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 WBKY, Stoughton, Wisconsin

November 17, 2022

Electronics Research Inc. is providing a new FM directional antenna system that is specially designed to meet the FCC requirements and the general needs of radio station WBKY.

The antenna is the ERI model LP-2E-DA configuration. The circular polarized system consists of two full-wavelength spaced bays using one driven circular polarized radiating element, four horizontal parasitic elements and two vertical parasitic elements per bay. The antenna was mounted on the North 303 degrees East tower leg with bracketry to provide an antenna orientation of North 266 degrees East. The antenna was tested on a 42" Allied tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 95.9 megahertz, which is the center of the FM broadcast channel assigned to WBKY.

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
WBKY, Stoughton, Wisconsin

(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 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 42" Allied 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.

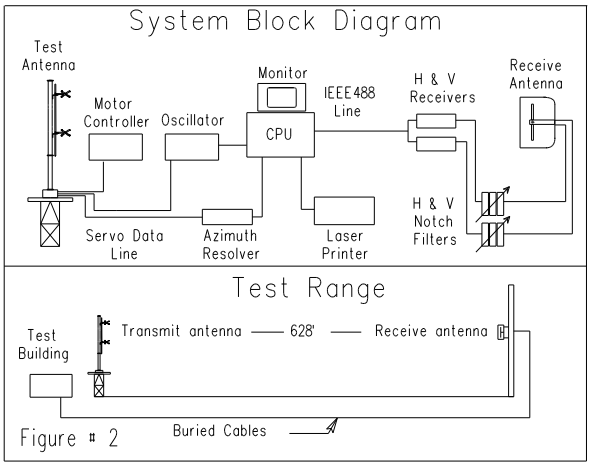

Figure # 2

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 95.9 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.

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

The LP-2E-DA array is to be mounted on the North 335 degrees East tower face of the 42" face tower at a bearing of North 335 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 measured individual horizontal and vertical components, the composite maximum of either the horizontal or vertical component at any azimuth and the FCC filed envelope pattern. The horizontal plane relative field list for the composite pattern and the individual H & V components are shown as Figure #65A.

Directional Antenna System
for
WBKY, Stoughton, Wisconsin

(Continued)

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 2.00 kilowatts (3.010 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 #65A 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 25 feet 3 inches.

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.

Test Range Director
Electronics Research, Inc.

ERI® Horizontal Plane Relative Field Pattern

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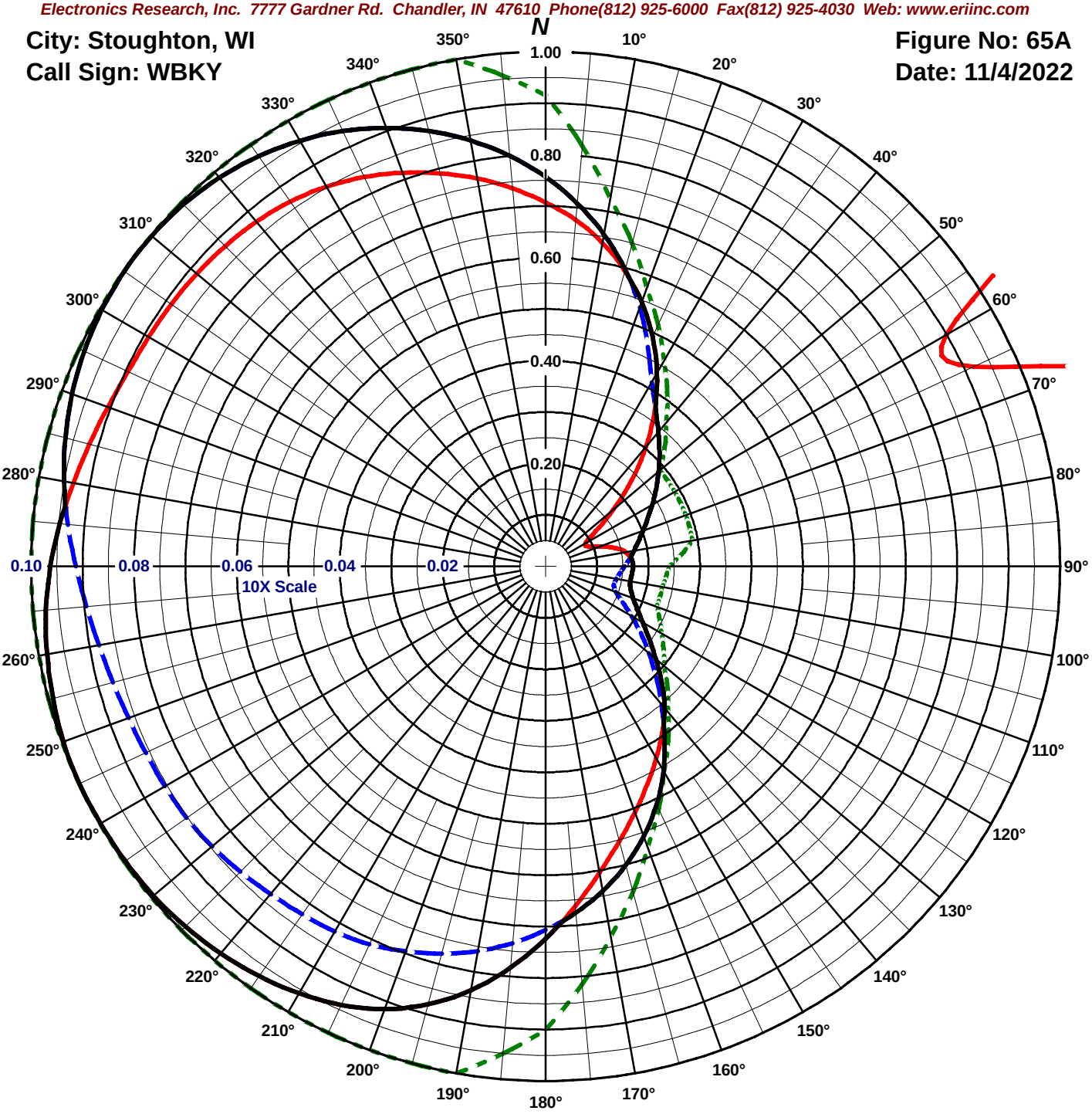
City: Stoughton, WI
Call Sign: WBKY

Figure No: 65A
Date: 11/4/2022



Antenna Orientation: 266° True

Frequency: 95.9 MHz
Antenna Type: LP-2E-DA

Antenna Mounting: 26" radome brkt
Tower Type: 42" Allied

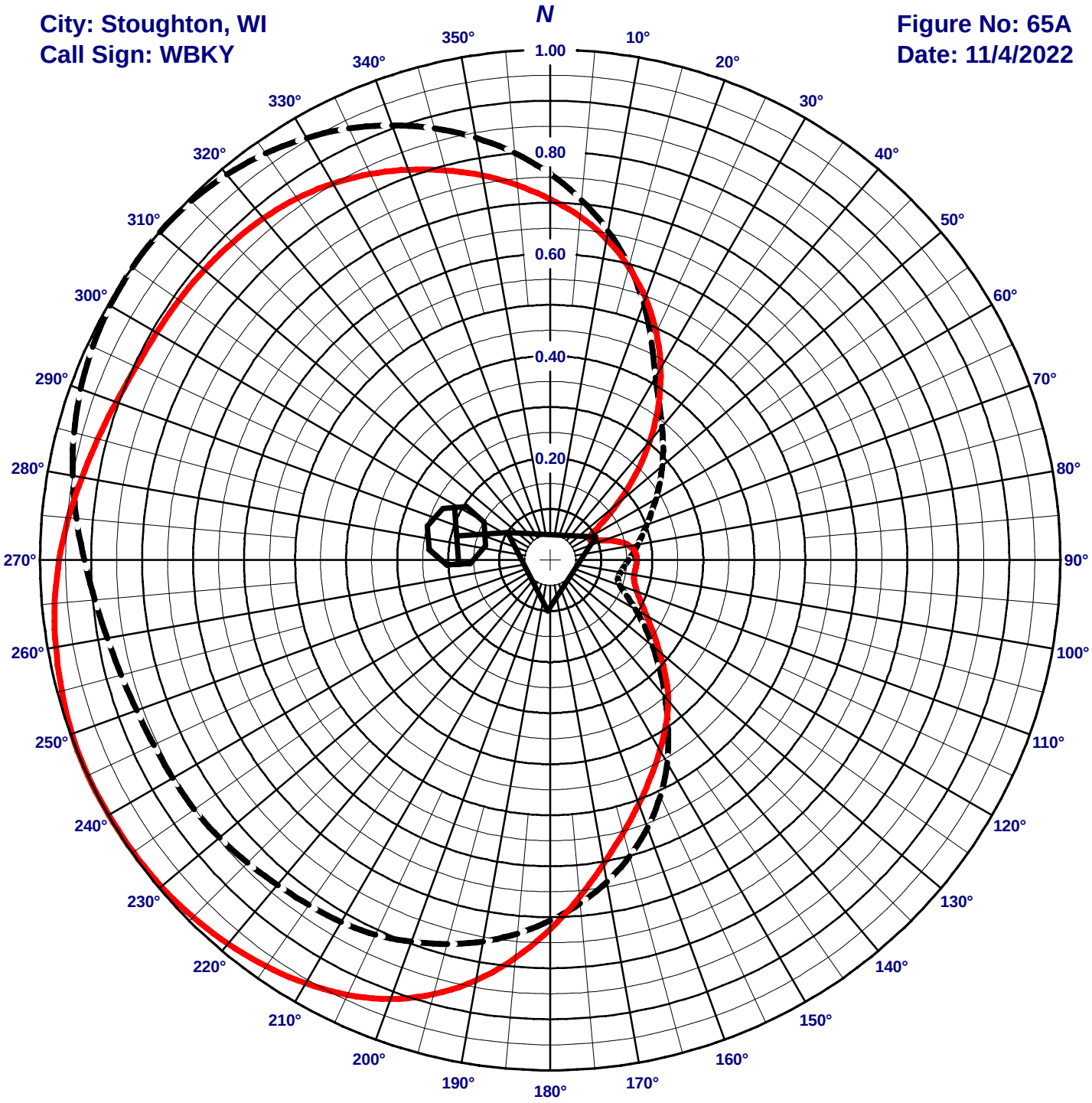
HORIZONTAL	VERTICAL	COMPOSITE	FCC ENVELOPE
RMS: .698	RMS: .69	RMS: .73	RMS: .776
Maximum: 1 @ 244°	Maximum: 1 @ 307°	Maximum: 1 @ 244°	Maximum: 1 @ 190°
Minimum: .087 @ 62°	Minimum: .137 @ 104°	Minimum: .167 @ 84°	Minimum: .23 @ 100°

Two bay test. Fiberglass anti-rotation brackets. 14" centerline. Horizontal and vertical parasites.

ERI® Horizontal Plane Relative Field Pattern

City: Stoughton, WI
Call Sign: WBKY

Figure No: 65A
Date: 11/4/2022



Frequency: 95.9 MHz
Antenna Type: LP-2E-DA
Antenna Orientation: 266° True
Antenna Mounting: 26" radome brkt
Tower Type 42" Allied

VERTICAL	HORIZONTAL
RMS: .69	RMS: .698
Maximum: 1 @ 307°	Maximum: 1 @ 244°
Minimum: .137 @ 104°	Minimum: .087 @ 62°

Two bay test. Fiberglass anti-rotation brackets. 14" center line. Horizontal and vertical parasites.
The antenna is mounted on the 303° tower leg.

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ERI® Horizontal Plane Relative Field Pattern

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Figure# 65A
Station: WBKY
Location: Stoughton, WI
Frequency: 95.9 MHz

Date: 11/4/2022
Antenna: LP-2E-DA
Antenna Orientation: 266° True
Number of Bays: 2

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.707	1.000	0.002	0.757	1.145	0.589	180°	0.723	1.046	0.197	0.707	0.999	-0.004
5°	0.675	0.912	-0.400	0.708	1.002	0.009	185°	0.783	1.225	0.881	0.735	1.080	0.333
10°	0.638	0.814	-0.891	0.655	0.857	-0.668	190°	0.836	1.399	1.458	0.759	1.152	0.614
15°	0.595	0.707	-1.505	0.597	0.714	-1.466	195°	0.881	1.552	1.908	0.779	1.214	0.840
20°	0.546	0.596	-2.247	0.535	0.573	-2.416	200°	0.915	1.676	2.242	0.796	1.267	1.027
25°	0.492	0.484	-3.150	0.470	0.442	-3.545	205°	0.940	1.768	2.475	0.810	1.312	1.180
30°	0.433	0.375	-4.262	0.413	0.341	-4.671	210°	0.958	1.836	2.638	0.819	1.343	1.281
35°	0.370	0.274	-5.627	0.372	0.277	-5.570	215°	0.972	1.888	2.760	0.825	1.362	1.341
40°	0.304	0.184	-7.343	0.341	0.233	-6.334	220°	0.982	1.928	2.852	0.831	1.382	1.404
45°	0.236	0.112	-9.518	0.313	0.196	-7.076	225°	0.990	1.960	2.922	0.839	1.408	1.485
50°	0.172	0.059	-12.275	0.287	0.165	-7.831	230°	0.995	1.981	2.969	0.846	1.433	1.562
55°	0.119	0.028	-15.491	0.262	0.138	-8.616	235°	0.998	1.991	2.991	0.852	1.450	1.614
60°	0.090	0.016	-17.917	0.239	0.114	-9.416	240°	0.999	1.997	3.003	0.854	1.460	1.643
65°	0.092	0.017	-17.727	0.219	0.096	-10.192	245°	1.000	2.000	3.010	0.857	1.470	1.673
70°	0.114	0.026	-15.870	0.201	0.081	-10.914	250°	0.997	1.990	2.988	0.862	1.488	1.725
75°	0.139	0.039	-14.109	0.187	0.070	-11.571	255°	0.991	1.965	2.935	0.871	1.516	1.806
80°	0.158	0.050	-13.004	0.174	0.061	-12.165	260°	0.984	1.936	2.869	0.882	1.555	1.916
85°	0.168	0.056	-12.492	0.163	0.053	-12.727	265°	0.975	1.901	2.789	0.896	1.605	2.055
90°	0.170	0.058	-12.371	0.153	0.047	-13.282	270°	0.963	1.853	2.679	0.913	1.667	2.220
95°	0.168	0.057	-12.465	0.145	0.042	-13.750	275°	0.948	1.797	2.545	0.932	1.738	2.400
100°	0.167	0.056	-12.514	0.140	0.039	-14.095	280°	0.932	1.738	2.399	0.950	1.807	2.569
105°	0.171	0.059	-12.320	0.137	0.038	-14.226	285°	0.918	1.685	2.266	0.966	1.868	2.713
110°	0.181	0.065	-11.844	0.145	0.042	-13.737	290°	0.905	1.640	2.147	0.979	1.918	2.829
115°	0.196	0.077	-11.123	0.166	0.055	-12.605	295°	0.896	1.606	2.057	0.989	1.957	2.916
120°	0.218	0.095	-10.214	0.193	0.075	-11.263	300°	0.891	1.587	2.005	0.996	1.984	2.975
125°	0.246	0.121	-9.176	0.226	0.102	-9.920	305°	0.888	1.578	1.981	1.000	1.998	3.007
130°	0.280	0.156	-8.061	0.262	0.138	-8.614	310°	0.885	1.567	1.950	0.999	1.998	3.005
135°	0.319	0.204	-6.908	0.304	0.184	-7.342	315°	0.880	1.549	1.902	0.995	1.980	2.967
140°	0.360	0.259	-5.872	0.350	0.246	-6.098	320°	0.874	1.529	1.845	0.986	1.945	2.889
145°	0.395	0.312	-5.057	0.403	0.325	-4.882	325°	0.865	1.498	1.755	0.973	1.893	2.772
150°	0.430	0.370	-4.320	0.458	0.420	-3.764	330°	0.852	1.451	1.617	0.955	1.825	2.612
155°	0.467	0.437	-3.594	0.510	0.521	-2.831	335°	0.835	1.394	1.442	0.933	1.741	2.409
160°	0.508	0.517	-2.869	0.558	0.623	-2.057	340°	0.814	1.325	1.221	0.907	1.644	2.159
165°	0.553	0.612	-2.134	0.601	0.723	-1.408	345°	0.791	1.250	0.969	0.876	1.534	1.857
170°	0.604	0.730	-1.364	0.640	0.820	-0.861	350°	0.765	1.171	0.687	0.840	1.412	1.499
175°	0.663	0.878	-0.566	0.675	0.912	-0.400	355°	0.737	1.087	0.364	0.801	1.282	1.078

Horizontal Polarization:
Maximum: 1.966 (2.936 dB)
Horizontal Plane: 1.966 (2.936 dB)
Maximum ERP: 2.000 kW

Vertical Polarization:
Maximum: 1.966 (2.936 dB)
Horizontal Plane: 1.966 (2.936 dB)
Maximum ERP: 2.000 kW

Total Input Power: 1.017 kW
Reference: WBKY65A.FIG

ERI® Horizontal Plane Relative Field Pattern

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Figure# 1 **Date: 11/4/2022**
Station: WBKY **Antenna: LP-2E-DA**
Location: Stoughton, WI **Antenna Orientation: 266° True**
Frequency: 95.9 MHz **Number of Bays: 2**

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.757	1.145	0.589	Vertical	180°	0.723	1.046	0.197	Horizontal
5°	0.708	1.002	0.009	Vertical	185°	0.783	1.225	0.881	Horizontal
10°	0.655	0.857	-0.668	Vertical	190°	0.836	1.399	1.458	Horizontal
15°	0.597	0.714	-1.466	Vertical	195°	0.881	1.552	1.908	Horizontal
20°	0.546	0.596	-2.247	Horizontal	200°	0.915	1.676	2.242	Horizontal
25°	0.492	0.484	-3.150	Horizontal	205°	0.940	1.768	2.475	Horizontal
30°	0.433	0.375	-4.262	Horizontal	210°	0.958	1.836	2.638	Horizontal
35°	0.372	0.277	-5.570	Vertical	215°	0.972	1.888	2.760	Horizontal
40°	0.341	0.233	-6.334	Vertical	220°	0.982	1.928	2.852	Horizontal
45°	0.313	0.196	-7.076	Vertical	225°	0.990	1.960	2.922	Horizontal
50°	0.287	0.165	-7.831	Vertical	230°	0.995	1.981	2.969	Horizontal
55°	0.262	0.138	-8.616	Vertical	235°	0.998	1.991	2.991	Horizontal
60°	0.239	0.114	-9.416	Vertical	240°	0.999	1.997	3.003	Horizontal
65°	0.219	0.096	-10.192	Vertical	245°	1.000	2.000	3.010	Horizontal
70°	0.201	0.081	-10.914	Vertical	250°	0.997	1.990	2.988	Horizontal
75°	0.187	0.070	-11.571	Vertical	255°	0.991	1.965	2.935	Horizontal
80°	0.174	0.061	-12.165	Vertical	260°	0.984	1.936	2.869	Horizontal
85°	0.168	0.056	-12.492	Horizontal	265°	0.975	1.901	2.789	Horizontal
90°	0.170	0.058	-12.371	Horizontal	270°	0.963	1.853	2.679	Horizontal
95°	0.168	0.057	-12.465	Horizontal	275°	0.948	1.797	2.545	Horizontal
100°	0.167	0.056	-12.514	Horizontal	280°	0.950	1.807	2.569	Vertical
105°	0.171	0.059	-12.320	Horizontal	285°	0.966	1.868	2.713	Vertical
110°	0.181	0.065	-11.844	Horizontal	290°	0.979	1.918	2.829	Vertical
115°	0.196	0.077	-11.123	Horizontal	295°	0.989	1.957	2.916	Vertical
120°	0.218	0.095	-10.214	Horizontal	300°	0.996	1.984	2.975	Vertical
125°	0.246	0.121	-9.176	Horizontal	305°	1.000	1.998	3.007	Vertical
130°	0.280	0.156	-8.061	Horizontal	310°	0.999	1.998	3.005	Vertical
135°	0.319	0.204	-6.908	Horizontal	315°	0.995	1.980	2.967	Vertical
140°	0.360	0.259	-5.872	Horizontal	320°	0.986	1.945	2.889	Vertical
145°	0.403	0.325	-4.882	Vertical	325°	0.973	1.893	2.772	Vertical
150°	0.458	0.420	-3.764	Vertical	330°	0.955	1.825	2.612	Vertical
155°	0.510	0.521	-2.831	Vertical	335°	0.933	1.741	2.409	Vertical
160°	0.558	0.623	-2.057	Vertical	340°	0.907	1.644	2.159	Vertical
165°	0.601	0.723	-1.408	Vertical	345°	0.876	1.534	1.857	Vertical
170°	0.640	0.820	-0.861	Vertical	350°	0.840	1.412	1.499	Vertical
175°	0.675	0.912	-0.400	Vertical	355°	0.801	1.282	1.078	Vertical

Horizontal Polarization:
Maximum: 1.966 (2.936 dB)
Horizontal Plane: 1.966 (2.936 dB)
Maximum ERP: 2.000 kW

Vertical Polarization:
Maximum: 1.966 (2.936 dB)
Horizontal Plane: 1.966 (2.936 dB)
Maximum ERP: 2.000 kW

Total Input Power: 1.017 kW
Reference: WBKY65A.FIG

Vertical Plane Relative Field Pattern

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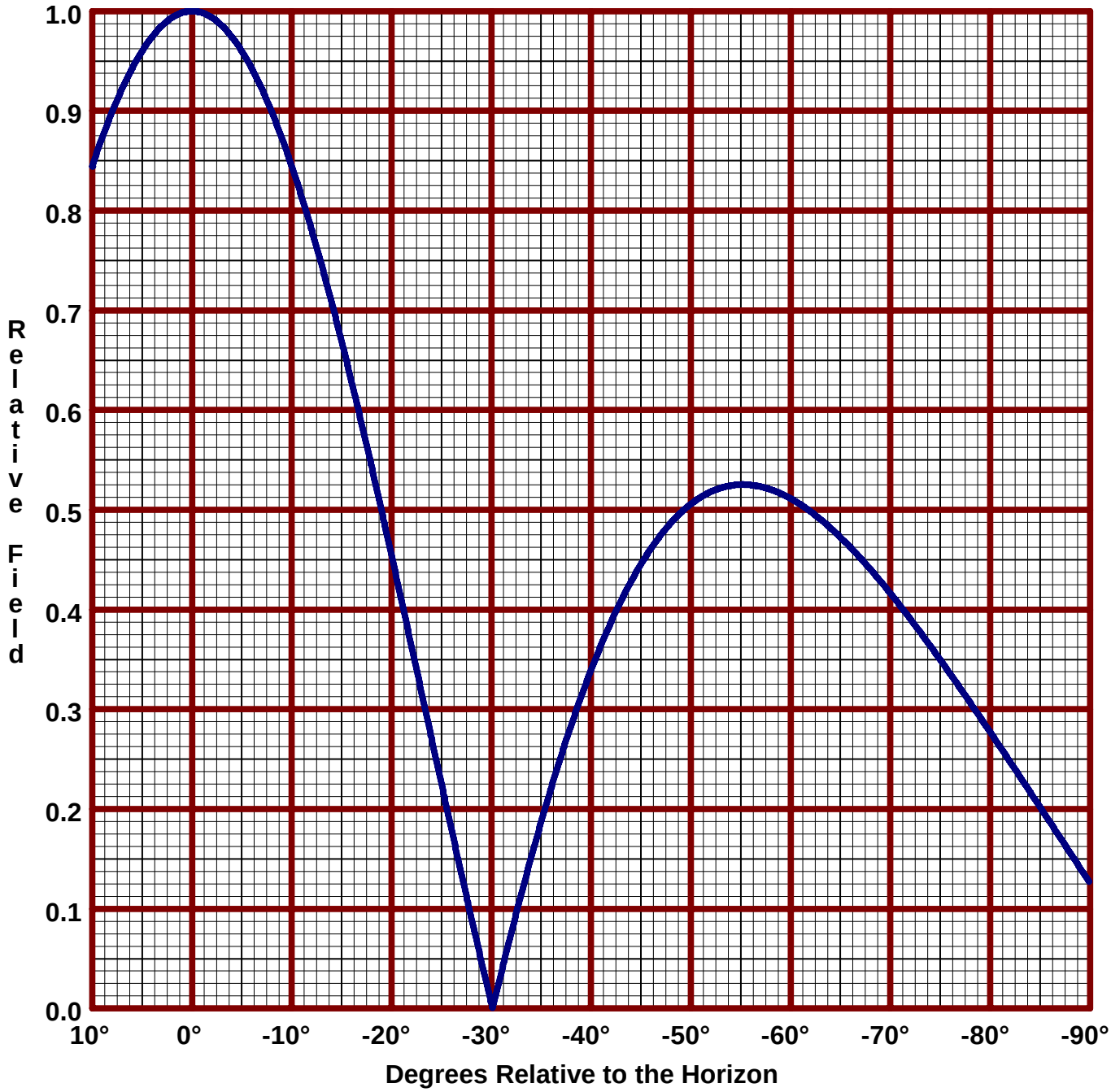
Figure No: 3
Call Sign: WBKY
Location: Stoughton, WI
Frequency: 95.9 MHz
Antenna: 2 bay LP-2E-DA

Date: 11/4/2022
H/V Power Ratio: 1
1 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 1.966 (2.936 dB)
Horizontal Plane: 1.966 (2.936 dB)
Maximum ERP: 2.000 kW

Vertical Polarization:
Maximum: 1.966 (2.936 dB)
Horizontal Plane: 1.966 (2.936 dB)
Maximum ERP: 2.000 kW

Directional Antenna System
for
WBKY, Stoughton, Wisconsin

(continued)

ANTENNA SPECIFICATIONS

Antenna Type:	LP-2E-DA
Frequency:	95.9 MHz
Number of Bays:	Two

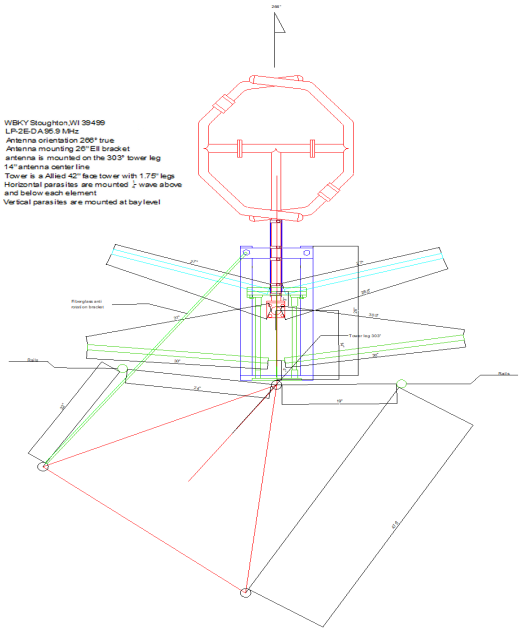
MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	19 ft 9 in
Aperture length required:	25 ft 3 in
Orientation:	266° true

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

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	2.000 kW (3.010 dBk)
Horizontal maximum power gain:	1.966 (2.936 dB)
Maximum vertical ERP:	2.000 kW (3.010 dBk)
Vertical maximum power gain:	1.966 (2.936 dB)
Total input power:	1.017 kW (0.073 dBk)



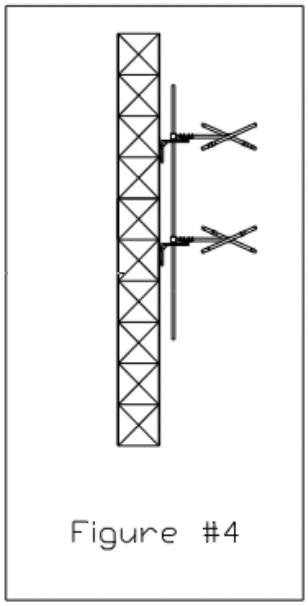


Figure #4