Electronics Research, Inc.

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

Directional Antenna System for WAYM, Columbia, Tennessee

November 7, 2003

Electronics Research Inc. is providing a custom fabricated antenna system that is specially designed to meet the FCC requirements and the general needs of radio station WAYM.

The antenna is the ERI model LP-4E-DA-HW configuration. The circular polarized system consists of 4 half-wavelength spaced bays using one driven circular polarized radiating element per bay, three horizontal parasitic elements per bay and two vertical parasitic elements per bay. The antenna was tested on a 12 3/4" o.d. pole, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 88.7 megahertz, which is the center of the FM broadcast channel assigned to WAYM.

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
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DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of two bay levels of the circular polarized system with the associated horizontal and 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 1 5/8 inch o.d. rigid coaxial line was used to feed the test antenna, and a section of 1 5/8 inch o.d. rigid outer conductor only was attached above the test antenna. The lines were properly grounded during all tests.

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 12 3/4" o.d. pole 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 azimuth indicating mechanism, resolution of this azimuth measuring device is one-tenth of a degree.

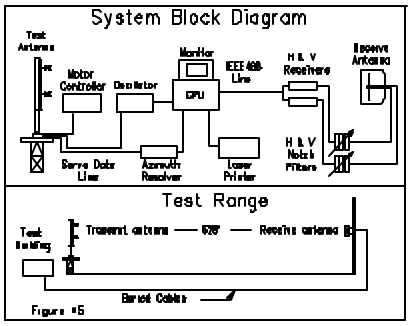


Figure #5

The antenna under test was operated in the transmitting mode and fed from a Wavetek Model 3000 signal generator. The frequency of the signal source was set at 88.7 MHz and was constantly monitored by an Anritsu Model ML521B measuring receiver.

A broad-band 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 4 half-wavelength spaced bays using one driven circular polarized radiating element per bay, three horizontal parasitic elements per bay and two 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 LP-4E-DA-HW array is to be mounted on the 12 3/4" o.d. pole at a bearing of North 217 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 plane relative field pattern is shown on Figure #3 attached. The power in the maximum will reach 15.5 kilowatts (11.903 dBk).

The power at North 10-80 degrees East does not exceed 0.500 kilowatts (-3.01 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.

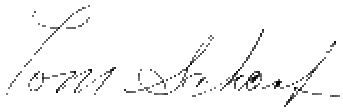
Directional Antenna System
For
WAYM, Columbia, Tennessee

(Continued)

The clear vertical length of the structure required to support the antenna is 31 ft 7 in 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.

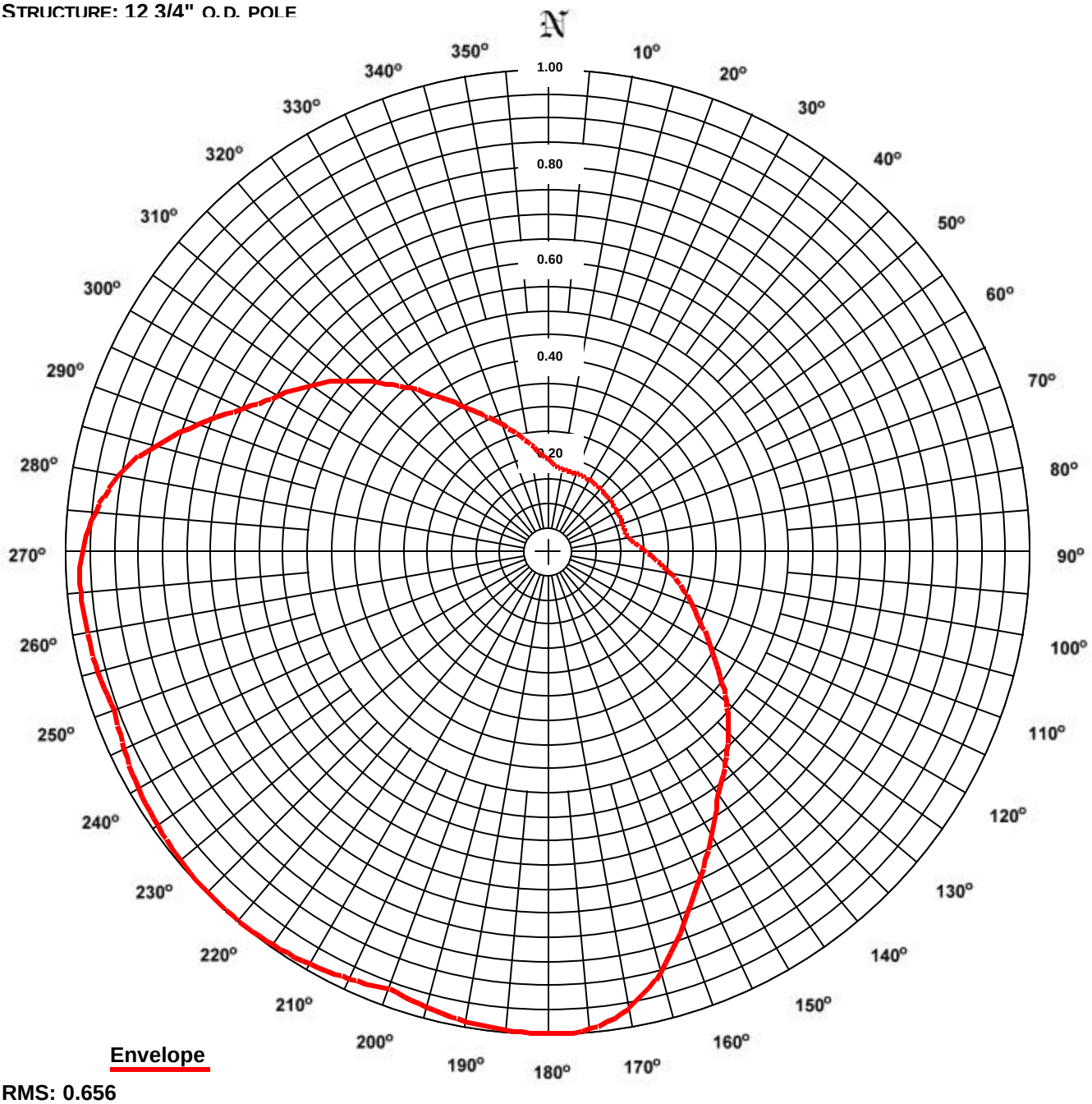


ERI® Horizontal Plane Relative Field Pattern

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

FIGURE: 1
STATION: WAYM
LOCATION: COLUMBIA, TN.
ANTENNA TYPE: LP-4E-DA-HW
STRUCTURE: 12 3/4" O.D. POLE

DATE: 11/7/03
FREQUENCY: 88.7 MHZ
ORIENTATION: 217° TRUE
MOUNTING: STANDARD



Envelope

RMS: 0.656
Maximum: 1.000 @ 178° True
Minimum: 0.163 @ 74° True

COMMENTS: OMPOSITE PATTERN: THIS PATTERN SHOWS THE MAXIMUM OF EITHER THE H OR V AZIMUTH VALUES. THIS PATTERN DOES NOT EXCEED THE FCC FILED COMPOSITE PATTERN AT ANY AZIMUTH. THE RMS OF THIS PATTERN IS GREATER THAN 85% OF THE FILED FCC COMPOSITE PATTERN BPED -20030124AGA.

ERI® Horizontal Plane Relative Field List

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Station: WAYM
Location: Columbia, TN.
Frequency: 88.7 MHz

Antenna: LP-4E-DA-HW
Orientation: 217° True
Tower: 12 3/4" o.d. pole

Figure: 1
Date: 11/7/03
Reference: waym2m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0º	0.190	0.56	-2.52	Vertical	180º	1.000	15.49	11.90	Horizontal
5º	0.179	0.50	-3.04	Vertical	185º	0.996	15.38	11.87	Horizontal
10º	0.174	0.47	-3.30	Vertical	190º	0.989	15.16	11.81	Horizontal
15º	0.173	0.46	-3.34	Vertical	195º	0.978	14.83	11.71	Horizontal
20º	0.173	0.46	-3.35	Vertical	200º	0.964	14.40	11.58	Horizontal
25º	0.172	0.46	-3.38	Vertical	205º	0.978	14.83	11.71	Vertical
30º	0.171	0.46	-3.42	Vertical	210º	0.989	15.15	11.81	Vertical
35º	0.170	0.45	-3.47	Vertical	215º	0.996	15.38	11.87	Vertical
40º	0.169	0.44	-3.54	Vertical	220º	1.000	15.49	11.90	Vertical
45º	0.168	0.44	-3.61	Vertical	225º	0.999	15.48	11.90	Vertical
50º	0.166	0.43	-3.68	Vertical	230º	0.996	15.39	11.87	Vertical
55º	0.165	0.42	-3.73	Vertical	235º	0.991	15.21	11.82	Vertical
60º	0.164	0.42	-3.78	Vertical	240º	0.983	14.97	11.75	Vertical
65º	0.164	0.42	-3.81	Vertical	245º	0.972	14.64	11.66	Vertical
70º	0.163	0.41	-3.83	Vertical	250º	0.961	14.30	11.55	Horizontal
75º	0.164	0.42	-3.82	Vertical	255º	0.968	14.52	11.62	Horizontal
80º	0.169	0.44	-3.53	Vertical	260º	0.973	14.67	11.66	Horizontal
85º	0.183	0.52	-2.84	Horizontal	265º	0.975	14.73	11.68	Horizontal
90º	0.203	0.64	-1.95	Horizontal	270º	0.968	14.53	11.62	Horizontal
95º	0.228	0.80	-0.94	Horizontal	275º	0.945	13.83	11.41	Horizontal
100º	0.257	1.03	0.11	Vertical	280º	0.904	12.67	11.03	Horizontal
105º	0.287	1.28	1.06	Vertical	285º	0.847	11.12	10.46	Horizontal
110º	0.318	1.57	1.95	Vertical	290º	0.773	9.26	9.67	Horizontal
115º	0.349	1.88	2.75	Vertical	295º	0.702	7.63	8.83	Horizontal
120º	0.387	2.32	3.65	Vertical	300º	0.648	6.51	8.14	Vertical
125º	0.430	2.87	4.58	Vertical	305º	0.601	5.60	7.48	Vertical
130º	0.482	3.60	5.56	Vertical	310º	0.553	4.74	6.76	Vertical
135º	0.527	4.31	6.34	Vertical	315º	0.497	3.82	5.83	Vertical
140º	0.572	5.07	7.05	Vertical	320º	0.443	3.04	4.83	Vertical
145º	0.612	5.81	7.64	Horizontal	325º	0.391	2.37	3.74	Vertical
150º	0.677	7.11	8.52	Horizontal	330º	0.348	1.87	2.73	Vertical
155º	0.744	8.59	9.34	Horizontal	335º	0.310	1.49	1.74	Vertical
160º	0.821	10.45	10.19	Horizontal	340º	0.282	1.23	0.91	Vertical
165º	0.903	12.63	11.01	Horizontal	345º	0.254	1.00	-0.01	Vertical
170º	0.961	14.33	11.56	Horizontal	350º	0.228	0.81	-0.94	Vertical
175º	0.994	15.30	11.85	Horizontal	355º	0.206	0.66	-1.81	Vertical

Polarization: **Envelope**
Maximum Field: **1.000 @ 178° True**
Minimum Field: **0.163 @ 74° True**
RMS: **0.656**
Maximum ERP: **15.500 kW**
Maximum Power Gain: **3.091 (4.901 dB)**

Total Input Power: 5.014 kW

ERI® Horizontal Plane Relative Field Pattern

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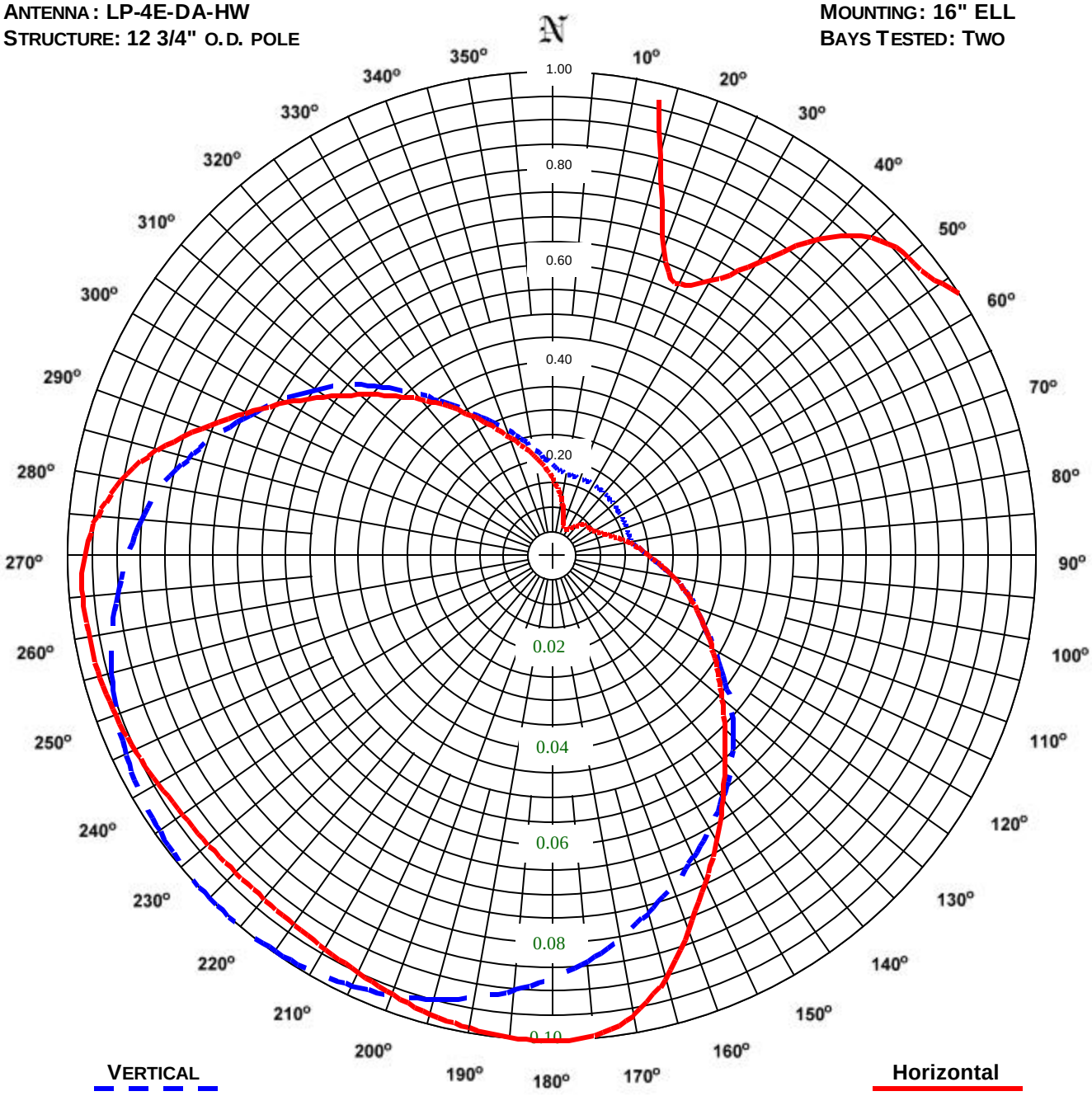
FIGURE NO: 2
STATION: WAYM
LOCATION: COLUMBIA, TN.
ANTENNA: LP-4E-DA-HW
STRUCTURE: 12 3/4" O.D. POLE

DATE: 11/7/03
FREQUENCY: 88.7 MHz
ORIENTATION: 217° TRUE
MOUNTING: 16" ELL
BAYS TESTED: TWO



VERTICAL

RMS: 0.628
MAXIMUM: 1.000 @ 222° TRUE
MINIMUM: 0.163 @ 74° TRUE

Horizontal

RMS: 0.640
Maximum: 1.000 @ 178° True
Minimum: 0.062 @ 24° True

10V

COMMENTS: MEASURED PATTERNS OF THE HORIZONTAL AND VERTICAL COMPONENTS.

ERI® Horizontal Plane Relative Field List

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Station: WAYM
Location: Columbia, TN.
Frequency: 88.7 MHz

Antenna: LP-4E-DA-HW
Orientation: 217° True
Tower: 12 3/4" o.d. pole

Figure: 2
Date: 11/7/03
Reference: waym2m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0º	0.162	0.41	-3.90	0.190	0.56	-2.52	180º	1.000	15.49	11.90	0.870	11.74	10.70
5º	0.138	0.30	-5.27	0.179	0.50	-3.04	185º	0.996	15.38	11.87	0.899	12.53	10.98
10º	0.114	0.20	-6.95	0.174	0.47	-3.30	190º	0.989	15.16	11.81	0.924	13.24	11.22
15º	0.086	0.11	-9.43	0.173	0.46	-3.34	195º	0.978	14.83	11.71	0.946	13.86	11.42
20º	0.067	0.07	-11.53	0.173	0.46	-3.35	200º	0.964	14.40	11.58	0.964	14.39	11.58
25º	0.062	0.06	-12.22	0.172	0.46	-3.38	205º	0.949	13.95	11.45	0.978	14.83	11.71
30º	0.066	0.07	-11.71	0.171	0.46	-3.42	210º	0.937	13.62	11.34	0.989	15.15	11.81
35º	0.074	0.09	-10.67	0.170	0.45	-3.47	215º	0.929	13.39	11.27	0.996	15.38	11.87
40º	0.086	0.11	-9.43	0.169	0.44	-3.54	220º	0.925	13.26	11.23	1.000	15.49	11.90
45º	0.093	0.13	-8.70	0.168	0.44	-3.61	225º	0.925	13.25	11.22	0.999	15.48	11.90
50º	0.096	0.14	-8.45	0.166	0.43	-3.68	230º	0.927	13.32	11.25	0.996	15.39	11.87
55º	0.098	0.15	-8.24	0.165	0.42	-3.73	235º	0.932	13.47	11.30	0.991	15.21	11.82
60º	0.104	0.17	-7.73	0.164	0.42	-3.78	240º	0.940	13.70	11.37	0.983	14.97	11.75
65º	0.114	0.20	-6.95	0.164	0.42	-3.81	245º	0.951	14.01	11.46	0.972	14.64	11.66
70º	0.128	0.25	-5.98	0.163	0.41	-3.83	250º	0.961	14.30	11.55	0.959	14.25	11.54
75º	0.145	0.33	-4.87	0.164	0.42	-3.82	255º	0.968	14.52	11.62	0.943	13.78	11.39
80º	0.163	0.41	-3.84	0.169	0.44	-3.53	260º	0.973	14.67	11.66	0.925	13.25	11.22
85º	0.183	0.52	-2.84	0.181	0.51	-2.93	265º	0.975	14.73	11.68	0.904	12.66	11.02
90º	0.203	0.64	-1.95	0.200	0.62	-2.06	270º	0.968	14.53	11.62	0.880	12.01	10.80
95º	0.228	0.80	-0.94	0.226	0.79	-1.00	275º	0.945	13.83	11.41	0.854	11.32	10.54
100º	0.257	1.02	0.10	0.257	1.03	0.11	280º	0.904	12.67	11.03	0.822	10.48	10.21
105º	0.285	1.26	1.01	0.287	1.28	1.06	285º	0.847	11.12	10.46	0.780	9.44	9.75
110º	0.317	1.56	1.92	0.318	1.57	1.95	290º	0.773	9.26	9.67	0.737	8.42	9.25
115º	0.348	1.87	2.72	0.349	1.88	2.75	295º	0.702	7.63	8.83	0.692	7.41	8.70
120º	0.381	2.25	3.52	0.387	2.32	3.65	300º	0.637	6.29	7.99	0.648	6.51	8.14
125º	0.417	2.69	4.30	0.430	2.87	4.58	305º	0.577	5.15	7.12	0.601	5.60	7.48
130º	0.456	3.22	5.08	0.482	3.60	5.56	310º	0.522	4.22	6.26	0.553	4.74	6.76
135º	0.502	3.91	5.92	0.527	4.31	6.34	315º	0.472	3.45	5.38	0.497	3.82	5.83
140º	0.553	4.74	6.76	0.572	5.07	7.05	320º	0.426	2.81	4.49	0.443	3.04	4.83
145º	0.612	5.81	7.64	0.610	5.76	7.61	325º	0.381	2.24	3.51	0.391	2.37	3.74
150º	0.677	7.11	8.52	0.649	6.53	8.15	330º	0.338	1.77	2.48	0.348	1.87	2.73
155º	0.744	8.59	9.34	0.686	7.30	8.63	335º	0.299	1.38	1.41	0.310	1.49	1.74
160º	0.821	10.45	10.19	0.725	8.15	9.11	340º	0.263	1.07	0.30	0.282	1.23	0.91
165º	0.903	12.63	11.01	0.763	9.02	9.55	345º	0.237	0.87	-0.59	0.254	1.00	-0.01
170º	0.961	14.33	11.56	0.802	9.97	9.99	350º	0.211	0.69	-1.62	0.228	0.81	-0.94
175º	0.994	15.30	11.85	0.838	10.88	10.37	355º	0.187	0.54	-2.67	0.206	0.66	-1.81

Polarization:	**Horizontal**	**Vertical**
Maximum Field:	**1.000 @ 178° True**	**1.000 @ 222° True**
Minimum Field:	**0.062 @ 24° True**	**0.163 @ 74° True**
RMS:	**0.640**	**0.628**
Maximum ERP:	**15.500 kW**	**15.500 kW**
Maximum Power Gain:	**3.091 (4.901 dB)**	**3.091 (4.901 dB)**

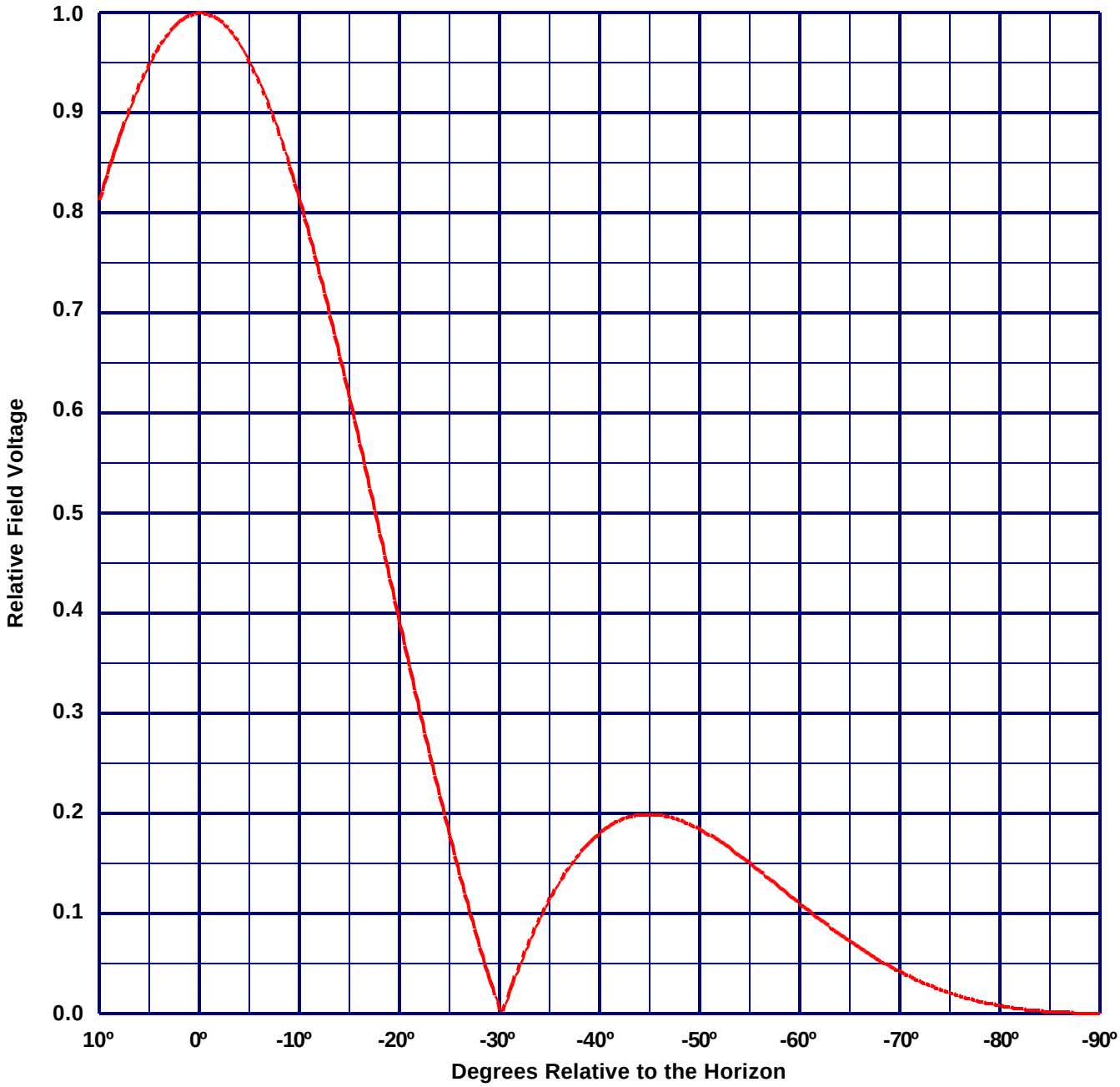
Total Input Power: 5.014 kW

Vertical Plane Relative Field Pattern

WAYM, Columbia, TN., 88.7 MHz

Figure#: 3 Date: 11/7/03

A 4 level, .5 wave-length spaced LP-4E-DA-HW 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: 3.091 (4.901 dB)	Maximum: 3.091 (4.901 dB)
Horizontal Plane: 3.091 (4.901 dB)	Horizontal Plane: 3.091 (4.901 dB)

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Directional Antenna System
for
WAYM, Columbia, Tennessee

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type: LP-4E-DA-HW
Frequency: 88.7 MHz
Number of Bays: four

MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	25 ft 4 in
Aperture length required:	31 ft. 7 in
Orientation:	217º true

Input flange to the antenna 1 5/8 inch female

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	15.5 kW (11.903 dBk)
Horizontal maximum power gain:	3.091 (4.901 dB)
Maximum vertical ERP:	15.5 kW (11.903 dBk)
Vertical maximum power gain:	3.091 (4.901 dB)
Total input power:	5.014 kW (7.002 dBk)

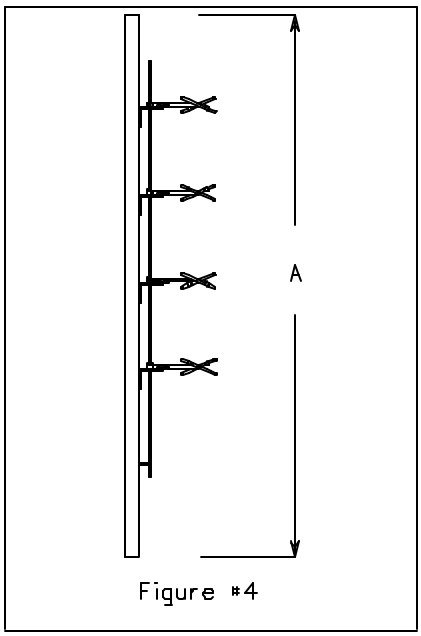

Figure #4