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 WJFK, Manassas, Virginia

January 29, 2014

Electronics Research Inc. is providing modifications to an existing antenna system that is specially designed to meet the FCC requirements and the general needs of radio station WJFK.

The antenna is an existing ERI model MP-4C-DA-HW configuration. The circular polarized system consists of 4 half-wavelength spaced bays using one driven circular polarized radiating element per bay, one horizontal parasitic element per bay and two vertical parasitic elements interleaved between alternate bay pairs. The antenna was tested on an 18" o.d. pole, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 106.7 megahertz, which is the center of the FM broadcast channel assigned to WJFK.

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
WJFK, Manassas, Virginia

(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 an 18" o.d. pole 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.

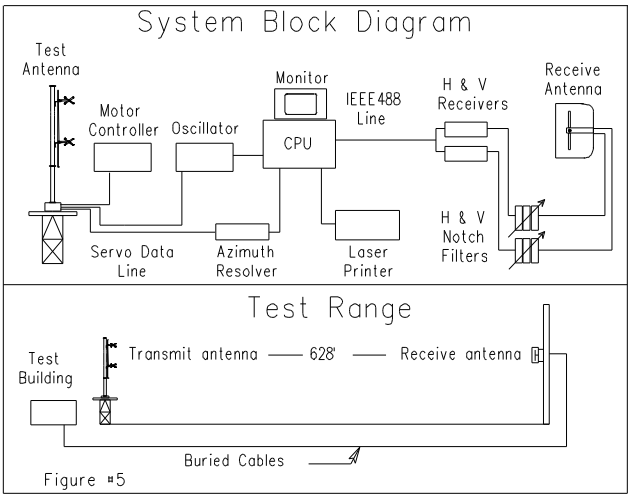

Figure #5

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

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(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 4 half-wavelength spaced bays using one driven circular polarized radiating element per bay, one horizontal parasitic element per bay and two vertical parasitic elements interleaved between alternate bay pairs. 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 existing MP-4C-DA-HW array is to be mounted on the 18" o.d. pole at a bearing of North 220 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 20 kilowatts (13.01 dBk).

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The power at North 40 degrees East does not exceed 3.5 kilowatts (5.441 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 33 feet 9 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.

ERI® Horizontal Plane Relative Field Pattern

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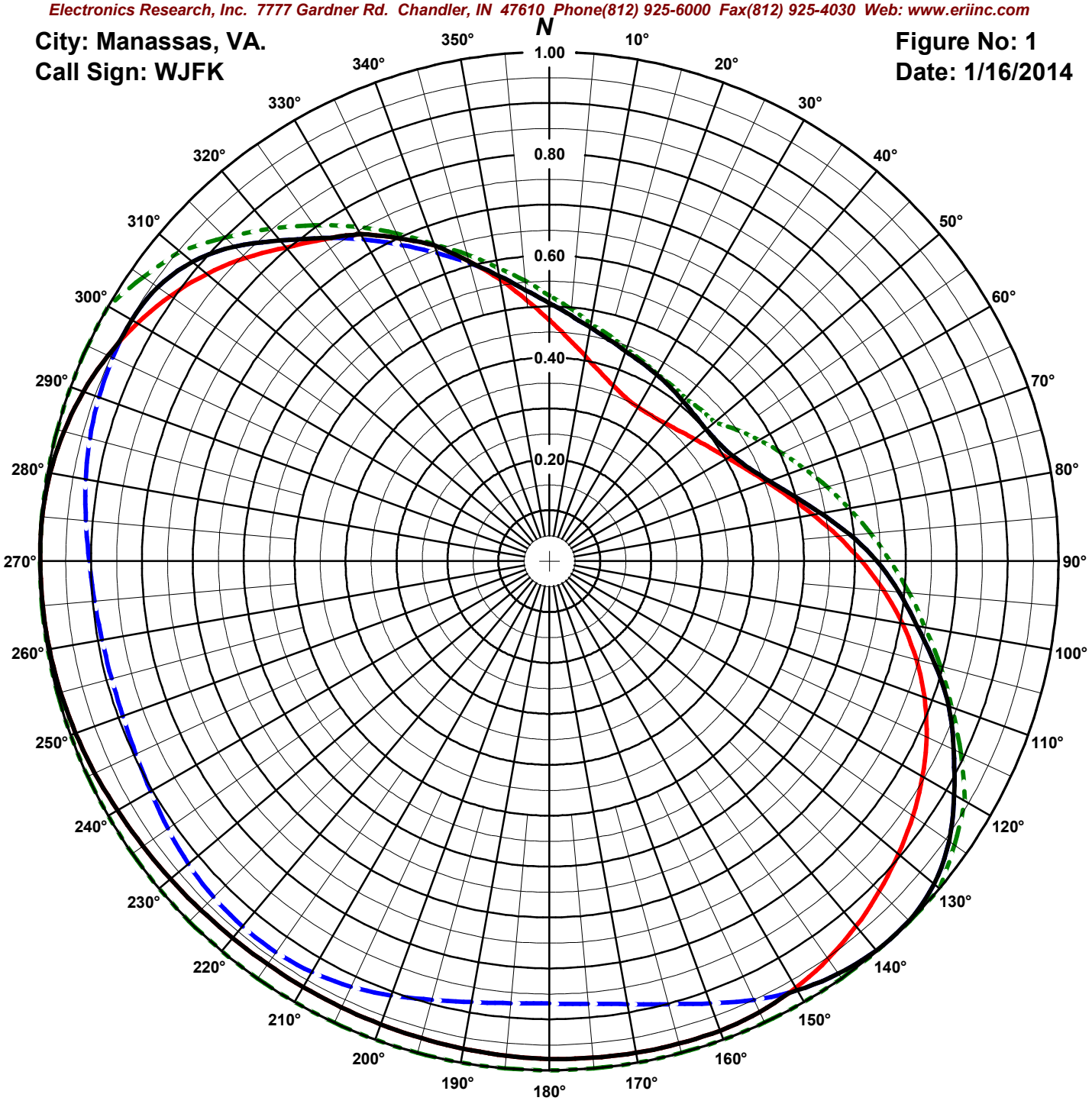
City: Manassas, VA.
Call Sign: WJFK

Figure No: 1
Date: 1/16/2014



Antenna Orientation: 220° True

Frequency: 106.7 MHz
Antenna Type: MP-4C-DA-HW

Antenna Mounting: Standard
Tower Type: 18" Pole

HORIZONTAL	VERTICAL	COMPOSITE	FCC ENVELOPE
RMS: .806	RMS: .79	RMS: .823	RMS: .844
Maximum: 1 @ 273°	Maximum: 1 @ 137°	Maximum: 1 @ 137°	Maximum: 1 @ 130°
Minimum: .348 @ 32°	Minimum: .402 @ 50°	Minimum: .402 @ 50°	Minimum: .417 @ 40°

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 BPH-20121106AAQ.

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: 1/16/2014**
Station: WJFK **Antenna: MP-4C-DA-HW**
Location: Manassas, VA. **Antenna Orientation: 220° True**
Frequency: 106.7 MHz **Number of Bays: 4**

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.506	5.128	7.100	Vertical	180°	0.978	19.111	12.813	Horizontal
5°	0.485	4.696	6.717	Vertical	185°	0.975	19.021	12.792	Horizontal
10°	0.466	4.339	6.374	Vertical	190°	0.972	18.913	12.768	Horizontal
15°	0.451	4.062	6.087	Vertical	195°	0.970	18.819	12.746	Horizontal
20°	0.438	3.837	5.840	Vertical	200°	0.968	18.747	12.729	Horizontal
25°	0.430	3.698	5.680	Vertical	205°	0.967	18.696	12.717	Horizontal
30°	0.423	3.575	5.532	Vertical	210°	0.966	18.666	12.711	Horizontal
35°	0.416	3.458	5.388	Vertical	215°	0.966	18.659	12.709	Horizontal
40°	0.409	3.351	5.251	Vertical	220°	0.967	18.688	12.716	Horizontal
45°	0.404	3.270	5.145	Vertical	225°	0.968	18.755	12.731	Horizontal
50°	0.402	3.239	5.104	Vertical	230°	0.971	18.858	12.755	Horizontal
55°	0.405	3.285	5.165	Vertical	235°	0.975	18.998	12.787	Horizontal
60°	0.415	3.441	5.367	Vertical	240°	0.979	19.176	12.828	Horizontal
65°	0.433	3.745	5.734	Vertical	245°	0.985	19.389	12.875	Horizontal
70°	0.460	4.229	6.262	Vertical	250°	0.990	19.583	12.919	Horizontal
75°	0.496	4.925	6.924	Vertical	255°	0.994	19.741	12.954	Horizontal
80°	0.541	5.859	7.678	Vertical	260°	0.997	19.862	12.980	Horizontal
85°	0.593	7.025	8.467	Vertical	265°	0.999	19.945	12.998	Horizontal
90°	0.643	8.279	9.180	Vertical	270°	1.000	19.991	13.008	Horizontal
95°	0.689	9.488	9.772	Vertical	275°	0.999	19.979	13.006	Horizontal
100°	0.733	10.758	10.317	Vertical	280°	0.995	19.805	12.968	Horizontal
105°	0.784	12.296	10.898	Vertical	285°	0.986	19.460	12.891	Horizontal
110°	0.834	13.923	11.437	Vertical	290°	0.973	18.947	12.775	Horizontal
115°	0.876	15.356	11.863	Vertical	295°	0.956	18.274	12.618	Horizontal
120°	0.918	16.852	12.267	Vertical	300°	0.947	17.926	12.535	Vertical
125°	0.958	18.358	12.638	Vertical	305°	0.938	17.605	12.456	Vertical
130°	0.986	19.452	12.890	Vertical	310°	0.914	16.719	12.232	Vertical
135°	0.999	19.957	13.001	Vertical	315°	0.874	15.265	11.837	Vertical
140°	0.998	19.937	12.997	Vertical	320°	0.822	13.519	11.309	Vertical
145°	0.989	19.577	12.917	Vertical	325°	0.774	11.993	10.789	Vertical
150°	0.973	18.949	12.776	Vertical	330°	0.742	11.003	10.415	Horizontal
155°	0.977	19.093	12.809	Horizontal	335°	0.700	9.793	9.909	Horizontal
160°	0.981	19.252	12.845	Horizontal	340°	0.660	8.716	9.403	Horizontal
165°	0.981	19.253	12.845	Horizontal	345°	0.610	7.430	8.710	Horizontal
170°	0.980	19.227	12.839	Horizontal	350°	0.569	6.470	8.109	Vertical
175°	0.979	19.179	12.828	Horizontal	355°	0.534	5.701	7.560	Vertical

Horizontal Polarization:
Maximum: 1.948 (2.896 dB)
Horizontal Plane: 1.948 (2.896 dB)
Maximum ERP: 20.000 kW

Vertical Polarization:
Maximum: 1.948 (2.896 dB)
Horizontal Plane: 1.948 (2.896 dB)
Maximum ERP: 20.000 kW

Total Input Power: 10.266 kW
Reference: WJFK2M.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: 1/16/2014**
Station: WJFK **Antenna: MP-4C-DA-HW**
Location: Manassas, VA. **Antenna Orientation: 220° True**
Frequency: 106.7 MHz **Number of Bays: 4**

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.474	4.487	6.520	0.506	5.128	7.100	180°	0.978	19.111	12.813	0.869	15.105	11.791
5°	0.438	3.838	5.841	0.485	4.696	6.717	185°	0.975	19.021	12.792	0.872	15.192	11.816
10°	0.408	3.335	5.231	0.466	4.339	6.374	190°	0.972	18.913	12.768	0.879	15.465	11.894
15°	0.385	2.958	4.711	0.451	4.062	6.087	195°	0.970	18.819	12.746	0.892	15.916	12.018
20°	0.367	2.691	4.299	0.438	3.837	5.840	200°	0.968	18.747	12.729	0.908	16.490	12.172
25°	0.355	2.519	4.013	0.430	3.698	5.680	205°	0.967	18.696	12.717	0.922	17.006	12.306
30°	0.349	2.436	3.866	0.423	3.575	5.532	210°	0.966	18.666	12.711	0.932	17.368	12.397
35°	0.349	2.435	3.864	0.416	3.458	5.388	215°	0.966	18.659	12.709	0.937	17.549	12.443
40°	0.353	2.498	3.975	0.409	3.351	5.251	220°	0.967	18.688	12.716	0.937	17.549	12.443
45°	0.362	2.616	4.176	0.404	3.270	5.145	225°	0.968	18.755	12.731	0.933	17.400	12.405
50°	0.373	2.780	4.441	0.402	3.239	5.104	230°	0.971	18.858	12.755	0.925	17.121	12.335
55°	0.387	2.996	4.765	0.405	3.285	5.165	235°	0.975	18.998	12.787	0.915	16.732	12.236
60°	0.405	3.277	5.155	0.415	3.441	5.367	240°	0.979	19.176	12.828	0.904	16.343	12.133
65°	0.427	3.645	5.617	0.433	3.745	5.734	245°	0.985	19.389	12.875	0.896	16.052	12.055
70°	0.454	4.128	6.157	0.460	4.229	6.262	250°	0.990	19.583	12.919	0.891	15.882	12.009
75°	0.487	4.750	6.767	0.496	4.925	6.924	255°	0.994	19.741	12.954	0.890	15.837	11.997
80°	0.526	5.527	7.425	0.541	5.859	7.678	260°	0.997	19.862	12.980	0.892	15.904	12.015
85°	0.568	6.456	8.100	0.593	7.025	8.467	265°	0.999	19.945	12.998	0.896	16.069	12.060
90°	0.613	7.514	8.759	0.643	8.279	9.180	270°	1.000	19.991	13.008	0.904	16.328	12.129
95°	0.659	8.677	9.383	0.689	9.488	9.772	275°	0.999	19.979	13.006	0.913	16.680	12.222
100°	0.704	9.905	9.958	0.733	10.758	10.317	280°	0.995	19.805	12.968	0.924	17.081	12.325
105°	0.746	11.132	10.466	0.784	12.296	10.898	285°	0.986	19.460	12.891	0.934	17.436	12.415
110°	0.784	12.297	10.898	0.834	13.923	11.437	290°	0.973	18.947	12.775	0.941	17.705	12.481
115°	0.817	13.362	11.259	0.876	15.356	11.863	295°	0.956	18.274	12.618	0.945	17.879	12.523
120°	0.846	14.322	11.560	0.918	16.852	12.267	300°	0.934	17.450	12.418	0.947	17.926	12.535
125°	0.872	15.191	11.816	0.958	18.358	12.638	305°	0.908	16.486	12.171	0.938	17.605	12.456
130°	0.895	16.008	12.043	0.986	19.452	12.890	310°	0.877	15.396	11.874	0.914	16.719	12.232
135°	0.917	16.800	12.253	0.999	19.957	13.001	315°	0.843	14.196	11.522	0.874	15.265	11.837
140°	0.937	17.543	12.441	0.998	19.937	12.997	320°	0.803	12.905	11.107	0.822	13.519	11.309
145°	0.954	18.199	12.601	0.989	19.577	12.917	325°	0.772	11.916	10.761	0.774	11.993	10.789
150°	0.968	18.733	12.726	0.973	18.949	12.776	330°	0.742	11.003	10.415	0.730	10.644	10.271
155°	0.977	19.093	12.809	0.951	18.077	12.571	335°	0.700	9.793	9.909	0.685	9.387	9.725
160°	0.981	19.252	12.845	0.924	17.086	12.326	340°	0.660	8.716	9.403	0.643	8.277	9.179
165°	0.981	19.253	12.845	0.901	16.232	12.104	345°	0.610	7.430	8.710	0.606	7.335	8.654
170°	0.980	19.227	12.839	0.884	15.615	11.935	350°	0.563	6.334	8.017	0.569	6.470	8.109
175°	0.979	19.179	12.828	0.873	15.240	11.830	355°	0.515	5.310	7.251	0.534	5.701	7.560

Horizontal Polarization:
Maximum: 1.948 (2.896 dB)
Horizontal Plane: 1.948 (2.896 dB)
Maximum ERP: 20.000 kW

Vertical Polarization:
Maximum: 1.948 (2.896 dB)
Horizontal Plane: 1.948 (2.896 dB)
Maximum ERP: 20.000 kW

Total Input Power: 10.266 kW
Reference: WJFK2M.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: WJFK
Location: Manassas, VA.
Frequency: 106.7 MHz
4 bay MP-4C-DA-HW antenna

Date: 1/16/2014
H/V Power Ratio: 1
.5 Wave-length Spacing
0° Beam Tilt
0% First Null Fill

Horizontal Polarization:
Maximum: 1.948 (2.896 dB)
Horizontal Plane: 1.948 (2.896 dB)
Maximum ERP: 20.000 kW

Vertical Polarization:
Maximum: 1.948 (2.896 dB)
Horizontal Plane: 1.948 (2.896 dB)
Maximum ERP: 20.000 kW

Directional Antenna System
for
WJFK, Manassas, Virginia

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	MP-4C-DA-HW
Frequency:	106.7 MHz
Number of Bays:	Four

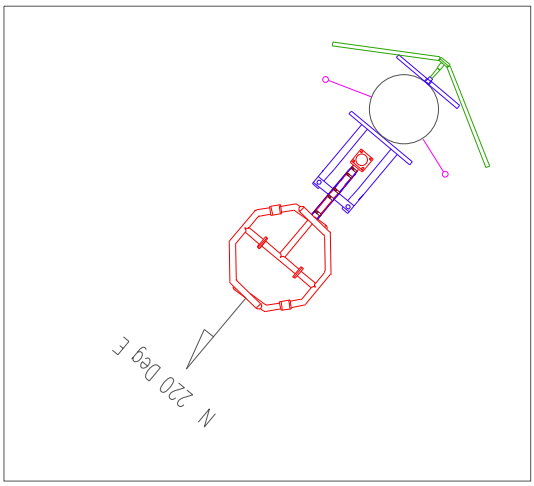
MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	17 ft 3 in
Aperture length required:	33 ft 9 in [1]
Orientation:	220° true

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

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	20.000 kW (13.01 dBk)
Horizontal maximum power gain:	1.948 (2.896 dB))
Maximum vertical ERP:	20.000 kW (13.01 dBk)
Vertical maximum power gain:	1.948 (2.896 dB)
Total input power:	10.266 kW (10.114 dBk)



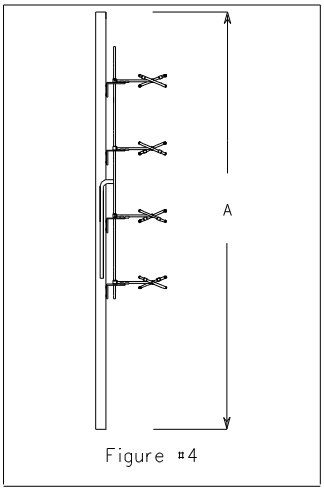


Figure #4