



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  
KBIL, Park City, Montana***

May 10, 2006

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 KBIL.

The antenna is the ERI model P300-2B-DA configuration. The vertically polarized system consists of 2 full-wavelength spaced bays using one driven vertical dipole and two vertical parasitic elements per bay. The antenna was mounted on the North 347 degrees East tower leg with bracketry to provide an antenna orientation of North 347 degrees East. The antenna was tested on a Rohn 55G tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 89.7 megahertz, which is the center of the FM broadcast channel assigned to KBIL.

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 KBIL, Park City, Montana

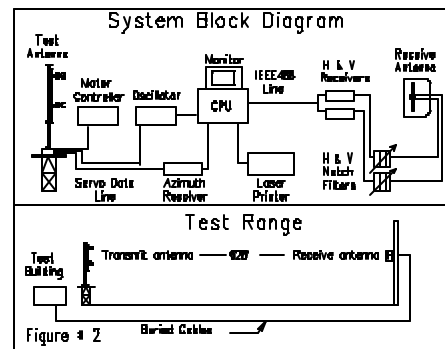
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## DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of a full-scale model of the complete vertically polarized system with the associated 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 3 1/8 inch o.d. rigid coaxial line was used to feed the test antenna, and a section of 3 1/8 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 the vertical polarization components.

The proof-of-performance was accomplished using a Rohn 55G 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 North Atlantic Model 8500 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 calibrated 1-05. The frequency of the signal source was set at 89.7 MHz and was constantly monitored by an Anritsu Model ML521B measuring receiver calibrated 6-05.

A broadband vertical dipole system, located approximately 628 form 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.

# Directional Antenna System For KBIL, Park City, Montana

(Continued)

The signal received by the dipole system were fed to the test building by way of a buried Helix cable to an Anritsu Model ML521B measuring receiver. 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 co-ordinated graph paper in a clockwise direction.

## CONCLUSIONS

The vertically polarized system consists of 2 full-wavelength spaced bays using one driven vertical dipole and two vertical parasitic 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 P300-2B-DA array is to be mounted on the North 347 degrees East tower leg of the Rohn 55G tower at a bearing of North 347 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 relative field value of the vertical component relative to azimuth. A calculated vertical plane relative field pattern is shown on Figure #3 attached. The power in the maximum will reach 2.7 kilowatts (4.314 dBk).

The power at North 140 degrees East does not exceed 0.48 kilowatts (-3.188 dBk).

The vertical 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 30 ft 11 in.

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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", written in dark ink.

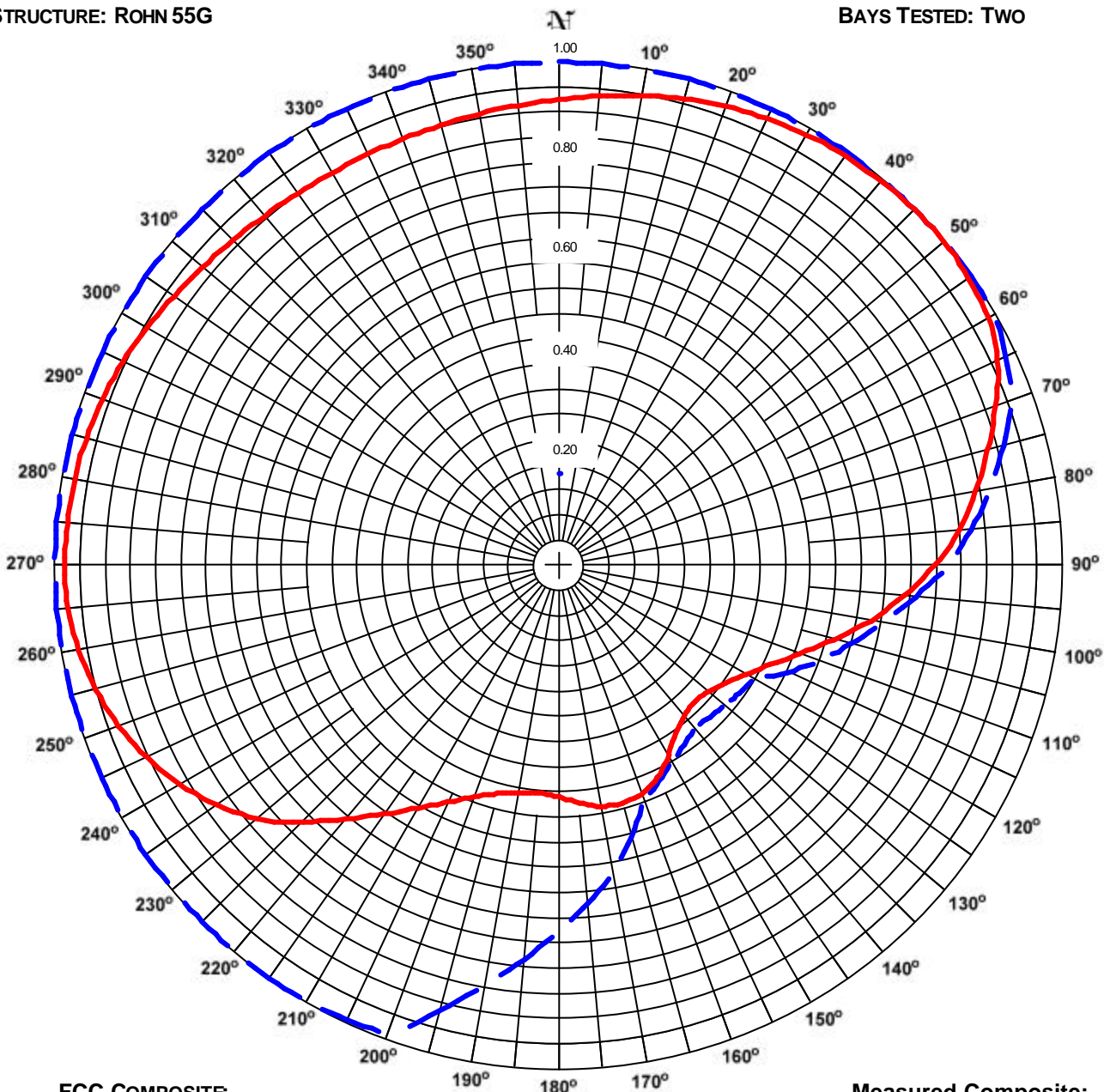
The Microsoft Word document on file electronically at Electronics Research, Inc. governs the specifications, scope, and configuration of the product described. All other representations whether verbal, printed, or electronic are subordinate to the master copy of this document on file at ERI.

# **ERI**® *Horizontal Plane Relative Field Pattern*

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FIGURE NO: 1  
STATION: KBIL  
LOCATION: PARK CITY, MT  
ANTENNA: P300-2B-DA  
STRUCTURE: ROHN 55G

DATE: 5/10/2006  
FREQUENCY: 89.7 MHz  
ORIENTATION: 347° TRUE  
MOUNTING: STANDARD  
BAYS TESTED: TWO



**FCC COMPOSITE**  
RMS: 0.891  
MAXIMUM: 1.000 @ 0° TRUE  
MINIMUM: 0.420 @ 140° TRUE

**Measured Composite:**  
RMS: 0.799  
Maximum: 1.000 @ 49° True  
Minimum: 0.383 @ 135° 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 BPED-20060228ANU.

# ERI<sup>®</sup> *Horizontal Plane Relative Field List*

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**Station: KBIL**  
**Location: Park City, MT**  
**Frequency: 89.7 MHz**

**Antenna: P300-2B-DA**  
**Orientation: 347° True**  
**Tower: Rohn 55G**

**Figure: 1**  
**Date: 5/10/2006**  
**Reference: kbil1m.fig**

Angle	Pattern Data			Polarization	Angle	Pattern Data			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.926	2.31	3.64	Vertical	180°	0.459	0.57	-2.45	Vertical
5°	0.936	2.36	3.74	Vertical	185°	0.453	0.55	-2.56	Vertical
10°	0.948	2.42	3.85	Vertical	190°	0.456	0.56	-2.50	Vertical
15°	0.960	2.49	3.96	Vertical	195°	0.468	0.59	-2.27	Vertical
20°	0.971	2.54	4.06	Vertical	200°	0.489	0.65	-1.90	Vertical
25°	0.980	2.59	4.14	Vertical	205°	0.518	0.72	-1.40	Vertical
30°	0.987	2.63	4.20	Vertical	210°	0.555	0.83	-0.80	Vertical
35°	0.993	2.66	4.25	Vertical	215°	0.601	0.98	-0.10	Vertical
40°	0.997	2.68	4.29	Vertical	220°	0.656	1.16	0.65	Vertical
45°	0.999	2.70	4.31	Vertical	225°	0.719	1.40	1.45	Vertical
50°	1.000	2.70	4.31	Vertical	230°	0.781	1.65	2.17	Vertical
55°	0.994	2.67	4.26	Vertical	235°	0.827	1.85	2.67	Vertical
60°	0.985	2.62	4.18	Vertical	240°	0.867	2.03	3.08	Vertical
65°	0.961	2.50	3.97	Vertical	245°	0.901	2.19	3.41	Vertical
70°	0.923	2.30	3.62	Vertical	250°	0.929	2.33	3.68	Vertical
75°	0.882	2.10	3.22	Vertical	255°	0.951	2.44	3.88	Vertical
80°	0.840	1.91	2.80	Vertical	260°	0.967	2.52	4.02	Vertical
85°	0.797	1.72	2.35	Vertical	265°	0.977	2.58	4.11	Vertical
90°	0.746	1.50	1.77	Vertical	270°	0.980	2.60	4.14	Vertical
95°	0.689	1.28	1.08	Vertical	275°	0.979	2.59	4.13	Vertical
100°	0.631	1.07	0.31	Vertical	280°	0.976	2.57	4.10	Vertical
105°	0.566	0.86	-0.63	Vertical	285°	0.971	2.55	4.06	Vertical
110°	0.511	0.70	-1.52	Vertical	290°	0.964	2.51	4.00	Vertical
115°	0.465	0.58	-2.33	Vertical	295°	0.955	2.46	3.91	Vertical
120°	0.430	0.50	-3.02	Vertical	300°	0.944	2.41	3.81	Vertical
125°	0.404	0.44	-3.55	Vertical	305°	0.932	2.35	3.70	Vertical
130°	0.388	0.41	-3.90	Vertical	310°	0.922	2.30	3.61	Vertical
135°	0.383	0.40	-4.03	Vertical	315°	0.914	2.25	3.53	Vertical
140°	0.389	0.41	-3.88	Vertical	320°	0.908	2.22	3.47	Vertical
145°	0.407	0.45	-3.50	Vertical	325°	0.903	2.20	3.43	Vertical
150°	0.436	0.51	-2.90	Vertical	330°	0.901	2.19	3.41	Vertical
155°	0.465	0.58	-2.34	Vertical	335°	0.901	2.19	3.40	Vertical
160°	0.482	0.63	-2.02	Vertical	340°	0.902	2.20	3.42	Vertical
165°	0.489	0.65	-1.90	Vertical	345°	0.906	2.21	3.45	Vertical
170°	0.485	0.63	-1.98	Vertical	350°	0.911	2.24	3.50	Vertical
175°	0.473	0.60	-2.20	Vertical	355°	0.917	2.27	3.57	Vertical

<b>Polarization:</b>	<b>Envelope</b>
<b>Maximum Field:</b>	<b>1.000 @ 49° True</b>
<b>Minimum Field:</b>	<b>0.383 @ 135° True</b>
<b>RMS:</b>	<b>0.799</b>
<b>Maximum ERP:</b>	<b>2.700 kW</b>
<b>Maximum Power Gain:</b>	<b>3.155 (4.990 dB)</b>

**Total Input Power: 0.856 kW**

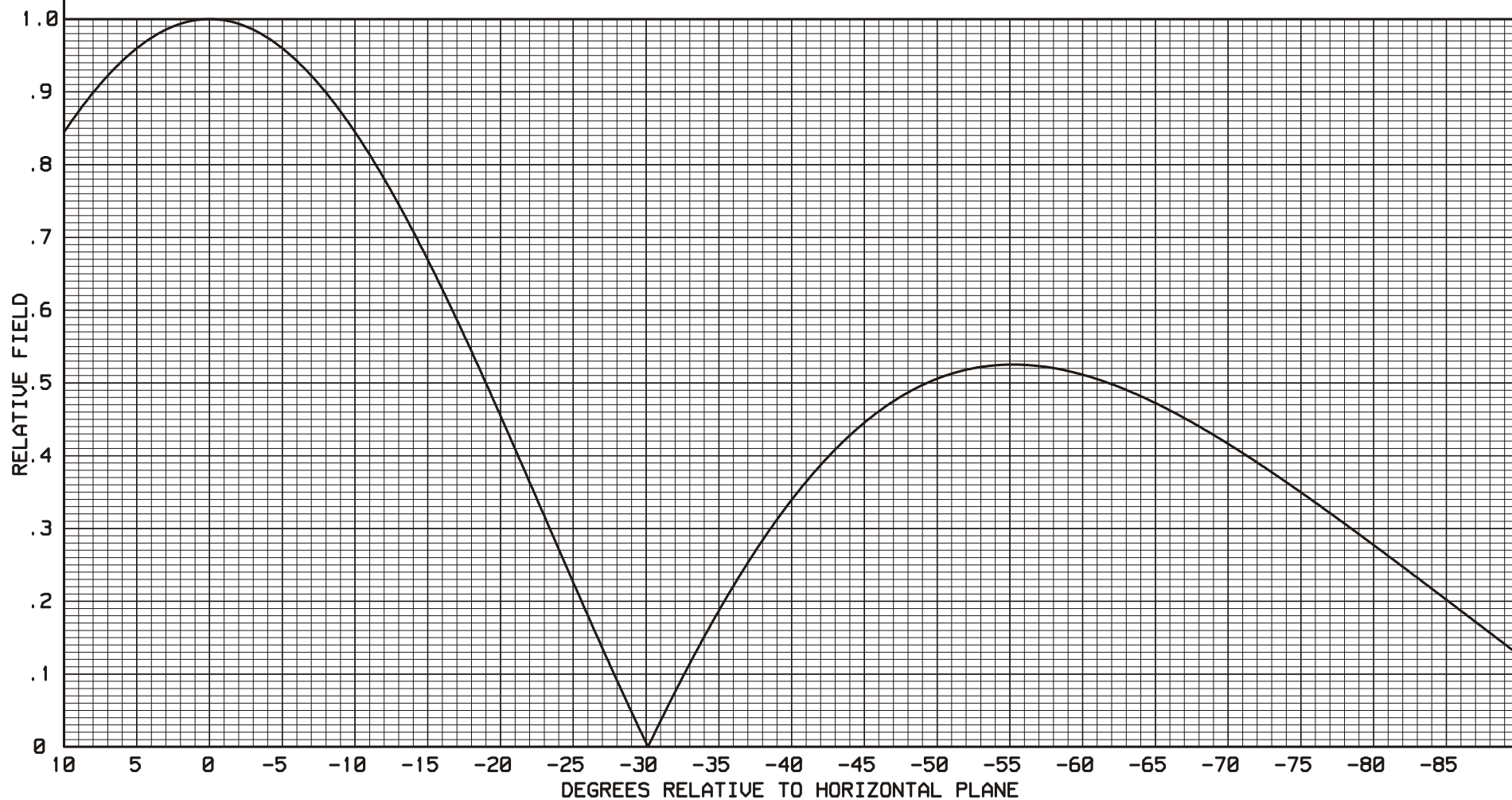
ELECTRONICS RESEARCH, INC.  
7777 GARDNER ROAD  
CHANDLER, IN. 47610

FIGURE 3

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

ERI TYPE P300-2B-DA  
VERTICALLY POLARIZED ANTENNA  
0 DEGREE ELECTRICAL BEAM TILT  
0 PERCENT NULL FILL

ELEMENT SPACING:  
1.0 WAVELENGTH



# Directional Antenna System for KBIL, Park City, Montana

(Continued)

## ANTENNA SPECIFICATIONS

Antenna Type:	P300-2B-DA
Frequency:	89.7 MHz
Number of Bays:	two

## MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	19 ft 7 in
Aperture length required:	30 ft 11 in
Orientation:	347° true
Input flange to the antenna 1 5/8" female	

## ELECTRICAL SPECIFICATIONS

(For directional use)

Maximum vertical ERP:	2.7 kW (4.314 dBk)
Vertical maximum power gain:	3.155 (4.99 dB)
Total input power:	0.856 kW (-0.677 dBk)

