

## Directional Antenna System For KTBJ, Festus, Missouri

August 13, 2001

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 KTBJ.

The antenna is the ERI model 1092-6CP-DA configuration. The circular polarized system consists of 6 full-wavelength spaced bays using two circular polarized radiating element, two horizontal parasitic elements placed one quarter wave above and below each bay and three vertical parasitic elements per bay. The antenna was mounted on the North 342 degrees East tower leg with bracketry to provide an antenna orientation of North 342 degrees East. The antenna was tested on a 57" ***ERI<sup>®</sup>  $\lambda$  MOUNTING SYSTEM***, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 89.3 megahertz which is the center of the FM broadcast channel assigned to KTBJ.

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.

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(Continued)

## DESCRIPTION OF THE TEST PROCEDURE

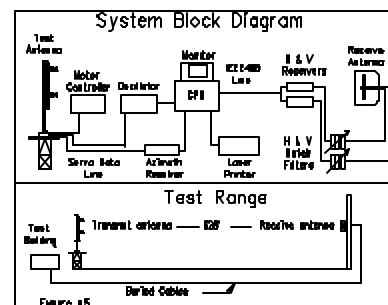
The test antenna consisted of one bay of the circular polarized system. The elements and brackets that were used in this test are electrically equivalent to those that will be supplied with the antenna.

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 57" **ERI<sup>®</sup> MOUNTING SYSTEM**, 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 89.3 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.



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(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 1092-6CP-DA array is to be mounted on the 57" **ERI<sup>®</sup>  $\lambda$  MOUNTING SYSTEM**, at a bearing of North 342 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 25 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.

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 70 feet if the antenna is to be top mounted.

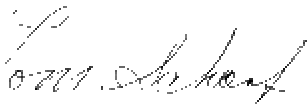
The directional antenna should not be mounted on the top of an antenna tower that includes a top-mounted platform larger than the cross-sectional area of the tower in the horizontal plane. No obstructions other than those that are specified by the blue prints supplied with the antenna are to be mounted within 75 ft. horizontally of the system.

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(Continued)

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 Scharf".

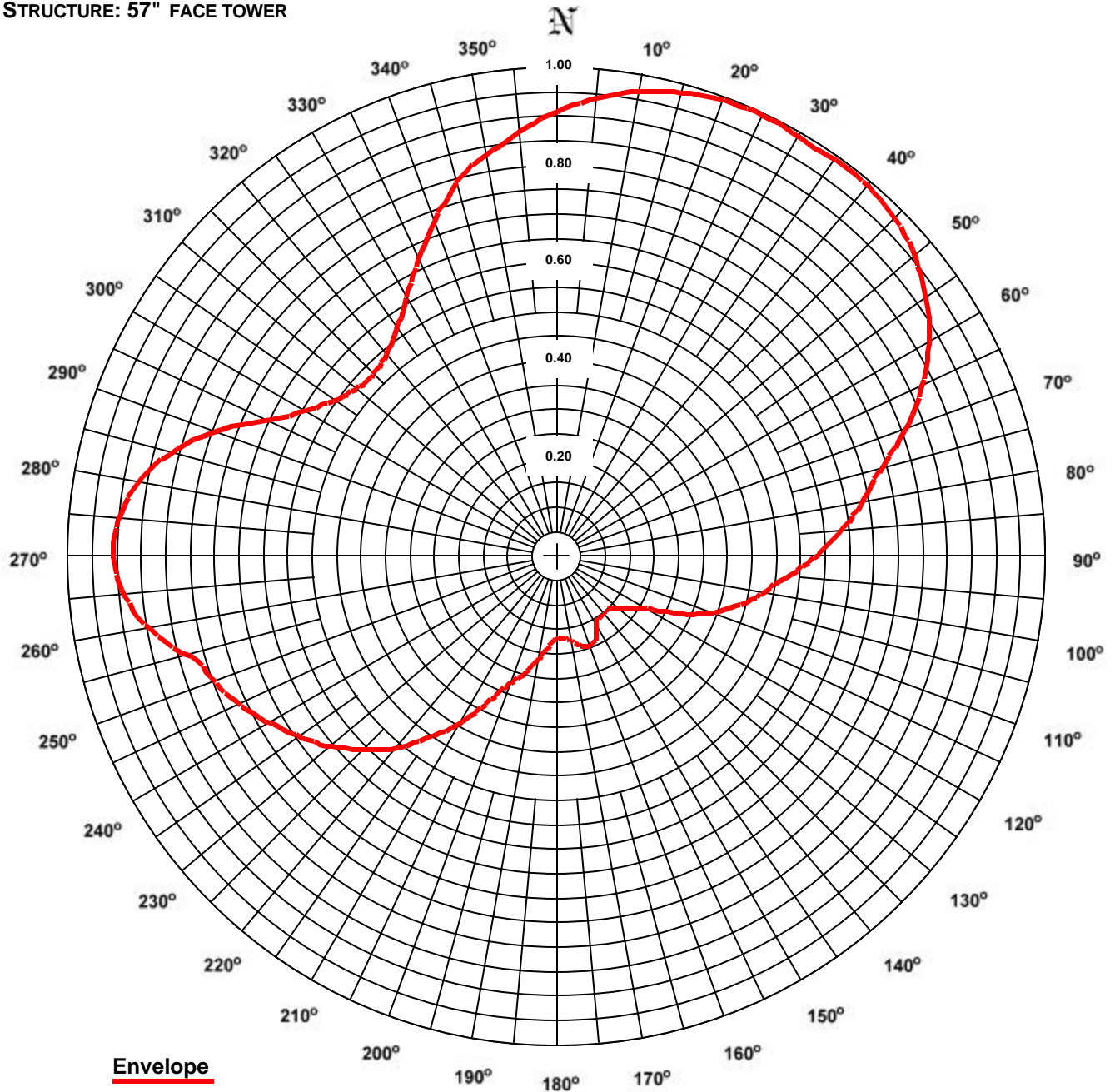
Tom Scharf

# **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: KTBJ  
LOCATION: FESTUS, MISSOURI  
ANTENNA TYPE: 1092-6CP-DA  
STRUCTURE: 57" FACE TOWER

DATE: 8/13/01  
FREQUENCY: 89.3 MHz  
ORIENTATION: 342° TRUE  
MOUNTING: CUSTOM



RMS: 0.656  
Maximum: 1.000 @ 24° True  
Minimum: 0.148 @ 136° True

COMMENTS: MEASURED PATTERNS OF THE HORIZONTAL AND VERTICAL COMPONENTS.

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

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**Station:** KTBJ  
**Location:** Festus, Missouri  
**Frequency:** 89.3 MHz

**Antenna:** 1092-6CP-DA  
**Orientation:** 342° True  
**Tower:** 57" face tower

**Figure:** 1  
**Date:** 8/13/01  
**Reference:** ktbj1m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.915	20.94	13.21	Horizontal	180°	0.165	0.68	-1.65	Vertical
5°	0.946	22.39	13.50	Horizontal	185°	0.181	0.82	-0.87	Vertical
10°	0.970	23.54	13.72	Horizontal	190°	0.209	1.09	0.38	Vertical
15°	0.987	24.37	13.87	Horizontal	195°	0.240	1.43	1.57	Vertical
20°	0.997	24.86	13.95	Horizontal	200°	0.272	1.84	2.66	Vertical
25°	1.000	24.99	13.98	Horizontal	205°	0.319	2.55	4.06	Horizontal
30°	0.995	24.74	13.93	Horizontal	210°	0.384	3.68	5.66	Horizontal
35°	0.994	24.72	13.93	Vertical	215°	0.443	4.90	6.90	Horizontal
40°	0.993	24.65	13.92	Vertical	220°	0.505	6.38	8.05	Horizontal
45°	0.980	24.02	13.81	Vertical	225°	0.553	7.65	8.84	Horizontal
50°	0.957	22.88	13.60	Vertical	230°	0.600	8.99	9.54	Horizontal
55°	0.923	21.28	13.28	Vertical	235°	0.638	10.18	10.08	Horizontal
60°	0.878	19.27	12.85	Vertical	240°	0.676	11.43	10.58	Horizontal
65°	0.823	16.92	12.28	Vertical	245°	0.713	12.72	11.04	Horizontal
70°	0.757	14.31	11.56	Vertical	250°	0.744	13.84	11.41	Horizontal
75°	0.683	11.65	10.66	Vertical	255°	0.776	15.06	11.78	Vertical
80°	0.631	9.95	9.98	Horizontal	260°	0.844	17.83	12.51	Vertical
85°	0.579	8.39	9.24	Horizontal	265°	0.888	19.73	12.95	Vertical
90°	0.526	6.91	8.39	Horizontal	270°	0.908	20.61	13.14	Vertical
95°	0.469	5.49	7.40	Horizontal	275°	0.901	20.28	13.07	Vertical
100°	0.424	4.50	6.53	Vertical	280°	0.872	19.00	12.79	Vertical
105°	0.377	3.55	5.50	Vertical	285°	0.822	16.90	12.28	Vertical
110°	0.327	2.67	4.26	Vertical	290°	0.752	14.14	11.50	Vertical
115°	0.263	1.74	2.39	Vertical	295°	0.666	11.10	10.45	Vertical
120°	0.204	1.04	0.18	Horizontal	300°	0.601	9.03	9.56	Horizontal
125°	0.174	0.76	-1.22	Horizontal	305°	0.561	7.87	8.96	Horizontal
130°	0.156	0.61	-2.15	Horizontal	310°	0.538	7.22	8.59	Horizontal
135°	0.148	0.55	-2.60	Horizontal	315°	0.532	7.06	8.49	Horizontal
140°	0.149	0.56	-2.55	Horizontal	320°	0.544	7.40	8.69	Horizontal
145°	0.151	0.57	-2.43	Horizontal	325°	0.573	8.20	9.14	Horizontal
150°	0.161	0.65	-1.86	Vertical	330°	0.617	9.51	9.78	Horizontal
155°	0.185	0.86	-0.66	Vertical	335°	0.674	11.36	10.55	Horizontal
160°	0.192	0.92	-0.36	Vertical	340°	0.734	13.49	11.30	Horizontal
165°	0.185	0.86	-0.67	Vertical	345°	0.794	15.76	11.98	Vertical
170°	0.172	0.74	-1.33	Vertical	350°	0.839	17.61	12.46	Vertical
175°	0.163	0.67	-1.76	Vertical	355°	0.877	19.23	12.84	Horizontal

**Polarization:**  
**Maximum Field:** 1.000 @ 24° True  
**Minimum Field:** 0.148 @ 136° True  
**RMS:** 0.656  
**Maximum ERP:** 25.000 kW  
**Maximum Power Gain:** 7.699 (8.864 dB)

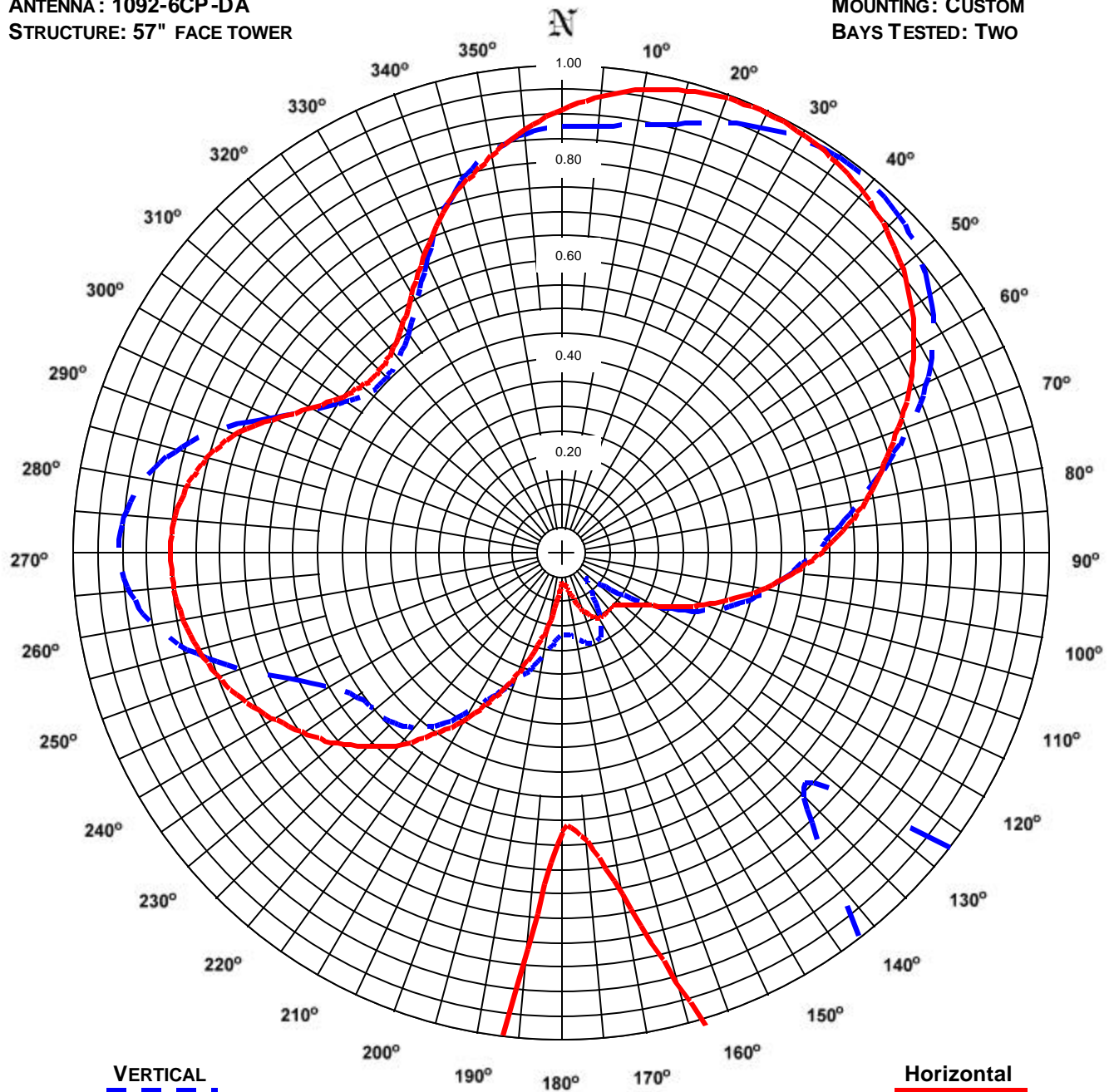
**Total Input Power:** 3.247 kW

# **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: KTBJ  
LOCATION: FESTUS, MISSOURI  
ANTENNA: 1092-6CP-DA  
STRUCTURE: 57" FACE TOWER

DATE: 8/13/01  
FREQUENCY: 89.3 MHz  
ORIENTATION: 342° TRUE  
MOUNTING: CUSTOM  
BAYS TESTED: TWO



**VERTICAL**  
RMS: 0.637  
MAXIMUM: 0.995 @ 37° TRUE  
MINIMUM: 0.068 @ 133° TRUE

**Horizontal**  
RMS: 0.637  
Maximum: 1.000 @ 24° True  
Minimum: 0.056 @ 179° True

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:** KTBJ  
**Location:** Festus, Missouri  
**Frequency:** 89.3 MHz

**Antenna:** 1092-6CP-DA  
**Orientation:** 342° True  
**Tower:** 57" face tower

**Figure:** 2  
**Date:** 8/13/01  
**Reference:** ktbj1m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.915	20.94	13.21	0.881	19.42	12.88	180°	0.057	0.08	-10.93	0.165	0.68	-1.65
5°	0.946	22.39	13.50	0.885	19.59	12.92	185°	0.081	0.16	-7.86	0.181	0.82	-0.87
10°	0.970	23.54	13.72	0.897	20.11	13.03	190°	0.135	0.46	-3.40	0.209	1.09	0.38
15°	0.987	24.37	13.87	0.917	21.01	13.23	195°	0.191	0.91	-0.40	0.240	1.43	1.57
20°	0.997	24.86	13.95	0.945	22.31	13.49	200°	0.256	1.64	2.16	0.272	1.84	2.66
25°	1.000	24.99	13.98	0.970	23.50	13.71	205°	0.319	2.55	4.06	0.313	2.45	3.89
30°	0.995	24.74	13.93	0.986	24.31	13.86	210°	0.384	3.68	5.66	0.363	3.30	5.18
35°	0.983	24.18	13.83	0.994	24.72	13.93	215°	0.443	4.90	6.90	0.418	4.37	6.41
40°	0.966	23.32	13.68	0.993	24.65	13.92	220°	0.505	6.38	8.05	0.460	5.28	7.23
45°	0.942	22.18	13.46	0.980	24.02	13.81	225°	0.553	7.65	8.84	0.486	5.91	7.72
50°	0.912	20.78	13.18	0.957	22.88	13.60	230°	0.600	8.99	9.54	0.498	6.20	7.93
55°	0.875	19.15	12.82	0.923	21.28	13.28	235°	0.638	10.18	10.08	0.508	6.46	8.11
60°	0.832	17.32	12.39	0.878	19.27	12.85	240°	0.676	11.43	10.58	0.543	7.36	8.67
65°	0.783	15.34	11.86	0.823	16.92	12.28	245°	0.713	12.72	11.04	0.601	9.04	9.56
70°	0.729	13.27	11.23	0.757	14.31	11.56	250°	0.744	13.84	11.41	0.684	11.71	10.68
75°	0.678	11.48	10.60	0.683	11.65	10.66	255°	0.769	14.77	11.69	0.776	15.06	11.78
80°	0.631	9.95	9.98	0.619	9.57	9.81	260°	0.787	15.47	11.89	0.844	17.83	12.51
85°	0.579	8.39	9.24	0.563	7.92	8.99	265°	0.798	15.93	12.02	0.888	19.73	12.95
90°	0.526	6.91	8.39	0.512	6.56	8.17	270°	0.803	16.13	12.08	0.908	20.61	13.14
95°	0.469	5.49	7.40	0.466	5.43	7.35	275°	0.799	15.96	12.03	0.901	20.28	13.07
100°	0.413	4.27	6.30	0.424	4.50	6.53	280°	0.783	15.34	11.86	0.872	19.00	12.79
105°	0.352	3.10	4.92	0.377	3.55	5.50	285°	0.756	14.30	11.55	0.822	16.90	12.28
110°	0.298	2.22	3.47	0.327	2.67	4.26	290°	0.718	12.90	11.10	0.752	14.14	11.50
115°	0.248	1.54	1.88	0.263	1.74	2.39	295°	0.658	10.82	10.34	0.666	11.10	10.45
120°	0.204	1.04	0.18	0.197	0.97	-0.12	300°	0.601	9.03	9.56	0.596	8.89	9.49
125°	0.174	0.76	-1.22	0.122	0.37	-4.31	305°	0.561	7.87	8.96	0.547	7.48	8.74
130°	0.156	0.61	-2.15	0.077	0.15	-8.29	310°	0.538	7.22	8.59	0.518	6.71	8.26
135°	0.148	0.55	-2.60	0.070	0.12	-9.10	315°	0.532	7.06	8.49	0.510	6.51	8.14
140°	0.149	0.56	-2.55	0.087	0.19	-7.21	320°	0.544	7.40	8.69	0.523	6.84	8.35
145°	0.151	0.57	-2.43	0.121	0.37	-4.35	325°	0.573	8.20	9.14	0.552	7.63	8.82
150°	0.148	0.55	-2.61	0.161	0.65	-1.86	330°	0.617	9.51	9.78	0.598	8.93	9.51
155°	0.136	0.47	-3.32	0.185	0.86	-0.66	335°	0.674	11.36	10.55	0.659	10.86	10.36
160°	0.117	0.34	-4.69	0.192	0.92	-0.36	340°	0.734	13.49	11.30	0.733	13.42	11.28
165°	0.090	0.20	-6.90	0.185	0.86	-0.67	345°	0.785	15.41	11.88	0.794	15.76	11.98
170°	0.071	0.12	-9.05	0.172	0.74	-1.33	350°	0.832	17.30	12.38	0.839	17.61	12.46
175°	0.059	0.09	-10.62	0.163	0.67	-1.76	355°	0.877	19.23	12.84	0.868	18.85	12.75

<b>Polarization:</b>	<b>Horizontal</b>	<b>Vertical</b>
<b>Maximum Field:</b>	<b>1.000 @ 24° True</b>	<b>0.995 @ 37° True</b>
<b>Minimum Field:</b>	<b>0.056 @ 179° True</b>	<b>0.068 @ 133° True</b>
<b>RMS:</b>	<b>0.637</b>	<b>0.637</b>
<b>Maximum ERP:</b>	<b>25.000 kW</b>	<b>24.774 kW</b>
<b>Maximum Power Gain:</b>	<b>7.699 (8.864 dB)</b>	<b>7.629 (8.825 dB)</b>

**Total Input Power: 3.247 kW**





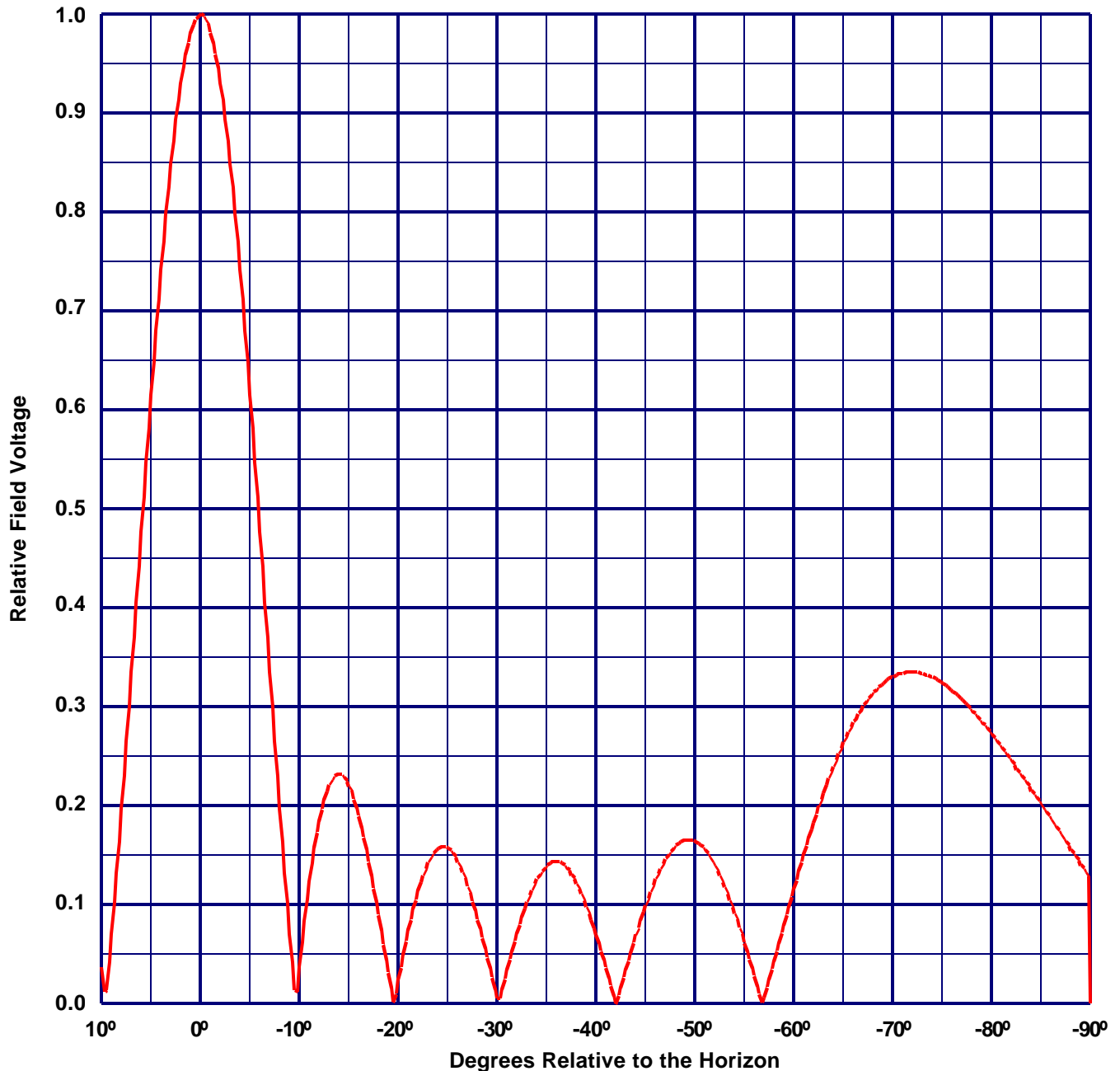
## Vertical Plane Relative Field Pattern

**KTBJ, Festus, Missouri, 89.3 MHz**

Figure#: 3

Date: 8/13/01

*A 6 level, 1 wave-length spaced 1092-6CP-DA directional antenna with 0° beam tilt, 0% null fill and a H/V maximum power ratio of 1.009*



**Vertical Polarization Gain:**

**Maximum: 7.629 (8.825 dB)**

**Horizontal Plane: 7.629 (8.825 dB)**

**Horizontal Polarization Gain:**

**Maximum: 7.699 (8.864 dB)**

**Horizontal Plane: 7.699 (8.864 dB)**

Directional Antenna System  
For  
KTBJ, Festus, Missouri

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	1092-6CP-DA
Frequency:	89.3 MHz
Number of Bays:	6

MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	64 ft 10 in
Aperture length required:	70 ft.
Orientation:	342° true
Input flange to the antenna	1 5/8 inch female

ELECTRICAL SPECIFICATIONS

(For directional use)

Maximum horizontal ERP:	25 kW (13.979 dBk)
Horizontal maximum power gain:	7.699 (8.864 dB)
Maximum vertical ERP:	24.774 kW (13.94 dBk)
Vertical maximum power gain:	7.629 (8.825 dB)
Total input power:	3.247 kW (5.115 dBk)