ELECTRONICS RESEARCH, INC. ERI®

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 WZKF, Prospect, Kentucky

April 16, 2010

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 WZKF.

The antenna is the ERI model MP-4C-DA configuration. The circular polarized system consists of 4 full-wavelength spaced bays using one driven circular polarized radiating element, two horizontal parasitic elements placed one quarter wave above and below each bay and two vertical parasitic elements per bay. The antenna was mounted on the North 303.465 degrees East tower face with bracketry to provide an antenna orientation of North 303.465 degrees East. The antenna was tested on a 30" Utility tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 98.9 megahertz, which is the center of the FM broadcast channel assigned to WZKF.

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.

(Continued)

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 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.

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 30" Utility 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 US Digital angle position indicator. The resolution of this angle position indicator is one-hundredth of a degree.

The antenna under test was operated in the transmitting mode and fed from a HP8657D signal generator. The frequency of the signal source was set at 98.9 MHz and was constantly monitored by a Rohde & Schwarz ESVD measuring receiver.

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 a Rohde & Schwarz measuring receiver. This data was interfaced to a laser jet printer by means of a computer system. Relative field strength was plotted as a function of azimuth.

(Continued)

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 full-wavelength spaced bays using one driven circular polarized radiating element, two horizontal parasitic elements placed one quarter wave above and below each 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 MP-4C-DA array is to be mounted on the North 303.465 degrees East tower face of the 30" Utility tower at a bearing of North 303.465 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 42.5 kilowatts (16.16.284 dBk).

The power at North 110 degrees East does not exceed 14.00 kilowatts (11.461 dBk).

The power at North 140 degrees East does not exceed 17.84 kilowatts (12.514 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.

(Continued)

The clear vertical length of the structure required to support the antenna is 52 ft 8 in.

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.

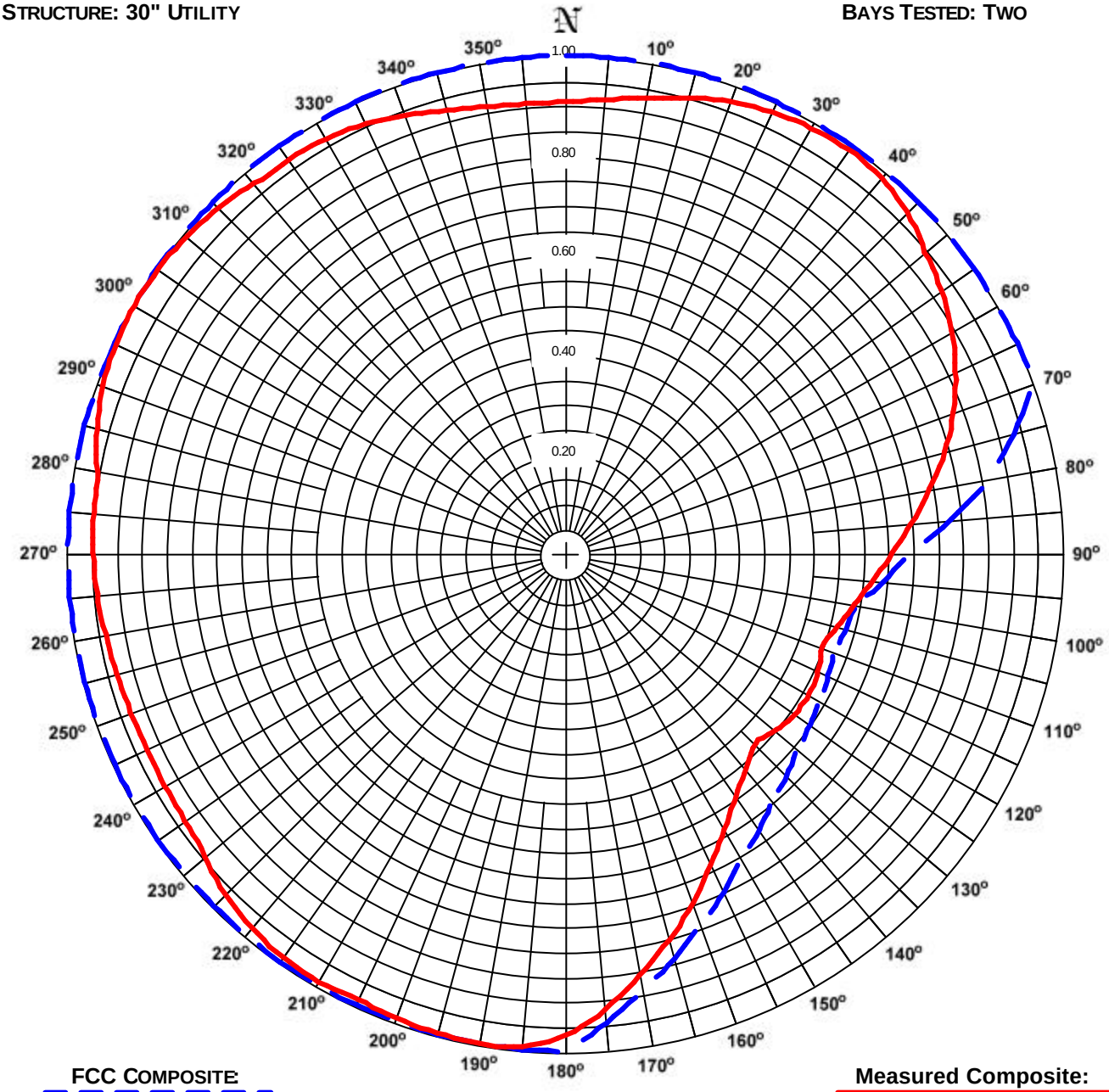
ELECTRONICS RESEARCH, INC.

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:
STATION: WZKF
LOCATION: PROSPECT, KY
ANTENNA: MP-4C-DA
STRUCTURE: 30" UTILITY

DATE: 4/16/2010
FREQUENCY: 98.9 MHZ
ORIENTATION: 303.465° TRUE
MOUNTING: STANDARD
BAYS TESTED: TWO



FCC COMPOSITE:
RMS: 0.927
MAXIMUM: 1.000 @ 0° TRUE
MINIMUM: 0.574 @ 110° TRUE

Measured Composite:
RMS: 0.881
Maximum: 1.000 @ 188° True
Minimum: 0.539 @ 134° 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 BPH-20090615AEX.

Horizontal Plane Relative Field List

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

Station: WZKF
Location: Prospect, KY
Frequency: 98.9 MHz

Antenna: MP-4C-DA
Orientation: 303.465° True
Tower: 30" Utility

Figure: 1
Date: 4/16/2010
Reference: wzkf1m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.907	35.41	15.49	Horizontal	180°	0.969	40.35	16.06	Horizontal
5°	0.915	36.04	15.57	Vertical	185°	0.995	42.55	16.29	Horizontal
10°	0.929	37.14	15.70	Vertical	190°	1.000	42.98	16.33	Horizontal
15°	0.948	38.64	15.87	Vertical	195°	0.998	42.80	16.31	Horizontal
20°	0.966	40.09	16.03	Vertical	200°	0.994	42.45	16.28	Horizontal
25°	0.979	41.18	16.15	Vertical	205°	0.988	41.93	16.23	Horizontal
30°	0.987	41.88	16.22	Vertical	210°	0.993	42.41	16.27	Vertical
35°	0.991	42.20	16.25	Vertical	215°	0.990	42.13	16.25	Vertical
40°	0.986	41.82	16.21	Vertical	220°	0.981	41.38	16.17	Vertical
45°	0.970	40.44	16.07	Vertical	225°	0.967	40.19	16.04	Vertical
50°	0.942	38.19	15.82	Horizontal	230°	0.947	38.56	15.86	Vertical
55°	0.921	36.50	15.62	Horizontal	235°	0.934	37.54	15.75	Horizontal
60°	0.895	34.47	15.37	Horizontal	240°	0.931	37.25	15.71	Horizontal
65°	0.865	32.14	15.07	Horizontal	245°	0.929	37.12	15.70	Horizontal
70°	0.829	29.55	14.70	Horizontal	250°	0.930	37.18	15.70	Horizontal
75°	0.789	26.73	14.27	Horizontal	255°	0.933	37.44	15.73	Horizontal
80°	0.743	23.76	13.76	Horizontal	260°	0.939	37.88	15.78	Horizontal
85°	0.697	20.88	13.20	Horizontal	265°	0.945	38.40	15.84	Horizontal
90°	0.656	18.49	12.67	Horizontal	270°	0.949	38.73	15.88	Horizontal
95°	0.620	16.53	12.18	Horizontal	275°	0.951	38.88	15.90	Horizontal
100°	0.590	14.96	11.75	Horizontal	280°	0.955	39.23	15.94	Vertical
105°	0.565	13.72	11.37	Horizontal	285°	0.974	40.82	16.11	Vertical
110°	0.548	12.89	11.10	Vertical	290°	0.988	41.99	16.23	Vertical
115°	0.559	13.46	11.29	Vertical	295°	0.997	42.72	16.31	Vertical
120°	0.565	13.71	11.37	Vertical	300°	1.000	43.00	16.33	Vertical
125°	0.562	13.59	11.33	Vertical	305°	0.998	42.82	16.32	Vertical
130°	0.552	13.10	11.17	Vertical	310°	0.993	42.36	16.27	Vertical
135°	0.540	12.52	10.98	Horizontal	315°	0.984	41.61	16.19	Vertical
140°	0.563	13.65	11.35	Horizontal	320°	0.971	40.58	16.08	Vertical
145°	0.597	15.30	11.85	Horizontal	325°	0.967	40.24	16.05	Horizontal
150°	0.639	17.54	12.44	Horizontal	330°	0.962	39.82	16.00	Horizontal
155°	0.690	20.48	13.11	Horizontal	335°	0.952	38.99	15.91	Horizontal
160°	0.748	24.04	13.81	Horizontal	340°	0.937	37.75	15.77	Horizontal
165°	0.804	27.77	14.44	Horizontal	345°	0.922	36.54	15.63	Horizontal
170°	0.860	31.80	15.02	Horizontal	350°	0.912	35.74	15.53	Horizontal
175°	0.920	36.38	15.61	Horizontal	355°	0.907	35.34	15.48	Horizontal

Polarization: **Envelope**
Maximum Field: **1.000 @ 188° True**
Minimum Field: **0.539 @ 134° True**
RMS: **0.881**
Maximum ERP: **43.000 kW**
Maximum Power Gain: **2.751 (4.395 dB)**

Total Input Power: 15.630 kW

ERI® Horizontal Plane Relative Field Pattern

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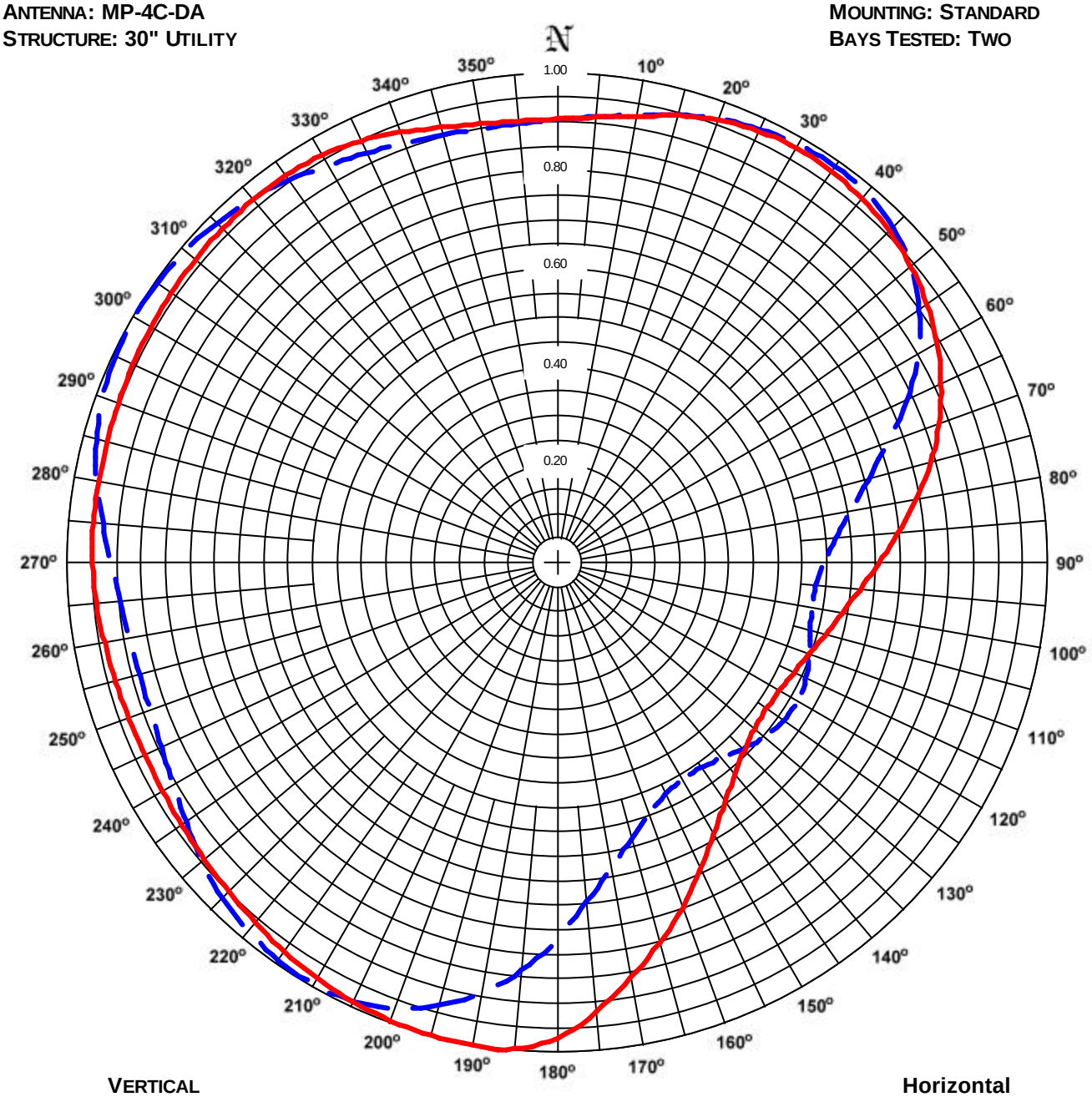
FIGURE NO: 2
STATION: WZKF
LOCATION: PROSPECT, KY
ANTENNA: MP-4C-DA
STRUCTURE: 30" UTILITY

DATE: 4/16/2010
FREQUENCY: 98.9 MHZ
ORIENTATION: 303.465° TRUE
MOUNTING: STANDARD
BAYS TESTED: TWO



VERTICAL

RMS: 0.842
MAXIMUM: 1.000 @ 300° TRUE
MINIMUM: 0.508 @ 148° TRUE

Horizontal

RMS: 0.874
Maximum: 1.000 @ 188° True
Minimum: 0.519 @ 125° True

COMMENTS: MEASURED PATTERNS OF THE HORIZONTAL AND VERTICAL COMPONENTS.

Horizontal Plane Relative Field List

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

Station: WZKF
Location: Prospect, KY
Frequency: 98.9 MHz

Antenna: MP-4C-DA
Orientation: 303.465° True
Tower: 30" Utility

Figure: 2
Date: 4/16/2010
Reference: wzkf1m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.907	35.41	15.49	0.906	35.31	15.48	180°	0.969	40.35	16.06	0.766	25.21	14.02
5°	0.915	35.97	15.56	0.915	36.04	15.57	185°	0.995	42.55	16.29	0.834	29.92	14.76
10°	0.928	37.01	15.68	0.929	37.14	15.70	190°	1.000	42.98	16.33	0.890	34.09	15.33
15°	0.947	38.53	15.86	0.948	38.64	15.87	195°	0.998	42.80	16.31	0.934	37.55	15.75
20°	0.963	39.90	16.01	0.966	40.09	16.03	200°	0.994	42.45	16.28	0.966	40.14	16.04
25°	0.974	40.79	16.11	0.979	41.18	16.15	205°	0.988	41.93	16.23	0.986	41.79	16.21
30°	0.979	41.19	16.15	0.987	41.88	16.22	210°	0.979	41.24	16.15	0.993	42.41	16.27
35°	0.977	41.05	16.13	0.991	42.20	16.25	215°	0.969	40.39	16.06	0.990	42.13	16.25
40°	0.970	40.49	16.07	0.986	41.82	16.21	220°	0.958	39.43	15.96	0.981	41.38	16.17
45°	0.959	39.53	15.97	0.970	40.44	16.07	225°	0.948	38.63	15.87	0.967	40.19	16.04
50°	0.942	38.19	15.82	0.942	38.14	15.81	230°	0.940	38.00	15.80	0.947	38.56	15.86
55°	0.921	36.50	15.62	0.902	34.98	15.44	235°	0.934	37.54	15.75	0.924	36.69	15.65
60°	0.895	34.47	15.37	0.851	31.11	14.93	240°	0.931	37.25	15.71	0.905	35.22	15.47
65°	0.865	32.14	15.07	0.787	26.66	14.26	245°	0.929	37.12	15.70	0.892	34.20	15.34
70°	0.829	29.55	14.70	0.717	22.10	13.44	250°	0.930	37.18	15.70	0.884	33.62	15.27
75°	0.789	26.73	14.27	0.656	18.51	12.67	255°	0.933	37.44	15.73	0.882	33.47	15.25
80°	0.743	23.76	13.76	0.607	15.84	12.00	260°	0.939	37.88	15.78	0.886	33.79	15.29
85°	0.697	20.88	13.20	0.570	13.95	11.45	265°	0.945	38.40	15.84	0.896	34.53	15.38
90°	0.656	18.49	12.67	0.544	12.72	11.04	270°	0.949	38.73	15.88	0.911	35.69	15.53
95°	0.620	16.53	12.18	0.530	12.07	10.82	275°	0.951	38.88	15.90	0.931	37.30	15.72
100°	0.590	14.96	11.75	0.528	11.98	10.78	280°	0.951	38.91	15.90	0.955	39.23	15.94
105°	0.565	13.72	11.37	0.534	12.28	10.89	285°	0.952	39.00	15.91	0.974	40.82	16.11
110°	0.545	12.79	11.07	0.548	12.89	11.10	290°	0.954	39.14	15.93	0.988	41.99	16.23
115°	0.531	12.14	10.84	0.559	13.46	11.29	295°	0.957	39.35	15.95	0.997	42.72	16.31
120°	0.523	11.75	10.70	0.565	13.71	11.37	300°	0.960	39.62	15.98	1.000	43.00	16.33
125°	0.519	11.60	10.64	0.562	13.59	11.33	305°	0.963	39.87	16.01	0.998	42.82	16.32
130°	0.525	11.85	10.74	0.552	13.10	11.17	310°	0.965	40.07	16.03	0.993	42.36	16.27
135°	0.540	12.52	10.98	0.534	12.28	10.89	315°	0.967	40.20	16.04	0.984	41.61	16.19
140°	0.563	13.65	11.35	0.518	11.56	10.63	320°	0.968	40.28	16.05	0.971	40.58	16.08
145°	0.597	15.30	11.85	0.510	11.17	10.48	325°	0.967	40.24	16.05	0.956	39.29	15.94
150°	0.639	17.54	12.44	0.509	11.16	10.48	330°	0.962	39.82	16.00	0.938	37.87	15.78
155°	0.690	20.48	13.11	0.522	11.70	10.68	335°	0.952	38.99	15.91	0.924	36.73	15.65
160°	0.748	24.04	13.81	0.546	12.83	11.08	340°	0.937	37.75	15.77	0.913	35.87	15.55
165°	0.804	27.77	14.44	0.583	14.61	11.65	345°	0.922	36.54	15.63	0.906	35.29	15.48
170°	0.860	31.80	15.02	0.632	17.16	12.35	350°	0.912	35.74	15.53	0.902	34.97	15.44
175°	0.920	36.38	15.61	0.693	20.64	13.15	355°	0.907	35.34	15.48	0.902	34.95	15.43

Polarization:	**Horizontal**	**Vertical**
Maximum Field:	**1.000 @ 188° True**	**1.000 @ 300° True**
Minimum Field:	**0.519 @ 125° True**	**0.508 @ 148° True**
RMS:	**0.874**	**0.842**
Maximum ERP:	**43.000 kW**	**43.000 kW**
Maximum Power Gain:	**2.751 (4.395 dB)**	**2.751 (4.395 dB)**

Total Input Power: 15.630 kW

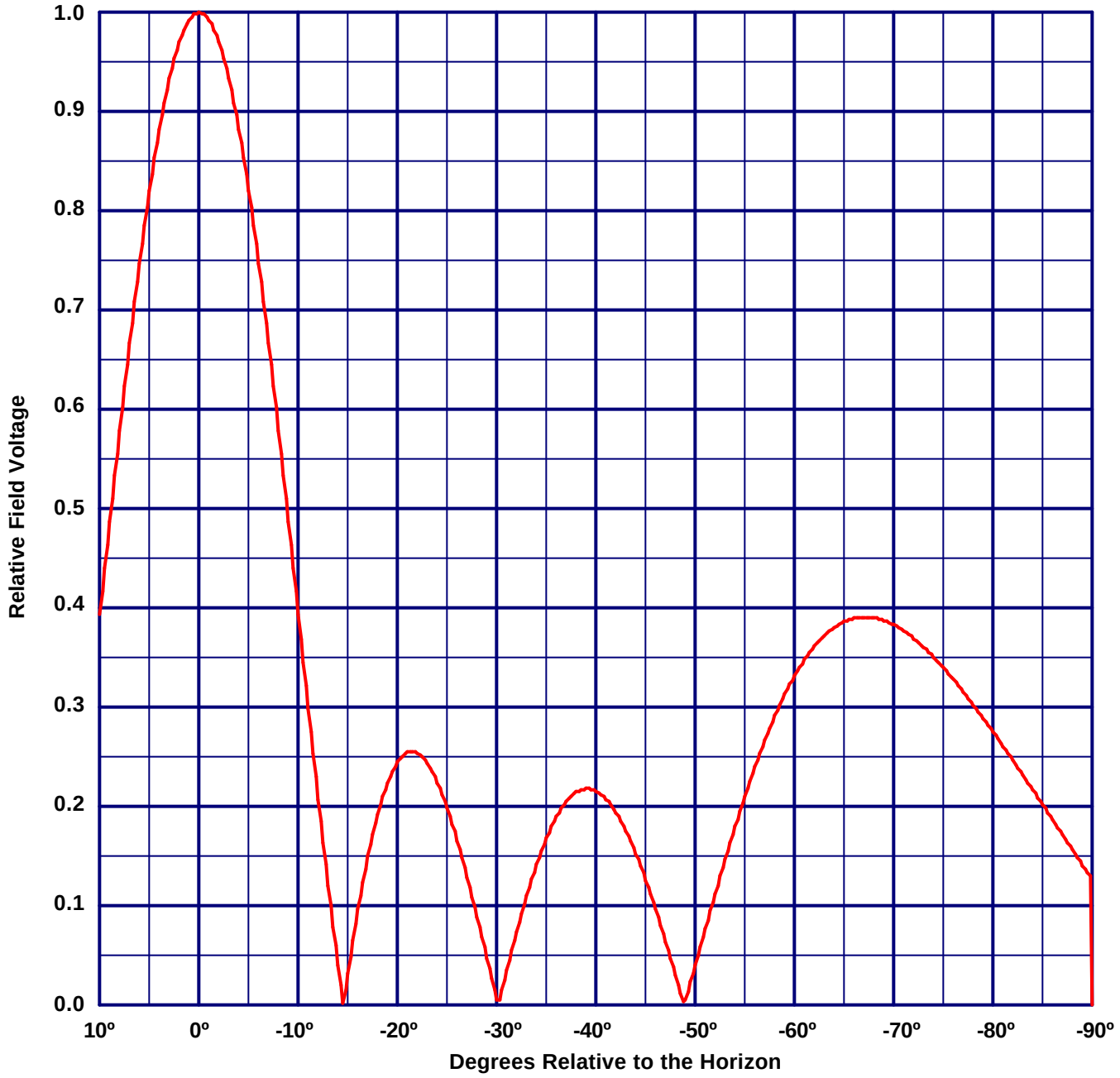
Vertical Plane Relative Field Pattern

WZKF, Prospect, KY, 98.9 MHz

Figure#: 3 Date: 4/16/2010

F i g u r e # : 3 D a t e : 4 / 1 6 /2 0 1 0

with 0° beam tilt, 0% null fill and a H/V maximum power ratio of 1.000



Vertical Polarization Gain:	Horizontal Polarization Gain:
Maximum: 2.751 (4.395 dB)	Maximum: 2.751 (4.395 dB)
Horizontal Plane: 2.751 (4.395 dB)	Horizontal Plane: 2.751 (4.395 dB)

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Directional Antenna System
for
WZKF, Prospect, KY

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	MP-4C-DA
Frequency:	98.9MHz
Number of Bays:	Four

MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	36 ft 9 in
Aperture length required:	52 ft 8 in
Orientation:	303.465° true

Input flange to the antenna 3 1/8“ female.

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	42.500 kW (16.284 dBk)
Horizontal maximum power gain:	2.751 (4.395 dB)
Maximum vertical ERP:	42.500 kW (16.284 dBk)
Vertical maximum power gain:	2.751 (4.395 dB)
Total input power:	15.448 kW (11.889 dBk)