

***Directional Antenna System  
for  
WCOX, Bedford, Pennsylvania***

August 3, 2023

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 WCOX.

The antenna is the ERI model LP-2E-HW-DA configuration. The circular polarized system consists of two half-wavelength spaced bays using one driven circular polarized radiating element per bay. The antenna was tested on a 24" Valmont tower, which is the structure the station plans to use to support the array.

All tests were performed on a frequency of 91.1 megahertz, which is the center of the FM broadcast channel assigned to WCOX.

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 WCOX, Bedford, Pennsylvania

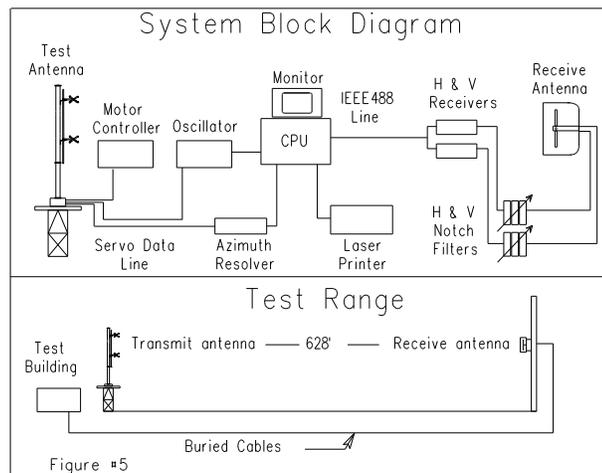
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## DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of a full-scale model of the complete 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. 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 full scale model of a 24" Valmont 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.



Directional Antenna System  
For  
WCOX, Bedford, Pennsylvania

(Continued)

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 91.1 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 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.

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-HW-DA array is to be mounted on the 24" Valmont tower at a bearing of North 310 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.

Directional Antenna System  
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(Continued)

Figure #4A 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 #4A.

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 1.9 kilowatts ( 2.788 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 #4A 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 20 feet, 5 inches if the antenna is to be top mounted.

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.

Directional Antenna System  
For  
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(Continued)

For further technical specifications, please consult the enclosed attachments. Should you desire any additional information, please contact us directly.

Electronics Research, Inc. values you as a customer. We are truly confident that we build the best antenna systems on the market. An ERI antenna and installation will fulfill your broadcasting needs.

A handwritten signature in black ink that reads "Dan Dowdle". The signature is written in a cursive, flowing style.

Daniel Dowdle  
Range Director  
ELECTRONICS RESEARCH, INC.

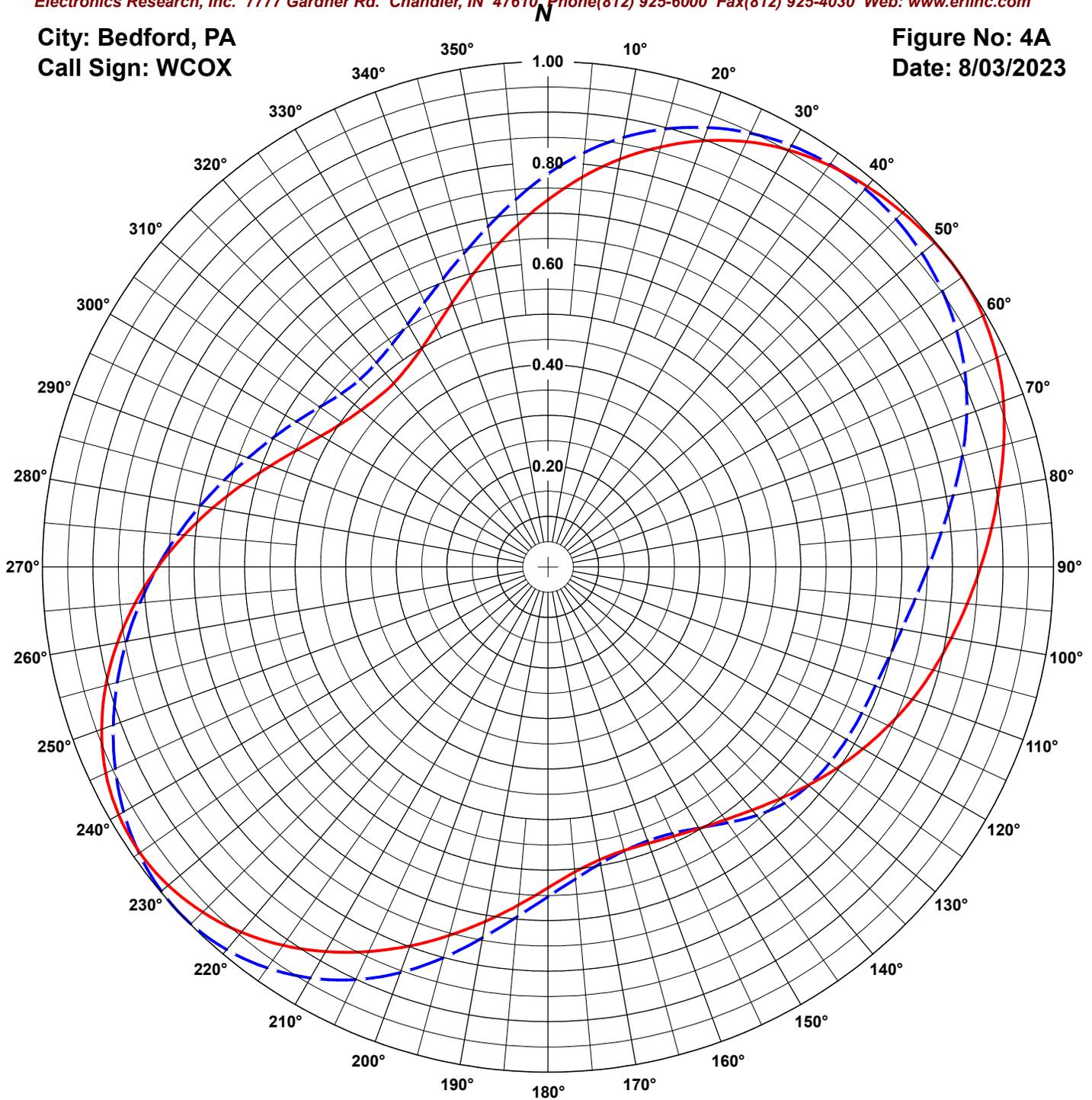
The Microsoft Word document on file electronically at Electronic Research, Inc. governs the specifications, scope, and configuration of the product described. All other representations whether verbal, printed, or electronic are subordinate to the master copy of this document on file at ERI.

# 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: Bedford, PA  
Call Sign: WCOX

Figure No: 4A  
Date: 8/03/2023



Frequency: 91.1 MHz  
Antenna Type: LP-2E-HW-DA  
Antenna Orientation: 310° True  
Antenna Mounting: 20" Radome brkt.  
Tower Type 24" Valmont

## VERTICAL

RMS: .779  
Maximum: 1 @ 227°  
Minimum: .525 @ 316°

## HORIZONTAL

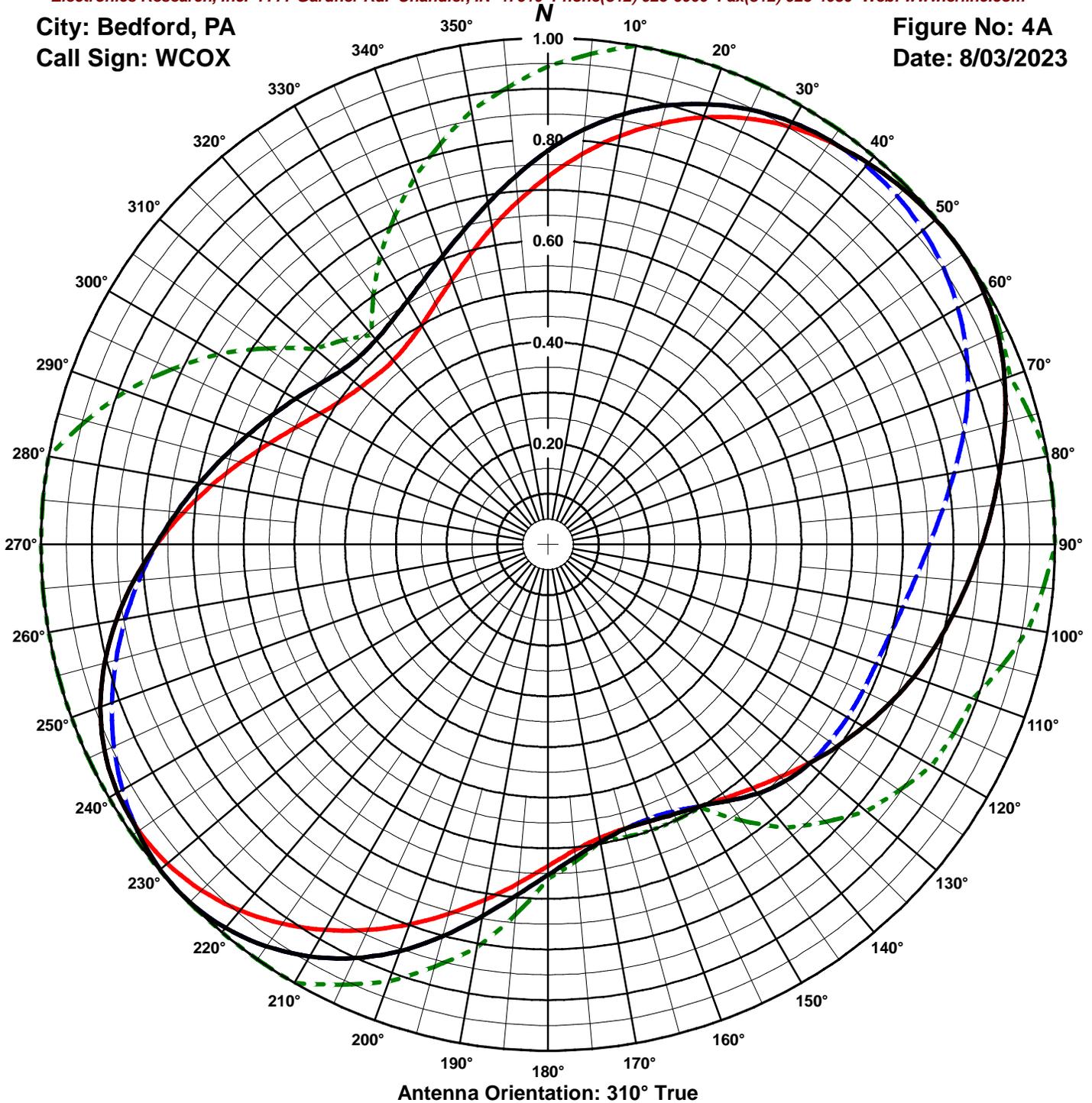
RMS: .779  
Maximum: 1 @ 54°  
Minimum: .474 @ 318°

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City: Bedford, PA  
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Date: 8/03/2023



Frequency: 91.1 MHz

Antenna Type: LP-2E-HW-DA

Antenna Mounting: 20" Radome brkt.

Tower Type: 24" Valmont

## HORIZONTAL

RMS: .779

Maximum: 1 @ 54°

Minimum: .474 @ 318°

## VERTICAL

RMS: .779

Maximum: 1 @ 227°

Minimum: .525 @ 316°

## COMPOSITE

RMS: .798

Maximum: 1 @ 54°

Minimum: .525 @ 316°

## FCC ENVELOPE

RMS: .886

Maximum: 1 @ 10°

Minimum: .54 @ 320°

Two-bay test. 3" extn. add to element tees'.

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

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Figure# 4A

Date: 8/03/2023

Station: WCOX

Antenna: LP-2E-HW-DA

Location: Bedford, PA

Antenna Orientation: 310° True

Frequency: 91.1 MHz

Number of Bays: 2

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.727	1.003	0.013	0.778	1.150	0.607	180°	0.635	0.767	-1.154	0.653	0.810	-0.915
5°	0.774	1.138	0.561	0.823	1.287	1.097	185°	0.672	0.858	-0.664	0.695	0.917	-0.374
10°	0.819	1.275	1.055	0.863	1.415	1.509	190°	0.713	0.965	-0.156	0.745	1.056	0.236
15°	0.860	1.406	1.480	0.897	1.529	1.845	195°	0.755	1.084	0.349	0.801	1.219	0.860
20°	0.897	1.530	1.846	0.925	1.626	2.111	200°	0.798	1.211	0.831	0.855	1.387	1.422
25°	0.928	1.638	2.143	0.947	1.704	2.315	205°	0.840	1.340	1.272	0.901	1.544	1.885
30°	0.952	1.724	2.364	0.963	1.761	2.458	210°	0.879	1.469	1.669	0.940	1.677	2.246
35°	0.970	1.787	2.522	0.973	1.797	2.545	215°	0.914	1.588	2.010	0.969	1.783	2.512
40°	0.983	1.835	2.636	0.976	1.810	2.576	220°	0.944	1.693	2.286	0.989	1.858	2.690
45°	0.992	1.869	2.717	0.973	1.800	2.554	225°	0.966	1.774	2.490	0.999	1.896	2.779
50°	0.998	1.893	2.772	0.965	1.771	2.482	230°	0.981	1.827	2.617	0.998	1.893	2.772
55°	1.000	1.899	2.785	0.952	1.722	2.361	235°	0.986	1.846	2.662	0.988	1.854	2.680
60°	0.994	1.876	2.731	0.934	1.656	2.192	240°	0.981	1.827	2.617	0.969	1.785	2.516
65°	0.980	1.823	2.609	0.910	1.574	1.970	245°	0.965	1.770	2.479	0.944	1.695	2.291
70°	0.959	1.746	2.421	0.882	1.477	1.693	250°	0.940	1.677	2.246	0.915	1.591	2.016
75°	0.933	1.655	2.188	0.848	1.368	1.360	255°	0.905	1.558	1.924	0.882	1.478	1.698
80°	0.907	1.562	1.937	0.814	1.258	0.997	260°	0.865	1.421	1.526	0.847	1.362	1.343
85°	0.881	1.474	1.686	0.781	1.159	0.642	265°	0.820	1.277	1.060	0.810	1.246	0.956
90°	0.856	1.392	1.437	0.753	1.076	0.320	270°	0.771	1.131	0.534	0.772	1.133	0.544
95°	0.833	1.317	1.196	0.729	1.010	0.044	275°	0.722	0.991	-0.041	0.735	1.026	0.112
100°	0.810	1.248	0.961	0.711	0.960	-0.178	280°	0.673	0.861	-0.649	0.698	0.926	-0.336
105°	0.789	1.182	0.728	0.697	0.924	-0.342	285°	0.627	0.747	-1.269	0.663	0.835	-0.784
110°	0.767	1.118	0.483	0.689	0.903	-0.445	290°	0.584	0.649	-1.878	0.631	0.756	-1.215
115°	0.743	1.050	0.213	0.685	0.892	-0.498	295°	0.548	0.570	-2.441	0.602	0.688	-1.626
120°	0.720	0.984	-0.071	0.682	0.885	-0.533	300°	0.518	0.510	-2.924	0.575	0.628	-2.021
125°	0.696	0.920	-0.360	0.679	0.876	-0.577	305°	0.496	0.468	-3.296	0.551	0.577	-2.386
130°	0.672	0.858	-0.663	0.673	0.860	-0.654	310°	0.483	0.442	-3.541	0.533	0.540	-2.674
135°	0.649	0.800	-0.969	0.661	0.831	-0.803	315°	0.475	0.428	-3.682	0.525	0.524	-2.805
140°	0.628	0.750	-1.249	0.642	0.784	-1.057	320°	0.475	0.428	-3.687	0.528	0.529	-2.768
145°	0.611	0.710	-1.489	0.618	0.727	-1.386	325°	0.483	0.443	-3.532	0.538	0.550	-2.600
150°	0.598	0.679	-1.681	0.597	0.677	-1.697	330°	0.500	0.474	-3.242	0.555	0.585	-2.331
155°	0.588	0.657	-1.823	0.582	0.644	-1.912	335°	0.524	0.522	-2.825	0.578	0.634	-1.976
160°	0.582	0.644	-1.911	0.577	0.633	-1.988	340°	0.555	0.586	-2.320	0.607	0.700	-1.548
165°	0.581	0.642	-1.926	0.582	0.643	-1.915	345°	0.593	0.667	-1.755	0.642	0.784	-1.057
170°	0.589	0.658	-1.817	0.596	0.676	-1.703	350°	0.635	0.766	-1.156	0.684	0.888	-0.516
175°	0.606	0.699	-1.558	0.620	0.730	-1.364	355°	0.680	0.879	-0.561	0.730	1.013	0.055

**Horizontal Polarization:**

**Maximum: 1.100 (0.415 dB)**

**Horizontal Plane: 1.100 (0.415 dB)**

**Maximum ERP: 1.900 kW**

**Vertical Polarization:**

**Maximum: 1.100 (0.415 dB)**

**Horizontal Plane: 1.100 (0.415 dB)**

**Maximum ERP: 1.900 kW**

**Total Input Power: 1.727 kW**

**Reference: WCOX4A.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# 4A

Date: 8/03/2023

Station: WCOX

Antenna: LP-2E-HW-DA

Location: Bedford, PA

Antenna Orientation: 310° True

Frequency: 91.1 MHz

Number of Bays: 2

Azimuth	Envelope			Polarization Maximum	Azimuth	Envelope			Polarization Maximum
	Field	kW	dBk			Field	kW	dBk	
0°	0.778	1.150	0.607	Vertical	180°	0.653	0.810	-0.915	Vertical
5°	0.823	1.287	1.097	Vertical	185°	0.695	0.917	-0.374	Vertical
10°	0.863	1.415	1.509	Vertical	190°	0.745	1.056	0.236	Vertical
15°	0.897	1.529	1.845	Vertical	195°	0.801	1.219	0.860	Vertical
20°	0.925	1.626	2.111	Vertical	200°	0.855	1.387	1.422	Vertical
25°	0.947	1.704	2.315	Vertical	205°	0.901	1.544	1.885	Vertical
30°	0.963	1.761	2.458	Vertical	210°	0.940	1.677	2.246	Vertical
35°	0.973	1.797	2.545	Vertical	215°	0.969	1.783	2.512	Vertical
40°	0.983	1.835	2.636	Horizontal	220°	0.989	1.858	2.690	Vertical
45°	0.992	1.869	2.717	Horizontal	225°	0.999	1.896	2.779	Vertical
50°	0.998	1.893	2.772	Horizontal	230°	0.998	1.893	2.772	Vertical
55°	1.000	1.899	2.785	Horizontal	235°	0.988	1.854	2.680	Vertical
60°	0.994	1.876	2.731	Horizontal	240°	0.981	1.827	2.617	Horizontal
65°	0.980	1.823	2.609	Horizontal	245°	0.965	1.770	2.479	Horizontal
70°	0.959	1.746	2.421	Horizontal	250°	0.940	1.677	2.246	Horizontal
75°	0.933	1.655	2.188	Horizontal	255°	0.905	1.558	1.924	Horizontal
80°	0.907	1.562	1.937	Horizontal	260°	0.865	1.421	1.526	Horizontal
85°	0.881	1.474	1.686	Horizontal	265°	0.820	1.277	1.060	Horizontal
90°	0.856	1.392	1.437	Horizontal	270°	0.772	1.133	0.544	Vertical
95°	0.833	1.317	1.196	Horizontal	275°	0.735	1.026	0.112	Vertical
100°	0.810	1.248	0.961	Horizontal	280°	0.698	0.926	-0.336	Vertical
105°	0.789	1.182	0.728	Horizontal	285°	0.663	0.835	-0.784	Vertical
110°	0.767	1.118	0.483	Horizontal	290°	0.631	0.756	-1.215	Vertical
115°	0.743	1.050	0.213	Horizontal	295°	0.602	0.688	-1.626	Vertical
120°	0.720	0.984	-0.071	Horizontal	300°	0.575	0.628	-2.021	Vertical
125°	0.696	0.920	-0.360	Horizontal	305°	0.551	0.577	-2.386	Vertical
130°	0.673	0.860	-0.654	Vertical	310°	0.533	0.540	-2.674	Vertical
135°	0.661	0.831	-0.803	Vertical	315°	0.525	0.524	-2.805	Vertical
140°	0.642	0.784	-1.057	Vertical	320°	0.528	0.529	-2.768	Vertical
145°	0.618	0.727	-1.386	Vertical	325°	0.538	0.550	-2.600	Vertical
150°	0.598	0.679	-1.681	Horizontal	330°	0.555	0.585	-2.331	Vertical
155°	0.588	0.657	-1.823	Horizontal	335°	0.578	0.634	-1.976	Vertical
160°	0.582	0.644	-1.911	Horizontal	340°	0.607	0.700	-1.548	Vertical
165°	0.582	0.643	-1.915	Vertical	345°	0.642	0.784	-1.057	Vertical
170°	0.596	0.676	-1.703	Vertical	350°	0.684	0.888	-0.516	Vertical
175°	0.620	0.730	-1.364	Vertical	355°	0.730	1.013	0.055	Vertical

**Horizontal Polarization:**

**Maximum: 1.100 (0.415 dB)**

**Horizontal Plane: 1.100 (0.415 dB)**

**Maximum ERP: 1.900 kW**

**Vertical Polarization:**

**Maximum: 1.100 (0.415 dB)**

**Horizontal Plane: 1.100 (0.415 dB)**

**Maximum ERP: 1.900 kW**

**Total Input Power: 1.727 kW**

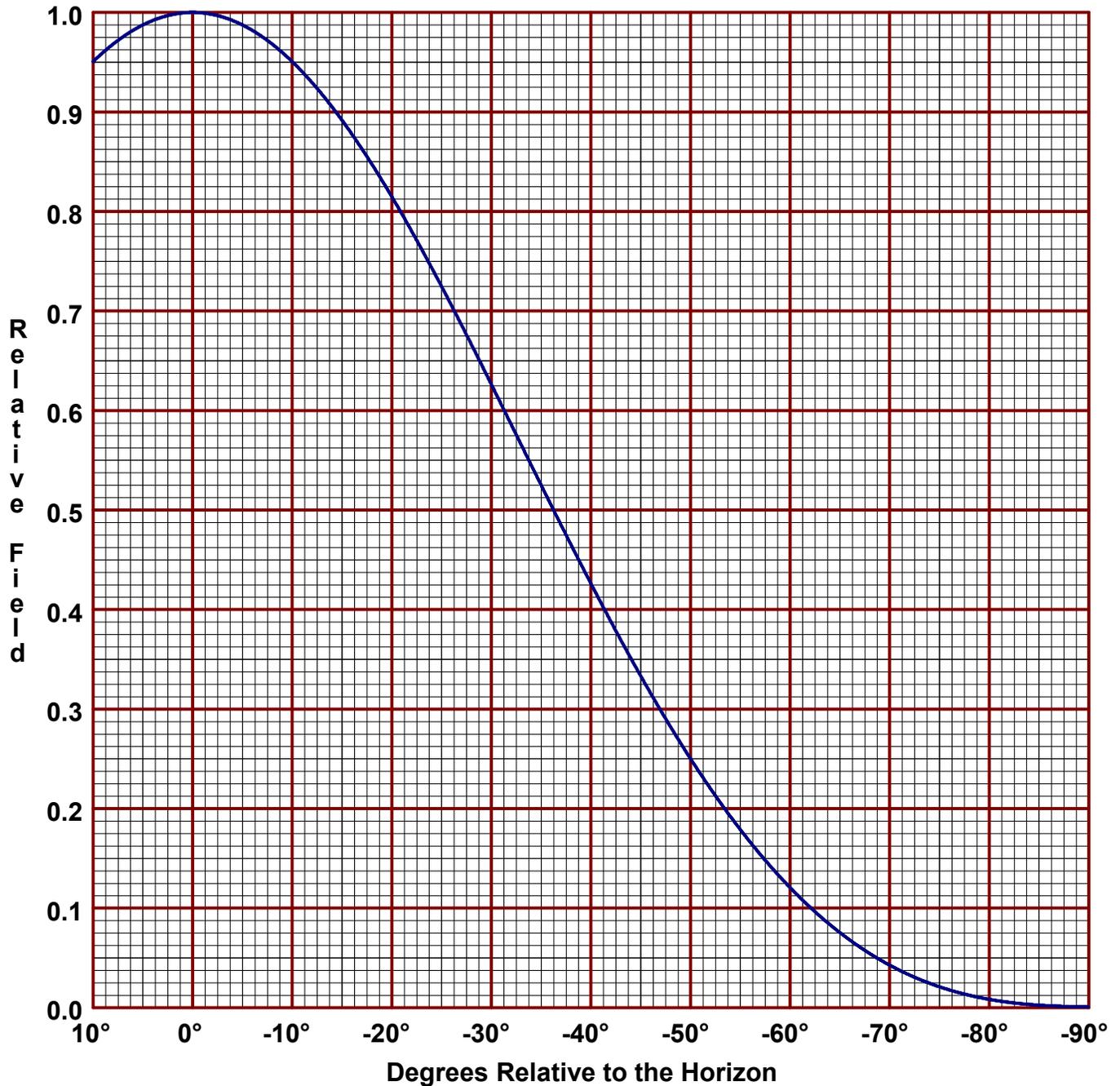
**Reference: WCOX4A.FIG**

# 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: WCOX  
Location: Bedford, PA  
Frequency: 91.1 MHz  
Antenna: 2 bay LP-2E-HW-DA

Date: 8/03/2023  
H/V Power Ratio: 1  
.5 Wave-length Spacing  
0° Beam Tilt  
0% First Null Fill



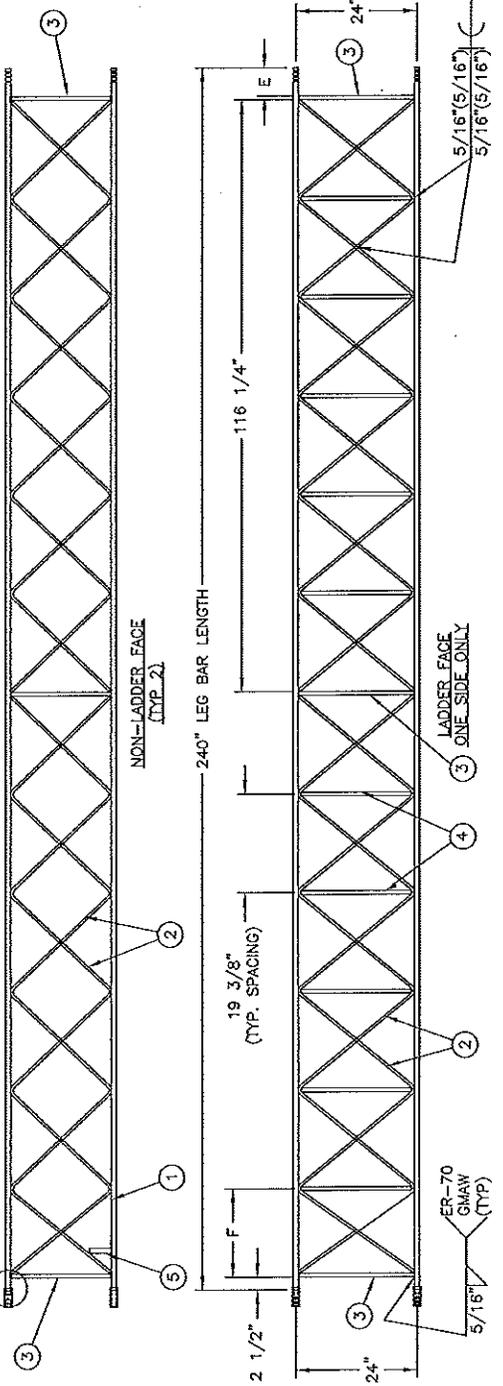
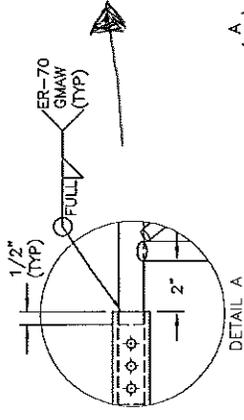
**Horizontal Polarization:**  
Maximum: 1.100 (0.415 dB)  
Horizontal Plane: 1.100 (0.415 dB)  
Maximum ERP: 1.900 kW

**Vertical Polarization:**  
Maximum: 1.100 (0.415 dB)  
Horizontal Plane: 1.100 (0.415 dB)  
Maximum ERP: 1.900 kW

100407

HEAVY STAMP PART NUMBER		PARTS LIST				
ITEM QTY	PART NO.	PART DESCRIPTION	LENGTH	UNIT WT.	NET WT.	
1	SEE ITEM 1	"A" DIA. DRILLED LEG BAR	240"			
2	SEE ITEM 2	"B" DIA. BENT WEBBING	116 1/4"			
3	350112	3/4" ROUND (A-572)	C			
4	10	3/4" ROUND (A-572)	D			
5	21-1820194	PART NUMBER ID TAG	5"	0.27#	0.27#	

PART NO.	ITEM 1 (P/N)	ITEM 2 (P/N)	A (LEG DIA.)	B (WEB DIA.)	C (LENGTH)	D (LENGTH)	E (DIM.)	F (DIM.)	TOTAL WEIGHT
100403	360136	153071	1"	1/2"	22 7/8"	21 7/8"	5 1/2"	17 3/8"	350.02#
109678	360136	153072	1"	9/16"	23"	21 7/8"	5 1/2"	17 3/8"	345.00#
132492	360136	153072	1"	5/8"	22 7/8"	21 5/8"	5 1/2"	17 3/8"	419.20#
100404	360139	186168	1 1/8"	1/2"	22 7/8"	21 7/8"	6 1/8"	17 1/4"	384.19#
100405	360137	186162	1 1/4"	1/2"	22 5/8"	21 5/8"	6 1/2"	16 3/8"	444.98#
107608	360137	350108	1 1/4"	9/16"	22 3/4"	21 5/8"	6 1/2"	16 3/4"	445.00#
132491	360137	186163	1 1/4"	5/8"	22 5/8"	21 3/8"	6 1/2"	16 3/8"	514.36#
109406	350122	186164	1 3/8"	1/2"	22 5/8"	21 3/8"	6 1/2"	16 1/2"	487.87#
100407	360138	186166	1 1/2"	1/2"	22 3/8"	21 3/8"	7"	15 7/8"	557.00#
231823	231737	186166	1 1/2"	1/2"	22 3/8"	21 3/8"	9"	15 7/8"	557.00#
100408	360139	186168	1 3/4"	1/2"	22 1/8"	21 1/8"	9"	13 7/8"	694.10#
125696	360139	350108	1 3/4"	9/16"	22 1/4"	21 1/8"	8"	14 1/4"	750.00#
107180	360140	350108	2"	9/16"	22"	20 7/8"	10 1/4"	13"	875.00#
132490	360140	186171	2"	5/8"	21 7/8"	20 5/8"	10 1/4"	12 5/8"	918.81#



		PART NO. SEE TABLE DWG. NO. 100403	
DESCRIPTION: 24" SECTION 1" THRU 2" LEG DIA 1/2" & 5/8" WEBBING			
PROPRIETARY NOTE: THE DATA AND TECHNIQUES CONTAINED IN THIS DRAWING ARE PROPRIETARY INFORMATION OF VALMONT INDUSTRIES AND CONSIDERED A TRADE SECRET. ANY USE OR DISCLOSURE WITHOUT THE CONSENT OF VALMONT INDUSTRIES IS STRICTLY PROHIBITED.	DR BY: RINK 01/07/1978 ENG. APPROVAL: TBC 07/17/2010	CPD NO.: MVC 07/16/2010 CHECKED BY: MVC 07/16/2010	DRAWING USAGE: SHOP DATE: 07/16/2010
TOLERANCE NOTE: DIMENSIONS UNLESS OTHERWISE NOTED ARE (PLUS OR MINUS) MACHINING 0.030" AND STRUCTURAL 0.060". BENDS ARE (+ OR -) 1/2 DEGREE.	4797 SAN 07/16/2010 4023 BTJ 03/22/2007 4023 BTJ 03/12/2007 3689 SAN 09/17/2004 2442 TRS 02/01/2001 RCH 08/05/1997 RCH 07/22/1997 MVC 12/04/1994	DATE: 07/16/2010 BY: MVC	REV. DESCRIPTION OF REVISIONS

# Directional Antenna System for WCOX, Bedford, Pennsylvania

(Continued)

## ANTENNA SPECIFICATIONS

Antenna Type: LP-2E-DA-HW  
Frequency: 91.1 MHz  
Number of Bays: Two

## MECHANICAL SPECIFICATIONS

Mounting: Custom  
System length: 14.193 ft  
Aperture length required: 20 ft 5 in  
Orientation: 310° true  
Input flange to the antenna 1 5/8" female

## ELECTRICAL SPECIFICATIONS

(For directional use)

Maximum horizontal ERP: 1.900 kW ( 2.788 dBk)  
Horizontal maximum power gain: 1.100 (0.415 dB)  
Maximum vertical ERP: 1.900 kW ( 2.788 dBk)  
Vertical maximum power gain: 1.100 (0.415 dB)  
Total input power: 1.727 kW ( 2.373 dBk)

