ERI® Electronics Research, Inc.
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 KTUN, Eagle, Colorado

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 KTUN.

The antenna is the ERI model MP-4AC-DA-HW-SP configuration. The circular polarized system consists of 4 half-wavelength spaced bays using one driven circular polarized radiating element per bay, two horizontal parasitic elements per bay and two vertical parasitic elements interleaved between alternate bay pairs. The antenna was mounted on the North 308 degrees East tower face with bracketry to provide an antenna orientation of North 308 degrees East. The antenna was tested on a Rohn 65G tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 101.7 megahertz, which is the center of the FM broadcast channel assigned to KTUN.

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
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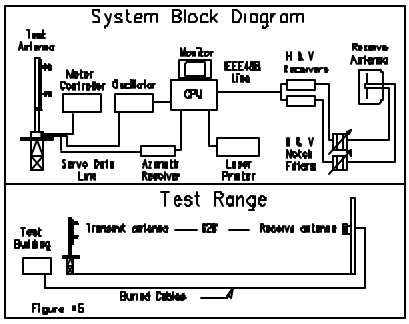
(Continued)

DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of two bay levels of the circular polarized system with the associated horizontal and 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 both horizontal and vertical polarization components. The antenna includes –0.54 degrees of beam tilt.

The proof-of-performance was accomplished using a Rohn 65G 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 101.7 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.

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. Both horizontal and vertical components were recorded separately.

CONCLUSIONS

The circular polarized system consists of 4 half-wavelength spaced bays using one driven circular polarized radiating element per bay, two horizontal parasitic elements per bay and two vertical parasitic elements interleaved between alternate bay pairs. 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 MP-4AC-DA-HW-SP array is to be mounted on the North 308 degrees East tower face of the Rohn 65G tower at a bearing of North 308 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 11.8 kilowatts (10.719 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.

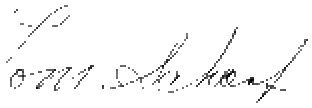
Directional Antenna System
For
KTUN, Eagle, Colorado

(Continued)

The clear vertical length of the structure required to support the antenna is 29 feet 5 inches 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. 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.

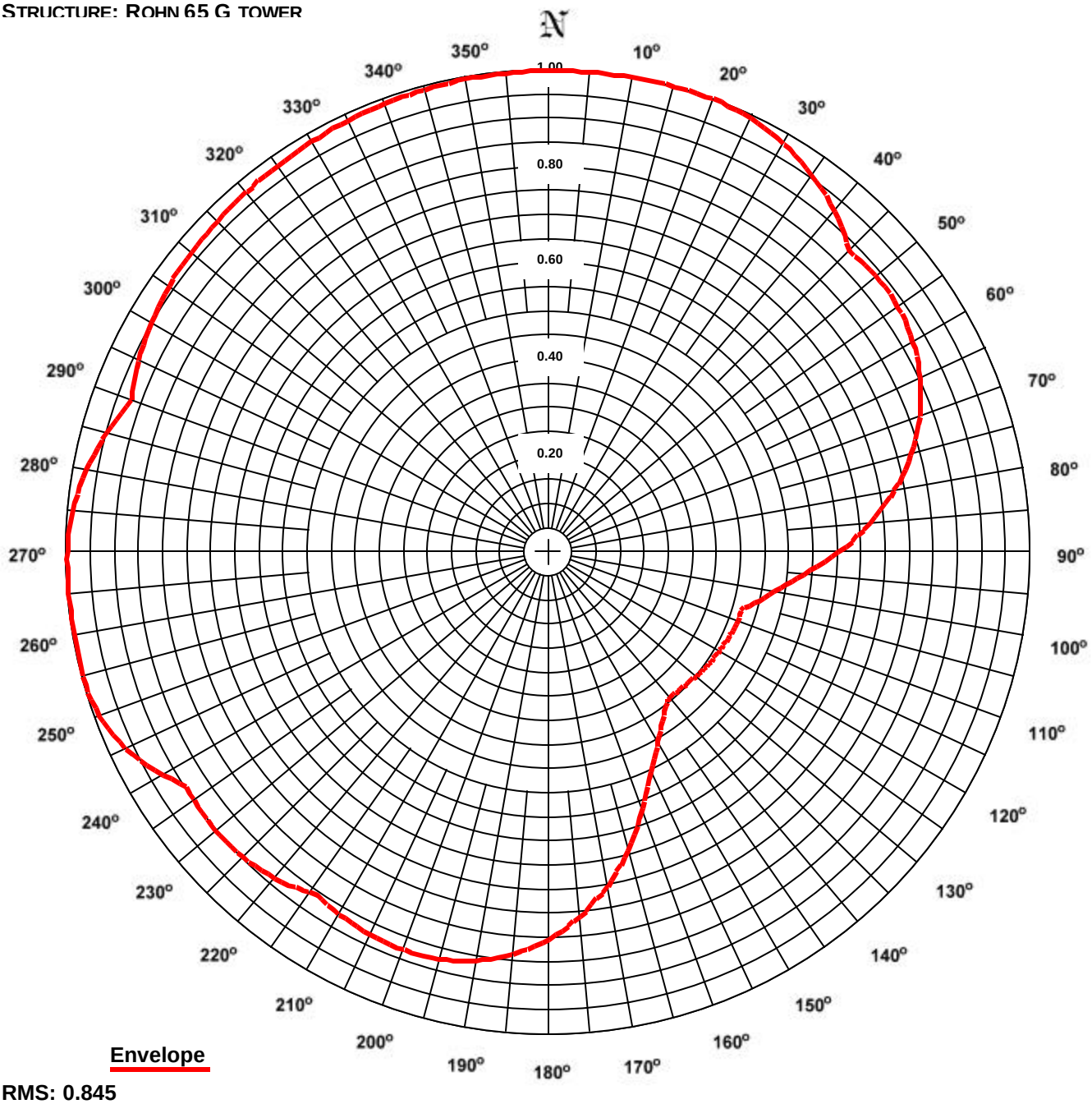


ERI® Horizontal Plane Relative Field Pattern

Electronics Research, Inc. 7777 Gardner Rd. Chandler, In 47610 Phone (812) 925-6000 Fax (812) 925-4030 http://www.eriinc.com/

FIGURE: 1
STATION: KTUN
LOCATION: EAGLE, CO
ANTENNA TYPE: MP-4AC-HW-DA-SP
STRUCTURE: ROHN 65 G TOWER

DATE: 9/23/2003
FREQUENCY: 101.7 MHz
Orientation: 308° True
MOUNTING: STANDARD



Envelope

RMS: 0.845
Maximum: 1.000 @ 11° True
Minimum: 0.394 @ 141° True

COMMENTS: DIRECTIONAL. COMPOSITE PATTERN: THIS PATTERN SHOWS THE MAXIMUM OF EITHER THE H OR V AZIMUTH VALUES. THIS PATTERN DOES NOT EXCEED THE FCC FILED COMPOSITE PATTERN AT ANY AZIMUTH. THE RMS OF THIS PATTERN IS GREATER THAN 85% OF THE FILED FCC COMPOSITE PATTERN BPH-2002813ABK.

ERI® Horizontal Plane Relative Field List

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Station: KTUN
Location: Eagle, CO
Frequency: 101.7 MHz

Antenna: MP-4AC-HW-DA-SP
Orientation: 308° True
Tower: 24" Rohn

Figure: 1
Date: 9/23/2003
Reference: ktun1m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0º	0.999	11.97	10.78	Vertical	180º	0.803	7.74	8.89	Horizontal
5º	1.000	11.99	10.79	Vertical	185º	0.837	8.41	9.25	Horizontal
10º	1.000	12.00	10.79	Vertical	190º	0.861	8.89	9.49	Horizontal
15º	1.000	12.00	10.79	Vertical	195º	0.875	9.18	9.63	Horizontal
20º	1.000	11.99	10.79	Vertical	200º	0.879	9.27	9.67	Horizontal
25º	0.993	11.83	10.73	Vertical	205º	0.876	9.20	9.64	Horizontal
30º	0.978	11.48	10.60	Vertical	210º	0.869	9.05	9.57	Horizontal
35º	0.955	10.94	10.39	Vertical	215º	0.863	8.94	9.52	Vertical
40º	0.923	10.22	10.10	Vertical	220º	0.883	9.37	9.72	Vertical
45º	0.883	9.36	9.71	Vertical	225º	0.896	9.63	9.84	Vertical
50º	0.889	9.48	9.77	Horizontal	230º	0.901	9.73	9.88	Vertical
55º	0.886	9.41	9.74	Horizontal	235º	0.899	9.69	9.86	Vertical
60º	0.873	9.14	9.61	Horizontal	240º	0.924	10.25	10.11	Horizontal
65º	0.851	8.68	9.39	Horizontal	245º	0.968	11.23	10.50	Horizontal
70º	0.819	8.06	9.06	Horizontal	250º	0.993	11.83	10.73	Horizontal
75º	0.779	7.28	8.62	Horizontal	255º	1.000	12.00	10.79	Horizontal
80º	0.729	6.38	8.05	Horizontal	260º	1.000	12.00	10.79	Horizontal
85º	0.670	5.39	7.32	Horizontal	265º	1.000	12.00	10.79	Horizontal
90º	0.602	4.35	6.39	Horizontal	270º	0.999	11.98	10.78	Horizontal
95º	0.533	3.41	5.32	Horizontal	275º	0.991	11.78	10.71	Horizontal
100º	0.476	2.72	4.34	Horizontal	280º	0.974	11.39	10.57	Horizontal
105º	0.431	2.23	3.48	Horizontal	285º	0.950	10.82	10.34	Horizontal
110º	0.417	2.09	3.20	Vertical	290º	0.921	10.18	10.08	Vertical
115º	0.415	2.06	3.15	Vertical	295º	0.939	10.57	10.24	Vertical
120º	0.411	2.02	3.06	Vertical	300º	0.952	10.87	10.36	Vertical
125º	0.406	1.98	2.96	Vertical	305º	0.961	11.08	10.44	Vertical
130º	0.401	1.93	2.85	Vertical	310º	0.965	11.18	10.48	Vertical
135º	0.397	1.89	2.77	Vertical	315º	0.969	11.27	10.52	Vertical
140º	0.394	1.87	2.71	Vertical	320º	0.974	11.39	10.57	Vertical
145º	0.415	2.07	3.16	Horizontal	325º	0.979	11.50	10.61	Vertical
150º	0.454	2.47	3.93	Horizontal	330º	0.983	11.60	10.65	Vertical
155º	0.505	3.06	4.85	Horizontal	335º	0.987	11.69	10.68	Vertical
160º	0.568	3.87	5.87	Horizontal	340º	0.990	11.77	10.71	Vertical
165º	0.641	4.94	6.94	Horizontal	345º	0.993	11.84	10.73	Vertical
170º	0.705	5.97	7.76	Horizontal	350º	0.996	11.89	10.75	Vertical
175º	0.759	6.92	8.40	Horizontal	355º	0.997	11.94	10.77	Vertical

Polarization: **Envelope**
Maximum Field: **1.000 @ 11° True**
Minimum Field: **0.394 @ 141° True**
RMS: **0.845**
Maximum ERP: **12.000 kW**
Maximum Power Gain: **1.953 (2.906 dB)**
Horizontal Plane Gain: **1.950 (2.901 dB)**

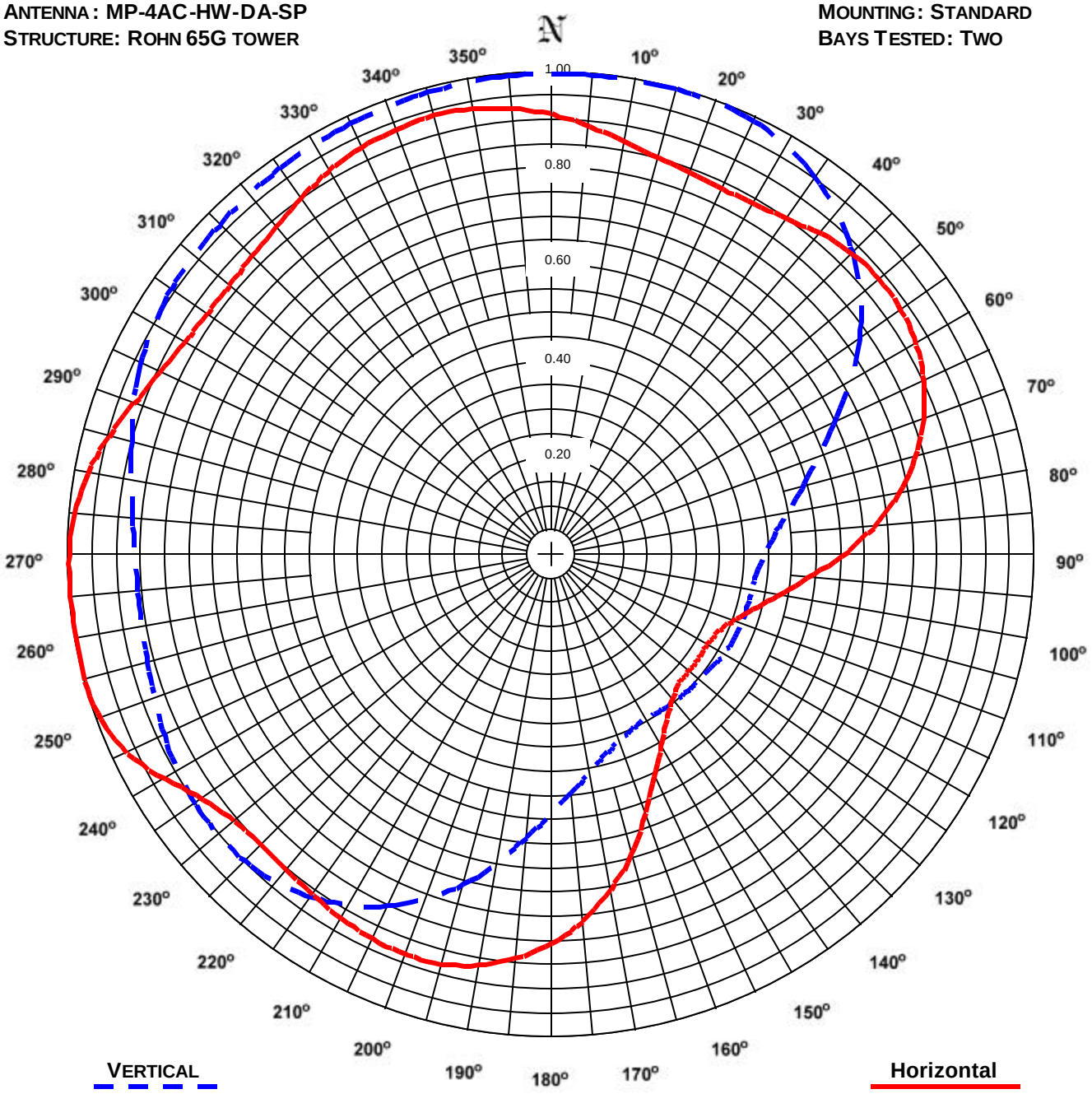
Total Input Power: 6.146 kW

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: KTUN
LOCATION: EAGLE, CO
ANTENNA: MP-4AC-HW-DA-SP
STRUCTURE: ROHN 65G TOWER

DATE: 9/23/2003
FREQUENCY: 101.7 MHz
ORIENTATION: 308° TRUE
MOUNTING: STANDARD
BAYS TESTED: TWO



VERTICAL

RMS: 0.784
MAXIMUM: 1.000 @ 11° TRUE
MINIMUM: 0.392 @ 150° TRUE

Horizontal

RMS: 0.811
Maximum: 1.000 @ 254° True
Minimum: 0.371 @ 120° True

COMMENTS: MEASURE PATTERNS OF ATHE HORIZONTAL AND VERTICAL COMPOENTS.

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: KTUN
Location: Eagle, CO
Frequency: 101.7 MHz

Antenna: MP-4AC-HW-DA-SP
Orientation: 308° True
Tower: 24" Rohn

Figure: 2
Date: 9/23/2003
Reference: ktun1m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0º	0.915	10.04	10.02	0.999	11.97	10.78	180º	0.803	7.74	8.89	0.536	3.45	5.38
5º	0.893	9.57	9.81	1.000	11.99	10.79	185º	0.837	8.41	9.25	0.587	4.14	6.17
10º	0.871	9.10	9.59	1.000	12.00	10.79	190º	0.861	8.89	9.49	0.646	5.01	7.00
15º	0.854	8.75	9.42	1.000	12.00	10.79	195º	0.875	9.18	9.63	0.705	5.97	7.76
20º	0.843	8.54	9.31	1.000	11.99	10.79	200º	0.879	9.27	9.67	0.756	6.86	8.37
25º	0.839	8.44	9.26	0.993	11.83	10.73	205º	0.876	9.20	9.64	0.800	7.68	8.85
30º	0.841	8.50	9.29	0.978	11.48	10.60	210º	0.869	9.05	9.57	0.835	8.38	9.23
35º	0.852	8.71	9.40	0.955	10.94	10.39	215º	0.859	8.85	9.47	0.863	8.94	9.52
40º	0.869	9.07	9.58	0.923	10.22	10.10	220º	0.852	8.70	9.40	0.883	9.37	9.72
45º	0.883	9.36	9.71	0.883	9.36	9.71	225º	0.849	8.64	9.37	0.896	9.63	9.84
50º	0.889	9.48	9.77	0.835	8.36	9.22	230º	0.856	8.79	9.44	0.901	9.73	9.88
55º	0.886	9.41	9.74	0.778	7.27	8.61	235º	0.881	9.31	9.69	0.899	9.69	9.86
60º	0.873	9.14	9.61	0.713	6.10	7.86	240º	0.924	10.25	10.11	0.893	9.57	9.81
65º	0.851	8.68	9.39	0.645	5.00	6.99	245º	0.968	11.23	10.50	0.884	9.39	9.73
70º	0.819	8.06	9.06	0.586	4.12	6.15	250º	0.993	11.83	10.73	0.874	9.16	9.62
75º	0.779	7.28	8.62	0.536	3.45	5.38	255º	1.000	12.00	10.79	0.866	8.99	9.54
80º	0.729	6.38	8.05	0.495	2.94	4.68	260º	1.000	12.00	10.79	0.861	8.89	9.49
85º	0.670	5.39	7.32	0.463	2.57	4.10	265º	1.000	12.00	10.79	0.860	8.87	9.48
90º	0.602	4.35	6.39	0.439	2.32	3.65	270º	0.999	11.98	10.78	0.863	8.94	9.51
95º	0.533	3.41	5.32	0.425	2.17	3.36	275º	0.991	11.78	10.71	0.871	9.11	9.59
100º	0.476	2.72	4.34	0.420	2.11	3.25	280º	0.974	11.39	10.57	0.884	9.37	9.72
105º	0.431	2.23	3.48	0.419	2.11	3.24	285º	0.950	10.82	10.34	0.900	9.73	9.88
110º	0.399	1.91	2.81	0.417	2.09	3.20	290º	0.919	10.13	10.06	0.921	10.18	10.08
115º	0.379	1.72	2.36	0.415	2.06	3.15	295º	0.894	9.60	9.82	0.939	10.57	10.24
120º	0.371	1.66	2.19	0.411	2.02	3.06	300º	0.878	9.25	9.66	0.952	10.87	10.36
125º	0.371	1.66	2.19	0.406	1.98	2.96	305º	0.870	9.07	9.58	0.961	11.08	10.44
130º	0.371	1.66	2.19	0.401	1.93	2.85	310º	0.870	9.08	9.58	0.965	11.18	10.48
135º	0.374	1.68	2.26	0.397	1.89	2.77	315º	0.876	9.20	9.64	0.969	11.27	10.52
140º	0.389	1.81	2.59	0.394	1.87	2.71	320º	0.886	9.43	9.74	0.974	11.39	10.57
145º	0.415	2.07	3.16	0.393	1.85	2.67	325º	0.902	9.77	9.90	0.979	11.50	10.61
150º	0.454	2.47	3.93	0.392	1.84	2.65	330º	0.920	10.15	10.06	0.983	11.60	10.65
155º	0.505	3.06	4.85	0.397	1.89	2.76	335º	0.932	10.43	10.18	0.987	11.69	10.68
160º	0.568	3.87	5.87	0.409	2.01	3.03	340º	0.940	10.61	10.26	0.990	11.77	10.71
165º	0.641	4.94	6.94	0.429	2.21	3.44	345º	0.943	10.67	10.28	0.993	11.84	10.73
170º	0.705	5.97	7.76	0.457	2.51	3.99	350º	0.939	10.59	10.25	0.996	11.89	10.75
175º	0.759	6.92	8.40	0.493	2.91	4.64	355º	0.930	10.38	10.16	0.997	11.94	10.77

Polarization:	**Horizontal**	**Vertical**
Maximum Field:	**1.000 @ 254° True**	**1.000 @ 11° True**
Minimum Field:	**0.371 @ 120° True**	**0.392 @ 150° True**
RMS:	**0.811**	**0.784**
Maximum ERP:	**12.000 kW**	**12.000 kW**
Maximum Power Gain:	**1.953 (2.906 dB)**	**1.953 (2.906 dB)**
Horizontal Plane Gain:	**1.950 (2.901 dB)**	**1.950 (2.901 dB)**

Total Input Power: 6.146 kW

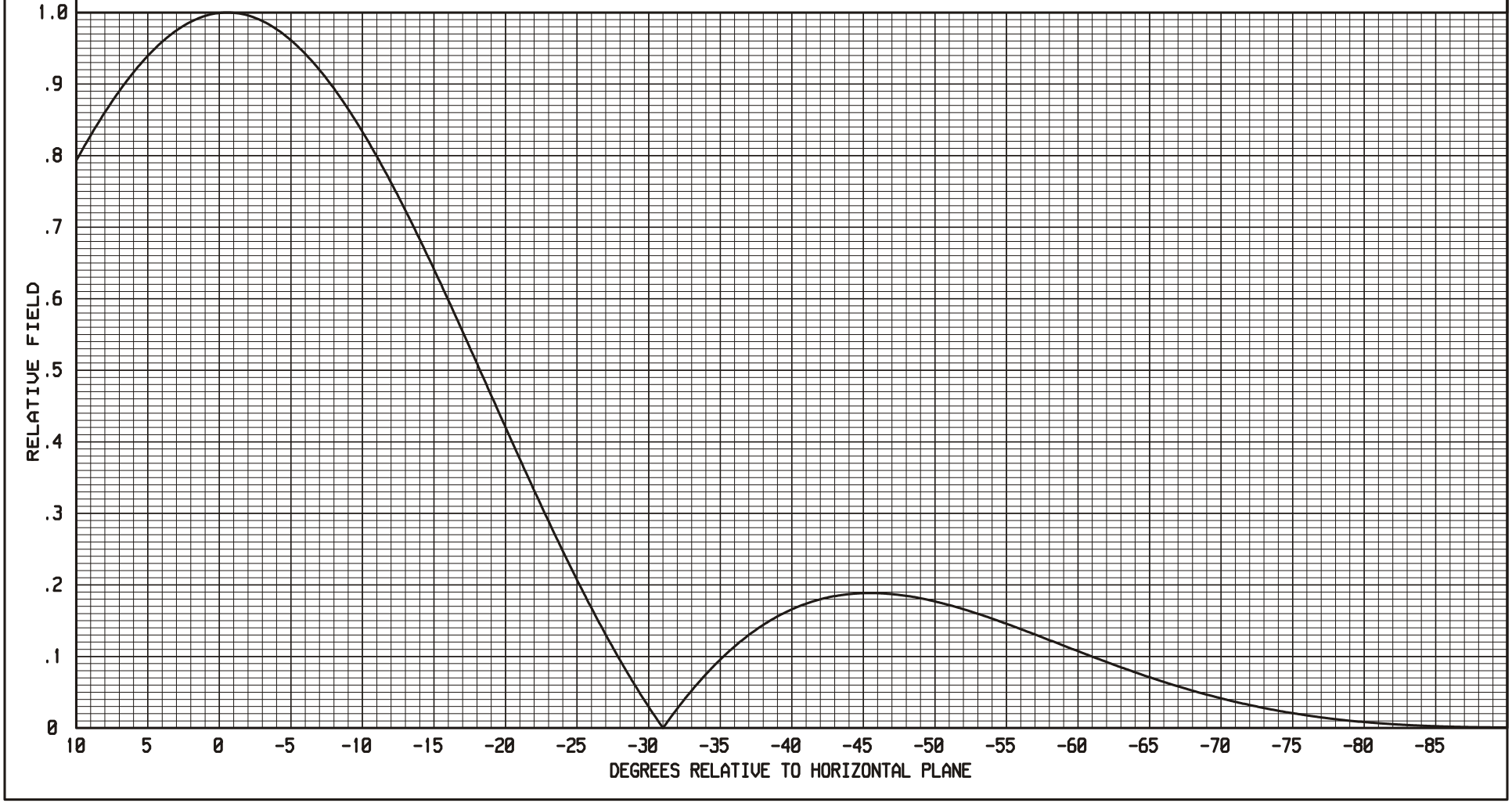
ELECTRONICS RESEARCH,INC.
7777 GARDNER ROAD
CHANDLER, IN. 47610

FIGURE 3

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

ERI TYPE MP-4AC-DA-HW BROADCAST ANTENNA
-0.54 DEGREE ELECTRICAL BEAM TILT
0 PERCENT FIRST NULL FILL
0 PERCENT SECOND NULL FILL

ELEMENT SPACING:
HALF-WAVE



Directional Antenna System
for
KTUN, Eagle, Colorado

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	MP-4AC-DA-HW-SP
Frequency:	101.7 MHz
Number of Bays:	four

MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	18 ft 1 in
Aperture length required:	29 ft 5 in.
Orientation:	308º true

Input flange to the antenna 3 1/8 inch female

ELECTRICAL SPECIFICATIONS
(For directional use)
(-0.54 degrees of Beam tilt)

Maximum horizontal ERP:	12 kW (10.792 dBk)
Horizontal maximum power gain:	1.953 (2.906 dB)
H pol H Plane power Gain:	1.950 (2.901 dB)
Maximum vertical ERP:	12 kW (10.792 dBk)
Vertical maximum power gain:	1.953 (2.906 dB)
V pol H plane power gain	1.950 (2.901 dB)
Total input power:	6.146 kW (7.886 dBk)

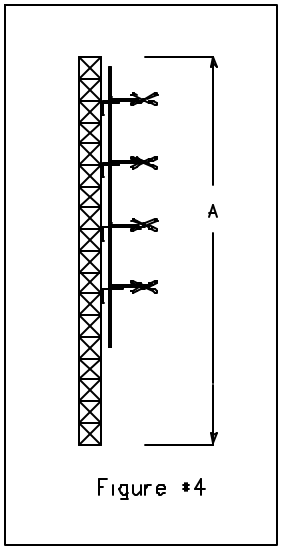


Figure #4