

***Directional Antenna System  
for  
WBHX, Tuckerton, New Jersey***

08/02/21

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

The antenna is the ERI model LP-2E-DA-HW configuration. The circular polarized system consists of two half-wavelength spaced bays using one driven circular polarized radiating element per bay, two horizontal parasitic element per bay and two vertical parasitic elements interleaved between the bays. The antenna was mounted on the North 99.25 degrees East tower face with bracketry to provide an antenna orientation of North 99.25 degrees East. The antenna was tested on a seven foot face tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 99.7 megahertz, which is the center of the FM broadcast channel assigned to WBHX.

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 WBHX, Tuckerton, New Jersey

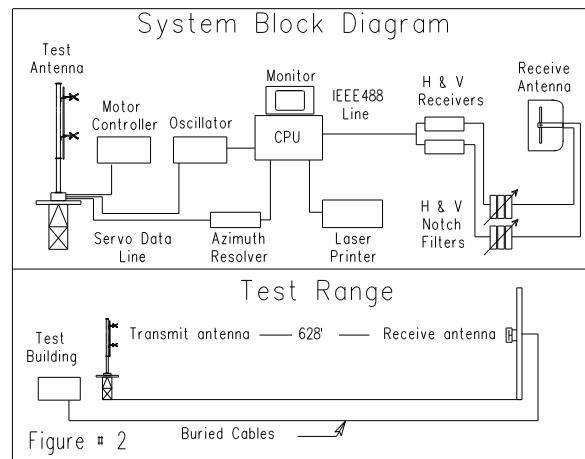
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## DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of a full-scale model of the complete circular polarized system with the associated 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 seven foot 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.



# Directional Antenna System for WBHX, Tuckerton, New Jersey

(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 co-ordinated 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, two horizontal parasitic elements per bay and two vertical parasitic elements interleaved between the bays. 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-HW array is to be mounted on the North 99.25 degrees East tower face of the seven foot face tower at a bearing of North 99.25 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.

Attached are the measured patterns of the horizontal and vertical components. The composite pattern shows the maximum of either the H or V azimuth values. This patterns is greater than 85% of the FCC filed composite pattern. 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 0.65 kilowatts ( -1.871 dBk).

Directional Antenna System  
for  
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(Continued)

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 19 feet 11 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.

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Dan Dowdle  
ERI Test Range Director

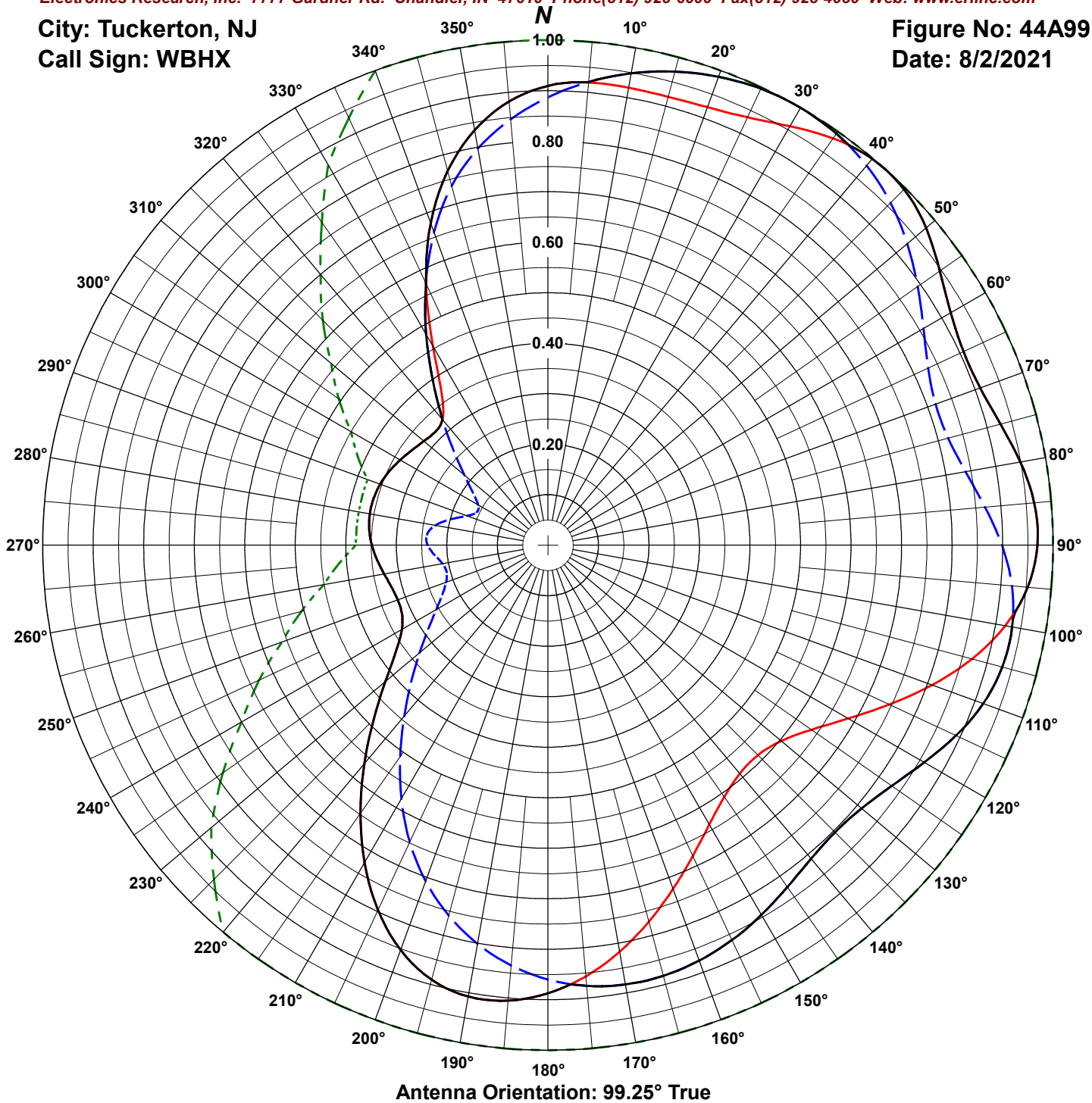
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# ERI<sup>®</sup> Horizontal Plane Relative Field Pattern

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

City: Tuckerton, NJ  
Call Sign: WBHX

Figure No: 44A99  
Date: 8/2/2021



Frequency: 99.7 MHz

Antenna Type: LP-2E-DA-HW

Antenna Mounting: Standard

Tower Type: 7' tower

## HORIZONTAL

RMS: .725

Maximum: 1 @ 42°

Minimum: .316 @ 249°

## VERTICAL

RMS: .721

Maximum: 1 @ 29°

Minimum: .155 @ 296°

## COMPOSITE

RMS: .763

Maximum: 1 @ 29°

Minimum: .316 @ 249°

## FCC ENVELOPE

RMS: .896

Maximum: 1 @ 0°

Minimum: .38 @ 270°

Two bay test. Custom face mounts 11.5" and horizontal & vertical parasitics. 2 bays tested.

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

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Figure# 44A99

Date: 8/2/2021

Station: WBHX

Antenna: LP-2E-DA-HW

Location: Tuckerton, NJ

Antenna Orientation: 99.25° True

Frequency: 99.7 MHz

Number of Bays: 2

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.909	0.537	-2.697	0.887	0.511	-2.916	180°	0.887	0.512	-2.909	0.860	0.481	-3.182
5°	0.920	0.550	-2.597	0.921	0.551	-2.588	185°	0.905	0.533	-2.736	0.835	0.453	-3.436
10°	0.920	0.550	-2.597	0.949	0.585	-2.329	190°	0.908	0.535	-2.713	0.801	0.418	-3.793
15°	0.919	0.549	-2.603	0.971	0.613	-2.129	195°	0.890	0.515	-2.879	0.759	0.374	-4.266
20°	0.923	0.554	-2.567	0.987	0.633	-1.984	200°	0.853	0.473	-3.255	0.708	0.326	-4.874
25°	0.935	0.568	-2.457	0.997	0.646	-1.895	205°	0.796	0.412	-3.848	0.648	0.273	-5.646
30°	0.958	0.596	-2.245	1.000	0.650	-1.872	210°	0.726	0.342	-4.654	0.580	0.218	-6.606
35°	0.984	0.629	-2.015	0.995	0.643	-1.915	215°	0.647	0.272	-5.654	0.509	0.169	-7.731
40°	0.999	0.648	-1.883	0.981	0.626	-2.035	220°	0.566	0.208	-6.822	0.442	0.127	-8.955
45°	0.997	0.646	-1.900	0.959	0.598	-2.235	225°	0.488	0.155	-8.108	0.383	0.095	-10.216
50°	0.977	0.621	-2.071	0.928	0.560	-2.517	230°	0.420	0.115	-9.412	0.331	0.071	-11.465
55°	0.947	0.583	-2.344	0.893	0.519	-2.849	235°	0.367	0.088	-10.574	0.289	0.054	-12.657
60°	0.921	0.551	-2.588	0.859	0.479	-3.195	240°	0.334	0.072	-11.403	0.255	0.042	-13.732
65°	0.908	0.536	-2.712	0.830	0.448	-3.484	245°	0.319	0.066	-11.796	0.230	0.035	-14.620
70°	0.911	0.539	-2.685	0.817	0.433	-3.630	250°	0.316	0.065	-11.869	0.214	0.030	-15.243
75°	0.927	0.559	-2.527	0.820	0.437	-3.592	255°	0.320	0.067	-11.755	0.207	0.028	-15.531
80°	0.950	0.586	-2.319	0.839	0.458	-3.392	260°	0.329	0.070	-11.530	0.212	0.029	-15.365
85°	0.966	0.607	-2.168	0.868	0.490	-3.098	265°	0.339	0.075	-11.262	0.225	0.033	-14.831
90°	0.969	0.610	-2.144	0.899	0.525	-2.798	270°	0.348	0.079	-11.027	0.238	0.037	-14.334
95°	0.953	0.591	-2.285	0.922	0.553	-2.576	275°	0.355	0.082	-10.868	0.240	0.037	-14.262
100°	0.919	0.549	-2.603	0.933	0.566	-2.473	280°	0.358	0.083	-10.798	0.226	0.033	-14.785
105°	0.869	0.491	-3.087	0.931	0.564	-2.490	285°	0.357	0.083	-10.814	0.199	0.026	-15.892
110°	0.810	0.426	-3.707	0.917	0.547	-2.623	290°	0.353	0.081	-10.909	0.170	0.019	-17.260
115°	0.746	0.362	-4.414	0.892	0.517	-2.867	295°	0.346	0.078	-11.079	0.155	0.016	-18.058
120°	0.686	0.306	-5.138	0.860	0.481	-3.181	300°	0.337	0.074	-11.307	0.160	0.017	-17.804
125°	0.637	0.264	-5.789	0.831	0.449	-3.480	305°	0.328	0.070	-11.548	0.181	0.021	-16.724
130°	0.603	0.236	-6.264	0.811	0.427	-3.694	310°	0.321	0.067	-11.753	0.216	0.030	-15.191
135°	0.588	0.225	-6.484	0.804	0.420	-3.768	315°	0.316	0.065	-11.870	0.264	0.045	-13.453
140°	0.591	0.227	-6.442	0.810	0.427	-3.696	320°	0.324	0.068	-11.648	0.324	0.068	-11.661
145°	0.609	0.241	-6.184	0.826	0.444	-3.528	325°	0.366	0.087	-10.593	0.397	0.102	-9.896
150°	0.639	0.265	-5.763	0.845	0.464	-3.331	330°	0.455	0.135	-8.705	0.482	0.151	-8.218
155°	0.679	0.299	-5.239	0.862	0.484	-3.156	335°	0.570	0.211	-6.749	0.572	0.212	-6.731
160°	0.724	0.341	-4.673	0.875	0.498	-3.028	340°	0.679	0.299	-5.240	0.659	0.282	-5.494
165°	0.772	0.387	-4.120	0.883	0.506	-2.955	345°	0.767	0.382	-4.176	0.736	0.352	-4.533
170°	0.818	0.434	-3.621	0.883	0.507	-2.949	350°	0.835	0.453	-3.442	0.798	0.413	-3.835
175°	0.857	0.478	-3.210	0.876	0.499	-3.022	355°	0.882	0.506	-2.962	0.846	0.466	-3.320

Horizontal Polarization:

Maximum: 1.275 (1.057 dB)

Horizontal Plane: 1.275 (1.057 dB)

Maximum ERP: 0.650 kW

Vertical Polarization:

Maximum: 1.275 (1.057 dB)

Horizontal Plane: 1.275 (1.057 dB)

Maximum ERP: 0.650 kW

Total Input Power: 0.510 kW

Reference: WBHX44A99.FIG

Two bay test. Custom face mounts 11.5" and horizontal & vertical parasitics. 2 bays tested.

# 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: 8/2/2021

Station: WBHX

Antenna: LP-2E-DA-HW

Location: Tuckerton, NJ

Antenna Orientation: 99.25° True

Frequency: 99.7 MHz

Number of Bays: 2

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.909	0.537	-2.697	Horizontal	180°	0.887	0.512	-2.909	Horizontal
5°	0.921	0.551	-2.588	Vertical	185°	0.905	0.533	-2.736	Horizontal
10°	0.949	0.585	-2.329	Vertical	190°	0.908	0.535	-2.713	Horizontal
15°	0.971	0.613	-2.129	Vertical	195°	0.890	0.515	-2.879	Horizontal
20°	0.987	0.633	-1.984	Vertical	200°	0.853	0.473	-3.255	Horizontal
25°	0.997	0.646	-1.895	Vertical	205°	0.796	0.412	-3.848	Horizontal
30°	1.000	0.650	-1.872	Vertical	210°	0.726	0.342	-4.654	Horizontal
35°	0.995	0.643	-1.915	Vertical	215°	0.647	0.272	-5.654	Horizontal
40°	0.999	0.648	-1.883	Horizontal	220°	0.566	0.208	-6.822	Horizontal
45°	0.997	0.646	-1.900	Horizontal	225°	0.488	0.155	-8.108	Horizontal
50°	0.977	0.621	-2.071	Horizontal	230°	0.420	0.115	-9.412	Horizontal
55°	0.947	0.583	-2.344	Horizontal	235°	0.367	0.088	-10.574	Horizontal
60°	0.921	0.551	-2.588	Horizontal	240°	0.334	0.072	-11.403	Horizontal
65°	0.908	0.536	-2.712	Horizontal	245°	0.319	0.066	-11.796	Horizontal
70°	0.911	0.539	-2.685	Horizontal	250°	0.316	0.065	-11.869	Horizontal
75°	0.927	0.559	-2.527	Horizontal	255°	0.320	0.067	-11.755	Horizontal
80°	0.950	0.586	-2.319	Horizontal	260°	0.329	0.070	-11.530	Horizontal
85°	0.966	0.607	-2.168	Horizontal	265°	0.339	0.075	-11.262	Horizontal
90°	0.969	0.610	-2.144	Horizontal	270°	0.348	0.079	-11.027	Horizontal
95°	0.953	0.591	-2.285	Horizontal	275°	0.355	0.082	-10.868	Horizontal
100°	0.933	0.566	-2.473	Vertical	280°	0.358	0.083	-10.798	Horizontal
105°	0.931	0.564	-2.490	Vertical	285°	0.357	0.083	-10.814	Horizontal
110°	0.917	0.547	-2.623	Vertical	290°	0.353	0.081	-10.909	Horizontal
115°	0.892	0.517	-2.867	Vertical	295°	0.346	0.078	-11.079	Horizontal
120°	0.860	0.481	-3.181	Vertical	300°	0.337	0.074	-11.307	Horizontal
125°	0.831	0.449	-3.480	Vertical	305°	0.328	0.070	-11.548	Horizontal
130°	0.811	0.427	-3.694	Vertical	310°	0.321	0.067	-11.753	Horizontal
135°	0.804	0.420	-3.768	Vertical	315°	0.316	0.065	-11.870	Horizontal
140°	0.810	0.427	-3.696	Vertical	320°	0.324	0.068	-11.648	Horizontal
145°	0.826	0.444	-3.528	Vertical	325°	0.397	0.102	-9.896	Vertical
150°	0.845	0.464	-3.331	Vertical	330°	0.482	0.151	-8.218	Vertical
155°	0.862	0.484	-3.156	Vertical	335°	0.572	0.212	-6.731	Vertical
160°	0.875	0.498	-3.028	Vertical	340°	0.679	0.299	-5.240	Horizontal
165°	0.883	0.506	-2.955	Vertical	345°	0.767	0.382	-4.176	Horizontal
170°	0.883	0.507	-2.949	Vertical	350°	0.835	0.453	-3.442	Horizontal
175°	0.876	0.499	-3.022	Vertical	355°	0.882	0.506	-2.962	Horizontal

Horizontal Polarization:

Maximum: 1.275 (1.057 dB)

Horizontal Plane: 1.275 (1.057 dB)

Maximum ERP: 0.650 kW

Vertical Polarization:

Maximum: 1.275 (1.057 dB)

Horizontal Plane: 1.275 (1.057 dB)

Maximum ERP: 0.650 kW

Total Input Power: 0.510 kW

Reference: WBHX44A99.FIG

Two bay test. Custom face mounts 11.5" and horizontal & vertical parasitics. 2 bays tested.

# 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: WBHX

Location: Tuckerton, NJ

Frequency: 99.7 MHz

Antenna: 2 bay LP-2E-DA-HW

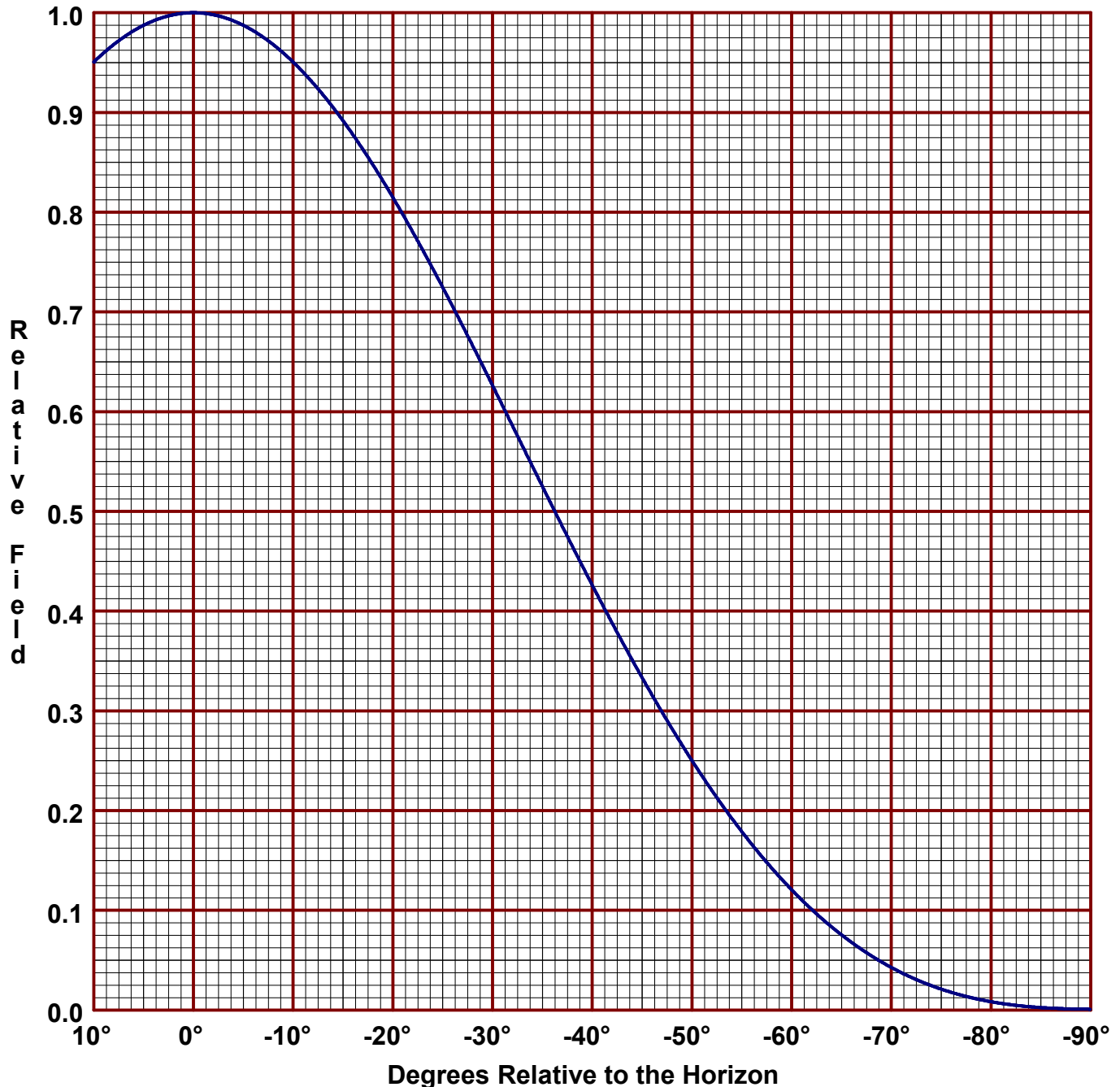
Date: 8/2/2021

H/V Power Ratio: 1

.5 Wave-length Spacing

0° Beam Tilt

0% First Null Fill



**Horizontal Polarization:**

**Maximum: 1.275 (1.057 dB)**

**Horizontal Plane: 1.275 (1.057 dB)**

**Maximum ERP: 0.650 kW**

**Vertical Polarization:**

**Maximum: 1.275 (1.057 dB)**

**Horizontal Plane: 1.275 (1.057 dB)**

**Maximum ERP: 0.650 kW**

Two bay test. Custom face mounts 11.5" and horizontal & vertical parasitics. 2 bays tested.



# Directional Antenna System for WBHX, Tuckerton, New Jersey

(Continued)

## ANTENNA SPECIFICATIONS

Antenna Type:	LP-2E-DA-HW
Frequency:	99.7 MHz
Number of Bays:	Two

## MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	13 ft 6 in
Aperture length required:	19 ft 11 in
Orientation:	99.25° true

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

## ELECTRICAL SPECIFICATIONS (For directional use)

Maximum horizontal ERP:	0.650 kW (-1.871 dBk)
Horizontal maximum power gain:	1.275 (1.057 dB)
Maximum vertical ERP:	0.650 kW (-1.871 dBk)
Vertical maximum power gain:	1.275 (1.057 dB)
Total input power:	0.510 kW (-2.924 dBk)

