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S.O. 27805

Report of Test CA5-FM/V/RM-Slant Array

for

Church Planters of America

WJHW 89.5 MHz Mayodan, NC

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a CA5-FM/V/RM-Slant Array to meet the needs of WJHW and to comply with the requirements of the FCC construction permit, file number BMPED-20090826ACS.

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 BMPED-20090826ACS indicates that the Horizontal radiation component shall not exceed 2.500 kW at any azimuth and is restricted to the following values at the azimuths specified:

165 - 175 Degrees T: 0.079 kW

From Figure 1A, the maximum radiation of the Horizontal component occurs at 66 Degrees T to 70 Degrees T. At the restricted azimuth of 165 - 175 Degrees T the Horizontal component is 18.27 dB down from the maximum of 2.500 kW, or 0.037 kW. At the restricted azimuth of 165 - 175 Degrees T the Vertical component does not exceed the Horizontal component and is thus compliant.

The R.M.S. of the Horizontal component is 0.662. The total Horizontal power gain is 1.373. The R.M.S. of the Vertical component is 0.560. The total Vertical power gain is 1.144. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.783. The R.M.S. of the measured composite pattern is 0.693. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.666. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One level of the CA5-FM/V/RM-Slant Array was mounted on a tower of precise scale to the Rohn 55G tower at the WJHW site. Each element in the array is oriented 45 degrees from vertical to produce the Vertical and Horizontal components. The azimuth of each element of the antenna was varied in relation to the tower, and attenuation was added as required 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-20090826ACS, a single level of the CA5-FM/V/RM-Slant Array 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 402.75 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 27805
Date: November 25, 2009

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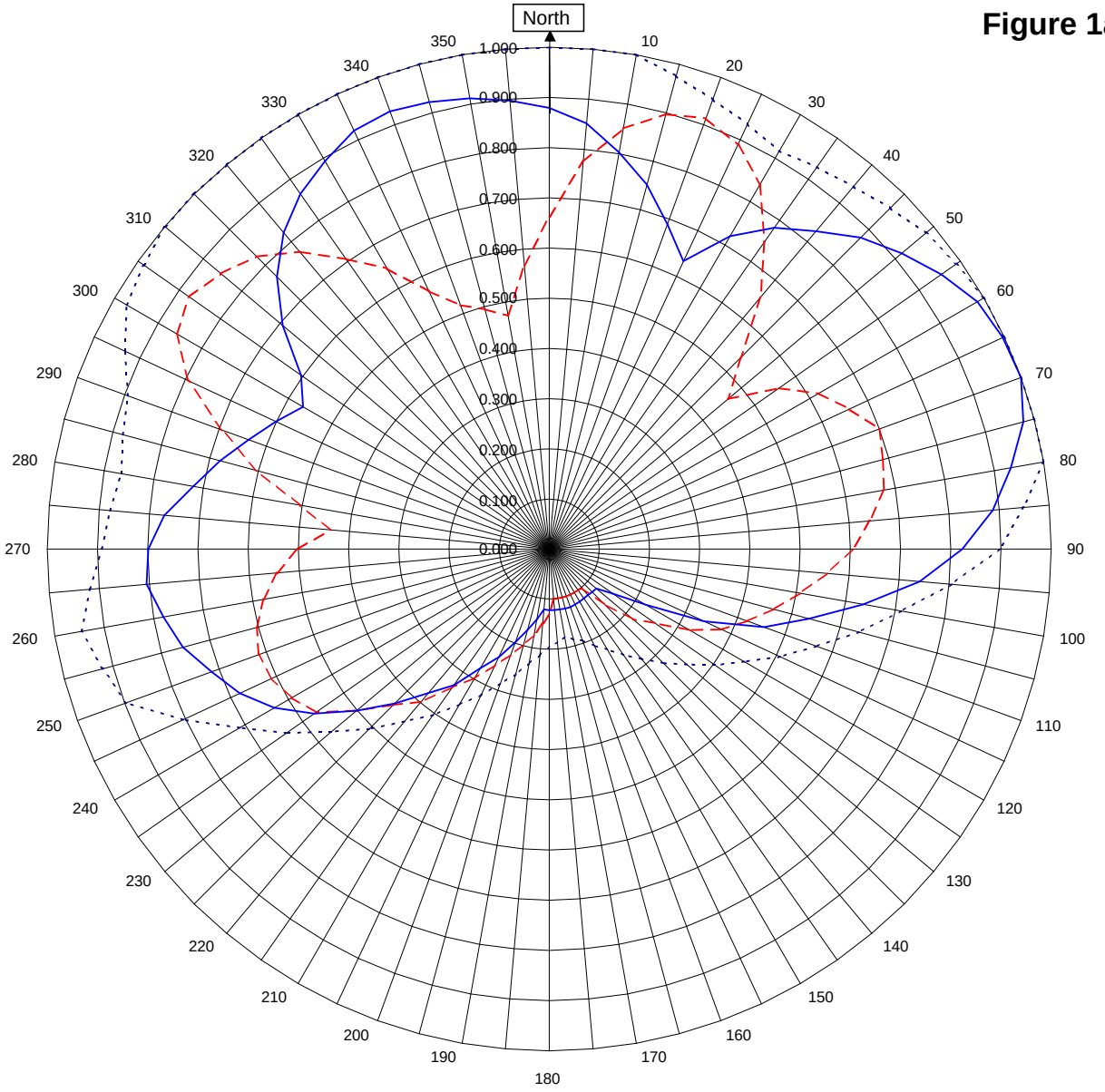
Figure 1a



WJHW Mayodan, NC

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November 25, 2009

Horizontal RMS	0.662
Vertical RMS	0.560
H/V Composite RMS	0.693
FCC Composite RMS	0.783

Frequency	89.5 / 402.75 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	CA5-FM/V/RM-Slant Array
Pattern Type	Directional Azimuth

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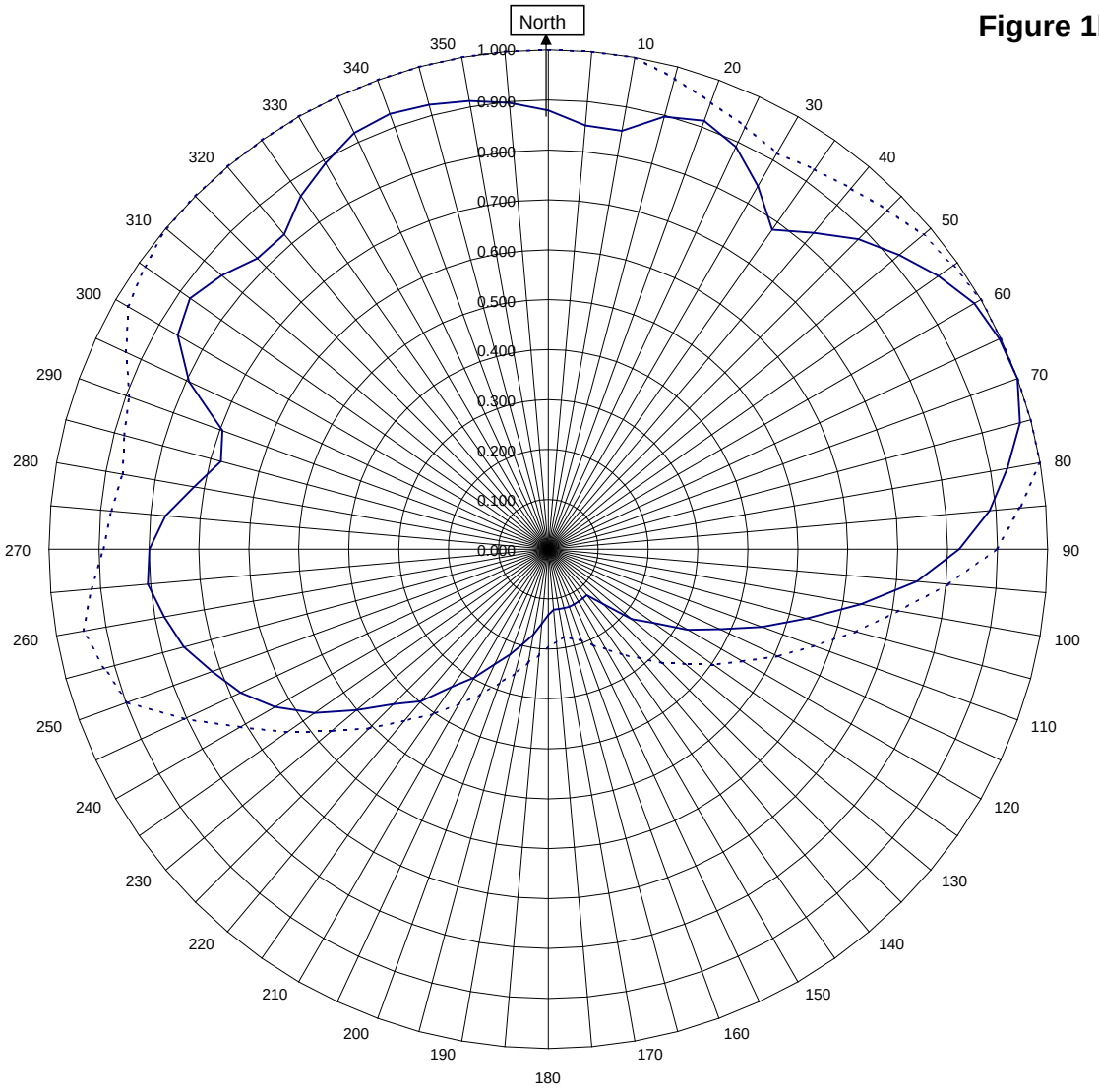
Figure 1b



WJHW Mayodan, NC

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November 25, 2009

_____H/VComposite RMS	0.693
……FCC Composite RMS	0.783

Frequency	89.5 / 402.75 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	CA5-FM/V/RM-Slant Array
Pattern Type	Directional H/V Composite

Figure 1c

Tabulation of Horizontal Azimuth Pattern
WJHW Mayodan, NC

Azimuth	Rel Field	Azimuth	Rel Field
0	0.879	180	0.122
10	0.802	190	0.143
20	0.689	200	0.198
30	0.720	210	0.275
40	0.827	220	0.374
45	0.878	225	0.435
50	0.917	230	0.501
60	0.985	240	0.632
70	1.000	250	0.716
80	0.934	260	0.781
90	0.823	270	0.799
100	0.635	280	0.720
110	0.455	290	0.637
120	0.222	300	0.566
130	0.122	310	0.693
135	0.121	315	0.767
140	0.120	320	0.823
150	0.121	330	0.893
160	0.123	340	0.928
170	0.122	350	0.912

Figure 1d

Tabulation of Vertical Azimuth Pattern
WJHW Mayodan, NC

Azimuth	Rel Field	Azimuth	Rel Field
0	0.662	180	0.132
10	0.851	190	0.174
20	0.913	200	0.224
30	0.839	210	0.297
40	0.655	220	0.397
45	0.541	225	0.439
50	0.465	230	0.501
60	0.620	240	0.592
70	0.700	250	0.616
80	0.677	260	0.578
90	0.605	270	0.501
100	0.507	280	0.504
110	0.420	290	0.694
120	0.323	300	0.857
130	0.218	310	0.854
135	0.155	315	0.824
140	0.102	320	0.773
150	0.100	330	0.646
160	0.100	340	0.517
170	0.100	350	0.472

Figure 1e

Tabulation of Composite Azimuth Pattern
WJHW Mayodan, NC

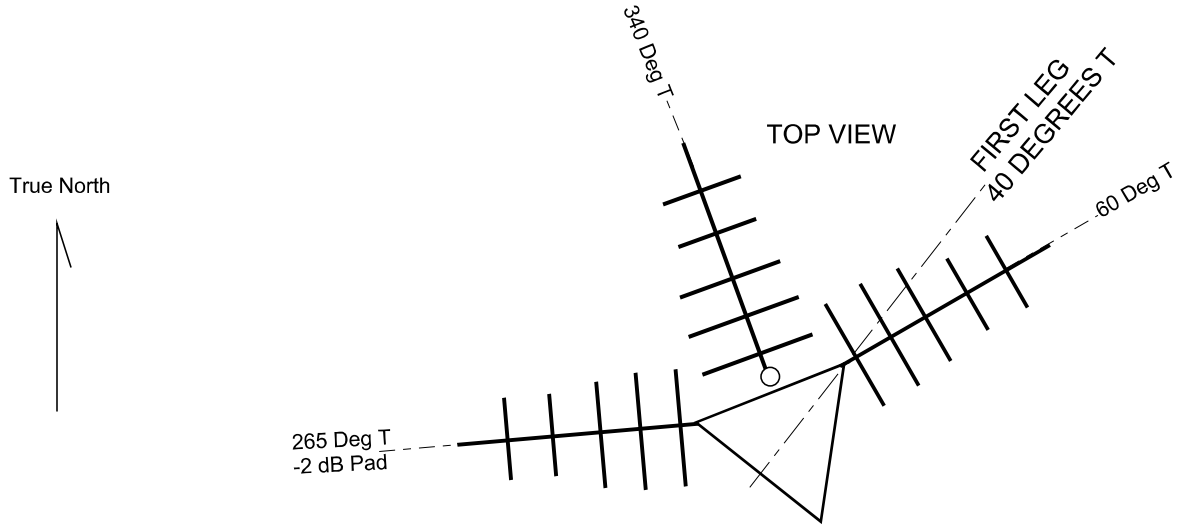
Azimuth	Rel Field	Azimuth	Rel Field
0	0.879	180	0.132
10	0.851	190	0.174
20	0.913	200	0.224
30	0.839	210	0.297
40	0.827	220	0.397
45	0.878	225	0.439
50	0.917	230	0.501
60	0.985	240	0.632
70	1.000	250	0.716
80	0.934	260	0.781
90	0.823	270	0.799
100	0.635	280	0.720
110	0.455	290	0.694
120	0.323	300	0.857
130	0.218	310	0.854
135	0.155	315	0.824
140	0.120	320	0.823
150	0.121	330	0.893
160	0.123	340	0.928
170	0.122	350	0.912

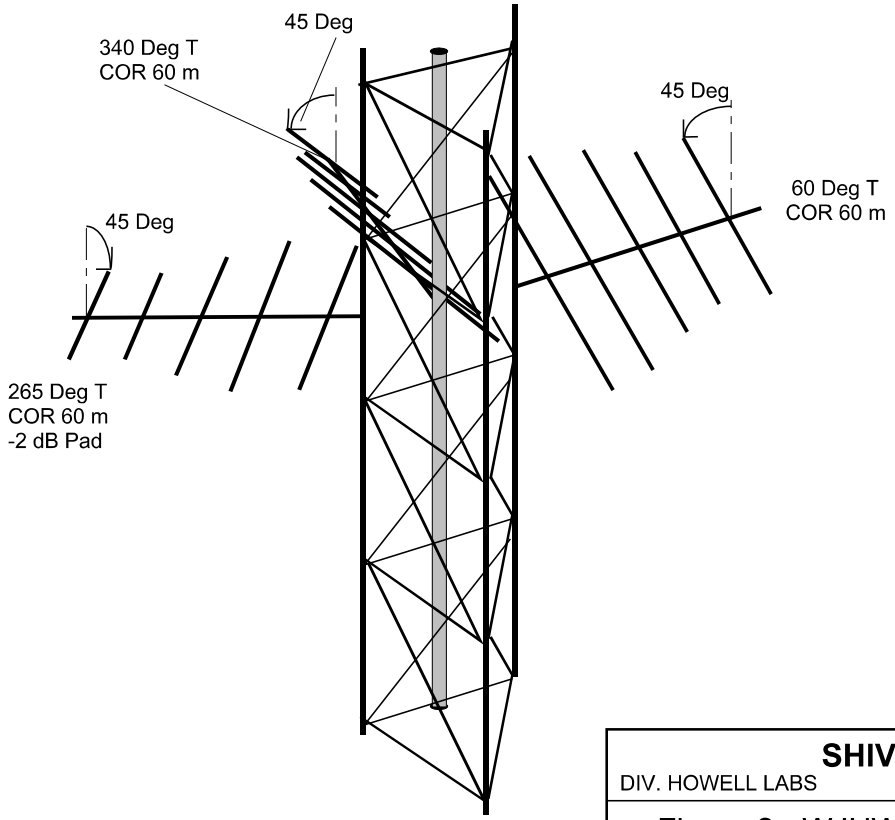
Figure 1f

Tabulation of FCC Directional Composite
WJHW Mayodan, NC

Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	0.194
10	1.000	190	0.231
20	0.953	200	0.285
30	0.916	210	0.358
40	0.943	220	0.449
50	0.980	230	0.566
60	1.000	240	0.712
70	1.000	250	0.897
80	1.000	260	0.946
90	0.897	270	0.891
100	0.712	280	0.866
110	0.566	290	0.893
120	0.449	300	0.972
130	0.358	310	1.000
140	0.285	320	1.000
150	0.231	330	1.000
160	0.194	340	1.000
170	0.178	350	1.000

REV NO	REVISON	DATE	APP'D





SIDE VIEW

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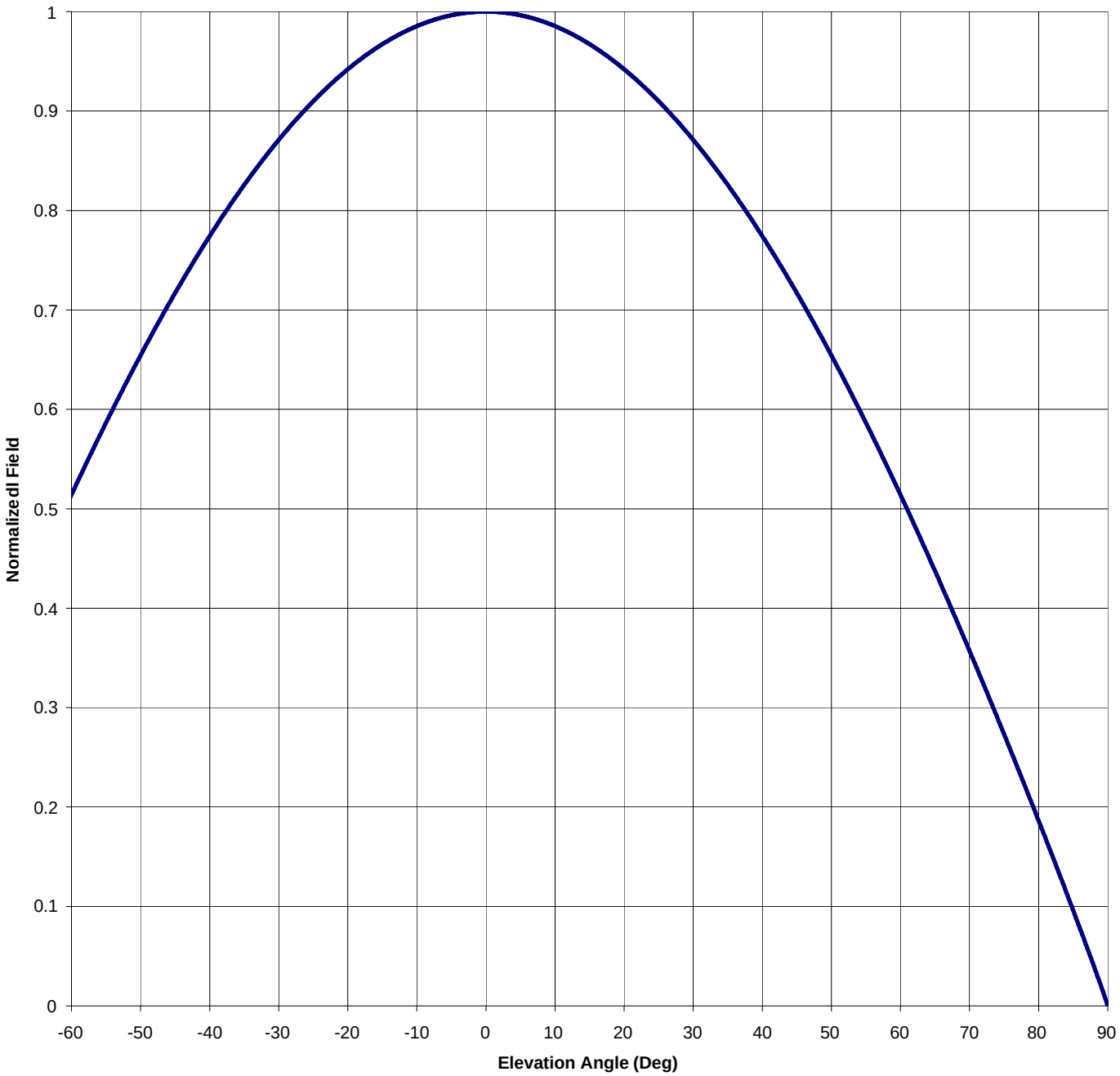
Figure 2 - WJHW 89.5 Mayodan, NC
CA5-FM/V/RM-DA Array

SIZE	CODE IDENT NO	DRAWING NO	REV
A		112509-BJR	- -

SCALE		SHEET
NONE	SO 27805	1 of 1

Antenna Mfg.:	**Shively Labs**			**Date:**	**11/25/2009**
Antenna Type:	**CA5-FM/V/RM-Slant**				
Station:	**WJHW**	**Beam Til**	**0**		
Frequency:	**89.5**	**Gain (Max)**	**1.373**	**1.377**	**dB**
Channel #:	**208**	**Gain (Horizon)**	**1.373**	**1.377**	**dB**
Figure:	**Figure 3**				



Antenna Mfg.: Shively Labs **Date:** 11/25/2009

Antenna Type: CA5-FM/V/RM-Slant

Station: WJHW **Beam Tilt** 0

Frequency: 89.5 **Gain (Max)** 1.373 **1.377 dB**

Channel #: 208 **Gain (Horizon)** 1.373 **1.377 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	0.729	0	1.000	46	0.705
-89	0.021	-43	0.741	1	1.000	47	0.693
-88	0.040	-42	0.752	2	0.999	48	0.680
-87	0.059	-41	0.763	3	0.999	49	0.667
-86	0.078	-40	0.774	4	0.998	50	0.654
-85	0.096	-39	0.785	5	0.996	51	0.641
-84	0.114	-38	0.796	6	0.995	52	0.628
-83	0.133	-37	0.806	7	0.993	53	0.614
-82	0.151	-36	0.816	8	0.991	54	0.600
-81	0.168	-35	0.826	9	0.988	55	0.586
-80	0.186	-34	0.835	10	0.985	56	0.572
-79	0.204	-33	0.845	11	0.982	57	0.558
-78	0.221	-32	0.854	12	0.979	58	0.544
-77	0.239	-31	0.862	13	0.975	59	0.529
-76	0.256	-30	0.871	14	0.971	60	0.514
-75	0.273	-29	0.879	15	0.967	61	0.499
-74	0.290	-28	0.887	16	0.963	62	0.484
-73	0.307	-27	0.895	17	0.958	63	0.469
-72	0.324	-26	0.903	18	0.953	64	0.453
-71	0.341	-25	0.910	19	0.948	65	0.437
-70	0.357	-24	0.917	20	0.942	66	0.422
-69	0.373	-23	0.924	21	0.936	67	0.406
-68	0.390	-22	0.930	22	0.930	68	0.390
-67	0.406	-21	0.936	23	0.924	69	0.373
-66	0.422	-20	0.942	24	0.917	70	0.357
-65	0.437	-19	0.948	25	0.910	71	0.341
-64	0.453	-18	0.953	26	0.903	72	0.324
-63	0.469	-17	0.958	27	0.895	73	0.307
-62	0.484	-16	0.963	28	0.887	74	0.290
-61	0.499	-15	0.967	29	0.879	75	0.273
-60	0.514	-14	0.971	30	0.871	76	0.256
-59	0.529	-13	0.975	31	0.862	77	0.239
-58	0.544	-12	0.979	32	0.854	78	0.221
-57	0.558	-11	0.982	33	0.845	79	0.204
-56	0.572	-10	0.985	34	0.835	80	0.186
-55	0.586	-9	0.988	35	0.826	81	0.168
-54	0.600	-8	0.991	36	0.816	82	0.151
-53	0.614	-7	0.993	37	0.806	83	0.133
-52	0.628	-6	0.995	38	0.796	84	0.114
-51	0.641	-5	0.996	39	0.785	85	0.096
-50	0.654	-4	0.998	40	0.774	86	0.078
-49	0.667	-3	0.999	41	0.763	87	0.059
-48	0.680	-2	0.999	42	0.752	88	0.040
-47	0.693	-1	1.000	43	0.741	89	0.021
-46	0.705	0	1.000	44	0.729	90	0.000
-45	0.717			45	0.717		

S.O. 27805 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

New FM Mayodan, NC

Scala CA5-FM/V/RM-Slant Array

Elevation Gain of Antenna 0.509

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

H RMS 0.662 V RMS 0.56 H/V Ratio 1.182

Elevation Gain of Horizontal Component 0.602

Elevation Gain of Vertical Component 0.431

Horizontal Azimuth Gain equals $1/(RMS)^2$. 2.282

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 2.658

Max. Vertical 0.913

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

Total Horizontal Power Gain = **1.373**

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

Total Vertical Power Gain = **1.144**

==========

ERP divided by Horizontal Power Gain equals Antenna Input Power

2.5 kW ERP Divided by H Gain 1.373 equals 1.82 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

1.82 kW Times V Gain 1.144 equals 2.08 kW V ERP

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

(0.913)^2 Times 2.50 Equals 2.08 kW Vertical ERP

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