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S.O. 29651

Report of Test 6016-1/3-DA

for

Delmarva Educational Association

WTRJ-FM 91.7 MHz Orange Park, FL

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6016-1/3-DA to meet the needs of WTRJ-FM and to comply with the requirements of the FCC License, file number BPED-20120504ABJ. 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-20120504ABJ indicates that the Horizontal radiation component shall not exceed 6.5 kW at any azimuth and is restricted to the following values at the azimuths specified:

200 Degrees T: 0.7 kW

From Figure 1A, the maximum radiation of the Horizontal component occurs at 060 Degrees T to 065 Degrees T and 315 Degrees T to 320 Degrees T. At the restricted azimuth of 200 Degrees T the Horizontal component is 10.934 dB down from the maximum of 6.5 kW, or 0.5 kW.

The R.M.S. of the Horizontal component is 0.678. The total Horizontal power gain is 1.545. The R.M.S. of the Vertical component is 0.643. The total Vertical power gain is 1.484. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.753. The R.M.S. of the measured composite pattern is 0.681. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.640. 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 WTRJ-FM 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-20120504ABJ, 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 412.65 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 19651
September 8, 2012

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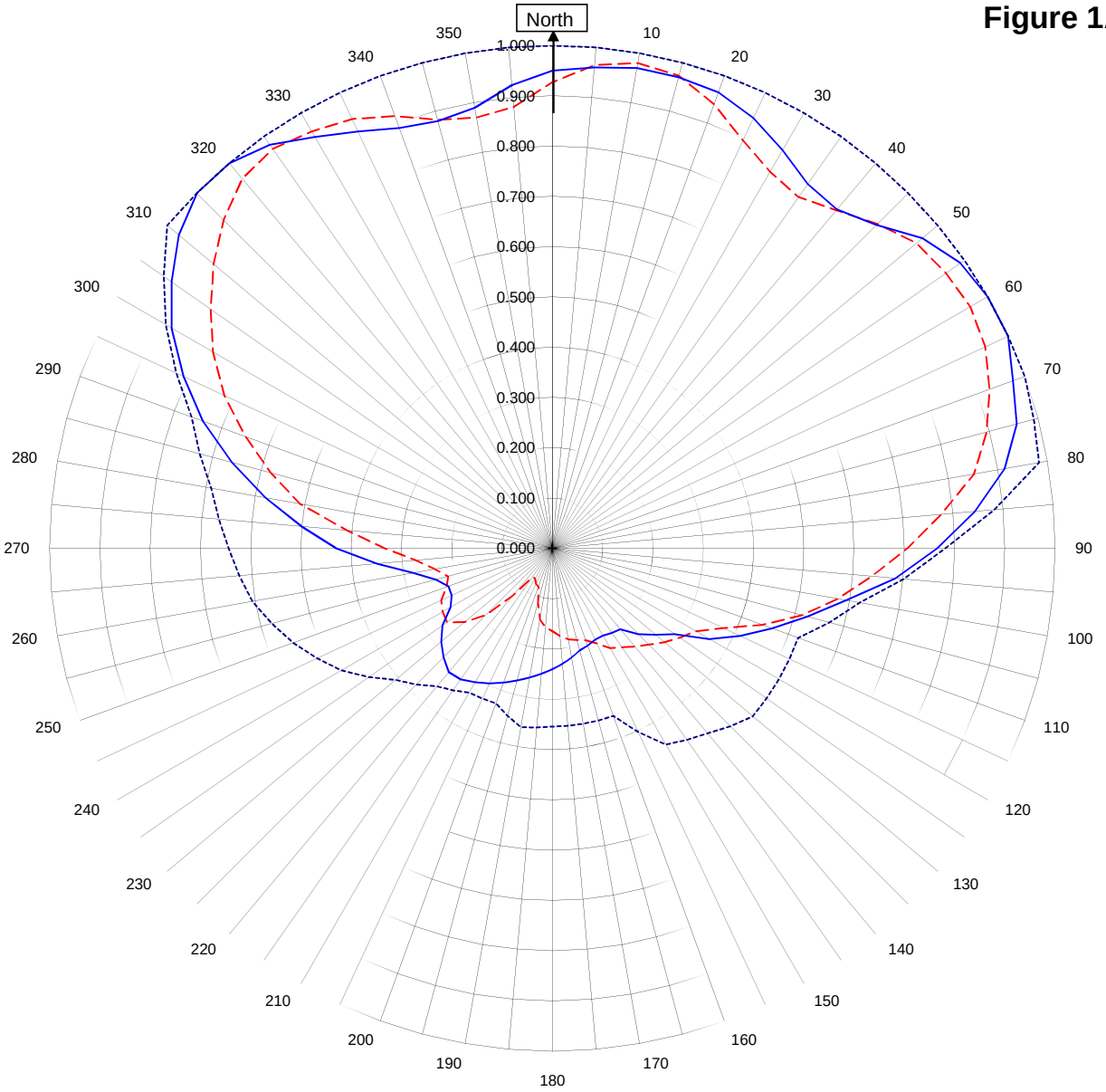
Figure 1A



WTRJ-FM Orange Park, FL

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September 8, 2012

Horizontal RMS	0.678
Vertical RMS	0.643
H/V Composite RMS	0.681
FCC Composite RMS	0.753

Frequency	91.7 / 412.65 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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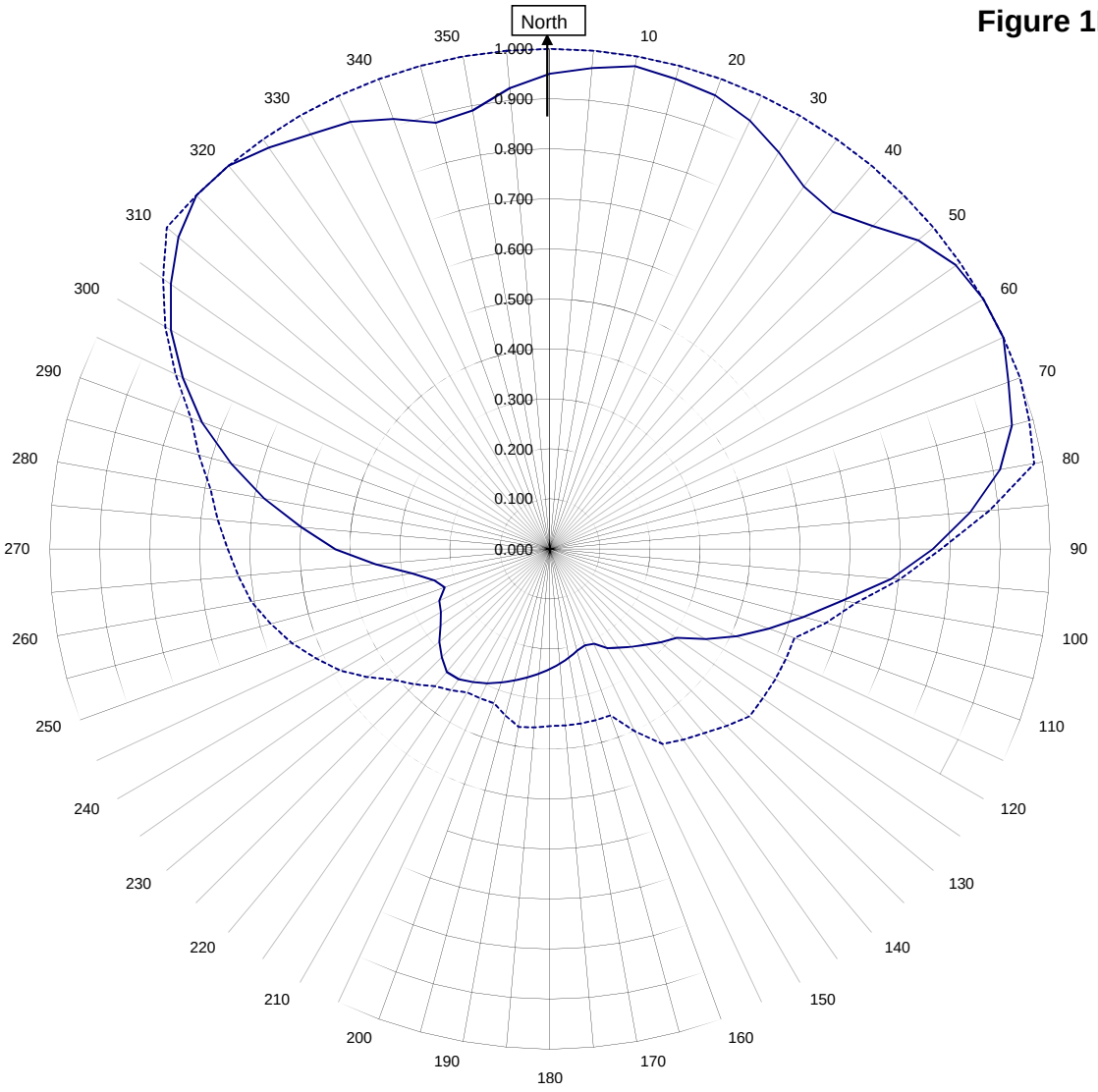
Figure 1B



WTRJ-FM Orange Park, FL

29651

September 8, 2012

_____H/VComposite RMS	0.681
……FCC Composite RMS	0.753

Frequency	91.7 / 412.65 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
WTRJ-FM Orange Park, FL

Azimuth	Rel Field	Azimuth	Rel Field
0	0.950	180	0.240
10	0.970	190	0.260
20	0.965	200	0.284
30	0.915	210	0.307
40	0.880	220	0.321
45	0.910	225	0.306
50	0.960	230	0.289
60	1.000	240	0.234
70	0.975	250	0.220
80	0.913	260	0.280
90	0.765	270	0.430
100	0.593	280	0.580
110	0.465	290	0.740
120	0.360	300	0.875
130	0.267	310	0.970
135	0.241	315	1.000
140	0.210	320	1.000
150	0.200	330	0.945
160	0.205	340	0.890
170	0.220	350	0.890

Figure 1D

Tabulation of Vertical Azimuth Pattern
WTRJ-FM Orange Park, FL

Azimuth	Rel Field	Azimuth	Rel Field
0	0.927	180	0.164
10	0.980	190	0.144
20	0.940	200	0.081
30	0.865	210	0.069
40	0.878	220	0.123
45	0.913	225	0.187
50	0.945	230	0.228
60	0.960	240	0.252
70	0.925	250	0.224
80	0.851	260	0.237
90	0.706	270	0.334
100	0.576	280	0.510
110	0.444	290	0.650
120	0.329	300	0.780
130	0.290	310	0.880
135	0.270	315	0.925
140	0.255	320	0.960
150	0.229	330	0.958
160	0.194	340	0.915
170	0.184	350	0.870

Figure 1E

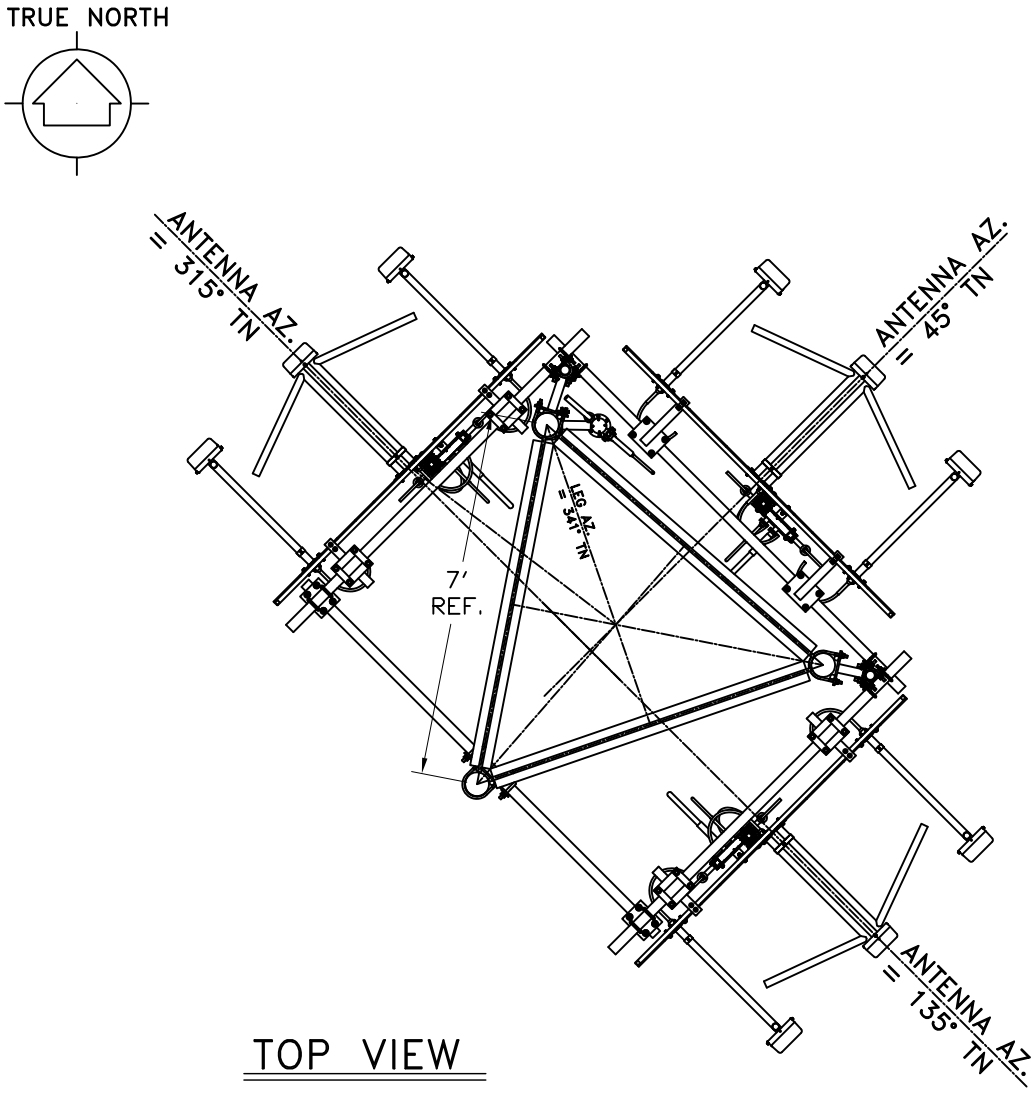
Tabulation of Composite Azimuth Pattern
WTRJ-FM Orange Park, FL

Azimuth	Rel Field	Azimuth	Rel Field
0	0.950	180	0.240
10	0.980	190	0.260
20	0.965	200	0.284
30	0.915	210	0.307
40	0.880	220	0.321
45	0.913	225	0.306
50	0.960	230	0.289
60	1.000	240	0.252
70	0.975	250	0.224
80	0.913	260	0.280
90	0.765	270	0.430
100	0.593	280	0.580
110	0.465	290	0.740
120	0.360	300	0.875
130	0.290	310	0.970
135	0.270	315	1.000
140	0.255	320	1.000
150	0.229	330	0.958
160	0.205	340	0.915
170	0.220	350	0.890

Figure 1F

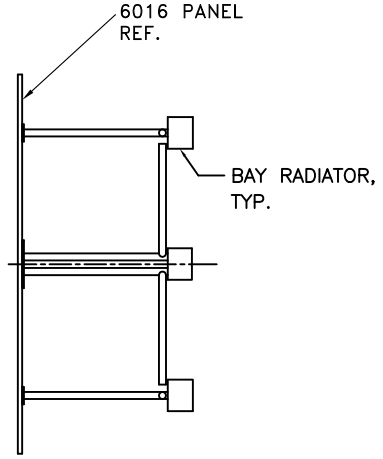
Tabulation of FCC Directional Composite
WTRJ-FM Orange Park, FL

Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	0.354
10	1.000	190	0.361
20	1.000	200	0.328
30	1.000	210	0.331
40	1.000	220	0.358
50	1.000	230	0.407
60	1.000	240	0.485
70	1.000	250	0.549
80	0.983	260	0.606
90	0.781	270	0.644
100	0.621	280	0.689
110	0.520	290	0.764
120	0.520	300	0.888
130	0.520	310	1.000
140	0.480	320	1.000
150	0.450	330	1.000
160	0.354	340	1.000
170	0.354	350	1.000



TOP VIEW

TOWER: 7' REF.



SIDE VIEW OF PANEL

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

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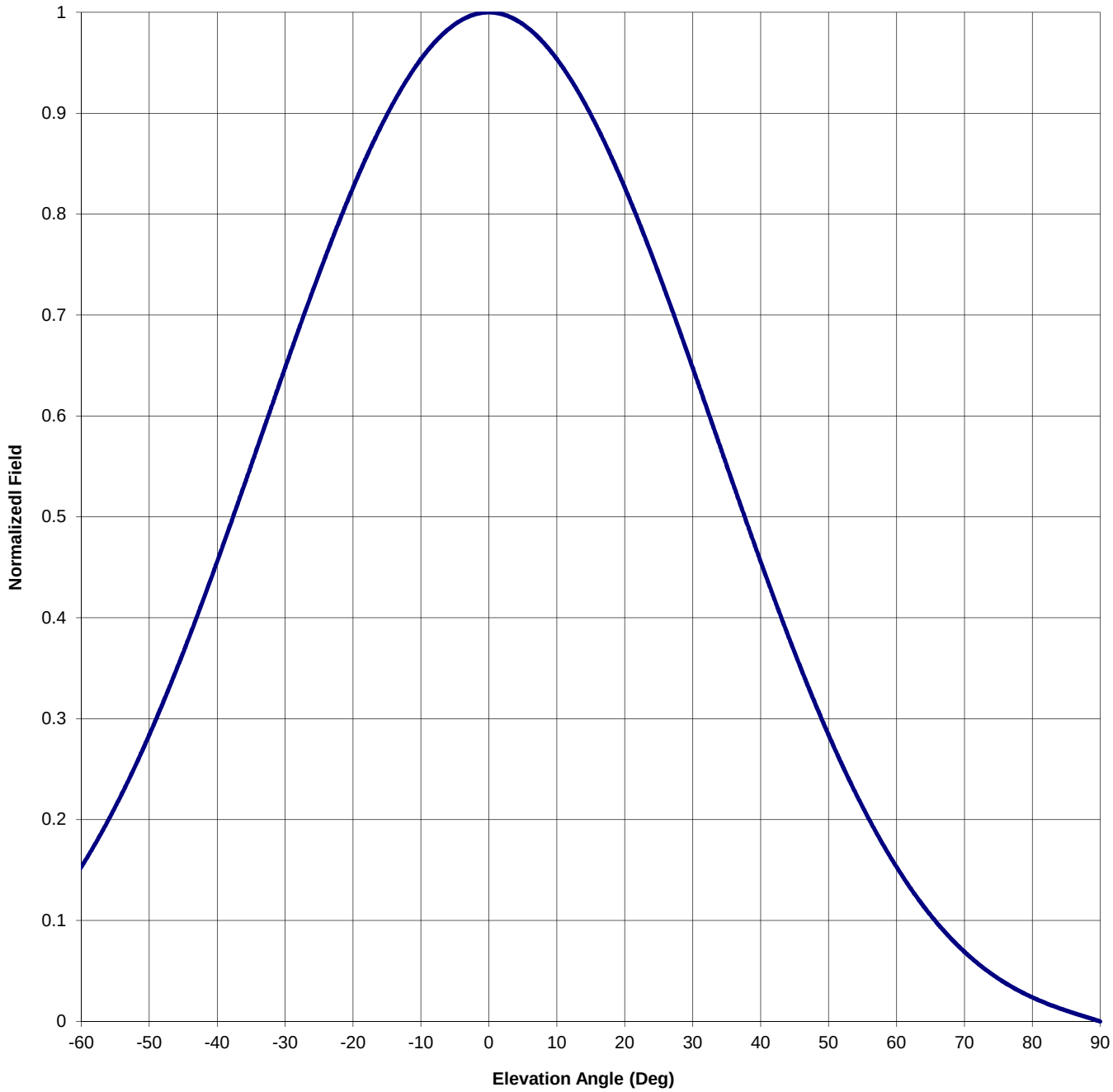
SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY:
30142	91.7 MHz	N.T.S.	ASP
			APPROVED BY: RAS

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:	**WTRJ-FM**	**Beam Tilt**	**0**		
Frequency:	**91.7**	**Gain (Max)**	**1.545**	**1.890**	**dB**
Channel #:	**219**	**Gain (Horizon)**	**1.545**	**1.890**	**dB**
Figure:	**Figure 3**				



Antenna Mfg.: Shively Labs **Date:** 9/8/2012

Antenna Type: 6016-1/3-DA

Station: WTRJ-FM **Beam Tilt** 0

Frequency: 91.7 **Gain (Max)** 1.545 1.890 dB

Channel #: 219 **Gain (Horizon)** 1.545 1.890 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	0.383	0	1.000	46	0.349
-89	0.002	-43	0.401	1	1.000	47	0.332
-88	0.004	-42	0.419	2	0.998	48	0.315
-87	0.006	-41	0.437	3	0.996	49	0.300
-86	0.009	-40	0.456	4	0.992	50	0.284
-85	0.011	-39	0.475	5	0.988	51	0.269
-84	0.013	-38	0.494	6	0.983	52	0.254
-83	0.016	-37	0.513	7	0.977	53	0.240
-82	0.018	-36	0.532	8	0.970	54	0.226
-81	0.021	-35	0.551	9	0.962	55	0.213
-80	0.024	-34	0.570	10	0.954	56	0.200
-79	0.027	-33	0.590	11	0.944	57	0.187
-78	0.031	-32	0.609	12	0.934	58	0.176
-77	0.034	-31	0.629	13	0.923	59	0.164
-76	0.038	-30	0.648	14	0.911	60	0.153
-75	0.043	-29	0.667	15	0.899	61	0.143
-74	0.047	-28	0.686	16	0.885	62	0.133
-73	0.052	-27	0.704	17	0.872	63	0.123
-72	0.057	-26	0.723	18	0.857	64	0.114
-71	0.063	-25	0.741	19	0.842	65	0.105
-70	0.069	-24	0.759	20	0.826	66	0.097
-69	0.075	-23	0.776	21	0.810	67	0.090
-68	0.082	-22	0.794	22	0.794	68	0.082
-67	0.090	-21	0.810	23	0.776	69	0.075
-66	0.097	-20	0.826	24	0.759	70	0.069
-65	0.105	-19	0.842	25	0.741	71	0.063
-64	0.114	-18	0.857	26	0.723	72	0.057
-63	0.123	-17	0.872	27	0.704	73	0.052
-62	0.133	-16	0.885	28	0.686	74	0.047
-61	0.143	-15	0.899	29	0.667	75	0.043
-60	0.153	-14	0.911	30	0.648	76	0.038
-59	0.164	-13	0.923	31	0.629	77	0.034
-58	0.176	-12	0.934	32	0.609	78	0.031
-57	0.187	-11	0.944	33	0.590	79	0.027
-56	0.200	-10	0.954	34	0.570	80	0.024
-55	0.213	-9	0.962	35	0.551	81	0.021
-54	0.226	-8	0.970	36	0.532	82	0.018
-53	0.240	-7	0.977	37	0.513	83	0.016
-52	0.254	-6	0.983	38	0.494	84	0.013
-51	0.269	-5	0.988	39	0.475	85	0.011
-50	0.284	-4	0.992	40	0.456	86	0.009
-49	0.300	-3	0.996	41	0.437	87	0.006
-48	0.315	-2	0.998	42	0.419	88	0.004
-47	0.332	-1	1.000	43	0.401	89	0.002
-46	0.349	0	1.000	44	0.383	90	0.000
-45	0.366			45	0.366		

S.O. 29651 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WTRJ-FM Orange Park, FL

MODEL 6016-1/3-DA

Elevation Gain of Antenna 0.674

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

H RMS 0.677972 V RMS 0.643494 H/V Ratio 1.054

Elevation Gain of Horizontal Component 0.710

Elevation Gain of Vertical Component 0.640

Horizontal Azimuth Gain equals $1/(RMS)^2$. 2.176

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 2.319

Max. Vertical 0.98

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

Total Horizontal Power Gain = **1.545**

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

Total Vertical Power Gain = **1.484**

==========

ERP divided by Horizontal Power Gain equals Antenna Input Power

8.6 kW ERP Divided by H Gain 1.545 equals 5.567 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

5.567 kW Times V Gain 1.484 equals 8.259 kW V ERP

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

(0.98)^2 Times 8.60 Equals 8.259 kW Vertical ERP

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