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 KSWP, Lufkin, Texas

July 10, 2018

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 KSWP.

The antenna is the ERI model SHP-8AC-DA configuration. The circular polarized system consists of 8 full-wavelength spaced bays using one driven circular polarized radiating element, one horizontal parasitic element placed one quarter wave above and below each bay and four vertical parasitic elements per bay. The antenna was mounted off the North 34 degrees East tower face with bracketry to provide an antenna orientation of North 71° 57' 31" degrees East. The antenna was tested on a 24" ERI® λ ***MOUNTING SYSTEM***, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 90.9 megahertz, which is the center of the FM broadcast channel assigned to KSWP.

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
KSWP, Lufkin, Texas

(Continued)

DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of two bay levels of the 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 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 24" ERI®λ ***MOUNTING SYSTEM***, 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.

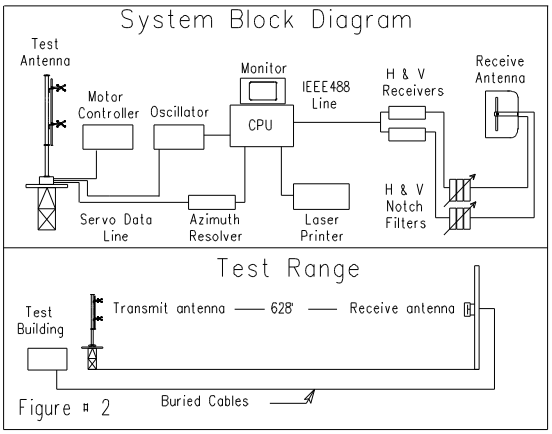

Figure # 2

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

A broadband horizontal and vertical dipole system, located approximately 628 feet from the test antenna, was used to receive the emitted test signals.

(Continued)

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 8 full-wavelength spaced bays using one driven circular polarized radiating element, one horizontal parasitic element placed one quarter wave above and below each bay and four vertical 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-8AC-DA array is to be mounted off the North 34 degrees East tower face of the 24" ERI®λ ***MOUNTING SYSTEM***, at a bearing of North 71° 57' 31" 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 (20.000 dBk).

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(Continued)

The power at North 245 degrees East does not exceed 26 kilowatts (14.15 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 91 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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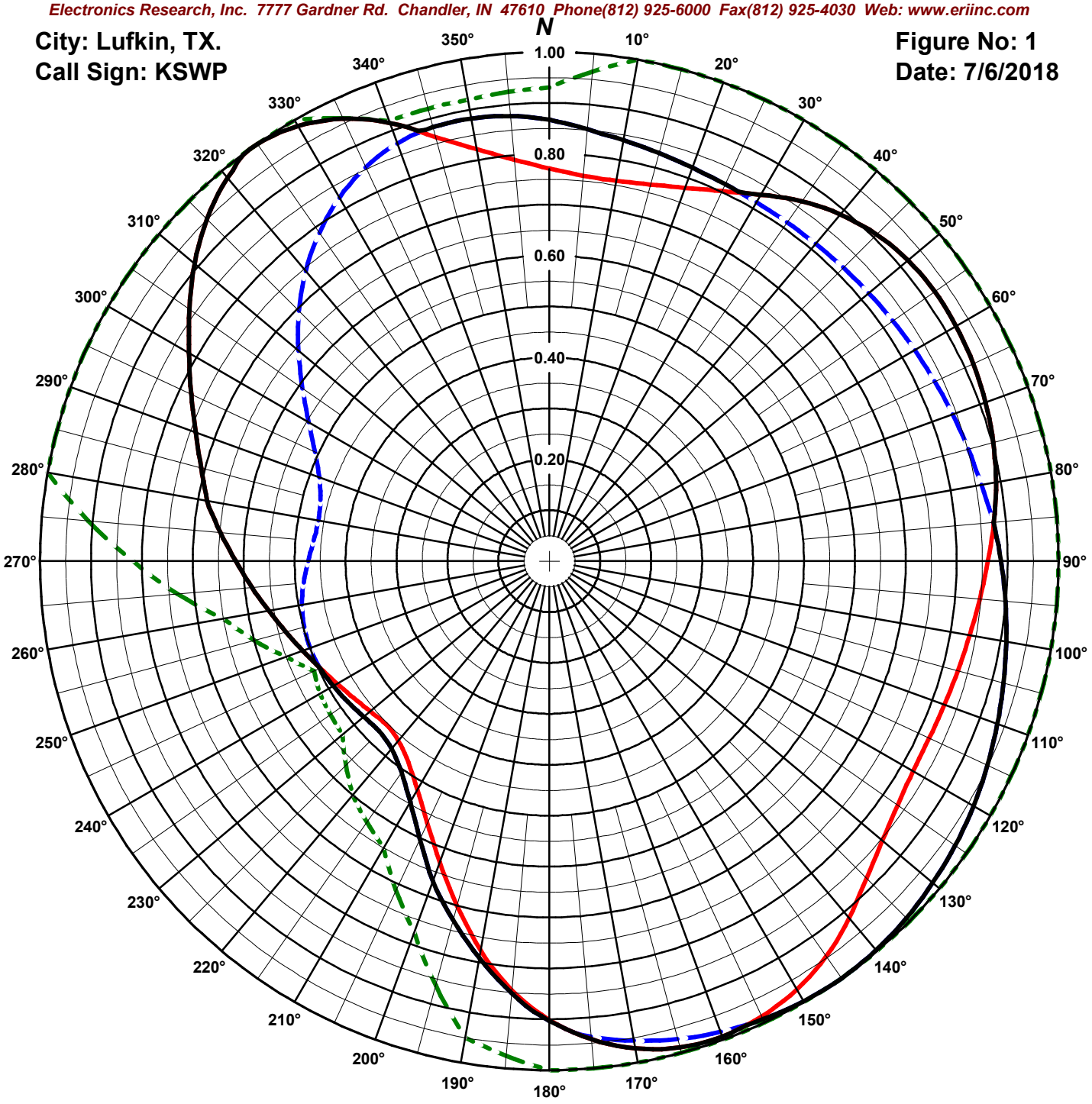
City: Lufkin, TX.
Call Sign: KSWP

Figure No: 1
Date: 7/6/2018



Antenna Orientation:N 70° 57 ' 31" E True

Frequency: 90.9 MHz
Antenna Type: SHP-8AC-DA

Antenna Mounting: Custom
Tower Type: 24" Lambda tower

HORIZONTAL	VERTICAL	COMPOSITE	FCC ENVELOPE
RMS: .808	RMS: .783	RMS: .836	RMS: .924
Maximum: 1 @ 324°	Maximum: 1 @ 145°	Maximum: 1 @ 145°	Maximum: 1 @ 10°
Minimum: .453 @ 224°	Minimum: .46 @ 280°	Minimum: .473 @ 226°	Minimum: .51 @ 245°

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 BPED-20160822AAX.

ERI® Horizontal Plane Relative Field Pattern

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Figure# 1
Station: KSWP
Location: Lufkin, TX.
Frequency: 90.9 MHz

Date: 7/6/2018
Antenna: SHP-8AC-DA
Antenna Orientation: 71° 57' 31" True
Number of Bays: 8

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.867	75.091	18.756	Vertical	180°	0.903	81.498	19.111	Vertical
5°	0.852	72.515	18.604	Vertical	185°	0.852	72.508	18.604	Vertical
10°	0.839	70.469	18.480	Vertical	190°	0.792	62.694	17.972	Vertical
15°	0.830	68.854	18.379	Vertical	195°	0.729	53.214	17.260	Vertical
20°	0.822	67.599	18.299	Vertical	200°	0.669	44.785	16.511	Vertical
25°	0.817	66.720	18.243	Vertical	205°	0.601	36.144	15.580	Vertical
30°	0.831	69.021	18.390	Horizontal	210°	0.546	29.823	14.746	Vertical
35°	0.863	74.457	18.719	Horizontal	215°	0.506	25.630	14.088	Vertical
40°	0.889	79.015	18.977	Horizontal	220°	0.482	23.208	13.656	Vertical
45°	0.908	82.395	19.159	Horizontal	225°	0.473	22.339	13.491	Vertical
50°	0.919	84.510	19.269	Horizontal	230°	0.475	22.605	13.542	Vertical
55°	0.924	85.301	19.310	Horizontal	235°	0.482	23.270	13.668	Vertical
60°	0.922	85.061	19.297	Horizontal	240°	0.490	24.007	13.803	Vertical
65°	0.918	84.311	19.259	Horizontal	245°	0.497	24.660	13.920	Vertical
70°	0.912	83.096	19.196	Horizontal	250°	0.515	26.485	14.230	Horizontal
75°	0.902	81.430	19.108	Horizontal	255°	0.536	28.694	14.578	Horizontal
80°	0.891	79.324	18.994	Horizontal	260°	0.560	31.309	14.957	Horizontal
85°	0.876	76.799	18.854	Horizontal	265°	0.586	34.371	15.362	Horizontal
90°	0.887	78.696	18.960	Vertical	270°	0.616	37.925	15.789	Horizontal
95°	0.899	80.834	19.076	Vertical	275°	0.648	42.021	16.235	Horizontal
100°	0.911	83.016	19.192	Vertical	280°	0.682	46.503	16.675	Horizontal
105°	0.923	85.281	19.309	Vertical	285°	0.708	50.079	16.997	Horizontal
110°	0.936	87.652	19.428	Vertical	290°	0.739	54.609	17.373	Horizontal
115°	0.949	90.128	19.549	Vertical	295°	0.776	60.216	17.797	Horizontal
120°	0.962	92.550	19.664	Vertical	300°	0.817	66.751	18.245	Horizontal
125°	0.973	94.721	19.764	Vertical	305°	0.863	74.397	18.716	Horizontal
130°	0.983	96.629	19.851	Vertical	310°	0.909	82.642	19.172	Horizontal
135°	0.992	98.333	19.927	Vertical	315°	0.950	90.324	19.558	Horizontal
140°	0.998	99.565	19.981	Vertical	320°	0.982	96.499	19.845	Horizontal
145°	1.000	100.000	20.000	Vertical	325°	1.000	99.960	19.998	Horizontal
150°	0.998	99.614	19.983	Vertical	330°	0.987	97.339	19.883	Horizontal
155°	0.993	98.547	19.936	Vertical	335°	0.958	91.860	19.631	Horizontal
160°	0.994	98.740	19.945	Horizontal	340°	0.916	83.932	19.239	Horizontal
165°	0.989	97.805	19.904	Horizontal	345°	0.882	77.856	18.913	Vertical
170°	0.972	94.443	19.752	Horizontal	350°	0.883	77.924	18.917	Vertical
175°	0.942	88.815	19.485	Horizontal	355°	0.878	77.007	18.865	Vertical

Horizontal Polarization:
Maximum: 6.740 (8.287 dB)
Horizontal Plane: 6.740 (8.287 dB)
Maximum ERP: 100.000 kW

Vertical Polarization:
Maximum: 6.740 (8.287 dB)
Horizontal Plane: 6.740 (8.287 dB)
Maximum ERP: 100.000 kW

Total Input Power: 14.837 kW
Reference: KSWP2M.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: 7/6/2018**
Station: KSWP **Antenna: SHP-8AC-DA**
Location: Lufkin, TX. **Antenna Orientation: 71° 57' 31" True**
Frequency: 90.9 MHz **Number of Bays: 8**

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.771	59.427	17.740	0.867	75.091	18.756	180°	0.901	81.138	19.092	0.903	81.498	19.111
5°	0.760	57.740	17.615	0.852	72.515	18.604	185°	0.846	71.543	18.546	0.852	72.508	18.604
10°	0.758	57.529	17.599	0.839	70.469	18.480	190°	0.777	60.327	17.805	0.792	62.694	17.972
15°	0.766	58.623	17.681	0.830	68.854	18.379	195°	0.700	48.995	16.901	0.729	53.214	17.260
20°	0.780	60.860	17.843	0.822	67.599	18.299	200°	0.629	39.595	15.976	0.669	44.785	16.511
25°	0.802	64.295	18.082	0.817	66.720	18.243	205°	0.567	32.149	15.072	0.601	36.144	15.580
30°	0.831	69.021	18.390	0.814	66.210	18.209	210°	0.518	26.827	14.286	0.546	29.823	14.746
35°	0.863	74.457	18.719	0.813	66.070	18.200	215°	0.483	23.282	13.670	0.506	25.630	14.088
40°	0.889	79.015	18.977	0.814	66.211	18.209	220°	0.461	21.225	13.268	0.482	23.208	13.656
45°	0.908	82.395	19.159	0.816	66.540	18.231	225°	0.453	20.530	13.124	0.473	22.339	13.491
50°	0.919	84.510	19.269	0.819	67.054	18.264	230°	0.459	21.064	13.235	0.475	22.605	13.542
55°	0.924	85.301	19.310	0.823	67.755	18.309	235°	0.469	21.957	13.416	0.482	23.270	13.668
60°	0.922	85.061	19.297	0.829	68.645	18.366	240°	0.481	23.145	13.645	0.490	24.007	13.803
65°	0.918	84.311	19.259	0.835	69.729	18.434	245°	0.496	24.646	13.917	0.497	24.660	13.920
70°	0.912	83.096	19.196	0.843	71.010	18.513	250°	0.515	26.485	14.230	0.500	24.984	13.977
75°	0.902	81.430	19.108	0.851	72.494	18.603	255°	0.536	28.694	14.578	0.498	24.826	13.949
80°	0.891	79.324	18.994	0.862	74.241	18.706	260°	0.560	31.309	14.957	0.493	24.298	13.856
85°	0.876	76.799	18.854	0.875	76.527	18.838	265°	0.586	34.371	15.362	0.484	23.444	13.700
90°	0.861	74.189	18.703	0.887	78.696	18.960	270°	0.616	37.925	15.789	0.473	22.398	13.502
95°	0.849	72.008	18.574	0.899	80.834	19.076	275°	0.648	42.021	16.235	0.464	21.548	13.334
100°	0.838	70.286	18.469	0.911	83.016	19.192	280°	0.682	46.503	16.675	0.460	21.185	13.260
105°	0.831	69.008	18.389	0.923	85.281	19.309	285°	0.708	50.079	16.997	0.465	21.608	13.346
110°	0.826	68.162	18.335	0.936	87.652	19.428	290°	0.739	54.609	17.373	0.481	23.091	13.635
115°	0.823	67.742	18.309	0.949	90.128	19.549	295°	0.776	60.216	17.797	0.508	25.782	14.113
120°	0.825	68.064	18.329	0.962	92.550	19.664	300°	0.817	66.751	18.245	0.545	29.747	14.734
125°	0.835	69.756	18.436	0.973	94.721	19.764	305°	0.863	74.397	18.716	0.591	34.962	15.436
130°	0.854	72.909	18.628	0.983	96.629	19.851	310°	0.909	82.642	19.172	0.643	41.332	16.163
135°	0.881	77.619	18.900	0.992	98.333	19.927	315°	0.950	90.324	19.558	0.695	48.337	16.843
140°	0.916	83.884	19.237	0.998	99.565	19.981	320°	0.982	96.499	19.845	0.744	55.301	17.427
145°	0.948	89.847	19.535	1.000	100.000	20.000	325°	1.000	99.960	19.998	0.787	61.974	17.922
150°	0.972	94.405	19.750	0.998	99.614	19.983	330°	0.987	97.339	19.883	0.824	67.931	18.321
155°	0.987	97.396	19.885	0.993	98.547	19.936	335°	0.958	91.860	19.631	0.853	72.799	18.621
160°	0.994	98.740	19.945	0.984	96.823	19.860	340°	0.916	83.932	19.239	0.873	76.230	18.821
165°	0.989	97.805	19.904	0.972	94.462	19.753	345°	0.862	74.294	18.710	0.882	77.856	18.913
170°	0.972	94.443	19.752	0.956	91.487	19.614	350°	0.822	67.490	18.292	0.883	77.924	18.917
175°	0.942	88.815	19.485	0.938	87.930	19.441	355°	0.792	62.665	17.970	0.878	77.007	18.865

Horizontal Polarization:
Maximum: 6.740 (8.287 dB)
Horizontal Plane: 6.740 (8.287 dB)
Maximum ERP: 100.000 kW

Vertical Polarization:
Maximum: 6.740 (8.287 dB)
Horizontal Plane: 6.740 (8.287 dB)
Maximum ERP: 100.000 kW

Total Input Power: 14.837 kW
Reference: KSWP2M.FIG
This list shows the azimuth values for the horizontal and vertical components.

Vertical Plane Relative Field Pattern

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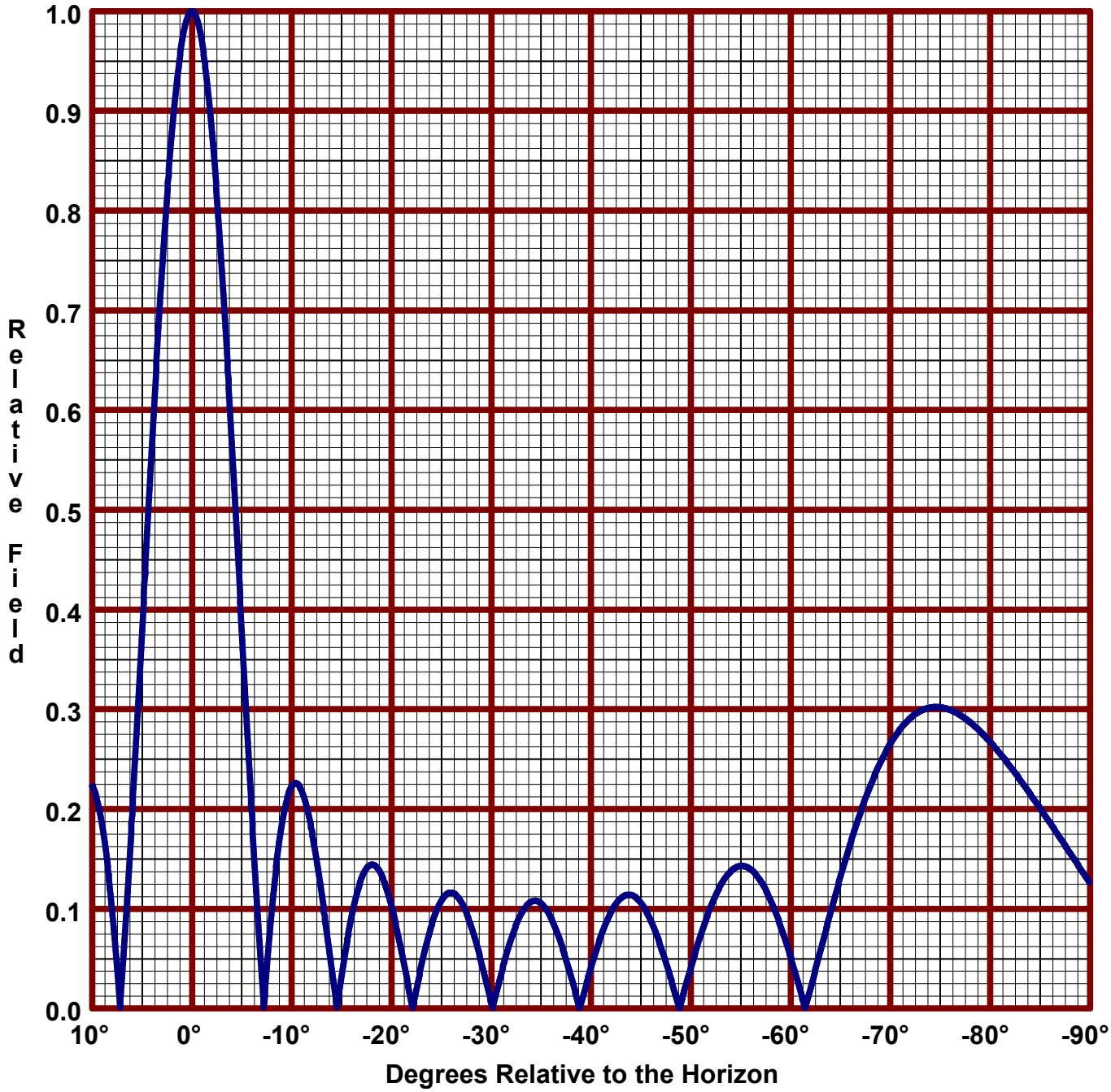
Figure No: 3
Call Sign: KSWP
Location: Lufkin, TX.
Frequency: 90.9 MHz
Antenna: 8 bay SHP-8AC-DA

Date: 7/6/2018
H/V Power Ratio: 1
1 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 6.740 (8.287 dB)
Horizontal Plane: 6.740 (8.287 dB)
Maximum ERP: 100.000 kW

Vertical Polarization:
Maximum: 6.740 (8.287 dB)
Horizontal Plane: 6.740 (8.287 dB)
Maximum ERP: 100.000 kW

Directional Antenna System
for
KSWP, Lufkin, Texas

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	SHP-8AC-DA
Frequency:	90.9 MHz
Number of Bays:	Eight

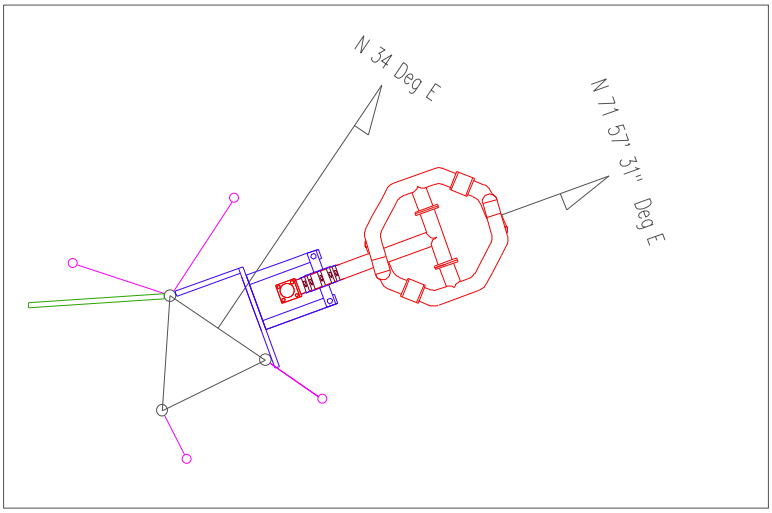
MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	79 ft 6 in
Aperture length required:	90 ft
Orientation:	71° 57’ 31” true

Input flange to the antenna 3 1/8” female.

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	100.000 kW (20.000 dBk)
Horizontal maximum power gain:	6.740 (8.287 dB)
Maximum vertical ERP:	100.000 kW (20.000 dBk)
Vertical maximum power gain:	6.740 (8.287 dB)
Total input power:	14.837 kW (11.713 dBk)



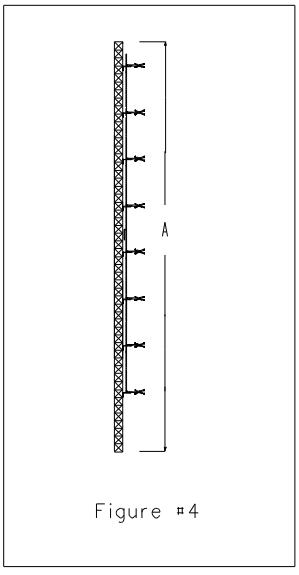


Figure #4