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 WRNX, Amherst, Massachusetts

July 28, 2011

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 WRNX.

The antenna is the ERI model LP-1E-DA configuration. The circular polarized system consists of one bay using one driven circular polarized radiating element and four vertical parasitic elements. The antenna was mounted on the North 305 degrees East tower face with bracketry to provide an antenna orientation of North 305 degrees East. The antenna was tested on a 16 ¾" face tower center to center for the legs, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 100.9 megahertz, which is the center of the FM broadcast channel assigned to WRNX.

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
WRNX, Amherst, Massachusetts

(Continued)

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, and a section of 1 5/8 inch o.d. quarter wave stub 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 16 ¾" face tower center to center for the legs 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.

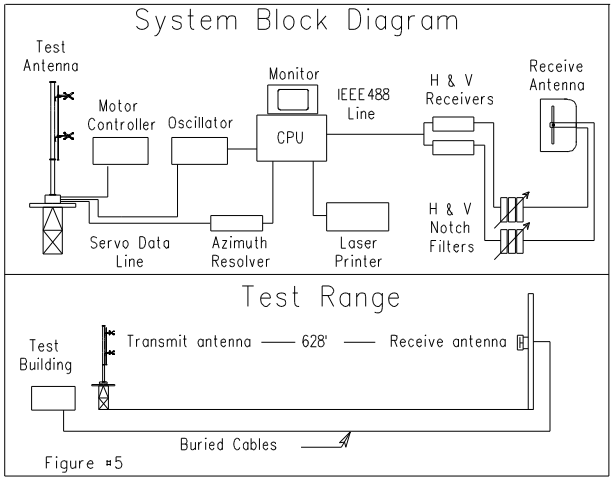

Figure #5

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

(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 one bay using one driven circular polarized radiating element and four vertical parasitic elements. 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-1E-DA array is to be mounted on the North 305 degrees East tower face of the 16 ¾" face tower center to center for the legs at a bearing of North 305 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. The measured composite pattern between 20 and 70 degrees true maintains a relative field of at least 0.910 to comply with the special condition on the construction permit file number BPH-20101227AAO.

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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 0.870 kilowatts (-.605 dBk).

The power at North 140-150 degrees East does not exceed 0.480 kilowatts (-3.188 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 15 feet.

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

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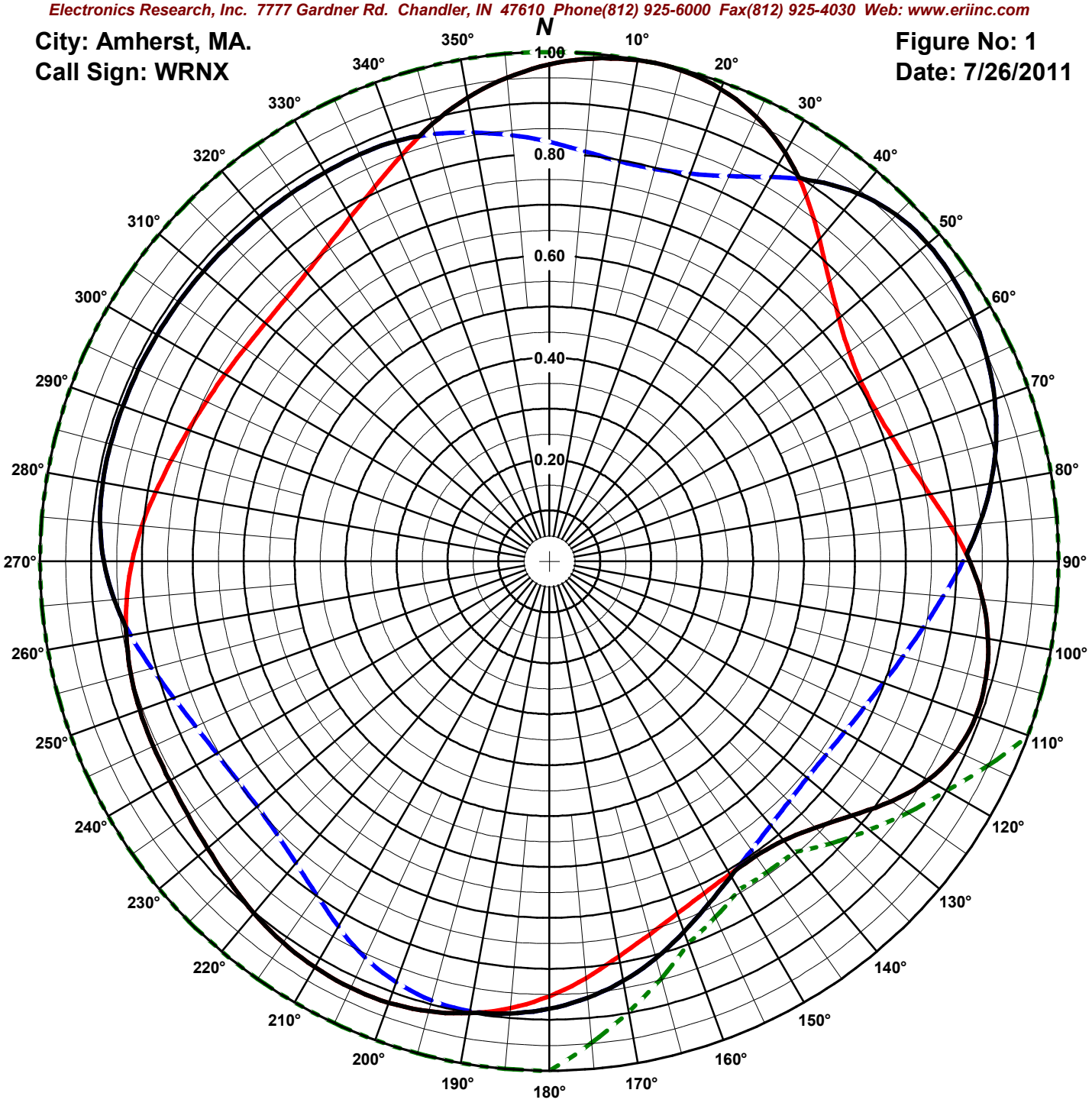
City: Amherst, MA.
Call Sign: WRNX

Figure No: 1
Date: 7/26/2011



Antenna Orientation: 305° True

Frequency: 100.9 MHz
Antenna Type: LP-1E-DA

Antenna Mounting: 22" Ell
Tower Type: 16 3/4" face tower

HORIZONTAL	VERTICAL	COMPOSITE	FCC ENVELOPE
RMS: .834	RMS: .834	RMS: .886	RMS: .972
Maximum: 1 @ 12°	Maximum: .97 @ 51°	Maximum: 1 @ 12°	Maximum: 1 @ 0°
Minimum: .705 @ 62°	Minimum: .661 @ 129°	Minimum: .707 @ 146°	Minimum: .744 @ 150°

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 BPH-20101227AAO.

ERI® Horizontal Plane Relative Field Pattern

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Figure# 1 **Date: 7/26/2011**
Station: WRNX **Antenna: LP-1E-DA**
Location: Amherst, MA. **Antenna Orientation: 305° True**
Frequency: 100.9 MHz **Number of Bays: 1**

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.976	0.828	-0.819	Horizontal	180°	0.878	0.671	-1.730	Vertical
5°	0.991	0.854	-0.685	Horizontal	185°	0.891	0.691	-1.608	Vertical
10°	0.999	0.868	-0.614	Horizontal	190°	0.901	0.706	-1.514	Horizontal
15°	0.998	0.867	-0.619	Horizontal	195°	0.915	0.728	-1.381	Horizontal
20°	0.986	0.846	-0.725	Horizontal	200°	0.922	0.740	-1.309	Horizontal
25°	0.962	0.806	-0.938	Horizontal	205°	0.924	0.742	-1.296	Horizontal
30°	0.926	0.747	-1.269	Horizontal	210°	0.920	0.737	-1.328	Horizontal
35°	0.911	0.722	-1.413	Vertical	215°	0.913	0.725	-1.396	Horizontal
40°	0.943	0.773	-1.117	Vertical	220°	0.902	0.708	-1.501	Horizontal
45°	0.963	0.806	-0.937	Vertical	225°	0.888	0.687	-1.632	Horizontal
50°	0.970	0.819	-0.868	Vertical	230°	0.876	0.667	-1.755	Horizontal
55°	0.968	0.816	-0.884	Vertical	235°	0.867	0.653	-1.849	Horizontal
60°	0.961	0.803	-0.953	Vertical	240°	0.861	0.645	-1.908	Horizontal
65°	0.948	0.782	-1.068	Vertical	245°	0.858	0.641	-1.934	Horizontal
70°	0.930	0.753	-1.231	Vertical	250°	0.856	0.637	-1.960	Horizontal
75°	0.908	0.717	-1.443	Vertical	255°	0.851	0.630	-2.008	Horizontal
80°	0.881	0.675	-1.709	Vertical	260°	0.843	0.619	-2.086	Horizontal
85°	0.848	0.626	-2.032	Vertical	265°	0.858	0.640	-1.939	Vertical
90°	0.826	0.593	-2.269	Horizontal	270°	0.875	0.665	-1.769	Vertical
95°	0.854	0.635	-1.975	Horizontal	275°	0.885	0.682	-1.662	Vertical
100°	0.875	0.666	-1.767	Horizontal	280°	0.890	0.690	-1.613	Vertical
105°	0.888	0.685	-1.641	Horizontal	285°	0.891	0.691	-1.603	Vertical
110°	0.891	0.691	-1.605	Horizontal	290°	0.891	0.691	-1.606	Vertical
115°	0.882	0.677	-1.694	Horizontal	295°	0.890	0.690	-1.613	Vertical
120°	0.859	0.642	-1.928	Horizontal	300°	0.889	0.688	-1.623	Vertical
125°	0.821	0.586	-2.320	Horizontal	305°	0.888	0.686	-1.636	Vertical
130°	0.776	0.524	-2.807	Horizontal	310°	0.886	0.684	-1.652	Vertical
135°	0.739	0.475	-3.231	Horizontal	315°	0.885	0.681	-1.668	Vertical
140°	0.716	0.446	-3.510	Horizontal	320°	0.883	0.679	-1.681	Vertical
145°	0.707	0.435	-3.619	Horizontal	325°	0.882	0.677	-1.692	Vertical
150°	0.714	0.443	-3.534	Vertical	330°	0.882	0.676	-1.700	Vertical
155°	0.741	0.478	-3.208	Vertical	335°	0.881	0.675	-1.704	Vertical
160°	0.774	0.521	-2.834	Vertical	340°	0.878	0.671	-1.733	Vertical
165°	0.807	0.567	-2.467	Vertical	345°	0.888	0.687	-1.632	Horizontal
170°	0.836	0.609	-2.157	Vertical	350°	0.924	0.743	-1.290	Horizontal
175°	0.860	0.644	-1.912	Vertical	355°	0.953	0.791	-1.021	Horizontal

Horizontal Polarization:
Maximum: 0.630 (-2.006 dB)
Horizontal Plane: 0.630 (-2.006 dB)
Maximum ERP: 0.870 kW

Vertical Polarization:
Maximum: 0.593 (-2.268 dB)
Horizontal Plane: 0.593 (-2.268 dB)
Maximum ERP: 0.819 kW

Total Input Power: 1.381 kW
Reference: WRNX1M.FIG

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

ERI® Horizontal Plane Relative Field Pattern

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Figure# 1A **Date: 7/26/2011**
Station: WRNX **Antenna: LP-1E-DA**
Location: Amherst, MA. **Antenna Orientation: 305° True**
Frequency: 100.9 MHz **Number of Bays: 1**

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.976	0.828	-0.819	0.824	0.591	-2.286	180°	0.854	0.634	-1.979	0.878	0.671	-1.730
5°	0.991	0.854	-0.685	0.808	0.568	-2.460	185°	0.880	0.674	-1.713	0.891	0.691	-1.608
10°	0.999	0.868	-0.614	0.797	0.553	-2.572	190°	0.901	0.706	-1.514	0.896	0.699	-1.555
15°	0.998	0.867	-0.619	0.797	0.553	-2.571	195°	0.915	0.728	-1.381	0.892	0.693	-1.596
20°	0.986	0.846	-0.725	0.810	0.571	-2.437	200°	0.922	0.740	-1.309	0.879	0.672	-1.725
25°	0.962	0.806	-0.938	0.835	0.606	-2.175	205°	0.924	0.742	-1.296	0.858	0.640	-1.940
30°	0.926	0.747	-1.269	0.871	0.660	-1.802	210°	0.920	0.737	-1.328	0.828	0.597	-2.241
35°	0.879	0.672	-1.729	0.911	0.722	-1.413	215°	0.913	0.725	-1.396	0.798	0.554	-2.566
40°	0.825	0.592	-2.274	0.943	0.773	-1.117	220°	0.902	0.708	-1.501	0.773	0.520	-2.837
45°	0.778	0.527	-2.783	0.963	0.806	-0.937	225°	0.888	0.687	-1.632	0.757	0.498	-3.025
50°	0.742	0.479	-3.193	0.970	0.819	-0.868	230°	0.876	0.667	-1.755	0.749	0.488	-3.120
55°	0.718	0.449	-3.478	0.968	0.816	-0.884	235°	0.867	0.653	-1.849	0.748	0.487	-3.124
60°	0.706	0.434	-3.624	0.961	0.803	-0.953	240°	0.861	0.645	-1.908	0.754	0.495	-3.055
65°	0.706	0.434	-3.625	0.948	0.782	-1.068	245°	0.858	0.641	-1.934	0.766	0.511	-2.916
70°	0.716	0.446	-3.511	0.930	0.753	-1.231	250°	0.856	0.637	-1.960	0.785	0.535	-2.713
75°	0.733	0.468	-3.301	0.908	0.717	-1.443	255°	0.851	0.630	-2.008	0.809	0.569	-2.450
80°	0.759	0.501	-3.004	0.881	0.675	-1.709	260°	0.843	0.619	-2.086	0.835	0.606	-2.172
85°	0.792	0.545	-2.635	0.848	0.626	-2.032	265°	0.833	0.603	-2.195	0.858	0.640	-1.939
90°	0.826	0.593	-2.269	0.812	0.574	-2.410	270°	0.819	0.584	-2.337	0.875	0.665	-1.769
95°	0.854	0.635	-1.975	0.777	0.525	-2.795	275°	0.803	0.561	-2.512	0.885	0.682	-1.662
100°	0.875	0.666	-1.767	0.746	0.484	-3.150	280°	0.785	0.536	-2.709	0.890	0.690	-1.613
105°	0.888	0.685	-1.641	0.720	0.451	-3.463	285°	0.768	0.513	-2.896	0.891	0.691	-1.603
110°	0.891	0.691	-1.605	0.698	0.424	-3.726	290°	0.754	0.495	-3.056	0.891	0.691	-1.606
115°	0.882	0.677	-1.694	0.682	0.404	-3.935	295°	0.743	0.480	-3.185	0.890	0.690	-1.613
120°	0.859	0.642	-1.928	0.670	0.390	-4.085	300°	0.735	0.470	-3.281	0.889	0.688	-1.623
125°	0.821	0.586	-2.320	0.663	0.382	-4.174	305°	0.730	0.463	-3.343	0.888	0.686	-1.636
130°	0.776	0.524	-2.807	0.662	0.381	-4.194	310°	0.728	0.460	-3.368	0.886	0.684	-1.652
135°	0.739	0.475	-3.231	0.666	0.386	-4.135	315°	0.731	0.464	-3.330	0.885	0.681	-1.668
140°	0.716	0.446	-3.510	0.676	0.398	-4.003	320°	0.740	0.477	-3.215	0.883	0.679	-1.681
145°	0.707	0.435	-3.619	0.692	0.417	-3.801	325°	0.757	0.499	-3.022	0.882	0.677	-1.692
150°	0.709	0.438	-3.589	0.714	0.443	-3.534	330°	0.781	0.530	-2.755	0.882	0.676	-1.700
155°	0.719	0.450	-3.467	0.741	0.478	-3.208	335°	0.811	0.573	-2.421	0.881	0.675	-1.704
160°	0.736	0.471	-3.270	0.774	0.521	-2.834	340°	0.849	0.626	-2.031	0.878	0.671	-1.733
165°	0.759	0.501	-3.005	0.807	0.567	-2.467	345°	0.888	0.687	-1.632	0.868	0.656	-1.831
170°	0.788	0.540	-2.676	0.836	0.609	-2.157	350°	0.924	0.743	-1.290	0.855	0.636	-1.968
175°	0.822	0.587	-2.311	0.860	0.644	-1.912	355°	0.953	0.791	-1.021	0.840	0.613	-2.122

Horizontal Polarization:
Maximum: 0.630 (-2.006 dB)
Horizontal Plane: 0.630 (-2.006 dB)
Maximum ERP: 0.870 kW

Vertical Polarization:
Maximum: 0.593 (-2.268 dB)
Horizontal Plane: 0.593 (-2.268 dB)
Maximum ERP: 0.819 kW

Total Input Power: 1.381 kW
Reference: WRNX1M.FIG

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

ERI® Vertical Plane Relative Field Pattern

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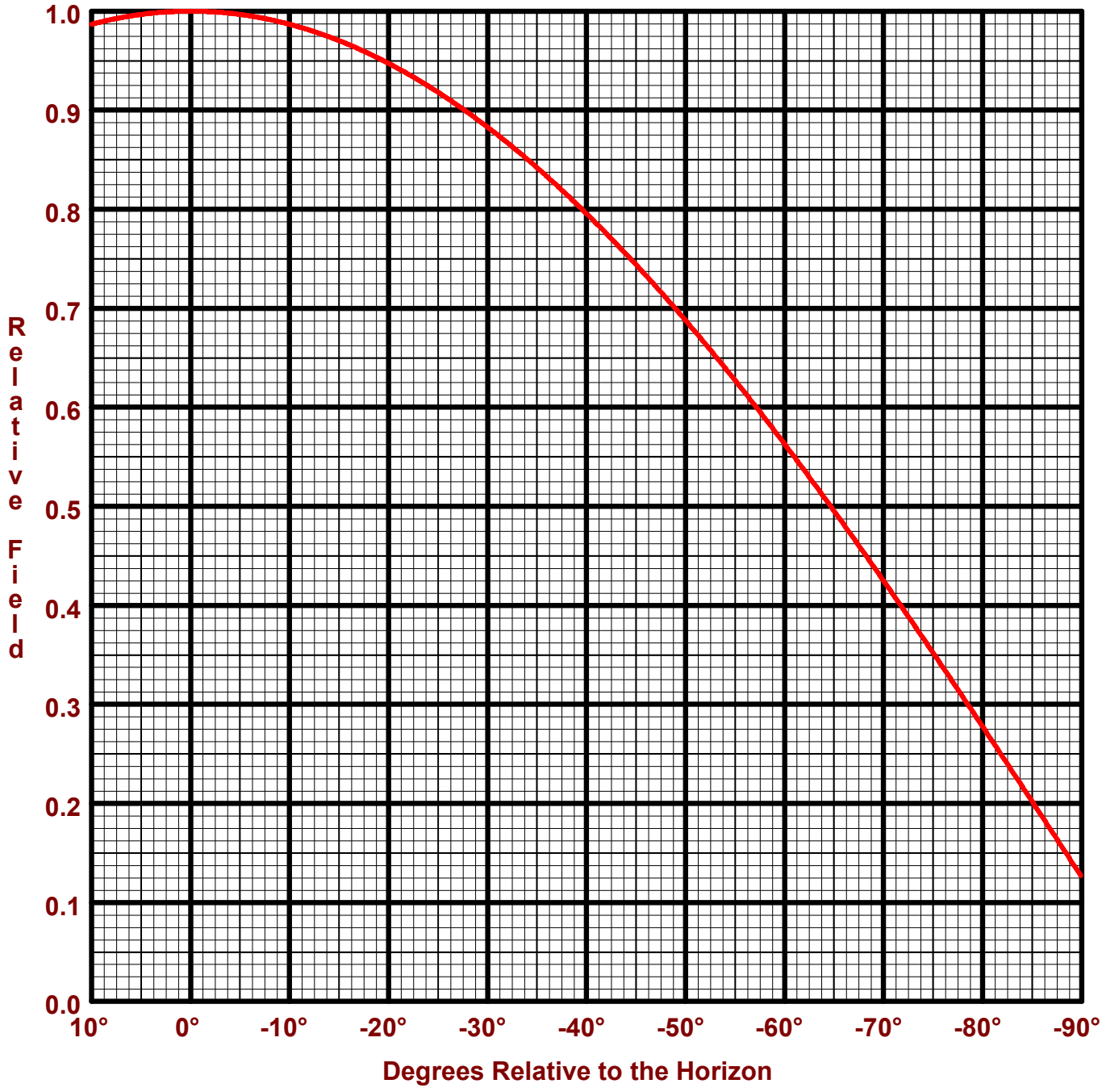
Figure No: 3
Call Sign: WRNX
Location: Amherst, MA.
Frequency: 100.9 MHz
1 bay LP-1E-DA antenna

Date: 7/26/2011
1 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 0.630 (-2.006 dB)
Horizontal Plane: 0.630 (-2.006 dB)
Maximum ERP: 0.870 kW

Vertical Polarization:
Maximum: 0.593 (-2.268 dB)
Horizontal Plane: 0.593 (-2.268 dB)
Maximum ERP: 0.819 kW

Directional Antenna System
for
WRNX, Amherst, Massachusetts

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	LP-1E-DA
Frequency:	100.9
Number of Bays:	One

MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	8 ft 7 in
Aperture length required:	15 ft
Orientation:	305º true

Input flange to the antenna 1 5/8 female.

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	0.870 kW (-0.605 dBk)
Horizontal maximum power gain:	0.630 (-2.006 dB)
Maximum vertical ERP:	0.819 kW (-0.867 dBk)
Vertical maximum power gain:	0.593 (-2.268 dB)
Total input power:	1.381 kW (1.402 dBk)