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 KUAF, Fayetteville, Arkansas

November 13, 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 KUAF.

The antenna is the ERI model MP-8C-DA configuration. The circular polarized system consists of 8 full-wavelength spaced bays using one driven circular polarized radiating element, one horizontal parasitic elements placed one quarter wave above and below each bay and two vertical parasitic elements per bay. The antenna was mounted on the North 111 degrees East tower face with bracketry to provide an antenna orientation of North 111 degrees East. The antenna was tested on a 24" face Bell tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 91.3 megahertz, which is the center of the FM broadcast channel assigned to KUAF.

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
KUAF, Fayetteville, Arkansas

(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" face Bell 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.

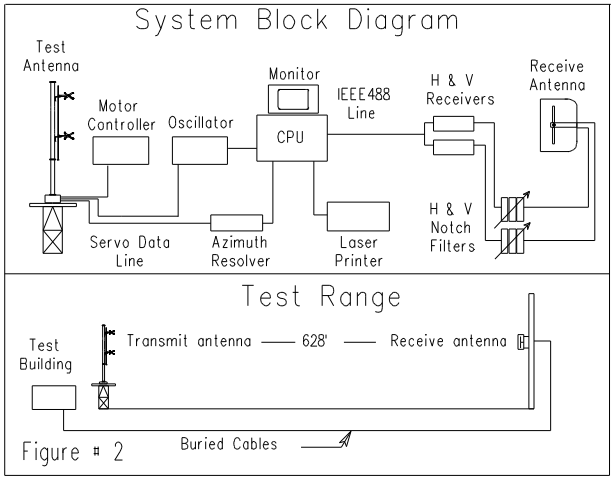


Figure # 2

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 91.3 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. 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 elements placed one quarter wave above and below each bay and two 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 MP-8C-DA array is to be mounted on the North 111 degrees East tower face of the 24" face Bell tower at a bearing of North 111 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).

Directional Antenna System
For
KUAF, Fayetteville, Arkansas

(Continued)

The power at North 20 degrees East does not exceed 64 kilowatts (18.062 dBk).

The power at North 120 degrees East does not exceed 41 kilowatts (16.128 dBk).

The power at North 290 degrees East does not exceed 9.9 kilowatts (9.956 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 90 feet 2 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.

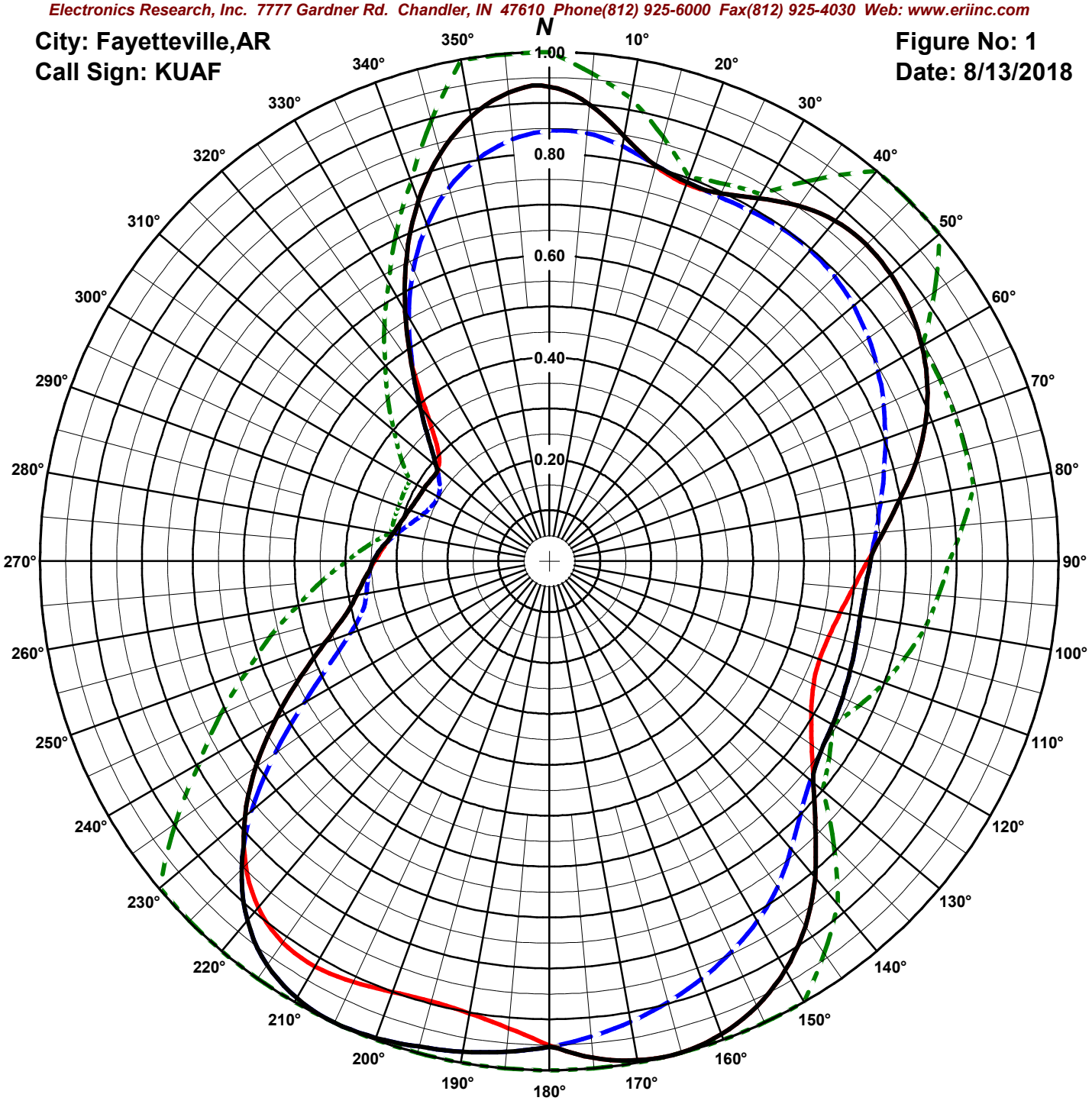
Tom Schaefer

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: Fayetteville,AR
Call Sign: KUAF

Figure No: 1
Date: 8/13/2018



Antenna Orientation: 111° True

Frequency: 91.3 MHz
Antenna Type: MP-8C-DA

Antenna Mounting: Standard
Tower Type: 24" Bell Tower

HORIZONTAL	VERTICAL	COMPOSITE	FCC ENVELOPE
RMS: .734	RMS: .71	RMS: .748	RMS: .813
Maximum: 1 @ 166°	Maximum: 1 @ 205°	Maximum: 1 @ 166°	Maximum: 1 @ 0°
Minimum: .281 @ 309°	Minimum: .252 @ 299°	Minimum: .281 @ 308°	Minimum: .315 @ 290°

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-20161216ABE.

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# 1 **Date: 8/13/2018**
Station: KUAF **Antenna: MP-8C-DA**
Location: Fayetteville,AR **Antenna Orientation: 111° True**
Frequency: 91.3 MHz **Number of Bays: 8**

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.932	86.839	19.387	Horizontal	180°	0.954	91.005	19.591	Vertical
5°	0.901	81.118	19.091	Horizontal	185°	0.968	93.621	19.714	Vertical
10°	0.848	71.861	18.565	Horizontal	190°	0.979	95.761	19.812	Vertical
15°	0.805	64.868	18.120	Vertical	195°	0.987	97.407	19.886	Vertical
20°	0.792	62.734	17.975	Vertical	200°	0.996	99.289	19.969	Vertical
25°	0.797	63.462	18.025	Horizontal	205°	1.000	100.000	20.000	Vertical
30°	0.823	67.659	18.303	Horizontal	210°	0.991	98.220	19.922	Vertical
35°	0.852	72.620	18.611	Horizontal	215°	0.967	93.550	19.710	Vertical
40°	0.873	76.170	18.818	Horizontal	220°	0.922	84.988	19.294	Vertical
45°	0.880	77.398	18.887	Horizontal	225°	0.854	72.932	18.629	Vertical
50°	0.875	76.635	18.844	Horizontal	230°	0.780	60.815	17.840	Horizontal
55°	0.864	74.621	18.729	Horizontal	235°	0.703	49.414	16.939	Horizontal
60°	0.845	71.405	18.537	Horizontal	240°	0.620	38.422	15.846	Horizontal
65°	0.819	67.069	18.265	Horizontal	245°	0.539	29.044	14.630	Horizontal
70°	0.786	61.727	17.905	Horizontal	250°	0.468	21.940	13.412	Horizontal
75°	0.745	55.522	17.445	Horizontal	255°	0.416	17.279	12.375	Horizontal
80°	0.699	48.883	16.892	Horizontal	260°	0.384	14.779	11.697	Horizontal
85°	0.659	43.380	16.373	Horizontal	265°	0.362	13.116	11.178	Horizontal
90°	0.631	39.803	15.999	Vertical	270°	0.346	11.949	10.773	Vertical
95°	0.622	38.738	15.881	Vertical	275°	0.328	10.776	10.325	Vertical
100°	0.620	38.410	15.844	Vertical	280°	0.312	9.736	9.884	Horizontal
105°	0.623	38.872	15.896	Vertical	285°	0.301	9.053	9.568	Horizontal
110°	0.629	39.517	15.968	Vertical	290°	0.293	8.558	9.323	Horizontal
115°	0.635	40.349	16.058	Vertical	295°	0.287	8.235	9.156	Horizontal
120°	0.642	41.213	16.150	Vertical	300°	0.284	8.076	9.072	Horizontal
125°	0.651	42.439	16.278	Vertical	305°	0.282	7.966	9.012	Horizontal
130°	0.677	45.854	16.614	Horizontal	310°	0.290	8.408	9.247	Vertical
135°	0.739	54.587	17.371	Horizontal	315°	0.334	11.146	10.471	Vertical
140°	0.812	65.896	18.189	Horizontal	320°	0.395	15.572	11.923	Vertical
145°	0.876	76.758	18.851	Horizontal	325°	0.471	22.208	13.465	Horizontal
150°	0.927	85.945	19.342	Horizontal	330°	0.566	32.000	15.051	Horizontal
155°	0.965	93.046	19.687	Horizontal	335°	0.662	43.832	16.418	Horizontal
160°	0.989	97.760	19.902	Horizontal	340°	0.752	56.537	17.523	Horizontal
165°	0.999	99.893	19.995	Horizontal	345°	0.828	68.595	18.363	Horizontal
170°	0.995	99.068	19.959	Horizontal	350°	0.886	78.514	18.949	Horizontal
175°	0.979	95.840	19.815	Horizontal	355°	0.923	85.261	19.307	Horizontal

Horizontal Polarization:
Maximum: 8.177 (9.126 dB)
Horizontal Plane: 8.177 (9.126 dB)
Maximum ERP: 100.000 kW

Vertical Polarization:
Maximum: 8.177 (9.126 dB)
Horizontal Plane: 8.177 (9.126 dB)
Maximum ERP: 100.000 kW

Total Input Power: 12.230 kW
Reference: KUAF2M.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: 8/13/2018**
Station: KUAF | **Antenna: MP-8C-DA**
Location: Fayetteville,AR | **Antenna Orientation: 111° True**
Frequency: 91.3 MHz | **Number of Bays: 8**

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.932	86.839	19.387	0.846	71.531	18.545	180°	0.951	90.430	19.563	0.954	91.005	19.591
5°	0.901	81.118	19.091	0.844	71.203	18.525	185°	0.921	84.768	19.282	0.968	93.621	19.714
10°	0.848	71.861	18.565	0.827	68.441	18.353	190°	0.902	81.362	19.104	0.979	95.761	19.812
15°	0.804	64.617	18.103	0.805	64.868	18.120	195°	0.895	80.103	19.036	0.987	97.407	19.886
20°	0.788	62.035	17.926	0.792	62.734	17.975	200°	0.901	81.111	19.091	0.996	99.289	19.969
25°	0.797	63.462	18.025	0.790	62.353	17.949	205°	0.912	83.139	19.198	1.000	100.000	20.000
30°	0.823	67.659	18.303	0.793	62.901	17.987	210°	0.920	84.565	19.272	0.991	98.220	19.922
35°	0.852	72.620	18.611	0.797	63.600	18.035	215°	0.914	83.457	19.215	0.967	93.550	19.710
40°	0.873	76.170	18.818	0.797	63.537	18.030	220°	0.888	78.896	18.971	0.922	84.988	19.294
45°	0.880	77.398	18.887	0.791	62.584	17.965	225°	0.843	71.112	18.519	0.854	72.932	18.629
50°	0.875	76.635	18.844	0.780	60.887	17.845	230°	0.780	60.815	17.840	0.764	58.297	17.656
55°	0.864	74.621	18.729	0.765	58.538	17.674	235°	0.703	49.414	16.939	0.657	43.108	16.346
60°	0.845	71.405	18.537	0.745	55.547	17.447	240°	0.620	38.422	15.846	0.556	30.897	14.899
65°	0.819	67.069	18.265	0.725	52.490	17.201	245°	0.539	29.044	14.630	0.475	22.539	13.529
70°	0.786	61.727	17.905	0.703	49.393	16.937	250°	0.468	21.940	13.412	0.416	17.302	12.381
75°	0.745	55.522	17.445	0.680	46.226	16.649	255°	0.416	17.279	12.375	0.380	14.421	11.590
80°	0.699	48.883	16.892	0.660	43.613	16.396	260°	0.384	14.779	11.697	0.364	13.276	11.231
85°	0.659	43.380	16.373	0.644	41.435	16.174	265°	0.362	13.116	11.178	0.357	12.729	11.048
90°	0.625	39.104	15.922	0.631	39.803	15.999	270°	0.343	11.742	10.697	0.346	11.949	10.773
95°	0.599	35.913	15.553	0.622	38.738	15.881	275°	0.326	10.625	10.263	0.328	10.776	10.325
100°	0.580	33.693	15.275	0.620	38.410	15.844	280°	0.312	9.736	9.884	0.305	9.317	9.693
105°	0.569	32.362	15.100	0.623	38.872	15.896	285°	0.301	9.053	9.568	0.283	7.991	9.026
110°	0.565	31.870	15.034	0.629	39.517	15.968	290°	0.293	8.558	9.323	0.265	7.048	8.481
115°	0.573	32.785	15.157	0.635	40.349	16.058	295°	0.287	8.235	9.156	0.255	6.493	8.125
120°	0.594	35.287	15.476	0.642	41.213	16.150	300°	0.284	8.076	9.072	0.252	6.359	8.034
125°	0.629	39.550	15.971	0.651	42.439	16.278	305°	0.282	7.966	9.012	0.263	6.912	8.396
130°	0.677	45.854	16.614	0.670	44.836	16.516	310°	0.286	8.180	9.127	0.290	8.408	9.247
135°	0.739	54.587	17.371	0.699	48.798	16.884	315°	0.309	9.558	9.804	0.334	11.146	10.471
140°	0.812	65.896	18.189	0.738	54.503	17.364	320°	0.371	13.757	11.385	0.395	15.572	11.923
145°	0.876	76.758	18.851	0.781	61.011	17.854	325°	0.471	22.208	13.465	0.469	22.013	13.427
150°	0.927	85.945	19.342	0.817	66.689	18.241	330°	0.566	32.000	15.051	0.551	30.339	14.820
155°	0.965	93.046	19.687	0.847	71.666	18.553	335°	0.662	43.832	16.418	0.632	39.927	16.013
160°	0.989	97.760	19.902	0.873	76.269	18.823	340°	0.752	56.537	17.523	0.703	49.383	16.936
165°	0.999	99.893	19.995	0.897	80.535	19.060	345°	0.828	68.595	18.363	0.760	57.741	17.615
170°	0.995	99.068	19.959	0.919	84.434	19.265	350°	0.886	78.514	18.949	0.803	64.445	18.092
175°	0.979	95.840	19.815	0.938	87.934	19.442	355°	0.923	85.261	19.307	0.831	69.118	18.396

Horizontal Polarization:
Maximum: 8.177 (9.126 dB)
Horizontal Plane: 8.177 (9.126 dB)
Maximum ERP: 100.000 kW

Vertical Polarization:
Maximum: 8.177 (9.126 dB)
Horizontal Plane: 8.177 (9.126 dB)
Maximum ERP: 100.000 kW

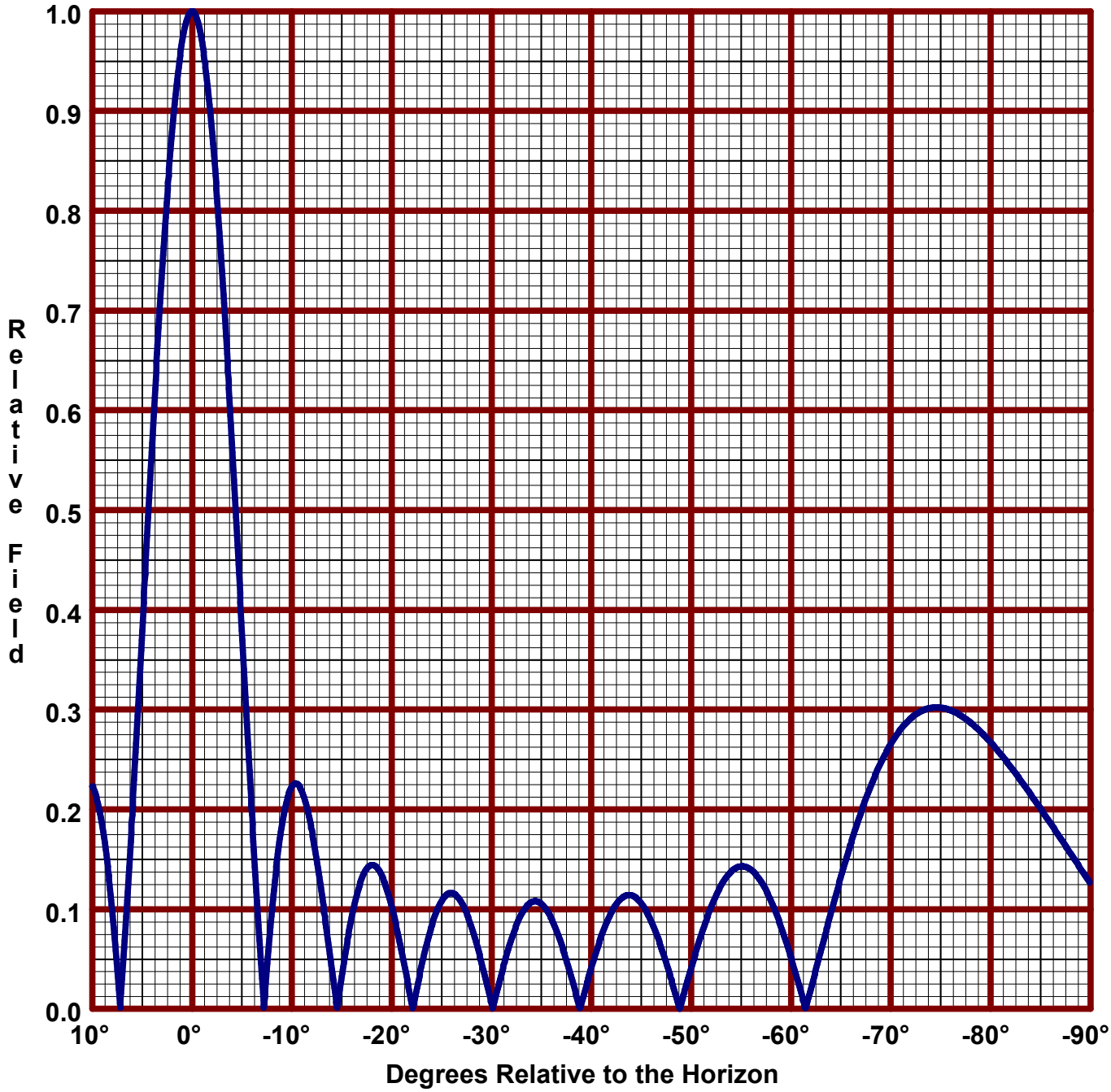
Total Input Power: 12.230 kW
Reference: KUAF2M.FIG
This list shows the azimuth values for the horizontal and vertical components.

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: KUAF
Location: Fayetteville,AR
Frequency: 91.3 MHz
Antenna: 8 bay MP-8C-DA

Date: 8/13/2018
H/V Power Ratio: 1
1 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 8.177 (9.126 dB)
Horizontal Plane: 8.177 (9.126 dB)
Maximum ERP: 100.000 kW

Vertical Polarization:
Maximum: 8.177 (9.126 dB)
Horizontal Plane: 8.177 (9.126 dB)
Maximum ERP: 100.000 kW

Directional Antenna System
for
KUAF, Fayetteville, Arkansas

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	MP-8C-DA
Frequency:	91.3 MHz
Number of Bays:	Eight

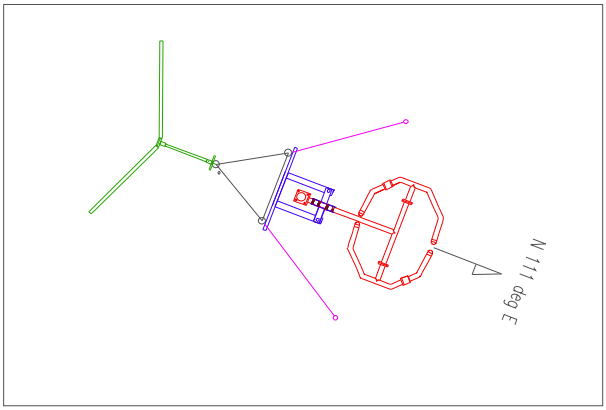
MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	79 ft 2 in
Aperture length required:	90 ft 2 in [1]
Orientation:	111° 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:	8.177 (9.126 dB)
Maximum vertical ERP:	100 kW (20 dBk)
Vertical maximum power gain:	8.177 (9.126 dB)
Total input power:	12.230 kW (10.874 dBk)



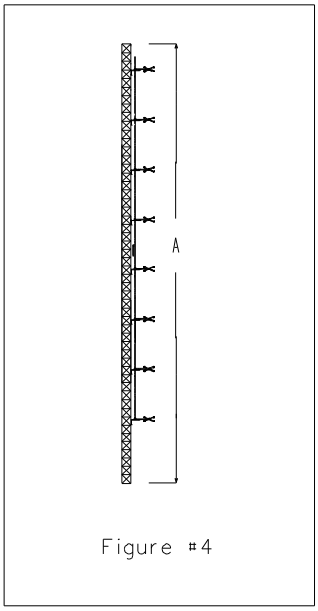


Figure #4