ELECTRONICS RESEARCH, INC.

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 WCCP, Clemson, South Carolina

March 18, 2014

Appendix B:
Directional Antenna Proof
WCCP-FM License Application
May 2014

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 WCCP.

The antenna is the ERI model MP-3E-DA configuration. The circular polarized system consists of 3 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 three vertical parasitic elements per bay. The antenna was mounted on the North 345 degrees East tower face with bracketry to provide an antenna orientation of North 345 degrees East. The antenna was tested on a 18" face tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 105.5 megahertz, which is the center of the FM broadcast channel assigned to WCCP.

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
WCCP, Clemson, South Carolina

(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 18" 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.

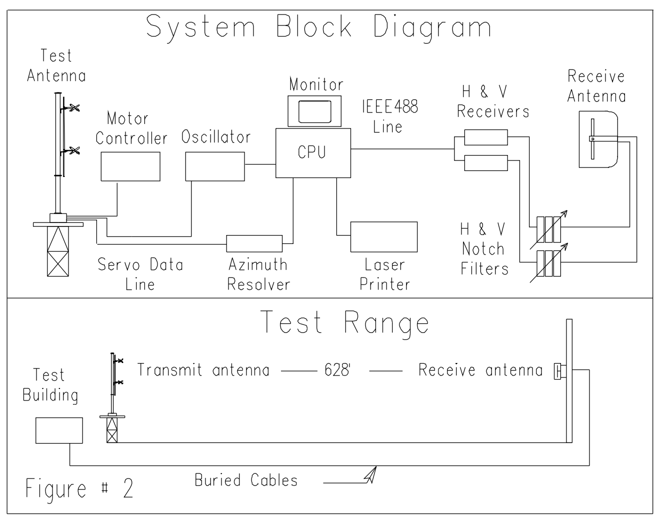


Figure # 2

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

Directional Antenna System
For
WCCP, Clemson, South Carolina

(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 3 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 three vertical parasitic elements per bay. 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 MP-3E-DA array is to be mounted on the North 345 degrees East tower face of the 18" face tower at a bearing of North 345 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.

Directional Antenna System
For
WCCP, Clemson, South Carolina

(Continued)

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).

The power at North 170-190 degrees East does not exceed 4.6 kilowatts (6.628 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 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.

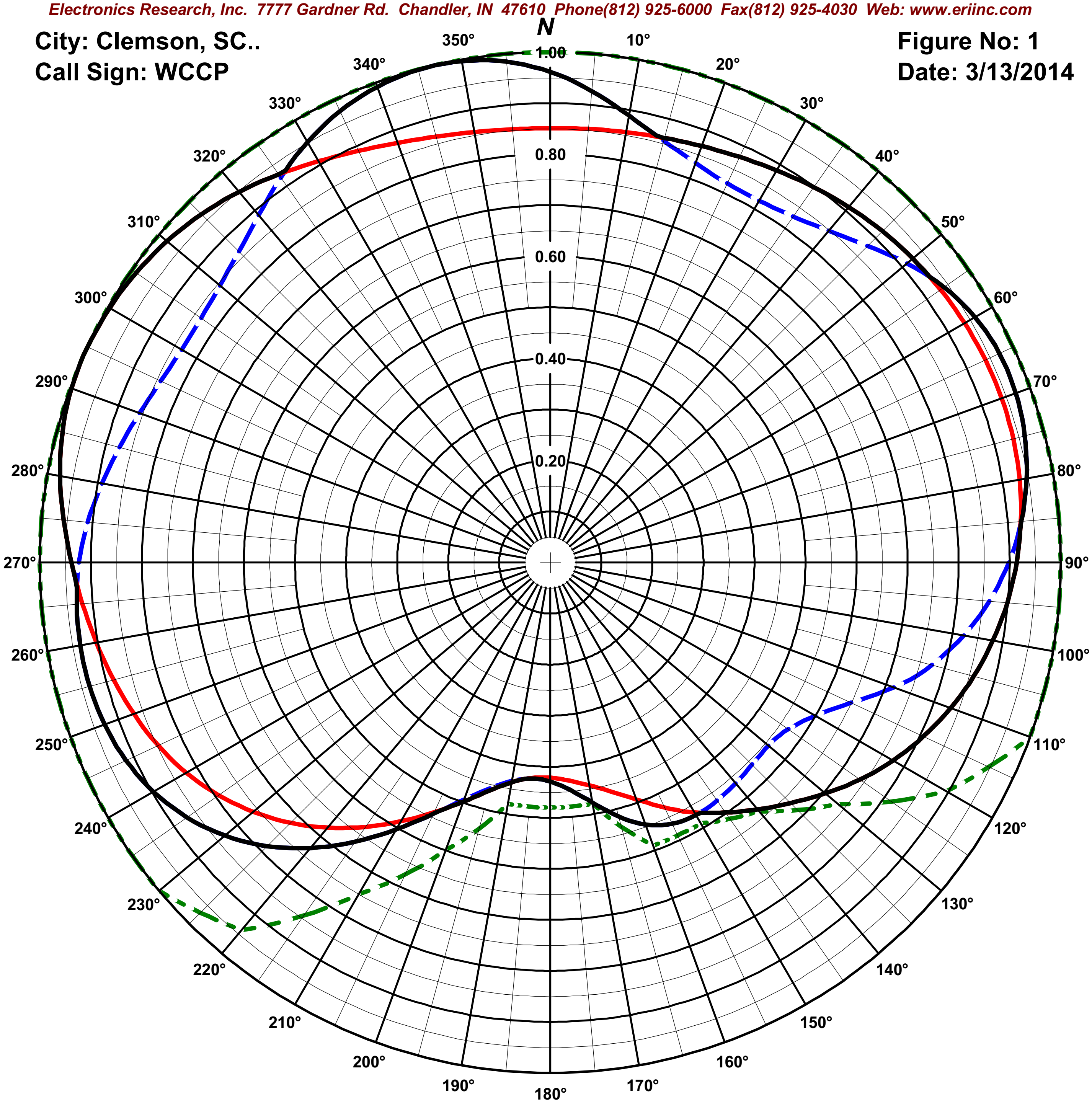
The Microsoft Word document on file electronically at Electronic Research, Inc. governs the specifications, scope, and configuration of the product described. All other representations whether verbal, printed, or electronic are subordinate to the master copy of this document on file at ERI.

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: Clemson, SC..
Call Sign: WCCP

Figure No: 1
Date: 3/13/2014



Antenna Orientation: 345° True

Frequency: 105.5 MHz
Antenna Type: MP-3E-DA

Antenna Mounting: Standard
Tower Type: 18" Dielectric Tower

HORIZONTAL	VERTICAL	COMPOSITE	FCC ENVELOPE
RMS: .819	RMS: .807	RMS: .844	RMS: .912
Maximum: 1 @ 294°	Maximum: 1 @ 347°	Maximum: 1 @ 294°	Maximum: 1 @ 0°
Minimum: .421 @ 182°	Minimum: .424 @ 184°	Minimum: .424 @ 184°	Minimum: .48 @ 170°

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-20130514AAZ.

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
Station: WCCP
Location: Clemson, SC..
Frequency: 105.5 MHz

Date: 3/13/2014
Antenna: MP-3E-DA
Antenna Orientation: 345° True
Number of Bays: 3

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.962	18.490	12.669	Vertical	180°	0.429	3.679	5.657	Vertical
5°	0.927	17.205	12.357	Vertical	185°	0.425	3.605	5.570	Vertical
10°	0.889	15.805	11.988	Vertical	190°	0.437	3.825	5.827	Horizontal
15°	0.861	14.838	11.714	Horizontal	195°	0.463	4.288	6.323	Horizontal
20°	0.868	15.075	11.782	Horizontal	200°	0.498	4.970	6.963	Horizontal
25°	0.877	15.373	11.868	Horizontal	205°	0.543	5.906	7.713	Vertical
30°	0.887	15.735	11.969	Horizontal	210°	0.604	7.292	8.629	Vertical
35°	0.898	16.144	12.080	Horizontal	215°	0.668	8.932	9.509	Vertical
40°	0.909	16.541	12.186	Horizontal	220°	0.730	10.658	10.277	Vertical
45°	0.919	16.890	12.276	Horizontal	225°	0.785	12.339	10.913	Vertical
50°	0.927	17.181	12.350	Horizontal	230°	0.832	13.857	11.417	Vertical
55°	0.941	17.707	12.481	Vertical	235°	0.870	15.121	11.796	Vertical
60°	0.961	18.463	12.663	Vertical	240°	0.897	16.108	12.070	Vertical
65°	0.971	18.845	12.752	Vertical	245°	0.917	16.816	12.257	Vertical
70°	0.970	18.826	12.747	Vertical	250°	0.929	17.254	12.369	Vertical
75°	0.962	18.517	12.676	Vertical	255°	0.934	17.460	12.420	Vertical
80°	0.948	17.957	12.542	Vertical	260°	0.935	17.473	12.424	Vertical
85°	0.926	17.158	12.345	Vertical	265°	0.931	17.343	12.391	Vertical
90°	0.914	16.693	12.225	Horizontal	270°	0.938	17.588	12.452	Horizontal
95°	0.899	16.152	12.082	Horizontal	275°	0.957	18.308	12.626	Horizontal
100°	0.881	15.506	11.905	Horizontal	280°	0.975	19.012	12.790	Horizontal
105°	0.859	14.761	11.691	Horizontal	285°	0.989	19.574	12.917	Horizontal
110°	0.834	13.926	11.438	Horizontal	290°	0.998	19.917	12.992	Horizontal
115°	0.807	13.010	11.143	Horizontal	295°	1.000	19.997	13.010	Horizontal
120°	0.775	12.025	10.801	Horizontal	300°	0.997	19.874	12.983	Horizontal
125°	0.741	10.982	10.407	Horizontal	305°	0.990	19.600	12.923	Horizontal
130°	0.703	9.894	9.954	Horizontal	310°	0.980	19.190	12.831	Horizontal
135°	0.666	8.879	9.484	Horizontal	315°	0.966	18.650	12.707	Horizontal
140°	0.631	7.968	9.014	Horizontal	320°	0.948	17.986	12.549	Horizontal
145°	0.598	7.151	8.544	Horizontal	325°	0.928	17.222	12.361	Horizontal
150°	0.571	6.524	8.145	Vertical	330°	0.951	18.098	12.576	Vertical
155°	0.565	6.375	8.045	Vertical	335°	0.975	19.029	12.794	Vertical
160°	0.546	5.961	7.753	Vertical	340°	0.992	19.667	12.937	Vertical
165°	0.515	5.297	7.240	Vertical	345°	1.000	19.981	13.006	Vertical
170°	0.478	4.561	6.591	Vertical	350°	0.998	19.901	12.989	Vertical
175°	0.447	3.999	6.020	Vertical	355°	0.985	19.395	12.877	Vertical

Horizontal Polarization:
Maximum: 2.241 (3.505 dB)
Horizontal Plane: 2.241 (3.505 dB)
Maximum ERP: 20.000 kW

Vertical Polarization:
Maximum: 2.241 (3.505 dB)
Horizontal Plane: 2.241 (3.505 dB)
Maximum ERP: 20.000 kW

Total Input Power: 8.923 kW
Reference: WCCP1M.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: 3/13/2014**
Station: WCCP | **Antenna: MP-3E-DA**
Location: Clemson, SC.. | **Antenna Orientation: 345° True**
Frequency: 105.5 MHz | **Number of Bays: 3**

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.851	14.490	11.611	0.962	18.490	12.669	180°	0.422	3.556	5.509	0.429	3.679	5.657
5°	0.853	14.545	11.627	0.927	17.205	12.357	185°	0.424	3.589	5.550	0.425	3.605	5.570
10°	0.856	14.662	11.662	0.889	15.805	11.988	190°	0.437	3.825	5.827	0.435	3.776	5.770
15°	0.861	14.838	11.714	0.856	14.650	11.658	195°	0.463	4.288	6.323	0.458	4.192	6.224
20°	0.868	15.075	11.782	0.833	13.861	11.418	200°	0.498	4.970	6.963	0.494	4.883	6.887
25°	0.877	15.373	11.868	0.820	13.441	11.284	205°	0.540	5.836	7.661	0.543	5.906	7.713
30°	0.887	15.735	11.969	0.819	13.399	11.271	210°	0.585	6.855	8.360	0.604	7.292	8.629
35°	0.898	16.144	12.080	0.828	13.719	11.373	215°	0.632	7.989	9.025	0.668	8.932	9.509
40°	0.909	16.541	12.186	0.848	14.388	11.580	220°	0.678	9.189	9.632	0.730	10.658	10.277
45°	0.919	16.890	12.276	0.878	15.413	11.879	225°	0.721	10.391	10.167	0.785	12.339	10.913
50°	0.927	17.181	12.350	0.912	16.633	12.210	230°	0.760	11.539	10.622	0.832	13.857	11.417
55°	0.933	17.410	12.408	0.941	17.707	12.481	235°	0.794	12.605	11.005	0.870	15.121	11.796
60°	0.937	17.576	12.449	0.961	18.463	12.663	240°	0.823	13.559	11.322	0.897	16.108	12.070
65°	0.940	17.679	12.475	0.971	18.845	12.752	245°	0.848	14.367	11.574	0.917	16.816	12.257
70°	0.941	17.707	12.482	0.970	18.826	12.747	250°	0.868	15.057	11.777	0.929	17.254	12.369
75°	0.939	17.631	12.463	0.962	18.517	12.676	255°	0.886	15.686	11.955	0.934	17.460	12.420
80°	0.934	17.436	12.415	0.948	17.957	12.542	260°	0.903	16.298	12.121	0.935	17.473	12.424
85°	0.925	17.123	12.336	0.926	17.158	12.345	265°	0.920	16.924	12.285	0.931	17.343	12.391
90°	0.914	16.693	12.225	0.898	16.138	12.078	270°	0.938	17.588	12.452	0.923	17.048	12.317
95°	0.899	16.152	12.082	0.864	14.917	11.737	275°	0.957	18.308	12.626	0.909	16.544	12.186
100°	0.881	15.506	11.905	0.822	13.525	11.311	280°	0.975	19.012	12.790	0.892	15.900	12.014
105°	0.859	14.761	11.691	0.774	11.994	10.789	285°	0.989	19.574	12.917	0.873	15.245	11.831
110°	0.834	13.926	11.438	0.716	10.246	10.105	290°	0.998	19.917	12.992	0.856	14.650	11.658
115°	0.807	13.010	11.143	0.650	8.459	9.273	295°	1.000	19.997	13.010	0.842	14.170	11.514
120°	0.775	12.025	10.801	0.600	7.205	8.576	300°	0.997	19.874	12.983	0.834	13.908	11.433
125°	0.741	10.982	10.407	0.569	6.483	8.118	305°	0.990	19.600	12.923	0.835	13.940	11.443
130°	0.703	9.894	9.954	0.558	6.222	7.940	310°	0.980	19.190	12.831	0.844	14.263	11.542
135°	0.666	8.879	9.484	0.559	6.260	7.965	315°	0.966	18.650	12.707	0.862	14.873	11.724
140°	0.631	7.968	9.014	0.565	6.379	8.048	320°	0.948	17.986	12.549	0.888	15.783	11.982
145°	0.598	7.151	8.544	0.570	6.487	8.120	325°	0.928	17.222	12.361	0.920	16.946	12.291
150°	0.565	6.390	8.055	0.571	6.524	8.145	330°	0.907	16.471	12.167	0.951	18.098	12.576
155°	0.529	5.602	7.484	0.565	6.375	8.045	335°	0.890	15.827	11.994	0.975	19.029	12.794
160°	0.494	4.881	6.885	0.546	5.961	7.753	340°	0.875	15.313	11.851	0.992	19.667	12.937
165°	0.465	4.326	6.361	0.515	5.297	7.240	345°	0.864	14.927	11.740	1.000	19.981	13.006
170°	0.443	3.930	5.944	0.478	4.561	6.591	350°	0.856	14.664	11.663	0.998	19.901	12.989
175°	0.429	3.677	5.655	0.447	3.999	6.020	355°	0.852	14.522	11.620	0.985	19.395	12.877

Horizontal Polarization:
Maximum: 2.241 (3.505 dB)
Horizontal Plane: 2.241 (3.505 dB)
Maximum ERP: 20.000 kW

Vertical Polarization:
Maximum: 2.241 (3.505 dB)
Horizontal Plane: 2.241 (3.505 dB)
Maximum ERP: 20.000 kW

Total Input Power: 8.923 kW
Reference: WCCP1M.FIG

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

Vertical Plane Relative Field Pattern

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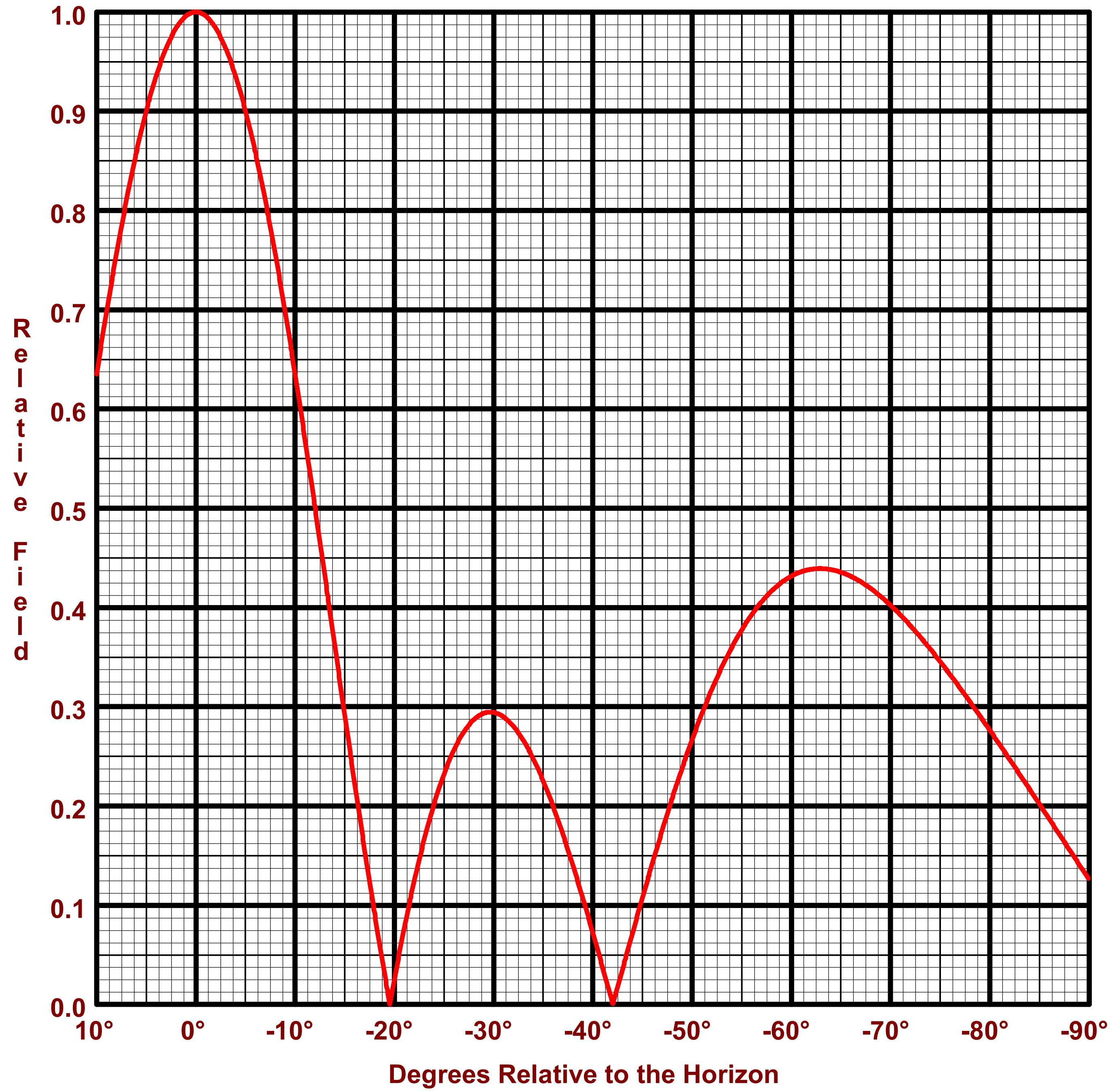
Figure No: 3
Call Sign: WCCP
Location: Clemson, SC..
Frequency: 105.5 MHz
3 bay MP-3E-DA antenna

Date: 3/13/2014
H/V Power Ratio: 1
1 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 2.241 (3.505 dB)
Horizontal Plane: 2.241 (3.505 dB)
Maximum ERP: 20.000 kW

Vertical Polarization:
Maximum: 2.241 (3.505 dB)
Horizontal Plane: 2.241 (3.505 dB)
Maximum ERP: 20.000 kW

Directional Antenna System
for
WCCP, Clemson, South Carolina

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	MP-3E-DA
Frequency:	105.5 MHz
Number of Bays:	Three

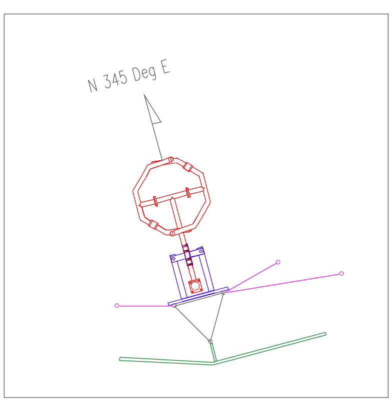
MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	26 ft 11 in
Aperture length required:	33 ft 6 in
Orientation:	345° 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:	2.241 (3.505 dB)
Maximum vertical ERP:	20.000 kW (13.01 dBk)
Vertical maximum power gain:	2.241 (3.505 dB)
Total input power:	8.923kW (9.505 dBk)



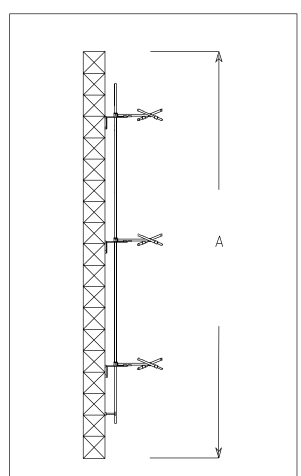


Figure #4