Shively Labs
a division of Howell Laboratories,Inc.

- An Employee-Owned Company -

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S.O. 27358

Report of Test 6513-3-DA

for

AMERICAN FAMILY ASSOCIATION

WRIH 88.1 MHz Richmond, VA

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6513-3-DA to meet the needs of WRIH and to comply with the requirements of the FCC construction permit, file number BPED-20071031ADY.

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 Vertical Polarization for the Measured Azimuth Pattern
Figure 1D - Tabulation of the Measured Composite Azimuth Pattern
Figure 1E - Tabulation of the FCC Composite

The calculated elevation pattern of the antenna is shown in Figure 3.

Construction permit file number BPED-20071031ADY indicates that the Vertical radiation component shall not exceed 5.0 kW at any azimuth and is restricted to the following values at the azimuths specified:

30 Degrees T: 0.481 kW

40 Degrees T: 0.512 kW

190 to 200 Degrees T: 3.097 kW

From Figure 1A, the maximum radiation of the Vertical component occurs at 269 Degrees T to 276 Degrees T. At the restricted azimuth of 30 Degrees T the Vertical component is 10.52 dB down from the maximum of 5.0 kW, or 0.444 kW. At the restricted azimuth of 40 Degrees T the Vertical component is 10.29 dB down from the maximum of 5.0 kW, or 0.468 kW. At the restricted azimuth of 190 to 200 Degrees T the Vertical component is 2.08 dB down from the maximum of 5.0 kW, or 3.097 kW.

The R.M.S. of the Vertical component is 0.746. The total Vertical power gain is 5.570. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.831. The R.M.S. of the measured composite pattern is 0.747. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.706. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6513-3-DA was mounted on a tower of precise scale to the Allied-24 tower at the WRIH site. The spacing of the antenna to the tower was varied and vertical parasitic elements were attached to the interbay feedline to achieve the vertical pattern shown in Figure 1A. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BPED-20071031ADY, a single level of the 6513-3-DA 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 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

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 1A.

Respectfully submitted by:

Robert A. Surette
Director of Sales Engineering
S/O 27358
March 27, 2009

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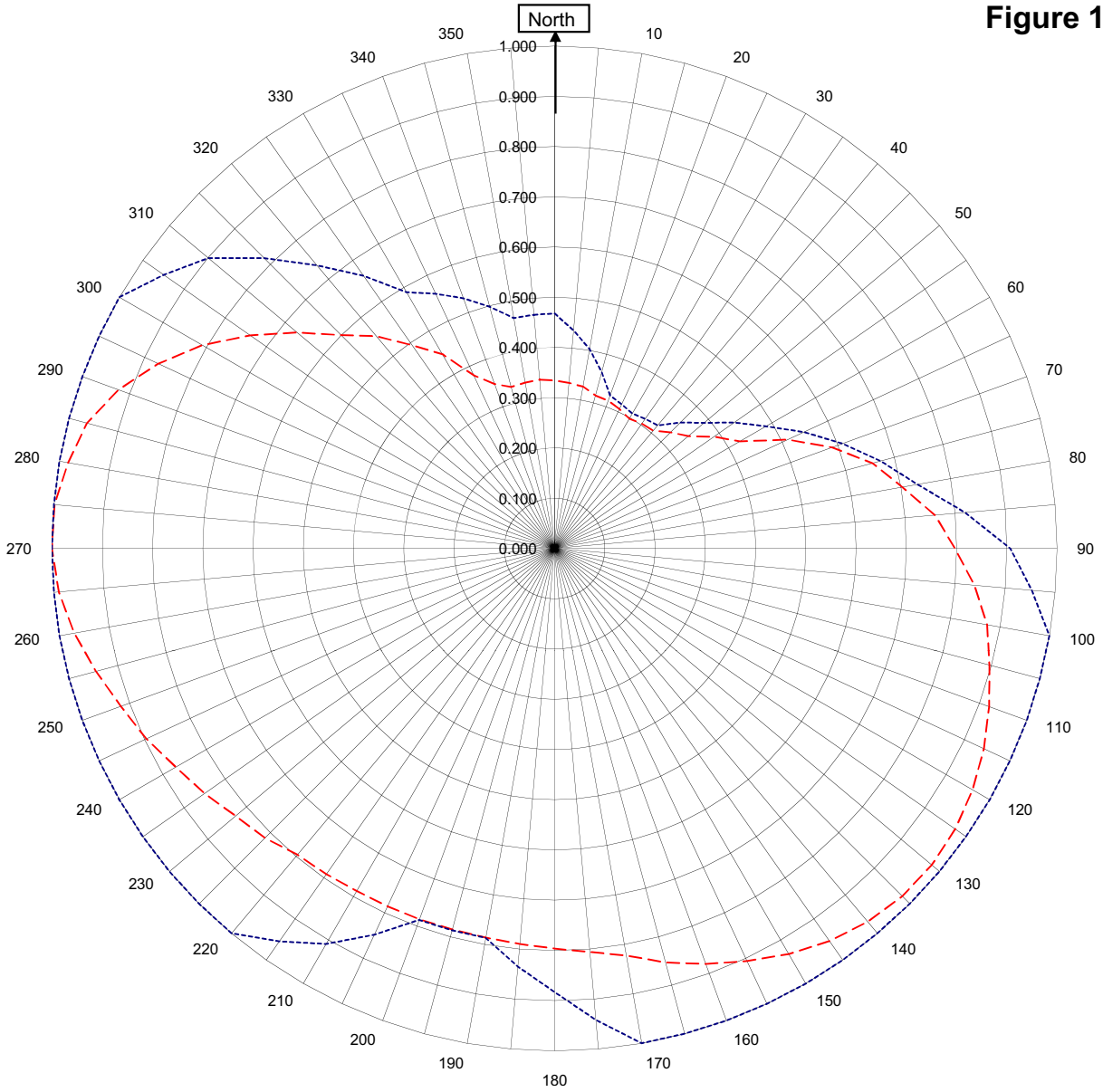
Figure 1A



WRIH Richmond, VA

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March 27, 2009

Horizontal RMS	0.000
Vertical RMS	0.746
H/V Composite RMS	0.747
FCC Composite RMS	0.831

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

Antenna Model	6513-3-DA Pattern Sh-06-A
Pattern Type	Directional Azimuth

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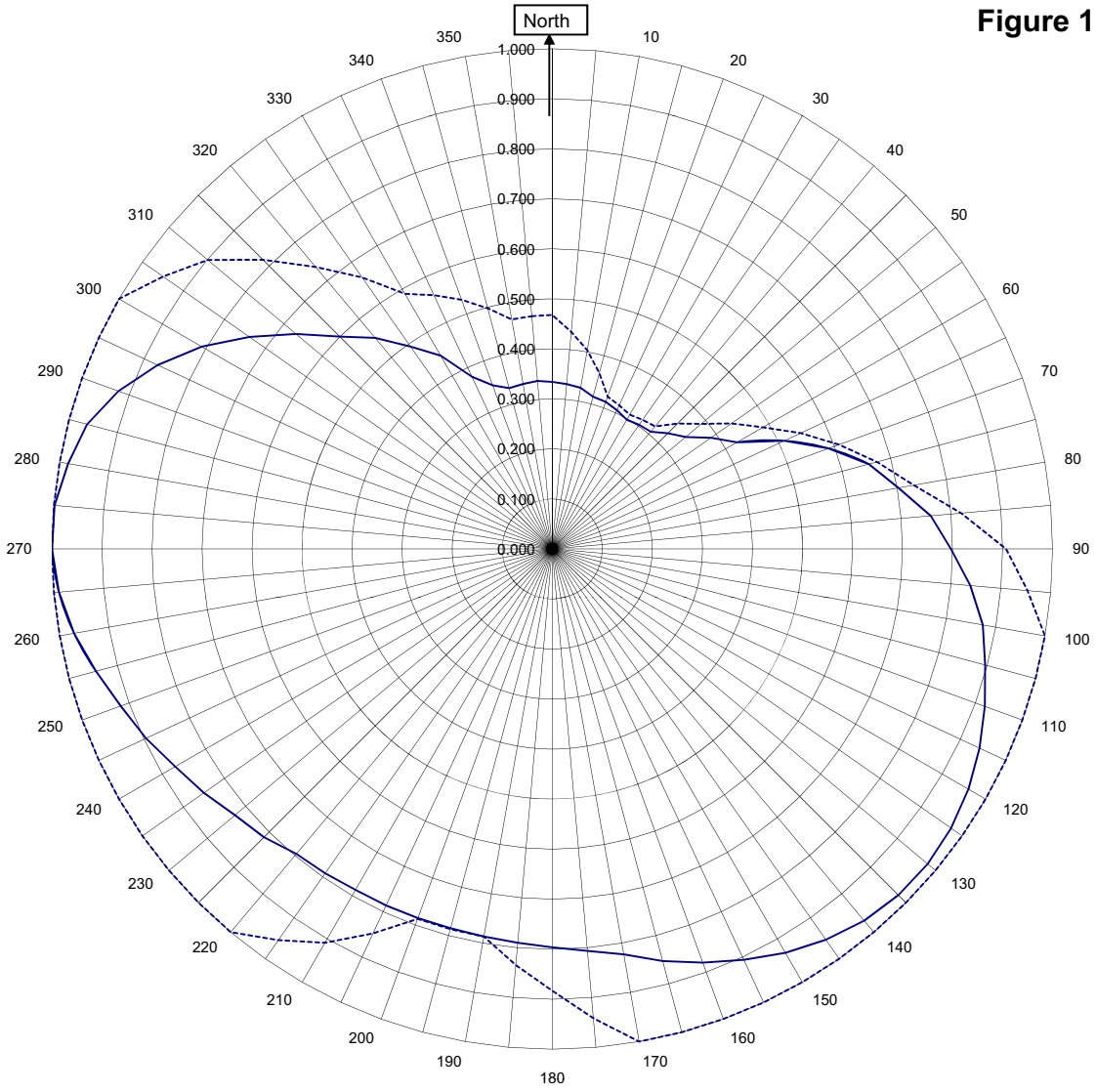
Figure 1B



WRIH Richmond, VA

27358

March 27, 2009

_____H/VComposite RMS	0.747
……..FCC Composite RMS	0.831

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

Antenna Model	6513-3-DA Pattern Sh-06-A
Pattern Type	Directional H/V Composite

Figure 1C

Tabulation of Vertical Azimuth Pattern
WRIH Richmond, VA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.334	180	0.796
10	0.327	190	0.787
20	0.313	200	0.785
30	0.298	210	0.787
40	0.306	220	0.796
45	0.327	225	0.815
50	0.348	230	0.828
60	0.427	240	0.870
70	0.588	250	0.918
80	0.703	260	0.971
90	0.797	270	1.000
100	0.874	280	0.983
110	0.920	290	0.923
120	0.961	300	0.809
130	0.980	310	0.669
135	0.979	315	0.600
140	0.970	320	0.551
150	0.932	330	0.446
160	0.880	340	0.348
170	0.823	350	0.335

Figure 1D

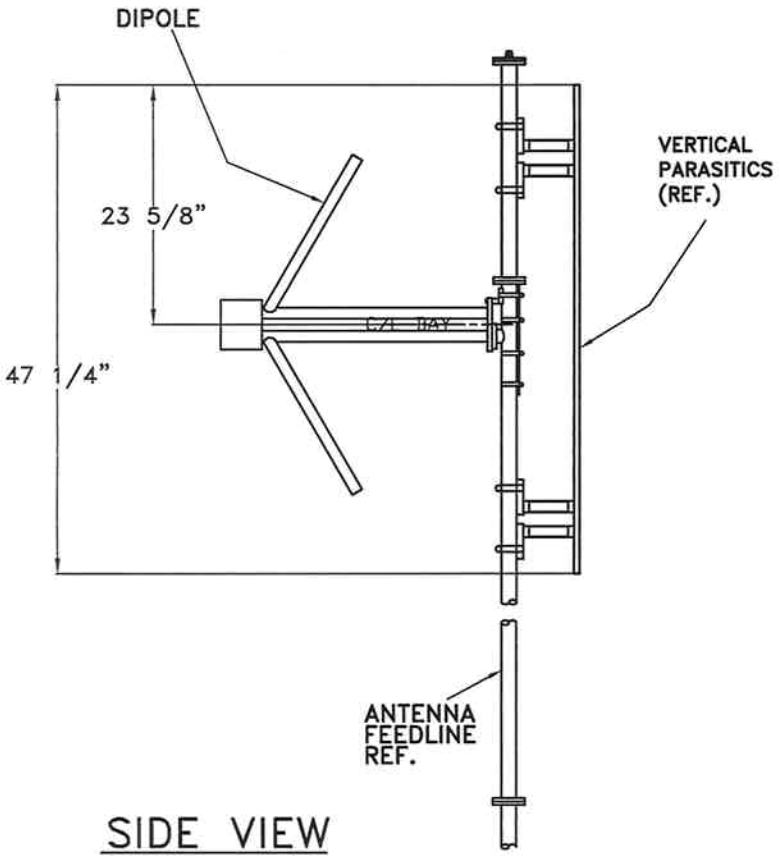
Tabulation of Composite Azimuth Pattern
WRIH Richmond, VA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.334	180	0.796
10	0.327	190	0.787
20	0.313	200	0.785
30	0.298	210	0.787
40	0.306	220	0.796
45	0.327	225	0.815
50	0.348	230	0.828
60	0.427	240	0.870
70	0.588	250	0.918
80	0.703	260	0.971
90	0.797	270	1.000
100	0.874	280	0.983
110	0.920	290	0.923
120	0.961	300	0.809
130	0.980	310	0.669
135	0.979	315	0.600
140	0.970	320	0.551
150	0.932	330	0.446
160	0.880	340	0.348
170	0.823	350	0.335

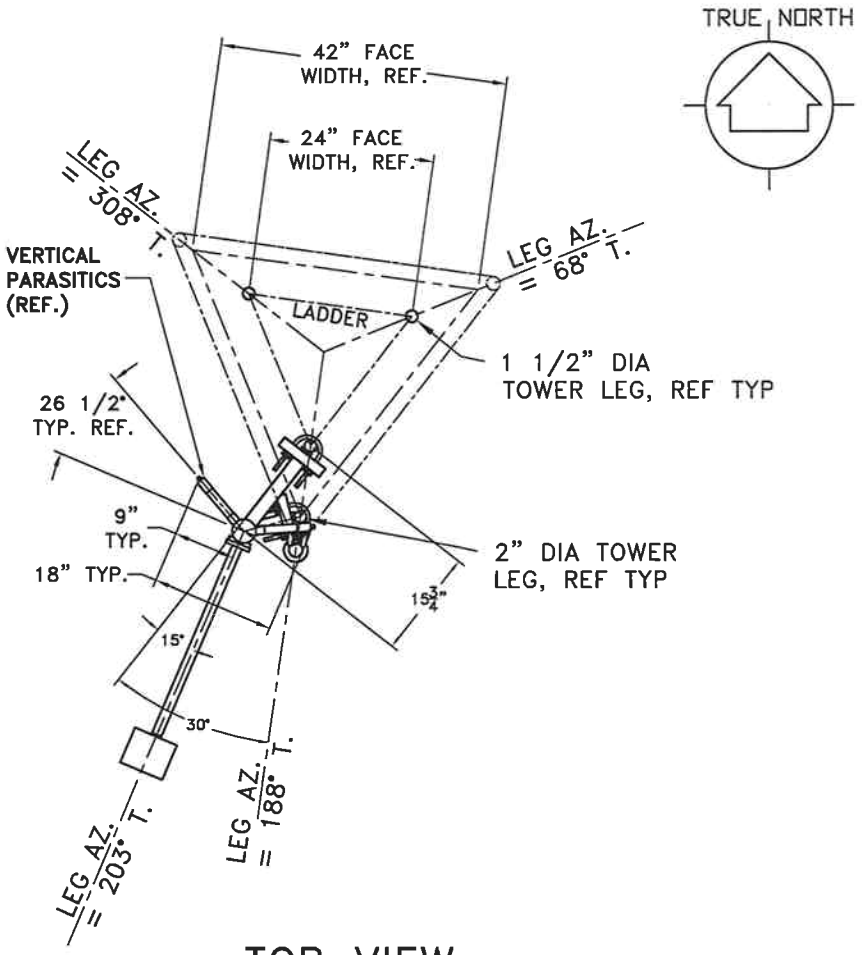
Figure 1E

Tabulation of FCC Directional Composite
WRIH Richmond, VA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.468	180	0.883
10	0.403	190	0.787
20	0.324	200	0.787
30	0.310	210	0.909
40	0.320	220	1.000
50	0.389	230	1.000
60	0.486	240	1.000
70	0.610	250	1.000
80	0.734	260	1.000
90	0.907	270	1.000
100	1.000	280	1.000
110	1.000	290	1.000
120	1.000	300	1.000
130	1.000	310	0.899
140	1.000	320	0.736
150	1.000	330	0.589
160	1.000	340	0.530
170	1.000	350	0.466



SIDE VIEW



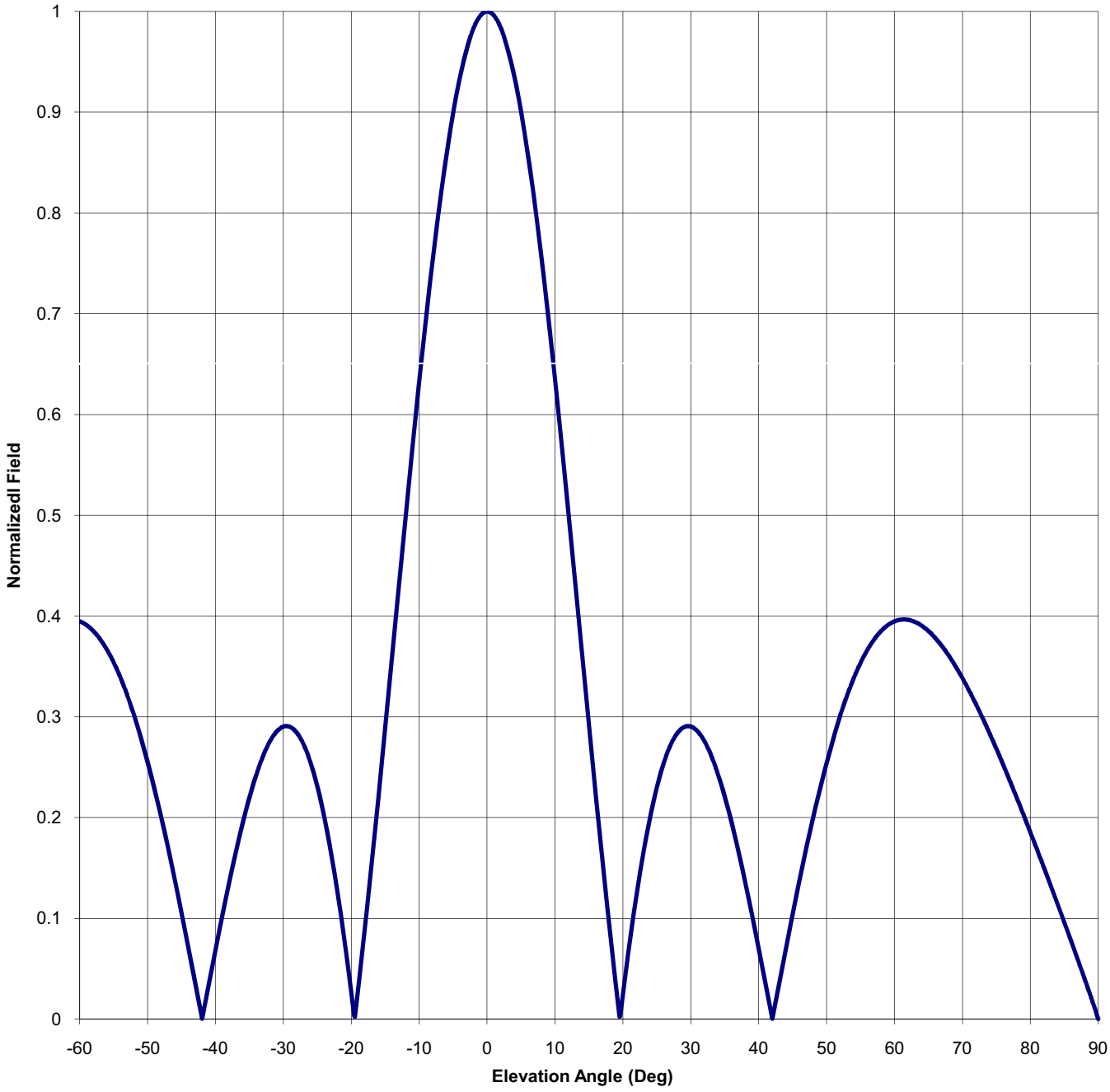
TOP VIEW

ALLIED 24" FACE WIDTH TOWER
ATOP A 42" FACE WIDTH TOWER

ANTENNA HEADING: 203° TRUE NORTH

SHIVELY LABS A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE, USA			
SHOP ORDER: 27358	FREQUENCY: 88.1	SCALE: N.T.S.	DRAWN BY: ASP APPROVED BY: DAB
TITLE: MODEL 6513-3-DIRECTIONAL ANTENNA FM STATION			
DATE: 3/26/09	FIGURE 2		

Antenna Mfg.:	**Shively Labs**			**Date: 3/27/2009**
Antenna Type:	**6513-3-DA**			
Station:	**WRIH**	**Beam Tilt**	**0**	
Frequency:	**88.1**	**Gain (Max)**	**5.570**	**7.459 dB**
Channel #:	**202**	**Gain (Horizon)**	**5.570**	**7.459 dB**
Figure:	**3**			



Antenna Mfg.: Shively Labs
Antenna Type: 6513-3-DA
Station: WRIH
Frequency: 88.1
Channel #: 202
Figure: 3

Beam Tilt 0
Gain (Max) 5.570 — 7.459 dB
Gain (Horizon) 5.570 — 7.459 dB

Date: 3/27/2009

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	0.070	0	1.000	46	0.138
-89	0.021	-43	0.036	1	0.996	47	0.169
-88	0.040	-42	0.000	2	0.984	48	0.200
-87	0.059	-41	0.035	3	0.963	49	0.228
-86	0.078	-40	0.070	4	0.935	50	0.255
-85	0.096	-39	0.103	5	0.900	51	0.279
-84	0.114	-38	0.136	6	0.858	52	0.301
-83	0.132	-37	0.167	7	0.809	53	0.321
-82	0.150	-36	0.195	8	0.755	54	0.338
-81	0.168	-35	0.221	9	0.697	55	0.354
-80	0.185	-34	0.243	10	0.634	56	0.366
-79	0.203	-33	0.261	11	0.568	57	0.377
-78	0.220	-32	0.276	12	0.500	58	0.385
-77	0.236	-31	0.286	13	0.430	59	0.391
-76	0.252	-30	0.290	14	0.360	60	0.395
-75	0.268	-29	0.290	15	0.290	61	0.396
-74	0.283	-28	0.284	16	0.222	62	0.396
-73	0.298	-27	0.272	17	0.155	63	0.394
-72	0.312	-26	0.254	18	0.091	64	0.390
-71	0.326	-25	0.230	19	0.031	65	0.385
-70	0.338	-24	0.201	20	0.025	66	0.378
-69	0.350	-23	0.165	21	0.077	67	0.370
-68	0.360	-22	0.124	22	0.124	68	0.360
-67	0.370	-21	0.077	23	0.165	69	0.350
-66	0.378	-20	0.025	24	0.201	70	0.338
-65	0.385	-19	0.031	25	0.230	71	0.326
-64	0.390	-18	0.091	26	0.254	72	0.312
-63	0.394	-17	0.155	27	0.272	73	0.298
-62	0.396	-16	0.222	28	0.284	74	0.283
-61	0.396	-15	0.290	29	0.290	75	0.268
-60	0.395	-14	0.360	30	0.290	76	0.252
-59	0.391	-13	0.430	31	0.286	77	0.236
-58	0.385	-12	0.500	32	0.276	78	0.220
-57	0.377	-11	0.568	33	0.261	79	0.203
-56	0.366	-10	0.634	34	0.243	80	0.185
-55	0.354	-9	0.697	35	0.221	81	0.168
-54	0.338	-8	0.755	36	0.195	82	0.150
-53	0.321	-7	0.809	37	0.167	83	0.132
-52	0.301	-6	0.858	38	0.136	84	0.114
-51	0.279	-5	0.900	39	0.103	85	0.096
-50	0.255	-4	0.935	40	0.070	86	0.078
-49	0.228	-3	0.963	41	0.035	87	0.059
-48	0.200	-2	0.984	42	0.000	88	0.040
-47	0.169	-1	0.996	43	0.036	89	0.021
-46	0.138	0	1.000	44	0.070	90	0.000
-45	0.105			45	0.105		

S.O. 27358 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WRIH 88.1 MHz Richmond, VA

MODEL 6513-3-DA

Elevation Gain of Antenna 3.1

V RMS 0.746

Vertical Azimuth Gain equals $1/(RMS)^2$ 1.797

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

Total Vertical Power Gain **5.570**

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ERP divided by Vertical Power Gain equals Antenna Input Power

5 kW ERP Divided by V Gain 5.570 Equals **0.898** kW Antenna Input Power