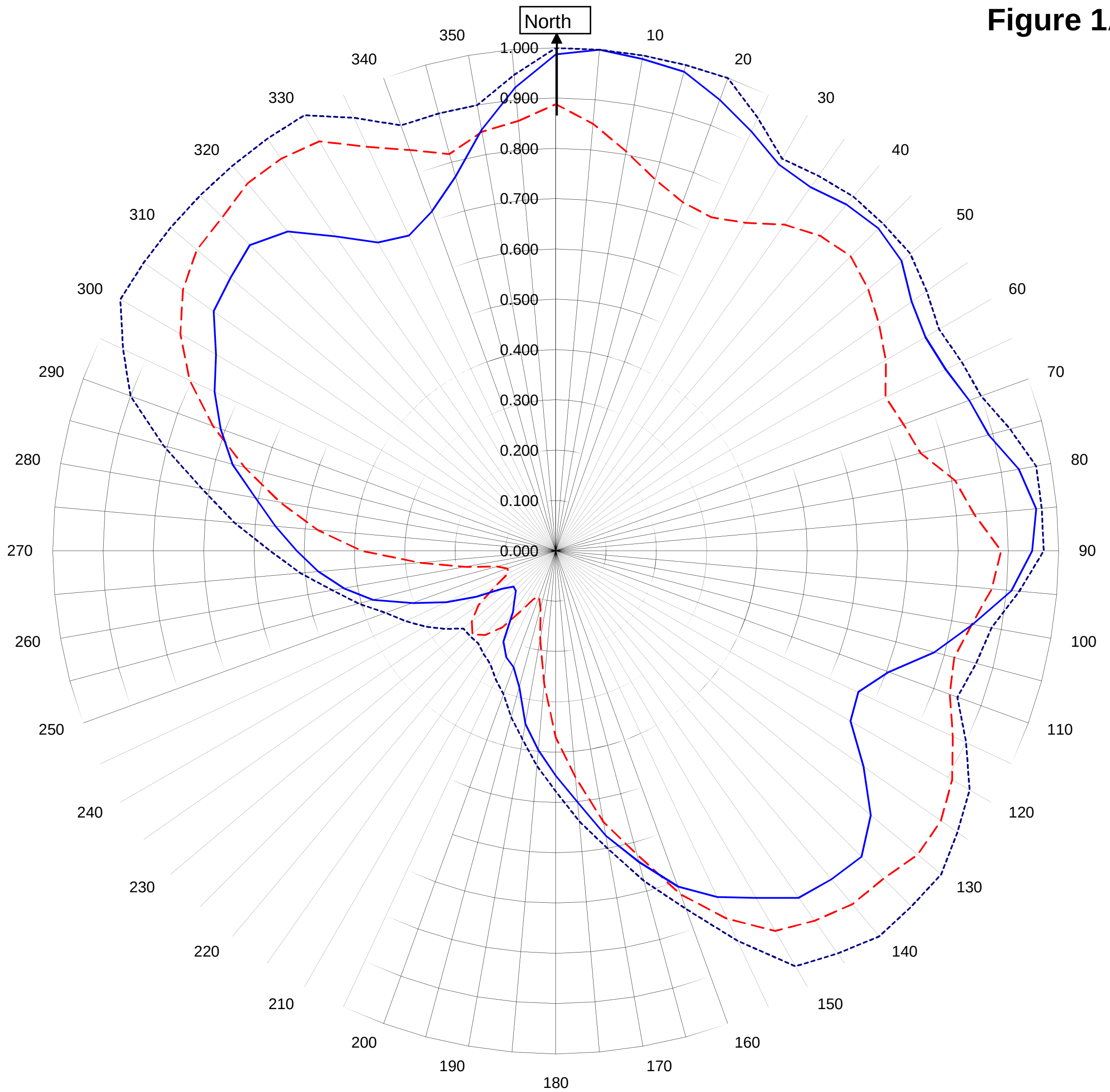
Figure 1A



WCRJ   JACKSONVILLE, FL.

57164

September 8, 2012

Horizontal RMS	0.721
Vertical RMS	0.708
H/V Composite RMS	0.762
...............FCC Composite RMS	0.809

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

Antenna Model	6016-1/3-DA
Pattern Type	Directional Azimuth

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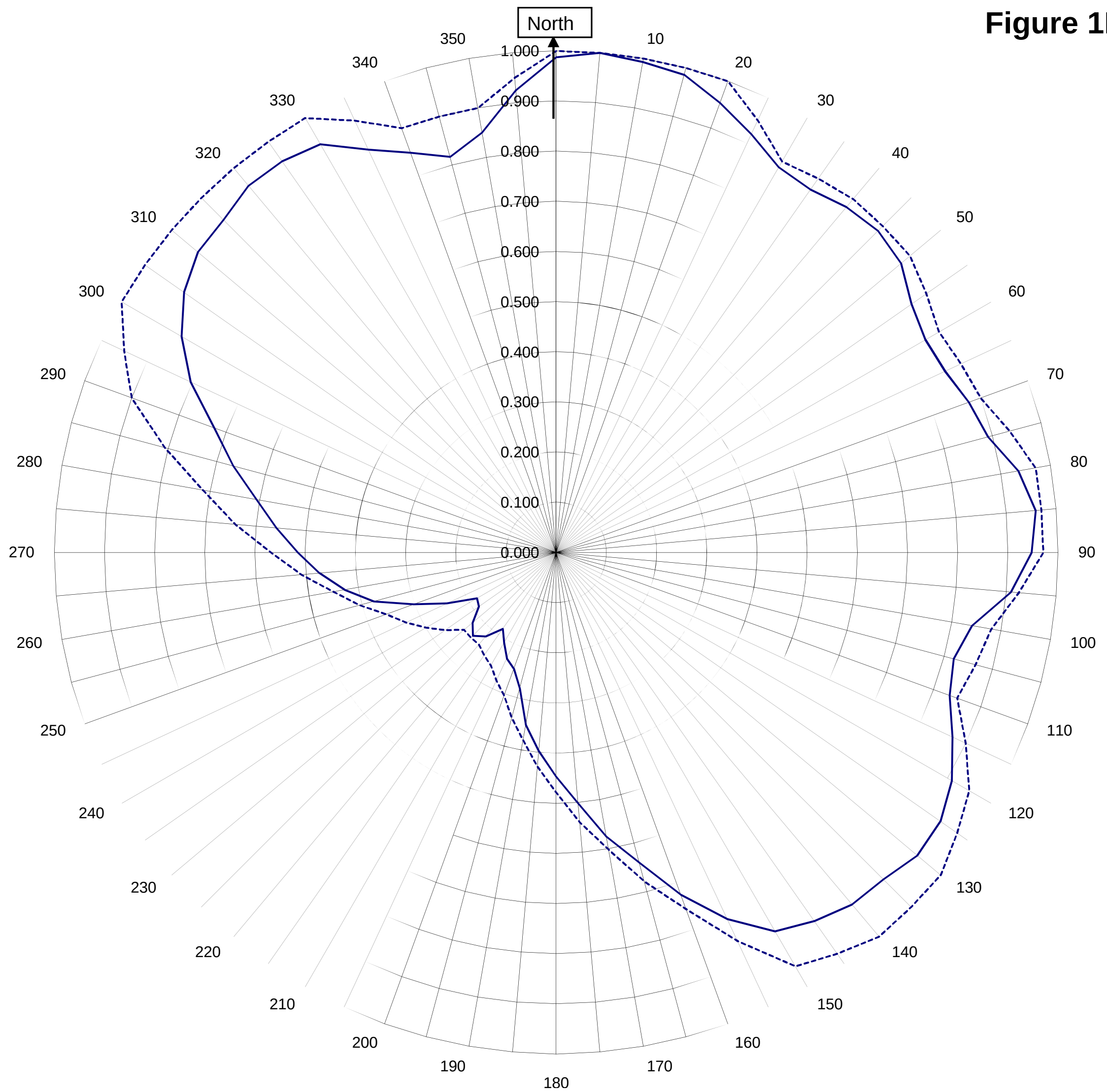
Figure 1B



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September 8, 2012

__________H/VComposite RMS	0.762
……………FCC Composite RMS	0.809

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

Antenna Model	6016-1/3-DA
Pattern Type	Directional H/V Composite

Figure 1C

Tabulation of Horizontal Azimuth Pattern
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Azimuth	Rel Field	Azimuth	Rel Field
0	0.987	180	0.447
10	0.993	190	0.349
20	0.954	200	0.246
30	0.887	210	0.208
40	0.899	220	0.128
45	0.907	225	0.113
50	0.897	230	0.110
60	0.849	240	0.182
70	0.875	250	0.302
80	0.935	260	0.428
90	0.947	270	0.515
100	0.841	280	0.606
110	0.704	290	0.709
120	0.676	300	0.780
130	0.818	310	0.845
135	0.859	315	0.860
140	0.852	320	0.829
150	0.796	330	0.708
160	0.710	340	0.719
170	0.575	350	0.850

Figure 1D

Tabulation of Vertical Azimuth Pattern
WCRJ JACKSONVILLE, FL.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.888	180	0.371
10	0.806	190	0.178
20	0.738	200	0.097
30	0.753	210	0.137
40	0.818	220	0.218
45	0.829	225	0.235
50	0.811	230	0.218
60	0.758	240	0.137
70	0.736	250	0.102
80	0.806	260	0.183
90	0.885	270	0.386
100	0.840	280	0.557
110	0.834	290	0.725
120	0.910	300	0.862
130	0.939	310	0.932
135	0.922	315	0.938
140	0.917	320	0.954
150	0.872	330	0.940
160	0.726	340	0.848
170	0.548	350	0.846

Figure 1E

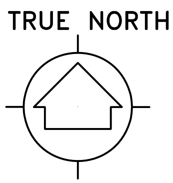
Tabulation of Composite Azimuth Pattern
WCRJ JACKSONVILLE, FL.

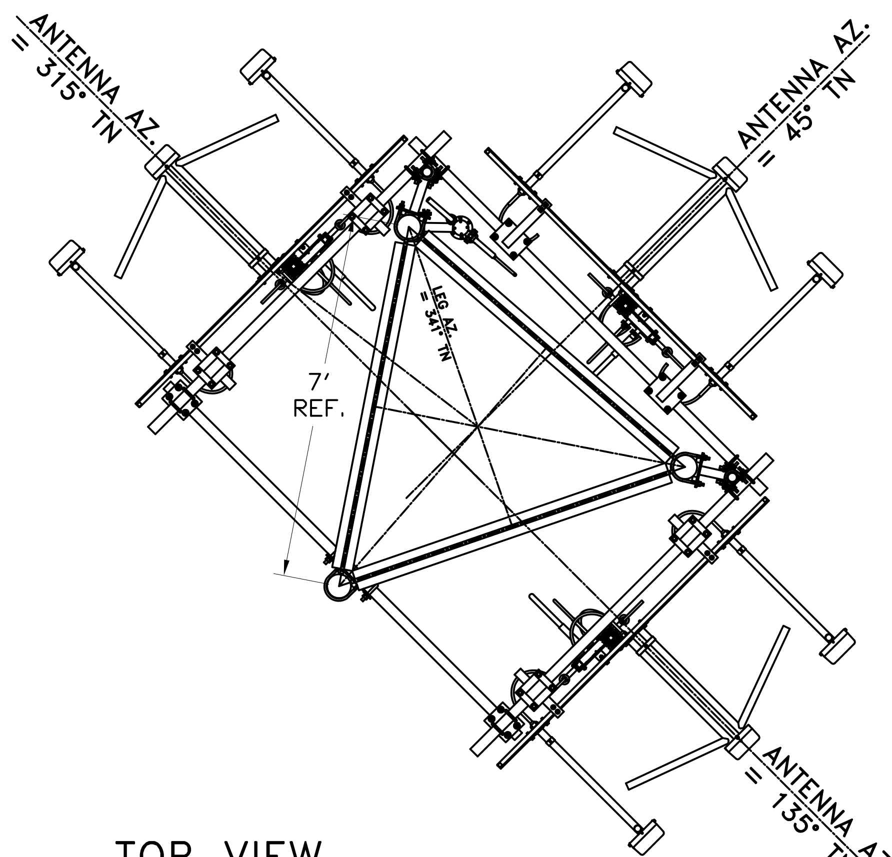
Azimuth	Rel Field	Azimuth	Rel Field
0	0.987	180	0.447
10	0.993	190	0.349
20	0.954	200	0.246
30	0.887	210	0.208
40	0.899	220	0.218
45	0.907	225	0.235
50	0.897	230	0.218
60	0.849	240	0.182
70	0.875	250	0.302
80	0.935	260	0.428
90	0.947	270	0.515
100	0.841	280	0.606
110	0.834	290	0.725
120	0.910	300	0.862
130	0.939	310	0.932
135	0.922	315	0.938
140	0.917	320	0.954
150	0.872	330	0.940
160	0.726	340	0.848
170	0.575	350	0.850

Figure 1F

Tabulation of FCC Directional Composite
WCRJ JACKSONVILLE, FL.

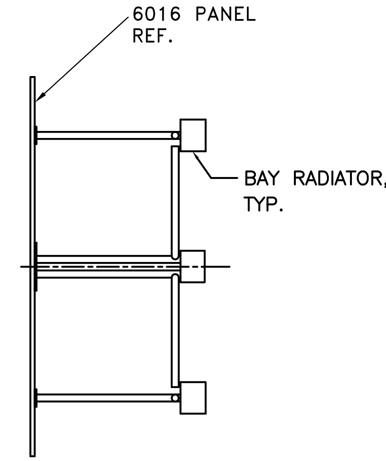
Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	0.478
10	1.000	190	0.380
20	1.000	200	0.304
30	0.900	210	0.260
40	0.920	220	0.240
50	0.920	230	0.240
60	0.880	240	0.300
70	0.900	250	0.360
80	0.970	260	0.451
90	0.970	270	0.568
100	0.880	280	0.715
110	0.850	290	0.900
120	0.950	300	1.000
130	1.000	310	1.000
140	1.000	320	1.000
150	0.953	330	1.000
160	0.757	340	0.900
170	0.602	350	0.900





TOP VIEW

TOWER: 7' REF.



SIDE VIEW OF PANEL

ANTENNA AZIMUTHS = 45°, 135° & 315° TN

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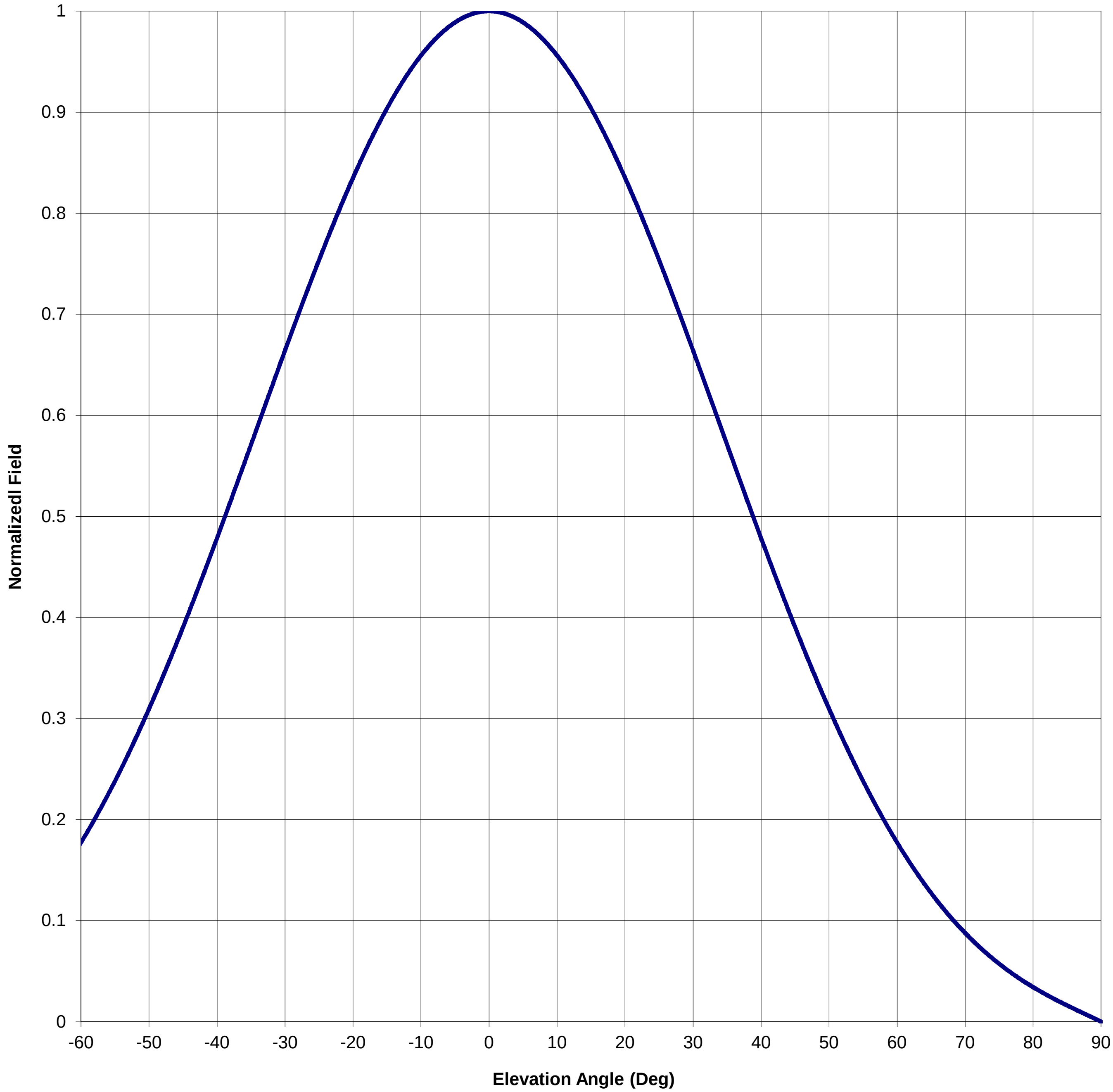
SHOP ORDER: 30142	FREQUENCY: 88.1 MHz	SCALE: N.T.S.	DRAWN BY: ASP APPROVED BY: RAS
TITLE: MODEL–6016–1/3–DIRECTIONAL ANTENNA			
DATE: 9/10/12	FIGURE 2		

Antenna Mfg.:	**Shively Labs**			**Date:**	**9/8/2012**
Antenna Type:	**6016-1/3-DA**				
Station:	**WCRJ-FM**	**Beam Tilt**	**0**		
Frequency:	**88.1**	**Gain (Max)**	**1.287**	**1.095**	**dB**
Channel #:	**201**	**Gain (Horizon)**	**1.287**	**1.095**	**dB**
Figure:	**Figure 3**				



Antenna Mfg.: **Shively Labs** — **Date:** **9/8/2012**
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Frequency: **88.1** — **Gain (Max)** **1.287** **1.095 dB**
Channel #: **201** — **Gain (Horizon)** **1.287** **1.095 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	0.408	0	1.000	46	0.374
-89	0.003	-43	0.425	1	1.000	47	0.357
-88	0.007	-42	0.443	2	0.998	48	0.341
-87	0.010	-41	0.461	3	0.996	49	0.325
-86	0.013	-40	0.479	4	0.993	50	0.310
-85	0.016	-39	0.497	5	0.989	51	0.295
-84	0.020	-38	0.515	6	0.984	52	0.280
-83	0.023	-37	0.534	7	0.978	53	0.266
-82	0.027	-36	0.552	8	0.972	54	0.252
-81	0.030	-35	0.571	9	0.964	55	0.238
-80	0.034	-34	0.590	10	0.956	56	0.225
-79	0.038	-33	0.609	11	0.947	57	0.213
-78	0.043	-32	0.627	12	0.937	58	0.200
-77	0.047	-31	0.646	13	0.927	59	0.189
-76	0.052	-30	0.664	14	0.916	60	0.177
-75	0.057	-29	0.683	15	0.904	61	0.167
-74	0.063	-28	0.701	16	0.891	62	0.156
-73	0.069	-27	0.719	17	0.878	63	0.146
-72	0.075	-26	0.736	18	0.864	64	0.137
-71	0.081	-25	0.754	19	0.850	65	0.127
-70	0.088	-24	0.771	20	0.835	66	0.119
-69	0.095	-23	0.787	21	0.820	67	0.110
-68	0.103	-22	0.804	22	0.804	68	0.103
-67	0.110	-21	0.820	23	0.787	69	0.095
-66	0.119	-20	0.835	24	0.771	70	0.088
-65	0.127	-19	0.850	25	0.754	71	0.081
-64	0.137	-18	0.864	26	0.736	72	0.075
-63	0.146	-17	0.878	27	0.719	73	0.069
-62	0.156	-16	0.891	28	0.701	74	0.063
-61	0.167	-15	0.904	29	0.683	75	0.057
-60	0.177	-14	0.916	30	0.664	76	0.052
-59	0.189	-13	0.927	31	0.646	77	0.047
-58	0.200	-12	0.937	32	0.627	78	0.043
-57	0.213	-11	0.947	33	0.609	79	0.038
-56	0.225	-10	0.956	34	0.590	80	0.034
-55	0.238	-9	0.964	35	0.571	81	0.030
-54	0.252	-8	0.972	36	0.552	82	0.027
-53	0.266	-7	0.978	37	0.534	83	0.023
-52	0.280	-6	0.984	38	0.515	84	0.020
-51	0.295	-5	0.989	39	0.497	85	0.016
-50	0.310	-4	0.993	40	0.479	86	0.013
-49	0.325	-3	0.996	41	0.461	87	0.010
-48	0.341	-2	0.998	42	0.443	88	0.007
-47	0.357	-1	1.000	43	0.425	89	0.003
-46	0.374	0	1.000	44	0.408	90	0.000
-45	0.390			45	0.390		

S.O. 57164 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WCRJ JACKSONVILLE, FL.

MODEL 6016-1/3-DA

Elevation Gain of Antenna 0.657

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

H RMS 0.721232 V RMS 0.707694 H/V Ratio 1.019

Elevation Gain of Horizontal Component 0.670

Elevation Gain of Vertical Component 0.645

Horizontal Azimuth Gain equals $1/(RMS)^2$. 1.922

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 1.817

Max. Vertical 0.954

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

Total Horizontal Power Gain = **1.287**

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

Total Vertical Power Gain = **1.171**

==

ERP divided by Horizontal Power Gain equals Antenna Input Power

8.0 kW ERP Divided by H Gain 1.287 equals 6.215 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

6.215 kW Times V Gain 1.171 equals 7.281 kW V ERP

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

(0.954)^2 Times 8.00 Equals 7.281 kW Vertical ERP

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