

Directional Antenna System for KTCL, Wheat Ridge, Colorado

November 14, 2008

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

The antenna is the ERI model 1181-2CP-DA-SP configuration. The antenna was tested on a 6' face tower, which is the structure the station plans to use to support the array. The antenna will be mount on the tower at a bearing of North 170 degrees East All tests were performed on a frequency of 93.3 megahertz, which is the center of the FM broadcast channel assigned to KTCL.

The other FM station that will be transmitting from this directional antenna are KRFX @ 103.5 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 Proposed For KTCL, Wheat Ridge, Colorado

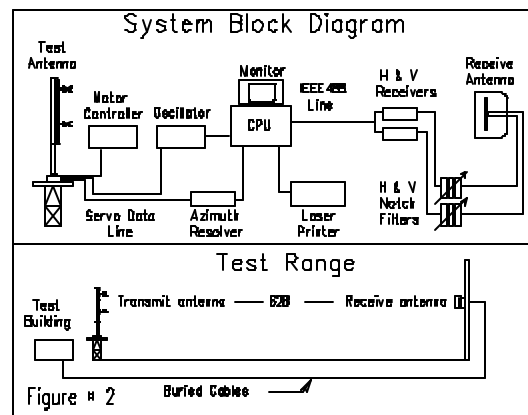
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DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of one bay of the circular polarized system. The element 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 6' face 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 93.3 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 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.

Directional Antenna System
Proposed For
KTCL, Wheat Ridge, Colorado

(Continued)

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 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 1181-2CP-DA-SP array is to be mounted on the 6' face tower at a bearing of North 170 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 23 kilowatts (13.617 dBk).

The power at North 330-20 degrees East does not exceed 0.730 kilowatts (-1.367 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 than 85% of the filed composite pattern.

The clear vertical length of the structure required to support the antenna is 27 feet 8 inches.

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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 black ink, appearing to read "Tom Schaefer". The signature is fluid and cursive, with a large initial "T" and a long, sweeping underline.

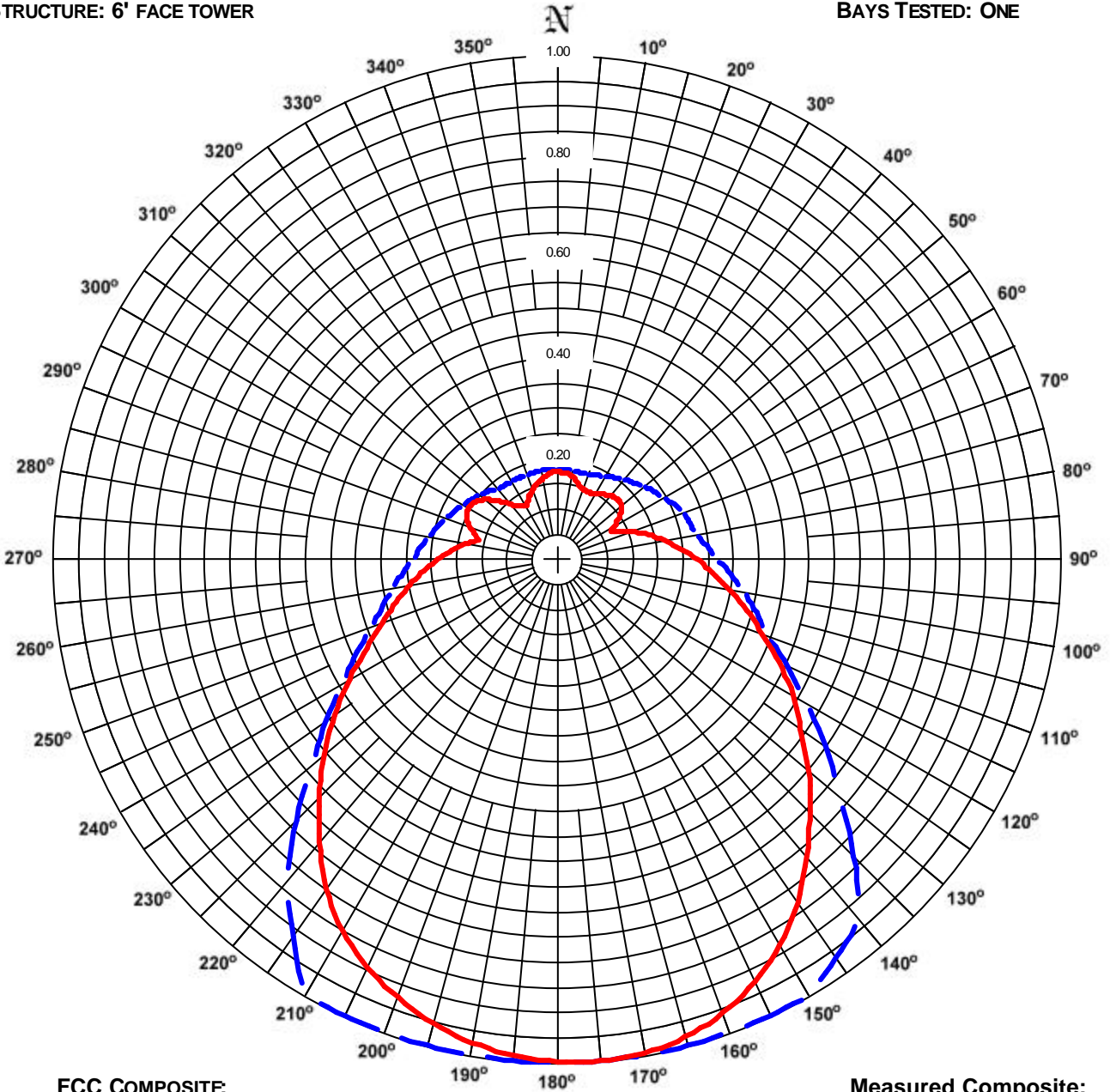
The Microsoft Word document on file electronically at Electronic Research, Inc. governs the specifications, scope, and configuration of the product described. All other representations whether verbal, printed, or electronic are subordinate to the master copy of this document on file at ERI.

ERI® *Horizontal Plane Relative Field Pattern*

Electronics Research, Inc. 7777 Gardner Rd. Chandler, In 47610 Phone (812) 925-6000 Fax (812) 925-

FIGURE NO: 1
STATION: KTCL
Location: Wheat Ridge, CO
ANTENNA: 1181-2CP-DA
STRUCTURE: 6' FACE TOWER

DATE: 11/12/2008
FREQUENCY: 93.3 MHz
Orientation: 170° True
MOUNTING: CUSTOM
BAYS TESTED: ONE



FCC COMPOSITE
RMS: 0.567
MAXIMUM: 1.000 @ 150° TRUE
MINIMUM: 0.178 @ 0° TRUE

Measured Composite:
RMS: 0.522
Maximum: 1.000 @ 174° True
Minimum: 0.119 @ 63° 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 BXPB-20080219AWL.

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: KTCL

Location: Wheat Ridge, CO.

Frequency: 93.3 MHz

Antenna: 1181-2CP-DA-SP

Orientation: 170° True

Tower: 6' face tower

Figure: 1

Date: 11/12/2008

Reference: ktcl1m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.175	0.70	-1.55	Horizontal	180°	0.998	22.91	13.60	Horizontal
5°	0.172	0.68	-1.70	Vertical	185°	0.990	22.53	13.53	Horizontal
10°	0.167	0.64	-1.94	Vertical	190°	0.975	21.86	13.40	Horizontal
15°	0.156	0.56	-2.52	Vertical	195°	0.954	20.93	13.21	Horizontal
20°	0.148	0.50	-2.97	Horizontal	200°	0.927	19.76	12.96	Horizontal
25°	0.146	0.49	-3.07	Horizontal	205°	0.894	18.37	12.64	Horizontal
30°	0.149	0.51	-2.90	Horizontal	210°	0.853	16.73	12.24	Horizontal
35°	0.156	0.56	-2.50	Horizontal	215°	0.799	14.68	11.67	Horizontal
40°	0.164	0.62	-2.07	Horizontal	220°	0.734	12.40	10.93	Horizontal
45°	0.169	0.65	-1.85	Horizontal	225°	0.668	10.28	10.12	Horizontal
50°	0.165	0.63	-2.03	Horizontal	230°	0.603	8.38	9.23	Horizontal
55°	0.152	0.53	-2.75	Horizontal	235°	0.539	6.69	8.26	Horizontal
60°	0.130	0.39	-4.09	Horizontal	240°	0.477	5.23	7.18	Horizontal
65°	0.130	0.39	-4.09	Vertical	245°	0.418	4.01	6.03	Vertical
70°	0.159	0.58	-2.38	Vertical	250°	0.370	3.14	4.97	Vertical
75°	0.187	0.81	-0.93	Vertical	255°	0.331	2.52	4.02	Vertical
80°	0.216	1.07	0.29	Vertical	260°	0.297	2.03	3.08	Vertical
85°	0.245	1.38	1.39	Vertical	265°	0.266	1.62	2.10	Vertical
90°	0.276	1.76	2.44	Vertical	270°	0.237	1.29	1.11	Vertical
95°	0.311	2.22	3.46	Vertical	275°	0.210	1.02	0.08	Vertical
100°	0.348	2.79	4.46	Vertical	280°	0.180	0.75	-1.27	Vertical
105°	0.389	3.48	5.41	Vertical	285°	0.164	0.62	-2.10	Horizontal
110°	0.434	4.33	6.36	Horizontal	290°	0.184	0.78	-1.09	Horizontal
115°	0.486	5.44	7.36	Horizontal	295°	0.198	0.90	-0.44	Horizontal
120°	0.540	6.71	8.27	Horizontal	300°	0.203	0.95	-0.22	Horizontal
125°	0.590	8.01	9.04	Horizontal	305°	0.198	0.90	-0.44	Horizontal
130°	0.652	9.77	9.90	Vertical	310°	0.183	0.77	-1.12	Horizontal
135°	0.710	11.59	10.64	Vertical	315°	0.163	0.61	-2.15	Horizontal
140°	0.771	13.67	11.36	Vertical	320°	0.142	0.46	-3.35	Horizontal
145°	0.832	15.91	12.02	Vertical	325°	0.127	0.37	-4.30	Horizontal
150°	0.884	17.97	12.55	Vertical	330°	0.123	0.35	-4.60	Horizontal
155°	0.927	19.75	12.95	Vertical	335°	0.134	0.41	-3.85	Vertical
160°	0.959	21.17	13.26	Vertical	340°	0.146	0.49	-3.12	Vertical
165°	0.983	22.21	13.47	Vertical	345°	0.155	0.55	-2.56	Vertical
170°	0.996	22.83	13.58	Vertical	350°	0.163	0.61	-2.15	Horizontal
175°	1.000	23.00	13.62	Vertical	355°	0.171	0.67	-1.74	Horizontal

Polarization:

Maximum Field:

Minimum Field:

RMS:

Maximum ERP:

Maximum Power Gain:

Envelope

1.000 @ 174° True

0.119 @ 63° True

0.522

23.000 kW

3.323 (5.216 dB)

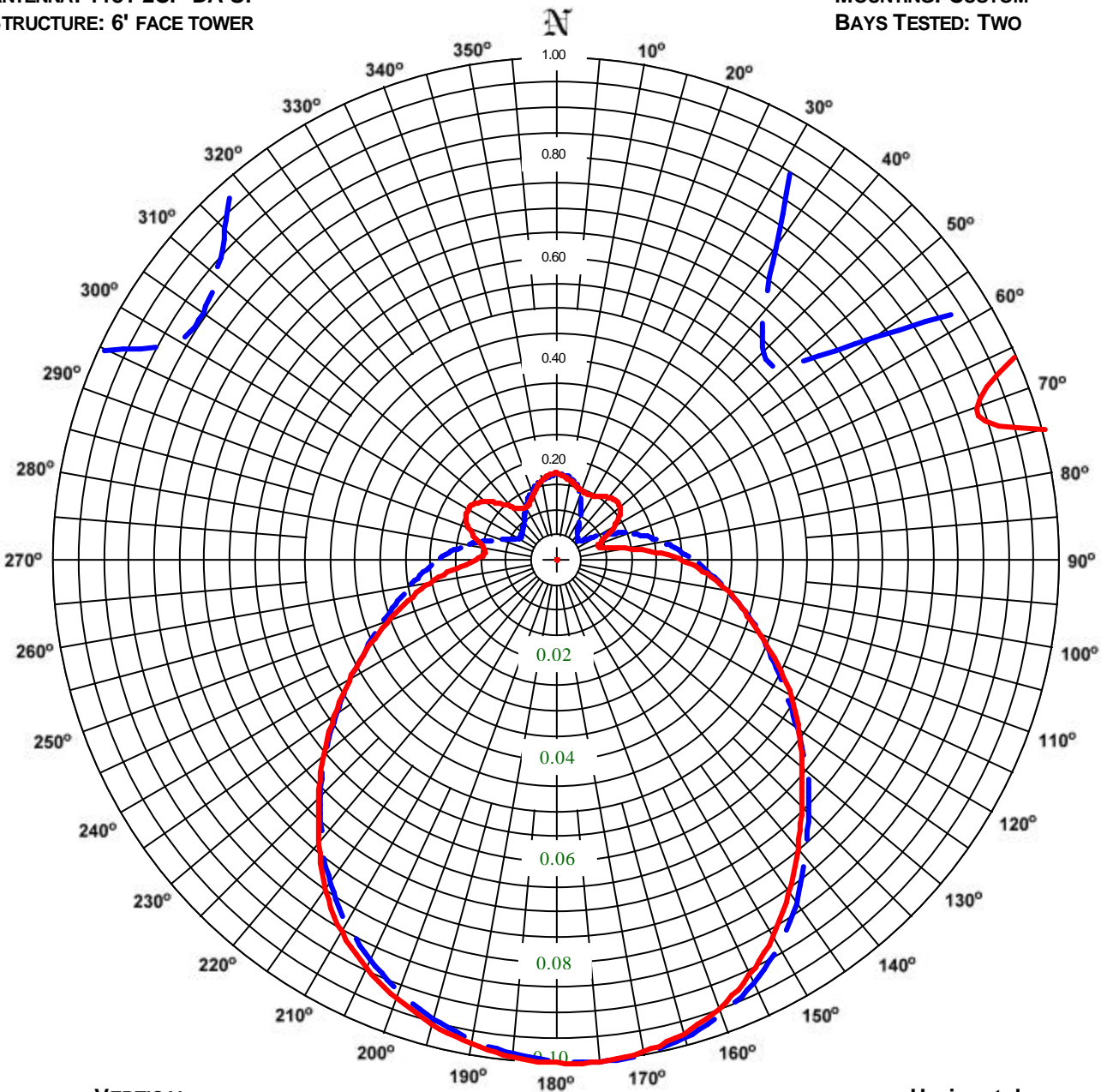
Total Input Power: 6.921 kW

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:
STATION: KTCL
LOCATION: WHEAT RIDGE, CO.
ANTENNA: 1181-2CP-DA-SP
STRUCTURE: 6' FACE TOWER

DATE: 11/12/2008
FREQUENCY: 93.3 MHz
ORIENTATION: 170° TRUE
MOUNTING: CUSTOM
BAYS TESTED: TWO



VERTICAL

RMS: 0.514
MAXIMUM: 1.000 @ 174° TRUE
MINIMUM: 0.058 @ 47° TRUE

10X Scale

Horizontal

RMS: 0.515
Maximum: 1.000 @ 177° True
Minimum: 0.089 @ 71° True

COMMENTS: MEASURED PATTERNS 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: KTCL
Location: Wheat Ridge, CO.
Frequency: 93.3 MHz

Antenna: 1181-2CP-DA
Orientation: 170° True
Tower: 6' face tower

Figure: 2
Date: 11/12/2008
Reference: ktcl1m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.175	0.70	-1.55	0.171	0.67	-1.71	180°	0.998	22.91	13.60	0.995	22.78	13.57
5°	0.170	0.66	-1.78	0.172	0.68	-1.70	185°	0.990	22.53	13.53	0.984	22.26	13.48
10°	0.162	0.61	-2.17	0.167	0.64	-1.94	190°	0.975	21.86	13.40	0.966	21.47	13.32
15°	0.154	0.55	-2.62	0.156	0.56	-2.52	195°	0.954	20.93	13.21	0.942	20.42	13.10
20°	0.148	0.50	-2.97	0.139	0.45	-3.50	200°	0.927	19.76	12.96	0.912	19.13	12.82
25°	0.146	0.49	-3.07	0.117	0.31	-5.03	205°	0.894	18.37	12.64	0.875	17.63	12.46
30°	0.149	0.51	-2.90	0.094	0.20	-6.93	210°	0.853	16.73	12.24	0.833	15.94	12.03
35°	0.156	0.56	-2.50	0.076	0.13	-8.75	215°	0.799	14.68	11.67	0.783	14.09	11.49
40°	0.164	0.62	-2.07	0.064	0.09	-10.22	220°	0.734	12.40	10.93	0.725	12.09	10.83
45°	0.169	0.65	-1.85	0.058	0.08	-11.07	225°	0.668	10.28	10.12	0.663	10.10	10.04
50°	0.165	0.63	-2.03	0.061	0.09	-10.70	230°	0.603	8.38	9.23	0.601	8.32	9.20
55°	0.152	0.53	-2.75	0.078	0.14	-8.58	235°	0.539	6.69	8.26	0.534	6.57	8.18
60°	0.130	0.39	-4.09	0.103	0.25	-6.10	240°	0.477	5.23	7.18	0.473	5.14	7.11
65°	0.104	0.25	-6.01	0.130	0.39	-4.09	245°	0.416	3.99	6.01	0.418	4.01	6.03
70°	0.089	0.18	-7.41	0.159	0.58	-2.38	250°	0.359	2.96	4.71	0.370	3.14	4.97
75°	0.101	0.23	-6.32	0.187	0.81	-0.93	255°	0.304	2.13	3.28	0.331	2.52	4.02
80°	0.141	0.46	-3.39	0.216	1.07	0.29	260°	0.255	1.50	1.76	0.297	2.03	3.08
85°	0.198	0.90	-0.44	0.245	1.38	1.39	265°	0.208	0.99	-0.02	0.266	1.62	2.10
90°	0.254	1.49	1.72	0.276	1.76	2.44	270°	0.166	0.64	-1.97	0.237	1.29	1.11
95°	0.302	2.10	3.23	0.311	2.22	3.46	275°	0.144	0.48	-3.19	0.210	1.02	0.08
100°	0.346	2.75	4.39	0.348	2.79	4.46	280°	0.147	0.49	-3.06	0.180	0.75	-1.27
105°	0.388	3.46	5.39	0.389	3.48	5.41	285°	0.164	0.62	-2.10	0.151	0.52	-2.82
110°	0.434	4.33	6.36	0.433	4.31	6.35	290°	0.184	0.78	-1.09	0.123	0.35	-4.62
115°	0.486	5.44	7.36	0.478	5.26	7.21	295°	0.198	0.90	-0.44	0.099	0.23	-6.44
120°	0.540	6.71	8.27	0.528	6.41	8.07	300°	0.203	0.95	-0.22	0.087	0.17	-7.59
125°	0.590	8.01	9.04	0.587	7.93	8.99	305°	0.198	0.90	-0.44	0.086	0.17	-7.71
130°	0.639	9.38	9.72	0.652	9.77	9.90	310°	0.183	0.77	-1.12	0.088	0.18	-7.46
135°	0.691	10.97	10.40	0.710	11.59	10.64	315°	0.163	0.61	-2.15	0.093	0.20	-7.00
140°	0.747	12.84	11.08	0.771	13.67	11.36	320°	0.142	0.46	-3.35	0.100	0.23	-6.37
145°	0.807	14.98	11.75	0.832	15.91	12.02	325°	0.127	0.37	-4.30	0.109	0.28	-5.60
150°	0.863	17.12	12.33	0.884	17.97	12.55	330°	0.123	0.35	-4.60	0.121	0.34	-4.74
155°	0.910	19.03	12.79	0.927	19.75	12.95	335°	0.127	0.37	-4.31	0.134	0.41	-3.85
160°	0.947	20.62	13.14	0.959	21.17	13.26	340°	0.138	0.43	-3.62	0.146	0.49	-3.12
165°	0.974	21.83	13.39	0.983	22.21	13.47	345°	0.151	0.52	-2.80	0.155	0.55	-2.56
170°	0.992	22.63	13.55	0.996	22.83	13.58	350°	0.163	0.61	-2.15	0.163	0.61	-2.15
175°	1.000	22.98	13.61	1.000	23.00	13.62	355°	0.171	0.67	-1.74	0.168	0.65	-1.88

Polarization:	Horizontal	Vertical
Maximum Field:	1.000 @ 177° True	1.000 @ 174° True
Minimum Field:	0.089 @ 71° True	0.058 @ 47° True
RMS:	0.515	0.514
Maximum ERP:	23.000 kW	23.000 kW
Maximum Power Gain:	3.323 (5.216 dB)	3.323 (5.216 dB)

Total Input Power: 6.921kW

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

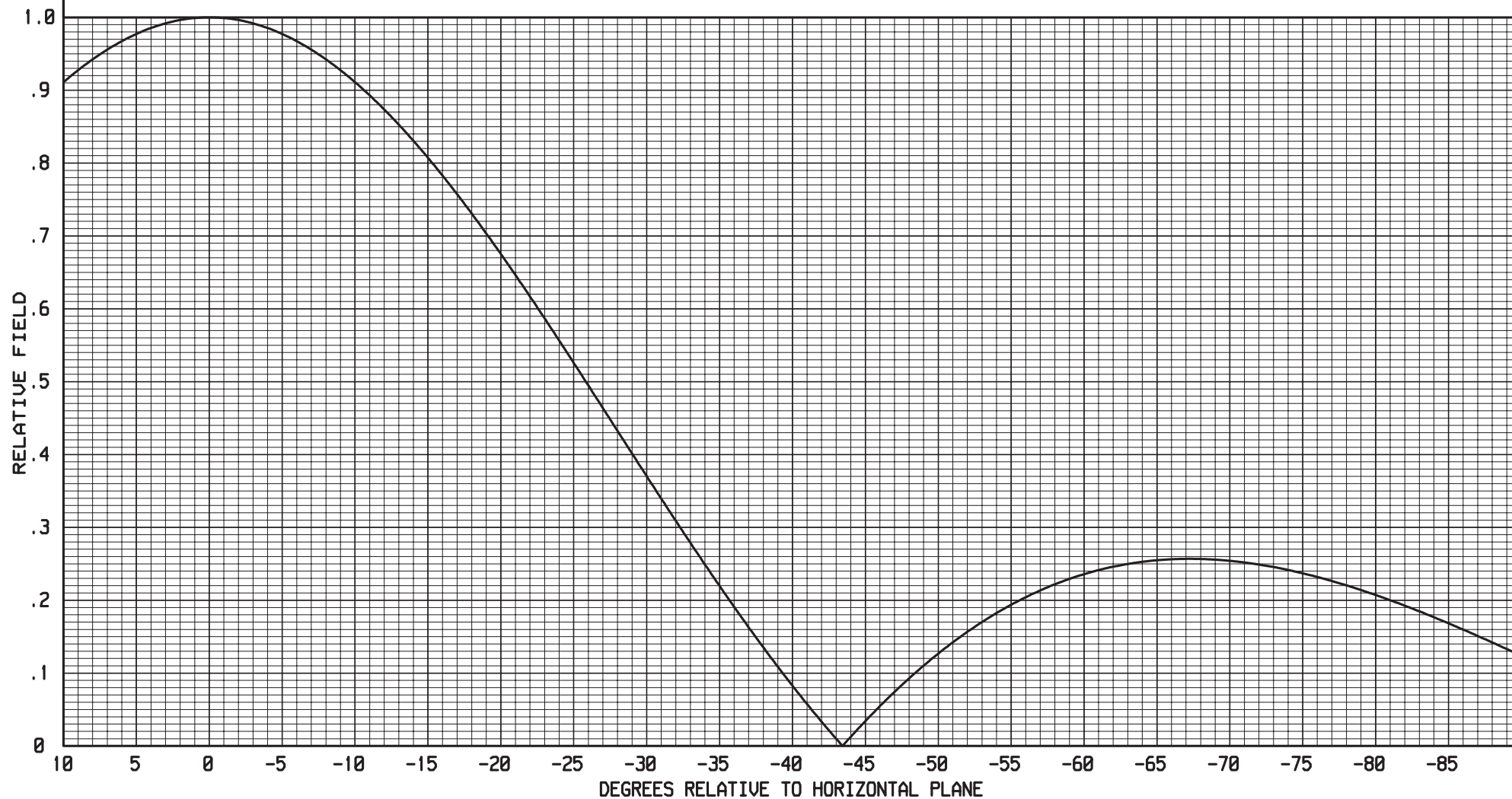
FIGURE 3A

-----THEORETICAL-----
VERTICAL PLANE RELATIVE FIELD

93.3 MHz.

2 LEVELS OF ERI TYPE 1180 ELEMENTS
+0.00 DEGREE(S) BEAM TILT
0 PERCENT FIRST NULL FILL
0 PERCENT SECOND NULL FILL

BAY SPACING:
92.00 INCHES



Directional Antenna System for KTCL, Wheat Ridge , Colorado

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	1181-2CP-DA-SP
Frequency:	93.3 MHz
Number of Bays:	Two

MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	13 ft 8 in
Aperture length required:	27 ft 8 in
Orientation:	170° true

Input flange to the antenna 3 1/8" female.

ELECTRICAL SPECIFICATIONS (For directional use)

Maximum horizontal ERP:	23 kW (13.617 dBk)
Horizontal maximum power gain:	3.323 (5.216 dB)
Maximum vertical ERP:	23 kW (13.617 dBk)
Vertical maximum power gain:	3.323 (5.216 dB)
Total input power:	6.921 kW (8.402 dBk)

