

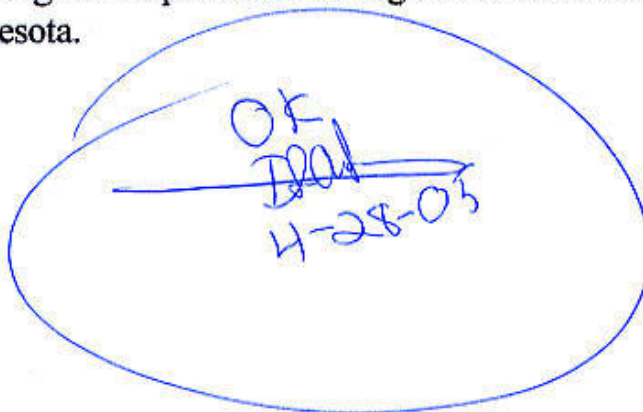
***Directional Antenna System  
for  
WURK, Elwood, Indiana***

April 20, 2005

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 WURK.

The antenna is the ERI model LP-6C-DA-HW configuration. The circular polarized system consists of 6 half-wavelength spaced bays using one driven circular polarized radiating element per bay and four vertical parasitic elements per bay. The antenna was mounted on the North 60 degrees East tower face with bracketry to provide an antenna orientation of North 60 degrees East. The antenna was tested on a 24" Pi-Rod tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 101.7 megahertz, which is the center of the FM broadcast channel assigned to WURK.

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 WURK, Elwood, Indiana

(Continued)

## DESCRIPTION OF THE TEST PROCEDURE

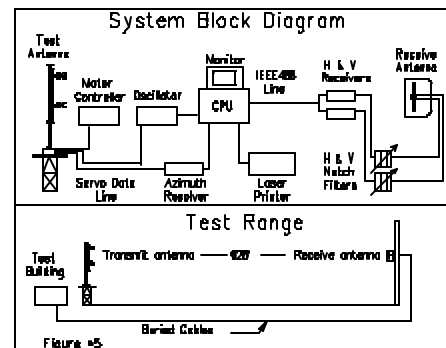
The test antenna consisted of two bay levels of the circular polarized system with the associated vertical parasitic elements. The elements and brackets that were used in this test are electrically equivalent to those that will be supplied with the antenna. A section of 1 5/8 inch o.d. rigid coaxial 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 24" Pi-Rod 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 azimuth indicating mechanism, resolution of this azimuth measuring device is one-tenth of a degree.

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 101.7 MHz and was constantly monitored by an Anritsu Model ML521B 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 an Anritsu Model ML521B measuring receiver.



# Directional Antenna System For WURK, Elwood, Indiana

(Continued)

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 coordinated graph paper in a clockwise direction. Both horizontal and vertical components were recorded separately.

## CONCLUSIONS

The circular polarized system consists of 6 half-wavelength spaced bays using one driven circular polarized radiating element per bay and four 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-6C-DA-HW array is to be mounted on the North 60 degrees East tower face of the 24" Pi- Rod tower at a bearing of North 60 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 6 kilowatts (7.782 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 than 85% of the filed composite pattern.

The clear vertical length of the structure required to support the antenna is 39 feet.

Directional Antenna System  
For  
WURK, Elwood, Indiana

(Continued)

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.

A handwritten signature in cursive script, appearing to read "L. H. Schaefer".

# **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: WURK

LOCATION: ELWOOD, IN

ANTENNA TYPE: LP-6C-DA-HW

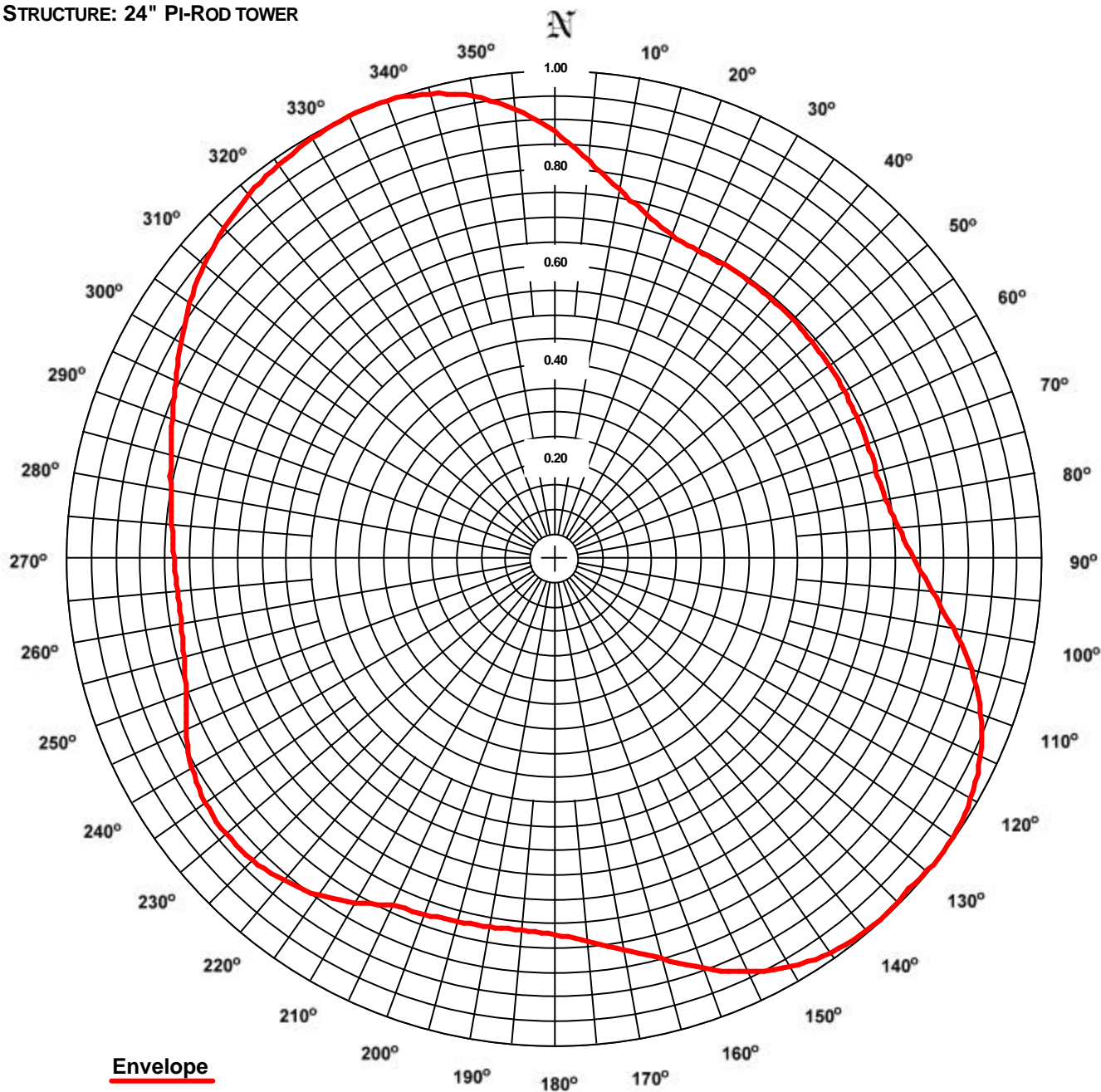
STRUCTURE: 24" PI-ROD TOWER

DATE: 4/20/05

FREQUENCY: 101.7 MHz

ORIENTATION: 60° TRUE

MOUNTING: CUSTOM



RMS: 0.844

Maximum: 1.000 @ 127° True

Minimum: 0.684 @ 75° True

COMMENTS: COMPOSITE PATTERN: THIS PATTERN SHOWS THE MAXIMUM OF EITHER THE H OR V AZIMUTH VALUES. THIS PATTERN IS GREATER THAN 85% OF THE FCC FILED COMPOSITE PATTERN BPH-20050302ADT

# **ERI**® *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: WURK**  
**Location: Elwood, IN**  
**Frequency: 101.7 MHz**

**Antenna: LP-6C-DA-HW**  
**Orientation: 60° True**  
**Tower: 24" Pi Rod tower**

**Figure: 1**  
**Date: 4/20/05**  
**Reference: wurk1m.fig**

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.875	4.60	6.62	H (and/or) V	180°	0.773	3.59	5.55	H (and/or) V
5°	0.817	4.00	6.02	H (and/or) V	185°	0.767	3.53	5.48	H (and/or) V
10°	0.767	3.53	5.48	H (and/or) V	190°	0.769	3.55	5.50	H (and/or) V
15°	0.730	3.20	5.05	H (and/or) V	195°	0.772	3.58	5.54	H (and/or) V
20°	0.706	2.99	4.75	H (and/or) V	200°	0.778	3.64	5.61	H (and/or) V
25°	0.696	2.91	4.63	H (and/or) V	205°	0.788	3.72	5.71	H (and/or) V
30°	0.695	2.90	4.62	H (and/or) V	210°	0.818	4.01	6.03	H (and/or) V
35°	0.694	2.89	4.61	H (and/or) V	215°	0.845	4.28	6.32	H (and/or) V
40°	0.693	2.88	4.60	H (and/or) V	220°	0.864	4.48	6.52	H (and/or) V
45°	0.692	2.87	4.58	H (and/or) V	225°	0.876	4.61	6.64	H (and/or) V
50°	0.690	2.86	4.56	H (and/or) V	230°	0.881	4.66	6.68	H (and/or) V
55°	0.688	2.84	4.53	H (and/or) V	235°	0.875	4.59	6.62	H (and/or) V
60°	0.686	2.83	4.51	H (and/or) V	240°	0.859	4.43	6.47	H (and/or) V
65°	0.685	2.82	4.50	H (and/or) V	245°	0.834	4.17	6.20	H (and/or) V
70°	0.684	2.81	4.49	H (and/or) V	250°	0.804	3.88	5.89	H (and/or) V
75°	0.684	2.81	4.48	H (and/or) V	255°	0.787	3.72	5.70	H (and/or) V
80°	0.691	2.86	4.57	H (and/or) V	260°	0.778	3.63	5.60	H (and/or) V
85°	0.709	3.01	4.79	H (and/or) V	265°	0.777	3.62	5.59	H (and/or) V
90°	0.738	3.27	5.14	H (and/or) V	270°	0.781	3.66	5.63	H (and/or) V
95°	0.779	3.64	5.61	H (and/or) V	275°	0.788	3.73	5.72	H (and/or) V
100°	0.830	4.14	6.17	H (and/or) V	280°	0.800	3.84	5.84	H (and/or) V
105°	0.886	4.71	6.73	H (and/or) V	285°	0.815	3.99	6.01	H (and/or) V
110°	0.931	5.20	7.16	H (and/or) V	290°	0.835	4.18	6.21	H (and/or) V
115°	0.965	5.59	7.47	H (and/or) V	295°	0.858	4.42	6.45	H (and/or) V
120°	0.987	5.85	7.67	H (and/or) V	300°	0.885	4.70	6.72	H (and/or) V
125°	0.999	5.98	7.77	H (and/or) V	305°	0.913	5.00	6.99	H (and/or) V
130°	0.999	5.99	7.77	H (and/or) V	310°	0.937	5.27	7.22	H (and/or) V
135°	0.998	5.98	7.77	H (and/or) V	315°	0.957	5.50	7.40	H (and/or) V
140°	0.999	5.99	7.77	H (and/or) V	320°	0.973	5.69	7.55	H (and/or) V
145°	0.989	5.87	7.68	H (and/or) V	325°	0.986	5.83	7.66	H (and/or) V
150°	0.968	5.63	7.50	H (and/or) V	330°	0.994	5.93	7.73	H (and/or) V
155°	0.938	5.28	7.23	H (and/or) V	335°	0.999	5.99	7.77	H (and/or) V
160°	0.898	4.84	6.84	H (and/or) V	340°	0.999	5.98	7.77	H (and/or) V
165°	0.852	4.36	6.39	H (and/or) V	345°	0.986	5.84	7.66	H (and/or) V
170°	0.816	3.99	6.01	H (and/or) V	350°	0.962	5.55	7.44	H (and/or) V
175°	0.790	3.74	5.73	H (and/or) V	355°	0.925	5.13	7.10	H (and/or) V

**Polarization:**  
**Maximum Field:**  
**Minimum Field:**  
**RMS:**  
**Maximum ERP:**  
**Maximum Power Gain:**

**Envelope**  
**1.000 @ 127° True**  
**0.684 @ 75° True**  
**0.844**  
**6.000 kW**  
**2.697 (4.309 dB)**

**Total Input Power: 2.225 kW**

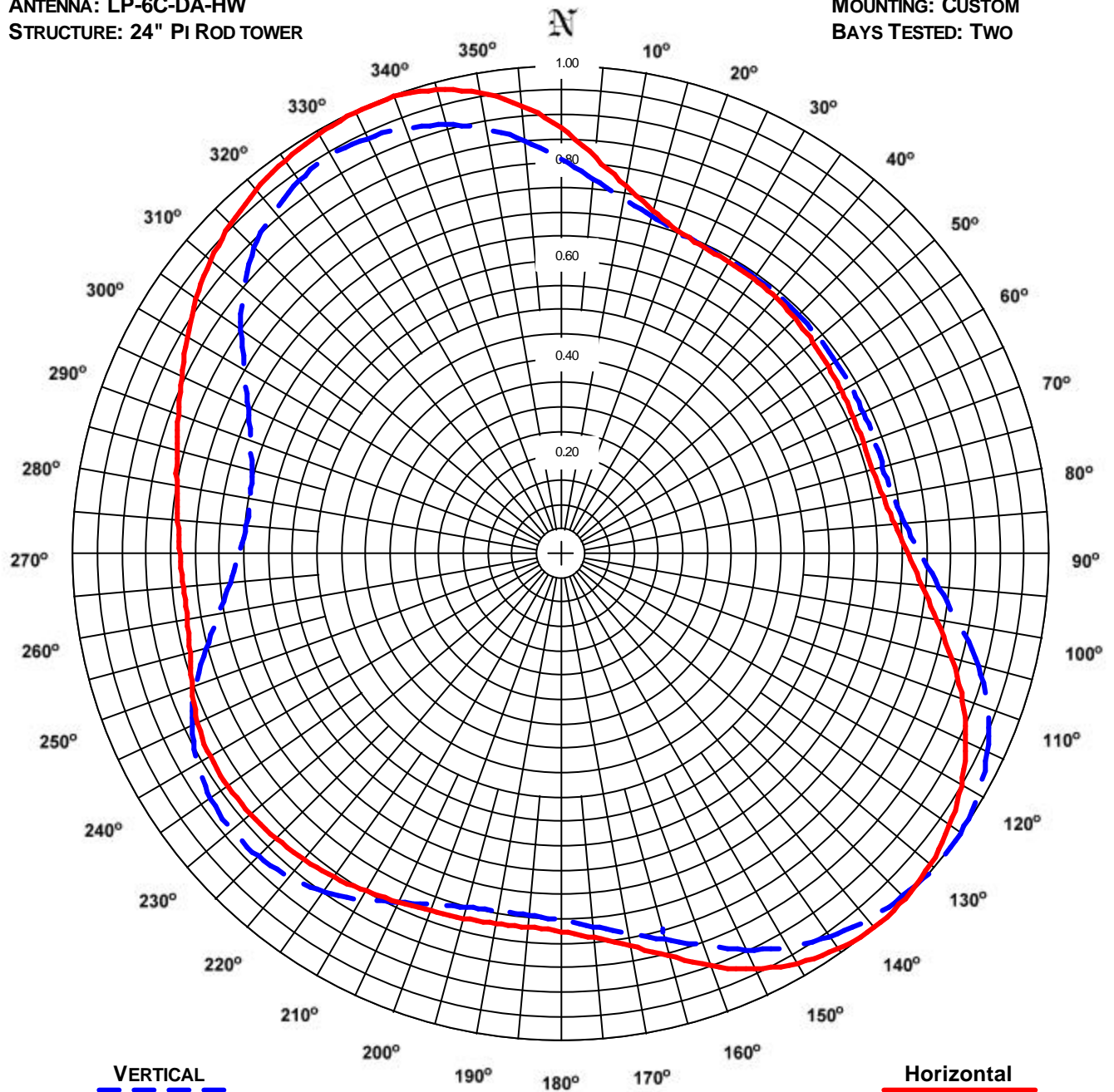


# **ERI**® *Horizontal Plane Relative Field Pattern*

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

FIGURE NO: 2  
STATION: WURK  
LOCATION: ELWOOD, IN  
ANTENNA: LP-6C-DA-HW  
STRUCTURE: 24" PI ROD TOWER

DATE: 4/20/05  
FREQUENCY: 101.7 MHz  
ORIENTATION: 60° TRUE  
MOUNTING: CUSTOM  
BAYS TESTED: TWO



RMS: 0.809  
MAXIMUM: 1.000 @ 127° TRUE  
MINIMUM: 0.645 @ 278° TRUE

RMS: 0.833  
Maximum: 1.000 @ 138° True  
Minimum: 0.661 @ 72° True

COMMENTS: MEASURED PATTERNS OF THE HORIZONTAL AND VERTICAL COMPONENTS.

# **ERI**® *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: WURK**  
**Location: Elwood, IN**  
**Frequency: 101.7 MHz**

**Antenna: LP-6C-DA-HW**  
**Orientation: 60° True**  
**Tower: 24" Pi Rod tower**

**Figure: 2**  
**Date: 4/20/05**  
**Reference: wurk1m.fig**

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.875	4.60	6.62	0.811	3.95	5.96	180°	0.773	3.59	5.55	0.751	3.39	5.30
5°	0.817	4.00	6.02	0.773	3.58	5.54	185°	0.767	3.53	5.48	0.743	3.31	5.20
10°	0.767	3.53	5.48	0.742	3.30	5.19	190°	0.769	3.55	5.50	0.742	3.31	5.19
15°	0.730	3.20	5.05	0.719	3.10	4.92	195°	0.772	3.58	5.54	0.750	3.37	5.28
20°	0.706	2.99	4.75	0.704	2.97	4.73	200°	0.778	3.64	5.61	0.765	3.51	5.45
25°	0.693	2.88	4.60	0.696	2.91	4.63	205°	0.787	3.71	5.70	0.788	3.72	5.71
30°	0.691	2.87	4.58	0.695	2.90	4.62	210°	0.797	3.81	5.81	0.818	4.01	6.03
35°	0.690	2.85	4.55	0.694	2.89	4.61	215°	0.809	3.92	5.94	0.845	4.28	6.32
40°	0.686	2.83	4.51	0.693	2.88	4.60	220°	0.818	4.01	6.04	0.864	4.48	6.52
45°	0.682	2.79	4.45	0.692	2.87	4.58	225°	0.825	4.08	6.11	0.876	4.61	6.64
50°	0.676	2.74	4.38	0.690	2.86	4.56	230°	0.829	4.13	6.16	0.881	4.66	6.68
55°	0.670	2.69	4.30	0.688	2.84	4.53	235°	0.832	4.15	6.18	0.875	4.59	6.62
60°	0.665	2.66	4.24	0.686	2.83	4.51	240°	0.830	4.14	6.16	0.859	4.43	6.47
65°	0.662	2.63	4.20	0.685	2.82	4.50	245°	0.821	4.04	6.07	0.834	4.17	6.20
70°	0.661	2.62	4.18	0.684	2.81	4.49	250°	0.804	3.88	5.89	0.798	3.82	5.83
75°	0.663	2.63	4.21	0.684	2.81	4.48	255°	0.787	3.72	5.70	0.754	3.41	5.32
80°	0.672	2.71	4.32	0.691	2.86	4.57	260°	0.778	3.63	5.60	0.712	3.04	4.83
85°	0.688	2.84	4.54	0.709	3.01	4.79	265°	0.777	3.62	5.59	0.681	2.78	4.44
90°	0.712	3.05	4.84	0.738	3.27	5.14	270°	0.781	3.66	5.63	0.659	2.61	4.16
95°	0.744	3.32	5.21	0.779	3.64	5.61	275°	0.788	3.73	5.72	0.647	2.51	4.00
100°	0.783	3.68	5.66	0.830	4.14	6.17	280°	0.800	3.84	5.84	0.646	2.51	3.99
105°	0.830	4.14	6.17	0.886	4.71	6.73	285°	0.815	3.99	6.01	0.656	2.59	4.13
110°	0.877	4.62	6.64	0.931	5.20	7.16	290°	0.835	4.18	6.21	0.677	2.75	4.39
115°	0.917	5.04	7.02	0.965	5.59	7.47	295°	0.858	4.42	6.45	0.708	3.01	4.78
120°	0.948	5.40	7.32	0.987	5.85	7.67	300°	0.885	4.70	6.72	0.749	3.36	5.27
125°	0.972	5.67	7.54	0.999	5.98	7.77	305°	0.913	5.00	6.99	0.800	3.84	5.84
130°	0.989	5.87	7.69	0.999	5.99	7.77	310°	0.937	5.27	7.22	0.849	4.33	6.36
135°	0.998	5.98	7.77	0.992	5.91	7.71	315°	0.957	5.50	7.40	0.888	4.73	6.75
140°	0.999	5.99	7.77	0.978	5.74	7.59	320°	0.973	5.69	7.55	0.917	5.05	7.03
145°	0.989	5.87	7.68	0.957	5.50	7.40	325°	0.986	5.83	7.66	0.935	5.25	7.20
150°	0.968	5.63	7.50	0.930	5.19	7.15	330°	0.994	5.93	7.73	0.944	5.34	7.28
155°	0.938	5.28	7.23	0.895	4.80	6.82	335°	0.999	5.99	7.77	0.941	5.31	7.25
160°	0.898	4.84	6.84	0.854	4.38	6.41	340°	0.999	5.98	7.77	0.930	5.19	7.15
165°	0.852	4.36	6.39	0.818	4.02	6.04	345°	0.986	5.84	7.66	0.912	4.99	6.98
170°	0.816	3.99	6.01	0.789	3.73	5.72	350°	0.962	5.55	7.44	0.886	4.71	6.73
175°	0.790	3.74	5.73	0.767	3.53	5.47	355°	0.925	5.13	7.10	0.852	4.36	6.39

<b>Polarization:</b>	<b>Horizontal</b>	<b>Vertical</b>
<b>Maximum Field:</b>	<b>1.000 @ 138° True</b>	<b>1.000 @ 127° True</b>
<b>Minimum Field:</b>	<b>0.661 @ 72° True</b>	<b>0.645 @ 278° True</b>
<b>RMS:</b>	<b>0.833</b>	<b>0.809</b>
<b>Maximum ERP:</b>	<b>6.000 kW</b>	<b>6.000 kW</b>
<b>Maximum Power Gain:</b>	<b>2.697 (4.309 dB)</b>	<b>2.697 (4.309 dB)</b>

**Total Input Power: 2.225 kW**





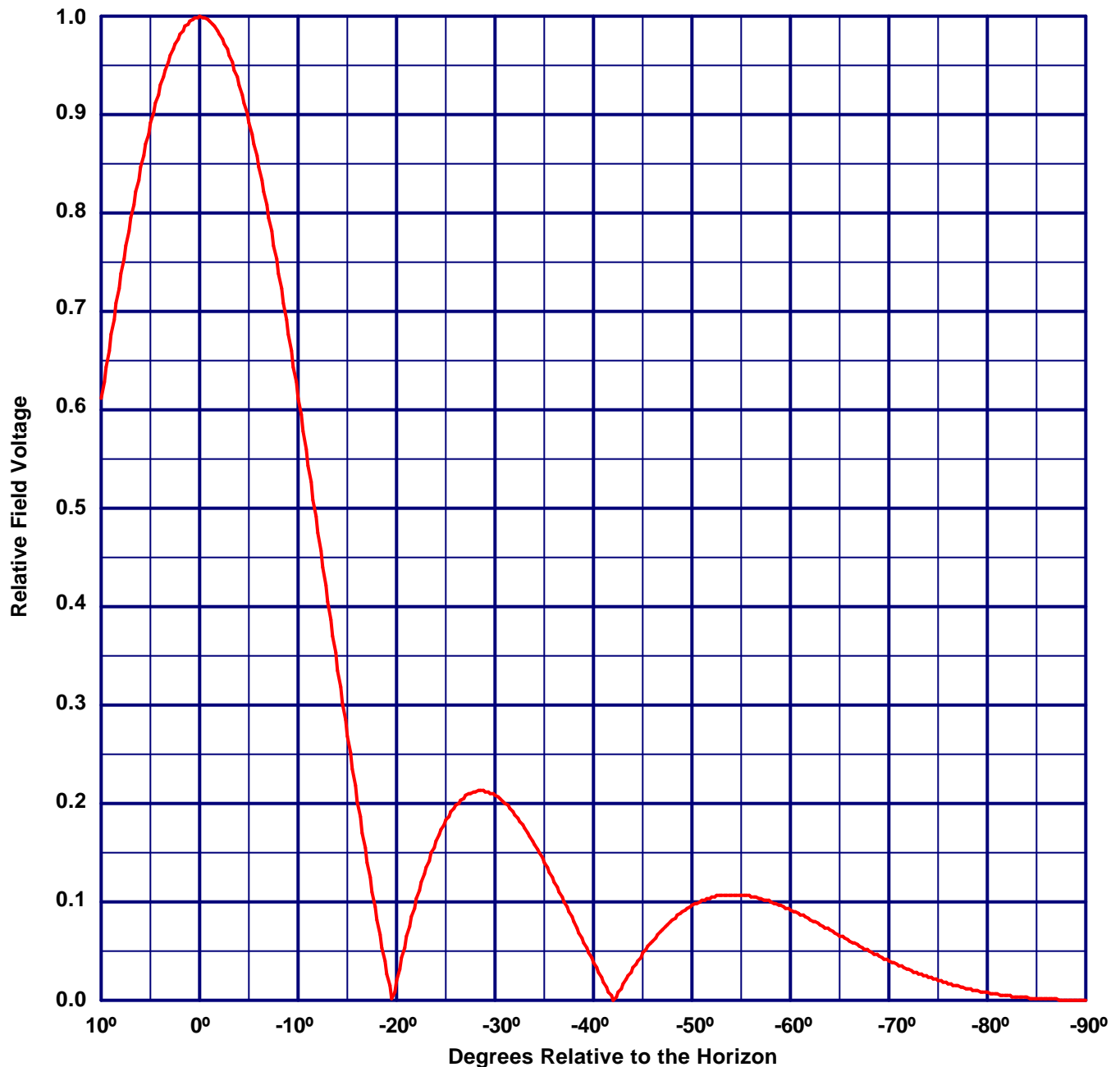
## Vertical Plane Relative Field Pattern

WURK, Elwood, IN, 101.7 MHz

Figure#: 3

Date: 4/20/05

A 6 level, .5 wave-length spaced LP-6C-DA-HW directional antenna  
with 0° beam tilt, 0% null fill and a H/V maximum power ratio of 1.000



Vertical Polarization Gain:

Maximum: 2.697 (4.309 dB)

Horizontal Plane: 2.697 (4.309 dB)

Horizontal Polarization Gain:

Maximum: 2.697 (4.309 dB)

Horizontal Plane: 2.697 (4.309 dB)

# Directional Antenna System for WURK, Elwood, Indiana

(Continued)

## ANTENNA SPECIFICATIONS

Antenna Type: LP-6C-DA-HW  
Frequency: 101.7 MHz  
Number of Bays: six

## MECHANICAL SPECIFICATIONS

Mounting: Custom  
System length: 27 ft 9 in  
Aperture length required: 39 ft.  
Orientation: 60° true  
Input flange to the antenna 1 5/8 inch female

## ELECTRICAL SPECIFICATIONS (For directional use)

Maximum horizontal ERP: 6 kW (7.782 dBk)  
Horizontal maximum power gain: 2.697 (4.309 dB)  
Maximum vertical ERP: 6 kW (7.782 dBk)  
Vertical maximum power gain: 2.697 (4.309 dB)  
Total input power: 2.225kW (3.473 dBk)

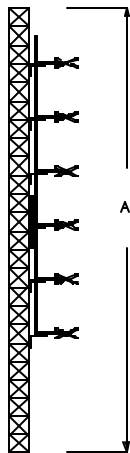


Figure #4

