ERI® Electronics Research, Inc.
Electronics Research, Inc. 7777 Gardner Rd. Chandler, In 47610 Phone (812) 925-6000 Fax (812) 925-4030 http://www.eriinc.com/

Modifications to an Existing Directional Antenna System for WMAG, High Point, North Carolina

December 21, 2005

Electronics Research Inc. is providing modifications to an existing antenna system that is specially designed to meet the FCC requirements and the general needs of radio station WMAG.

The antenna is the ERI model SHP-6AC-DA configuration. The circular polarized system consists of 6 full-wavelength spaced bays using one driven circular polarized radiating element and five vertical parasitic elements per bay. Special extended mounting brackets are used to mount the antenna on the North 81° 37' 55" degrees East tower leg with bracketry to provide an antenna orientation of North 23° 38' 07" degrees East. The antenna was tested on a 10' face tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 99.5 megahertz, which is the center of the FM broadcast channel assigned to WMAG.

Pattern measurements were made on a sixty-acre antenna pattern range that is owned and operated by Electronics Research, Inc. The tests were performed under the direction of Thomas B. Silliman, president of Electronics Research, Inc. Mr. Silliman has the Bachelor of Electrical Engineering and the Master of Electrical Engineering degrees from Cornell University and is a registered professional engineer in the states of Indiana, Maryland and Minnesota.

Directional Antenna System
For
WMAG, High Point, North Carolina

(Continued)

DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of one bay level of the circular polarized system with the associated vertical parasitic elements. The elements and brackets that were used in this test are electrically equivalent to those that will be supplied with the antenna. A section of 3 1/8 inch o.d. rigid coaxial line was used to feed the test antenna, and a section of 3 1/8 inch o.d. rigid outer conductor only was attached above the test antenna. The lines were properly grounded during all tests.

In conjunction with the driven element, each bay has (2) screens sections masking the two faces of the tower that are adjacent to the leg on which the antenna is mounted. These screens span each of the two faces and are one wavelength long per bay with the driven element centered vertically for each bay. The orientation of each of the screened faces is N 21 37' 55" E and N 141 37' 55" E respectively. The use of the screens were found to be required, as without screens, the directional patterns varies considerably with a movement of the antenna vertically on the tower leg, due to the different environmental conditions at different vertical levels on the electrical equivalent tower section.

The power distribution and phase relationship to the antenna elements was adjusted in order to achieve the directional radiation patterns for both horizontal and vertical polarization components.

The proof-of-performance was accomplished using a 10' face tower with identical dimension and configuration including all braces, ladders, conduits, coaxial lines and other appurtenances that are included in the actual aperture at which the antenna will be installed. The structure was erected vertically on a turntable mounted on a non-metallic building with the antenna centered vertically on the structure, making the center of radiation of the test approximately 30 feet above ground. The turntable is equipped with a motor drive and a North Atlantic Model 8500 angle position indicator. The resolution of this angle position indicator is one-hundredth of a degree.

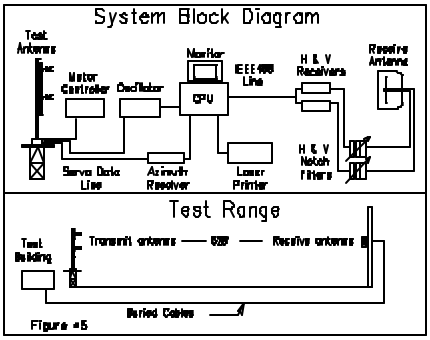


Figure #5

The antenna under test was operated in the transmitting mode and fed from a HP8657D signal generator calibrated 1-05. The frequency of the signal source was set at 99.5 MHz and was constantly monitored by an Anritsu Model ML521B measuring receiver calibrated 6-05.

A broadband horizontal and vertical dipole system, located approximately 628 feet from the test antenna, was used to receive the emitted test signals. The dipole system was mounted at the same height above terrain as the center of the antenna under test. The signals received by the dipole system were fed to the test building by way of two buried Heliax cables to an Anritsu Model ML521B measuring receiver. This data was interfaced to a Hewlett-Packard Laser Jet 4P printer by means of a Pentium computer system. Relative field strength was plotted as a function of azimuth.

The measurements were performed by rotating the test antenna in a counter-clockwise direction and plotting the received signal on polar co-ordinated graph paper in a clockwise direction. Both horizontal and vertical components were recorded separately.

CONCLUSIONS

The circular polarized system consists of 6 full-wavelength spaced bays using one driven circular polarized radiating element and five vertical parasitic elements per bay. The power distribution and phase relationship will be fixed when antenna is manufactured. Proper maintenance of the elements should be all that is required to maintain the pattern in adjustment.

The SHP-6AC-DA array is to be mounted on the North 81° 37’ 55” degrees East tower leg of the 10' face tower at a bearing of North 23° 38’ 07” degrees East. Blue prints provided with the antenna will show the proper antenna orientation alignment. The antenna alignment procedure should be directed by a licensed surveyor as prescribed by the FCC.

Figure #1 represents the maximum value of either the horizontal or vertical component at any azimuth. The measured horizontal plane relative field pattern, for both the horizontal and vertical polarization components, is shown on Figure #2 attached. The actual measured pattern does not exceed the authorized FCC composite pattern at any azimuth. A calculated vertical

(Continued)

plane relative field pattern is shown on Figure #3 attached. The power in the maximum will reach 100 kilowatts (20 dBk).

The power at North 238.5 degrees East does not exceed 10 kilowatts (10 dBk). The power at North 329.7 degrees East does not exceed 50 kilowatts (16.99 dBk).

The RMS of the vertically polarized horizontal plane component does not exceed the RMS of the horizontally polarized horizontal plane component.

The composite horizontal and vertical maximum relative field pattern obtained from the measured data as shown on Figure #1 has an RMS that is greater that 85% of the filed composite pattern.

The clear vertical length of the structure required to support the antenna is 65 feet if the antenna is to be top mounted.

The directional antenna should not be mounted on the top of an antenna tower that includes a top-mounted platform larger than the cross-sectional area of the tower in the horizontal plane. No obstructions other than those that are specified by the blue prints supplied with the antenna are to be mounted within 75 ft. horizontally of the system. The vertical distance to the nearest obstruction should be a minimum of 10 ft. from the directional antenna. Metallic guy wires should be a minimum distance of forty feet horizontally from the antenna.

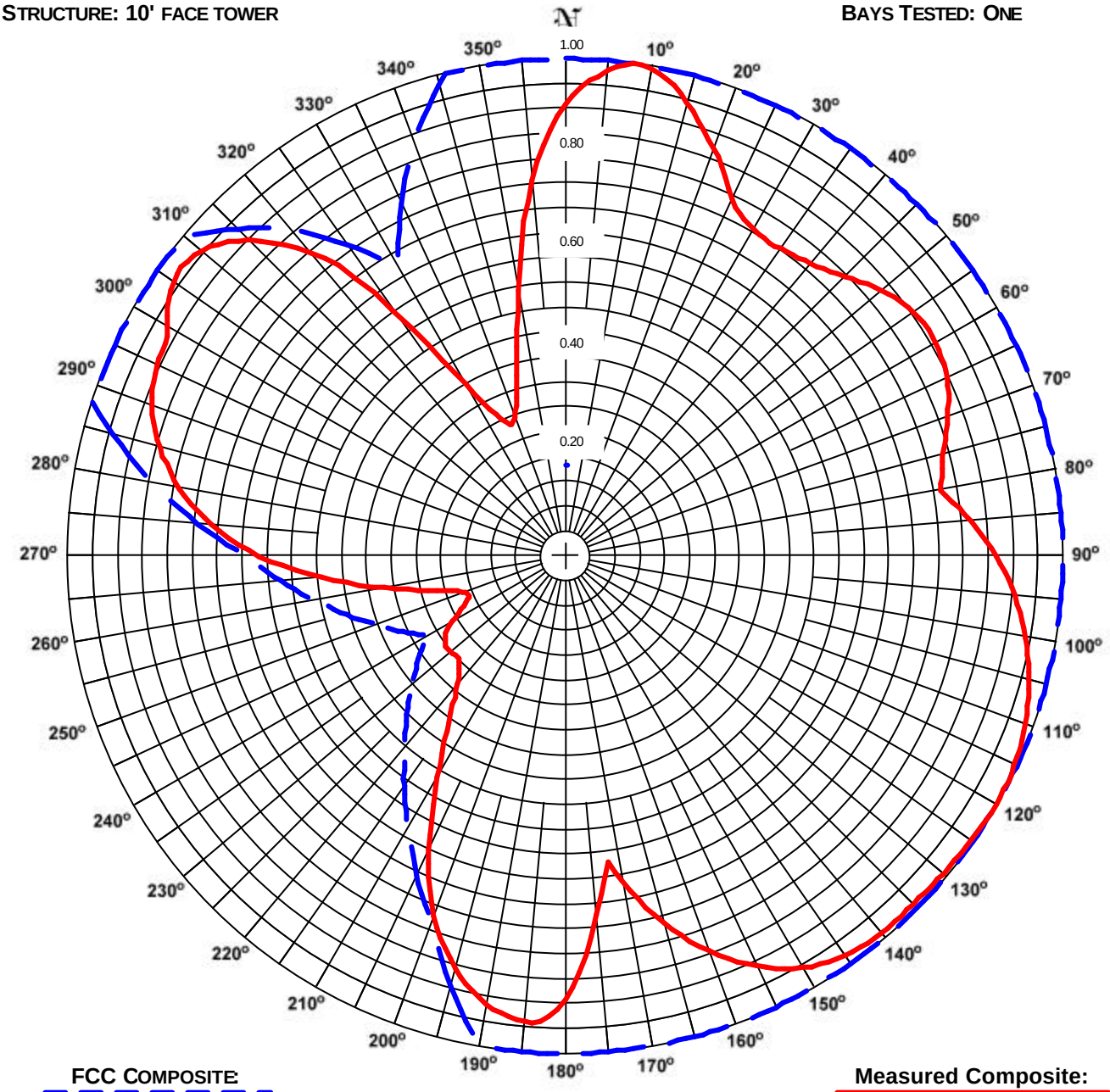
ELECTRONICS RESEARCH, INC.

ERI® Horizontal Plane Relative Field Pattern

Electronics Research, Inc. 7777 Gardner Rd. Chandler, In 47610 Phone (812) 925-6000 Fax (812) 925-4030 http://www.eriinc.com/

FIGURE NO: 1
STATION: WMAG
LOCATION: HIGHPOINT, NC
ANTENNA: SHP-6AC-DA
STRUCTURE: 10' FACE TOWER

DATE: 12/21/05
FREQUENCY: 99.5 MHZ
ORIENTATION: 23.6353° TRUE
MOUNTING: CUSTOM
BAYS TESTED: ONE



FCC COMPOSITE:
RMS: 0.898
MAXIMUM: 1.000 @ 0° TRUE
MINIMUM: 0.320 @ 240° TRUE

Measured Composite:
RMS: 0.777
Maximum: 1.000 @ 8° True
Minimum: 0.208 @ 248° True

COMMENTS: COMPOSITE PATTERN: THIS PATTERN SHOWS THE MAXIMUM OF EITHER THE H OR V AZIMUTH VALUES. THIS PATTERN IS GREATER THAT 85% OF THE FCC FILED COMPOSITE PATTERN BMLH -19900404KC

ERI® Horizontal Plane Relative Field List

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Station: WMAG
Location: Highpoint, NC
Frequency: 99.5 MHz

Antenna: SHP-6AC-DA
Orientation: 23.6356° True
Tower: 10' face tower

Figure: 1
Date: 12/21/2005
Reference: WMAG2M.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0º	0.908	82.43	19.16	Vertical	180º	0.892	79.51	19.00	Horizontal
5º	0.980	95.95	19.82	Horizontal	185º	0.939	88.16	19.45	Horizontal
10º	0.995	99.01	19.96	Horizontal	190º	0.914	83.51	19.22	Horizontal
15º	0.946	89.41	19.51	Horizontal	195º	0.857	73.52	18.66	Horizontal
20º	0.874	76.35	18.83	Vertical	200º	0.770	59.23	17.73	Horizontal
25º	0.791	62.60	17.97	Horizontal	205º	0.650	42.31	16.26	Horizontal
30º	0.757	57.33	17.58	Horizontal	210º	0.513	26.36	14.21	Horizontal
35º	0.755	56.96	17.56	Horizontal	215º	0.407	16.60	12.20	Horizontal
40º	0.768	58.99	17.71	Horizontal	220º	0.337	11.34	10.55	Horizontal
45º	0.796	63.35	18.02	Horizontal	225º	0.301	9.08	9.58	Horizontal
50º	0.831	69.02	18.39	Horizontal	230º	0.300	9.02	9.55	Horizontal
55º	0.856	73.19	18.64	Horizontal	235º	0.296	8.74	9.41	Horizontal
60º	0.859	73.84	18.68	Horizontal	240º	0.263	6.93	8.41	Horizontal
65º	0.846	71.58	18.55	Horizontal	245º	0.221	4.89	6.89	Horizontal
70º	0.818	66.89	18.25	Horizontal	250º	0.213	4.54	6.57	Vertical
75º	0.786	61.85	17.91	Horizontal	255º	0.267	7.14	8.54	Vertical
80º	0.767	58.86	17.70	Horizontal	260º	0.369	13.61	11.34	Vertical
85º	0.818	66.99	18.26	Vertical	265º	0.492	24.25	13.85	Vertical
90º	0.866	75.00	18.75	Vertical	270º	0.615	37.82	15.78	Vertical
95º	0.906	82.15	19.15	Vertical	275º	0.714	50.94	17.07	Vertical
100º	0.939	88.26	19.46	Vertical	280º	0.787	61.92	17.92	Vertical
105º	0.965	93.20	19.69	Vertical	285º	0.843	71.14	18.52	Vertical
110º	0.984	96.86	19.86	Vertical	290º	0.884	78.12	18.93	Vertical
115º	0.996	99.14	19.96	Vertical	295º	0.906	82.12	19.14	Vertical
120º	1.000	100.00	20.00	Vertical	300º	0.925	85.51	19.32	Horizontal
125º	0.997	99.31	19.97	Vertical	305º	0.961	92.37	19.66	Horizontal
130º	0.992	98.50	19.93	Vertical	310º	0.954	91.06	19.59	Horizontal
135º	0.989	97.85	19.91	Vertical	315º	0.898	80.71	19.07	Horizontal
140º	0.989	97.76	19.90	Vertical	320º	0.796	63.34	18.02	Horizontal
145º	0.980	96.09	19.83	Vertical	325º	0.603	36.34	15.60	Horizontal
150º	0.955	91.26	19.60	Vertical	330º	0.399	15.93	12.02	Vertical
155º	0.910	82.73	19.18	Vertical	335º	0.305	9.29	9.68	Vertical
160º	0.844	71.30	18.53	Vertical	340º	0.296	8.75	9.42	Vertical
165º	0.763	58.18	17.65	Vertical	345º	0.378	14.30	11.55	Vertical
170º	0.663	43.96	16.43	Vertical	350º	0.543	29.45	14.69	Vertical
175º	0.723	52.28	17.18	Horizontal	355º	0.760	57.73	17.61	Vertical

Polarization: **Envelope**
Maximum Field: **1.000 @ 8° True**
Minimum Field: **0.208 @ 248° True**
RMS: **0.777**
Maximum ERP: **100.000 kW**
Maximum Power Gain: **6.224 (7.941 dB)**

Total Input Power: 16.067 kW

ERI® Horizontal Plane Relative Field Pattern

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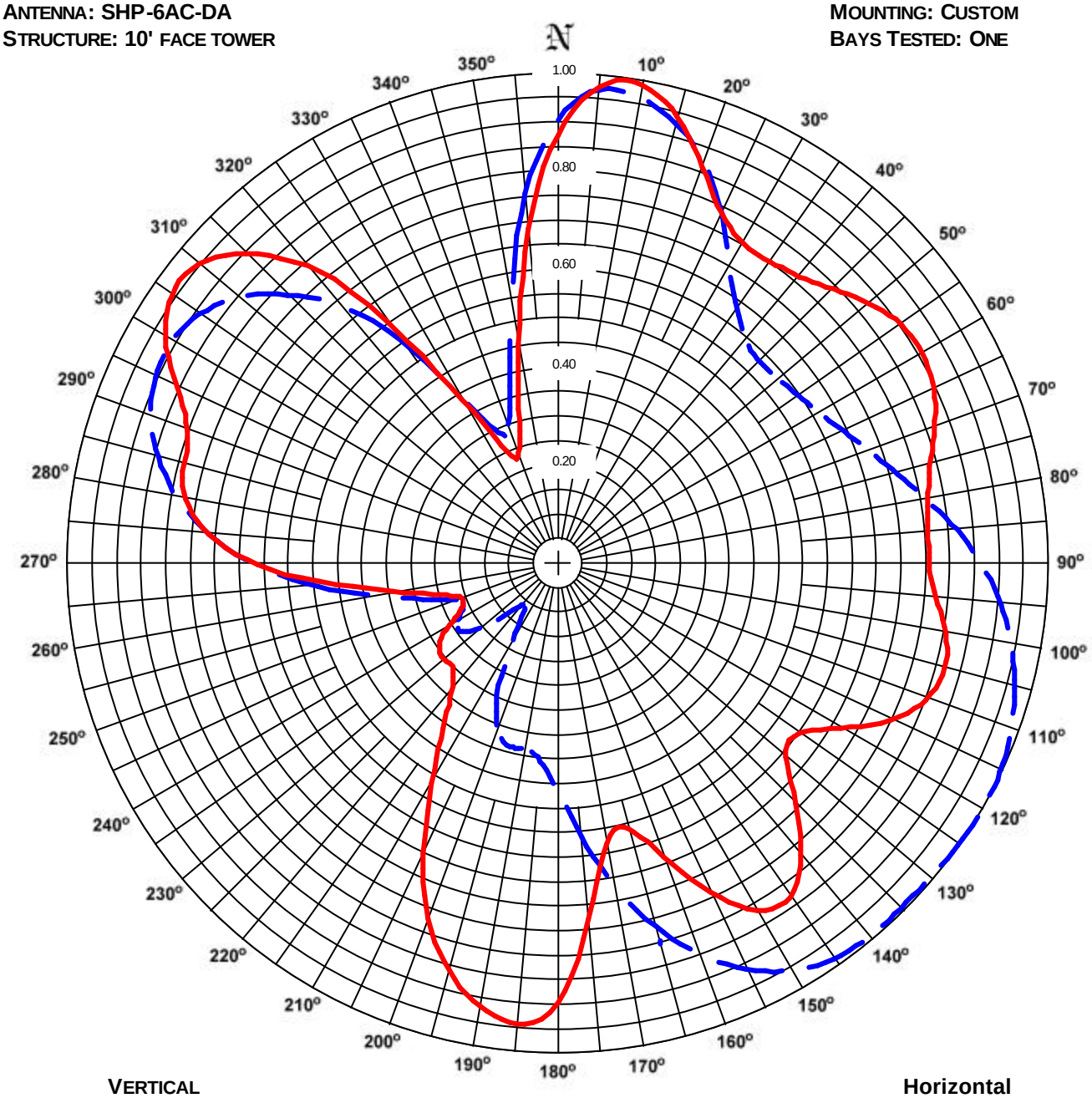
FIGURE NO: 2
STATION: WMAG
LOCATION: HIGHPOINT, NC
ANTENNA: SHP-6AC-DA
STRUCTURE: 10' FACE TOWER

DATE: 12/21/2005
FREQUENCY: 99.5 MHZ
ORIENTATION: 23.6356° TRUE
MOUNTING: CUSTOM
BAYS TESTED: ONE



VERTICAL

RMS: 0.706
MAXIMUM: 1.000 @ 120° TRUE
MINIMUM: 0.104 @ 220° TRUE

Horizontal

RMS: 0.714
Maximum: 1.000 @ 8° True
Minimum: 0.205 @ 250° True

COMMENTS: MEASURED PATTERNS OF THE HORIZONTAL AND VERTICAL COMPONENTS.

ERI® Horizontal Plane Relative Field List

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Station: WMAG
Location: Highpoint, NC
Frequency: 99.5 MHz

Antenna: SHP-6AC-DA
Orientation: 23.6356° True
Tower: 10' face tower

Figure: 2
Date: 12/21/2005
Reference: wmag2m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0º	0.877	76.94	18.86	0.908	82.43	19.16	180º	0.892	79.51	19.00	0.459	21.10	13.24
5º	0.980	95.95	19.82	0.974	94.81	19.77	185º	0.939	88.16	19.45	0.401	16.08	12.06
10º	0.995	99.01	19.96	0.967	93.54	19.71	190º	0.914	83.51	19.22	0.382	14.61	11.65
15º	0.946	89.41	19.51	0.933	87.00	19.40	195º	0.857	73.52	18.66	0.382	14.63	11.65
20º	0.865	74.87	18.74	0.874	76.35	18.83	200º	0.770	59.23	17.73	0.358	12.80	11.07
25º	0.791	62.60	17.97	0.790	62.44	17.95	205º	0.650	42.31	16.26	0.292	8.52	9.30
30º	0.757	57.33	17.58	0.702	49.28	16.93	210º	0.513	26.36	14.21	0.195	3.80	5.80
35º	0.755	56.96	17.56	0.638	40.71	16.10	215º	0.407	16.60	12.20	0.129	1.66	2.21
40º	0.768	58.99	17.71	0.599	35.85	15.54	220º	0.337	11.34	10.55	0.104	1.09	0.37
45º	0.796	63.35	18.02	0.584	34.11	15.33	225º	0.301	9.08	9.58	0.130	1.69	2.27
50º	0.831	69.02	18.39	0.588	34.61	15.39	230º	0.300	9.02	9.55	0.194	3.78	5.77
55º	0.856	73.19	18.64	0.600	35.98	15.56	235º	0.296	8.74	9.41	0.237	5.62	7.49
60º	0.859	73.84	18.68	0.619	38.26	15.83	240º	0.263	6.93	8.41	0.237	5.62	7.49
65º	0.846	71.58	18.55	0.645	41.54	16.18	245º	0.221	4.89	6.89	0.214	4.58	6.61
70º	0.818	66.89	18.25	0.678	45.92	16.62	250º	0.205	4.20	6.23	0.213	4.54	6.57
75º	0.786	61.85	17.91	0.718	51.55	17.12	255º	0.236	5.57	7.46	0.267	7.14	8.54
80º	0.767	58.86	17.70	0.766	58.60	17.68	260º	0.319	10.16	10.07	0.369	13.61	11.34
85º	0.759	57.55	17.60	0.818	66.99	18.26	265º	0.453	20.54	13.13	0.492	24.25	13.85
90º	0.758	57.41	17.59	0.866	75.00	18.75	270º	0.611	37.34	15.72	0.615	37.82	15.78
95º	0.775	60.08	17.79	0.906	82.15	19.15	275º	0.712	50.75	17.05	0.714	50.94	17.07
100º	0.804	64.59	18.10	0.939	88.26	19.46	280º	0.771	59.52	17.75	0.787	61.92	17.92
105º	0.818	66.87	18.25	0.965	93.20	19.69	285º	0.789	62.30	17.95	0.843	71.14	18.52
110º	0.800	64.00	18.06	0.984	96.86	19.86	290º	0.804	64.68	18.11	0.884	78.12	18.93
115º	0.749	56.09	17.49	0.996	99.14	19.96	295º	0.855	73.14	18.64	0.906	82.12	19.14
120º	0.666	44.29	16.46	1.000	100.00	20.00	300º	0.925	85.51	19.32	0.909	82.71	19.18
125º	0.599	35.86	15.55	0.997	99.31	19.97	305º	0.961	92.37	19.66	0.892	79.51	19.00
130º	0.607	36.88	15.67	0.992	98.50	19.93	310º	0.954	91.06	19.59	0.849	72.13	18.58
135º	0.686	47.05	16.73	0.989	97.85	19.91	315º	0.898	80.71	19.07	0.780	60.83	17.84
140º	0.773	59.74	17.76	0.989	97.76	19.90	320º	0.796	63.34	18.02	0.691	47.72	16.79
145º	0.826	68.23	18.34	0.980	96.09	19.83	325º	0.603	36.34	15.60	0.557	31.06	14.92
150º	0.812	65.89	18.19	0.955	91.26	19.60	330º	0.391	15.32	11.85	0.399	15.93	12.02
155º	0.736	54.16	17.34	0.910	82.73	19.18	335º	0.268	7.19	8.57	0.305	9.29	9.68
160º	0.633	40.08	16.03	0.844	71.30	18.53	340º	0.236	5.58	7.47	0.296	8.75	9.42
165º	0.555	30.83	14.89	0.763	58.18	17.65	345º	0.305	9.28	9.67	0.378	14.30	11.55
170º	0.577	33.35	15.23	0.663	43.96	16.43	350º	0.458	20.99	13.22	0.543	29.45	14.69
175º	0.723	52.28	17.18	0.555	30.84	14.89	355º	0.689	47.53	16.77	0.760	57.73	17.61

Polarization:	**Horizontal**	**Vertical**
Maximum Field:	**1.000 @ 8° True**	**1.000 @ 120° True**
Minimum Field:	**0.205 @ 250° True**	**0.104 @ 220° True**
RMS:	**0.714**	**0.706**
Maximum ERP:	**100.000 kW**	**100.000 kW**
Maximum Power Gain:	**6.224 (7.941 dB)**	**6.224 (7.941 dB)**

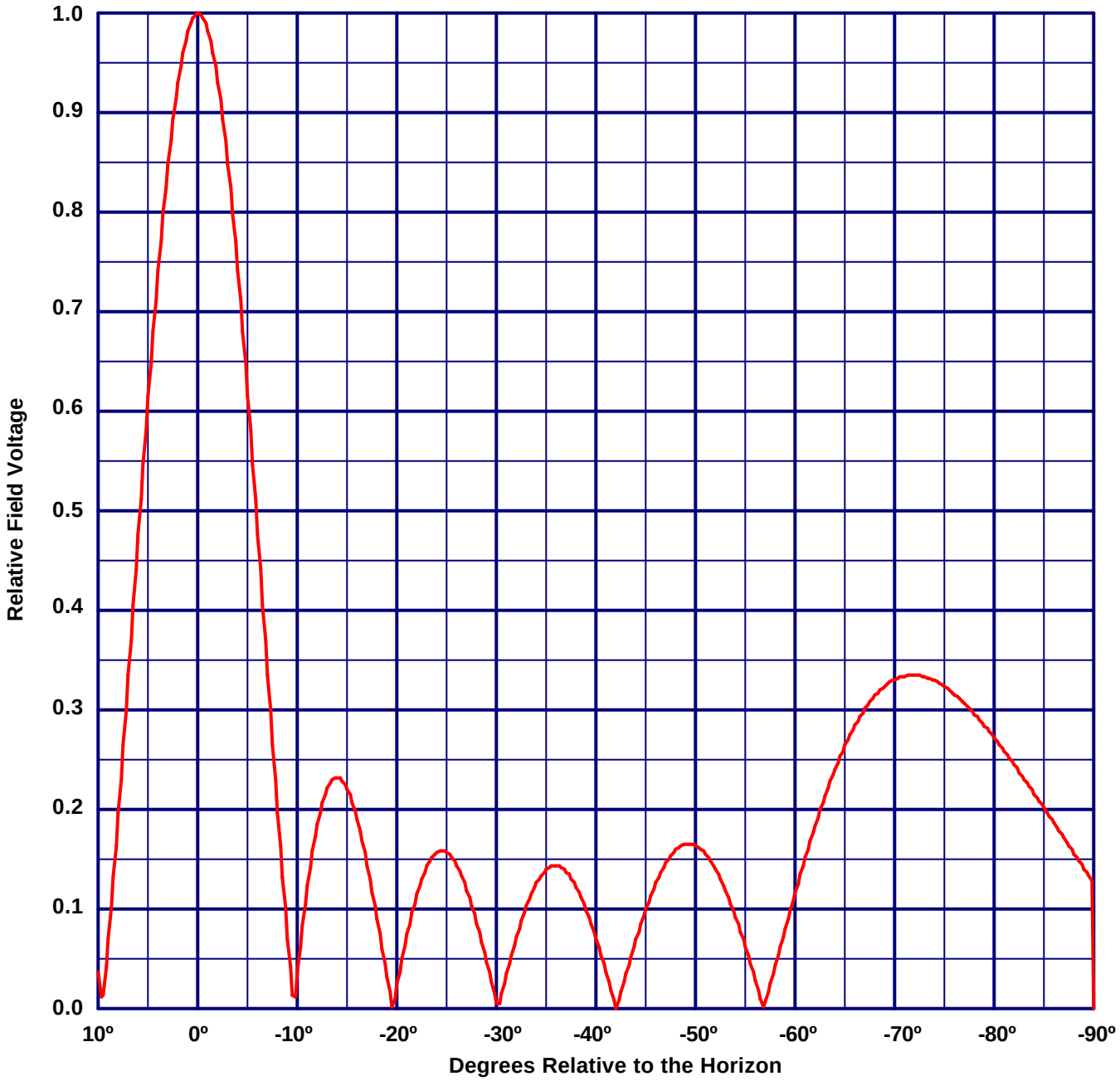
Total Input Power: 16.067 kW

Vertical Plane Relative Field Pattern

WMAG, Highpoint, NC, 99.5 MHz

Figure#: 3 Date: 12/21/05

A 6 level, 1 wave-length spaced SHP-6AC-DA directional antenna with 0° beam tilt, 0% null fill and a H/V maximum power ratio of 1.000



Vertical Polarization Gain:	Horizontal Polarization Gain:
Maximum: 6.224 (7.941 dB) Horizontal Plane: 6.224 (7.941 dB)	Maximum: 6.224 (7.941 dB) Horizontal Plane: 6.224 (7.941 dB)

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Directional Antenna System
for
WMAG, High Point, North Carolina

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	SHP-6AC-DA
Frequency:	99.5 MHz
Number of Bays:	Six

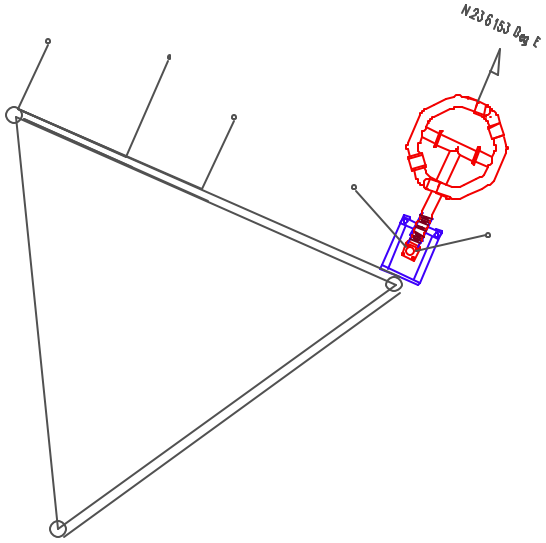
MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	57 ft 8 in
Aperture length required:	69 ft 3 in.
Orientation:	23.6353° true

Input flange to the antenna 3 1/8 inch female

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	100 kW (20 dBk)
Horizontal maximum power gain:	6.225 (7.941 dB)
Maximum vertical ERP:	100 kW (20 dBk)
Vertical maximum power gain:	6.224 (7.941 dB)
Total input power:	16.067 kW (12.059 dBk)



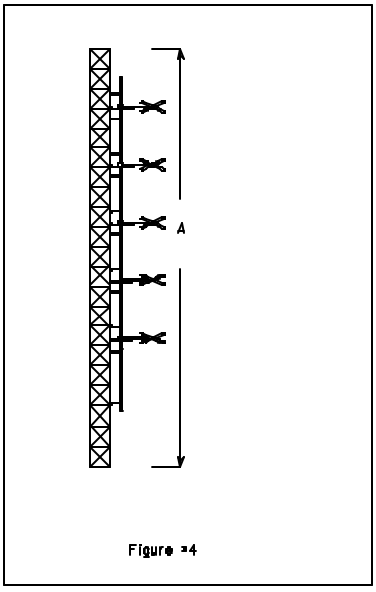


Figure 4