

Directional Antenna System for WWBB, Providence, Rhode Island

October 7, 2014

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 WWBB.

The antenna is the ERI model SHP-1AE-DA configuration. The circular polarized system consists of one bay using one driven circular polarized radiating element, two horizontal parasitic elements placed 30" above the bay and two horizontal parasitic elements placed 30" below the bay and two vertical parasitic elements at bay level. A quarter scale model of the antenna was tested on a 2.75" pipe that equal to the 11" o.d. pole, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 101.5 megahertz, which is the center of the FM broadcast channel assigned to WWBB.

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 WWBB, Providence, Rhode Island

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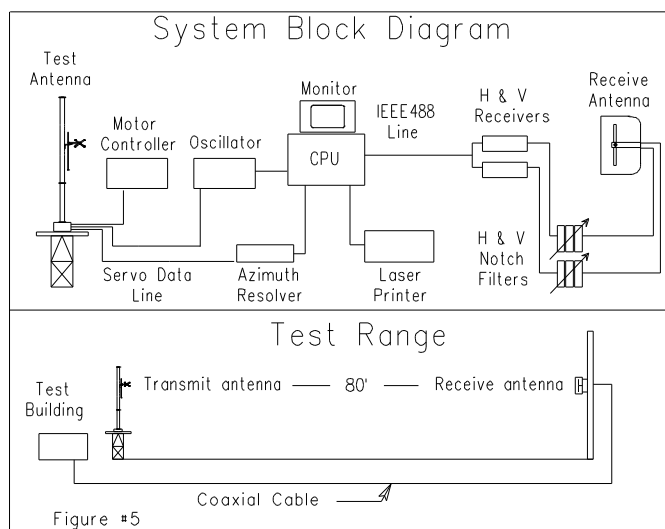
DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of a quarter scale model of the complete circular polarized system with the associated horizontal and vertical parasitic elements. 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 2.75" pipe at quarter scale equal to 11" o.d. pole at full scale 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 17 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.

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 406 MHz at quarter scale, which corresponds to the actual frequency of 101.5 MHz and was constantly monitored by a Rohde & Schwarz ESVD measuring receiver.



Directional Antenna System For WWBB, Providence, Rhode Island

(Continued)

A dipole antenna mounted in a 10' parabolic dish was used for both polarizations, located approximately 80 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 a coaxial cable 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, two horizontal parasitic elements placed 30" above the bay and two horizontal parasitic elements placed 30" below the bay and two vertical parasitic elements at bay level. 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 SHP-1AE-DA array is to be mounted on the 11" o.d. pole at a bearing of North 200 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 6 kilowatts (7.782 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 than 85% of the filed composite pattern.

The clear vertical length of the structure required to support the antenna is 15 feet 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.

ELECTRONICS RESEARCH, INC.

A handwritten signature in black ink, appearing to read "Tom Schaefer". The signature is fluid and cursive, with a large initial "T" and a long, sweeping underline.

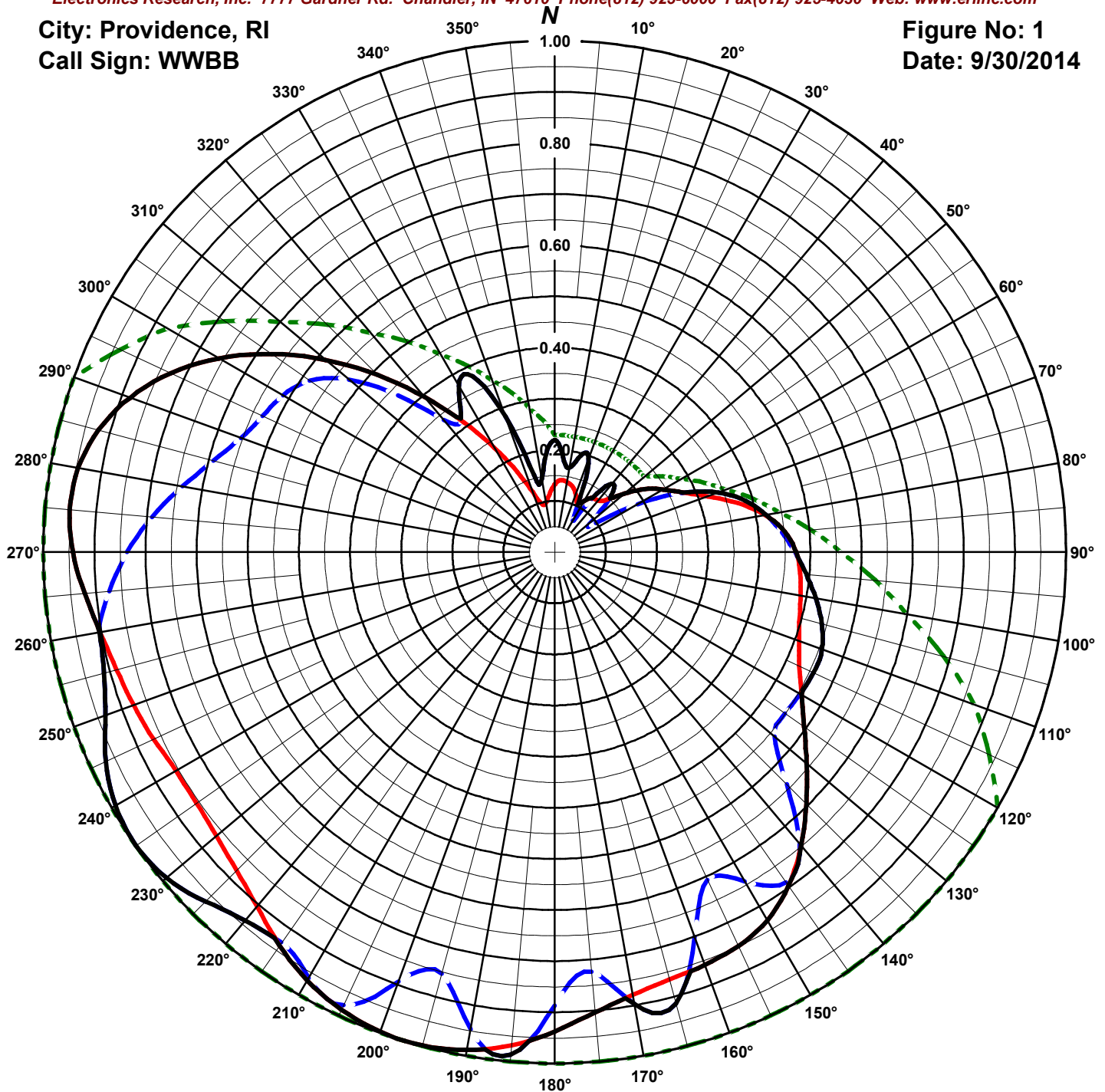
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ERI® Horizontal Plane Relative Field Pattern

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

City: Providence, RI
Call Sign: WWBB

Figure No: 1
Date: 9/30/2014



Antenna Orientation: 200° True

Frequency: 101.5 MHz

Antenna Type: SHP-1AE-DA

Antenna Mounting: Custom

Tower Type: 11" pole

HORIZONTAL

RMS: .667

Maximum: 1 @ 197°

Minimum: .095 @ 347°

VERTICAL

RMS: .647

Maximum: 1 @ 235°

Minimum: .072 @ 30°

COMPOSITE

RMS: .689

Maximum: 1 @ 197°

Minimum: .105 @ 26°

FCC ENVELOPE

RMS: .786

Maximum: 1 @ 120°

Minimum: .229 @ 0°

Measured patterns of the horizontal and vertical components, with the composite maximum of either the H or V components and the filed FCC envelope pattern BPH-20140804ADCL.

ERI® Horizontal Plane Relative Field Pattern

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Figure# 1

Date: 9/30/2014

Station: WWBB

Antenna: SHP-1AE-DA

Location: Providence, RI

Antenna Orientation: 200° True

Frequency: 101.5 MHz

Number of Bays: 1

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.219	0.288	-5.411	Vertical	180°	0.938	5.277	7.224	Horizontal
5°	0.187	0.211	-6.762	Vertical	185°	0.987	5.842	7.666	Vertical
10°	0.168	0.168	-7.734	Vertical	190°	0.989	5.864	7.682	Horizontal
15°	0.195	0.228	-6.421	Vertical	195°	0.999	5.985	7.771	Horizontal
20°	0.195	0.227	-6.431	Vertical	200°	0.998	5.974	7.763	Horizontal
25°	0.119	0.085	-10.709	Vertical	205°	0.987	5.846	7.668	Horizontal
30°	0.115	0.079	-10.998	Horizontal	210°	0.967	5.613	7.492	Horizontal
35°	0.129	0.100	-10.018	Horizontal	215°	0.938	5.284	7.230	Horizontal
40°	0.174	0.182	-7.404	Vertical	220°	0.941	5.312	7.252	Vertical
45°	0.156	0.146	-8.344	Vertical	225°	0.966	5.596	7.479	Vertical
50°	0.178	0.191	-7.198	Horizontal	230°	0.991	5.889	7.700	Vertical
55°	0.215	0.276	-5.588	Horizontal	235°	1.000	6.000	7.782	Vertical
60°	0.245	0.360	-4.438	Horizontal	240°	0.991	5.898	7.707	Vertical
65°	0.276	0.457	-3.398	Horizontal	245°	0.969	5.629	7.505	Vertical
70°	0.340	0.694	-1.584	Vertical	250°	0.935	5.246	7.199	Vertical
75°	0.387	0.897	-0.474	Vertical	255°	0.912	4.993	6.984	Vertical
80°	0.419	1.056	0.236	Vertical	260°	0.904	4.900	6.902	Vertical
85°	0.452	1.225	0.882	Horizontal	265°	0.923	5.108	7.082	Horizontal
90°	0.472	1.337	1.262	Horizontal	270°	0.942	5.324	7.262	Horizontal
95°	0.494	1.464	1.656	Vertical	275°	0.952	5.435	7.352	Horizontal
100°	0.518	1.613	2.076	Vertical	280°	0.946	5.373	7.302	Horizontal
105°	0.540	1.752	2.436	Vertical	285°	0.924	5.119	7.092	Horizontal
110°	0.556	1.856	2.686	Vertical	290°	0.883	4.680	6.702	Horizontal
115°	0.559	1.872	2.722	Vertical	295°	0.828	4.114	6.142	Horizontal
120°	0.557	1.863	2.702	Horizontal	300°	0.758	3.445	5.372	Horizontal
125°	0.596	2.129	3.282	Horizontal	305°	0.675	2.737	4.372	Horizontal
130°	0.643	2.479	3.942	Horizontal	310°	0.585	2.052	3.122	Horizontal
135°	0.696	2.905	4.632	Horizontal	315°	0.490	1.440	1.582	Horizontal
140°	0.749	3.367	5.272	Horizontal	320°	0.396	0.940	-0.268	Horizontal
145°	0.797	3.813	5.812	Horizontal	325°	0.319	0.610	-2.144	Vertical
150°	0.832	4.152	6.182	Horizontal	330°	0.375	0.844	-0.734	Vertical
155°	0.850	4.337	6.372	Horizontal	335°	0.379	0.864	-0.634	Vertical
160°	0.859	4.428	6.462	Horizontal	340°	0.282	0.477	-3.214	Vertical
165°	0.915	5.019	7.006	Vertical	345°	0.156	0.146	-8.344	Vertical
170°	0.898	4.837	6.846	Vertical	350°	0.145	0.126	-8.981	Vertical
175°	0.904	4.900	6.902	Horizontal	355°	0.193	0.224	-6.504	Vertical

Horizontal Polarization:

Maximum: 1.013 (0.056 dB)

Horizontal Plane: 1.013 (0.056 dB)

Maximum ERP: 6.000 kW

Vertical Polarization:

Maximum: 1.013 (0.056 dB)

Horizontal Plane: 1.013 (0.056 dB)

Maximum ERP: 6.000 kW

Total Input Power: 5.924 kW

Reference: WWBB2M.FIG

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

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# 1A

Date: 9/30/2014

Station: WWBB

Antenna: SHP-1AE-DA

Location: Providence, RI

Antenna Orientation: 200° True

Frequency: 101.5 MHz

Number of Bays: 1

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.132	0.105	-9.788	0.219	0.288	-5.411	180°	0.938	5.277	7.224	0.887	4.716	6.736
5°	0.141	0.119	-9.228	0.187	0.211	-6.762	185°	0.968	5.626	7.502	0.987	5.842	7.666
10°	0.139	0.116	-9.368	0.168	0.168	-7.734	190°	0.989	5.864	7.682	0.948	5.390	7.316
15°	0.133	0.107	-9.718	0.195	0.228	-6.421	195°	0.999	5.985	7.771	0.854	4.371	6.406
20°	0.120	0.087	-10.628	0.195	0.227	-6.431	200°	0.998	5.974	7.763	0.893	4.786	6.800
25°	0.105	0.067	-11.758	0.119	0.085	-10.709	205°	0.987	5.846	7.668	0.978	5.736	7.586
30°	0.115	0.079	-10.998	0.072	0.031	-15.114	210°	0.967	5.613	7.492	0.962	5.550	7.443
35°	0.129	0.100	-10.018	0.127	0.097	-10.124	215°	0.938	5.284	7.230	0.932	5.207	7.166
40°	0.132	0.104	-9.838	0.174	0.182	-7.404	220°	0.905	4.915	6.915	0.941	5.312	7.252
45°	0.145	0.127	-8.968	0.156	0.146	-8.344	225°	0.880	4.645	6.670	0.966	5.596	7.479
50°	0.178	0.191	-7.198	0.097	0.057	-12.454	230°	0.863	4.473	6.506	0.991	5.889	7.700
55°	0.215	0.276	-5.588	0.099	0.059	-12.314	235°	0.855	4.388	6.422	1.000	6.000	7.782
60°	0.245	0.360	-4.438	0.187	0.209	-6.794	240°	0.855	4.388	6.422	0.991	5.898	7.707
65°	0.276	0.457	-3.398	0.274	0.449	-3.474	245°	0.865	4.490	6.522	0.969	5.629	7.505
70°	0.319	0.610	-2.148	0.340	0.694	-1.584	250°	0.876	4.605	6.632	0.935	5.246	7.199
75°	0.370	0.823	-0.848	0.387	0.897	-0.474	255°	0.887	4.723	6.742	0.912	4.993	6.984
80°	0.418	1.048	0.202	0.419	1.056	0.236	260°	0.903	4.889	6.892	0.904	4.900	6.902
85°	0.452	1.225	0.882	0.446	1.193	0.766	265°	0.923	5.108	7.082	0.874	4.587	6.616
90°	0.472	1.337	1.262	0.470	1.326	1.226	270°	0.942	5.324	7.262	0.836	4.193	6.226
95°	0.482	1.394	1.442	0.494	1.464	1.656	275°	0.952	5.435	7.352	0.790	3.746	5.736
100°	0.489	1.433	1.562	0.518	1.613	2.076	280°	0.946	5.373	7.302	0.739	3.278	5.156
105°	0.496	1.476	1.692	0.540	1.752	2.436	285°	0.924	5.119	7.092	0.691	2.861	4.566
110°	0.508	1.550	1.902	0.556	1.856	2.686	290°	0.883	4.680	6.702	0.653	2.556	4.076
115°	0.528	1.672	2.232	0.559	1.872	2.722	295°	0.828	4.114	6.142	0.630	2.380	3.766
120°	0.557	1.863	2.702	0.554	1.843	2.656	300°	0.758	3.445	5.372	0.613	2.257	3.536
125°	0.596	2.129	3.282	0.550	1.815	2.589	305°	0.675	2.737	4.372	0.584	2.049	3.116
130°	0.643	2.479	3.942	0.561	1.891	2.766	310°	0.585	2.052	3.122	0.525	1.654	2.186
135°	0.696	2.905	4.632	0.642	2.469	3.926	315°	0.490	1.440	1.582	0.433	1.123	0.506
140°	0.749	3.367	5.272	0.745	3.331	5.226	320°	0.396	0.940	-0.268	0.338	0.685	-1.644
145°	0.797	3.813	5.812	0.788	3.729	5.716	325°	0.310	0.576	-2.398	0.319	0.610	-2.144
150°	0.832	4.152	6.182	0.743	3.316	5.206	330°	0.236	0.333	-4.778	0.375	0.844	-0.734
155°	0.850	4.337	6.372	0.707	3.003	4.776	335°	0.173	0.180	-7.448	0.379	0.864	-0.634
160°	0.859	4.428	6.462	0.801	3.851	5.856	340°	0.124	0.093	-10.318	0.282	0.477	-3.214
165°	0.865	4.491	6.523	0.915	5.019	7.006	345°	0.098	0.057	-12.418	0.156	0.146	-8.344
170°	0.879	4.639	6.665	0.898	4.837	6.846	350°	0.098	0.057	-12.418	0.145	0.126	-8.981
175°	0.904	4.900	6.902	0.824	4.070	6.096	355°	0.114	0.078	-11.088	0.193	0.224	-6.504

Horizontal Polarization:

Maximum: 1.013 (0.056 dB)

Horizontal Plane: 1.013 (0.056 dB)

Maximum ERP: 6.000 kW

Vertical Polarization:

Maximum: 1.013 (0.056 dB)

Horizontal Plane: 1.013 (0.056 dB)

Maximum ERP: 6.000 kW

Total Input Power: 5.924 kW

Reference: WWBB2M.FIG

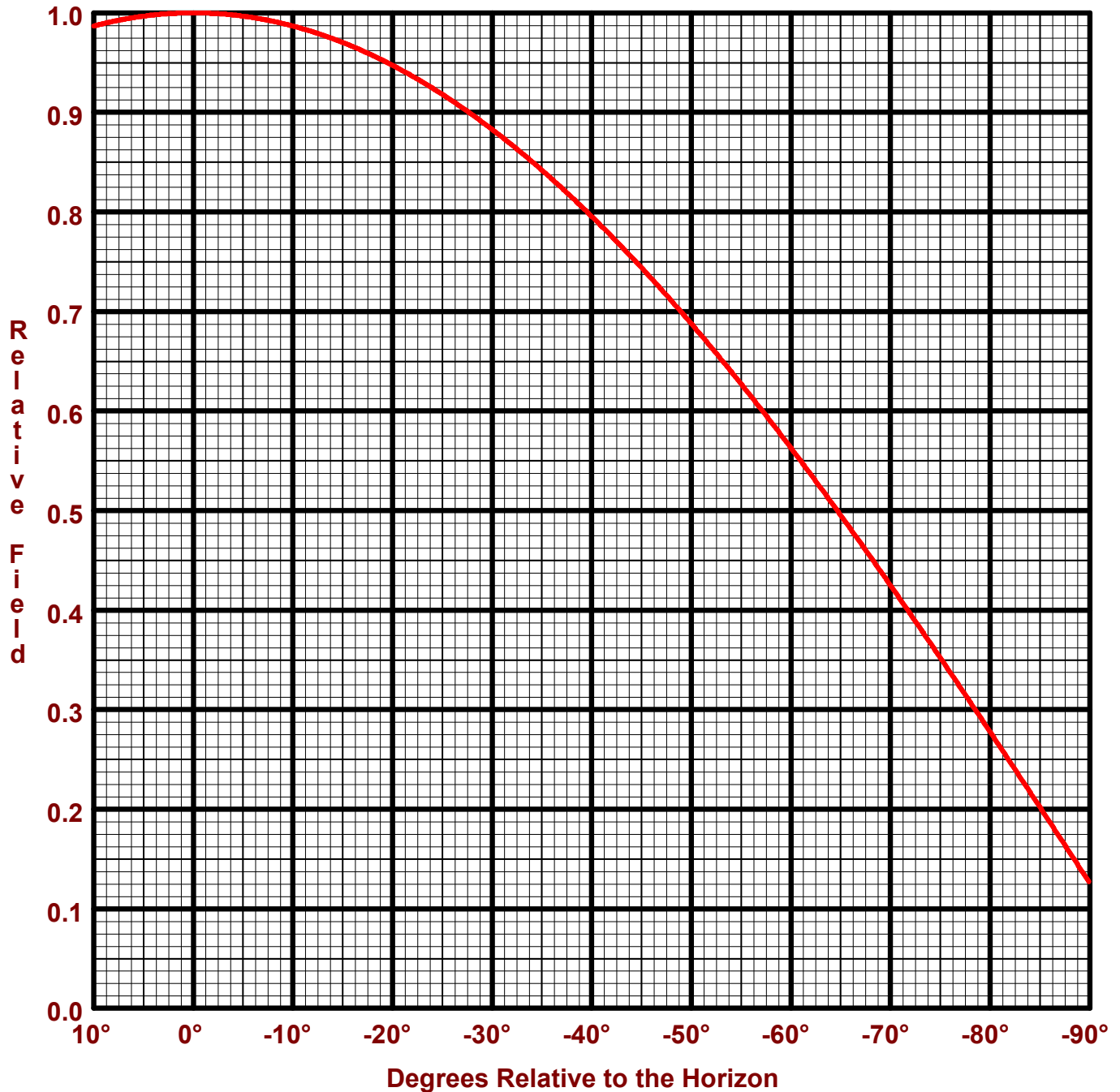
This list shows the azimuth values for the horizontal and vertical components.

ERI[®] Vertical Plane Relative Field Pattern

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Figure No: 3
Call Sign: WWBB
Location: Providence, RI
Frequency: 101.5 MHz
1 bay SHP-1AE-DA antenna

Date: 9/30/2014
H/V Power Ratio: 1
1 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 1.013 (0.056 dB)
Horizontal Plane: 1.013 (0.056 dB)
Maximum ERP: 6.000 kW

Vertical Polarization:
Maximum: 1.013 (0.056 dB)
Horizontal Plane: 1.013 (0.056 dB)
Maximum ERP: 6.000 kW

Directional Antenna System for WWBB, Providence, Rhode Island

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type: SHP-1AE-DA
Frequency: 101.5 MHz
Number of Bays: One

MECHANICAL SPECIFICATIONS

Mounting: Standard
System length: 8 ft 7 in
Aperture length required: 15 ft
Orientation: 200° true
Input flange to the antenna 3 1/8" female.

ELECTRICAL SPECIFICATIONS (For directional use)

Maximum horizontal ERP: 6.000 kW (7.782 dBk)
Horizontal maximum power gain: 1.013 (0.056 dB)
Maximum vertical ERP: 6.000 kW (7.782 dBk)
Vertical maximum power gain: 1.013 (0.056 dB)
Total input power: 5.924 kW (7.726 dBk)

