



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
KKRO, Redding, California***

February 13, 2007

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 KKRO.

The antenna is the ERI model LP-1E-DA configuration. The circular polarized system consists of one bay using one driven circular polarized radiating element, one horizontal parasitic element placed one quarter wave above and below each bay and two vertical parasitic elements. The antenna was tested on a 3.25" o.d. pole, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 91.5 megahertz, which is the center of the FM broadcast channel assigned to KKRO.

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 KKRO, Redding, California

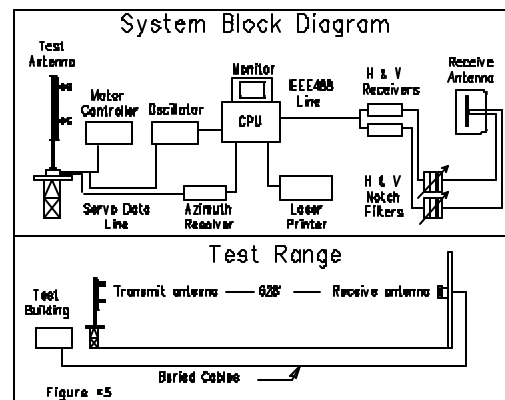
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DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of a full-scale model of the complete 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 1 5/8 inch o.d. rigid coaxial line was used to feed the test antenna, and a section of 1 5/8 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 3.25" 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.



The antenna under test was operated in the transmitting mode and fed from a HP8657D signal generator calibrated 1-05. The frequency of the signal source was set at 91.5 MHz and was constantly monitored by a Rohde & Schwarz ESVD measuring receiver calibrated 11-06.

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.

Directional Antenna System
Proposed For
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(Continued)

The signals received by the dipole system were fed to the test building by way of two buried Heliax cables to an Rohde & Schwarz measuring receiver. This data was interfaced to a Hewlett-Packard Laser Jet 4P printer by means of a Pentium 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 one bay using one driven circular polarized radiating element, one horizontal parasitic element placed one quarter wave above and below each bay and two vertical parasitic elements. 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 LP-1E-DA array is to be mounted on the 3.25" o.d. pole at a bearing of North 205 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 0.37 kilowatts (-4.318 dBk).

The power at North 10-20 degrees East does not exceed 0.027 kilowatts (-15.686 dBk).

The RMS of the vertically polarized horizontal plane component does not exceed the RMS of the horizontally polarized horizontal plane component.

Directional Antenna System
Proposed For
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(Continued)

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 15 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.

A handwritten signature in black ink, appearing to read "Tom Scharf". The signature is written in a cursive, flowing style with a large initial "T".

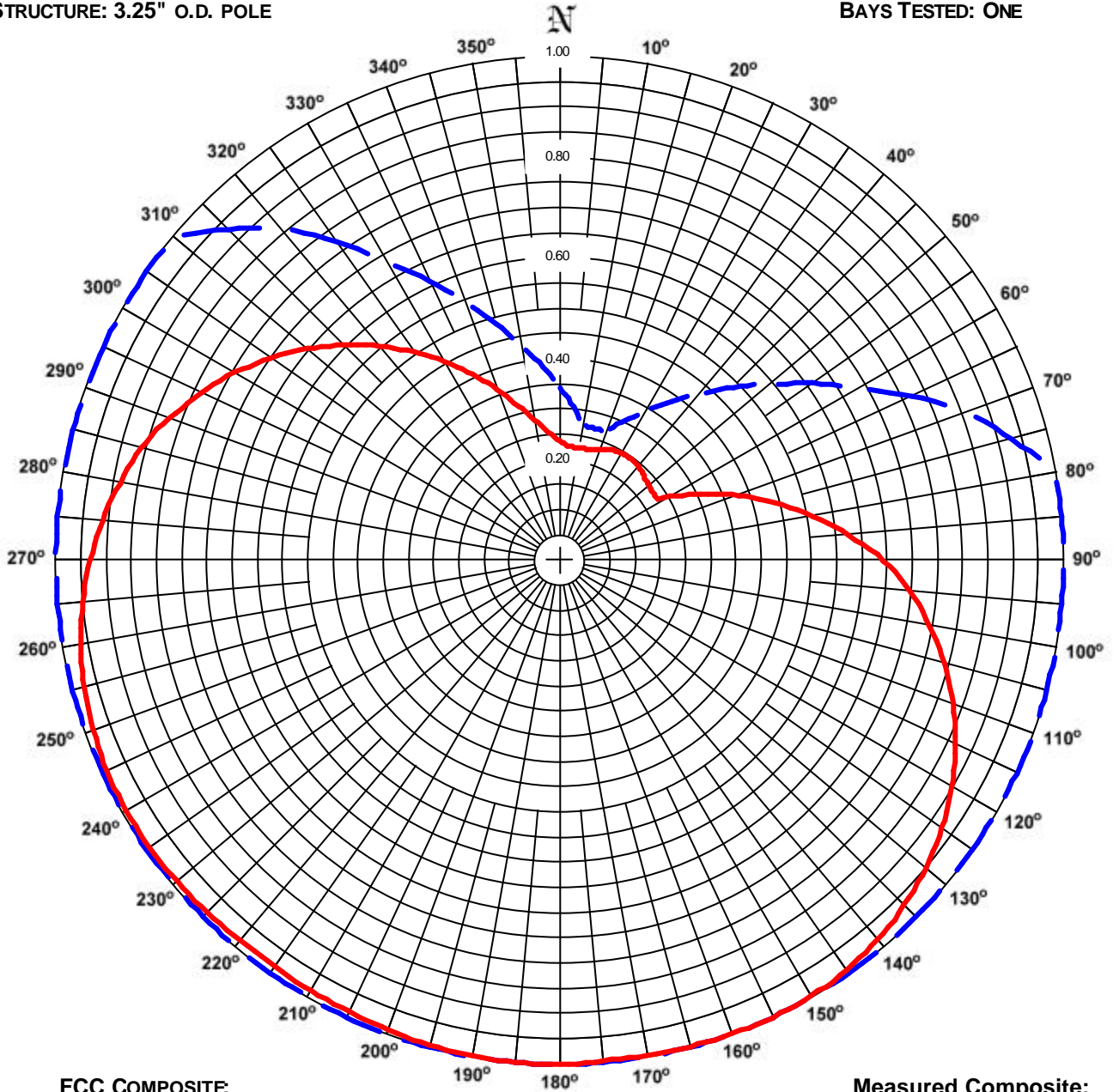
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ERI® *Horizontal Plane Relative Field Pattern*

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: KKRO
LOCATION: REDDING, CA
ANTENNA: LP-1E-DA
STRUCTURE: 3.25" O.D. POLE

DATE: 2/13/2007
FREQUENCY: 91.5 MHz
ORIENTATION: 205° TRUE
MOUNTING: STANDARD
BAYS TESTED: ONE



FCC COMPOSITE
RMS: 0.878
MAXIMUM: 1.000 @ 80° TRUE
MINIMUM: 0.272 @ 10° TRUE

Measured Composite:
RMS: 0.763
Maximum: 1.000 @ 154° True
Minimum: 0.226 @ 8° 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 BMPED-20061010ADF

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: KKRO
Location: Redding, CA
Frequency: 91.5 MHz

Antenna: LP-1E-DA
Orientation: 205° True
Tower: 3.25" o.d. pole

Figure: 1
Date: 2/13/2007
Reference: kkro1m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.238	0.02	-16.79	Vertical	180°	1.000	0.37	-4.32	Vertical
5°	0.228	0.02	-17.16	Vertical	185°	1.000	0.37	-4.32	Vertical
10°	0.226	0.02	-17.22	Vertical	190°	0.998	0.37	-4.33	Vertical
15°	0.230	0.02	-17.10	Vertical	195°	0.996	0.37	-4.36	Vertical
20°	0.236	0.02	-16.86	Vertical	200°	0.992	0.36	-4.39	Vertical
25°	0.243	0.02	-16.61	Vertical	205°	0.988	0.36	-4.42	Vertical
30°	0.247	0.02	-16.47	Vertical	210°	0.986	0.36	-4.44	Vertical
35°	0.247	0.02	-16.46	Vertical	215°	0.985	0.36	-4.45	Vertical
40°	0.244	0.02	-16.58	Vertical	220°	0.986	0.36	-4.44	Vertical
45°	0.237	0.02	-16.81	Vertical	225°	0.988	0.36	-4.42	Vertical
50°	0.231	0.02	-17.03	Vertical	230°	0.991	0.36	-4.40	Vertical
55°	0.229	0.02	-17.13	Vertical	235°	0.993	0.36	-4.38	Vertical
60°	0.254	0.02	-16.22	Horizontal	240°	0.993	0.36	-4.38	Vertical
65°	0.311	0.04	-14.47	Horizontal	245°	0.991	0.36	-4.40	Vertical
70°	0.378	0.05	-12.76	Horizontal	250°	0.985	0.36	-4.45	Vertical
75°	0.442	0.07	-11.42	Horizontal	255°	0.976	0.35	-4.53	Vertical
80°	0.511	0.10	-10.15	Horizontal	260°	0.965	0.34	-4.63	Vertical
85°	0.575	0.12	-9.12	Horizontal	265°	0.950	0.33	-4.77	Vertical
90°	0.644	0.15	-8.14	Horizontal	270°	0.932	0.32	-4.93	Vertical
95°	0.698	0.18	-7.44	Horizontal	275°	0.911	0.31	-5.13	Vertical
100°	0.747	0.21	-6.85	Horizontal	280°	0.886	0.29	-5.36	Vertical
105°	0.791	0.23	-6.35	Horizontal	285°	0.859	0.27	-5.64	Vertical
110°	0.831	0.26	-5.92	Horizontal	290°	0.825	0.25	-5.99	Vertical
115°	0.867	0.28	-5.56	Horizontal	295°	0.786	0.23	-6.41	Vertical
120°	0.899	0.30	-5.25	Horizontal	300°	0.745	0.21	-6.87	Vertical
125°	0.926	0.32	-4.99	Horizontal	305°	0.700	0.18	-7.41	Vertical
130°	0.949	0.33	-4.77	Horizontal	310°	0.654	0.16	-8.01	Vertical
135°	0.968	0.35	-4.60	Horizontal	315°	0.605	0.14	-8.68	Vertical
140°	0.982	0.36	-4.47	Horizontal	320°	0.556	0.11	-9.42	Vertical
145°	0.992	0.36	-4.38	Horizontal	325°	0.506	0.09	-10.24	Vertical
150°	0.998	0.37	-4.33	Horizontal	330°	0.456	0.08	-11.13	Vertical
155°	1.000	0.37	-4.32	Horizontal	335°	0.407	0.06	-12.12	Vertical
160°	1.000	0.37	-4.32	Horizontal	340°	0.361	0.05	-13.17	Vertical
165°	0.999	0.37	-4.33	Horizontal	345°	0.318	0.04	-14.28	Vertical
170°	0.998	0.37	-4.34	Horizontal	350°	0.283	0.03	-15.29	Vertical
175°	0.998	0.37	-4.34	Vertical	355°	0.256	0.02	-16.15	Vertical

Polarization:
Maximum Field:
Minimum Field:
RMS:
Maximum ERP:
Maximum Power Gain:

Envelope
1.000 @ 154° True
0.226 @ 8° True
0.763
0.370 kW
0.830 (-0.811 dB)

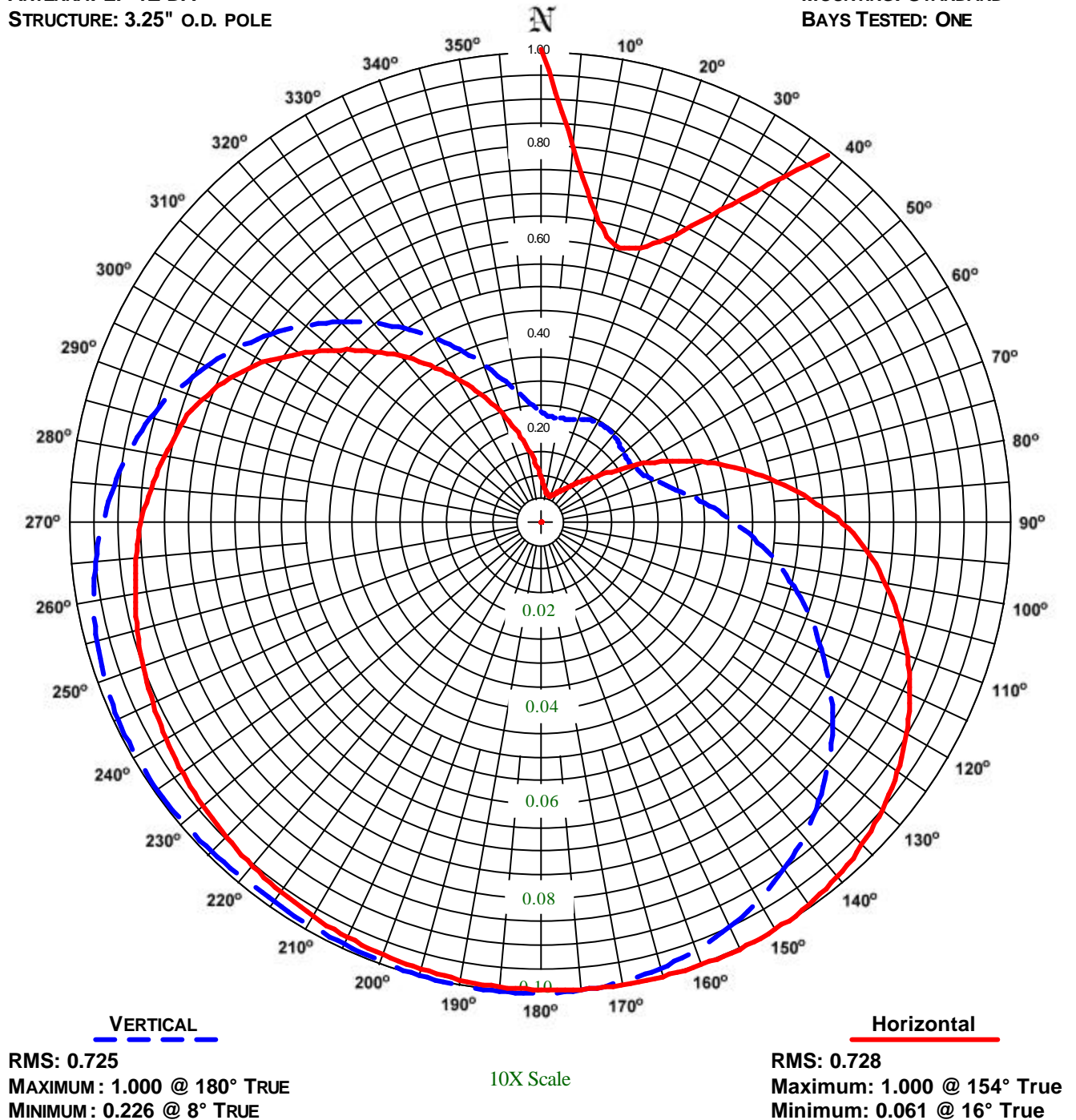
Total Input Power: 0.446 kW

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: KKRO
LOCATION: REDDING, CA
ANTENNA: LP-1E-DA
STRUCTURE: 3.25" O.D. POLE

DATE: 2/13/2007
FREQUENCY: 91.5 MHz
ORIENTATION: 205° TRUE
MOUNTING: STANDARD
BAYS TESTED: ONE



COMMENTS: MEASURED PATTERN 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: KKRO
Location: Redding, CA
Frequency: 91.5 MHz

Antenna: LP-1E-DA
Orientation: 205° True
Tower: 3.25" o.d. pole

Figure: 2
Date: 2/13/2007
Reference: kkro1m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.101	0.00	-24.24	0.238	0.02	-16.79	180°	0.993	0.36	-4.38	1.000	0.37	-4.32
5°	0.080	0.00	-26.22	0.228	0.02	-17.16	185°	0.990	0.36	-4.40	1.000	0.37	-4.32
10°	0.067	0.00	-27.79	0.226	0.02	-17.22	190°	0.986	0.36	-4.44	0.998	0.37	-4.33
15°	0.061	0.00	-28.58	0.230	0.02	-17.10	195°	0.982	0.36	-4.47	0.996	0.37	-4.36
20°	0.062	0.00	-28.41	0.236	0.02	-16.86	200°	0.977	0.35	-4.52	0.992	0.36	-4.39
25°	0.068	0.00	-27.70	0.243	0.02	-16.61	205°	0.972	0.35	-4.56	0.988	0.36	-4.42
30°	0.077	0.00	-26.60	0.247	0.02	-16.47	210°	0.966	0.35	-4.62	0.986	0.36	-4.44
35°	0.090	0.00	-25.25	0.247	0.02	-16.46	215°	0.960	0.34	-4.67	0.985	0.36	-4.45
40°	0.107	0.00	-23.77	0.244	0.02	-16.58	220°	0.953	0.34	-4.74	0.986	0.36	-4.44
45°	0.127	0.01	-22.24	0.237	0.02	-16.81	225°	0.945	0.33	-4.81	0.988	0.36	-4.42
50°	0.154	0.01	-20.56	0.231	0.02	-17.03	230°	0.937	0.32	-4.88	0.991	0.36	-4.40
55°	0.196	0.01	-18.47	0.229	0.02	-17.13	235°	0.928	0.32	-4.97	0.993	0.36	-4.38
60°	0.254	0.02	-16.22	0.232	0.02	-17.01	240°	0.919	0.31	-5.05	0.993	0.36	-4.38
65°	0.311	0.04	-14.47	0.243	0.02	-16.60	245°	0.909	0.31	-5.15	0.991	0.36	-4.40
70°	0.378	0.05	-12.76	0.263	0.03	-15.92	250°	0.899	0.30	-5.25	0.985	0.36	-4.45
75°	0.442	0.07	-11.42	0.291	0.03	-15.05	255°	0.887	0.29	-5.35	0.976	0.35	-4.53
80°	0.511	0.10	-10.15	0.327	0.04	-14.03	260°	0.876	0.28	-5.47	0.965	0.34	-4.63
85°	0.575	0.12	-9.12	0.370	0.05	-12.96	265°	0.864	0.28	-5.59	0.950	0.33	-4.77
90°	0.644	0.15	-8.14	0.416	0.06	-11.93	270°	0.851	0.27	-5.72	0.932	0.32	-4.93
95°	0.698	0.18	-7.44	0.465	0.08	-10.97	275°	0.832	0.26	-5.92	0.911	0.31	-5.13
100°	0.747	0.21	-6.85	0.515	0.10	-10.08	280°	0.813	0.24	-6.12	0.886	0.29	-5.36
105°	0.791	0.23	-6.35	0.565	0.12	-9.28	285°	0.794	0.23	-6.32	0.859	0.27	-5.64
110°	0.831	0.26	-5.92	0.615	0.14	-8.54	290°	0.767	0.22	-6.62	0.825	0.25	-5.99
115°	0.867	0.28	-5.56	0.663	0.16	-7.89	295°	0.728	0.20	-7.08	0.786	0.23	-6.41
120°	0.899	0.30	-5.25	0.713	0.19	-7.26	300°	0.683	0.17	-7.63	0.745	0.21	-6.87
125°	0.926	0.32	-4.99	0.758	0.21	-6.72	305°	0.627	0.15	-8.38	0.700	0.18	-7.41
130°	0.949	0.33	-4.77	0.800	0.24	-6.26	310°	0.573	0.12	-9.16	0.654	0.16	-8.01
135°	0.968	0.35	-4.60	0.838	0.26	-5.86	315°	0.517	0.10	-10.04	0.605	0.14	-8.68
140°	0.982	0.36	-4.47	0.871	0.28	-5.51	320°	0.466	0.08	-10.96	0.556	0.11	-9.42
145°	0.992	0.36	-4.38	0.901	0.30	-5.22	325°	0.409	0.06	-12.09	0.506	0.09	-10.24
150°	0.998	0.37	-4.33	0.927	0.32	-4.98	330°	0.358	0.05	-13.24	0.456	0.08	-11.13
155°	1.000	0.37	-4.32	0.949	0.33	-4.77	335°	0.303	0.03	-14.68	0.407	0.06	-12.12
160°	1.000	0.37	-4.32	0.967	0.35	-4.61	340°	0.257	0.02	-16.12	0.361	0.05	-13.17
165°	0.999	0.37	-4.33	0.981	0.36	-4.48	345°	0.207	0.02	-18.00	0.318	0.04	-14.28
170°	0.998	0.37	-4.34	0.991	0.36	-4.39	350°	0.164	0.01	-20.01	0.283	0.03	-15.29
175°	0.996	0.37	-4.36	0.998	0.37	-4.34	355°	0.129	0.01	-22.11	0.256	0.02	-16.15

Polarization:	Horizontal	Vertical
Maximum Field:	1.000 @ 154° True	1.000 @ 180° True
Minimum Field:	0.061 @ 16° True	0.226 @ 8° True
RMS:	0.728	0.725
Maximum ERP:	0.370 kW	0.370 kW
Maximum Power Gain:	0.830 (-0.811 dB)	0.830 (-0.811 dB)

Total Input Power: 0.446 kW



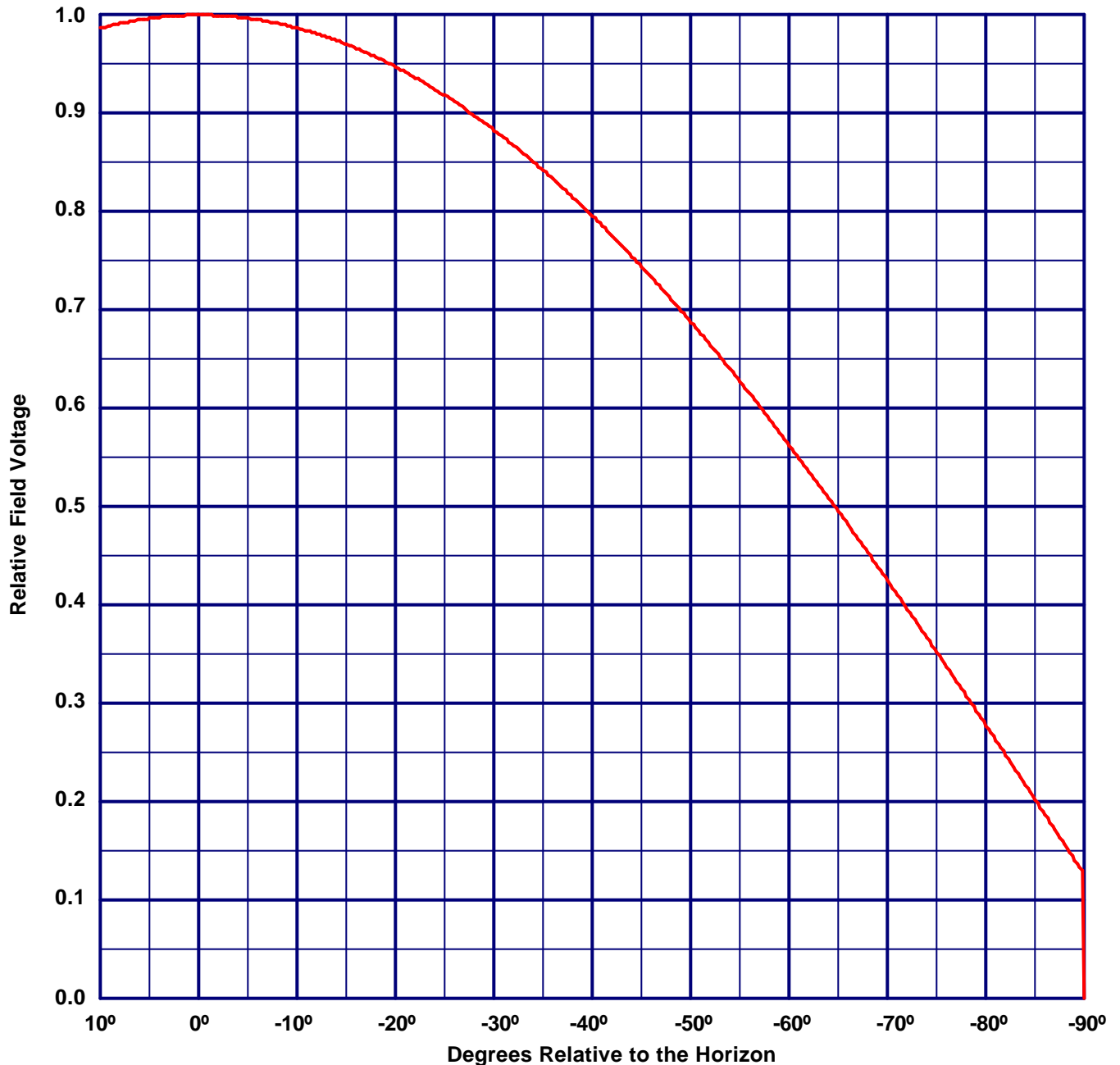
Vertical Plane Relative Field Pattern

KKRO, Redding, CA, 91.5 MHz

Figure#: 3

Date: 2/13/2007

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



Vertical Polarization Gain:

Maximum: 0.830 (-0.811 dB)

Horizontal Plane: 0.830 (-0.811 dB)

Horizontal Polarization Gain:

Maximum: 0.830 (-0.811 dB)

Horizontal Plane: 0.830 (-0.811 dB)

Directional Antenna System for KKRO, Redding, California

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	LP-1E-DA
Frequency:	91.5MHZ
Number of Bays:	One

MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	8 ft 7 in
Aperture length required:	15 ft
Orientation:	205° true

Input flange to the antenna 1 5/8" female.

ELECTRICAL SPECIFICATIONS

(For directional use)

Maximum horizontal ERP:	0.370 kW (-4.318 dBk)
Horizontal maximum power gain:	0.830 (-0.811 dB)
Maximum vertical ERP:	0.370 kW (-4.318 dBk)
Vertical maximum power gain:	0.830 (-0.811 dB)
Total input power:	0.446 kW (-3.508 dBk)

