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 KFRG, San Bernardino, California

March 3, 2016

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 KFRG.

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 and two horizontal parasitic elements per bay. The antenna was mounted on the North 207 degrees East tower leg with bracketry to provide an antenna orientation of North 197 degrees East. The antenna was tested on a self-support tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 95.1 megahertz, which is the center of the FM broadcast channel assigned to KFRG.

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
KFRG, San Bernardino, California

(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 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 self support 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.

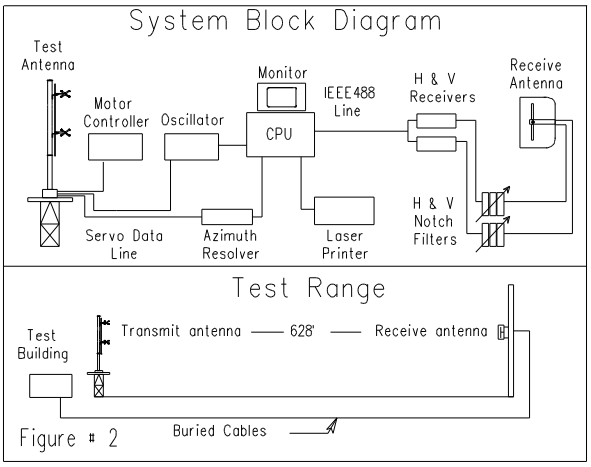

Figure # 2

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 95.1 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 two half-wavelength spaced bays using one driven circular polarized radiating element per bay and two horizontal parasitic elements per bay. 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 North 207 degrees East tower leg of the self-support tower at a bearing of North 197 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 5 kilowatts (6.99 dBk).

(Continued)

The power at North 10 degrees East does not exceed 0.165 kilowatts (-7.825 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 25 feet 2 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.

ERI® Horizontal Plane Relative Field Pattern

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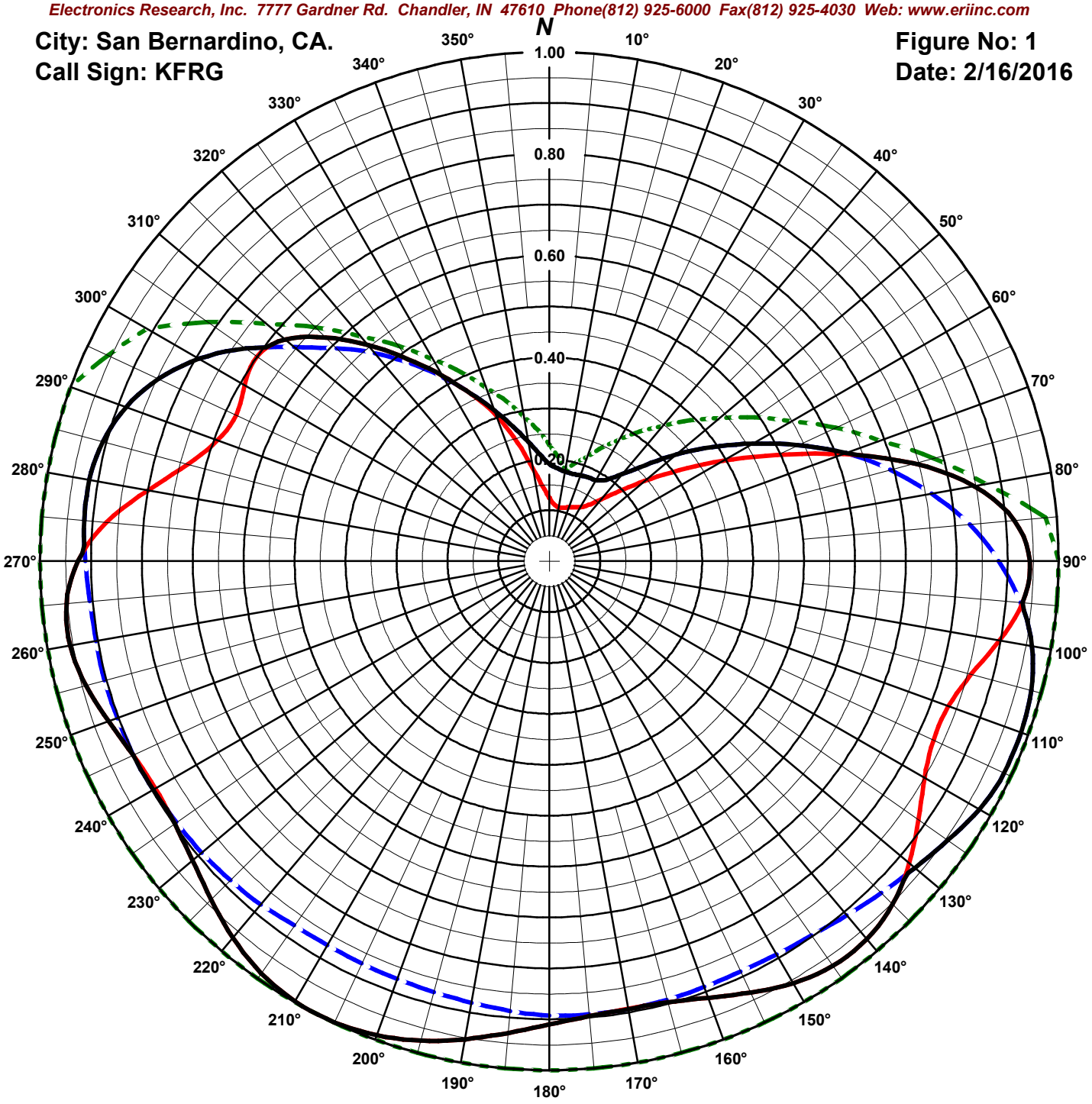
City: San Bernardino, CA.
Call Sign: KFRG

Figure No: 1
Date: 2/16/2016



Antenna Orientation: 197° True

Frequency: 95.1 MHz
Antenna Type: LP-2E-DA-HW

Antenna Mounting: Custom
Tower Type: Self support Tower

HORIZONTAL	VERTICAL	COMPOSITE	FCC ENVELOPE
RMS: .753	RMS: .753	RMS: .781	RMS: .836
Maximum: 1 @ 207°	Maximum: .986 @ 113°	Maximum: 1 @ 207°	Maximum: 1 @ 90°
Minimum: .107 @ 11°	Minimum: .177 @ 14°	Minimum: .177 @ 14°	Minimum: .181 @ 10°

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 BXPH-20151120AVE.

ERI® Horizontal Plane Relative Field Pattern

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Figure# 1 **Date: 2/16/2016**
Station: KFRG **Antenna: LP-2E-DA-HW**
Location: San Bernardino, CA. **Antenna Orientation: 197° True**
Frequency: 95.1 MHz **Number of Bays: 2**

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.191	0.182	-7.391	Vertical	180°	0.910	4.142	6.173	Horizontal
5°	0.183	0.167	-7.767	Vertical	185°	0.930	4.327	6.362	Horizontal
10°	0.179	0.159	-7.975	Vertical	190°	0.954	4.547	6.577	Horizontal
15°	0.177	0.157	-8.033	Vertical	195°	0.975	4.753	6.770	Horizontal
20°	0.179	0.160	-7.956	Vertical	200°	0.991	4.908	6.909	Horizontal
25°	0.181	0.164	-7.847	Vertical	205°	0.999	4.991	6.982	Horizontal
30°	0.184	0.169	-7.731	Vertical	210°	0.998	4.984	6.975	Horizontal
35°	0.195	0.191	-7.195	Vertical	215°	0.987	4.873	6.878	Horizontal
40°	0.223	0.248	-6.054	Vertical	220°	0.966	4.666	6.690	Horizontal
45°	0.267	0.357	-4.476	Vertical	225°	0.939	4.411	6.445	Horizontal
50°	0.326	0.532	-2.743	Vertical	230°	0.915	4.182	6.214	Horizontal
55°	0.391	0.762	-1.178	Vertical	235°	0.898	4.033	6.057	Horizontal
60°	0.462	1.065	0.275	Vertical	240°	0.898	4.034	6.057	Vertical
65°	0.539	1.450	1.614	Vertical	245°	0.901	4.063	6.088	Horizontal
70°	0.620	1.923	2.841	Vertical	250°	0.921	4.238	6.272	Horizontal
75°	0.741	2.744	4.385	Horizontal	255°	0.942	4.438	6.471	Horizontal
80°	0.847	3.590	5.551	Horizontal	260°	0.955	4.561	6.591	Horizontal
85°	0.916	4.199	6.232	Horizontal	265°	0.952	4.529	6.560	Horizontal
90°	0.944	4.452	6.485	Horizontal	270°	0.925	4.281	6.315	Horizontal
95°	0.933	4.353	6.388	Horizontal	275°	0.917	4.200	6.233	Vertical
100°	0.962	4.629	6.655	Vertical	280°	0.917	4.204	6.236	Vertical
105°	0.979	4.797	6.810	Vertical	285°	0.907	4.116	6.145	Vertical
110°	0.985	4.855	6.862	Vertical	290°	0.884	3.908	5.920	Vertical
115°	0.985	4.856	6.862	Vertical	295°	0.846	3.583	5.542	Vertical
120°	0.975	4.753	6.770	Vertical	300°	0.794	3.155	4.990	Vertical
125°	0.956	4.567	6.596	Vertical	305°	0.728	2.648	4.230	Vertical
130°	0.937	4.391	6.426	Vertical	310°	0.677	2.295	3.608	Horizontal
135°	0.954	4.546	6.576	Horizontal	315°	0.621	1.929	2.853	Horizontal
140°	0.970	4.701	6.722	Horizontal	320°	0.554	1.536	1.864	Horizontal
145°	0.970	4.707	6.728	Horizontal	325°	0.485	1.175	0.699	Horizontal
150°	0.957	4.581	6.610	Horizontal	330°	0.421	0.885	-0.532	Horizontal
155°	0.935	4.372	6.406	Horizontal	335°	0.363	0.658	-1.815	Vertical
160°	0.913	4.164	6.196	Horizontal	340°	0.315	0.497	-3.039	Vertical
165°	0.897	4.027	6.050	Horizontal	345°	0.273	0.373	-4.281	Vertical
170°	0.893	3.991	6.011	Vertical	350°	0.238	0.283	-5.479	Vertical
175°	0.897	4.025	6.048	Horizontal	355°	0.211	0.222	-6.539	Vertical

Horizontal Polarization:
Maximum: 1.177 (0.707 dB)
Horizontal Plane: 1.177 (0.707 dB)
Maximum ERP: 5.000 kW

Vertical Polarization:
Maximum: 1.144 (0.585 dB)
Horizontal Plane: 1.144 (0.585 dB)
Maximum ERP: 4.861 kW

Total Input Power: 4.249 kW
Reference: KFRG1M.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: 2/16/2016**

Station: KFRG | **Antenna: LP-2E-DA-HW**

Location: San Bernadino, CA. | **Antenna Orientation: 197° True**

Frequency: 95.1 MHz | **Number of Bays: 2**

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.124	0.077	-11.136	0.191	0.182	-7.391	180°	0.910	4.142	6.173	0.892	3.981	6.000
5°	0.112	0.063	-12.039	0.183	0.167	-7.767	185°	0.930	4.327	6.362	0.887	3.933	5.947
10°	0.107	0.057	-12.409	0.179	0.159	-7.975	190°	0.954	4.547	6.577	0.881	3.878	5.886
15°	0.108	0.059	-12.303	0.177	0.157	-8.033	195°	0.975	4.753	6.770	0.876	3.838	5.841
20°	0.113	0.063	-11.973	0.179	0.160	-7.956	200°	0.991	4.908	6.909	0.873	3.815	5.814
25°	0.117	0.068	-11.649	0.181	0.164	-7.847	205°	0.999	4.991	6.982	0.872	3.800	5.798
30°	0.122	0.075	-11.250	0.184	0.169	-7.731	210°	0.998	4.984	6.975	0.871	3.793	5.790
35°	0.135	0.091	-10.429	0.195	0.191	-7.195	215°	0.987	4.873	6.878	0.873	3.813	5.812
40°	0.158	0.125	-9.031	0.223	0.248	-6.054	220°	0.966	4.666	6.690	0.881	3.878	5.886
45°	0.195	0.190	-7.222	0.267	0.357	-4.476	225°	0.939	4.411	6.445	0.886	3.924	5.937
50°	0.245	0.300	-5.230	0.326	0.532	-2.743	230°	0.915	4.182	6.214	0.891	3.967	5.984
55°	0.311	0.484	-3.148	0.391	0.762	-1.178	235°	0.898	4.033	6.057	0.894	3.997	6.018
60°	0.394	0.776	-1.103	0.462	1.065	0.275	240°	0.893	3.989	6.009	0.898	4.034	6.057
65°	0.493	1.216	0.851	0.539	1.450	1.614	245°	0.901	4.063	6.088	0.901	4.061	6.086
70°	0.614	1.884	2.750	0.620	1.923	2.841	250°	0.921	4.238	6.272	0.902	4.072	6.098
75°	0.741	2.744	4.385	0.693	2.401	3.804	255°	0.942	4.438	6.471	0.904	4.090	6.117
80°	0.847	3.590	5.551	0.762	2.903	4.629	260°	0.955	4.561	6.591	0.904	4.086	6.113
85°	0.916	4.199	6.232	0.828	3.431	5.354	265°	0.952	4.529	6.560	0.905	4.099	6.127
90°	0.944	4.452	6.485	0.883	3.894	5.904	270°	0.925	4.281	6.315	0.911	4.151	6.182
95°	0.933	4.353	6.388	0.929	4.318	6.353	275°	0.873	3.813	5.812	0.917	4.200	6.233
100°	0.897	4.027	6.049	0.962	4.629	6.655	280°	0.800	3.199	5.051	0.917	4.204	6.236
105°	0.858	3.682	5.660	0.979	4.797	6.810	285°	0.735	2.698	4.311	0.907	4.116	6.145
110°	0.834	3.479	5.414	0.985	4.855	6.862	290°	0.693	2.402	3.806	0.884	3.908	5.920
115°	0.832	3.463	5.395	0.985	4.856	6.862	295°	0.678	2.301	3.620	0.846	3.583	5.542
120°	0.851	3.620	5.587	0.975	4.753	6.770	300°	0.691	2.385	3.776	0.794	3.155	4.990
125°	0.885	3.914	5.926	0.956	4.567	6.596	305°	0.700	2.453	3.898	0.728	2.648	4.230
130°	0.923	4.260	6.294	0.937	4.391	6.426	310°	0.677	2.295	3.608	0.654	2.136	3.297
135°	0.954	4.546	6.576	0.922	4.248	6.282	315°	0.621	1.929	2.853	0.591	1.747	2.423
140°	0.970	4.701	6.722	0.908	4.125	6.154	320°	0.554	1.536	1.864	0.533	1.423	1.532
145°	0.970	4.707	6.728	0.897	4.027	6.050	325°	0.485	1.175	0.699	0.473	1.120	0.493
150°	0.957	4.581	6.610	0.892	3.982	6.001	330°	0.421	0.885	-0.532	0.416	0.867	-0.620
155°	0.935	4.372	6.406	0.889	3.954	5.971	335°	0.361	0.653	-1.852	0.363	0.658	-1.815
160°	0.913	4.164	6.196	0.890	3.962	5.979	340°	0.305	0.465	-3.328	0.315	0.497	-3.039
165°	0.897	4.027	6.050	0.892	3.977	5.996	345°	0.241	0.290	-5.377	0.273	0.373	-4.281
170°	0.893	3.983	6.002	0.893	3.991	6.011	350°	0.185	0.171	-7.662	0.238	0.283	-5.479
175°	0.897	4.025	6.048	0.894	3.992	6.012	355°	0.147	0.108	-9.677	0.211	0.222	-6.539

Horizontal Polarization:
Maximum: 1.177 (0.707 dB)
Horizontal Plane: 1.177 (0.707 dB)
Maximum ERP: 5.000 kW

Vertical Polarization:
Maximum: 1.144 (0.585 dB)
Horizontal Plane: 1.144 (0.585 dB)
Maximum ERP: 4.861 kW

Total Input Power: 4.249 kW
Reference: KFRG1M.FIG
This list shows the azimuth values for the horizontal and vertical components.

Vertical Plane Relative Field Pattern

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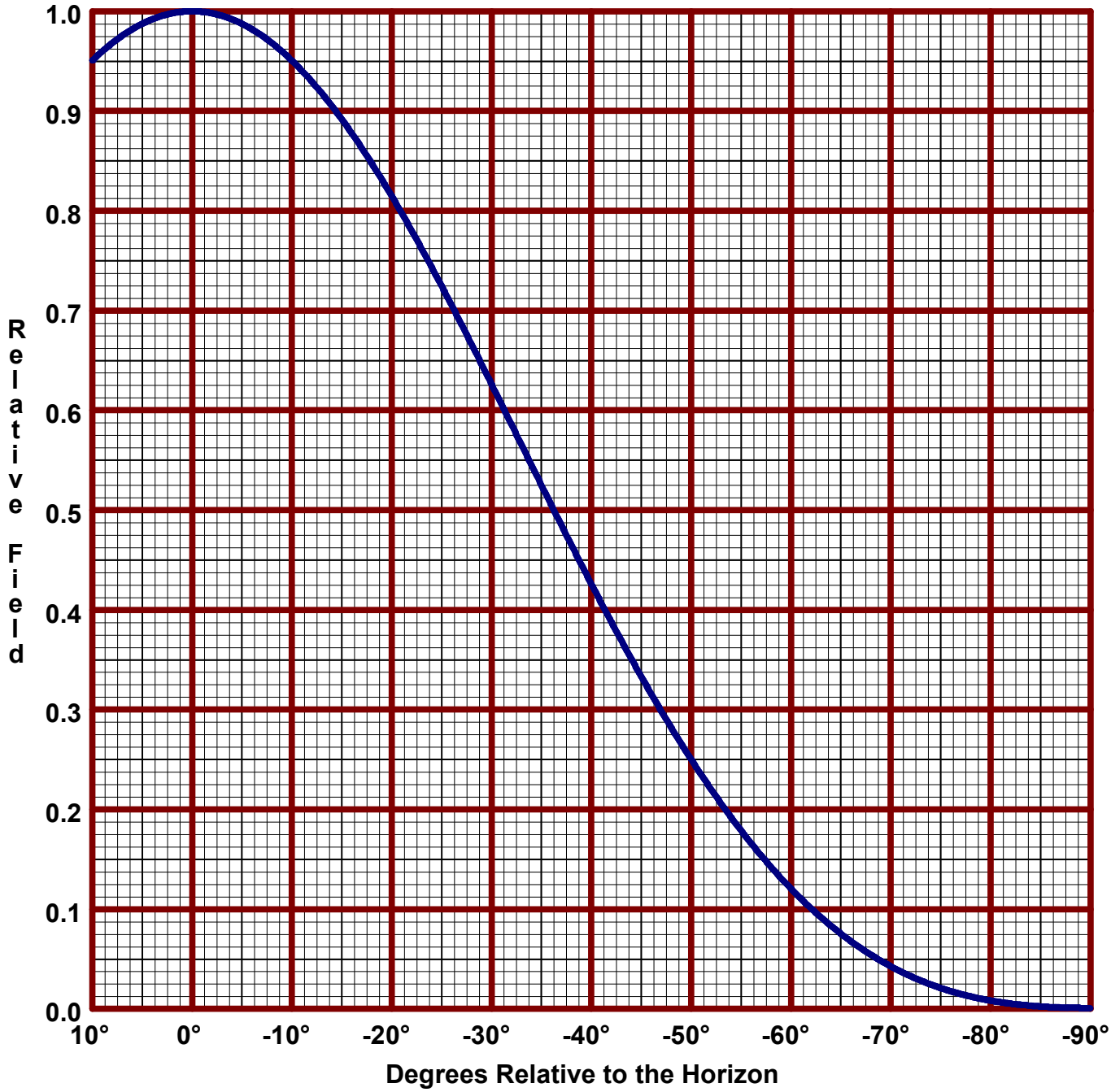
Figure No: 3
Call Sign: KFRG
Location: San Bernardino, CA.
Frequency: 95.1 MHz
Antenna: 2 bay LP-2E-DA-HW

Date: 2/16/2016
H/V Power Ratio: 0.972
.5 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 1.177 (0.707 dB)
Horizontal Plane: 1.177 (0.707 dB)
Maximum ERP: 5.000 kW

Vertical Polarization:
Maximum: 1.144 (0.585 dB)
Horizontal Plane: 1.144 (0.585 dB)
Maximum ERP: 4.861 kW

Directional Antenna System
for
KFRG, San Bernardino, California

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	LP-2E-DA-HW
Frequency:	95.1 MHz
Number of Bays:	Two

MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	13 ft 10 in
Aperture length required:	25 ft 2 in
Orientation:	197° true

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

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	5.000 kW (6.99 dBk)
Horizontal maximum power gain:	1.177 (0.707 dB)
Maximum vertical ERP:	4.861 kW (6.867 dBk)
Vertical maximum power gain:	1.144 (0.585 dB)
Total input power:	4.249 kW (6.283 dBk)