

***Directional Antenna System  
for  
WJFR, Jacksonville, Florida***

March 15, 2023

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

The antenna is the ERI model LP-4E-DA configuration. The circular polarized system consists of four full-wavelength spaced bays using one driven circular polarized radiating element per bay, two horizontal parasitic elements mounted  $\frac{1}{4}$  wave above and 2 horizontal parasites mount below each bayand The system also includes two vertical parasitic elements per antenna bay. The antenna was mounted on the North 300 degrees East tower leg with bracketry to provide an antenna orientation of North 316 degrees East. The antenna was tested on a 72" guyed tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 88.7 megahertz, which is the center of the FM broadcast channel assigned to the WJFR.

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 WJFR Jacksonville, Florida

(Continued)

## DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of a full-scale model of two bay levels 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 an 72" 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.

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 88.7 MHz and was constantly monitored by a Rohde & Schwarz ESVD measuring receiver.

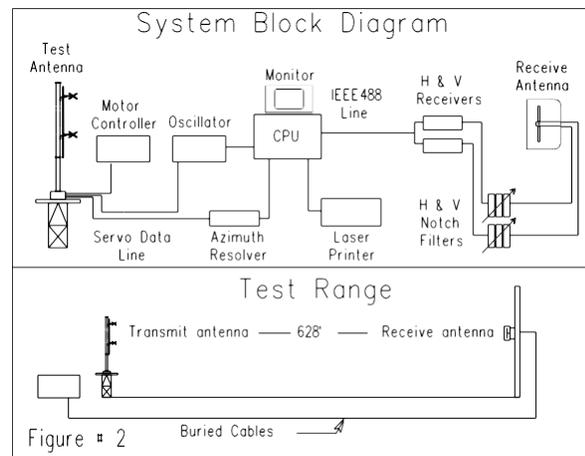


Figure # 2

# Directional Antenna System for WJFR Jacksonville, Florida

(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 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 four full-wavelength spaced bays using one driven circular polarized radiating element per bay, four horizontal parasitic element per bay and two vertical parasitic elements per 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-4E-DA array is to be mounted on the North 300 degrees East tower leg of the 72" face tower at a bearing of North 316 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 # 64 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 # 64. The actual measured pattern does not exceed the authorized FCC composite pattern at any azimuth.

Directional Antenna System  
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(Continued)

A calculated vertical plane relative field pattern is shown on Figure #3 attached. The power in the maximum will reach 12 kilowatts (10.792 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 47 feet 7 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.

A handwritten signature in black ink, reading "Dan Dowdle". The signature is written in a cursive, flowing style with a large initial "D".

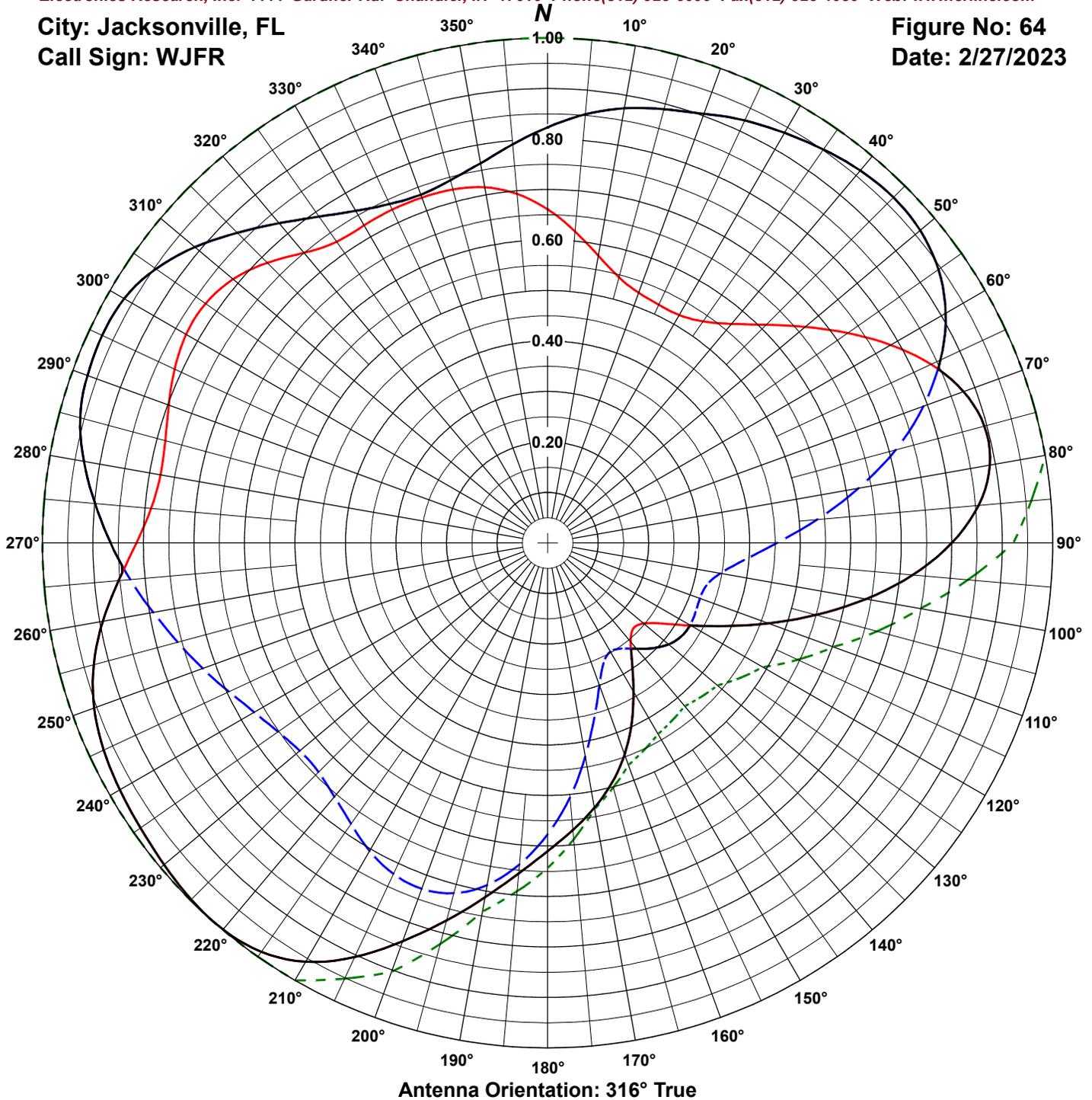
Dan Dowdle  
ERI Range Director

# ERI<sup>®</sup> 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: Jacksonville, FL  
Call Sign: WJFR

Figure No: 64  
Date: 2/27/2023



Frequency: 88.7 MHz  
Antenna Type: LP-4E-DA

Antenna Mounting: 25" Radome Brkt.  
Tower Type: 72" Guy Tower

**HORIZONTAL**

**RMS: .724**  
**Maximum: 1 @ 222°**  
**Minimum: .24 @ 134°**

**VERTICAL**

**RMS: .724**  
**Maximum: .973 @ 295°**  
**Minimum: .249 @ 149°**

**COMPOSITE**

**RMS: .806**  
**Maximum: 1 @ 222°**  
**Minimum: .268 @ 142°**

**FCC ENVELOPE**

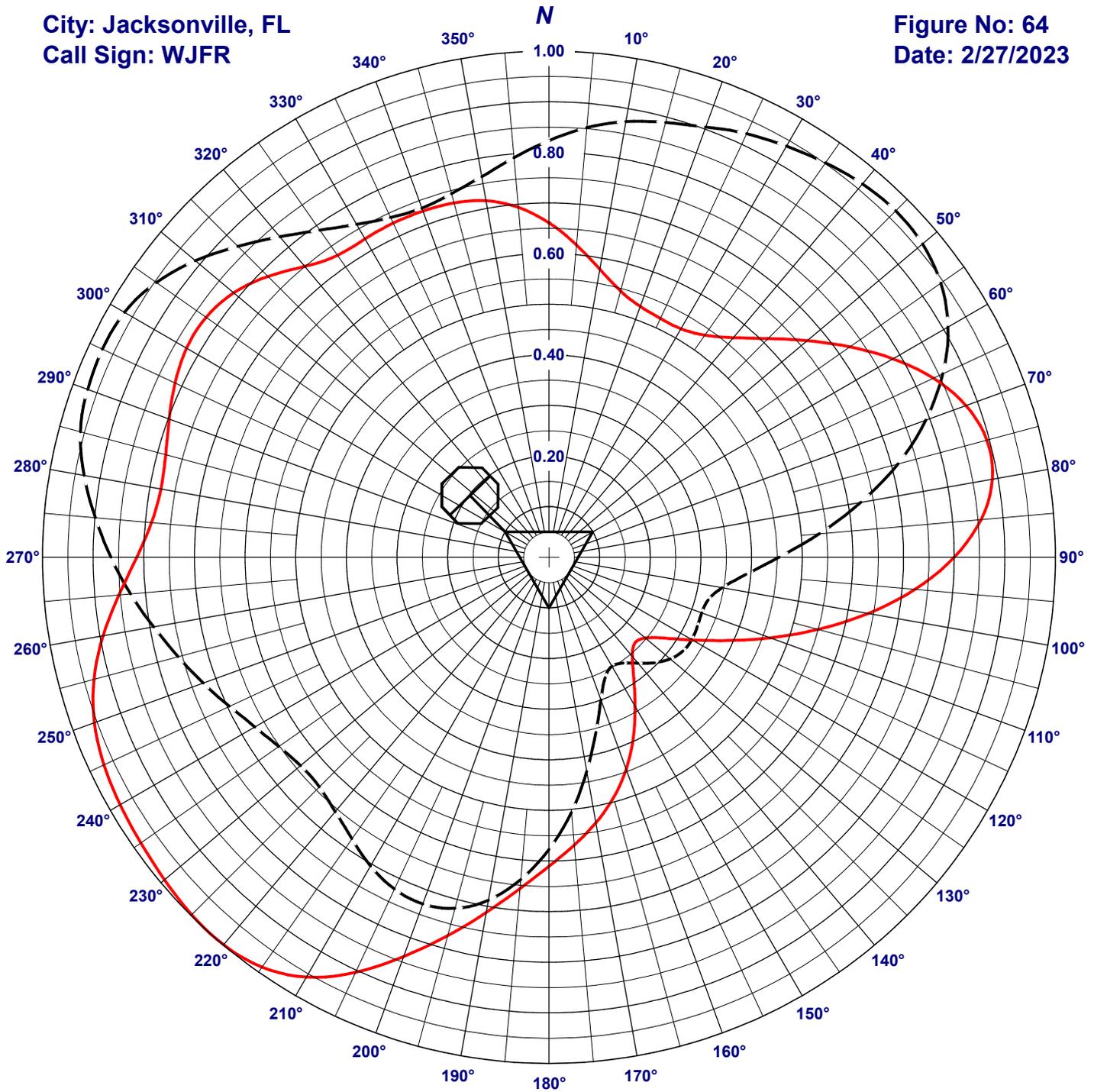
**RMS: .895**  
**Maximum: 1 @ 0°**  
**Minimum: .422 @ 140°**

Two-bay test. Horizontal and Vertical parasites.

# ERI<sup>®</sup> Horizontal Plane Relative Field Pattern

City: Jacksonville, FL  
Call Sign: WJFR

Figure No: 64  
Date: 2/27/2023



Frequency: 88.7 MHz  
Antenna Type: LP-4E-DA  
Antenna Orientation: 316° True  
Antenna Mounting: 25" Radome Brkt.  
Tower Type 72" Guy Tower

**VERTICAL**  
RMS: .724  
Maximum: .973 @ 295°  
Minimum: .249 @ 149°

**HORIZONTAL**  
RMS: .724  
Maximum: 1 @ 222°  
Minimum: .24 @ 134°

Two-bay test. Horizontal and Vertical parasites. The antenna is mounted on the 300° tower leg.

# ERI<sup>®</sup> 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# 64

Date: 2/27/2023

Station: WJFR

Antenna: LP-4E-DA

Location: Jacksonville, FL

Antenna Orientation: 316° True

Frequency: 88.7 MHz

Number of Bays: 4

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.661	5.239	7.193	0.823	8.126	9.099	180°	0.611	4.474	6.507	0.577	3.998	6.018
5°	0.620	4.606	6.634	0.852	8.710	9.400	185°	0.657	5.181	7.144	0.639	4.903	6.905
10°	0.578	4.004	6.025	0.874	9.166	9.622	190°	0.713	6.093	7.848	0.688	5.678	7.542
15°	0.545	3.561	5.516	0.889	9.491	9.773	195°	0.774	7.189	8.567	0.718	6.189	7.916
20°	0.527	3.336	5.232	0.904	9.814	9.918	200°	0.839	8.456	9.272	0.729	6.375	8.045
25°	0.521	3.252	5.121	0.923	10.223	10.096	205°	0.905	9.830	9.926	0.723	6.270	7.973
30°	0.521	3.261	5.133	0.938	10.553	10.234	210°	0.958	11.004	10.415	0.704	5.952	7.747
35°	0.536	3.444	5.371	0.951	10.863	10.359	215°	0.988	11.720	10.689	0.678	5.523	7.422
40°	0.566	3.849	5.853	0.963	11.126	10.464	220°	0.999	11.987	10.787	0.656	5.168	7.133
45°	0.611	4.482	6.515	0.968	11.246	10.510	225°	0.998	11.956	10.776	0.641	4.934	6.932
50°	0.666	5.315	7.255	0.963	11.123	10.462	230°	0.991	11.788	10.714	0.640	4.922	6.921
55°	0.725	6.305	7.997	0.944	10.702	10.295	235°	0.984	11.614	10.650	0.651	5.092	7.069
60°	0.784	7.379	8.680	0.910	9.933	9.971	240°	0.978	11.471	10.596	0.671	5.395	7.320
65°	0.837	8.413	9.249	0.858	8.836	9.463	245°	0.970	11.283	10.524	0.696	5.818	7.648
70°	0.876	9.215	9.645	0.792	7.523	8.764	250°	0.955	10.949	10.394	0.727	6.336	8.018
75°	0.895	9.613	9.829	0.714	6.110	7.861	255°	0.930	10.378	10.161	0.758	6.901	8.389
80°	0.889	9.487	9.771	0.625	4.691	6.713	260°	0.894	9.592	9.819	0.793	7.540	8.774
85°	0.857	8.805	9.447	0.536	3.453	5.382	265°	0.852	8.718	9.404	0.829	8.255	9.167
90°	0.800	7.685	8.856	0.454	2.477	3.939	270°	0.814	7.949	9.003	0.865	8.983	9.534
95°	0.726	6.320	8.007	0.390	1.828	2.619	275°	0.788	7.444	8.718	0.899	9.704	9.869
100°	0.640	4.910	6.911	0.347	1.445	1.598	280°	0.778	7.263	8.611	0.932	10.428	10.182
105°	0.550	3.636	5.606	0.325	1.270	1.039	285°	0.783	7.364	8.671	0.958	11.011	10.418
110°	0.465	2.599	4.148	0.321	1.235	0.916	290°	0.798	7.643	8.832	0.969	11.270	10.519
115°	0.390	1.821	2.602	0.323	1.254	0.985	295°	0.815	7.962	9.010	0.973	11.352	10.551
120°	0.327	1.281	1.077	0.325	1.270	1.039	300°	0.826	8.191	9.133	0.968	11.238	10.507
125°	0.279	0.932	-0.308	0.323	1.252	0.975	305°	0.827	8.198	9.137	0.946	10.744	10.312
130°	0.248	0.739	-1.314	0.313	1.172	0.690	310°	0.812	7.922	8.988	0.912	9.970	9.987
135°	0.240	0.691	-1.605	0.295	1.042	0.177	315°	0.785	7.386	8.684	0.869	9.052	9.567
140°	0.256	0.786	-1.044	0.273	0.896	-0.476	320°	0.750	6.750	8.293	0.826	8.197	9.136
145°	0.292	1.023	0.099	0.255	0.783	-1.064	325°	0.728	6.362	8.036	0.789	7.470	8.733
150°	0.340	1.388	1.423	0.249	0.742	-1.295	330°	0.726	6.329	8.013	0.759	6.922	8.402
155°	0.394	1.858	2.691	0.262	0.826	-0.832	335°	0.728	6.366	8.039	0.741	6.581	8.183
160°	0.446	2.383	3.771	0.300	1.079	0.329	340°	0.728	6.356	8.032	0.734	6.464	8.105
165°	0.492	2.903	4.629	0.358	1.538	1.869	345°	0.725	6.303	7.996	0.744	6.637	8.220
170°	0.533	3.404	5.320	0.429	2.213	3.450	350°	0.715	6.137	7.880	0.763	6.995	8.448
175°	0.571	3.911	5.923	0.506	3.074	4.878	355°	0.694	5.777	7.617	0.792	7.536	8.771

**Horizontal Polarization:**

**Maximum: 3.865 (5.871 dB)**

**Horizontal Plane: 3.865 (5.871 dB)**

**Maximum ERP: 12.000 kW**

**Vertical Polarization:**

**Maximum: 3.656 (5.630 dB)**

**Horizontal Plane: 3.656 (5.630 dB)**

**Maximum ERP: 11.352 kW**

**Total Input Power: 3.105 kW**

**Reference: WJFR64.FIG**

# ERI<sup>®</sup> 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: 2/27/2023

Station: WJFR

Antenna: LP-4E-DA

Location: Jacksonville, FL

Antenna Orientation: 316° True

Frequency: 88.7 MHz

Number of Bays: 4

Azimuth	Envelope			Polarization Maximum	Azimuth	Envelope			Polarization Maximum
	Field	kW	dBk			Field	kW	dBk	
0°	0.823	8.126	9.099	Vertical	180°	0.611	4.474	6.507	Horizontal
5°	0.852	8.710	9.400	Vertical	185°	0.657	5.181	7.144	Horizontal
10°	0.874	9.166	9.622	Vertical	190°	0.713	6.093	7.848	Horizontal
15°	0.889	9.491	9.773	Vertical	195°	0.774	7.189	8.567	Horizontal
20°	0.904	9.814	9.918	Vertical	200°	0.839	8.456	9.272	Horizontal
25°	0.923	10.223	10.096	Vertical	205°	0.905	9.830	9.926	Horizontal
30°	0.938	10.553	10.234	Vertical	210°	0.958	11.004	10.415	Horizontal
35°	0.951	10.863	10.359	Vertical	215°	0.988	11.720	10.689	Horizontal
40°	0.963	11.126	10.464	Vertical	220°	0.999	11.987	10.787	Horizontal
45°	0.968	11.246	10.510	Vertical	225°	0.998	11.956	10.776	Horizontal
50°	0.963	11.123	10.462	Vertical	230°	0.991	11.788	10.714	Horizontal
55°	0.944	10.702	10.295	Vertical	235°	0.984	11.614	10.650	Horizontal
60°	0.910	9.933	9.971	Vertical	240°	0.978	11.471	10.596	Horizontal
65°	0.858	8.836	9.463	Vertical	245°	0.970	11.283	10.524	Horizontal
70°	0.876	9.215	9.645	Horizontal	250°	0.955	10.949	10.394	Horizontal
75°	0.895	9.613	9.829	Horizontal	255°	0.930	10.378	10.161	Horizontal
80°	0.889	9.487	9.771	Horizontal	260°	0.894	9.592	9.819	Horizontal
85°	0.857	8.805	9.447	Horizontal	265°	0.852	8.718	9.404	Horizontal
90°	0.800	7.685	8.856	Horizontal	270°	0.865	8.983	9.534	Vertical
95°	0.726	6.320	8.007	Horizontal	275°	0.899	9.704	9.869	Vertical
100°	0.640	4.910	6.911	Horizontal	280°	0.932	10.428	10.182	Vertical
105°	0.550	3.636	5.606	Horizontal	285°	0.958	11.011	10.418	Vertical
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115°	0.390	1.821	2.602	Horizontal	295°	0.973	11.352	10.551	Vertical
120°	0.327	1.281	1.077	Horizontal	300°	0.968	11.238	10.507	Vertical
125°	0.323	1.252	0.975	Vertical	305°	0.946	10.744	10.312	Vertical
130°	0.313	1.172	0.690	Vertical	310°	0.912	9.970	9.987	Vertical
135°	0.295	1.042	0.177	Vertical	315°	0.869	9.052	9.567	Vertical
140°	0.273	0.896	-0.476	Vertical	320°	0.826	8.197	9.136	Vertical
145°	0.292	1.023	0.099	Horizontal	325°	0.789	7.470	8.733	Vertical
150°	0.340	1.388	1.423	Horizontal	330°	0.759	6.922	8.402	Vertical
155°	0.394	1.858	2.691	Horizontal	335°	0.741	6.581	8.183	Vertical
160°	0.446	2.383	3.771	Horizontal	340°	0.734	6.464	8.105	Vertical
165°	0.492	2.903	4.629	Horizontal	345°	0.744	6.637	8.220	Vertical
170°	0.533	3.404	5.320	Horizontal	350°	0.763	6.995	8.448	Vertical
175°	0.571	3.911	5.923	Horizontal	355°	0.792	7.536	8.771	Vertical

**Horizontal Polarization:**

**Maximum: 3.865 (5.871 dB)**

**Horizontal Plane: 3.865 (5.871 dB)**

**Maximum ERP: 12.000 kW**

**Vertical Polarization:**

**Maximum: 3.656 (5.630 dB)**

**Horizontal Plane: 3.656 (5.630 dB)**

**Maximum ERP: 11.352 kW**

**Total Input Power: 3.105 kW**

**Reference: WJFR64.FIG**

# ERI<sup>®</sup> 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: WJFR

Location: Jacksonville, FL

Frequency: 88.7 MHz

Antenna: 4 bay LP-4E-DA

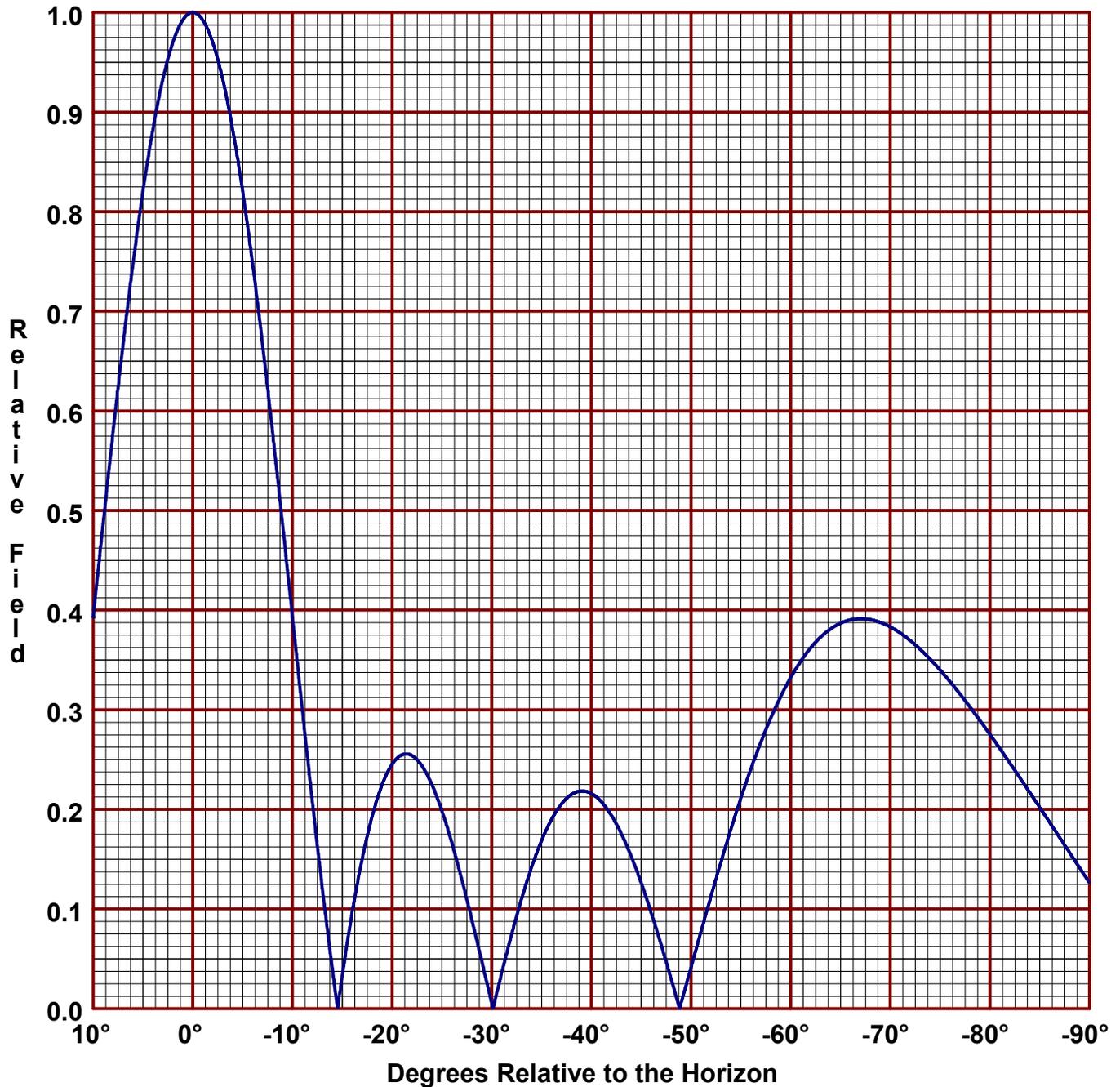
Date: 2/27/2023

H/V Power Ratio: 1

1 Wave-length Spacing

0° Beam Tilt

0% First Null Fill



**Horizontal Polarization:**

**Maximum: 3.865 (5.871 dB)**

**Horizontal Plane: 3.865 (5.871 dB)**

**Maximum ERP: 12.000 kW**

**Vertical Polarization:**

**Maximum: 3.656 (5.630 dB)**

**Horizontal Plane: 3.656 (5.630 dB)**

**Maximum ERP: 11.352 kW**

# Directional Antenna System for WJFR Jacksonville, Florida

(continued)

## ANTENNA SPECIFICATIONS

Antenna Type:	LP-4E-DA
Frequency:	88.7 MHz
Number of Bays:	Four

## MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	41 ft 4 in
Aperture length required:	47 feet 7 in
Orientation:	316° true

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

## ELECTRICAL SPECIFICATIONS (For directional use)

Maximum Horizontal ERP:	12.00 kW ( 10.792 dBk)
Horizontal Maximum Power Gain:	3.865 (5.871 dB) Maximum
Vertical ERP:	11.352 kW ( 13.979 dBk)
Vertical Maximum Power Gain:	3.656 (5.630 dB)
Total Input Power:	6.072 kW (4.921 dBk)



2 Bay Range Antenna

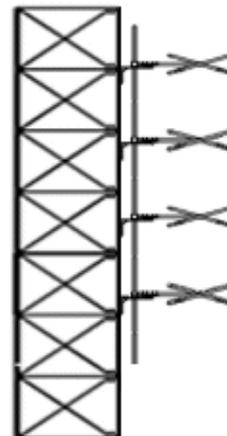


Figure #4