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 WRTR, Brookwood, Alabama

May 12, 2015

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 WRTR.

The antenna is the ERI model MP-6E-DA-HW configuration. The circular polarized system consists of 6 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 mounted on the North 105 degrees East tower leg with bracketry to provide an antenna orientation of North 72 degrees East. The antenna was tested on a 24" face tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 105.9 megahertz, which is the center of the FM broadcast channel assigned to WRTR.

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
WRTR, Brookwood, Alabama

(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 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.

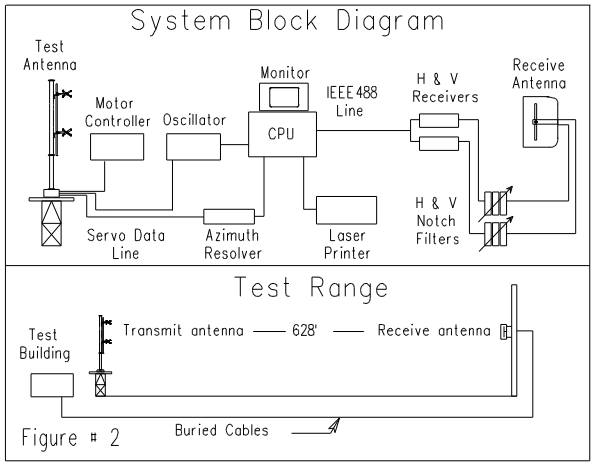

Figure # 2

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 105.9 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. 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 6 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 the antenna is manufactured. Proper maintenance of the elements should be all that is required to maintain the pattern in adjustment.

The MP-6E-DA-HW array is to be mounted on the North 105 degrees East tower leg of the 24" face tower at a bearing of North 72 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 25 kilowatts (13.979 dBk).

Directional Antenna System
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(Continued)

The power at North 270-280 degrees East does not exceed 4.4 kilowatts (6.435 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 39 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.

ERI® Horizontal Plane Relative Field Pattern

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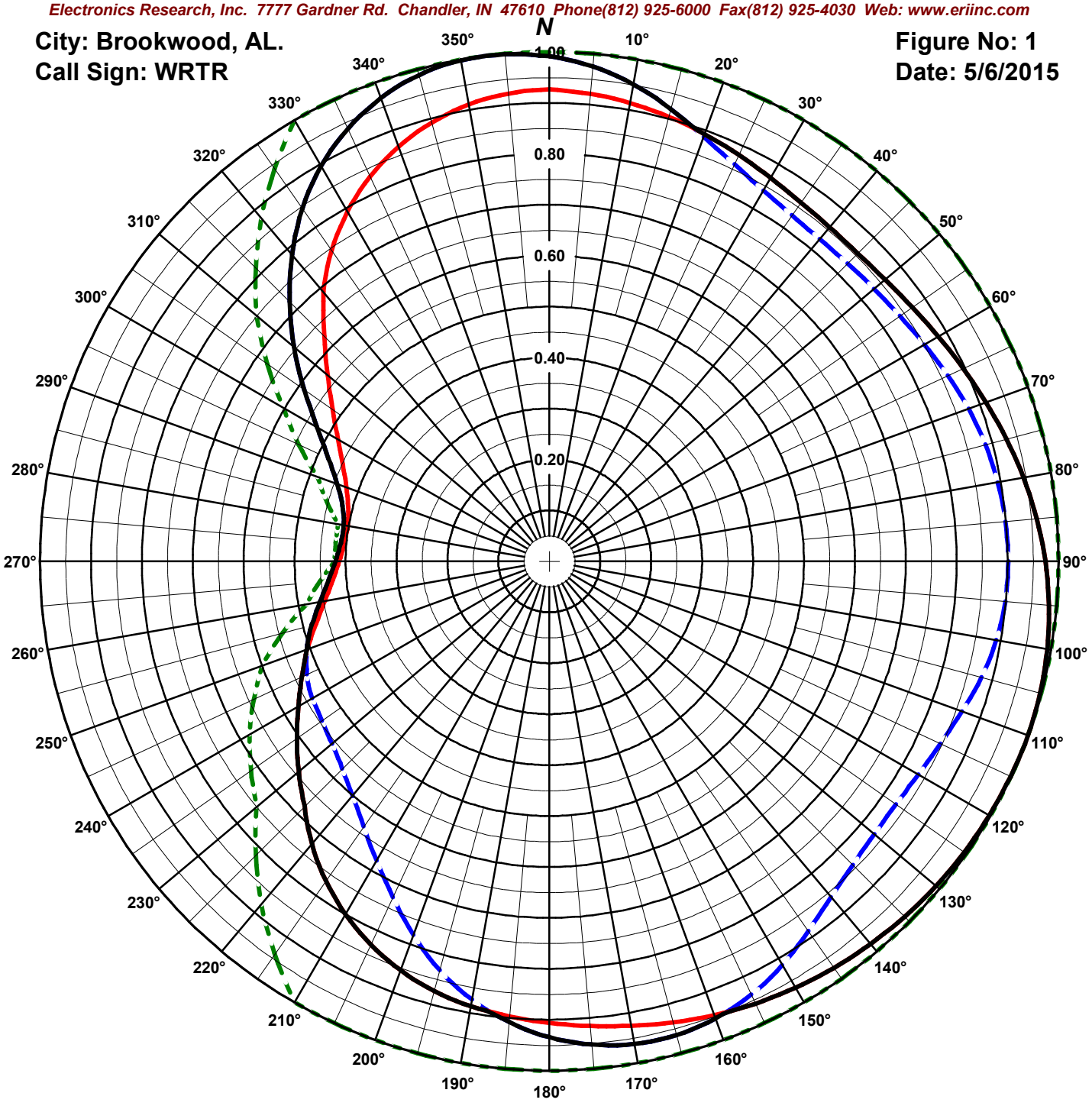
City: Brookwood, AL.
Call Sign: WRTR

Figure No: 1
Date: 5/6/2015



Antenna Orientation: 72° True

Frequency: 105.9 MHz
Antenna Type: MP-6E-DA-HW

Antenna Mounting: Standard
Tower Type: 24" Tower

HORIZONTAL	VERTICAL	COMPOSITE	FCC ENVELOPE
RMS: .82	RMS: .798	RMS: .84	RMS: .908
Maximum: 1 @ 110°	Maximum: 1 @ 353°	Maximum: 1 @ 110°	Maximum: 1 @ 0°
Minimum: .402 @ 279°	Minimum: .409 @ 278°	Minimum: .409 @ 278°	Minimum: .421 @ 270°

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-20150402AGL.

ERI® Horizontal Plane Relative Field Pattern

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Figure# 1 **Date: 5/6/2015**
Station: WRTR **Antenna: MP-6E-DA-HW**
Location: Brookwood, AL. **Antenna Orientation: 72° True**
Frequency: 105.9 MHz **Number of Bays: 6**

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.991	24.569	13.904	Vertical	180°	0.934	21.819	13.388	Vertical
5°	0.975	23.775	13.761	Vertical	185°	0.908	20.614	13.142	Vertical
10°	0.951	22.615	13.544	Vertical	190°	0.887	19.678	12.940	Horizontal
15°	0.920	21.142	13.251	Vertical	195°	0.873	19.071	12.804	Horizontal
20°	0.892	19.913	12.991	Horizontal	200°	0.854	18.246	12.612	Horizontal
25°	0.880	19.376	12.873	Horizontal	205°	0.830	17.219	12.360	Horizontal
30°	0.869	18.889	12.762	Horizontal	210°	0.800	16.009	12.044	Horizontal
35°	0.861	18.527	12.678	Horizontal	215°	0.765	14.639	11.655	Horizontal
40°	0.856	18.323	12.630	Horizontal	220°	0.725	13.137	11.185	Horizontal
45°	0.856	18.307	12.626	Horizontal	225°	0.679	11.536	10.621	Horizontal
50°	0.860	18.509	12.674	Horizontal	230°	0.642	10.311	10.133	Horizontal
55°	0.870	18.916	12.768	Horizontal	235°	0.605	9.149	9.614	Horizontal
60°	0.882	19.462	12.892	Horizontal	240°	0.569	8.094	9.081	Horizontal
65°	0.897	20.101	13.032	Horizontal	245°	0.536	7.180	8.561	Horizontal
70°	0.912	20.815	13.184	Horizontal	250°	0.507	6.420	8.075	Horizontal
75°	0.929	21.578	13.340	Horizontal	255°	0.483	5.825	7.653	Vertical
80°	0.945	22.346	13.492	Horizontal	260°	0.457	5.218	7.175	Vertical
85°	0.961	23.079	13.632	Horizontal	265°	0.435	4.738	6.756	Vertical
90°	0.974	23.723	13.752	Horizontal	270°	0.420	4.410	6.445	Vertical
95°	0.985	24.244	13.846	Horizontal	275°	0.411	4.224	6.257	Vertical
100°	0.993	24.641	13.917	Horizontal	280°	0.410	4.203	6.236	Vertical
105°	0.998	24.903	13.962	Horizontal	285°	0.420	4.416	6.451	Vertical
110°	1.000	25.000	13.979	Horizontal	290°	0.443	4.907	6.908	Vertical
115°	0.999	24.969	13.974	Horizontal	295°	0.478	5.722	7.575	Vertical
120°	0.998	24.888	13.960	Horizontal	300°	0.526	6.927	8.405	Vertical
125°	0.995	24.756	13.937	Horizontal	305°	0.587	8.611	9.350	Vertical
130°	0.991	24.574	13.905	Horizontal	310°	0.654	10.700	10.294	Vertical
135°	0.987	24.343	13.864	Horizontal	315°	0.721	12.990	11.136	Vertical
140°	0.981	24.063	13.813	Horizontal	320°	0.786	15.425	11.882	Vertical
145°	0.974	23.734	13.754	Horizontal	325°	0.845	17.857	12.518	Vertical
150°	0.967	23.359	13.685	Horizontal	330°	0.896	20.063	13.024	Vertical
155°	0.958	22.938	13.606	Horizontal	335°	0.936	21.919	13.408	Vertical
160°	0.955	22.798	13.579	Vertical	340°	0.967	23.401	13.692	Vertical
165°	0.963	23.180	13.651	Vertical	345°	0.989	24.430	13.879	Vertical
170°	0.962	23.132	13.642	Vertical	350°	0.999	24.933	13.968	Vertical
175°	0.952	22.667	13.554	Vertical	355°	0.999	24.957	13.972	Vertical

Horizontal Polarization:
Maximum: 2.774 (4.431 dB)
Horizontal Plane: 2.774 (4.431 dB)
Maximum ERP: 25.000 kW

Vertical Polarization:
Maximum: 2.774 (4.431 dB)
Horizontal Plane: 2.774 (4.431 dB)
Maximum ERP: 25.000 kW

Total Input Power: 9.011 kW
Reference: WRTR1M.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: 5/6/2015**
Station: WRTR **Antenna: MP-6E-DA-HW**
Location: Brookwood, AL. **Antenna Orientation: 72° True**
Frequency: 105.9 MHz **Number of Bays: 6**

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.926	21.451	13.314	0.991	24.569	13.904	180°	0.906	20.528	13.123	0.934	21.819	13.388
5°	0.921	21.221	13.268	0.975	23.775	13.761	185°	0.897	20.098	13.032	0.908	20.614	13.142
10°	0.914	20.878	13.197	0.951	22.615	13.544	190°	0.887	19.678	12.940	0.874	19.084	12.807
15°	0.904	20.429	13.102	0.920	21.142	13.251	195°	0.873	19.071	12.804	0.831	17.270	12.373
20°	0.892	19.913	12.991	0.887	19.665	12.937	200°	0.854	18.246	12.612	0.780	15.227	11.826
25°	0.880	19.376	12.873	0.860	18.489	12.669	205°	0.830	17.219	12.360	0.727	13.219	11.212
30°	0.869	18.889	12.762	0.841	17.672	12.473	210°	0.800	16.009	12.044	0.678	11.502	10.608
35°	0.861	18.527	12.678	0.830	17.203	12.356	215°	0.765	14.639	11.655	0.635	10.089	10.039
40°	0.856	18.323	12.630	0.826	17.057	12.319	220°	0.725	13.137	11.185	0.601	9.022	9.553
45°	0.856	18.307	12.626	0.828	17.125	12.336	225°	0.679	11.536	10.621	0.575	8.267	9.174
50°	0.860	18.509	12.674	0.833	17.327	12.387	230°	0.642	10.311	10.133	0.557	7.750	8.893
55°	0.870	18.916	12.768	0.840	17.649	12.467	235°	0.605	9.149	9.614	0.545	7.438	8.714
60°	0.882	19.462	12.892	0.851	18.090	12.574	240°	0.569	8.094	9.081	0.537	7.212	8.581
65°	0.897	20.101	13.032	0.863	18.637	12.704	245°	0.536	7.180	8.561	0.525	6.895	8.385
70°	0.912	20.815	13.184	0.876	19.184	12.829	250°	0.507	6.420	8.075	0.506	6.413	8.070
75°	0.929	21.578	13.340	0.886	19.641	12.932	255°	0.474	5.621	7.498	0.483	5.825	7.653
80°	0.945	22.346	13.492	0.894	19.983	13.007	260°	0.448	5.009	6.998	0.457	5.218	7.175
85°	0.961	23.079	13.632	0.899	20.205	13.055	265°	0.427	4.561	6.590	0.435	4.738	6.756
90°	0.974	23.723	13.752	0.901	20.294	13.074	270°	0.413	4.257	6.291	0.420	4.410	6.445
95°	0.985	24.244	13.846	0.899	20.191	13.052	275°	0.404	4.084	6.111	0.411	4.224	6.257
100°	0.993	24.641	13.917	0.891	19.859	12.980	280°	0.402	4.042	6.066	0.410	4.203	6.236
105°	0.998	24.903	13.962	0.879	19.298	12.855	285°	0.409	4.178	6.210	0.420	4.416	6.451
110°	1.000	25.000	13.979	0.862	18.578	12.690	290°	0.424	4.492	6.525	0.443	4.907	6.908
115°	0.999	24.969	13.974	0.847	17.934	12.537	295°	0.447	5.003	6.992	0.478	5.722	7.575
120°	0.998	24.888	13.960	0.836	17.492	12.428	300°	0.479	5.741	7.590	0.526	6.927	8.405
125°	0.995	24.756	13.937	0.831	17.277	12.375	305°	0.519	6.745	8.290	0.587	8.611	9.350
130°	0.991	24.574	13.905	0.833	17.350	12.393	310°	0.568	8.066	9.067	0.654	10.700	10.294
135°	0.987	24.343	13.864	0.843	17.757	12.494	315°	0.625	9.766	9.897	0.721	12.990	11.136
140°	0.981	24.063	13.813	0.861	18.516	12.676	320°	0.690	11.916	10.761	0.786	15.425	11.882
145°	0.974	23.734	13.754	0.886	19.639	12.931	325°	0.745	13.877	11.423	0.845	17.857	12.518
150°	0.967	23.359	13.685	0.915	20.930	13.208	330°	0.793	15.702	11.960	0.896	20.063	13.024
155°	0.958	22.938	13.606	0.939	22.033	13.431	335°	0.833	17.339	12.390	0.936	21.919	13.408
160°	0.948	22.473	13.517	0.955	22.798	13.579	340°	0.866	18.744	12.729	0.967	23.401	13.692
165°	0.937	21.964	13.417	0.963	23.180	13.651	345°	0.892	19.881	12.984	0.989	24.430	13.879
170°	0.926	21.415	13.307	0.962	23.132	13.642	350°	0.910	20.724	13.165	0.999	24.933	13.968
175°	0.916	20.967	13.215	0.952	22.667	13.554	355°	0.922	21.251	13.274	0.999	24.957	13.972

Horizontal Polarization:
Maximum: 2.774 (4.431 dB)
Horizontal Plane: 2.774 (4.431 dB)
Maximum ERP: 25.000 kW

Vertical Polarization:
Maximum: 2.774 (4.431 dB)
Horizontal Plane: 2.774 (4.431 dB)
Maximum ERP: 25.000 kW

Total Input Power: 9.011 kW
Reference: WRTR1M.FIG

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

Vertical Plane Relative Field Pattern

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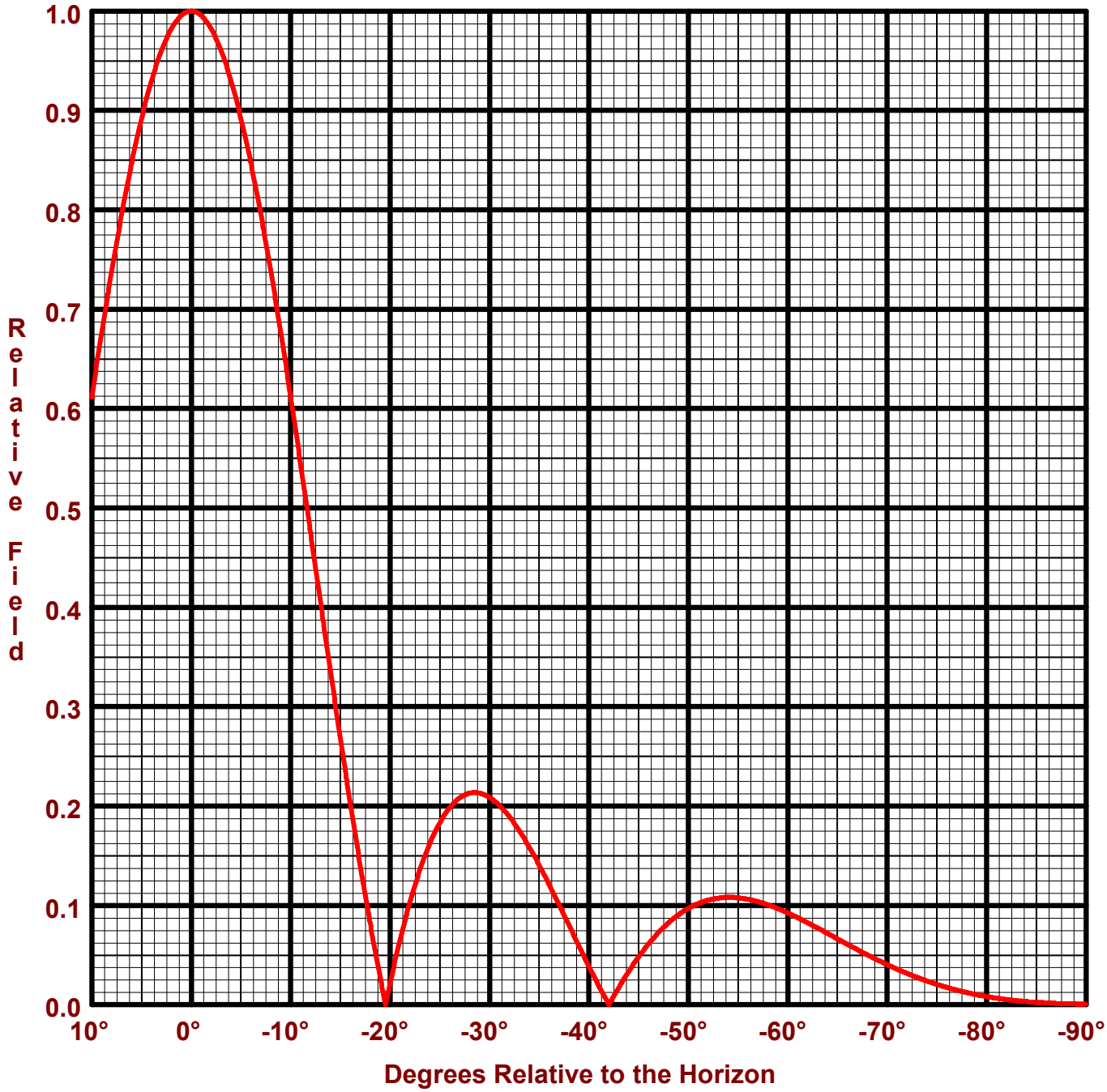
Figure No: 3
Call Sign: WRTR
Location: Brookwood, AL.
Frequency: 105.9 MHz
6 bay MP-6E-DA-HW antenna

Date: 5/6/2015
H/V Power Ratio: 1
.5 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 2.774 (4.431 dB)
Horizontal Plane: 2.774 (4.431 dB)
Maximum ERP: 25.000 kW

Vertical Polarization:
Maximum: 2.774 (4.431 dB)
Horizontal Plane: 2.774 (4.431 dB)
Maximum ERP: 25.000 kW

Directional Antenna System
for
WRTR, Brookwood, Alabama

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	MP-6E-DA-HW
Frequency:	105.9 MHz
Number of Bays:	Six

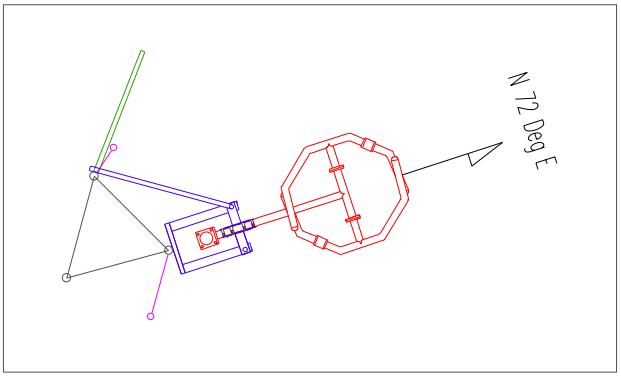
MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	31 ft 7 in
Aperture length required:	43 ft 1 in
Orientation:	72° true

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

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	25.000 kW (13.979 dBk)
Horizontal maximum power gain:	2.774 (4.431 dB)
Maximum vertical ERP:	25.000 kW (13.979 dBk)
Vertical maximum power gain:	2.774 (4.431 dB)
Total input power:	9.011 kW (9.548 dBk)



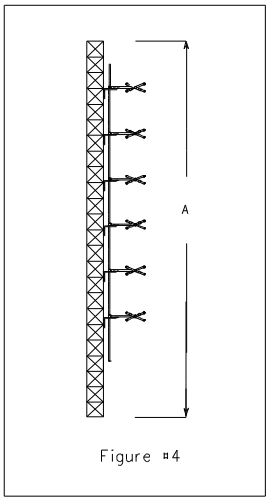


Figure #4