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 WOUF, Beulah, Michigan

May 5, 2009

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 WOUF.

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, two 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 250 degrees East tower leg with bracketry to provide an antenna orientation of North 255 degrees East. The antenna was tested on an 18" face tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 92.3 megahertz, which is the center of the FM broadcast channel assigned to WOUF.

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
Proposed For
WOUF, Beulah, Michigan

(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.

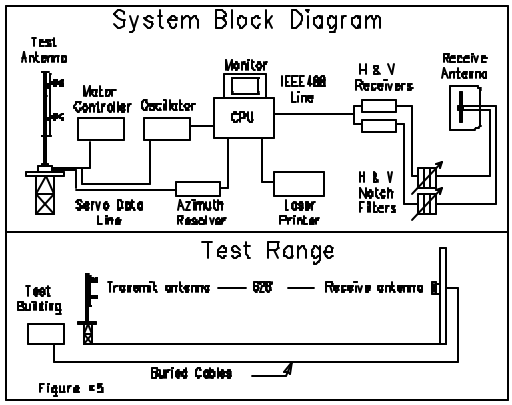

Figure #5

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

(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, two 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 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 250 degrees East tower leg of the 18" face tower at a bearing of North 255 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 maximum value of either the horizontal or vertical component at any azimuth. The measured horizontal plane relative field pattern, for both the horizontal and vertical polarization components, is shown on Figure #2 attached. 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 50 kilowatts (16.99 dBk).

The power at North 90 degrees East does not exceed 8.300 kilowatts (9.191 dBk).

(Continued)

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 36 feet 3 in.

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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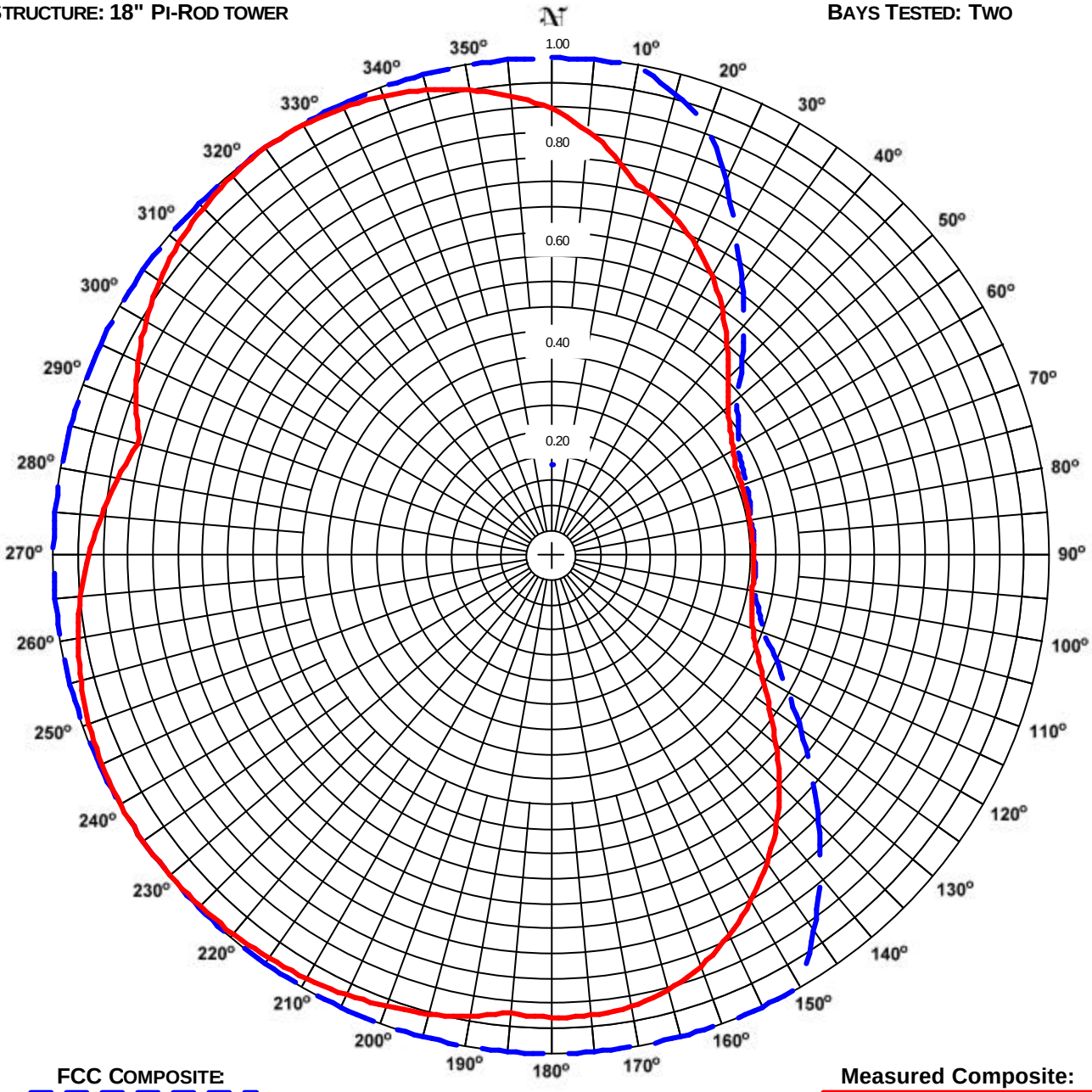
FIGURE NO: 1
STATION: WOUF
LOCATION: BEULAH, MI
ANTENNA: MP-3E-DA
STRUCTURE: 18" PI-ROD TOWER

DATE: 5/4/2009
FREQUENCY: 92.3 MHZ
ORIENTATION: 255° TRUE
MOUNTING: CUSTOM
BAYS TESTED: TWO



FCC COMPOSITE:
RMS: 0.874
MAXIMUM: 1.000 @ 0° TRUE
MINIMUM: 0.408 @ 90° TRUE

Measured Composite:
RMS: 0.815
Maximum: 1.000 @ 235° True
Minimum: 0.405 @ 80° True

COMMENTS: COMPOSITE PATTERN: THIS PATTERN SHOWS THE MAXIMUM OF EITHER THE H OR V AZIMUTH VALUES. THIS PATTERN IS GREATER THAT 85% OF THE FCC FILED COMPOSITE PATTERN BPH-20051216ABL.

ERI® Horizontal Plane Relative Field List

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Station: WOUF
Location: Beulah, MI
Frequency: 92.3 MHz

Antenna: MP-3E-DA
Orientation: 255° True
Tower: 18" Pi Rod tower

Figure: 1
Date: 5/4/2009
Reference: wouf2m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0º	0.900	40.50	16.07	Vertical	180º	0.927	42.98	16.33	Vertical
5º	0.856	36.62	15.64	Vertical	185º	0.923	42.62	16.30	Vertical
10º	0.801	32.12	15.07	Vertical	190º	0.939	44.04	16.44	Horizontal
15º	0.755	28.48	14.55	Horizontal	195º	0.954	45.47	16.58	Horizontal
20º	0.724	26.19	14.18	Horizontal	200º	0.964	46.43	16.67	Horizontal
25º	0.688	23.65	13.74	Horizontal	205º	0.973	47.32	16.75	Horizontal
30º	0.647	20.91	13.20	Horizontal	210º	0.981	48.11	16.82	Horizontal
35º	0.600	17.99	12.55	Horizontal	215º	0.987	48.73	16.88	Horizontal
40º	0.550	15.12	11.79	Horizontal	220º	0.993	49.25	16.92	Horizontal
45º	0.502	12.61	11.01	Horizontal	225º	0.996	49.65	16.96	Horizontal
50º	0.464	10.75	10.31	Horizontal	230º	0.999	49.91	16.98	Horizontal
55º	0.439	9.65	9.84	Horizontal	235º	1.000	50.00	16.99	Horizontal
60º	0.423	8.93	9.51	Horizontal	240º	0.999	49.88	16.98	Horizontal
65º	0.411	8.47	9.28	Vertical	245º	0.995	49.45	16.94	Horizontal
70º	0.408	8.32	9.20	Vertical	250º	0.988	48.83	16.89	Horizontal
75º	0.406	8.23	9.16	Vertical	255º	0.978	47.80	16.79	Horizontal
80º	0.405	8.20	9.14	Vertical	260º	0.965	46.54	16.68	Horizontal
85º	0.406	8.23	9.15	Vertical	265º	0.950	45.08	16.54	Horizontal
90º	0.407	8.30	9.19	Vertical	270º	0.929	43.18	16.35	Horizontal
95º	0.409	8.37	9.23	Vertical	275º	0.907	41.17	16.15	Horizontal
100º	0.410	8.39	9.24	Vertical	280º	0.885	39.12	15.92	Horizontal
105º	0.416	8.66	9.38	Vertical	285º	0.861	37.07	15.69	Horizontal
110º	0.432	9.32	9.69	Vertical	290º	0.887	39.36	15.95	Vertical
115º	0.457	10.43	10.18	Vertical	295º	0.916	41.95	16.23	Vertical
120º	0.491	12.06	10.82	Vertical	300º	0.941	44.23	16.46	Vertical
125º	0.535	14.33	11.56	Vertical	305º	0.961	46.16	16.64	Vertical
130º	0.589	17.35	12.39	Vertical	310º	0.977	47.72	16.79	Vertical
135º	0.649	21.06	13.23	Vertical	315º	0.989	48.89	16.89	Vertical
140º	0.704	24.80	13.94	Vertical	320º	0.996	49.64	16.96	Vertical
145º	0.755	28.49	14.55	Vertical	325º	1.000	49.98	16.99	Vertical
150º	0.802	32.15	15.07	Vertical	330º	0.998	49.83	16.98	Vertical
155º	0.842	35.48	15.50	Vertical	335º	0.992	49.25	16.92	Vertical
160º	0.878	38.52	15.86	Vertical	340º	0.982	48.25	16.84	Vertical
165º	0.905	40.91	16.12	Vertical	345º	0.968	46.86	16.71	Vertical
170º	0.920	42.28	16.26	Vertical	350º	0.950	45.09	16.54	Vertical
175º	0.927	42.95	16.33	Vertical	355º	0.927	42.96	16.33	Vertical

Polarization: **Envelope**
Maximum Field: **1.000 @ 235° True**
Minimum Field: **0.405 @ 80° True**
RMS: **0.815**
Maximum ERP: **50.000 kW**
Maximum Power Gain: **2.539 (4.047 dB)**

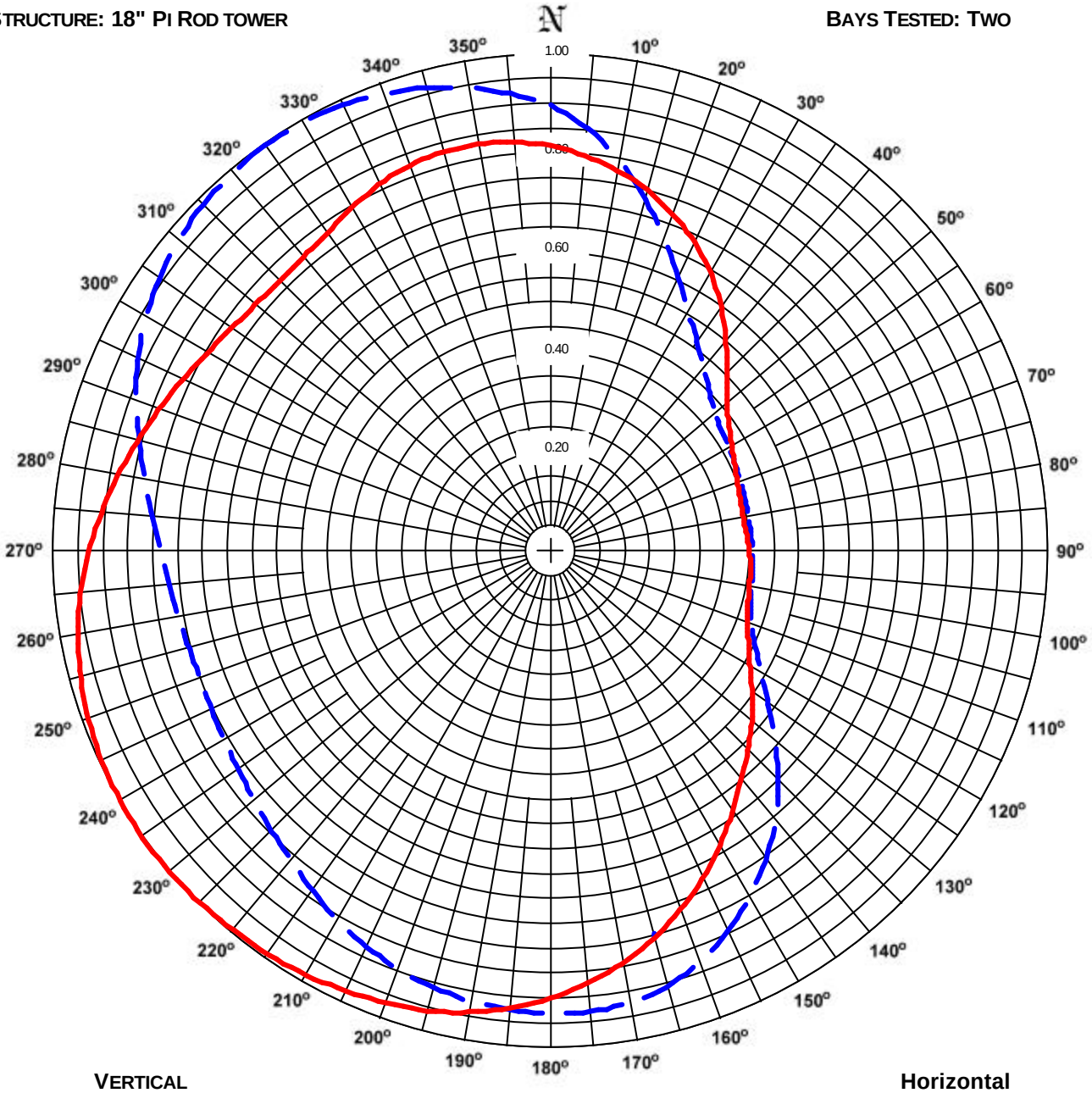
Total Input Power: 19.693 kW

ERI® Horizontal Plane Relative Field Pattern

Electronics Research, Inc. 7777 Gardner Rd. Chandler, In 47610 Phone (812) 925-6000 Fax (812) 925-4030 http://www.eriinc.com/

FIGURE NO: 2
STATION: WOUF
LOCATION: BEULAH, MI
ANTENNA: MP-3E-DA
STRUCTURE: 18" PI ROD TOWER

DATE: 5/4/2009
FREQUENCY: 92.3 MHZ
ORIENTATION: 255° TRUE
MOUNTING: CUSTOM
BAYS TESTED: TWO



VERTICAL

RMS: 0.763
MAXIMUM: 1.000 @ 326° TRUE
MINIMUM: 0.405 @ 80° TRUE

Horizontal

RMS: 0.764
Maximum: 1.000 @ 235° True
Minimum: 0.395 @ 80° True

COMMENTS: MEASURE PATTERNS OF THE HORIZONTAL AND VERTICAL COMPONENTS.

ERI® Horizontal Plane Relative Field List

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Station: WOUF
Location: Beulah, MI
Frequency: 92.3 MHz

Antenna: MP-3E-DA
Orientation: 255° True
Tower: 18" Pi-Rod tower

Figure: 2
Date: 5/4/2009
Reference: wouf2m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.819	33.53	15.25	0.900	40.50	16.07	180°	0.896	40.15	16.04	0.927	42.98	16.33
5°	0.802	32.15	15.07	0.856	36.62	15.64	185°	0.919	42.24	16.26	0.923	42.62	16.30
10°	0.781	30.48	14.84	0.801	32.12	15.07	190°	0.939	44.04	16.44	0.916	41.95	16.23
15°	0.755	28.48	14.55	0.736	27.08	14.33	195°	0.954	45.47	16.58	0.906	41.00	16.13
20°	0.724	26.19	14.18	0.671	22.53	13.53	200°	0.964	46.43	16.67	0.892	39.77	16.00
25°	0.688	23.65	13.74	0.610	18.61	12.70	205°	0.973	47.32	16.75	0.875	38.27	15.83
30°	0.647	20.91	13.20	0.557	15.51	11.91	210°	0.981	48.11	16.82	0.855	36.52	15.62
35°	0.600	17.99	12.55	0.516	13.32	11.24	215°	0.987	48.73	16.88	0.831	34.56	15.39
40°	0.550	15.12	11.79	0.482	11.60	10.65	220°	0.993	49.25	16.92	0.810	32.79	15.16
45°	0.502	12.61	11.01	0.454	10.29	10.12	225°	0.996	49.65	16.96	0.791	31.32	14.96
50°	0.464	10.75	10.31	0.433	9.39	9.73	230°	0.999	49.91	16.98	0.776	30.14	14.79
55°	0.439	9.65	9.84	0.422	8.91	9.50	235°	1.000	50.00	16.99	0.765	29.24	14.66
60°	0.423	8.93	9.51	0.416	8.67	9.38	240°	0.999	49.88	16.98	0.756	28.59	14.56
65°	0.410	8.41	9.25	0.411	8.47	9.28	245°	0.995	49.45	16.94	0.751	28.20	14.50
70°	0.401	8.06	9.06	0.408	8.32	9.20	250°	0.988	48.83	16.89	0.749	28.05	14.48
75°	0.396	7.85	8.95	0.406	8.23	9.16	255°	0.978	47.80	16.79	0.752	28.24	14.51
80°	0.395	7.80	8.92	0.405	8.20	9.14	260°	0.965	46.54	16.68	0.758	28.75	14.59
85°	0.397	7.87	8.96	0.406	8.23	9.15	265°	0.950	45.08	16.54	0.769	29.59	14.71
90°	0.401	8.02	9.04	0.407	8.30	9.19	270°	0.929	43.18	16.35	0.785	30.78	14.88
95°	0.404	8.16	9.12	0.409	8.37	9.23	275°	0.907	41.17	16.15	0.804	32.32	15.10
100°	0.406	8.26	9.17	0.410	8.39	9.24	280°	0.885	39.12	15.92	0.828	34.26	15.35
105°	0.412	8.47	9.28	0.416	8.66	9.38	285°	0.861	37.07	15.69	0.856	36.61	15.64
110°	0.423	8.93	9.51	0.432	9.32	9.69	290°	0.839	35.22	15.47	0.887	39.36	15.95
115°	0.440	9.69	9.86	0.457	10.43	10.18	295°	0.818	33.49	15.25	0.916	41.95	16.23
120°	0.465	10.79	10.33	0.491	12.06	10.82	300°	0.799	31.96	15.05	0.941	44.23	16.46
125°	0.496	12.28	10.89	0.535	14.33	11.56	305°	0.785	30.77	14.88	0.961	46.16	16.64
130°	0.529	13.99	11.46	0.589	17.35	12.39	310°	0.775	30.05	14.78	0.977	47.72	16.79
135°	0.562	15.80	11.99	0.649	21.06	13.23	315°	0.771	29.76	14.74	0.989	48.89	16.89
140°	0.598	17.89	12.52	0.704	24.80	13.94	320°	0.775	30.00	14.77	0.996	49.64	16.96
145°	0.638	20.35	13.09	0.755	28.49	14.55	325°	0.784	30.77	14.88	1.000	49.98	16.99
150°	0.681	23.18	13.65	0.802	32.15	15.07	330°	0.800	32.01	15.05	0.998	49.83	16.98
155°	0.724	26.21	14.19	0.842	35.48	15.50	335°	0.817	33.33	15.23	0.992	49.25	16.92
160°	0.765	29.26	14.66	0.878	38.52	15.86	340°	0.829	34.33	15.36	0.982	48.25	16.84
165°	0.804	32.29	15.09	0.905	40.91	16.12	345°	0.835	34.84	15.42	0.968	46.86	16.71
170°	0.838	35.14	15.46	0.920	42.28	16.26	350°	0.835	34.82	15.42	0.950	45.09	16.54
175°	0.869	37.78	15.77	0.927	42.95	16.33	355°	0.829	34.34	15.36	0.927	42.96	16.33

Polarization:	**Horizontal**	**Vertical**
Maximum Field:	**1.000 @ 235° True**	**1.000 @ 326° True**
Minimum Field:	**0.395 @ 80° True**	**0.405 @ 80° True**
RMS:	**0.764**	**0.763**
Maximum ERP:	**50.000 kW**	**50.000 kW**
Maximum Power Gain:	**2.539 (4.047 dB)**	**2.539 (4.047 dB)**

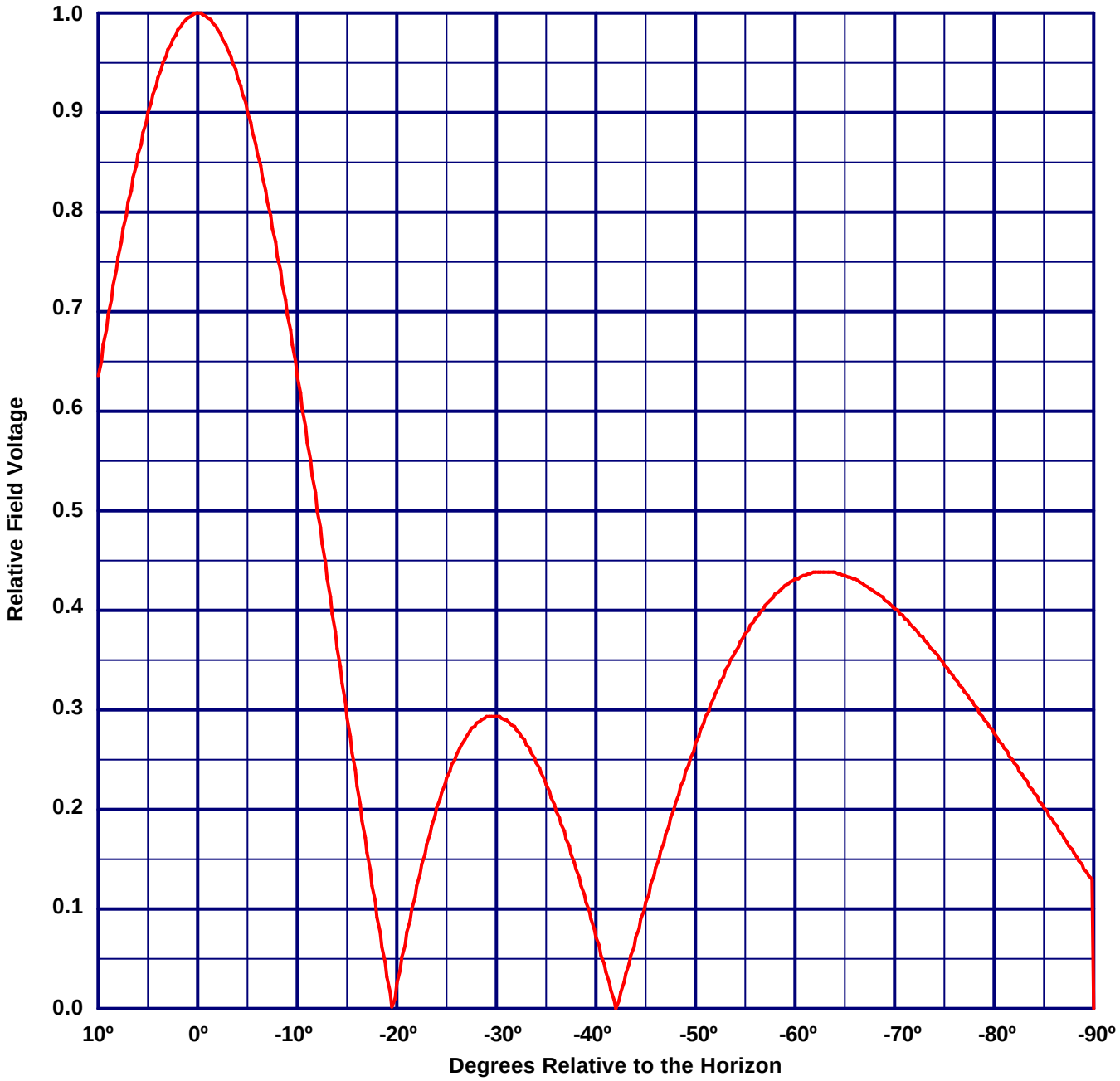
Total Input Power: 19.693 kW

Vertical Plane Relative Field Pattern

WOUF, Beulah, MI, 92.3 MHz

Figure#: 3 Date: 5/4/2009

A 3 level, 1 wave-length spaced MP-3E-DA directional antenna with 0° beam tilt, 0% null fill and a H/V maximum power ratio of 1.000



Vertical Polarization Gain:	Horizontal Polarization Gain:
Maximum: 2.539 (4.047 dB)	Maximum: 2.539 (4.047 dB)
Horizontal Plane: 2.539 (4.047 dB)	Horizontal Plane: 2.539 (4.047 dB)

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Directional Antenna System
for
WOUF, Beulah, Michigan

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	MP-3E-DA
Frequency:	92.3 MHz
Number of Bays:	Three

MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	30 ft
Aperture length required:	36 ft 3 in
The approximate weight:	356 lbs
The approximate windload:	20.628 ft^2 CaAa
Orientation:	255° true

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

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	50 kW (16.99 dBk)
Horizontal maximum power gain:	2.539 (4.047 dB)
Maximum vertical ERP:	50 kW (16.99 dBk)
Vertical maximum power gain:	2.539 (4.047 dB)
Total input power:	19.693 kW (12.943 dBk)