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 WLJW, Fife Lake, Michigan

December 11, 2013

Appendix B:
Directional Antenna Proof
WLJW-FM License Application
February 2014

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 WLJW.

The antenna is the ERI model MP-5E-DA configuration. The circular polarized system consists of 5 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 321 degrees East tower face with bracketry to provide an antenna orientation of North 321 degrees East. The antenna was tested on a 48" face 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 WLJW.

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
WLJW, Fife Lake, Michigan

(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 48" face 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.

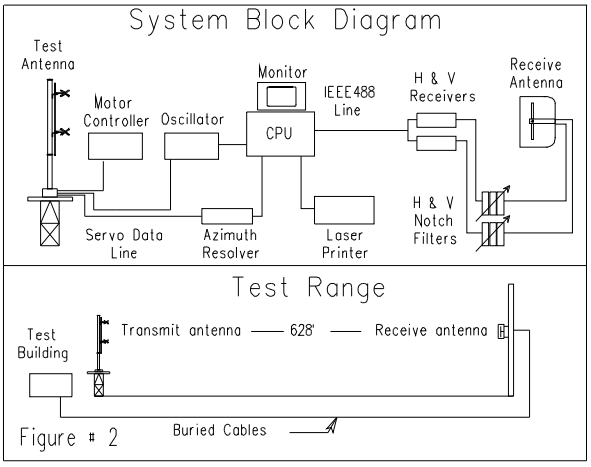


Figure # 2

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.

Directional Antenna System
For
WLJW, Fife Lake, Michigan

(Continued)

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 5 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-5E-DA array is to be mounted on the North 321 degrees East tower face of the 48" face tower at a bearing of North 321 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 #1 & 1A respectively. 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 19 kilowatts (12.788 dBk).

Directional Antenna System
For
WLJW, Fife Lake, Michigan

(Continued)

The power at North 120-140 degrees East does not exceed 5.5 kilowatts (7.404 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.

The clear vertical length of the structure required to support the antenna is 60 feet 10 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.

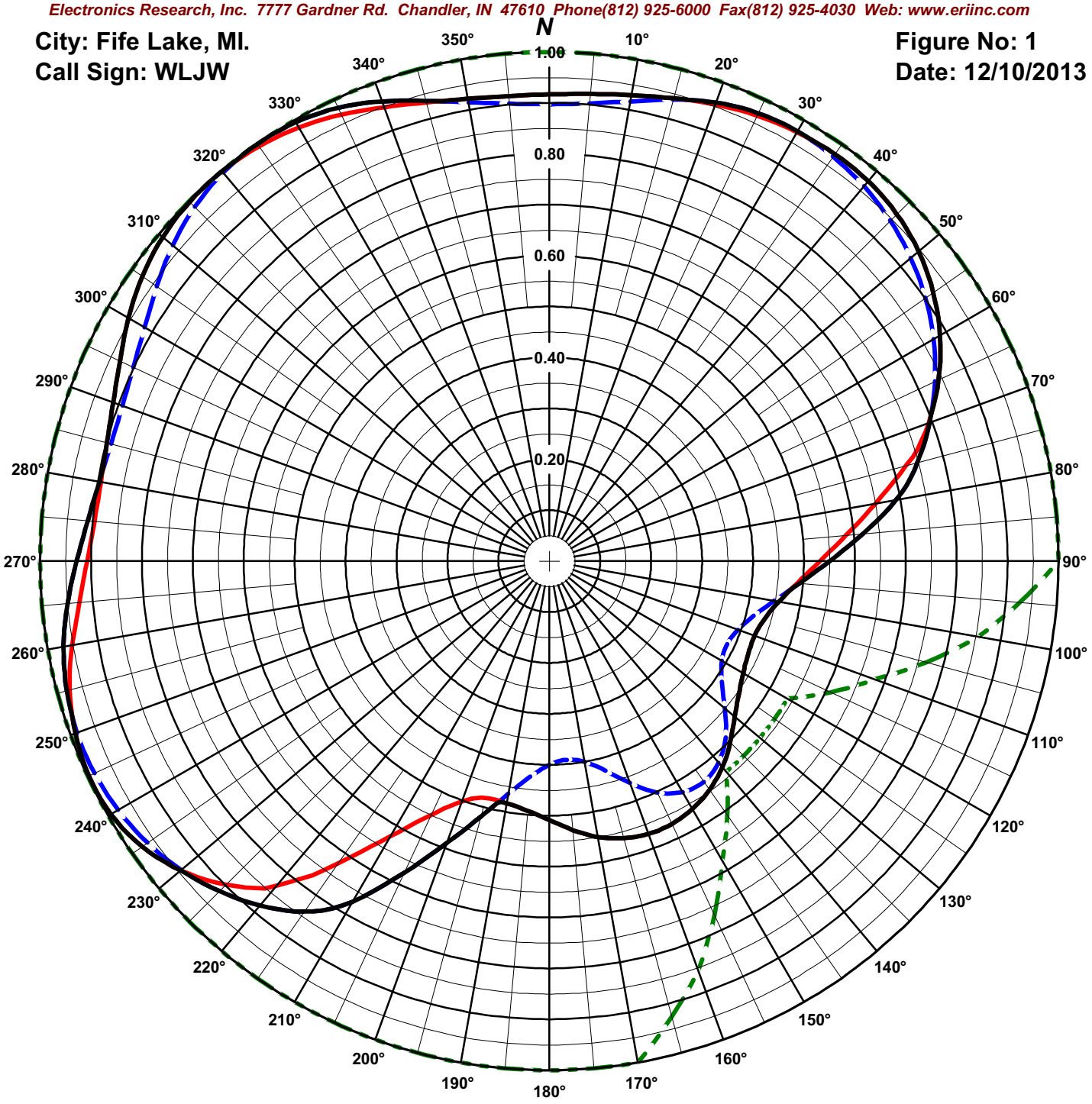
ELECTRONICS RESEARCH, INC.

ERI® Horizontal Plane Relative Field Pattern

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

City: Fife Lake, MI.
Call Sign: WLJW

Figure No: 1
Date: 12/10/2013



Antenna Orientation: 321° True

Frequency: 95.9 MHz
Antenna Type: MP-5E-DA

Antenna Mounting: Custom
Tower Type: 48" ERI

HORIZONTAL	VERTICAL	COMPOSITE	FCC ENVELOPE
RMS: .803	RMS: .798	RMS: .813	RMS: .946
Maximum: 1 @ 318°	Maximum: 1 @ 325°	Maximum: 1 @ 318°	Maximum: 1 @ 0°
Minimum: .429 @ 111°	Minimum: .385 @ 116°	Minimum: .429 @ 111°	Minimum: .54 @ 120°

Measured patterns of the horizontal and vertical components, with the composite maximum of either the the H or V components and the filed FCC envelope pattern BNPH-20120525ADL.

ERI® Horizontal Plane Relative Field Pattern

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

Figure# 1 **Date: 12/10/2013**
Station: WLJW **Antenna: MP-5E-DA**
Location: Fife Lake, MI. **Antenna Orientation: 321° True**
Frequency: 95.9 MHz **Number of Bays: 5**

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.917	15.965	12.032	Horizontal	180°	0.508	4.905	6.907	Horizontal
5°	0.921	16.121	12.074	Horizontal	185°	0.492	4.603	6.631	Horizontal
10°	0.929	16.406	12.150	Horizontal	190°	0.483	4.431	6.465	Horizontal
15°	0.941	16.825	12.260	Horizontal	195°	0.519	5.126	7.098	Vertical
20°	0.958	17.455	12.419	Vertical	200°	0.590	6.609	8.202	Vertical
25°	0.971	17.908	12.530	Vertical	205°	0.675	8.669	9.380	Vertical
30°	0.974	18.037	12.562	Vertical	210°	0.773	11.350	10.550	Vertical
35°	0.976	18.114	12.580	Horizontal	215°	0.841	13.430	11.281	Vertical
40°	0.974	18.040	12.562	Horizontal	220°	0.883	14.827	11.711	Vertical
45°	0.965	17.677	12.474	Horizontal	225°	0.917	15.966	12.032	Vertical
50°	0.947	17.023	12.310	Horizontal	230°	0.945	16.967	12.296	Horizontal
55°	0.920	16.094	12.067	Horizontal	235°	0.977	18.126	12.583	Horizontal
60°	0.886	14.914	11.736	Horizontal	240°	0.994	18.774	12.736	Horizontal
65°	0.843	13.515	11.308	Horizontal	245°	0.998	18.907	12.766	Horizontal
70°	0.795	12.004	10.793	Vertical	250°	0.990	18.631	12.702	Horizontal
75°	0.749	10.654	10.275	Vertical	255°	0.981	18.289	12.622	Vertical
80°	0.691	9.082	9.582	Vertical	260°	0.969	17.822	12.510	Vertical
85°	0.619	7.273	8.617	Vertical	265°	0.950	17.137	12.339	Vertical
90°	0.551	5.764	7.608	Vertical	270°	0.928	16.367	12.140	Vertical
95°	0.494	4.636	6.661	Vertical	275°	0.910	15.726	11.966	Vertical
100°	0.458	3.986	6.005	Horizontal	280°	0.897	15.294	11.845	Vertical
105°	0.438	3.643	5.615	Horizontal	285°	0.899	15.361	11.864	Horizontal
110°	0.429	3.496	5.436	Horizontal	290°	0.911	15.780	11.981	Horizontal
115°	0.431	3.529	5.477	Horizontal	295°	0.930	16.444	12.160	Horizontal
120°	0.440	3.672	5.650	Horizontal	300°	0.954	17.304	12.381	Horizontal
125°	0.454	3.925	5.938	Horizontal	305°	0.976	18.082	12.572	Horizontal
130°	0.476	4.296	6.331	Horizontal	310°	0.990	18.637	12.704	Horizontal
135°	0.503	4.801	6.813	Horizontal	315°	0.999	18.945	12.775	Horizontal
140°	0.529	5.309	7.250	Horizontal	320°	1.000	18.984	12.784	Horizontal
145°	0.548	5.714	7.570	Horizontal	325°	1.000	19.000	12.788	Vertical
150°	0.562	6.001	7.782	Horizontal	330°	0.995	18.820	12.746	Vertical
155°	0.569	6.161	7.896	Horizontal	335°	0.982	18.330	12.632	Vertical
160°	0.570	6.176	7.907	Horizontal	340°	0.961	17.548	12.442	Vertical
165°	0.563	6.033	7.805	Horizontal	345°	0.936	16.635	12.210	Vertical
170°	0.550	5.753	7.599	Horizontal	350°	0.922	16.152	12.082	Horizontal
175°	0.530	5.345	7.279	Horizontal	355°	0.917	15.966	12.032	Horizontal

Horizontal Polarization:
Maximum: 4.025 (6.047 dB)
Horizontal Plane: 4.025 (6.047 dB)
Maximum ERP: 19.000 kW

Vertical Polarization:
Maximum: 4.025 (6.047 dB)
Horizontal Plane: 4.025 (6.047 dB)
Maximum ERP: 19.000 kW

Total Input Power: 4.721 kW
Reference: WLJW2M.FIG

This list shows the the maximum azimuth values of either the horizontal or vertical components.

ERI Horizontal Plane Relative Field Pattern

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

Figure# 1A **Date: 12/10/2013**
Station: WLJW **Antenna: MP-5E-DA**
Location: Fife Lake, MI. **Antenna Orientation: 321° True**
Frequency: 95.9 MHz **Number of Bays: 5**

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.917	15.965	12.032	0.897	15.298	11.846	180°	0.508	4.905	6.907	0.400	3.042	4.832
5°	0.921	16.121	12.074	0.903	15.476	11.897	185°	0.492	4.603	6.631	0.425	3.425	5.346
10°	0.929	16.406	12.150	0.917	15.968	12.033	190°	0.483	4.431	6.465	0.464	4.096	6.124
15°	0.941	16.825	12.260	0.938	16.732	12.236	195°	0.481	4.402	6.437	0.519	5.126	7.098
20°	0.954	17.308	12.383	0.958	17.455	12.419	200°	0.503	4.798	6.811	0.590	6.609	8.202
25°	0.965	17.708	12.482	0.971	17.908	12.530	205°	0.550	5.751	7.597	0.675	8.669	9.380
30°	0.973	17.979	12.548	0.974	18.037	12.562	210°	0.624	7.405	8.695	0.773	11.350	10.550
35°	0.976	18.114	12.580	0.971	17.897	12.528	215°	0.725	9.983	9.993	0.841	13.430	11.281
40°	0.974	18.040	12.562	0.961	17.553	12.443	220°	0.831	13.136	11.185	0.883	14.827	11.711
45°	0.965	17.677	12.474	0.947	17.022	12.310	225°	0.899	15.350	11.861	0.917	15.966	12.032
50°	0.947	17.023	12.310	0.927	16.315	12.126	230°	0.945	16.967	12.296	0.943	16.909	12.281
55°	0.920	16.094	12.067	0.902	15.443	11.887	235°	0.977	18.126	12.583	0.964	17.646	12.466
60°	0.886	14.914	11.736	0.871	14.421	11.590	240°	0.994	18.774	12.736	0.978	18.161	12.591
65°	0.843	13.515	11.308	0.836	13.267	11.228	245°	0.998	18.907	12.766	0.985	18.447	12.659
70°	0.793	11.937	10.769	0.795	12.004	10.793	250°	0.990	18.631	12.702	0.987	18.508	12.674
75°	0.726	10.015	10.007	0.749	10.654	10.275	255°	0.975	18.046	12.564	0.981	18.289	12.622
80°	0.650	8.030	9.047	0.691	9.082	9.582	260°	0.951	17.192	12.353	0.969	17.822	12.510
85°	0.585	6.509	8.135	0.619	7.273	8.617	265°	0.926	16.305	12.123	0.950	17.137	12.339
90°	0.532	5.372	7.301	0.551	5.764	7.608	270°	0.908	15.654	11.946	0.928	16.367	12.140
95°	0.489	4.548	6.578	0.494	4.636	6.661	275°	0.897	15.277	11.840	0.910	15.726	11.966
100°	0.458	3.986	6.005	0.449	3.829	5.831	280°	0.894	15.183	11.814	0.897	15.294	11.845
105°	0.438	3.643	5.615	0.416	3.283	5.163	285°	0.899	15.361	11.864	0.891	15.085	11.785
110°	0.429	3.496	5.436	0.394	2.955	4.705	290°	0.911	15.780	11.981	0.892	15.126	11.797
115°	0.431	3.529	5.477	0.385	2.821	4.503	295°	0.930	16.444	12.160	0.901	15.430	11.884
120°	0.440	3.672	5.650	0.391	2.909	4.638	300°	0.954	17.304	12.381	0.918	15.999	12.041
125°	0.454	3.925	5.938	0.413	3.244	5.111	305°	0.976	18.082	12.572	0.941	16.819	12.258
130°	0.476	4.296	6.331	0.450	3.848	5.852	310°	0.990	18.637	12.704	0.965	17.696	12.479
135°	0.503	4.801	6.813	0.489	4.552	6.582	315°	0.999	18.945	12.775	0.984	18.402	12.649
140°	0.529	5.309	7.250	0.517	5.083	7.061	320°	1.000	18.984	12.784	0.996	18.851	12.753
145°	0.548	5.714	7.570	0.529	5.323	7.262	325°	0.994	18.785	12.738	1.000	19.000	12.788
150°	0.562	6.001	7.782	0.524	5.211	7.170	330°	0.984	18.383	12.644	0.995	18.820	12.746
155°	0.569	6.161	7.896	0.501	4.776	6.790	335°	0.968	17.788	12.501	0.982	18.330	12.632
160°	0.570	6.176	7.907	0.464	4.091	6.119	340°	0.949	17.095	12.329	0.961	17.548	12.442
165°	0.563	6.033	7.805	0.426	3.447	5.375	345°	0.933	16.529	12.182	0.936	16.635	12.210
170°	0.550	5.753	7.599	0.401	3.049	4.842	350°	0.922	16.152	12.082	0.915	15.906	12.016
175°	0.530	5.345	7.279	0.392	2.914	4.645	355°	0.917	15.966	12.032	0.902	15.456	11.891

Horizontal Polarization:
Maximum: 4.025 (6.047 dB)
Horizontal Plane: 4.025 (6.047 dB)
Maximum ERP: 19.000 kW

Vertical Polarization:
Maximum: 4.025 (6.047 dB)
Horizontal Plane: 4.025 (6.047 dB)
Maximum ERP: 19.000 kW

Total Input Power: 4.721 kW
Reference: WLJW2M.FIG

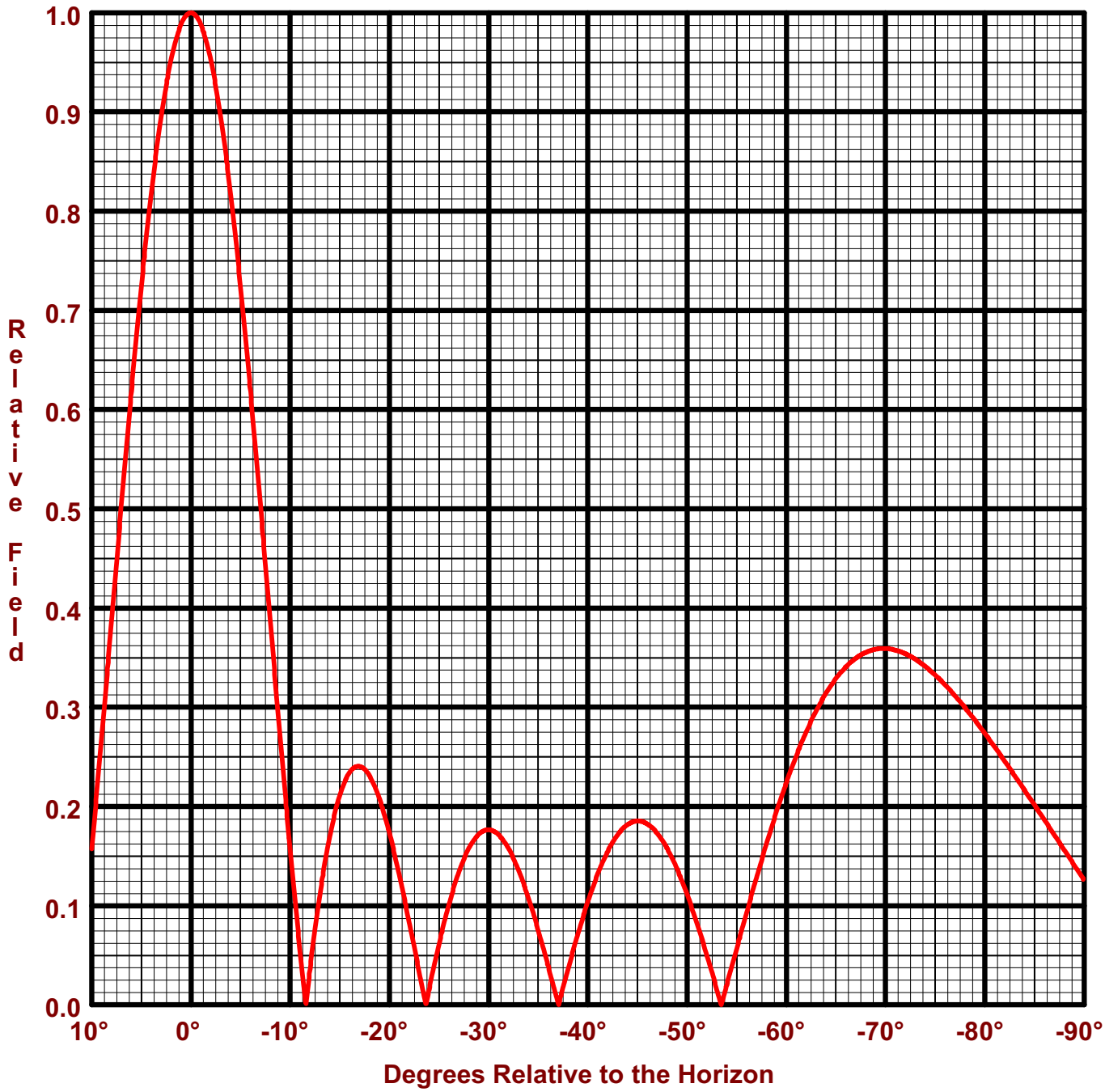
This list shows the azimuth values for the horizontal and vertical components.

Vertical Plane Relative Field Pattern

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

Figure No: 3
Call Sign: WLJW
Location: Fife Lake, MI.
Frequency: 95.9 MHz
5 bay MP-5E-DA antenna

Date: 12/10/2013
H/V Power Ratio: 1
1 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 4.025 (6.047 dB)
Horizontal Plane: 4.025 (6.047 dB)
Maximum ERP: 19.000 kW

Vertical Polarization:
Maximum: 4.025 (6.047 dB)
Horizontal Plane: 4.025 (6.047 dB)
Maximum ERP: 19.000 kW

Directional Antenna System
for
WLJW, Fife Lake, Michigan

(Continued)

ANTENNA SPECIFICATIONS

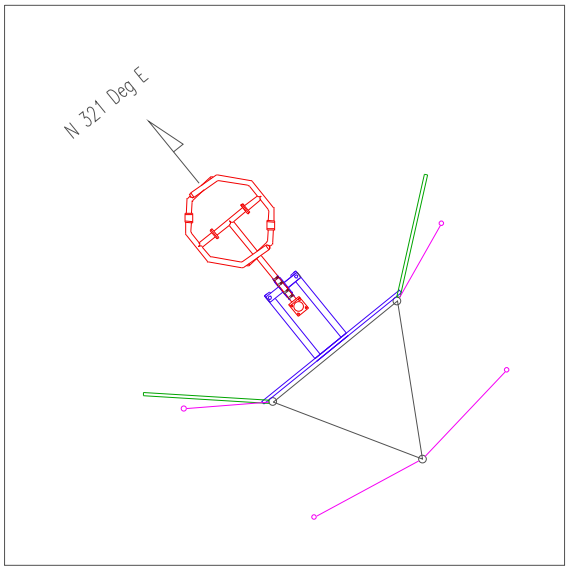
Antenna Type:	MP-5E-DA
Frequency:	95.9 MHz
Number of Bays:	Five

MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	49 ft 7 in
Aperture length required:	60 ft 10 in
Orientation:	321° true
Input flange to the antenna:	321” female.

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	19.000 kW (12.788 dBk)
Horizontal maximum power gain:	4.025 (6.047 dB)
Maximum vertical ERP:	19.000 kW (12.788 dBk)
Vertical maximum power gain:	4.025 (6.047 dB)
Total input power:	4.721 kW (6.74 dBk)



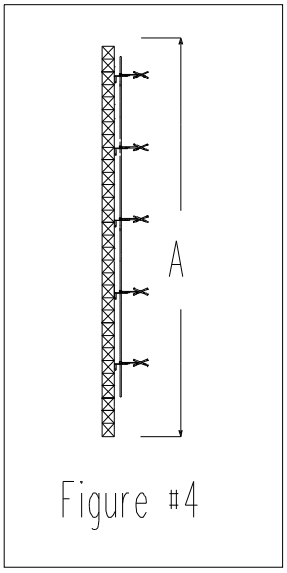


Figure #4