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 KGRI, Lebanon, Oregon

April 27, 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 KGRI.

The antenna is the ERI model LP-2E-DA-HW configuration. The circular polarized system consists of two half-wavelength spaced bays using one driven circular polarized radiating element per bay, three horizontal parasitic elements per bay and three vertical parasitic elements interleaved between the bays. The antenna was tested on a 6 5/8" o.d. pole, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 88.1 megahertz, which is the center of the FM broadcast channel assigned to KGRI.

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
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(Continued)

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 6 5/8" 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.

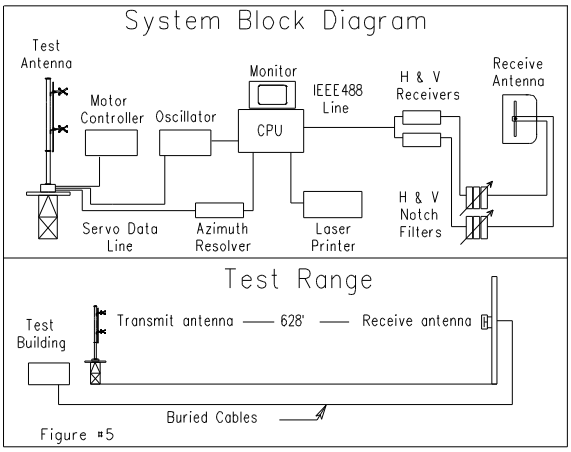

Figure #5

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 88.1 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.

Directional Antenna System
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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 two half-wavelength spaced bays using one driven circular polarized radiating element per bay, three horizontal parasitic elements per bay and three vertical parasitic elements interleaved between the bays. 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 LP-2E-DA-HW array is to be mounted on the 6 5/8" o.d. pole at a bearing of North 6 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 0.170 kilowatts (-7.696 dBk).

The power at North 210-230 degrees East does not exceed .0054 kilowatts (-22.676 dBk).

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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 20 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.

Tom Schaaf

ERI® Horizontal Plane Relative Field Pattern

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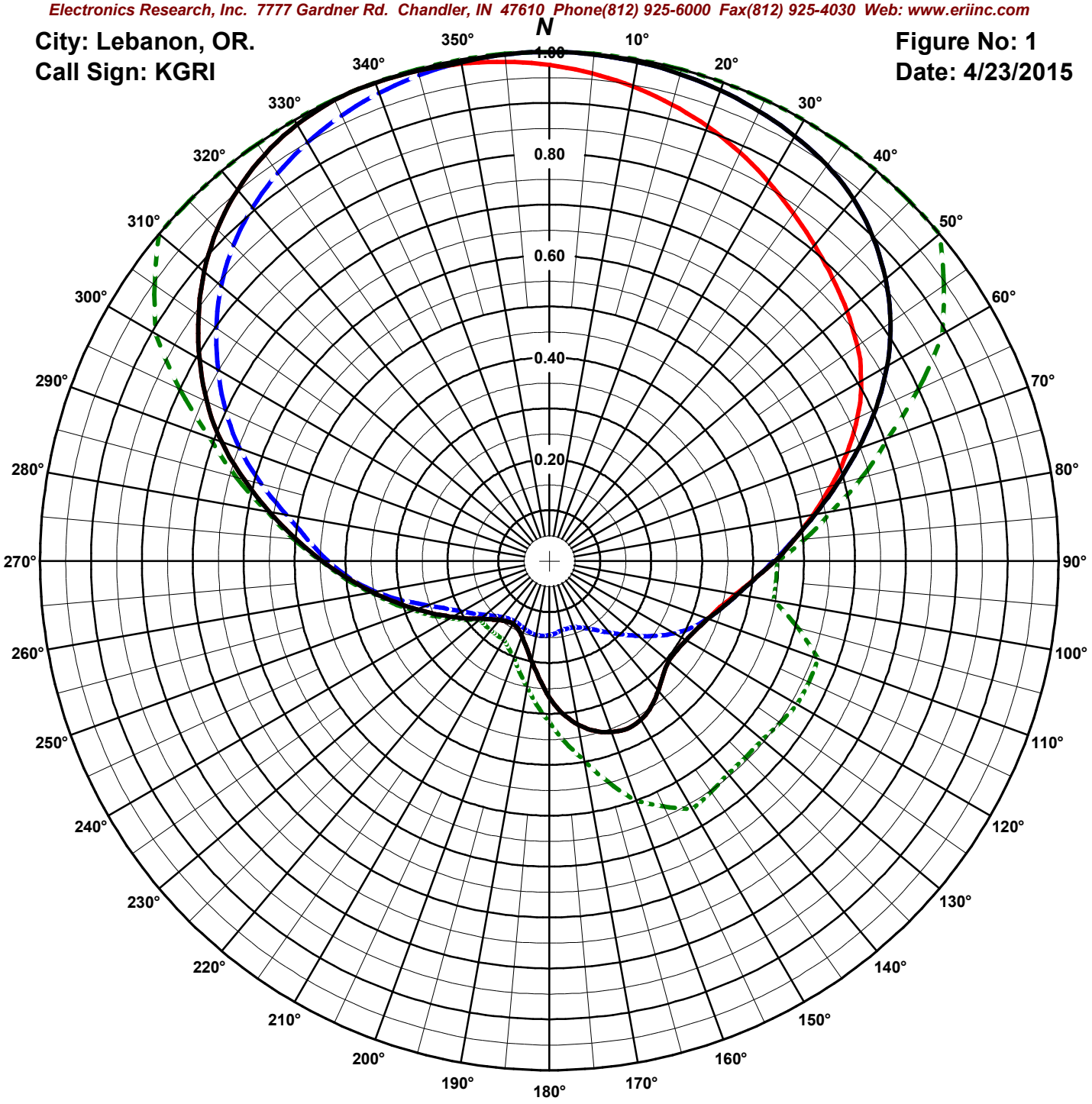
City: Lebanon, OR.
Call Sign: KGRI

Figure No: 1
Date: 4/23/2015



Antenna Orientation: 6° True

Frequency: 88.1 MHz
Antenna Type: LP-2E-DA-HW

Antenna Mounting: Standard
Tower Type: 6 5\8" o.d. Pole

HORIZONTAL	VERTICAL	COMPOSITE	FCC ENVELOPE
RMS: .616	RMS: .615	RMS: .637	RMS: .693
Maximum: 1 @ 338°	Maximum: 1 @ 0°	Maximum: 1 @ 0°	Maximum: 1 @ 0°
Minimum: .142 @ 210°	Minimum: .136 @ 210°	Minimum: .142 @ 210°	Minimum: .178 @ 210°

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 BPED-20120726AEZ.

ERI® Horizontal Plane Relative Field Pattern

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Figure# 1 **Date: 4/23/2015**
Station: KGRI **Antenna: LP-2E-DA-HW**
Location: Lebanon, OR. **Antenna Orientation: 6° True**
Frequency: 88.1 MHz **Number of Bays: 2**

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	1.000	0.170	-7.696	Vertical	180°	0.268	0.012	-19.146	Horizontal
5°	0.999	0.170	-7.706	Vertical	185°	0.231	0.009	-20.437	Horizontal
10°	0.996	0.169	-7.734	Vertical	190°	0.199	0.007	-21.702	Horizontal
15°	0.991	0.167	-7.778	Vertical	195°	0.175	0.005	-22.839	Horizontal
20°	0.984	0.165	-7.838	Vertical	200°	0.157	0.004	-23.764	Horizontal
25°	0.975	0.162	-7.915	Vertical	205°	0.146	0.004	-24.387	Horizontal
30°	0.964	0.158	-8.015	Vertical	210°	0.142	0.003	-24.632	Horizontal
35°	0.950	0.153	-8.143	Vertical	215°	0.145	0.004	-24.486	Horizontal
40°	0.929	0.147	-8.337	Vertical	220°	0.151	0.004	-24.107	Horizontal
45°	0.899	0.137	-8.619	Vertical	225°	0.162	0.004	-23.524	Horizontal
50°	0.862	0.126	-8.988	Vertical	230°	0.176	0.005	-22.778	Horizontal
55°	0.818	0.114	-9.444	Vertical	235°	0.197	0.007	-21.828	Horizontal
60°	0.766	0.100	-10.014	Vertical	240°	0.219	0.008	-20.879	Horizontal
65°	0.707	0.085	-10.706	Vertical	245°	0.246	0.010	-19.861	Horizontal
70°	0.646	0.071	-11.497	Vertical	250°	0.277	0.013	-18.843	Horizontal
75°	0.585	0.058	-12.352	Vertical	255°	0.312	0.017	-17.801	Horizontal
80°	0.530	0.048	-13.213	Vertical	260°	0.352	0.021	-16.759	Horizontal
85°	0.483	0.040	-14.018	Horizontal	265°	0.396	0.027	-15.731	Horizontal
90°	0.443	0.033	-14.762	Horizontal	270°	0.446	0.034	-14.703	Horizontal
95°	0.404	0.028	-15.558	Vertical	275°	0.499	0.042	-13.728	Horizontal
100°	0.375	0.024	-16.205	Vertical	280°	0.559	0.053	-12.752	Horizontal
105°	0.352	0.021	-16.765	Vertical	285°	0.620	0.065	-11.847	Horizontal
110°	0.331	0.019	-17.297	Horizontal	290°	0.685	0.080	-10.987	Horizontal
115°	0.319	0.017	-17.628	Horizontal	295°	0.742	0.094	-10.291	Horizontal
120°	0.310	0.016	-17.864	Horizontal	300°	0.793	0.107	-9.711	Horizontal
125°	0.306	0.016	-17.995	Horizontal	305°	0.841	0.120	-9.201	Horizontal
130°	0.306	0.016	-17.980	Horizontal	310°	0.884	0.133	-8.763	Horizontal
135°	0.317	0.017	-17.686	Horizontal	315°	0.922	0.144	-8.403	Horizontal
140°	0.333	0.019	-17.257	Horizontal	320°	0.952	0.154	-8.124	Horizontal
145°	0.349	0.021	-16.849	Horizontal	325°	0.974	0.161	-7.920	Horizontal
150°	0.360	0.022	-16.576	Horizontal	330°	0.990	0.167	-7.783	Horizontal
155°	0.363	0.022	-16.503	Horizontal	335°	0.998	0.169	-7.709	Horizontal
160°	0.357	0.022	-16.634	Horizontal	340°	1.000	0.170	-7.698	Horizontal
165°	0.345	0.020	-16.937	Horizontal	345°	0.997	0.169	-7.720	Horizontal
170°	0.326	0.018	-17.430	Horizontal	350°	0.995	0.168	-7.742	Vertical
175°	0.300	0.015	-18.146	Horizontal	355°	0.999	0.170	-7.707	Vertical

Horizontal Polarization:
Maximum: 1.762 (2.460 dB)
Horizontal Plane: 1.762 (2.460 dB)
Maximum ERP: 0.170 kW

Vertical Polarization:
Maximum: 1.762 (2.460 dB)
Horizontal Plane: 1.762 (2.460 dB)
Maximum ERP: 0.170 kW

Total Input Power: 0.096 kW
Reference: KGRI1M.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: 4/23/2015**
Station: KGRI **Antenna: LP-2E-DA-HW**
Location: Lebanon, OR. **Antenna Orientation: 6° True**
Frequency: 88.1 MHz **Number of Bays: 2**

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.974	0.161	-7.921	1.000	0.170	-7.696	180°	0.268	0.012	-19.146	0.145	0.004	-24.440
5°	0.962	0.157	-8.035	0.999	0.170	-7.706	185°	0.231	0.009	-20.437	0.147	0.004	-24.323
10°	0.947	0.152	-8.173	0.996	0.169	-7.734	190°	0.199	0.007	-21.702	0.147	0.004	-24.330
15°	0.929	0.147	-8.337	0.991	0.167	-7.778	195°	0.175	0.005	-22.839	0.145	0.004	-24.464
20°	0.909	0.140	-8.529	0.984	0.165	-7.838	200°	0.157	0.004	-23.764	0.141	0.003	-24.689
25°	0.886	0.133	-8.750	0.975	0.162	-7.915	205°	0.146	0.004	-24.387	0.138	0.003	-24.909
30°	0.860	0.126	-9.002	0.964	0.158	-8.015	210°	0.142	0.003	-24.632	0.136	0.003	-24.994
35°	0.835	0.119	-9.262	0.950	0.153	-8.143	215°	0.145	0.004	-24.486	0.138	0.003	-24.875
40°	0.810	0.112	-9.522	0.929	0.147	-8.337	220°	0.151	0.004	-24.107	0.144	0.004	-24.548
45°	0.786	0.105	-9.782	0.899	0.137	-8.619	225°	0.162	0.004	-23.524	0.152	0.004	-24.037
50°	0.763	0.099	-10.042	0.862	0.126	-8.988	230°	0.176	0.005	-22.778	0.164	0.005	-23.376
55°	0.738	0.093	-10.334	0.818	0.114	-9.444	235°	0.197	0.007	-21.828	0.180	0.005	-22.599
60°	0.707	0.085	-10.710	0.766	0.100	-10.014	240°	0.219	0.008	-20.879	0.199	0.007	-21.737
65°	0.668	0.076	-11.206	0.707	0.085	-10.706	245°	0.246	0.010	-19.861	0.222	0.008	-20.783
70°	0.622	0.066	-11.818	0.646	0.071	-11.497	250°	0.277	0.013	-18.843	0.254	0.011	-19.600
75°	0.573	0.056	-12.531	0.585	0.058	-12.352	255°	0.312	0.017	-17.801	0.298	0.015	-18.209
80°	0.526	0.047	-13.275	0.530	0.048	-13.213	260°	0.352	0.021	-16.759	0.346	0.020	-16.908
85°	0.483	0.040	-14.018	0.482	0.039	-14.044	265°	0.396	0.027	-15.731	0.392	0.026	-15.829
90°	0.443	0.033	-14.762	0.440	0.033	-14.828	270°	0.446	0.034	-14.703	0.434	0.032	-14.939
95°	0.404	0.028	-15.576	0.404	0.028	-15.558	275°	0.499	0.042	-13.728	0.476	0.038	-14.152
100°	0.372	0.024	-16.283	0.375	0.024	-16.205	280°	0.559	0.053	-12.752	0.525	0.047	-13.296
105°	0.347	0.021	-16.881	0.352	0.021	-16.765	285°	0.620	0.065	-11.847	0.585	0.058	-12.353
110°	0.331	0.019	-17.297	0.331	0.019	-17.310	290°	0.685	0.080	-10.987	0.647	0.071	-11.483
115°	0.319	0.017	-17.628	0.309	0.016	-17.907	295°	0.742	0.094	-10.291	0.702	0.084	-10.774
120°	0.310	0.016	-17.864	0.284	0.014	-18.640	300°	0.793	0.107	-9.711	0.751	0.096	-10.182
125°	0.306	0.016	-17.995	0.256	0.011	-19.537	305°	0.841	0.120	-9.201	0.798	0.108	-9.654
130°	0.306	0.016	-17.980	0.228	0.009	-20.518	310°	0.884	0.133	-8.763	0.841	0.120	-9.202
135°	0.317	0.017	-17.686	0.204	0.007	-21.503	315°	0.922	0.144	-8.403	0.877	0.131	-8.837
140°	0.333	0.019	-17.257	0.183	0.006	-22.439	320°	0.952	0.154	-8.124	0.906	0.140	-8.550
145°	0.349	0.021	-16.849	0.166	0.005	-23.285	325°	0.974	0.161	-7.920	0.930	0.147	-8.327
150°	0.360	0.022	-16.576	0.153	0.004	-24.000	330°	0.990	0.167	-7.783	0.949	0.153	-8.146
155°	0.363	0.022	-16.503	0.144	0.004	-24.544	335°	0.998	0.169	-7.709	0.965	0.158	-8.002
160°	0.357	0.022	-16.634	0.138	0.003	-24.876	340°	1.000	0.170	-7.698	0.978	0.163	-7.888
165°	0.345	0.020	-16.937	0.137	0.003	-24.974	345°	0.997	0.169	-7.720	0.988	0.166	-7.802
170°	0.326	0.018	-17.430	0.139	0.003	-24.866	350°	0.992	0.167	-7.764	0.995	0.168	-7.742
175°	0.300	0.015	-18.146	0.142	0.003	-24.647	355°	0.984	0.165	-7.831	0.999	0.170	-7.707

Horizontal Polarization:
Maximum: 1.762 (2.460 dB)
Horizontal Plane: 1.762 (2.460 dB)
Maximum ERP: 0.170 kW

Vertical Polarization:
Maximum: 1.762 (2.460 dB)
Horizontal Plane: 1.762 (2.460 dB)
Maximum ERP: 0.170 kW

Total Input Power: 0.096 kW
Reference: KGRI1M.FIG

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

ERI® Vertical Plane Relative Field Pattern

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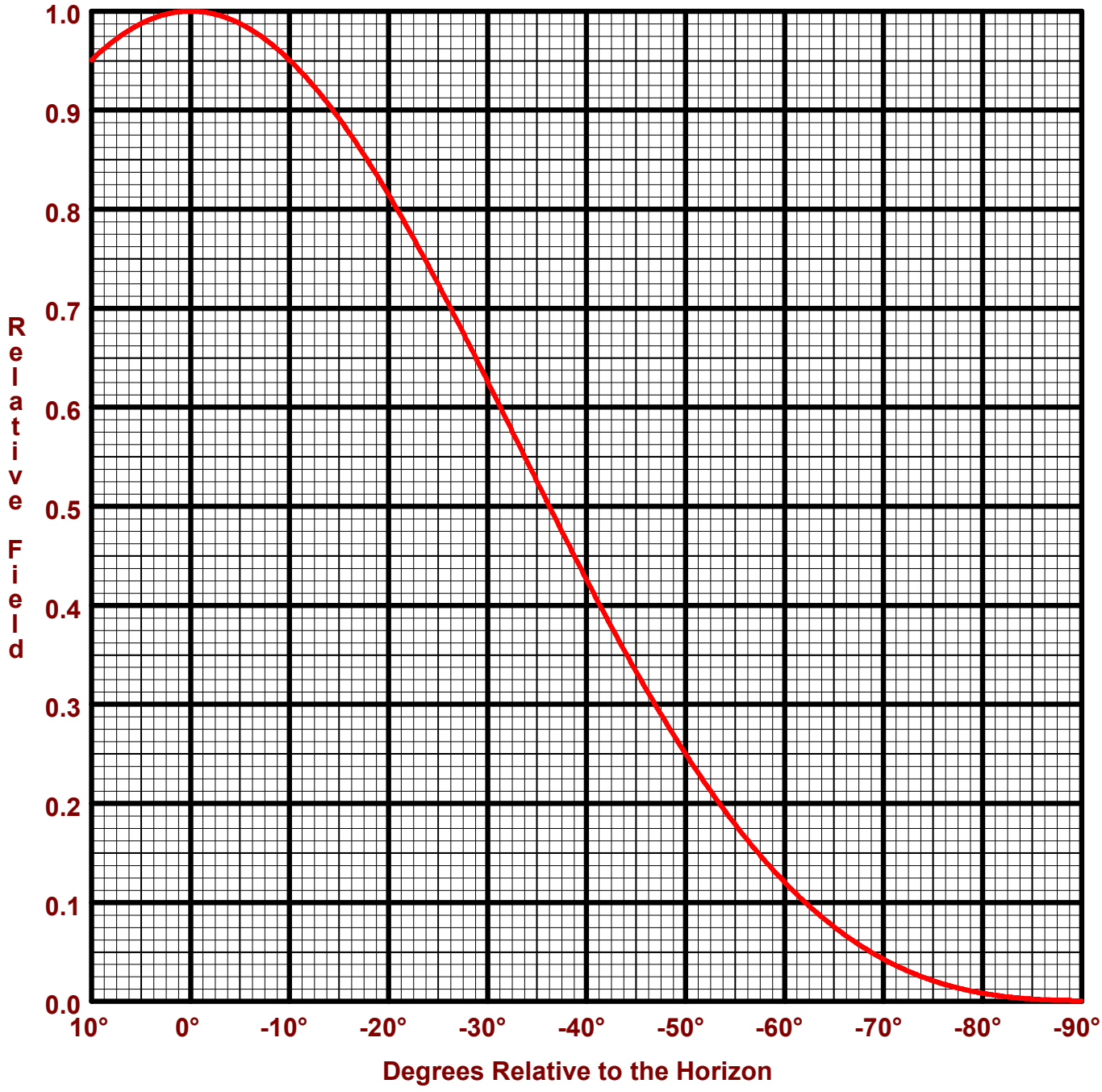
Figure No: 3
Call Sign: KGRI
Location: Lebanon, OR.
Frequency: 88.1 MHz
2 bay LP-2E-DA-HW antenna

Date: 4/23/2015
H/V Power Ratio: 1
.5 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 1.762 (2.460 dB)
Horizontal Plane: 1.762 (2.460 dB)
Maximum ERP: 0.170 kW

Vertical Polarization:
Maximum: 1.762 (2.460 dB)
Horizontal Plane: 1.762 (2.460 dB)
Maximum ERP: 0.170 kW

Directional Antenna System
for
KGRI, Lebanon, Oregon

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	LP-2E-DA-HW
Frequency:	88.1 MHz
Number of Bays:	Two

MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	14 ft 5 in
Aperture length required:	20 ft 6 in
Orientation:	6° true

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

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	0.170 kW (7.696 dBk)
Horizontal maximum power gain:	1.762 (2.460 dB)
Maximum vertical ERP:	0.170 kW (7.696 dBk)
Vertical maximum power gain:	1.762 (2.460 dB)
Total input power:	0.096 kW (-10.177 dBk)