

***Directional Antenna System
for
WUBU, South Bend, Indiana***

February 10, 2009

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 WUBU.

The antenna is the ERI model LP-2E-DA-HW configuration. The circular polarized system consists of two half-wavelength spaced bays using one driven circular polarized radiating element per bay and one horizontal parasitic element per bay. The antenna was tested on a 6 5/8" o.d. pole, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 106.3 megahertz, which is the center of the FM broadcast channel assigned to WUBU.

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 Proposed For WUBU, South Bend, Indiana

(Continued)

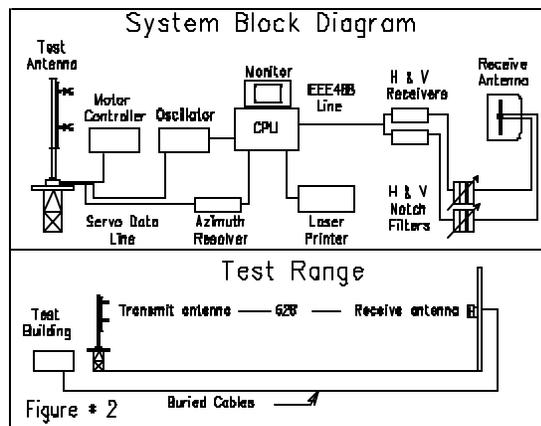
DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of a full-scale model of the complete circular polarized system with the associated horizontal parasitic element. 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 6 5/8" 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 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 106.3 MHz and was constantly monitored by a Rohde & Schwarz ESVD measuring receiver.



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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 Heliac 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.

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 two half-wavelength spaced bays using one driven circular polarized radiating element per bay and one horizontal parasitic element 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-2E-DA-HW array is to be mounted on the 6 5/8" o.d. pole at a bearing of North 294 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 3 kilowatts (4.771 dBk).

The power at North 110 degrees East does not exceed 0.750 kilowatts (-1.249 dBk).

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(Continued)

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 19 ft 7 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.



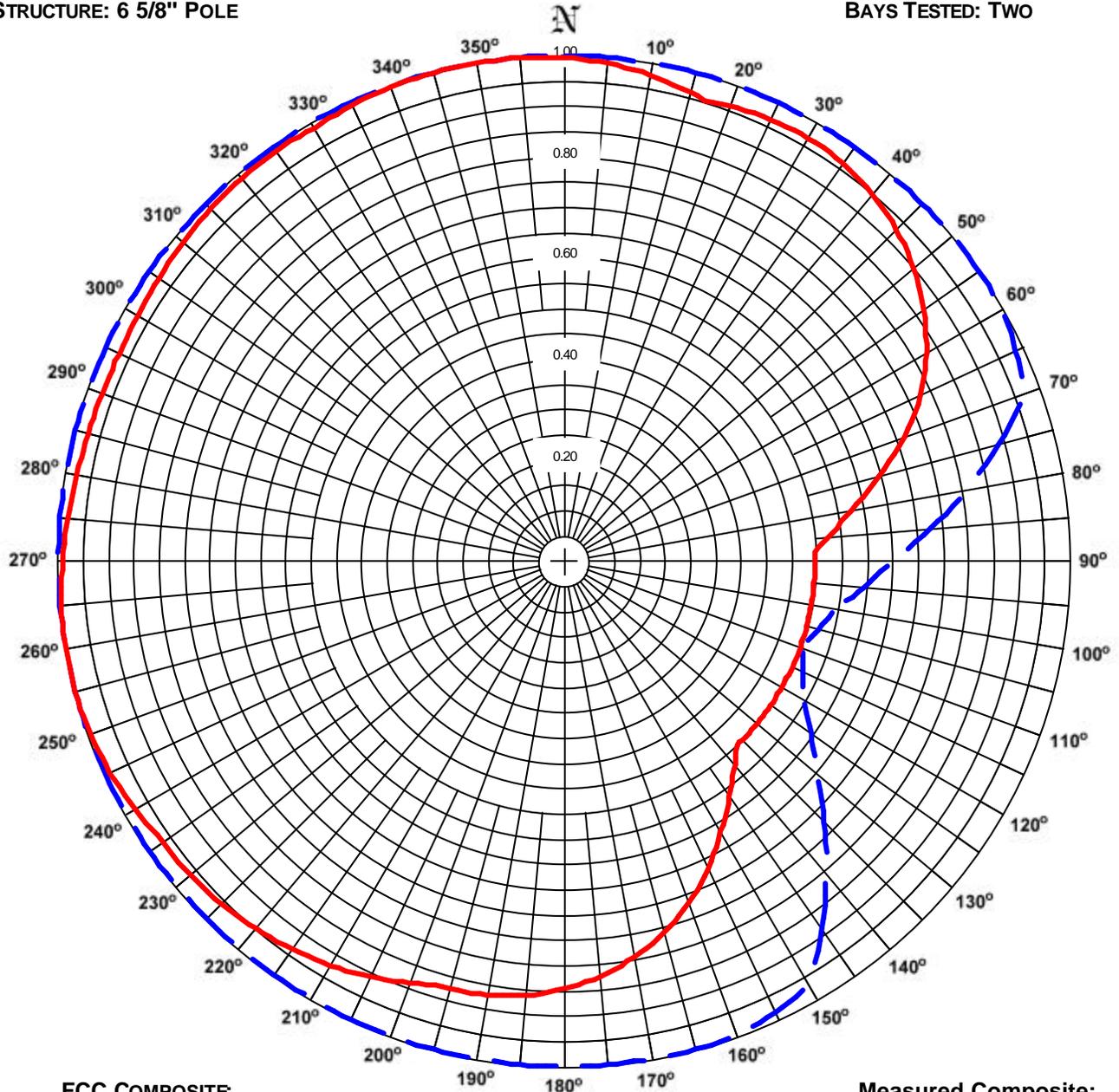
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ERI[®] Horizontal Plane Relative Field Pattern

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: WUBU
LOCATION: SOUTH BEND, IN
ANTENNA: LP-2E-DA-HW
STRUCTURE: 6 5/8" POLE

DATE: 2/9/2009
FREQUENCY: 106.3 MHz
ORIENTATION: 294° TRUE
MOUNTING: STANDARD
BAYS TESTED: TWO



 FCC COMPOSITE
RMS: 0.940
MAXIMUM: 1.000 @ 0° TRUE
MINIMUM: 0.500 @ 110° TRUE

 Measured Composite:
RMS: 0.862
Maximum: 1.000 @ 256° True
Minimum: 0.495 @ 91° 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-20040825AAG.

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: WUBU
Location: South Bend, IN
Frequency: 106.3 MHz

Antenna: LP-2E-DA-HW
Orientation: 294° True
Tower: 6 5/8" Pole

Figure: 1
Date: 2/9/2009
Reference: wubu2m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.995	2.97	4.73	H (and/or) V	180°	0.847	2.15	3.33	H (and/or) V
5°	0.988	2.93	4.66	H (and/or) V	185°	0.862	2.23	3.49	H (and/or) V
10°	0.976	2.86	4.56	H (and/or) V	190°	0.871	2.28	3.58	H (and/or) V
15°	0.960	2.77	4.42	H (and/or) V	195°	0.875	2.30	3.61	H (and/or) V
20°	0.957	2.75	4.39	H (and/or) V	200°	0.889	2.37	3.75	H (and/or) V
25°	0.964	2.79	4.45	H (and/or) V	205°	0.907	2.47	3.93	H (and/or) V
30°	0.966	2.80	4.47	H (and/or) V	210°	0.924	2.56	4.08	H (and/or) V
35°	0.960	2.77	4.42	H (and/or) V	215°	0.937	2.64	4.21	H (and/or) V
40°	0.947	2.69	4.30	H (and/or) V	220°	0.949	2.70	4.32	H (and/or) V
45°	0.928	2.58	4.12	H (and/or) V	225°	0.958	2.75	4.40	H (and/or) V
50°	0.901	2.44	3.87	H (and/or) V	230°	0.965	2.79	4.46	H (and/or) V
55°	0.867	2.26	3.53	H (and/or) V	235°	0.970	2.82	4.50	H (and/or) V
60°	0.826	2.05	3.11	H (and/or) V	240°	0.980	2.88	4.60	H (and/or) V
65°	0.778	1.81	2.59	H (and/or) V	245°	0.990	2.94	4.68	H (and/or) V
70°	0.715	1.53	1.85	H (and/or) V	250°	0.996	2.98	4.74	H (and/or) V
75°	0.643	1.24	0.94	H (and/or) V	255°	1.000	3.00	4.77	H (and/or) V
80°	0.577	1.00	0.00	H (and/or) V	260°	0.999	3.00	4.77	H (and/or) V
85°	0.521	0.81	-0.89	H (and/or) V	265°	0.998	2.99	4.75	H (and/or) V
90°	0.495	0.74	-1.33	H (and/or) V	270°	0.991	2.95	4.69	H (and/or) V
95°	0.495	0.74	-1.33	H (and/or) V	275°	0.985	2.91	4.64	H (and/or) V
100°	0.496	0.74	-1.33	H (and/or) V	280°	0.978	2.87	4.58	H (and/or) V
105°	0.496	0.74	-1.32	H (and/or) V	285°	0.974	2.85	4.55	H (and/or) V
110°	0.497	0.74	-1.31	H (and/or) V	290°	0.971	2.83	4.52	H (and/or) V
115°	0.497	0.74	-1.30	H (and/or) V	295°	0.971	2.83	4.52	H (and/or) V
120°	0.497	0.74	-1.29	H (and/or) V	300°	0.973	2.84	4.53	H (and/or) V
125°	0.498	0.74	-1.29	H (and/or) V	305°	0.976	2.86	4.56	H (and/or) V
130°	0.498	0.74	-1.29	H (and/or) V	310°	0.982	2.89	4.62	H (and/or) V
135°	0.499	0.75	-1.26	H (and/or) V	315°	0.987	2.92	4.66	H (and/or) V
140°	0.524	0.83	-0.83	H (and/or) V	320°	0.990	2.94	4.68	H (and/or) V
145°	0.569	0.97	-0.13	H (and/or) V	325°	0.991	2.95	4.69	H (and/or) V
150°	0.619	1.15	0.61	H (and/or) V	330°	0.990	2.94	4.68	H (and/or) V
155°	0.672	1.35	1.31	H (and/or) V	335°	0.995	2.97	4.72	H (and/or) V
160°	0.719	1.55	1.91	H (and/or) V	340°	0.999	2.99	4.76	H (and/or) V
165°	0.761	1.74	2.40	H (and/or) V	345°	1.000	3.00	4.77	H (and/or) V
170°	0.796	1.90	2.79	H (and/or) V	350°	1.000	3.00	4.77	H (and/or) V
175°	0.825	2.04	3.10	H (and/or) V	355°	0.999	3.00	4.77	H (and/or) V

Polarization:
Maximum Field: 1.000 @ 256° True
Minimum Field: 0.495 @ 91° True
RMS: 0.862
Maximum ERP: 3.000 kW
Maximum Power Gain: 0.961 (-0.174 dB)

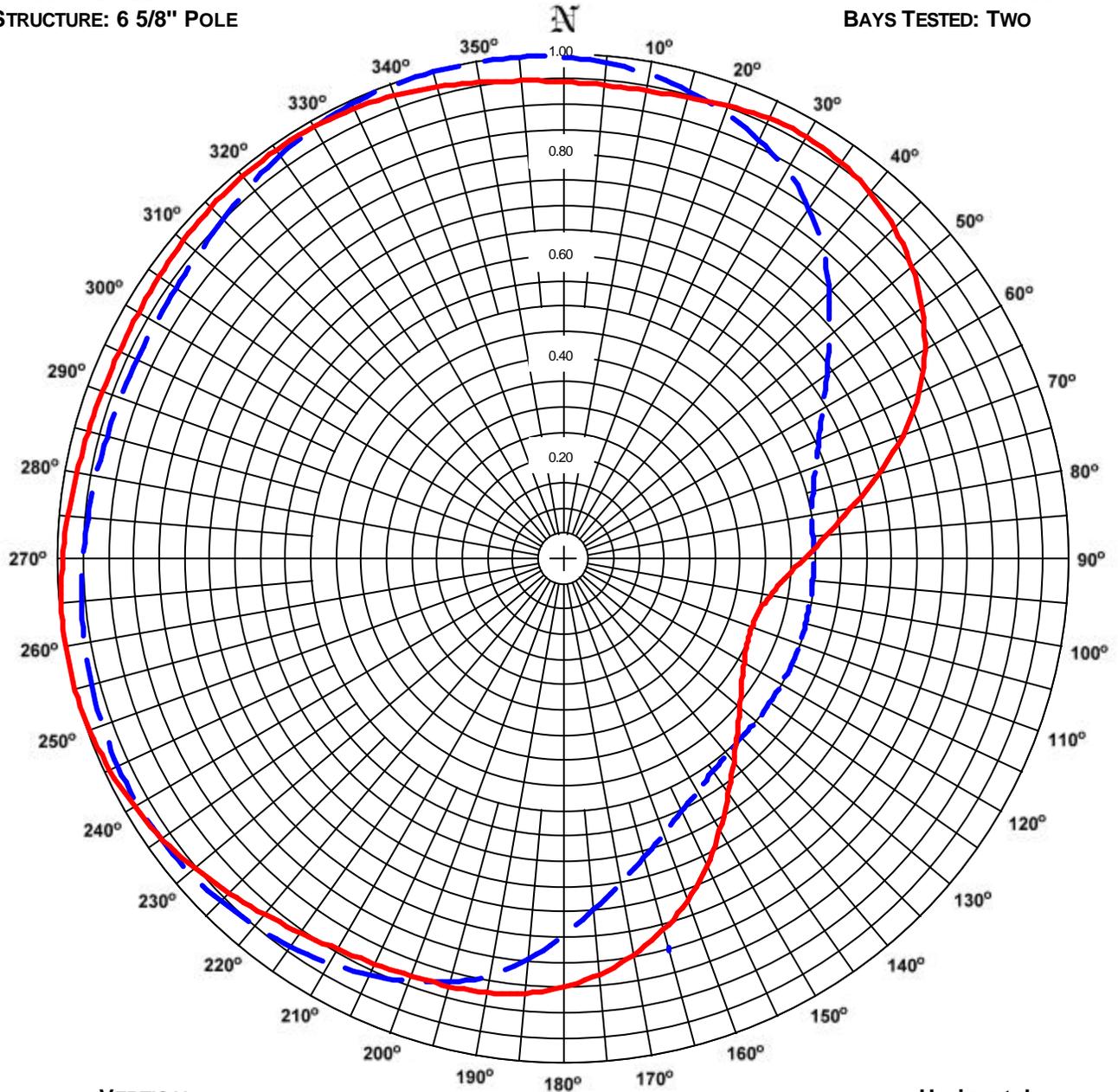
Total Input Power: 3.123 kW

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: WUBU
LOCATION: SOUTH BEND, IN
ANTENNA: LP-2E-DA-HW
STRUCTURE: 6 5/8" POLE

DATE: 2/9/2009
FREQUENCY: 106.3 MHz
ORIENTATION: 294° TRUE
MOUNTING: STANDARD
BAYS TESTED: TWO



VERTICAL

RMS: 0.817
MAXIMUM: 1.000 @ 344° TRUE
MINIMUM: 0.495 @ 91° TRUE

Horizontal

RMS: 0.850
Maximum: 1.000 @ 256° True
Minimum: 0.396 @ 110° 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: WUBU
Location: South Bend, IN
Frequency: 106.3 MHz

Antenna: LP-2E-DA-HW
Orientation: 294° True
Tower: 6 5/8" Pole

Figure: 2
Date: 2/9/2009
Reference: wubu2m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.947	2.69	4.30	0.995	2.97	4.73	180°	0.847	2.15	3.33	0.745	1.67	2.22
5°	0.944	2.67	4.27	0.988	2.93	4.66	185°	0.862	2.23	3.49	0.794	1.89	2.77
10°	0.943	2.67	4.26	0.976	2.86	4.56	190°	0.871	2.28	3.58	0.836	2.10	3.22
15°	0.948	2.70	4.31	0.960	2.77	4.42	195°	0.875	2.30	3.61	0.867	2.25	3.53
20°	0.957	2.75	4.39	0.941	2.65	4.24	200°	0.878	2.31	3.64	0.889	2.37	3.75
25°	0.964	2.79	4.45	0.916	2.52	4.01	205°	0.883	2.34	3.69	0.907	2.47	3.93
30°	0.966	2.80	4.47	0.888	2.37	3.74	210°	0.892	2.39	3.78	0.924	2.56	4.08
35°	0.960	2.77	4.42	0.849	2.16	3.35	215°	0.903	2.45	3.89	0.937	2.64	4.21
40°	0.947	2.69	4.30	0.800	1.92	2.83	220°	0.918	2.53	4.02	0.949	2.70	4.32
45°	0.928	2.58	4.12	0.744	1.66	2.21	225°	0.935	2.62	4.18	0.958	2.75	4.40
50°	0.901	2.44	3.87	0.688	1.42	1.52	230°	0.952	2.72	4.35	0.965	2.79	4.46
55°	0.867	2.26	3.53	0.637	1.22	0.85	235°	0.968	2.81	4.49	0.970	2.82	4.50
60°	0.826	2.05	3.11	0.593	1.06	0.24	240°	0.980	2.88	4.60	0.972	2.83	4.52
65°	0.778	1.81	2.59	0.558	0.93	-0.30	245°	0.990	2.94	4.68	0.972	2.83	4.52
70°	0.715	1.53	1.85	0.531	0.84	-0.73	250°	0.996	2.98	4.74	0.970	2.82	4.51
75°	0.643	1.24	0.94	0.511	0.78	-1.05	255°	1.000	3.00	4.77	0.967	2.80	4.48
80°	0.577	1.00	0.00	0.500	0.75	-1.25	260°	0.999	3.00	4.77	0.963	2.78	4.44
85°	0.521	0.81	-0.89	0.496	0.74	-1.32	265°	0.998	2.99	4.75	0.957	2.75	4.39
90°	0.475	0.68	-1.69	0.495	0.74	-1.33	270°	0.991	2.95	4.69	0.951	2.71	4.33
95°	0.440	0.58	-2.36	0.495	0.74	-1.33	275°	0.985	2.91	4.64	0.944	2.68	4.28
100°	0.415	0.52	-2.87	0.496	0.74	-1.33	280°	0.978	2.87	4.58	0.940	2.65	4.23
105°	0.400	0.48	-3.18	0.496	0.74	-1.32	285°	0.974	2.85	4.55	0.936	2.63	4.20
110°	0.396	0.47	-3.27	0.497	0.74	-1.31	290°	0.971	2.83	4.52	0.933	2.61	4.17
115°	0.401	0.48	-3.16	0.497	0.74	-1.30	295°	0.971	2.83	4.52	0.932	2.61	4.16
120°	0.413	0.51	-2.92	0.497	0.74	-1.29	300°	0.973	2.84	4.53	0.933	2.61	4.17
125°	0.431	0.56	-2.54	0.498	0.74	-1.29	305°	0.976	2.86	4.56	0.936	2.63	4.20
130°	0.456	0.62	-2.06	0.498	0.74	-1.29	310°	0.982	2.89	4.62	0.943	2.67	4.26
135°	0.487	0.71	-1.48	0.499	0.75	-1.26	315°	0.987	2.92	4.66	0.952	2.72	4.35
140°	0.524	0.83	-0.83	0.504	0.76	-1.18	320°	0.990	2.94	4.68	0.965	2.79	4.46
145°	0.569	0.97	-0.13	0.514	0.79	-1.00	325°	0.991	2.95	4.69	0.978	2.87	4.57
150°	0.619	1.15	0.61	0.530	0.84	-0.74	330°	0.990	2.94	4.68	0.988	2.93	4.66
155°	0.672	1.35	1.31	0.552	0.91	-0.39	335°	0.985	2.91	4.64	0.995	2.97	4.72
160°	0.719	1.55	1.91	0.579	1.01	0.03	340°	0.979	2.87	4.59	0.999	2.99	4.76
165°	0.761	1.74	2.40	0.612	1.12	0.51	345°	0.970	2.82	4.51	1.000	3.00	4.77
170°	0.796	1.90	2.79	0.651	1.27	1.04	350°	0.960	2.77	4.42	1.000	3.00	4.77
175°	0.825	2.04	3.10	0.695	1.45	1.62	355°	0.952	2.72	4.35	0.999	3.00	4.77

Polarization:	Horizontal	Vertical
Maximum Field:	1.000 @ 256° True	1.000 @ 344° True
Minimum Field:	0.396 @ 110° True	0.495 @ 91° True
RMS:	0.850	0.817
Maximum ERP:	3.000 kW	3.000 kW
Maximum Power Gain:	0.961 (-0.174 dB)	0.961 (-0.174 dB)

Total Input Power: 3.123 kW

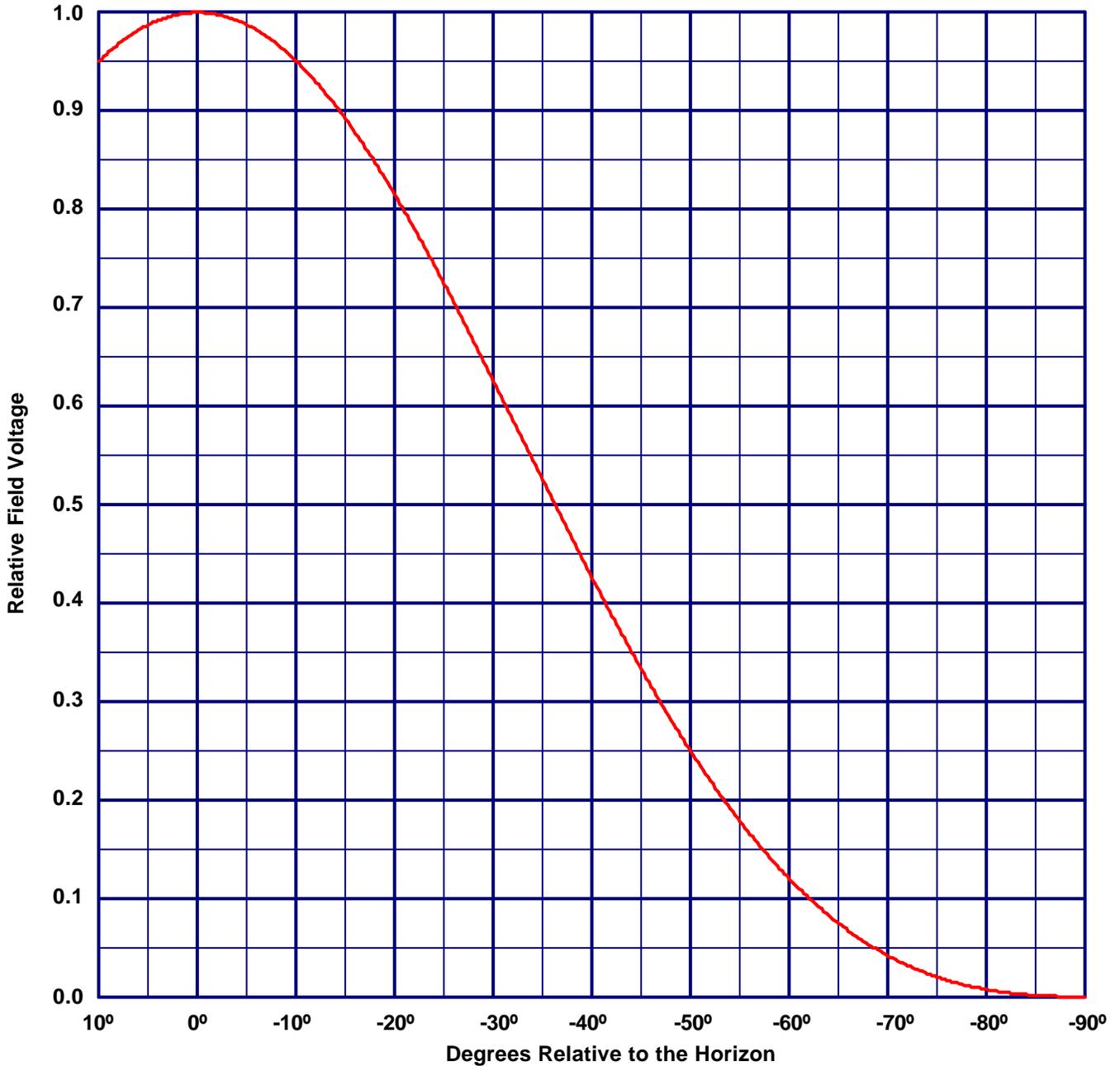


Vertical Plane Relative Field Pattern

WUBU, South Bend, IN, 106.3 MHz

Figure#: 3 Date: 2/9/2009

A 2 level, .5 wave-length spaced LP-2E-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: 0.961 (-0.174 dB)
Horizontal Plane: 0.961 (-0.174 dB)

Horizontal Polarization Gain:
Maximum: 0.961 (-0.174 dB)
Horizontal Plane: 0.961 (-0.174 dB)

Directional Antenna System for WUBU, South Bend, Indiana

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	LP-2E-DA-HW
Frequency:	106.3 MHz
Number of Bays:	Two

MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	12 ft 11 in
Aperture length required:	19 ft 7 in
Orientation:	294° true

Input flange to the antenna 1 5/8" female.

ELECTRICAL SPECIFICATIONS

(For directional use)

Maximum horizontal ERP:	3.000 kW (4.771 dBk)
Horizontal maximum power gain:	0.961 (-0.174 dB)
Maximum vertical ERP:	3.000 kW (4.771 dBk)
Vertical maximum power gain:	0.961 (-0.174 dB)
Total input power:	3.123 kW (4.946 dBk)

