

***Directional Antenna System  
For  
KALC, Denver, Colorado***

April 6, 2010

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

The antenna is the ERI model 1082-8CP-DA configuration. The circular polarized system consists of eight 92" spaced bays using two driven circular polarized radiating elements per bay. The antenna was tested on a 60" face ERI tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 105.9 megahertz, which is the center of the FM broadcast channel assigned to KALC.

The other FM stations that will be transmitting from this directional antenna are KDJM @ 92.5 MHz, KCTL @ 93.3 MHz, KFMD @ 95.7 MHz, KRFX @ 103.5 MHz, and KBPI @ 106.7 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 KALC, Denver, Colorado

(Continued)

## DESCRIPTION OF THE TEST PROCEDURE

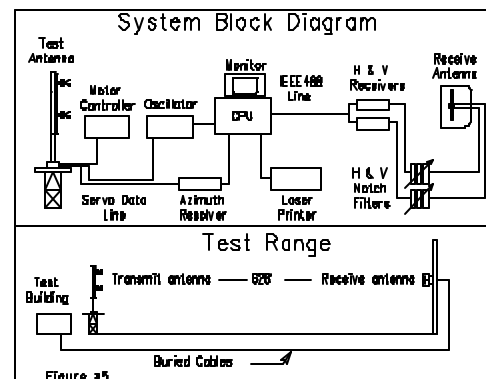
The test antenna consisted of four bay levels of the circular polarized system. The elements and brackets that were used in this test are the actual components that will be supplied with the antenna. The lines were properly grounded during all tests.

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 60" face ERI 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 azimuth indicating mechanism, resolution of this azimuth measuring device is one-tenth of a degree.

The antenna under test was operated in the transmitting mode and fed from a Wavetek Model 3000 signal generator. The frequency of the signal source was set at 105.9 MHz and was constantly monitored by an Anritsu Model ML521B measuring receiver.

A broad-band 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 an Anritsu Model ML521B measuring receiver.



# Directional Antenna System For KALC, Denver, Colorado

(Continued)

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

## CONCLUSIONS

The circular polarized system consists of eight 92" spaced bays using two driven circular polarized radiating 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 1082-8CP-DA array is to be mounted on the 60" face ERI tower at a bearing of North 51.5 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. A calculated vertical plane relative field pattern is shown on Figure #3D attached. The power in the maximum will reach 25.000 kilowatts (13.979 dBk).

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

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(Continued)

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 cursive script, appearing to read "Tom Schaefer". The signature is written in black ink and is positioned below the company name.

# **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: 1

STATION: KALC

LOCATION: DENVER, CO.

ANTENNA TYPE: 1082-8CP-DA

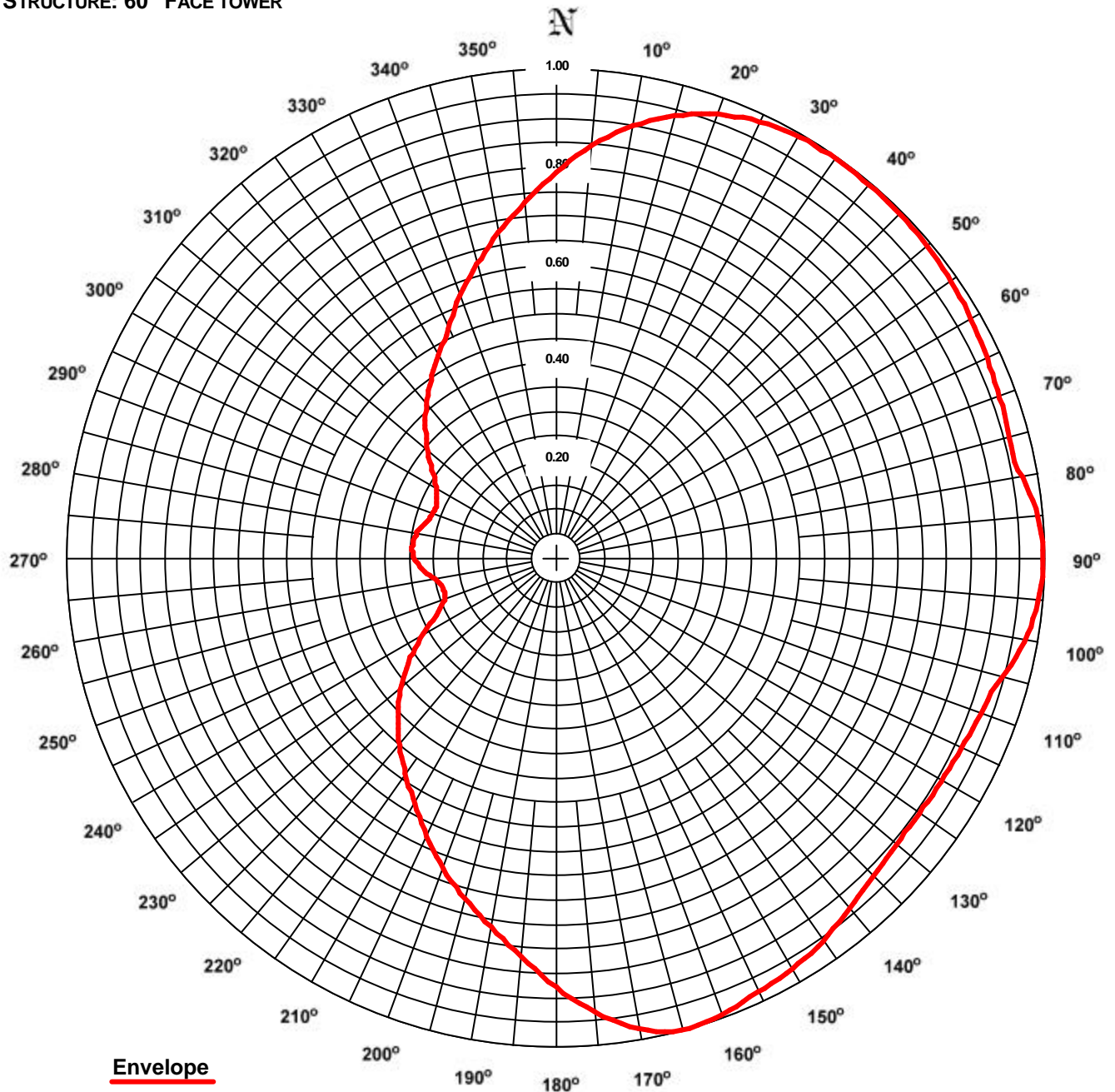
STRUCTURE: 60" FACE TOWER

DATE: 4/6/10

FREQUENCY: 105.9 MHz

ORIENTATION: 51.5° TRUE

MOUNTING: CUSTOM



RMS: 0.760

Maximum: 1.000 @ 32° True

Minimum: 0.236 @ 253° True

COMMENTS: COMPOSITE PATTERN: THIS PATTERN SHOWS THE MAXIMUM OF EITHER THE H OR V AZIMUTH VALUES.

# ERI<sup>®</sup> *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: KALC**  
**Location: Denver, CO.**  
**Frequency: 105.9 MHz**

**Antenna: 1082-8CP-DA**  
**Orientation: 51.5° True**  
**Tower: 60" Face**

**Figure: 1**  
**Date: 4/6/10**  
**Reference: lalc1m**

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.792	15.69	11.96	Horizontal	180°	0.875	19.13	12.82	Vertical
5°	0.851	18.11	12.58	Horizontal	185°	0.816	16.63	12.21	Vertical
10°	0.900	20.27	13.07	Horizontal	190°	0.763	14.55	11.63	Vertical
15°	0.940	22.08	13.44	Horizontal	195°	0.718	12.88	11.10	Vertical
20°	0.969	23.49	13.71	Horizontal	200°	0.673	11.32	10.54	Vertical
25°	0.989	24.45	13.88	Horizontal	205°	0.624	9.75	9.89	Vertical
30°	0.999	24.94	13.97	Horizontal	210°	0.577	8.34	9.21	Vertical
35°	1.000	25.00	13.98	Horizontal	215°	0.536	7.19	8.57	Vertical
40°	1.000	24.98	13.98	Horizontal	220°	0.498	6.19	7.92	Vertical
45°	0.998	24.88	13.96	Horizontal	225°	0.457	5.22	7.18	Vertical
50°	0.994	24.71	13.93	Horizontal	230°	0.415	4.30	6.33	Vertical
55°	0.989	24.45	13.88	Horizontal	235°	0.368	3.39	5.30	Vertical
60°	0.982	24.12	13.82	Horizontal	240°	0.320	2.57	4.09	Vertical
65°	0.974	23.73	13.75	Horizontal	245°	0.271	1.84	2.65	Vertical
70°	0.967	23.40	13.69	Horizontal	250°	0.242	1.47	1.66	Vertical
75°	0.962	23.15	13.65	Horizontal	255°	0.238	1.41	1.50	Vertical
80°	0.970	23.53	13.72	Vertical	260°	0.249	1.55	1.90	Vertical
85°	0.990	24.50	13.89	Vertical	265°	0.271	1.83	2.63	Vertical
90°	0.997	24.87	13.96	Vertical	270°	0.289	2.08	3.19	Vertical
95°	0.991	24.53	13.90	Vertical	275°	0.295	2.18	3.39	Vertical
100°	0.973	23.65	13.74	Vertical	280°	0.291	2.11	3.25	Vertical
105°	0.943	22.24	13.47	Vertical	285°	0.279	1.95	2.89	Vertical
110°	0.925	21.37	13.30	Horizontal	290°	0.270	1.82	2.60	Vertical
115°	0.915	20.95	13.21	Horizontal	295°	0.270	1.82	2.59	Vertical
120°	0.909	20.68	13.15	Horizontal	300°	0.282	1.99	2.98	Vertical
125°	0.907	20.56	13.13	Horizontal	305°	0.306	2.35	3.71	Vertical
130°	0.909	20.67	13.15	Horizontal	310°	0.342	2.92	4.65	Vertical
135°	0.918	21.07	13.24	Horizontal	315°	0.377	3.55	5.51	Vertical
140°	0.933	21.76	13.38	Horizontal	320°	0.413	4.26	6.29	Vertical
145°	0.953	22.69	13.56	Horizontal	325°	0.447	4.99	6.98	Vertical
150°	0.968	23.41	13.69	Horizontal	330°	0.482	5.81	7.64	Vertical
155°	0.976	23.84	13.77	Horizontal	335°	0.520	6.77	8.31	Horizontal
160°	0.992	24.59	13.91	Vertical	340°	0.575	8.27	9.18	Horizontal
165°	0.996	24.82	13.95	Vertical	345°	0.626	9.79	9.91	Horizontal
170°	0.975	23.77	13.76	Vertical	350°	0.679	11.53	10.62	Horizontal
175°	0.929	21.56	13.34	Vertical	355°	0.733	13.45	11.29	Horizontal

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

**Envelope**  
**1.000 @ 32° True**  
**0.236 @ 253° True**  
**0.760**  
**25.000 kW**  
**7.053 (8.484 dB)**

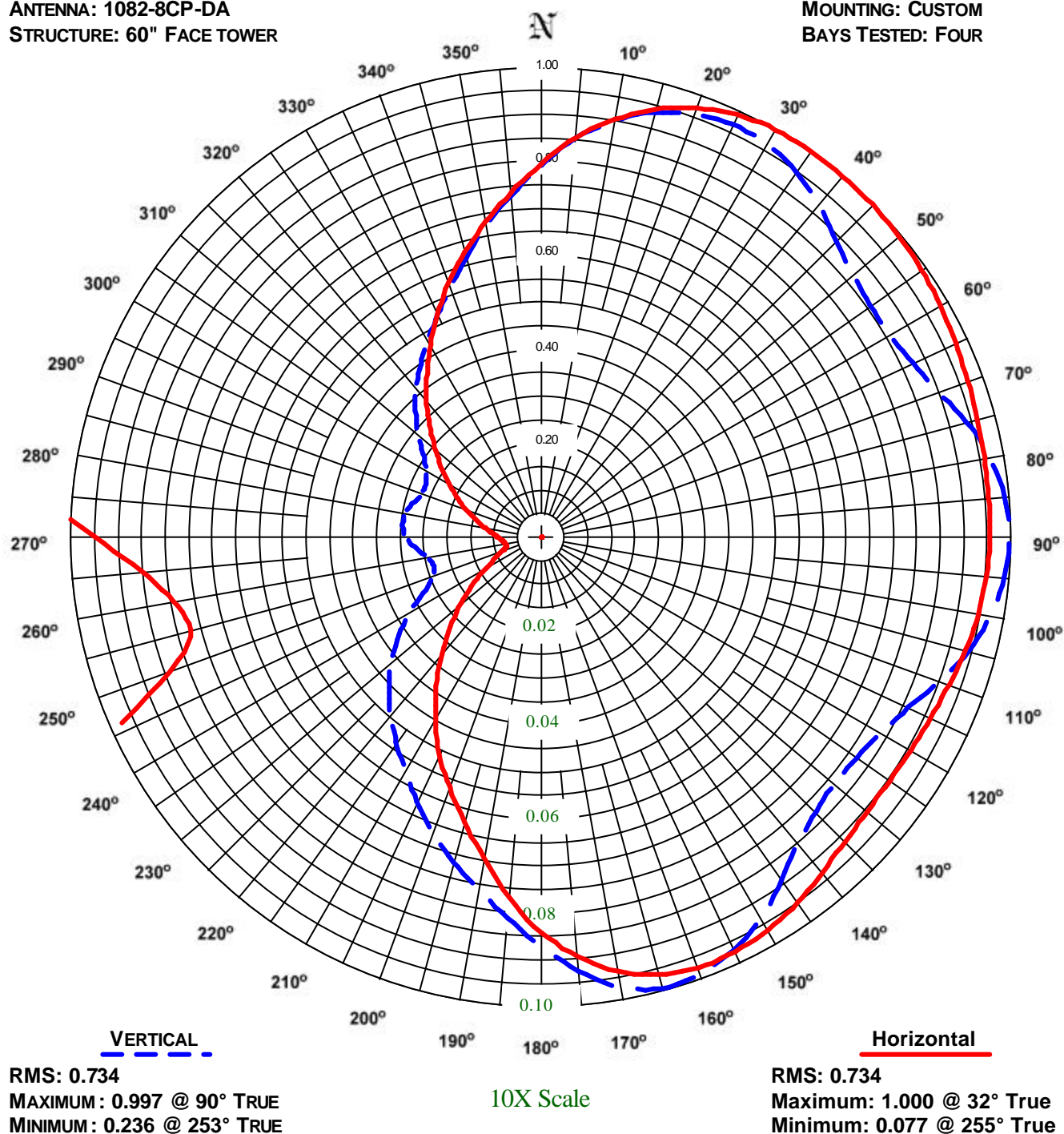
**Total Input Power: 3.544 kW**

# **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: KALC  
LOCATION: DENVER, CO.  
ANTENNA: 1082-8CP-DA  
STRUCTURE: 60" FACE TOWER

DATE: 4/6/10  
FREQUENCY: 105.9 MHz  
ORIENTATION: 51.5° TRUE  
MOUNTING: CUSTOM  
BAYS TESTED: FOUR



COMMENTS: MEASURED PATTERNS OF THE HORIZONTAL AND VERTICAL COMPONENTS.

# ERI<sup>®</sup> *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: KALC**  
**Location: Denver, CO.**  
**Frequency: 105.9 MHz**

**Antenna: 1082-8CP-DA**  
**Orientation: 51.5° True**  
**Tower: 60" Face**

**Figure: 2**  
**Date: 4/6/10**  
**Reference: lalc1m.fig**

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.792	15.69	11.96	0.788	15.54	11.91	180°	0.843	17.76	12.49	0.875	19.13	12.82
5°	0.851	18.11	12.58	0.849	18.04	12.56	185°	0.772	14.90	11.73	0.816	16.63	12.21
10°	0.900	20.27	13.07	0.898	20.15	13.04	190°	0.695	12.09	10.82	0.763	14.55	11.63
15°	0.940	22.08	13.44	0.933	21.78	13.38	195°	0.629	9.90	9.96	0.718	12.88	11.10
20°	0.969	23.49	13.71	0.956	22.86	13.59	200°	0.570	8.11	9.09	0.673	11.32	10.54
25°	0.989	24.45	13.88	0.966	23.35	13.68	205°	0.512	6.56	8.17	0.624	9.75	9.89
30°	0.999	24.94	13.97	0.962	23.16	13.65	210°	0.448	5.02	7.01	0.577	8.34	9.21
35°	1.000	25.00	13.98	0.947	22.43	13.51	215°	0.390	3.81	5.81	0.536	7.19	8.57
40°	1.000	24.98	13.98	0.921	21.20	13.26	220°	0.327	2.68	4.27	0.498	6.19	7.92
45°	0.998	24.88	13.96	0.889	19.76	12.96	225°	0.272	1.84	2.66	0.457	5.22	7.18
50°	0.994	24.71	13.93	0.867	18.80	12.74	230°	0.222	1.24	0.92	0.415	4.30	6.33
55°	0.989	24.45	13.88	0.856	18.33	12.63	235°	0.173	0.75	-1.26	0.368	3.39	5.30
60°	0.982	24.12	13.82	0.858	18.40	12.65	240°	0.132	0.44	-3.61	0.320	2.57	4.09
65°	0.974	23.73	13.75	0.873	19.04	12.80	245°	0.102	0.26	-5.83	0.271	1.84	2.65
70°	0.967	23.40	13.69	0.900	20.24	13.06	250°	0.084	0.18	-7.53	0.242	1.47	1.66
75°	0.962	23.15	13.65	0.938	22.00	13.42	255°	0.077	0.15	-8.27	0.238	1.41	1.50
80°	0.959	22.98	13.61	0.970	23.53	13.72	260°	0.079	0.16	-8.02	0.249	1.55	1.90
85°	0.957	22.89	13.60	0.990	24.50	13.89	265°	0.085	0.18	-7.39	0.271	1.83	2.63
90°	0.956	22.85	13.59	0.997	24.87	13.96	270°	0.095	0.23	-6.44	0.289	2.08	3.19
95°	0.953	22.70	13.56	0.991	24.53	13.90	275°	0.109	0.30	-5.28	0.295	2.18	3.39
100°	0.946	22.38	13.50	0.973	23.65	13.74	280°	0.126	0.40	-4.00	0.291	2.11	3.25
105°	0.936	21.92	13.41	0.943	22.24	13.47	285°	0.147	0.54	-2.65	0.279	1.95	2.89
110°	0.925	21.37	13.30	0.903	20.37	13.09	290°	0.172	0.74	-1.30	0.270	1.82	2.60
115°	0.915	20.95	13.21	0.864	18.67	12.71	295°	0.198	0.98	-0.08	0.270	1.82	2.59
120°	0.909	20.68	13.15	0.837	17.52	12.44	300°	0.228	1.30	1.13	0.282	1.99	2.98
125°	0.907	20.56	13.13	0.821	16.87	12.27	305°	0.260	1.68	2.26	0.306	2.35	3.71
130°	0.909	20.67	13.15	0.817	16.70	12.23	310°	0.296	2.19	3.40	0.342	2.92	4.65
135°	0.918	21.07	13.24	0.829	17.16	12.35	315°	0.335	2.81	4.48	0.377	3.55	5.51
140°	0.933	21.76	13.38	0.854	18.22	12.61	320°	0.379	3.59	5.55	0.413	4.26	6.29
145°	0.953	22.69	13.56	0.893	19.92	12.99	325°	0.422	4.46	6.49	0.447	4.99	6.98
150°	0.968	23.41	13.69	0.939	22.03	13.43	330°	0.470	5.51	7.41	0.482	5.81	7.64
155°	0.976	23.84	13.77	0.972	23.63	13.74	335°	0.520	6.77	8.31	0.519	6.74	8.29
160°	0.978	23.93	13.79	0.992	24.59	13.91	340°	0.575	8.27	9.18	0.564	7.95	9.01
165°	0.967	23.36	13.68	0.996	24.82	13.95	345°	0.626	9.79	9.91	0.613	9.41	9.73
170°	0.940	22.09	13.44	0.975	23.77	13.76	350°	0.679	11.53	10.62	0.671	11.25	10.51
175°	0.899	20.20	13.05	0.929	21.56	13.34	355°	0.733	13.45	11.29	0.728	13.25	11.22

<b>Polarization:</b>	<b>Horizontal</b>	<b>Vertical</b>
<b>Maximum Field:</b>	<b>1.000 @ 32° True</b>	<b>0.997 @ 90° True</b>
<b>Minimum Field:</b>	<b>0.077 @ 255° True</b>	<b>0.236 @ 253° True</b>
<b>RMS:</b>	<b>0.734</b>	<b>0.734</b>
<b>Maximum ERP:</b>	<b>25.000 kW</b>	<b>24.869 kW</b>
<b>Maximum Power Gain:</b>	<b>7.053 (8.484 dB)</b>	<b>7.016 (8.461 dB)</b>

**Total Input Power: 3.544 kW**

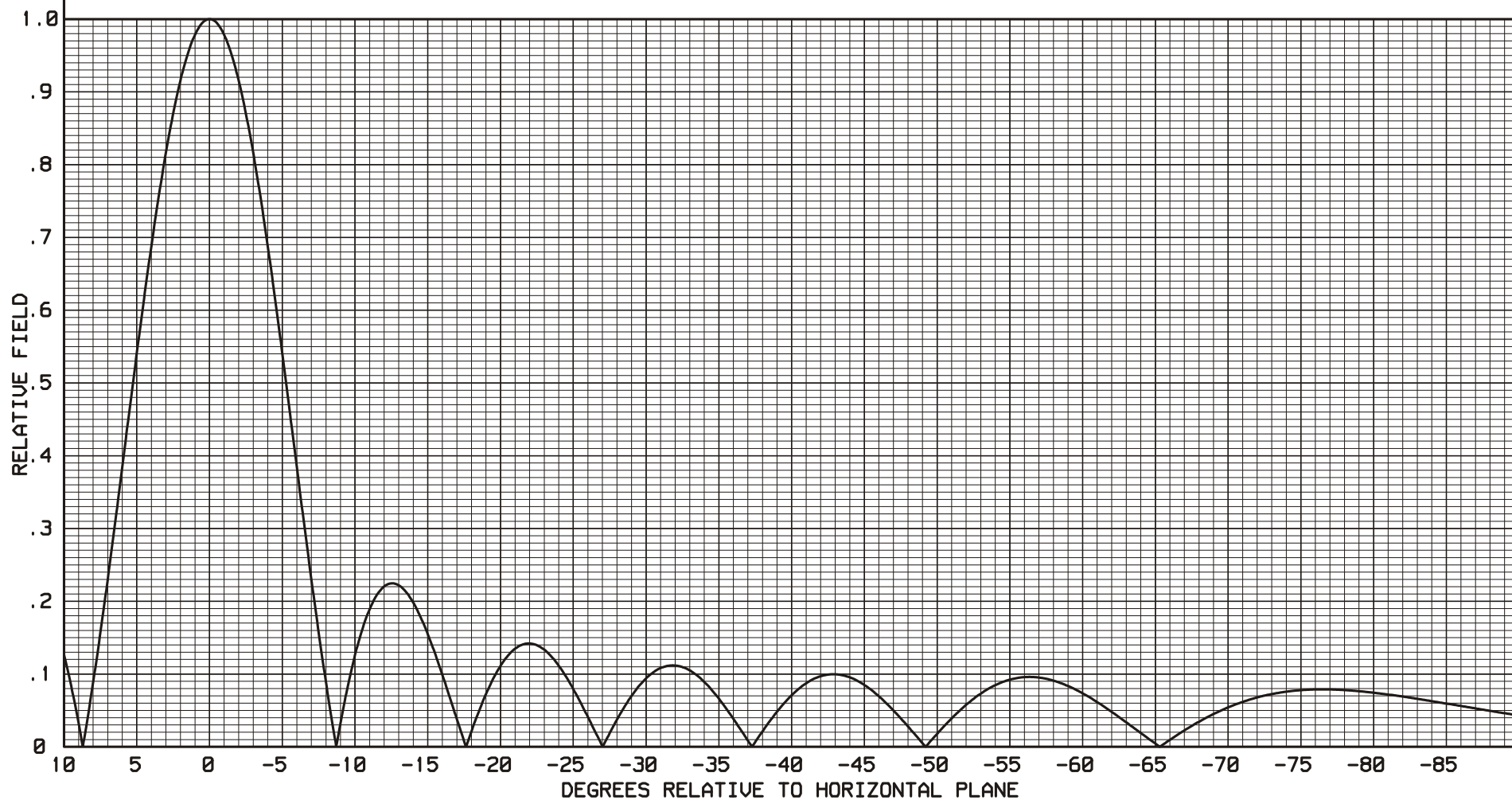


ELECTRONICS RESEARCH, INC.  
7777 GARDNER ROAD  
CHANDLER, IN. 47610

FIGURE 3D

----THEORETICAL----  
VERTICAL PLANE RELATIVE FIELD  
ERI TYPE 1082-8CP-DA ANTENNA  
0 DEGREE BEAM TILT  
0 PERCENT NULL FILL

105.9 MHz.  
BAY SPACING  
92.00 INCHES



# Directional Antenna System for KALC, Denver, Colorado

(Continued)

## ANTENNA SPECIFICATIONS

Antenna Type:	1082-8CP-DA
Frequency:	105.9 MHz
Number of Bays:	eight

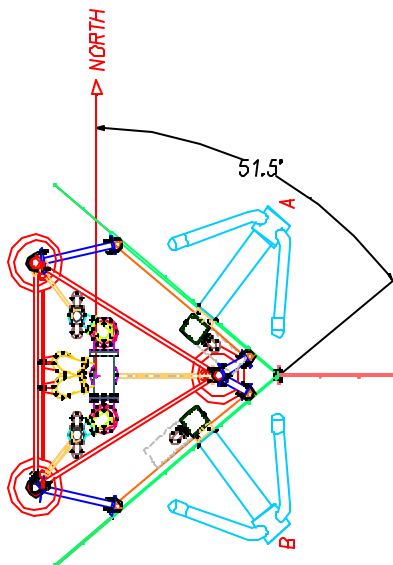
## MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	61.33 ft
Orientation:	51.5° true
Input flange to the antenna 6 1/8 inch female	

## ELECTRICAL SPECIFICATIONS

(For directional use)

Maximum horizontal ERP:	25.000 kW (13.979 dBk)
Horizontal maximum power gain:	7.053 (8.484 dB)
Maximum vertical ERP:	24.869 kW (13.957 dBk)
Vertical maximum power gain:	7.016 (8.461 dB)
Total input power:	3.544 kW (5.496 dBk)



Directional Antenna System  
For  
KALC, Denver, Colorado

(Continued)

Four Bay Test Model  
Of The Eight Bay Array

