

***Directional Antenna System
for
KQKS, Lakewood, Colorado***

July 7, 2017

Electronics Research Inc. is providing a custom fabricated diplexed antenna system that is specially designed to meet the FCC requirements and the general needs of radio station KQKS.

The antenna is the ERI model 1051-2CP-DA-SP configuration. The circular polarized system consists of two 60" spaced bays using one driven circular polarized radiating element per bay. The antenna was mounted on the North 60 degrees East tower leg with bracketry to provide an antenna orientation of North 70 degrees East. The antenna was tested on a Stainless G 8 tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 107.5 megahertz, which is the center of the FM broadcast channel assigned to KQKS. The antenna system is diplexed with KQMT, Denver, Colorado at 99.5 MHz.

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 KQKS, Lakewood, Colorado

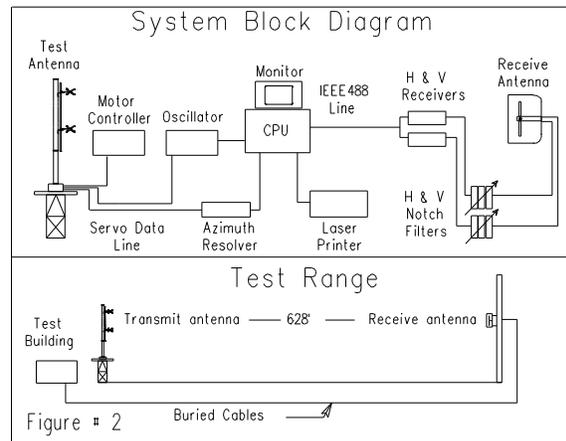
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DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of one bay level of the circular polarized system. The elements and brackets that were used in this test are electrically equivalent to those that will be supplied with the antenna.

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 Stainless G 8 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.



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 107.5 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. 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 Helix cables to a Rohde & Schwarz measuring receiver.

Directional Antenna System For KQKS, Lakewood, Colorado

(Continued)

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 two 60" spaced bays using one driven circular polarized radiating element 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 1051-2CP-DA-SP array is to be mounted on the North 60 degrees East tower leg of the Stainless G 8 tower at a bearing of North 70 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 33.000 kilowatts (15.185 dBk).

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

The clear vertical length of the structure required to support the antenna is 25 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.

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(Continued)

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.

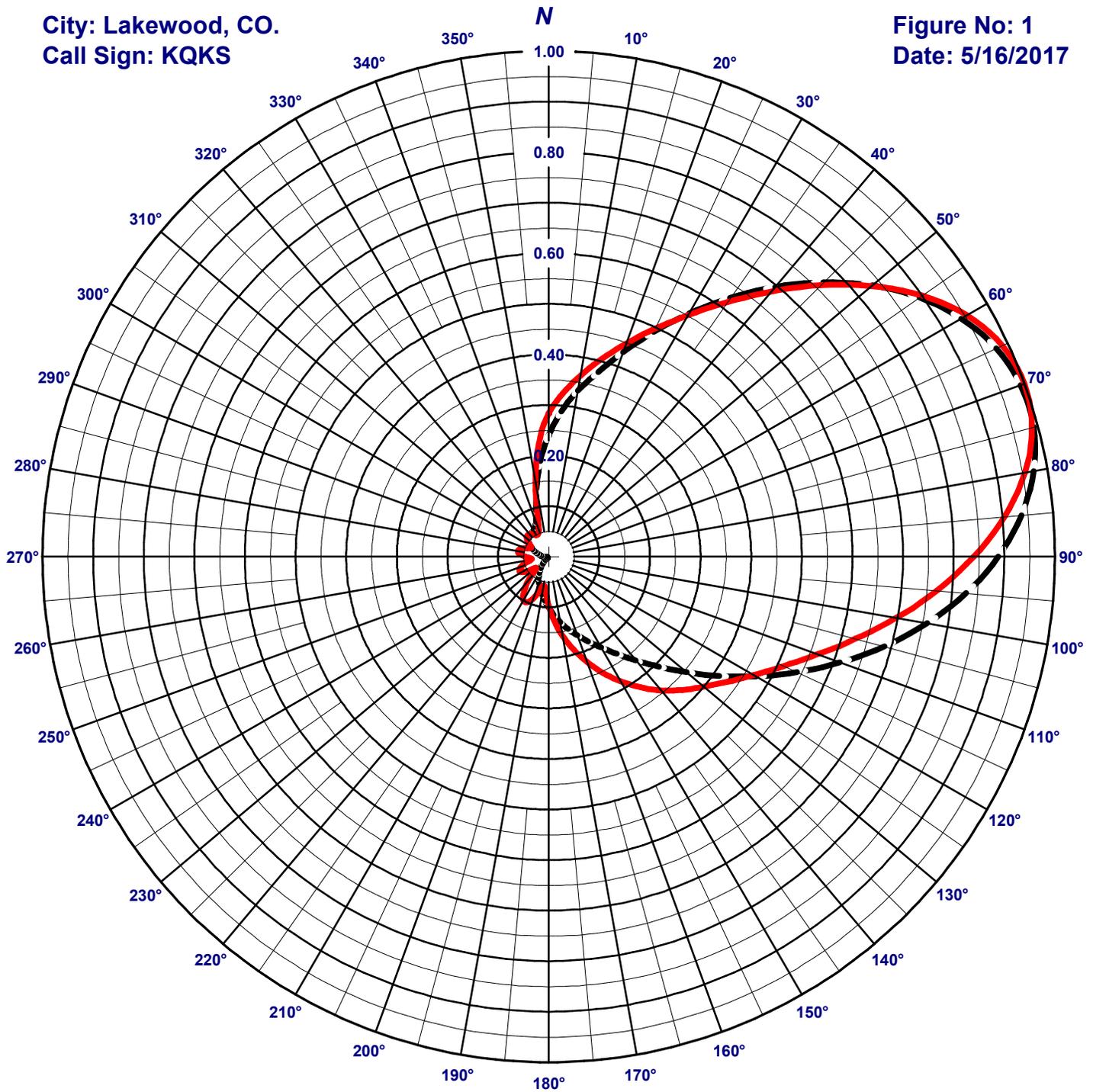
A handwritten signature in black ink, appearing to read "Tom Schaefer". The signature is written in a cursive style with a large, looping initial "T".

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

City: Lakewood, CO.
Call Sign: KQKS

Figure No: 1
Date: 5/16/2017



Frequency: 107.5 MHz
Antenna Type: 1051-2CP-DA-SP
Antenna Orientation: 70° True
Antenna Mounting: Custom
Tower Type Stainless G 8 tower

VERTICAL

RMS: .44
Maximum: .994 @ 73°
Minimum: .004 @ 253°

HORIZONTAL

RMS: .44
Maximum: 1 @ 70°
Minimum: .033 @ 228°

Measured patterns of the horizontal and vertical components.

ERI[®] Horizontal 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# 1

Station: KQKS

Location: Lakewood, CO.

Frequency: 107.5 MHz

Date: 5/16/2017

Antenna: 1051-2CP-DA-SP

Antenna Orientation: 70° True

Number of Bays: 2

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.284	2.656	4.242	Horizontal	180°	0.101	0.337	-4.725	Vertical
5°	0.324	3.466	5.398	Horizontal	185°	0.087	0.252	-5.978	Vertical
10°	0.364	4.372	6.406	Horizontal	190°	0.076	0.188	-7.250	Vertical
15°	0.405	5.411	7.333	Horizontal	195°	0.070	0.161	-7.930	Horizontal
20°	0.449	6.650	8.228	Horizontal	200°	0.088	0.253	-5.965	Horizontal
25°	0.498	8.178	9.127	Horizontal	205°	0.099	0.323	-4.905	Horizontal
30°	0.555	10.175	10.075	Vertical	210°	0.100	0.329	-4.834	Horizontal
35°	0.624	12.869	11.095	Vertical	215°	0.086	0.243	-6.135	Horizontal
40°	0.696	15.995	12.040	Vertical	220°	0.063	0.131	-8.827	Horizontal
45°	0.767	19.435	12.886	Vertical	225°	0.040	0.052	-12.873	Horizontal
50°	0.834	22.973	13.612	Vertical	230°	0.035	0.039	-14.050	Horizontal
55°	0.900	26.745	14.272	Horizontal	235°	0.048	0.076	-11.166	Horizontal
60°	0.954	30.038	14.777	Horizontal	240°	0.061	0.122	-9.135	Horizontal
65°	0.989	32.255	15.086	Horizontal	245°	0.064	0.135	-8.684	Horizontal
70°	1.000	33.000	15.185	Horizontal	250°	0.058	0.110	-9.590	Horizontal
75°	0.992	32.459	15.113	Vertical	255°	0.046	0.070	-11.574	Horizontal
80°	0.973	31.226	14.945	Vertical	260°	0.036	0.043	-13.695	Horizontal
85°	0.937	28.990	14.622	Vertical	265°	0.036	0.044	-13.598	Horizontal
90°	0.888	26.048	14.158	Vertical	270°	0.046	0.071	-11.475	Horizontal
95°	0.828	22.620	13.545	Vertical	275°	0.057	0.107	-9.696	Horizontal
100°	0.759	19.012	12.790	Vertical	280°	0.062	0.125	-9.015	Horizontal
105°	0.686	15.546	11.916	Vertical	285°	0.059	0.114	-9.445	Horizontal
110°	0.612	12.377	10.926	Vertical	290°	0.049	0.080	-10.964	Horizontal
115°	0.541	9.657	9.848	Vertical	295°	0.040	0.054	-12.678	Horizontal
120°	0.473	7.393	8.688	Vertical	300°	0.041	0.056	-12.530	Vertical
125°	0.432	6.145	7.885	Horizontal	305°	0.048	0.077	-11.151	Horizontal
130°	0.400	5.275	7.222	Horizontal	310°	0.056	0.103	-9.885	Horizontal
135°	0.373	4.583	6.612	Horizontal	315°	0.059	0.115	-9.380	Horizontal
140°	0.345	3.931	5.945	Horizontal	320°	0.058	0.111	-9.562	Horizontal
145°	0.315	3.283	5.162	Horizontal	325°	0.057	0.109	-9.641	Vertical
150°	0.284	2.671	4.267	Horizontal	330°	0.060	0.118	-9.282	Vertical
155°	0.254	2.127	3.278	Horizontal	335°	0.064	0.137	-8.633	Vertical
160°	0.222	1.623	2.104	Horizontal	340°	0.073	0.176	-7.533	Vertical
165°	0.190	1.192	0.764	Horizontal	345°	0.095	0.297	-5.272	Vertical
170°	0.159	0.836	-0.777	Horizontal	350°	0.149	0.729	-1.373	Horizontal
175°	0.128	0.542	-2.658	Horizontal	355°	0.224	1.661	2.205	Horizontal

Horizontal Polarization:

Maximum: 3.687 (5.667 dB)

Horizontal Plane: 3.687 (5.667 dB)

Maximum ERP: 33.000 kW

Vertical Polarization:

Maximum: 3.642 (5.614 dB)

Horizontal Plane: 3.642 (5.614 dB)

Maximum ERP: 32.600 kW

Total Input Power: 8.951 kW

Reference: KQKS1M.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: 5/16/2017

Station: KQKS

Antenna: 1051-2CP-DA-SP

Location: Lakewood, CO.

Antenna Orientation: 70° True

Frequency: 107.5 MHz

Number of Bays: 2

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.284	2.656	4.242	0.241	1.910	2.811	180°	0.097	0.308	-5.119	0.101	0.337	-4.725
5°	0.324	3.466	5.398	0.288	2.746	4.387	185°	0.068	0.154	-8.112	0.087	0.252	-5.978
10°	0.364	4.372	6.406	0.334	3.680	5.658	190°	0.058	0.111	-9.547	0.076	0.188	-7.250
15°	0.405	5.411	7.333	0.378	4.712	6.732	195°	0.070	0.161	-7.930	0.065	0.141	-8.498
20°	0.449	6.650	8.228	0.431	6.119	7.867	200°	0.088	0.253	-5.965	0.056	0.104	-9.843
25°	0.498	8.178	9.127	0.490	7.937	8.997	205°	0.099	0.323	-4.905	0.047	0.072	-11.419
30°	0.552	10.053	10.023	0.555	10.175	10.075	210°	0.100	0.329	-4.834	0.037	0.046	-13.391
35°	0.614	12.445	10.950	0.624	12.869	11.095	215°	0.086	0.243	-6.135	0.028	0.025	-15.988
40°	0.685	15.472	11.895	0.696	15.995	12.040	220°	0.063	0.131	-8.827	0.018	0.011	-19.655
45°	0.759	19.030	12.794	0.767	19.435	12.886	225°	0.040	0.052	-12.873	0.009	0.003	-25.317
50°	0.833	22.882	13.595	0.834	22.973	13.612	230°	0.035	0.039	-14.050	0.005	0.001	-31.480
55°	0.900	26.745	14.272	0.894	26.359	14.209	235°	0.048	0.076	-11.166	0.004	0.001	-32.704
60°	0.954	30.038	14.777	0.942	29.259	14.663	240°	0.061	0.122	-9.135	0.005	0.001	-30.453
65°	0.989	32.255	15.086	0.976	31.413	14.971	245°	0.064	0.135	-8.684	0.005	0.001	-30.948
70°	1.000	33.000	15.185	0.992	32.468	15.115	250°	0.058	0.110	-9.590	0.004	0.000	-33.348
75°	0.988	32.212	15.080	0.992	32.459	15.113	255°	0.046	0.070	-11.574	0.004	0.000	-33.401
80°	0.955	30.113	14.788	0.973	31.226	14.945	260°	0.036	0.043	-13.695	0.006	0.001	-29.962
85°	0.904	26.939	14.304	0.937	28.990	14.622	265°	0.036	0.044	-13.598	0.008	0.002	-26.504
90°	0.840	23.274	13.669	0.888	26.048	14.158	270°	0.046	0.071	-11.475	0.011	0.004	-23.704
95°	0.770	19.582	12.919	0.828	22.620	13.545	275°	0.057	0.107	-9.696	0.015	0.007	-21.429
100°	0.697	16.044	12.053	0.759	19.012	12.790	280°	0.062	0.125	-9.015	0.018	0.011	-19.545
105°	0.628	13.001	11.140	0.686	15.546	11.916	285°	0.059	0.114	-9.445	0.023	0.017	-17.689
110°	0.565	10.522	10.221	0.612	12.377	10.926	290°	0.049	0.080	-10.964	0.029	0.027	-15.611
115°	0.512	8.649	9.370	0.541	9.657	9.848	295°	0.040	0.054	-12.678	0.035	0.040	-13.961
120°	0.468	7.231	8.592	0.473	7.393	8.688	300°	0.041	0.055	-12.616	0.041	0.056	-12.530
125°	0.432	6.145	7.885	0.411	5.579	7.466	305°	0.048	0.077	-11.151	0.047	0.074	-11.322
130°	0.400	5.275	7.222	0.356	4.172	6.203	310°	0.056	0.103	-9.885	0.052	0.090	-10.468
135°	0.373	4.583	6.612	0.308	3.127	4.951	315°	0.059	0.115	-9.380	0.055	0.101	-9.956
140°	0.345	3.931	5.945	0.268	2.370	3.747	320°	0.058	0.111	-9.562	0.057	0.105	-9.769
145°	0.315	3.283	5.162	0.235	1.817	2.592	325°	0.054	0.094	-10.248	0.057	0.109	-9.641
150°	0.284	2.671	4.267	0.207	1.419	1.521	330°	0.049	0.081	-10.931	0.060	0.118	-9.282
155°	0.254	2.127	3.278	0.185	1.125	0.512	335°	0.050	0.081	-10.898	0.064	0.137	-8.633
160°	0.222	1.623	2.104	0.166	0.905	-0.431	340°	0.057	0.108	-9.648	0.073	0.176	-7.533
165°	0.190	1.192	0.764	0.148	0.725	-1.394	345°	0.086	0.244	-6.134	0.095	0.297	-5.272
170°	0.159	0.836	-0.777	0.132	0.572	-2.429	350°	0.149	0.729	-1.373	0.137	0.619	-2.085
175°	0.128	0.542	-2.658	0.116	0.442	-3.542	355°	0.224	1.661	2.205	0.190	1.189	0.753

Horizontal Polarization:

Maximum: 3.687 (5.667 dB)

Horizontal Plane: 3.687 (5.667 dB)

Maximum ERP: 33.000 kW

Vertical Polarization:

Maximum: 3.642 (5.614 dB)

Horizontal Plane: 3.642 (5.614 dB)

Maximum ERP: 32.600 kW

Total Input Power: 8.951 kW

Reference: KQKS1M.FIG

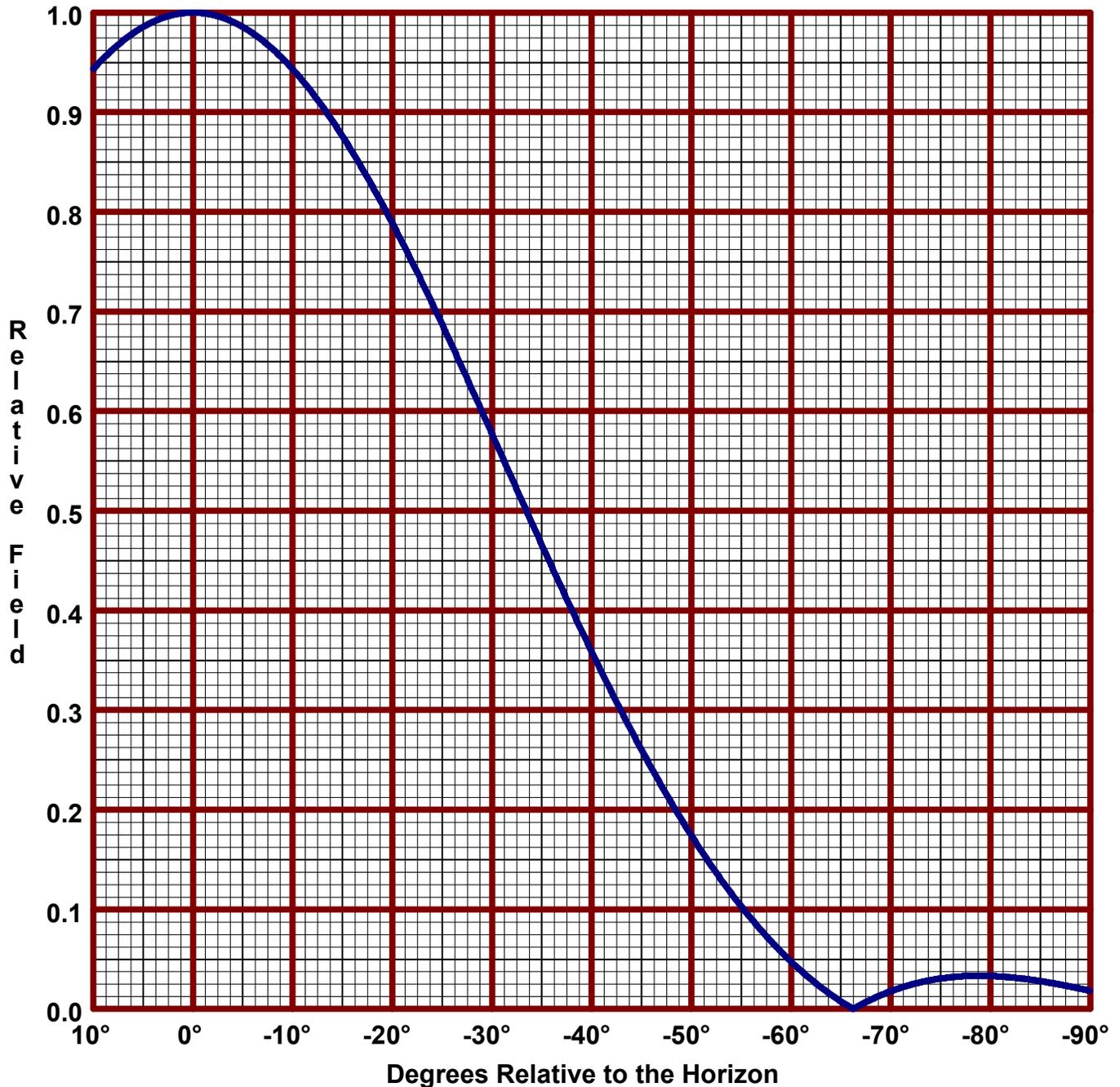
This list shows the azimuth values for the horizontal and vertical components.

ERI[®] Vertical Plane Relative Field Pattern

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Figure No: 3
Call Sign: KQKS
Location: Lakewood, CO.
Frequency: 107.5 MHz
Antenna: 2 bay 1051-2CP-DA

Date: 5/16/2017
H/V Power Ratio: 1
.548 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 3.687 (5.667 dB)
Horizontal Plane: 3.687 (5.667 dB)
Maximum ERP: 33.000 kW

Vertical Polarization:
Maximum: 3.642 (5.614 dB)
Horizontal Plane: 3.642 (5.614 dB)
Maximum ERP: 32.600 kW

Directional Antenna System for KQKS, Lakewood, Colorado

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type: 1051-2C-DA-SP
Frequency: 107.5 MHz
Number of Bays: Two

MECHANICAL SPECIFICATIONS

Mounting: Custom
System length: 15 ft 5 in
Aperture length required: 25
Orientation: 70° true
Input flange to the antenna 6 1/8" female.

ELECTRICAL SPECIFICATIONS

(For directional use)

Maximum horizontal ERP: 33.00 kW (15.185 dBk)
Horizontal maximum power gain: 3.687 (5.667 dB)
Maximum vertical ERP: 32.600 kW (15.132 dBk)
Vertical maximum power gain: 3.642 (5.614 dB)
Total input power: 8.951 kW (9.187 dBk)