

## ***Directional Antenna System for WFMA-FM, Marion, Alabama***

November 16, 2022

Electronics Research Inc. is providing modifications to an existing antenna system that is specially designed to meet the FCC requirements and the general needs of radio station WFMA-FM.

The antenna is the ERI model LP-8E-DA configuration. The circular polarized system consists of eight full-wavelength spaced bays using one driven circular polarized radiating element per bay, two horizontal parasitic elements mounted  $\frac{1}{4}$  wave above and two horizontal parasitic elements mounted  $\frac{1}{4}$  wave below each bay. The antenna was mounted on the North 93 degrees East tower face with bracketry to provide an antenna orientation of North 93 degrees East. The antenna was tested on a 24" Sabre tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 102.9 megahertz, which is the center of the FM broadcast channel assigned to WFMA-FM.

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 WFMA-FM, Marion, Alabama

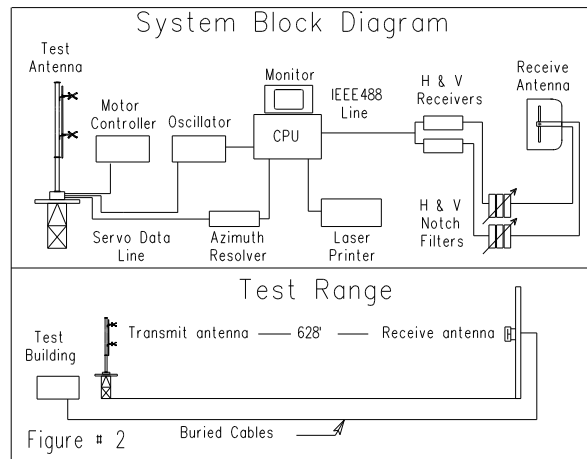
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## DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of a full-scale model of 2 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 a 24" face Sabre 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 WFMA-FM, Marion, Alabama

(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 102.9 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 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 eight full-wavelength spaced bays using one driven circular polarized radiating element and four horizontal 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-8E-DA array is to be mounted on the North 93 degrees East tower face of the 24" face tower at a bearing of North 93 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 for WFMA-FM, Marion, Alabama

(Continued)

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 #27. 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 24 kilowatts (13.802 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 82 feet 4 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.

Directional Antenna System  
for  
WFMA-FM, Marion, Alabama

(Continued)

A handwritten signature in black ink, reading "Dan Dowdle". The signature is written in a cursive style with a large, looped 'D' and a trailing flourish.

Dan Dowdle  
Test Range Director  
Electronics Research, Inc.

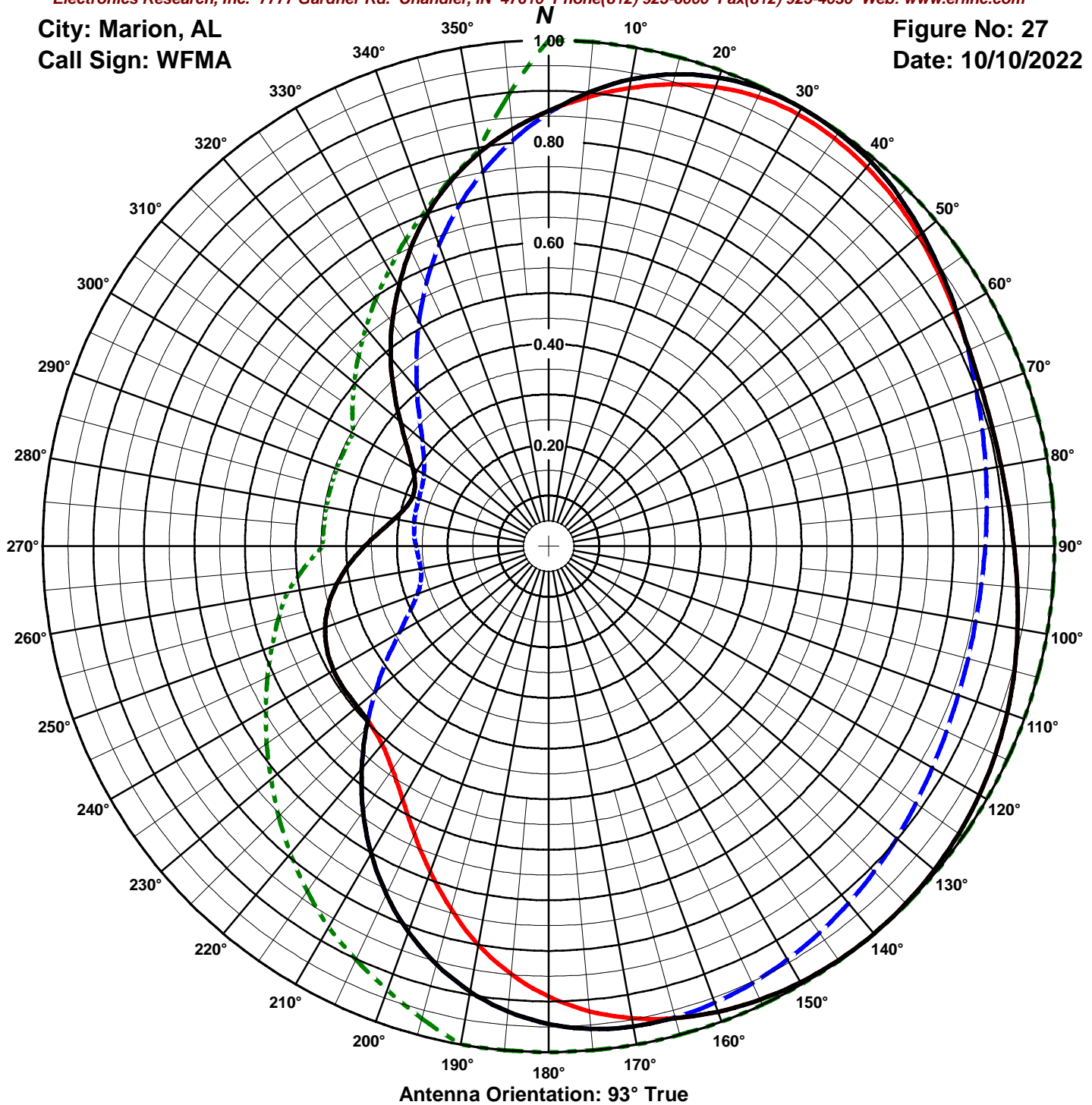
The Microsoft Word document on file electronically at Electronic Research, Inc. governs the specifications, scope, and configuration of the product described. All other representations whether verbal, printed, or electronic are subordinate to the master copy of this document on file at ERI.

# 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: Marion, AL  
Call Sign: WFMA

Figure No: 27  
Date: 10/10/2022



Frequency: 102.9 MHz  
Antenna Type: LP-8E-DA

Antenna Mounting: 26" Radome Brkt  
Tower Type: 24" Sabre

## HORIZONTAL

RMS: .781

Maximum: 1 @ 140°

Minimum: .286 @ 290°

## VERTICAL

RMS: .759

Maximum: 1 @ 30°

Minimum: .256 @ 261°

## COMPOSITE

RMS: .796

Maximum: 1 @ 30°

Minimum: .286 @ 290°

## FCC ENVELOPE

RMS: .861

Maximum: 1 @ 0°

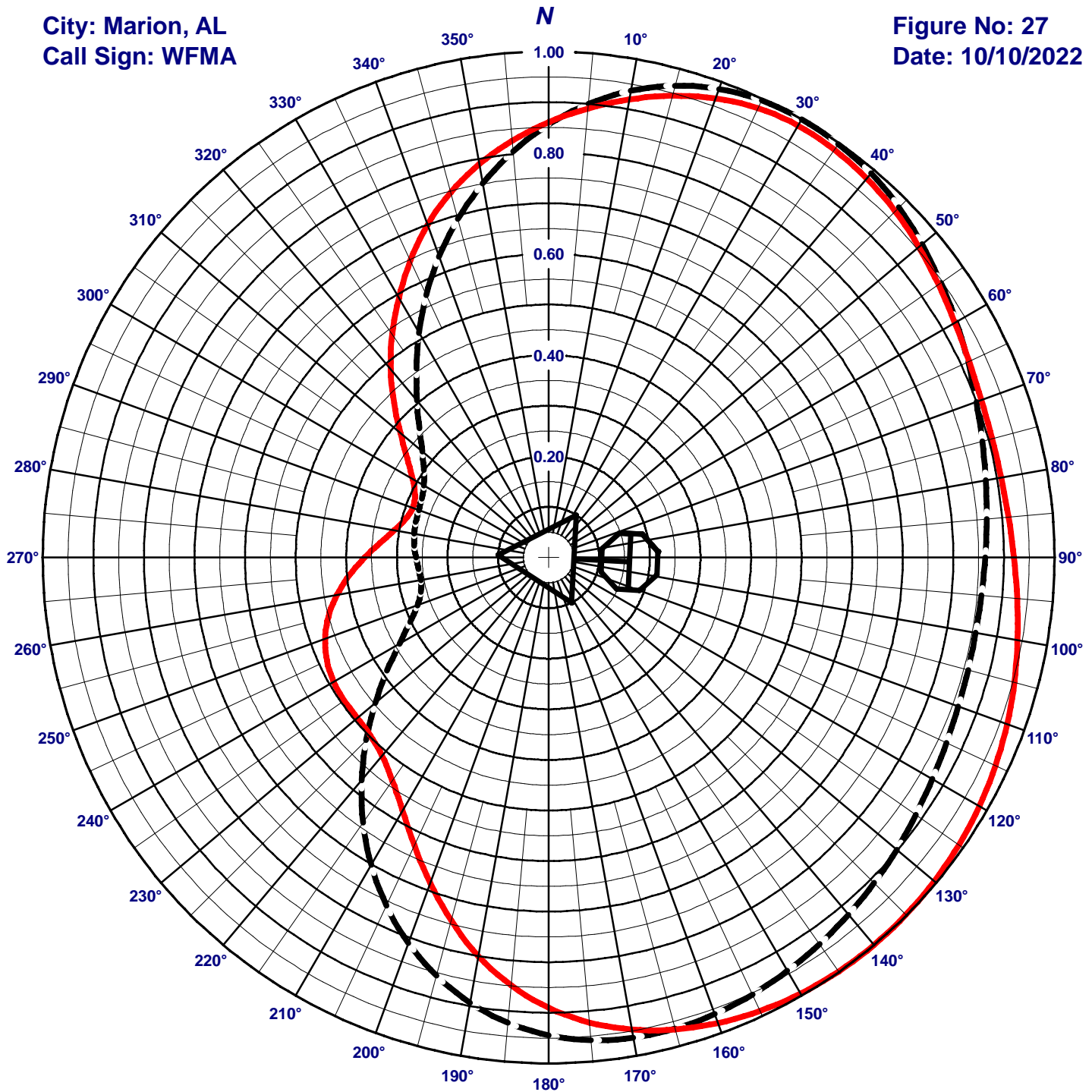
Minimum: .446 @ 270°

Two bay test. Left-hand loops.

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

City: Marion, AL  
Call Sign: WFMA

Figure No: 27  
Date: 10/10/2022



Frequency: 102.9 MHz  
Antenna Type: LP-8E-DA  
Antenna Orientation: 93° True  
Antenna Mounting: 26" Radome Brkt  
Tower Type 24" Sabre

**VERTICAL**  
RMS: .759  
Maximum: 1 @ 30°  
Minimum: .256 @ 261°

**HORIZONTAL**  
RMS: .781  
Maximum: 1 @ 140°  
Minimum: .286 @ 290°

Two bay test. Left-hand loops. The antenna is mounted on the 93° tower face.

# 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# 27

Station: WFMA

Location:

Frequency: 102.9 MHz

Date: 10/10/2022

Antenna: LP-8E-DA

Antenna Orientation: 93° True

Number of Bays: 8

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.860	17.768	12.496	0.856	17.593	12.454	180°	0.890	19.014	12.791	0.944	21.396	13.303
5°	0.891	19.052	12.799	0.900	19.437	12.886	185°	0.849	17.309	12.383	0.923	20.460	13.109
10°	0.919	20.291	13.073	0.937	21.060	13.235	190°	0.800	15.353	11.862	0.894	19.172	12.827
15°	0.945	21.429	13.310	0.966	22.379	13.498	195°	0.743	13.263	11.226	0.856	17.583	12.451
20°	0.966	22.374	13.498	0.985	23.307	13.675	200°	0.685	11.254	10.513	0.811	15.780	11.981
25°	0.980	23.042	13.625	0.997	23.842	13.773	205°	0.628	9.463	9.760	0.759	13.827	11.407
30°	0.986	23.323	13.678	1.000	24.000	13.802	210°	0.578	8.008	9.035	0.702	11.817	10.725
35°	0.984	23.246	13.663	0.998	23.891	13.782	215°	0.538	6.954	8.423	0.640	9.827	9.924
40°	0.978	22.961	13.610	0.991	23.583	13.726	220°	0.512	6.286	7.984	0.575	7.934	8.995
45°	0.968	22.510	13.524	0.979	23.008	13.619	225°	0.498	5.950	7.745	0.510	6.244	7.954
50°	0.955	21.897	13.404	0.963	22.264	13.476	230°	0.494	5.847	7.669	0.447	4.803	6.815
55°	0.940	21.227	13.269	0.947	21.503	13.325	235°	0.493	5.833	7.659	0.390	3.650	5.623
60°	0.927	20.632	13.145	0.931	20.781	13.177	240°	0.491	5.780	7.619	0.341	2.786	4.450
65°	0.917	20.188	13.051	0.915	20.079	13.027	245°	0.484	5.611	7.491	0.302	2.194	3.412
70°	0.911	19.897	12.988	0.900	19.424	12.883	250°	0.470	5.306	7.248	0.276	1.830	2.625
75°	0.908	19.769	12.960	0.887	18.900	12.765	255°	0.451	4.873	6.878	0.262	1.643	2.156
80°	0.908	19.805	12.968	0.877	18.473	12.665	260°	0.425	4.336	6.371	0.257	1.580	1.987
85°	0.913	19.988	13.008	0.869	18.130	12.584	265°	0.395	3.745	5.735	0.258	1.598	2.037
90°	0.920	20.304	13.076	0.863	17.876	12.523	270°	0.364	3.173	5.014	0.262	1.652	2.180
95°	0.930	20.736	13.167	0.859	17.693	12.478	275°	0.334	2.677	4.277	0.267	1.706	2.319
100°	0.941	21.247	13.273	0.857	17.631	12.463	280°	0.310	2.302	3.621	0.270	1.747	2.424
105°	0.953	21.799	13.384	0.858	17.678	12.474	285°	0.293	2.062	3.143	0.272	1.774	2.489
110°	0.964	22.325	13.488	0.861	17.811	12.507	290°	0.286	1.966	2.937	0.273	1.792	2.534
115°	0.974	22.785	13.577	0.867	18.056	12.566	295°	0.292	2.041	3.099	0.277	1.836	2.638
120°	0.983	23.193	13.654	0.876	18.399	12.648	300°	0.310	2.310	3.637	0.285	1.949	2.898
125°	0.990	23.531	13.716	0.886	18.852	12.753	305°	0.341	2.797	4.466	0.301	2.176	3.376
130°	0.995	23.771	13.760	0.898	19.365	12.870	310°	0.383	3.516	5.461	0.326	2.555	4.075
135°	0.999	23.931	13.790	0.910	19.868	12.982	315°	0.432	4.482	6.515	0.361	3.134	4.961
140°	1.000	24.000	13.802	0.922	20.384	13.093	320°	0.486	5.662	7.530	0.405	3.940	5.955
145°	0.999	23.951	13.793	0.933	20.892	13.200	325°	0.539	6.971	8.433	0.456	4.984	6.976
150°	0.995	23.779	13.762	0.944	21.374	13.299	330°	0.592	8.413	9.250	0.512	6.297	7.991
155°	0.989	23.471	13.705	0.953	21.796	13.384	335°	0.647	10.049	10.021	0.572	7.859	8.954
160°	0.979	23.011	13.619	0.961	22.143	13.452	340°	0.700	11.764	10.706	0.633	9.616	9.830
165°	0.966	22.387	13.500	0.964	22.319	13.487	345°	0.748	13.413	11.275	0.693	11.517	10.613
170°	0.947	21.542	13.333	0.964	22.297	13.483	350°	0.790	14.962	11.750	0.751	13.518	11.309
175°	0.923	20.430	13.103	0.957	22.002	13.425	355°	0.827	16.410	12.151	0.806	15.582	11.926

Horizontal Polarization:

Maximum: 7.183 (8.563 dB)

Horizontal Plane: 7.183 (8.563 dB)

Maximum ERP: 24.000 kW

Vertical Polarization:

Maximum: 7.183 (8.563 dB)

Horizontal Plane: 7.183 (8.563 dB)

Maximum ERP: 24.000 kW

Total Input Power: 3.341 kW

Reference: WFMA27.FIG

Two bay test. Left-hand loops.



# 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# 27

Station: WFMA

Location:

Frequency: 102.9 MHz

Date: 10/10/2022

Antenna: LP-8E-DA

Antenna Orientation: 93° True

Number of Bays: 8

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.860	17.768	12.496	Horizontal	180°	0.944	21.396	13.303	Vertical
5°	0.900	19.437	12.886	Vertical	185°	0.923	20.460	13.109	Vertical
10°	0.937	21.060	13.235	Vertical	190°	0.894	19.172	12.827	Vertical
15°	0.966	22.379	13.498	Vertical	195°	0.856	17.583	12.451	Vertical
20°	0.985	23.307	13.675	Vertical	200°	0.811	15.780	11.981	Vertical
25°	0.997	23.842	13.773	Vertical	205°	0.759	13.827	11.407	Vertical
30°	1.000	24.000	13.802	Vertical	210°	0.702	11.817	10.725	Vertical
35°	0.998	23.891	13.782	Vertical	215°	0.640	9.827	9.924	Vertical
40°	0.991	23.583	13.726	Vertical	220°	0.575	7.934	8.995	Vertical
45°	0.979	23.008	13.619	Vertical	225°	0.510	6.244	7.954	Vertical
50°	0.963	22.264	13.476	Vertical	230°	0.494	5.847	7.669	Horizontal
55°	0.947	21.503	13.325	Vertical	235°	0.493	5.833	7.659	Horizontal
60°	0.931	20.781	13.177	Vertical	240°	0.491	5.780	7.619	Horizontal
65°	0.917	20.188	13.051	Horizontal	245°	0.484	5.611	7.491	Horizontal
70°	0.911	19.897	12.988	Horizontal	250°	0.470	5.306	7.248	Horizontal
75°	0.908	19.769	12.960	Horizontal	255°	0.451	4.873	6.878	Horizontal
80°	0.908	19.805	12.968	Horizontal	260°	0.425	4.336	6.371	Horizontal
85°	0.913	19.988	13.008	Horizontal	265°	0.395	3.745	5.735	Horizontal
90°	0.920	20.304	13.076	Horizontal	270°	0.364	3.173	5.014	Horizontal
95°	0.930	20.736	13.167	Horizontal	275°	0.334	2.677	4.277	Horizontal
100°	0.941	21.247	13.273	Horizontal	280°	0.310	2.302	3.621	Horizontal
105°	0.953	21.799	13.384	Horizontal	285°	0.293	2.062	3.143	Horizontal
110°	0.964	22.325	13.488	Horizontal	290°	0.286	1.966	2.937	Horizontal
115°	0.974	22.785	13.577	Horizontal	295°	0.292	2.041	3.099	Horizontal
120°	0.983	23.193	13.654	Horizontal	300°	0.310	2.310	3.637	Horizontal
125°	0.990	23.531	13.716	Horizontal	305°	0.341	2.797	4.466	Horizontal
130°	0.995	23.771	13.760	Horizontal	310°	0.383	3.516	5.461	Horizontal
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140°	1.000	24.000	13.802	Horizontal	320°	0.486	5.662	7.530	Horizontal
145°	0.999	23.951	13.793	Horizontal	325°	0.539	6.971	8.433	Horizontal
150°	0.995	23.779	13.762	Horizontal	330°	0.592	8.413	9.250	Horizontal
155°	0.989	23.471	13.705	Horizontal	335°	0.647	10.049	10.021	Horizontal
160°	0.979	23.011	13.619	Horizontal	340°	0.700	11.764	10.706	Horizontal
165°	0.966	22.387	13.500	Horizontal	345°	0.748	13.413	11.275	Horizontal
170°	0.964	22.297	13.483	Vertical	350°	0.790	14.962	11.750	Horizontal
175°	0.957	22.002	13.425	Vertical	355°	0.827	16.410	12.151	Horizontal

Horizontal Polarization:

Maximum: 7.183 (8.563 dB)

Horizontal Plane: 7.183 (8.563 dB)

Maximum ERP: 24.000 kW

Vertical Polarization:

Maximum: 7.183 (8.563 dB)

Horizontal Plane: 7.183 (8.563 dB)

Maximum ERP: 24.000 kW

Total Input Power: 3.341 kW

Reference: WFMA27.FIG

Two bay test. Left-hand loops.

# 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: WFMA

Location: Marion, AL

Frequency: 102.9 MHz

Antenna: 8 bay LP-8E-DA

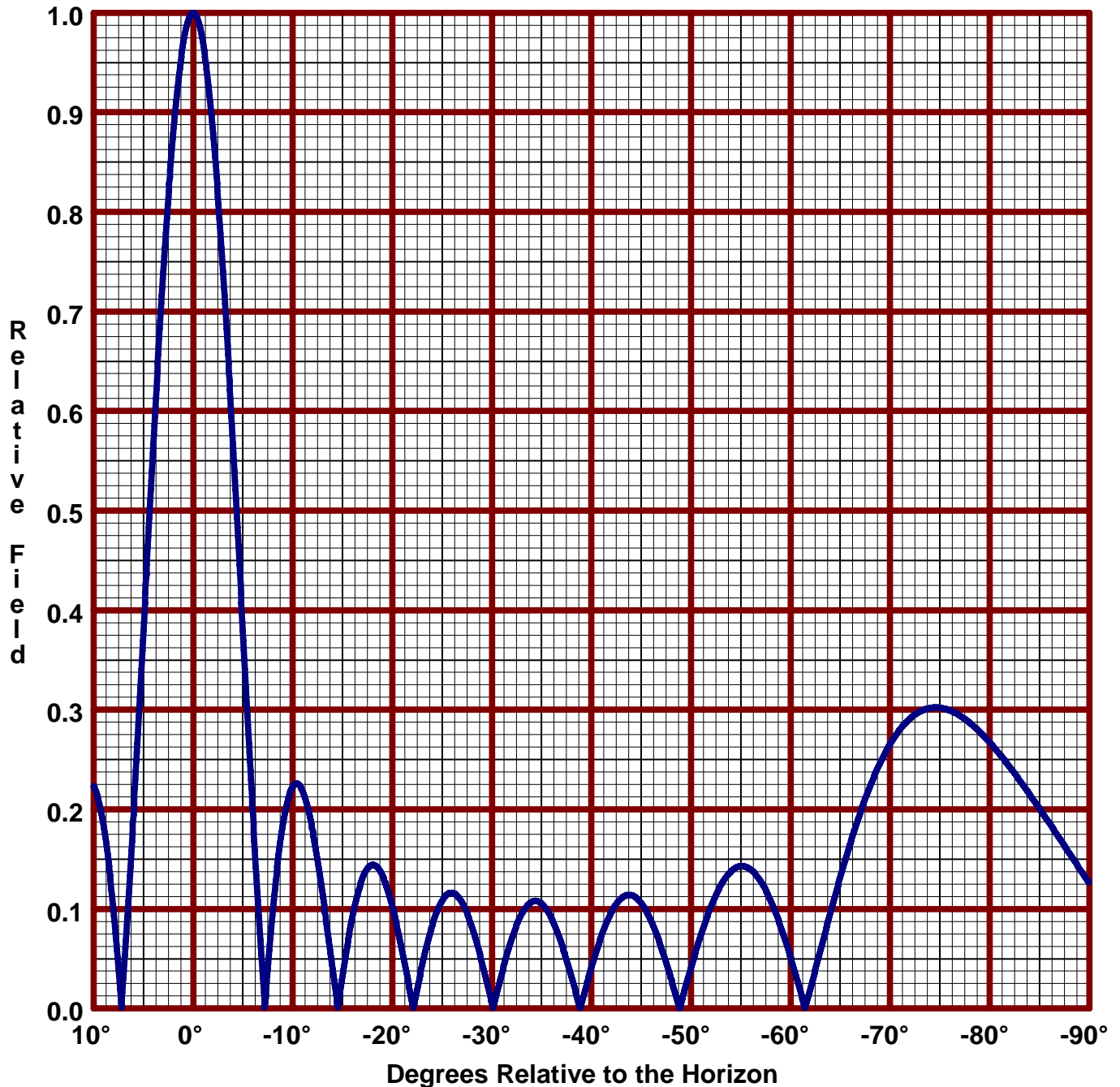
Date: 10/10/2022

H/V Power Ratio: 1

1 Wave-length Spacing

0° Beam Tilt

0% First Null Fill



Horizontal Polarization:

Maximum: 7.183 (8.563 dB)

Horizontal Plane: 7.183 (8.563 dB)

Maximum ERP: 24.000 kW

Vertical Polarization:

Maximum: 7.183 (8.563 dB)

Horizontal Plane: 7.183 (8.563 dB)

Maximum ERP: 24.000 kW

Two bay test. Left-hand loops.

# Directional Antenna System for WFMA-FM, Marion, Alabama

(continued)

## ANTENNA SPECIFICATIONS

Antenna Type:	LP-8E-DA
Frequency:	102.9 MHz
Number of Bays:	Eight

## MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	71 ft
Aperture length required:	82 ft 4 in
Orientation:	93° true
Input flange to the antenna 1 5/8" female.	

## ELECTRICAL SPECIFICATIONS (For directional use)

Maximum horizontal ERP:	24.0 kW (13.802 dBk)
Horizontal maximum power gain:	7.183 (8.563 dB)
Maximum vertical ERP:	24.0 kW (13.802 dBk)
Vertical maximum power gain:	7.183 (8.563 dB)
Total input power:	3.341 kW (5.239 dBk)

WFMA Marion, AL 39596

102.9 MHz LP-8E-DA

Antenna is mounted on a 24" Sabre tower with 1.5" legs on the 93° tower face  
26" Radome Bracket

*Left-hand loops*

Horizontal parasites are mounted  $\frac{1}{4}$  wave above and below each element

