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 WEQS, Sparta, Wisconsin

February 1, 2012

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 WEQS.

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 two horizontal parasitic elements placed one-quarter wave above and below the bay. The antenna was mounted on the North 266 degrees East tower leg with bracketry to provide an antenna orientation of North 263 degrees East. The antenna was tested on a 48" face tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 89.3 megahertz, which is the center of the FM broadcast channel assigned to WEQS.

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
WEQS, Sparta, Wisconsin

(Continued)

DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of a full-scale model of the complete circular polarized system with the associated horizontal 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 48" 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.

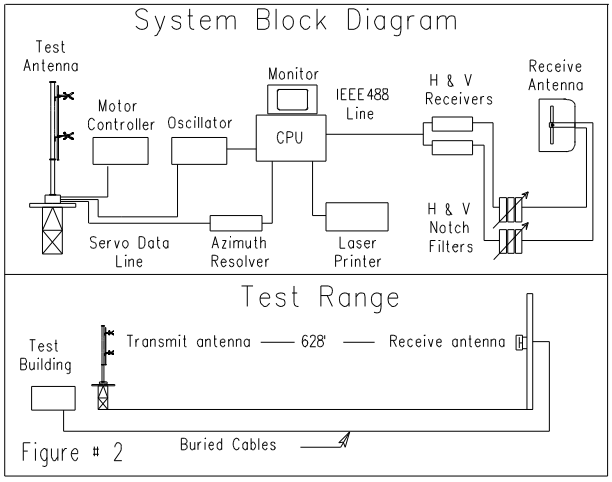

Figure # 2

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 89.3 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 two horizontal parasitic elements placed one-quarter wave above and below the 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-1E-DA array is to be mounted on the North 266 degrees East tower leg of the 48" face tower at a bearing of North 263 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. A calculated vertical plane relative field pattern is shown on Figure #3 attached. The power in the maximum will reach 0.450 kilowatts (-3.468 dBk).

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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 that 85% of the filed composite pattern.

The clear vertical length of the structure required to support the antenna is 20 ft.

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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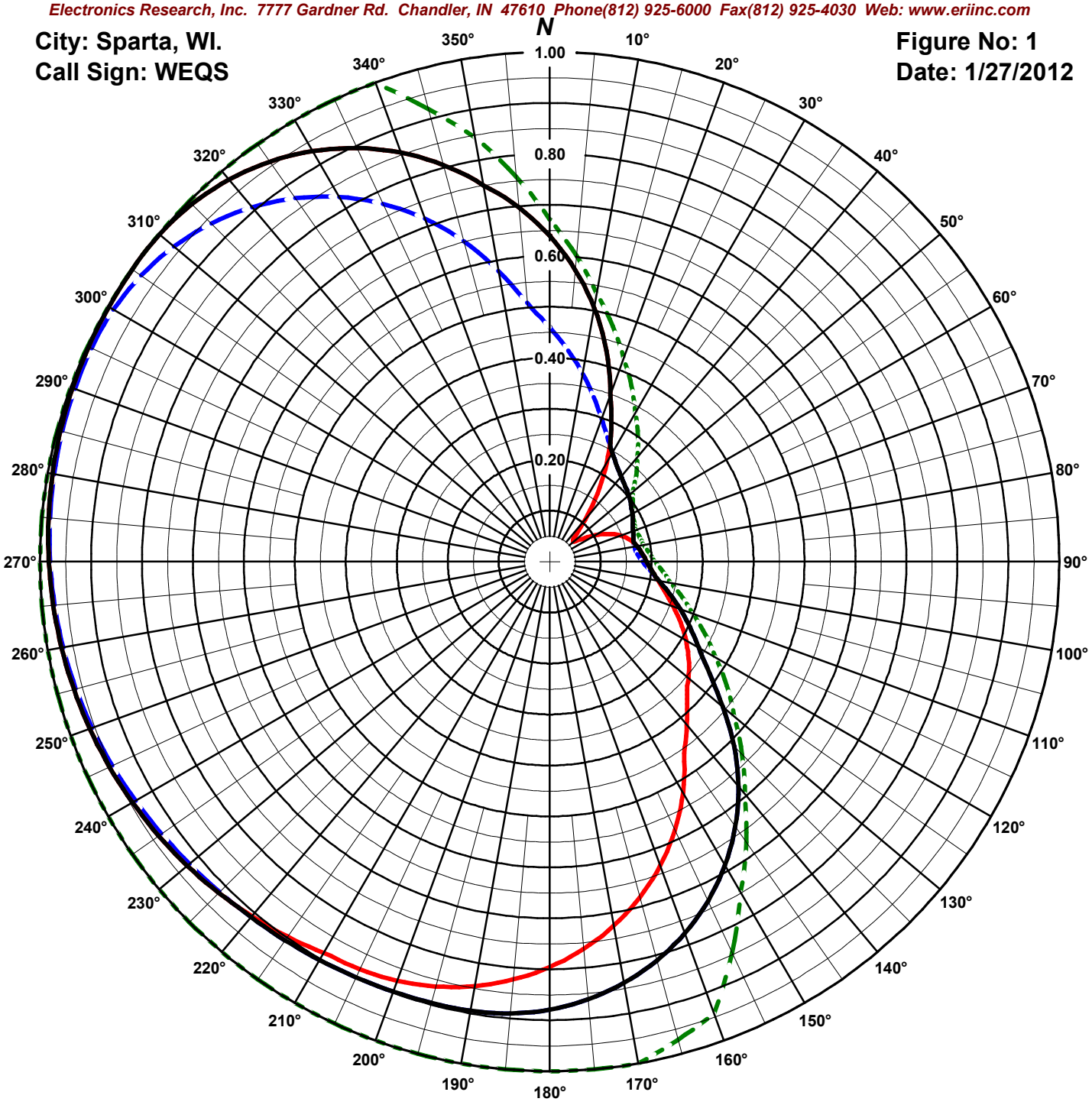
City: Sparta, WI.
Call Sign: WEQS

Figure No: 1
Date: 1/27/2012



Antenna Orientation: 263° True

Frequency: 89.3 MHz
Antenna Type: LP-1E-DA

Antenna Mounting: Standard
Tower Type: 48" Central

HORIZONTAL	VERTICAL	COMPOSITE	FCC ENVELOPE
RMS: .708	RMS: .708	RMS: .732	RMS: .787
Maximum: 1 @ 308°	Maximum: .992 @ 294°	Maximum: 1 @ 308°	Maximum: 1 @ 170°
Minimum: .061 @ 49°	Minimum: .169 @ 79°	Minimum: .169 @ 77°	Minimum: .179 @ 70°

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.

ERI® Horizontal Plane Relative Field Pattern

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Figure# 1 **Date: 1/27/2012**
Station: WEQS **Antenna: LP-1E-DA**
Location: Sparta, WI. **Antenna Orientation: 263° True**
Frequency: 89.3 MHz **Number of Bays: 1**

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.639	0.184	-7.355	Horizontal	180°	0.879	0.348	-4.586	Vertical
5°	0.575	0.149	-8.275	Horizontal	185°	0.890	0.356	-4.480	Vertical
10°	0.505	0.115	-9.404	Horizontal	190°	0.895	0.360	-4.432	Vertical
15°	0.429	0.083	-10.820	Horizontal	195°	0.896	0.362	-4.418	Vertical
20°	0.347	0.054	-12.657	Horizontal	200°	0.898	0.363	-4.405	Vertical
25°	0.286	0.037	-14.343	Horizontal	205°	0.900	0.364	-4.385	Vertical
30°	0.246	0.027	-15.646	Vertical	210°	0.903	0.367	-4.357	Vertical
35°	0.230	0.024	-16.249	Vertical	215°	0.906	0.370	-4.321	Vertical
40°	0.218	0.021	-16.702	Vertical	220°	0.911	0.374	-4.276	Vertical
45°	0.210	0.020	-17.041	Vertical	225°	0.919	0.380	-4.205	Horizontal
50°	0.202	0.018	-17.344	Vertical	230°	0.928	0.388	-4.116	Horizontal
55°	0.194	0.017	-17.698	Vertical	235°	0.937	0.395	-4.033	Horizontal
60°	0.187	0.016	-18.028	Vertical	240°	0.945	0.402	-3.957	Horizontal
65°	0.180	0.015	-18.347	Vertical	245°	0.953	0.409	-3.887	Horizontal
70°	0.174	0.014	-18.648	Vertical	250°	0.960	0.415	-3.822	Horizontal
75°	0.170	0.013	-18.851	Vertical	255°	0.967	0.420	-3.763	Horizontal
80°	0.174	0.014	-18.648	Horizontal	260°	0.973	0.426	-3.710	Horizontal
85°	0.182	0.015	-18.256	Horizontal	265°	0.978	0.430	-3.662	Horizontal
90°	0.190	0.016	-17.876	Horizontal	270°	0.983	0.435	-3.619	Horizontal
95°	0.201	0.018	-17.391	Horizontal	275°	0.987	0.438	-3.582	Horizontal
100°	0.218	0.021	-16.692	Vertical	280°	0.991	0.442	-3.551	Horizontal
105°	0.244	0.027	-15.725	Vertical	285°	0.994	0.444	-3.524	Horizontal
110°	0.273	0.033	-14.760	Vertical	290°	0.996	0.446	-3.503	Horizontal
115°	0.304	0.042	-13.819	Vertical	295°	0.998	0.448	-3.486	Horizontal
120°	0.338	0.051	-12.900	Vertical	300°	0.999	0.449	-3.475	Horizontal
125°	0.383	0.066	-11.808	Vertical	305°	1.000	0.450	-3.469	Horizontal
130°	0.444	0.089	-10.530	Vertical	310°	0.999	0.449	-3.475	Horizontal
135°	0.511	0.118	-9.294	Vertical	315°	0.992	0.443	-3.535	Horizontal
140°	0.576	0.149	-8.260	Vertical	320°	0.978	0.431	-3.657	Horizontal
145°	0.635	0.181	-7.413	Vertical	325°	0.958	0.413	-3.844	Horizontal
150°	0.688	0.213	-6.718	Vertical	330°	0.930	0.389	-4.098	Horizontal
155°	0.735	0.243	-6.144	Vertical	335°	0.895	0.361	-4.427	Horizontal
160°	0.776	0.271	-5.674	Vertical	340°	0.854	0.328	-4.839	Horizontal
165°	0.811	0.296	-5.292	Vertical	345°	0.806	0.292	-5.346	Horizontal
170°	0.840	0.317	-4.987	Vertical	350°	0.750	0.253	-5.964	Horizontal
175°	0.862	0.335	-4.754	Vertical	355°	0.698	0.219	-6.595	Horizontal

Horizontal Polarization:
Maximum: 0.873 (-0.588 dB)
Horizontal Plane: 0.873 (-0.588 dB)
Maximum ERP: 0.450 kW

Vertical Polarization:
Maximum: 0.859 (-0.658 dB)
Horizontal Plane: 0.859 (-0.658 dB)
Maximum ERP: 0.443 kW

Total Input Power: 0.515 kW
Reference: WEQS1M.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: 1/27/2012**
Station: WEQS | **Antenna: LP-1E-DA**
Location: Sparta, WI. | **Antenna Orientation: 263° True**
Frequency: 89.3 MHz | **Number of Bays: 1**

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.639	0.184	-7.355	0.460	0.095	-10.217	180°	0.796	0.285	-5.454	0.879	0.348	-4.586
5°	0.575	0.149	-8.275	0.416	0.078	-11.086	185°	0.823	0.305	-5.158	0.890	0.356	-4.480
10°	0.505	0.115	-9.404	0.374	0.063	-12.015	190°	0.846	0.322	-4.924	0.895	0.360	-4.432
15°	0.429	0.083	-10.820	0.334	0.050	-12.993	195°	0.863	0.335	-4.747	0.896	0.362	-4.418
20°	0.347	0.054	-12.657	0.298	0.040	-13.970	200°	0.875	0.345	-4.625	0.898	0.363	-4.405
25°	0.286	0.037	-14.343	0.269	0.033	-14.878	205°	0.882	0.350	-4.554	0.900	0.364	-4.385
30°	0.224	0.023	-16.469	0.246	0.027	-15.646	210°	0.887	0.354	-4.512	0.903	0.367	-4.357
35°	0.163	0.012	-19.214	0.230	0.024	-16.249	215°	0.898	0.363	-4.403	0.906	0.370	-4.321
40°	0.108	0.005	-22.777	0.218	0.021	-16.702	220°	0.909	0.372	-4.300	0.911	0.374	-4.276
45°	0.070	0.002	-26.539	0.210	0.020	-17.041	225°	0.919	0.380	-4.205	0.917	0.378	-4.224
50°	0.062	0.002	-27.653	0.202	0.018	-17.344	230°	0.928	0.388	-4.116	0.923	0.383	-4.165
55°	0.078	0.003	-25.606	0.194	0.017	-17.698	235°	0.937	0.395	-4.033	0.930	0.389	-4.097
60°	0.104	0.005	-23.127	0.187	0.016	-18.028	240°	0.945	0.402	-3.957	0.938	0.396	-4.022
65°	0.129	0.007	-21.267	0.180	0.015	-18.347	245°	0.953	0.409	-3.887	0.947	0.403	-3.942
70°	0.149	0.010	-20.013	0.174	0.014	-18.648	250°	0.960	0.415	-3.822	0.955	0.411	-3.867
75°	0.164	0.012	-19.193	0.170	0.013	-18.851	255°	0.967	0.420	-3.763	0.963	0.417	-3.798
80°	0.174	0.014	-18.648	0.169	0.013	-18.897	260°	0.973	0.426	-3.710	0.969	0.423	-3.738
85°	0.182	0.015	-18.256	0.173	0.013	-18.719	265°	0.978	0.430	-3.662	0.975	0.428	-3.686
90°	0.190	0.016	-17.876	0.182	0.015	-18.255	270°	0.983	0.435	-3.619	0.980	0.432	-3.642
95°	0.201	0.018	-17.391	0.198	0.018	-17.554	275°	0.987	0.438	-3.582	0.984	0.436	-3.606
100°	0.216	0.021	-16.765	0.218	0.021	-16.692	280°	0.991	0.442	-3.551	0.988	0.439	-3.577
105°	0.236	0.025	-16.027	0.244	0.027	-15.725	285°	0.994	0.444	-3.524	0.990	0.441	-3.556
110°	0.258	0.030	-15.221	0.273	0.033	-14.760	290°	0.996	0.446	-3.503	0.991	0.442	-3.542
115°	0.284	0.036	-14.412	0.304	0.042	-13.819	295°	0.998	0.448	-3.486	0.992	0.443	-3.538
120°	0.309	0.043	-13.672	0.338	0.051	-12.900	300°	0.999	0.449	-3.475	0.988	0.440	-3.568
125°	0.333	0.050	-13.020	0.383	0.066	-11.808	305°	1.000	0.450	-3.469	0.979	0.431	-3.655
130°	0.356	0.057	-12.448	0.444	0.089	-10.530	310°	0.999	0.449	-3.475	0.962	0.416	-3.804
135°	0.381	0.065	-11.842	0.511	0.118	-9.294	315°	0.992	0.443	-3.535	0.938	0.396	-4.020
140°	0.419	0.079	-11.030	0.576	0.149	-8.260	320°	0.978	0.431	-3.657	0.908	0.371	-4.307
145°	0.460	0.095	-10.218	0.635	0.181	-7.413	325°	0.958	0.413	-3.844	0.870	0.341	-4.673
150°	0.523	0.123	-9.097	0.688	0.213	-6.718	330°	0.930	0.389	-4.098	0.826	0.307	-5.129
155°	0.581	0.152	-8.181	0.735	0.243	-6.144	335°	0.895	0.361	-4.427	0.775	0.270	-5.686
160°	0.634	0.181	-7.422	0.776	0.271	-5.674	340°	0.854	0.328	-4.839	0.716	0.231	-6.366
165°	0.682	0.209	-6.788	0.811	0.296	-5.292	345°	0.806	0.292	-5.346	0.651	0.191	-7.196
170°	0.725	0.237	-6.259	0.840	0.317	-4.987	350°	0.750	0.253	-5.964	0.579	0.151	-8.213
175°	0.763	0.262	-5.818	0.862	0.335	-4.754	355°	0.698	0.219	-6.595	0.510	0.117	-9.325

Horizontal Polarization:
Maximum: 0.873 (-0.588 dB)
Horizontal Plane: 0.873 (-0.588 dB)
Maximum ERP: 0.450 kW

Vertical Polarization:
Maximum: 0.859 (-0.658 dB)
Horizontal Plane: 0.859 (-0.658 dB)
Maximum ERP: 0.443 kW

Total Input Power: 0.515 kW
Reference: WEQS1M.FIG

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

ERI® Vertical Plane Relative Field Pattern

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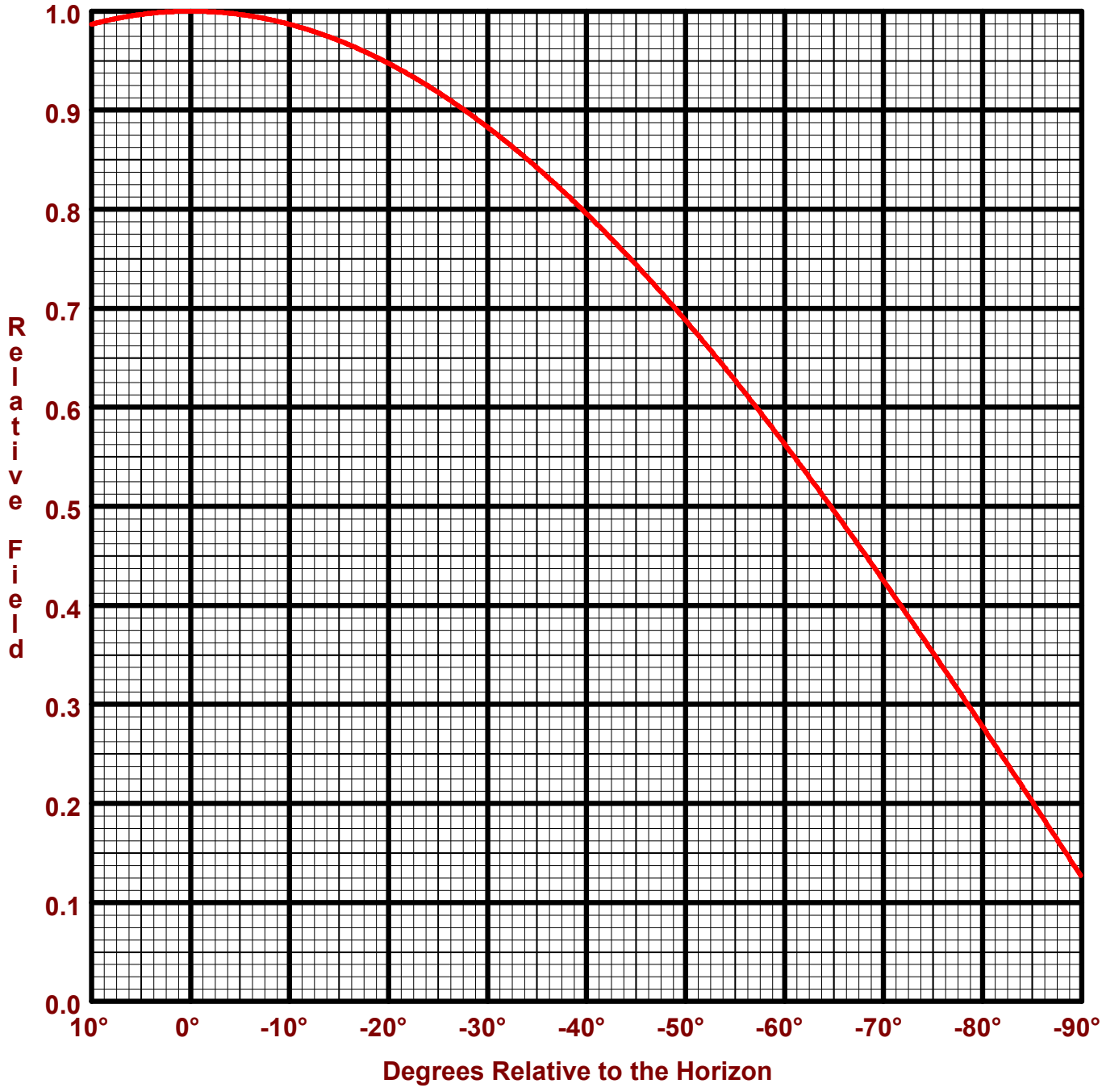
Figure No: 3
Call Sign: WEQS
Location: Sparta, WI.
Frequency: 89.3 MHz
1 bay LP-1E-DA antenna

Date: 1/27/2012
H/V Power Ratio: 1
1 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 0.873 (-0.588 dB)
Horizontal Plane: 0.873 (-0.588 dB)
Maximum ERP: 0.450 kW

Vertical Polarization:
Maximum: 0.859 (-0.658 dB)
Horizontal Plane: 0.859 (-0.658 dB)
Maximum ERP: 0.443 kW

Directional Antenna System
for
WEQS, Sparta, Wisconsin

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	LP-1E-DA
Frequency:	89.3 MHz
Number of Bays:	One

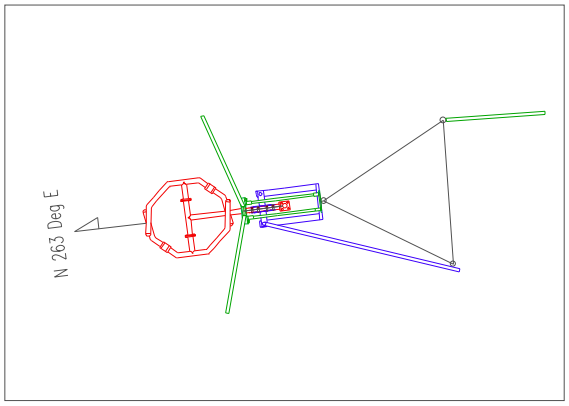
MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	8 ft 10 in
Aperture length required:	20 ft
Orientation:	263° true

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

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	0.450 kW (-3.468 dBk)
Horizontal maximum power gain:	0.873 (-0.588 dB)
Maximum vertical ERP:	0.443 kW (-3.538 dBk)
Vertical maximum power gain:	0.859 (-0.658 dB)
Total input power:	0.515 kW (-2.882 dBk)



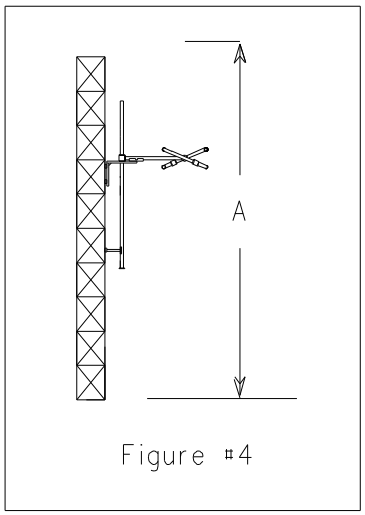


Figure #4