

***Directional Antenna System  
for  
WALR, Palmetto, Georgia***

September 28, 2017

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 WALR.

The antenna is the ERI model SHP-6AC-DA-HW configuration. The circular polarized system consists of 6 half-wavelength spaced bays using one driven circular polarized radiating element per bay and three horizontal parasitic elements per bay. The antenna was mounted on the North 65 degrees East tower leg with bracketry to provide an antenna orientation of North 65 degrees East. The antenna was tested on a 60 1/2" face tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 104.1 megahertz, which is the center of the FM broadcast channel assigned to WALR.

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 WALR, Palmetto, Georgia

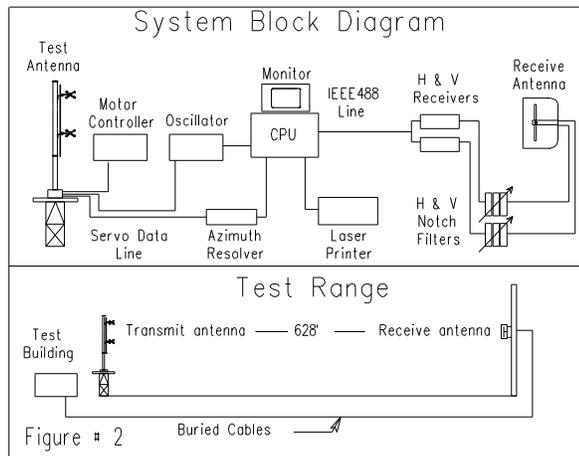
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## DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of two bay levels of the 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 3 1/8 inch o.d. rigid coaxial line was used to feed the test antenna, and a section of 3 1/8 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 60 1/2" 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.



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

# Directional Antenna System For WALR, Palmetto, Georgia

(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 coordinated graph paper in a clockwise direction. Both horizontal and vertical components were recorded separately.

## CONCLUSIONS

The circular polarized system consists of 6 half-wavelength spaced bays using one driven circular polarized radiating element per bay and three horizontal parasitic elements per 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 SHP-6AC-DA-HW array is to be mounted on the North 65 degrees East tower leg of the 60 1/2" face tower at a bearing of North 65 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 100 kilowatts (20 dBk).

Directional Antenna System  
For  
WALR, Palmetto, Georgia

(Continued)

The power at North 0 degrees East does not exceed 64 kilowatts (18.062 dBk).

The power at North 35-40 degrees East does not exceed 88 kilowatts (19.445 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 43 feet 6 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.



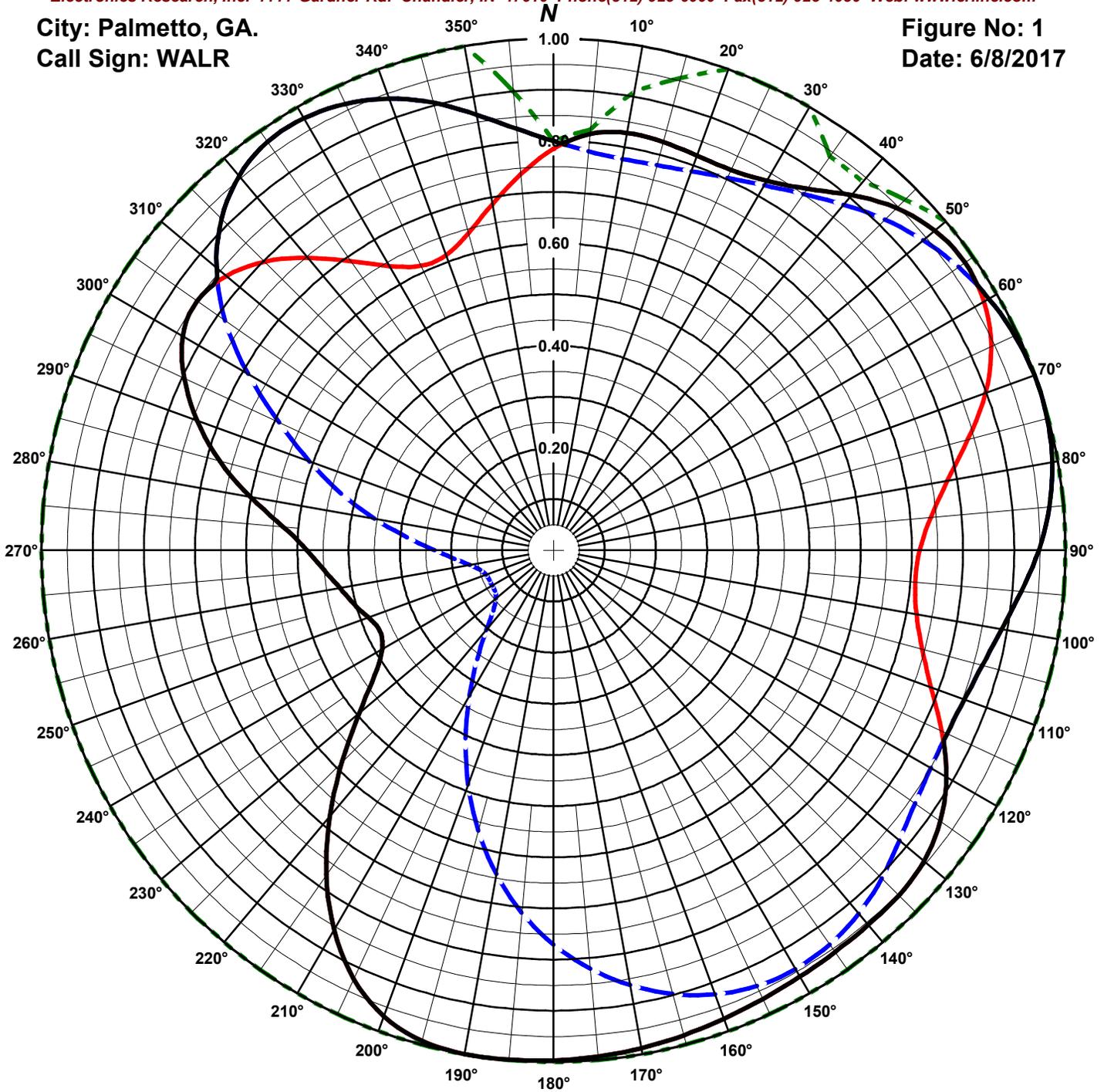
The Microsoft Word document on file electronically at Electronic Research, Inc. governs the specifications, scope, and configuration of the product described. All other representations whether verbal, printed, or electronic are subordinate to the master copy of this document on file at ERI.

# 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: Palmetto, GA.  
Call Sign: WALR

Figure No: 1  
Date: 6/8/2017



Antenna Orientation: 65° True

Frequency: 104.1 MHz

Antenna Type: SHP-6AC-DA-HW

Antenna Mounting: Standard

Tower Type: 60" Tower

**HORIZONTAL**

RMS: .801

Maximum: 1 @ 189°

Minimum: .374 @ 245°

**VERTICAL**

RMS: .764

Maximum: 1 @ 72°

Minimum: .138 @ 241°

**COMPOSITE**

RMS: .853

Maximum: 1 @ 72°

Minimum: .374 @ 245°

**FCC ENVELOPE**

RMS: .99

Maximum: 1 @ 20°

Minimum: .8 @ 0°

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 BPH-20160630ABI.

# 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# 1

Date: 6/8/2017

Station: WALR

Antenna: SHP-6AC-DA-HW

Location: Palmetto, GA.

Antenna Orientation: 65° True

Frequency: 104.1 MHz

Number of Bays: 6

Azimuth	Envelope			Polarization Maximum	Azimuth	Envelope			Polarization Maximum
	Field	kW	dBk			Field	kW	dBk	
0°	0.799	63.898	18.055	Vertical	180°	0.997	99.402	19.974	Horizontal
5°	0.817	66.677	18.240	Horizontal	185°	0.999	99.862	19.994	Horizontal
10°	0.828	68.547	18.360	Horizontal	190°	1.000	99.961	19.998	Horizontal
15°	0.826	68.232	18.340	Horizontal	195°	0.993	98.508	19.935	Horizontal
20°	0.821	67.332	18.282	Horizontal	200°	0.969	93.886	19.726	Horizontal
25°	0.820	67.285	18.279	Horizontal	205°	0.924	85.366	19.313	Horizontal
30°	0.833	69.469	18.418	Horizontal	210°	0.857	73.448	18.660	Horizontal
35°	0.863	74.412	18.716	Horizontal	215°	0.773	59.793	17.766	Horizontal
40°	0.906	82.063	19.141	Horizontal	220°	0.680	46.191	16.646	Horizontal
45°	0.946	89.512	19.519	Horizontal	225°	0.583	34.022	15.318	Horizontal
50°	0.972	94.452	19.752	Horizontal	230°	0.495	24.528	13.897	Horizontal
55°	0.981	96.214	19.832	Horizontal	235°	0.427	18.209	12.603	Horizontal
60°	0.983	96.544	19.847	Vertical	240°	0.386	14.910	11.735	Horizontal
65°	0.994	98.794	19.947	Vertical	245°	0.374	13.981	11.455	Horizontal
70°	1.000	99.922	19.997	Vertical	250°	0.384	14.783	11.698	Horizontal
75°	0.998	99.649	19.985	Vertical	255°	0.404	16.310	12.125	Horizontal
80°	0.989	97.835	19.905	Vertical	260°	0.424	17.936	12.537	Horizontal
85°	0.972	94.544	19.756	Vertical	265°	0.449	20.189	13.051	Horizontal
90°	0.948	89.858	19.536	Vertical	270°	0.482	23.205	13.656	Horizontal
95°	0.917	84.145	19.250	Vertical	275°	0.531	28.149	14.495	Horizontal
100°	0.889	79.034	18.978	Vertical	280°	0.601	36.139	15.580	Horizontal
105°	0.868	75.291	18.767	Vertical	285°	0.675	45.556	16.585	Horizontal
110°	0.854	72.928	18.629	Vertical	290°	0.740	54.815	17.389	Horizontal
115°	0.848	71.915	18.568	Vertical	295°	0.796	63.316	18.015	Horizontal
120°	0.886	78.477	18.947	Horizontal	300°	0.836	69.913	18.446	Horizontal
125°	0.922	85.088	19.299	Horizontal	305°	0.849	72.130	18.581	Horizontal
130°	0.945	89.302	19.509	Horizontal	310°	0.859	73.796	18.680	Vertical
135°	0.954	90.986	19.590	Horizontal	315°	0.917	84.007	19.243	Vertical
140°	0.956	91.410	19.610	Horizontal	320°	0.955	91.183	19.599	Vertical
145°	0.958	91.871	19.632	Horizontal	325°	0.974	94.871	19.771	Vertical
150°	0.962	92.592	19.666	Horizontal	330°	0.975	94.985	19.777	Vertical
155°	0.967	93.593	19.712	Horizontal	335°	0.962	92.591	19.666	Vertical
160°	0.974	94.881	19.772	Horizontal	340°	0.939	88.193	19.454	Vertical
165°	0.981	96.334	19.838	Horizontal	345°	0.905	81.984	19.137	Vertical
170°	0.988	97.628	19.896	Horizontal	350°	0.864	74.641	18.730	Vertical
175°	0.993	98.656	19.941	Horizontal	355°	0.827	68.362	18.348	Vertical

**Horizontal Polarization:**

**Maximum: 2.965 (4.720 dB)**

**Horizontal Plane: 2.965 (4.720 dB)**

**Maximum ERP: 100.000 kW**

**Vertical Polarization:**

**Maximum: 2.965 (4.720 dB)**

**Horizontal Plane: 2.965 (4.720 dB)**

**Maximum ERP: 100.000 kW**

**Total Input Power: 33.727 kW**

**Reference: WALR1M.FIG**

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

# 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# 1A

Date: 6/8/2017

Station: WALR

Antenna: SHP-6AC-DA-HW

Location: Palmetto, GA.

Antenna Orientation: 65° True

Frequency: 104.1 MHz

Number of Bays: 6

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.785	61.548	17.892	0.799	63.898	18.055	180°	0.997	99.402	19.974	0.771	59.390	17.737
5°	0.817	66.677	18.240	0.783	61.256	17.872	185°	0.999	99.862	19.994	0.711	50.542	17.036
10°	0.828	68.547	18.360	0.776	60.291	17.802	190°	1.000	99.961	19.998	0.642	41.226	16.152
15°	0.826	68.232	18.340	0.779	60.724	17.834	195°	0.993	98.508	19.935	0.567	32.157	15.073
20°	0.821	67.332	18.282	0.788	62.144	17.934	200°	0.969	93.886	19.726	0.487	23.728	13.753
25°	0.820	67.285	18.279	0.803	64.499	18.096	205°	0.924	85.366	19.313	0.406	16.459	12.164
30°	0.833	69.469	18.418	0.824	67.833	18.314	210°	0.857	73.448	18.660	0.328	10.766	10.320
35°	0.863	74.412	18.716	0.850	72.216	18.586	215°	0.773	59.793	17.766	0.259	6.730	8.280
40°	0.906	82.063	19.141	0.882	77.709	18.905	220°	0.680	46.191	16.646	0.204	4.172	6.203
45°	0.946	89.512	19.519	0.914	83.606	19.222	225°	0.583	34.022	15.318	0.166	2.769	4.423
50°	0.972	94.452	19.752	0.943	88.872	19.488	230°	0.495	24.528	13.897	0.146	2.143	3.310
55°	0.981	96.214	19.832	0.965	93.216	19.695	235°	0.427	18.209	12.603	0.139	1.937	2.872
60°	0.971	94.281	19.744	0.983	96.544	19.847	240°	0.386	14.910	11.735	0.138	1.903	2.795
65°	0.943	88.982	19.493	0.994	98.794	19.947	245°	0.374	13.981	11.455	0.138	1.906	2.801
70°	0.898	80.687	19.068	1.000	99.922	19.997	250°	0.384	14.783	11.698	0.140	1.965	2.934
75°	0.838	70.237	18.466	0.998	99.649	19.985	255°	0.404	16.310	12.125	0.149	2.206	3.435
80°	0.781	61.019	17.855	0.989	97.835	19.905	260°	0.424	17.936	12.537	0.166	2.753	4.398
85°	0.740	54.716	17.381	0.972	94.544	19.756	265°	0.449	20.189	13.051	0.194	3.749	5.739
90°	0.715	51.188	17.092	0.948	89.858	19.536	270°	0.482	23.205	13.656	0.232	5.388	7.315
95°	0.709	50.301	17.016	0.917	84.145	19.250	275°	0.531	28.149	14.495	0.287	8.229	9.154
100°	0.720	51.844	17.147	0.889	79.034	18.978	280°	0.601	36.139	15.580	0.355	12.571	10.994
105°	0.745	55.560	17.448	0.868	75.291	18.767	285°	0.675	45.556	16.585	0.429	18.400	12.648
110°	0.785	61.604	17.896	0.854	72.928	18.629	290°	0.740	54.815	17.389	0.506	25.653	14.091
115°	0.837	70.007	18.451	0.848	71.915	18.568	295°	0.796	63.316	18.015	0.591	34.984	15.439
120°	0.886	78.477	18.947	0.851	72.408	18.598	300°	0.836	69.913	18.446	0.689	47.436	16.761
125°	0.922	85.088	19.299	0.862	74.355	18.713	305°	0.849	72.130	18.581	0.783	61.231	17.870
130°	0.945	89.302	19.509	0.882	77.762	18.908	310°	0.834	69.514	18.421	0.859	73.796	18.680
135°	0.954	90.986	19.590	0.907	82.214	19.149	315°	0.798	63.632	18.037	0.917	84.007	19.243
140°	0.956	91.410	19.610	0.927	86.015	19.346	320°	0.746	55.648	17.454	0.955	91.183	19.599
145°	0.958	91.871	19.632	0.940	88.442	19.467	325°	0.689	47.492	16.766	0.974	94.871	19.771
150°	0.962	92.592	19.666	0.945	89.320	19.510	330°	0.641	41.138	16.142	0.975	94.985	19.777
155°	0.967	93.593	19.712	0.940	88.303	19.460	335°	0.613	37.601	15.752	0.962	92.591	19.666
160°	0.974	94.881	19.772	0.924	85.311	19.310	340°	0.614	37.643	15.757	0.939	88.193	19.454
165°	0.981	96.334	19.838	0.897	80.528	19.059	345°	0.642	41.177	16.147	0.905	81.984	19.137
170°	0.988	97.628	19.896	0.863	74.405	18.716	350°	0.687	47.143	16.734	0.864	74.641	18.730
175°	0.993	98.656	19.941	0.820	67.314	18.281	355°	0.737	54.328	17.350	0.827	68.362	18.348

**Horizontal Polarization:**

**Maximum: 2.965 (4.720 dB)**

**Horizontal Plane: 2.965 (4.720 dB)**

**Maximum ERP: 100.000 kW**

**Vertical Polarization:**

**Maximum: 2.965 (4.720 dB)**

**Horizontal Plane: 2.965 (4.720 dB)**

**Maximum ERP: 100.000 kW**

**Total Input Power: 33.727 kW**

**Reference: WALR1M.FIG**

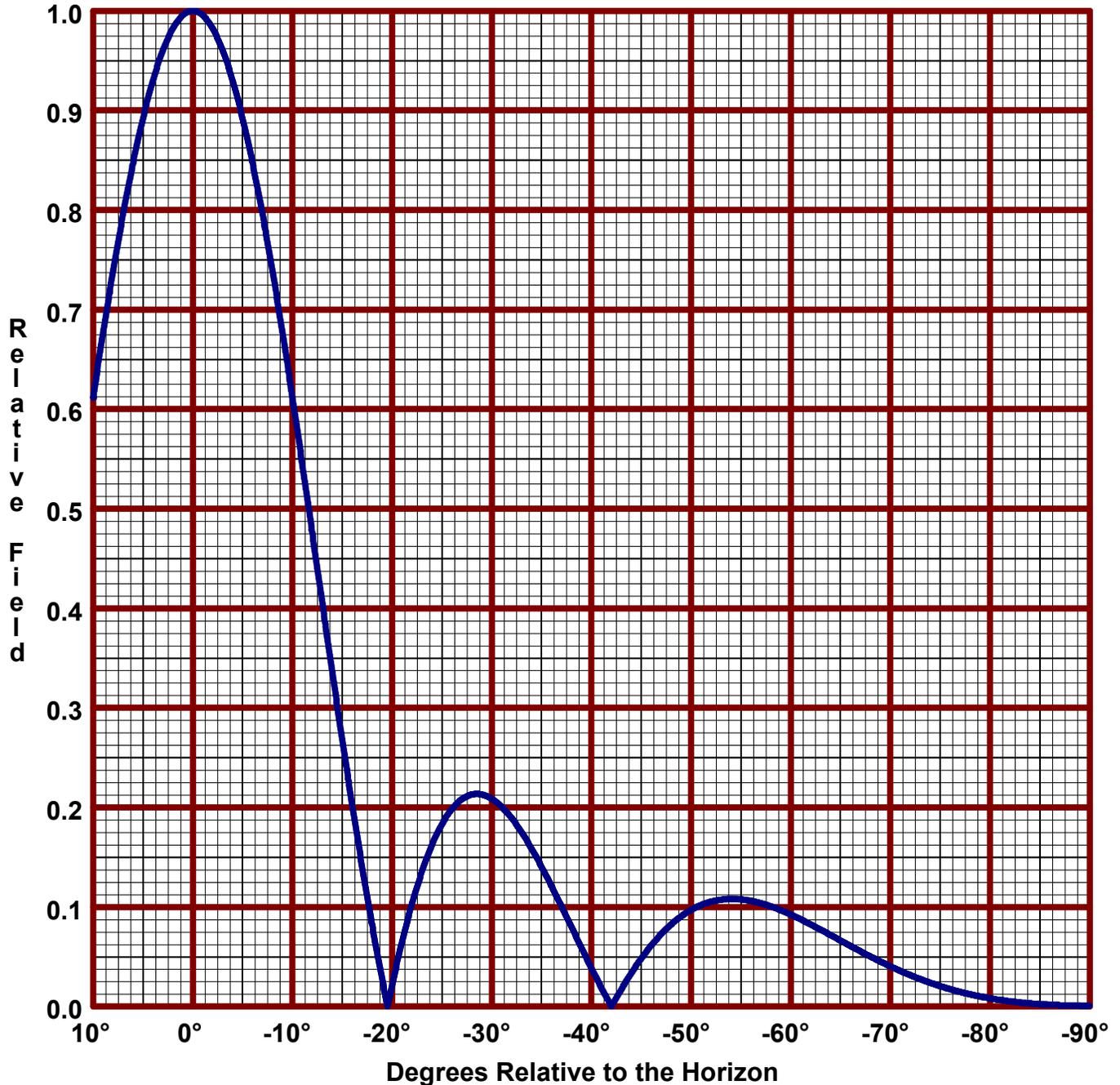
**This list shows the azimuth values for the horizontal and vertical components.**

# 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: WALR  
Location: Palmetto, GA.  
Frequency: 104.1 MHz  
Antenna: 6 bay SHP-6AC-DA-HW

Date: 6/8/2017  
H/V Power Ratio: 1  
.5 Wave-length Spacing  
0° Beam Tilt  
0% First Null Fill



**Horizontal Polarization:**  
Maximum: 2.965 (4.720 dB)  
Horizontal Plane: 2.965 (4.720 dB)  
Maximum ERP: 100.000 kW

**Vertical Polarization:**  
Maximum: 2.965 (4.720 dB)  
Horizontal Plane: 2.965 (4.720 dB)  
Maximum ERP: 100.000 kW

# Directional Antenna System for WALR, Palmetto, Georgia

(Continued)

## ANTENNA SPECIFICATIONS

Antenna Type: SHP-6AC-DA-HW  
Frequency: 104.1 MHz  
Number of Bays: Six

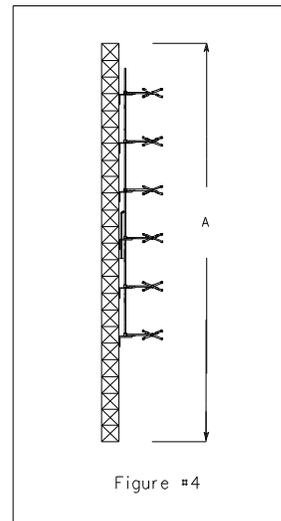
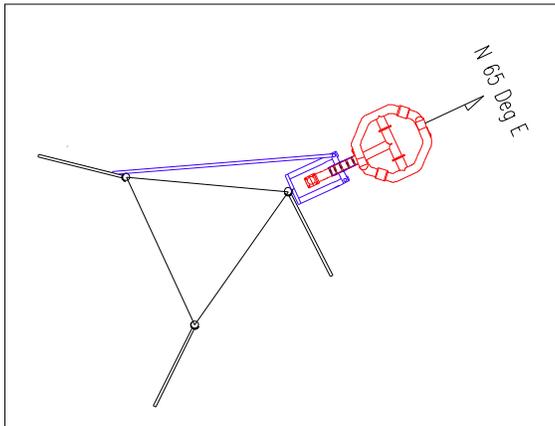
## MECHANICAL SPECIFICATIONS

Mounting: Standard  
System length: 27 ft 3 in  
Aperture length required: 43 ft 6"  
Orientation: 65° true  
Input flange to the antenna 3 1/8" female.

## ELECTRICAL SPECIFICATIONS

(For directional use)

Maximum horizontal ERP:	100 kW (20 dBk)
Horizontal maximum power gain:	2.965 (4.720 dB)
Maximum vertical ERP:	100 kW (20 dBk)
Vertical maximum power gain:	2.965 (4.720 dB)
Total input power:	33.727 kW (15.279 dBk)



**PRELIMINARY MECHANICAL SPECIFICATION FOR  
SHP-6AC-HW-SP**

*PREPARED FOR:*  
*WALR-FM (104.1 MHz) \* Palmetto, GA*  
*August 31, 2017*

*ANTENNA TYPE:*  
**SHP-6AC-HW-SP**

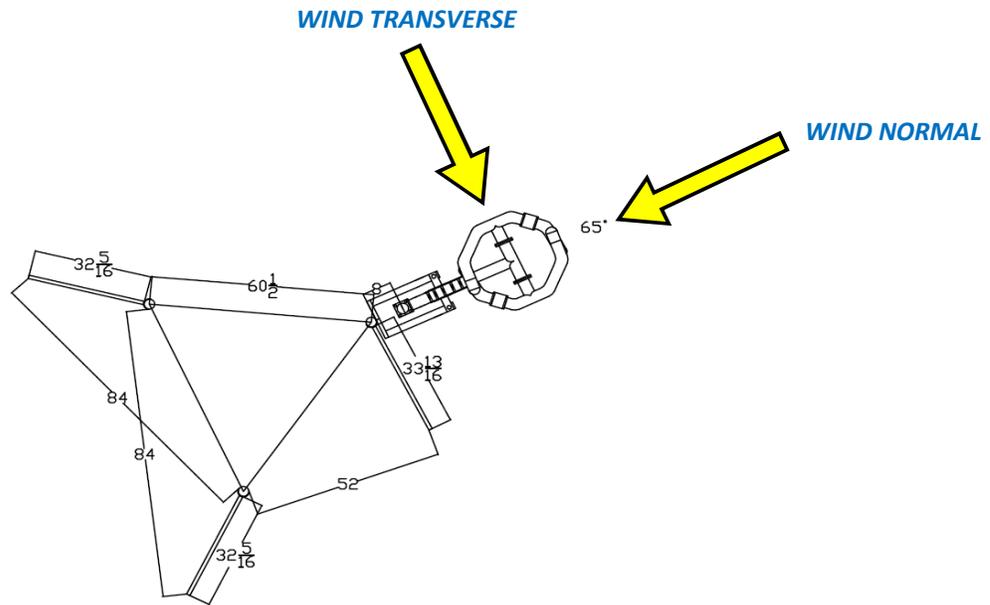
*PREPARED BY:*  
**James Ruedlinger, P.E.**  
**+1 812 925-6000 ext.282**  
**[jruedlinger@eriinc.com](mailto:jruedlinger@eriinc.com)**



## PRELIMINARY MECHANICAL SPECIFICATION FOR SHP-6AC-HW-SP

**ANTENNA MECHANICAL CHARACTERISTICS:**

		<i>Without Radomes</i>	<i>With Radomes</i>
ARRAY LENGTH:		27.3 feet	28.1 feet
CALCULATED WEIGHT:	No Ice:	685 lbs	1,085 lbs
	With 1/2" Ice:	1,125 lbs	1,835 lbs
CALCULATED EFFECTIVE PROJECTED AREA (EPA):	<b><u>NORMAL EXPOSURE</u></b>		
		<i>Without Radomes</i>	<i>With Radomes</i>
	No Ice:	24.9 ft <sup>2</sup>	54.7 ft <sup>2</sup>
	With 1/2" Ice:	32.6 ft <sup>2</sup>	63.2 ft <sup>2</sup>
	<b><u>TRANSVERSE EXPOSURE</u></b>		
		<i>Without Radomes</i>	<i>With Radomes</i>
	No Ice:	25.9 ft <sup>2</sup>	44.2 ft <sup>2</sup>
	With 1/2" Ice:	34.8 ft <sup>2</sup>	54.3 ft <sup>2</sup>



**NOTES:**

1. Please note, the listed weights and effective wind areas are based upon the **PRELIMINARY** design of the antenna.
2. All loads calculated in accordance with the ANSI/TIA-222-G standard.
3. Loading for antenna includes radiating elements/radomes, interbay feed, parasites, and standard mounting brackets.

Please contact ERI's Structural Division if you have any questions concerning the provided Mechanical Specifications.