



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 KMLU, McKee, Kentucky

July 15, 2011

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 KMLU.

The antenna is the ERI model MP-4E-DA configuration. The circular polarized system consists of 4 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 271 degrees East tower face with bracketry to provide an antenna orientation of North 271 degrees East. The antenna was tested on a 24" **ERI[®] λ MOUNTING SYSTEM**, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 89.3 megahertz, which is the center of the FM broadcast channel assigned to KMLU.

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.

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Directional Antenna System For KMLU, McKee, Kentucky

(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.

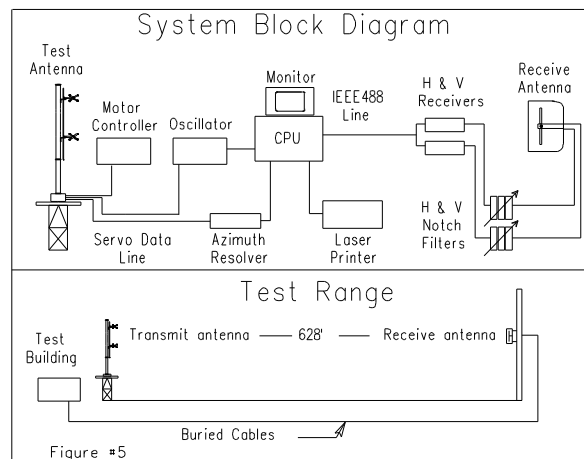
The power distribution and phase relationship to the antenna elements was adjusted in order to achieve the directional radiation patterns for both horizontal and vertical polarization components.

The proof-of-performance was accomplished using a 24" **ERI**® λ **MOUNTING SYSTEM**, 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.

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



Directional Antenna System For KMLU, McKee, Kentucky

(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 coordinated graph paper in a clockwise direction. Both horizontal and vertical components were recorded separately.

CONCLUSIONS

The circular polarized system consists of 4 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-4E-DA array is to be mounted on the North 271 degrees East tower face of the 24" **ERI[®] λ MOUNTING SYSTEM**, at a bearing of North 271 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 50.000 kilowatts (16.99 dBk).

Directional Antenna System
For
KMLU, McKee, Kentucky

(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 than 85% of the filed composite pattern.

The clear vertical length of the structure required to support the antenna is 47 feet 11 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.

A handwritten signature in black ink, appearing to read "Tom Scharf". The signature is fluid and cursive, with a large initial "T" and a stylized "S".

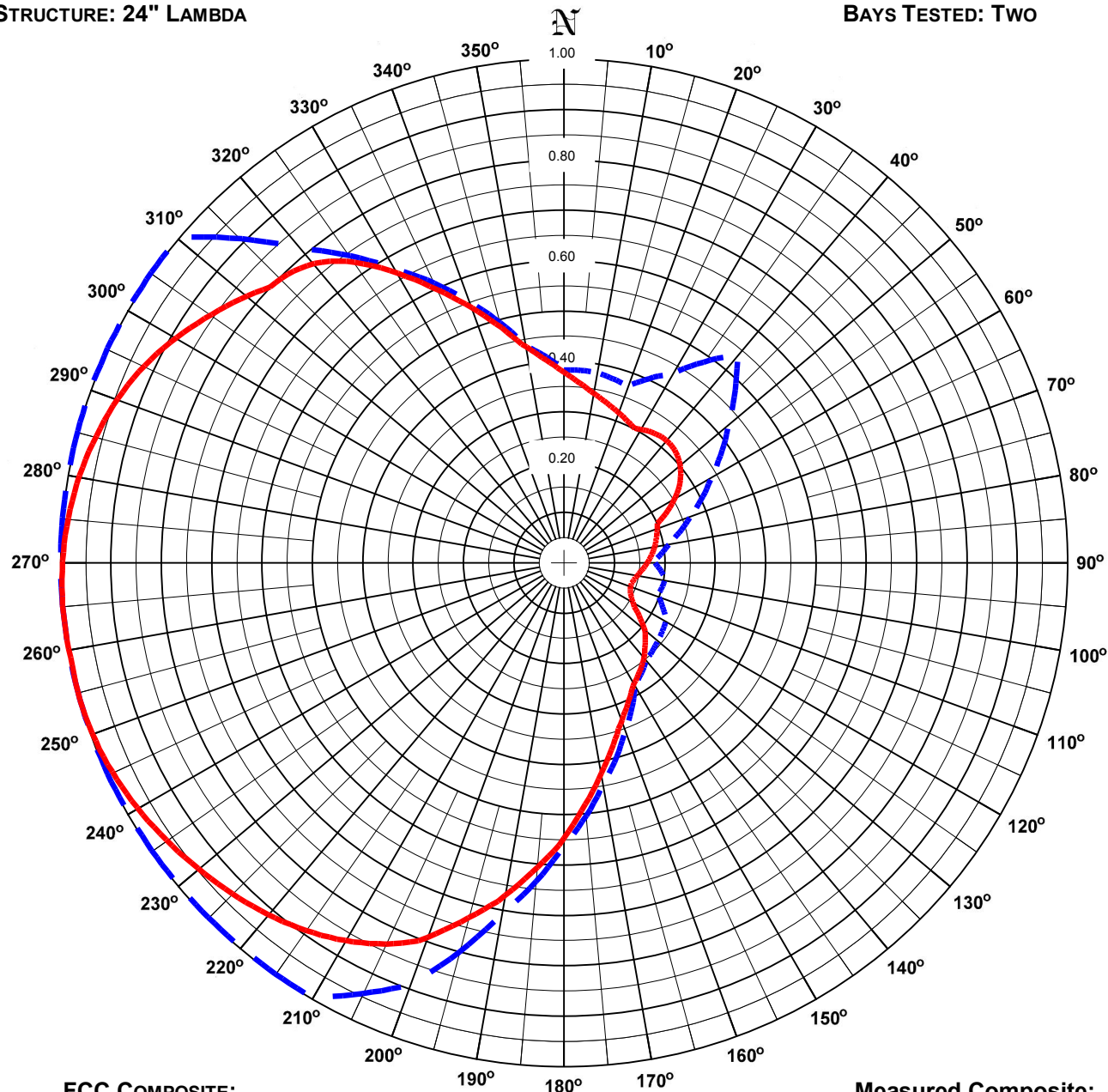
The Microsoft Word document on file electronically at Electronic Research, Inc. governs the specifications, scope, and configuration of the product described. All other representations whether verbal, printed, or electronic are subordinate to the master copy of this document on file at ERI.

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: 1
STATION: KMLU
LOCATION: MCKEE, KY.
ANTENNA: MP-4E-DA
STRUCTURE: 24" LAMBDA

DATE: 7/8/2011
FREQUENCY: 89.3 MHz
ORIENTATION: 271° TRUE
MOUNTING: STANDARD
BAYS TESTED: TWO



FCC COMPOSITE:

RMS: 0.671
MAXIMUM: 1.000 @ 210° TRUE
MINIMUM: 0.178 @ 90° TRUE

Measured Composite:

RMS: 0.623
Maximum: 1.000 @ 255° True
Minimum: 0.141 @ 110° True

COMMENTS: COMPOSITE PATTERN: THIS PATTERN SHOWS THE MAXIMUM OF EITHER THE H OR V AZIMUTH VALUES. THIS PATTERN IS GREATER THAN 85% OF THE FCC FILED COMPOSITE PATTERN.

ERI® *Horizontal Plane Relative Field List*

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

Station: KMLU
Location: McKee, KY.
Frequency: 89.3 MHz

Antenna: MP-4E-DA
Orientation: 271° True
Tower: 24" Lambda

Figure: 1
Date: 7/8/2011
Reference: kmlu1m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.375	7.04	8.47	Vertical	180°	0.550	15.11	11.79	Horizontal
5°	0.355	6.30	7.99	Vertical	185°	0.610	18.62	12.70	Horizontal
10°	0.338	5.73	7.58	Vertical	190°	0.674	22.72	13.56	Horizontal
15°	0.326	5.30	7.24	Vertical	195°	0.733	26.89	14.30	Horizontal
20°	0.314	4.94	6.94	Vertical	200°	0.795	31.60	15.00	Horizontal
25°	0.304	4.62	6.64	Vertical	205°	0.839	35.16	15.46	Horizontal
30°	0.302	4.57	6.60	Horizontal	210°	0.870	37.83	15.78	Horizontal
35°	0.311	4.83	6.84	Horizontal	215°	0.895	40.03	16.02	Horizontal
40°	0.314	4.93	6.93	Horizontal	220°	0.915	41.90	16.22	Horizontal
45°	0.311	4.83	6.84	Horizontal	225°	0.933	43.54	16.39	Horizontal
50°	0.300	4.50	6.54	Horizontal	230°	0.950	45.08	16.54	Horizontal
55°	0.282	3.97	5.99	Horizontal	235°	0.965	46.55	16.68	Horizontal
60°	0.256	3.27	5.14	Horizontal	240°	0.979	47.91	16.80	Horizontal
65°	0.222	2.47	3.93	Horizontal	245°	0.990	49.03	16.90	Horizontal
70°	0.197	1.94	2.87	Vertical	250°	0.998	49.76	16.97	Horizontal
75°	0.190	1.81	2.57	Vertical	255°	1.000	50.00	16.99	Horizontal
80°	0.183	1.68	2.25	Vertical	260°	0.999	49.94	16.98	Vertical
85°	0.176	1.54	1.89	Vertical	265°	1.000	49.96	16.99	Vertical
90°	0.167	1.40	1.46	Vertical	270°	0.996	49.59	16.95	Vertical
95°	0.158	1.25	0.97	Vertical	275°	0.988	48.84	16.89	Vertical
100°	0.150	1.12	0.50	Vertical	280°	0.977	47.73	16.79	Vertical
105°	0.143	1.03	0.12	Vertical	285°	0.962	46.26	16.65	Vertical
110°	0.141	0.99	-0.02	Vertical	290°	0.943	44.47	16.48	Vertical
115°	0.145	1.05	0.22	Vertical	295°	0.919	42.25	16.26	Vertical
120°	0.156	1.22	0.88	Vertical	300°	0.888	39.47	15.96	Vertical
125°	0.178	1.58	1.98	Horizontal	305°	0.855	36.51	15.62	Vertical
130°	0.208	2.16	3.34	Horizontal	310°	0.820	33.63	15.27	Vertical
135°	0.228	2.60	4.14	Horizontal	315°	0.794	31.54	14.99	Horizontal
140°	0.247	3.06	4.85	Horizontal	320°	0.771	29.75	14.73	Horizontal
145°	0.263	3.47	5.40	Horizontal	325°	0.724	26.23	14.19	Horizontal
150°	0.279	3.89	5.90	Horizontal	330°	0.660	21.76	13.38	Horizontal
155°	0.305	4.64	6.67	Horizontal	335°	0.595	17.68	12.47	Horizontal
160°	0.336	5.63	7.51	Vertical	340°	0.535	14.30	11.55	Horizontal
165°	0.377	7.12	8.52	Horizontal	345°	0.479	11.50	10.61	Horizontal
170°	0.427	9.13	9.60	Horizontal	350°	0.432	9.32	9.69	Vertical
175°	0.485	11.74	10.70	Horizontal	355°	0.400	8.01	9.03	Vertical

Polarization:
Maximum Field: 1.000 @ 255° True
Minimum Field: 0.141 @ 110° True
RMS: 0.623
Maximum ERP: 50.000 kW
Maximum Power Gain: 5.505 (7.408 dB)

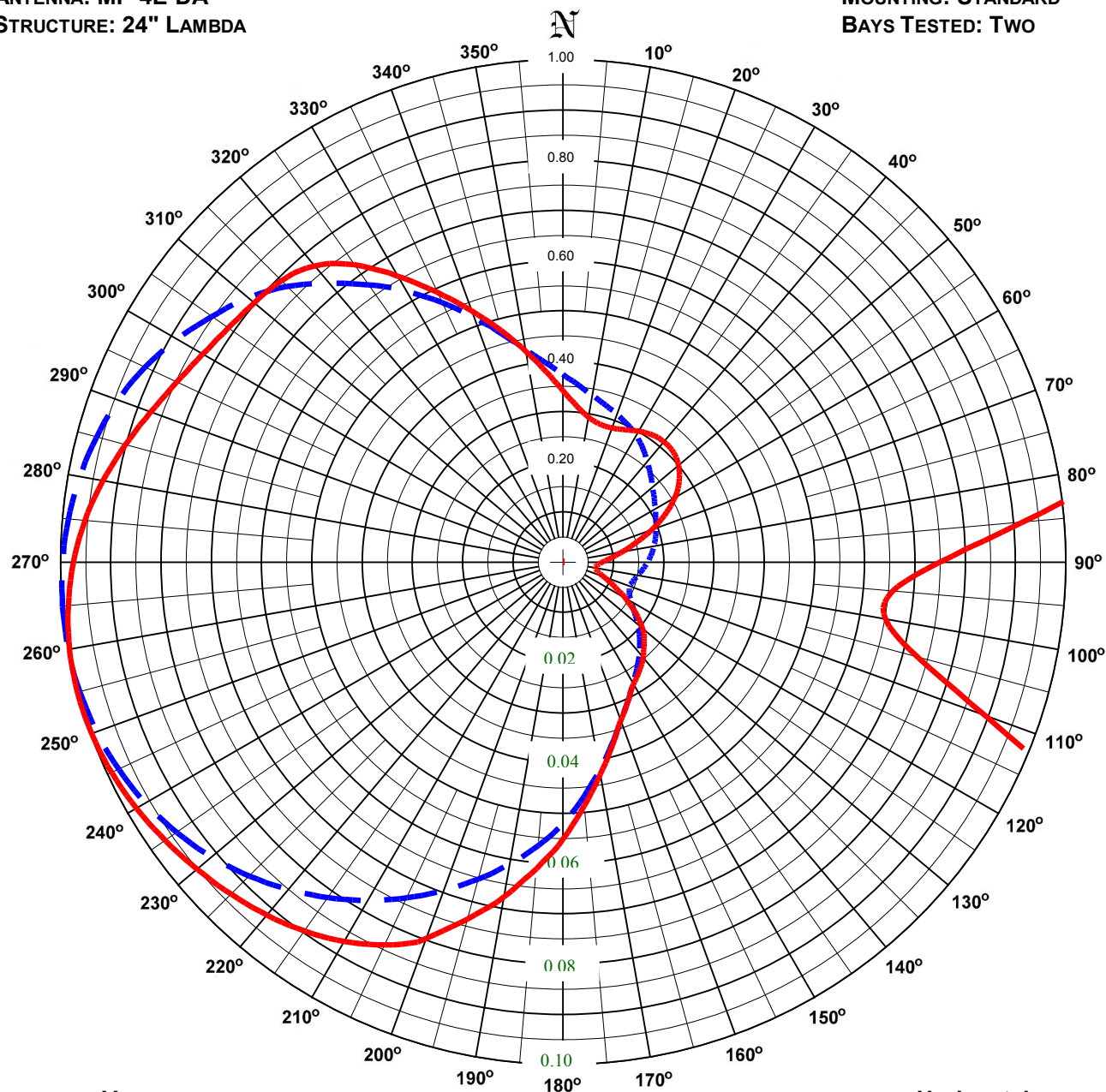
Total Input Power: 9.082 kW

ERI® *Horizontal Plane Relative Field Pattern*

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FIGURE NO: 2
STATION: KMLU
LOCATION: MCKEE, KY.
ANTENNA: MP-4E-DA
STRUCTURE: 24" LAMBDA

DATE: 7/8/2011
FREQUENCY: 89.3 MHz
ORIENTATION: 271° TRUE
MOUNTING: STANDARD
BAYS TESTED: TWO



VERTICAL

RMS: 0.602
MAXIMUM: 1.000 @ 263° TRUE
MINIMUM: 0.141 @ 110° TRUE

10X Scale

HORIZONTAL

RMS: 0.611
MAXIMUM: 1.000 @ 255° TRUE
MINIMUM: 0.064 @ 98° TRUE

COMMENTS: MEASURED PATTERNS OF THE HORIZONTAL AND VERTICAL COMPONENTS.

ERI[®] *Horizontal Plane Relative Field List*

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

Station: KMLU
Location: McKee, KY.
Frequency: 89.3 MHz

Antenna: MP-4E-DA
Orientation: 271° True
Tower: 24" Lambda

Figure: 2
Date: 7/8/2011
Reference: kmlu1m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.342	5.86	7.68	0.375	7.04	8.47	180°	0.550	15.11	11.79	0.518	13.43	11.28
5°	0.313	4.90	6.90	0.355	6.30	7.99	185°	0.610	18.62	12.70	0.565	15.94	12.02
10°	0.294	4.33	6.36	0.338	5.73	7.58	190°	0.674	22.72	13.56	0.608	18.49	12.67
15°	0.286	4.08	6.11	0.326	5.30	7.24	195°	0.733	26.89	14.30	0.651	21.19	13.26
20°	0.286	4.09	6.11	0.314	4.94	6.94	200°	0.795	31.60	15.00	0.693	24.04	13.81
25°	0.293	4.28	6.32	0.304	4.62	6.64	205°	0.839	35.16	15.46	0.735	27.01	14.32
30°	0.302	4.57	6.60	0.292	4.27	6.30	210°	0.870	37.83	15.78	0.775	30.04	14.78
35°	0.311	4.83	6.84	0.277	3.85	5.85	215°	0.895	40.03	16.02	0.813	33.05	15.19
40°	0.314	4.93	6.93	0.261	3.41	5.33	220°	0.915	41.90	16.22	0.849	36.01	15.56
45°	0.311	4.83	6.84	0.246	3.03	4.81	225°	0.933	43.54	16.39	0.881	38.85	15.89
50°	0.300	4.50	6.54	0.233	2.71	4.33	230°	0.950	45.08	16.54	0.911	41.49	16.18
55°	0.282	3.97	5.99	0.221	2.45	3.89	235°	0.965	46.55	16.68	0.936	43.85	16.42
60°	0.256	3.27	5.14	0.212	2.24	3.50	240°	0.979	47.91	16.80	0.958	45.85	16.61
65°	0.222	2.47	3.93	0.204	2.08	3.17	245°	0.990	49.03	16.90	0.974	47.47	16.76
70°	0.184	1.70	2.30	0.197	1.94	2.87	250°	0.998	49.76	16.97	0.987	48.69	16.87
75°	0.147	1.09	0.36	0.190	1.81	2.57	255°	1.000	50.00	16.99	0.995	49.51	16.95
80°	0.116	0.67	-1.73	0.183	1.68	2.25	260°	0.997	49.69	16.96	0.999	49.94	16.98
85°	0.091	0.42	-3.78	0.176	1.54	1.89	265°	0.988	48.85	16.89	1.000	49.96	16.99
90°	0.075	0.28	-5.55	0.167	1.40	1.46	270°	0.975	47.49	16.77	0.996	49.59	16.95
95°	0.066	0.22	-6.66	0.158	1.25	0.97	275°	0.955	45.63	16.59	0.988	48.84	16.89
100°	0.065	0.21	-6.73	0.150	1.12	0.50	280°	0.931	43.32	16.37	0.977	47.73	16.79
105°	0.073	0.27	-5.71	0.143	1.03	0.12	285°	0.903	40.73	16.10	0.962	46.26	16.65
110°	0.090	0.40	-3.94	0.141	0.99	-0.02	290°	0.874	38.21	15.82	0.943	44.47	16.48
115°	0.115	0.66	-1.83	0.145	1.05	0.22	295°	0.849	36.06	15.57	0.919	42.25	16.26
120°	0.145	1.06	0.23	0.156	1.22	0.88	300°	0.829	34.36	15.36	0.888	39.47	15.96
125°	0.178	1.58	1.98	0.174	1.52	1.81	305°	0.814	33.14	15.20	0.855	36.51	15.62
130°	0.208	2.16	3.34	0.195	1.90	2.79	310°	0.804	32.33	15.10	0.820	33.63	15.27
135°	0.228	2.60	4.14	0.216	2.32	3.66	315°	0.794	31.54	14.99	0.778	30.25	14.81
140°	0.247	3.06	4.85	0.236	2.78	4.44	320°	0.771	29.75	14.73	0.727	26.42	14.22
145°	0.263	3.47	5.40	0.256	3.28	5.16	325°	0.724	26.23	14.19	0.676	22.82	13.58
150°	0.279	3.89	5.90	0.278	3.87	5.88	330°	0.660	21.76	13.38	0.625	19.53	12.91
155°	0.305	4.64	6.67	0.304	4.63	6.66	335°	0.595	17.68	12.47	0.572	16.36	12.14
160°	0.335	5.62	7.49	0.336	5.63	7.51	340°	0.535	14.30	11.55	0.521	13.55	11.32
165°	0.377	7.12	8.52	0.374	6.99	8.45	345°	0.479	11.50	10.61	0.473	11.18	10.49
170°	0.427	9.13	9.60	0.418	8.75	9.42	350°	0.428	9.15	9.62	0.432	9.32	9.69
175°	0.485	11.74	10.70	0.467	10.93	10.39	355°	0.381	7.27	8.61	0.400	8.01	9.03

Polarization:	Horizontal	Vertical
Maximum Field:	1.000 @ 255° True	1.000 @ 263° True
Minimum Field:	0.064 @ 98° True	0.141 @ 110° True
RMS:	0.611	0.602
Maximum ERP:	50.000 kW	50.000 kW
Maximum Power Gain:	5.505 (7.408 dB)	5.505 (7.408 dB)

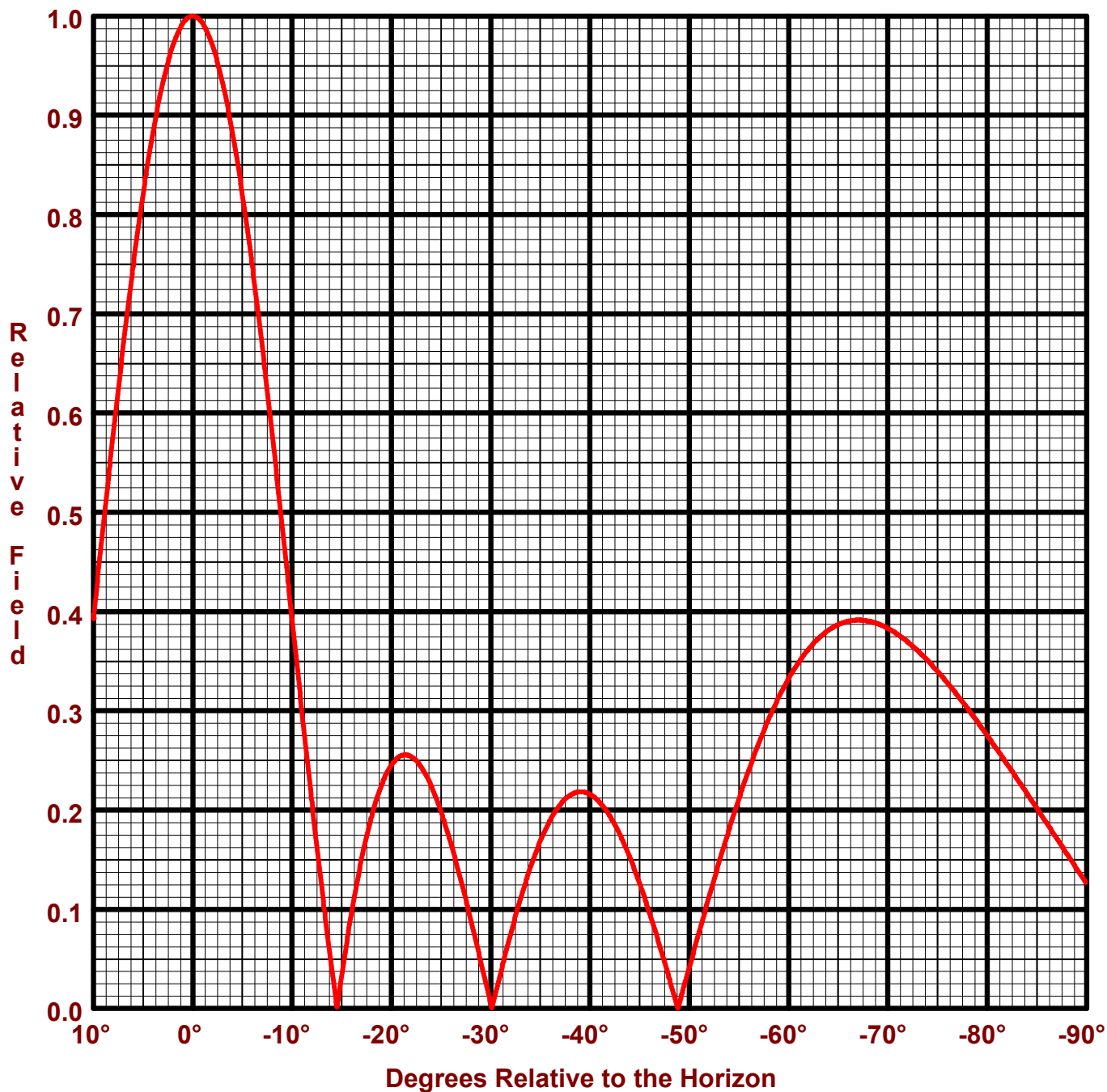
Total Input Power: 9.082 kW

ERI[®] 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: KMLU
Location: McKee, KY.
Frequency: 89.3 MHz
4 bay MP-4E-DA antenna

Date: 7/8/2011
H/V Power Ratio: 1
1 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 5.505 (7.408 dB)
Horizontal Plane: 5.505 (7.408 dB)
Maximum ERP: 50.000 kW

Vertical Polarization:
Maximum: 5.505 (7.408 dB)
Horizontal Plane: 5.505 (7.408 dB)
Maximum ERP: 50.000 kW

Directional Antenna System for KMLU, McKee, Kentucky

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	MP-4E-DA
Frequency:	89.3 MHz
Number of Bays:	Four

MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	41 ft 10 in
Aperture length required:	47 ft 11 in
Orientation:	271° true
Input flange to the antenna 3 1/8" female.	

ELECTRICAL SPECIFICATIONS (For directional use)

Maximum horizontal ERP:	50.000 kW (16.99 dBk)
Horizontal maximum power gain:	5.505 (7.408 dB)
Maximum vertical ERP:	50.000 kW (16.99 dBk)
Vertical maximum power gain:	5.505 (7.408 dB)
Total input power:	9.082 kW (9.582 dBk)

