

***Directional Antenna System  
for  
WDRV, Chicago, Illinois***

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

The antenna is the ERI model 1083-3CP-DA configuration. The circular polarized system consists of 3 fractional wavelength spaced bays using three driven circular polarized radiating element per bay. The ladder that is attached to the cylinder of the antenna system is orientated to North 322° 31' 59" East. The antenna was tested on a 19 3/4" face tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 97.1 megahertz, which is the center of the FM broadcast channel assigned to WDRV.

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 WDRV, Chicago, Illinois

(Continued)

## DESCRIPTION OF THE TEST PROCEDURE

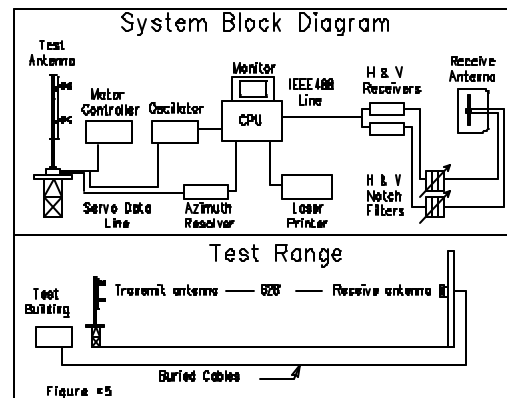
The test antenna consisted of one bay level of the circular polarized system. The elements and brackets that were used in this test are electrically equivalent to those that will be supplied with the antenna. The system was properly grounded during all tests.

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 19 3/4" 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 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 97.1 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 WDRV, Chicago, Illinois

(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 will consist of 3 fractional wavelength spaced bays using three driven circular polarized radiating element 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 1083-3CP-DA array with the ladder that is the attached to the cylinder of the antenna system is orientated to North  $322^{\circ} 31' 59''$  East on the of the 19 3/4" face tower. 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 8.3 kilowatts (9.191 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 30 feet 4 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 Shenefelt", written in dark ink.

# **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: WDRV

LOCATION: CHICAGO, IL.

ANTENNA TYPE: 1083-3CP-DA

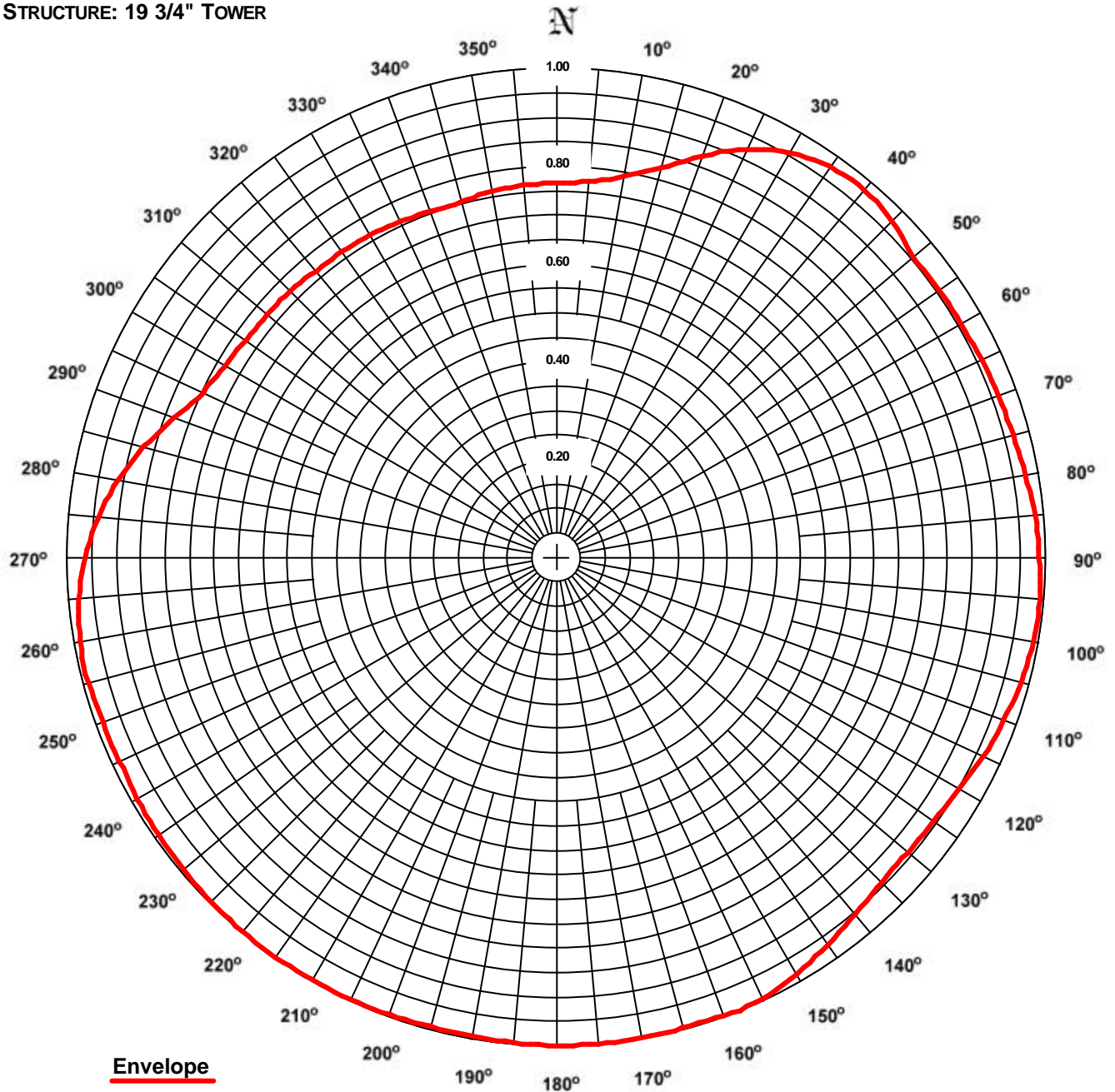
STRUCTURE: 19 3/4" TOWER

DATE: 2/4/04

FREQUENCY: 97.1 MHz

ORIENTATION: 322° 31' 59" TRUE

MOUNTING: CUSTOM



RMS: 0.928

Maximum: 1.000 @ 158° True

Minimum: 0.750 @ 343° True

COMMENTS: 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-200107AAQ.

# **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: WDRV**  
**Location: Chicago, IL.**  
**Frequency: 97.1 MHz**

**Antenna: 1083-3CP-DA**  
**Orientation: 322° 31' 59" True**  
**Tower: 19 3/4" Tower**

**Figure: 1**  
**Date: 2/4/04**  
**Reference: wdrv2m.fig**

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.766	4.86	6.87	Vertical	180°	1.000	8.29	9.19	Horizontal
5°	0.771	4.94	6.94	Vertical	185°	0.997	8.26	9.17	Horizontal
10°	0.791	5.19	7.15	Vertical	190°	0.995	8.21	9.14	Horizontal
15°	0.825	5.65	7.52	Vertical	195°	0.995	8.21	9.15	Horizontal
20°	0.873	6.32	8.01	Vertical	200°	0.997	8.25	9.17	Horizontal
25°	0.921	7.04	8.47	Vertical	205°	0.998	8.27	9.18	Horizontal
30°	0.955	7.56	8.79	Vertical	210°	0.999	8.28	9.18	Horizontal
35°	0.974	7.88	8.96	Vertical	215°	1.000	8.29	9.19	Horizontal
40°	0.979	7.96	9.01	Vertical	220°	0.999	8.29	9.19	Horizontal
45°	0.971	7.83	8.94	Vertical	225°	0.999	8.28	9.18	Horizontal
50°	0.953	7.54	8.77	Horizontal	230°	0.996	8.24	9.16	Horizontal
55°	0.955	7.57	8.79	Horizontal	235°	0.992	8.17	9.12	Horizontal
60°	0.956	7.58	8.80	Horizontal	240°	0.989	8.12	9.10	Vertical
65°	0.959	7.63	8.82	Horizontal	245°	0.987	8.08	9.07	Vertical
70°	0.963	7.70	8.86	Horizontal	250°	0.987	8.09	9.08	Vertical
75°	0.968	7.77	8.91	Horizontal	255°	0.991	8.15	9.11	Vertical
80°	0.975	7.88	8.97	Horizontal	260°	0.989	8.12	9.09	Vertical
85°	0.982	8.01	9.04	Horizontal	265°	0.979	7.96	9.01	Vertical
90°	0.988	8.10	9.09	Horizontal	270°	0.963	7.70	8.86	Vertical
95°	0.992	8.17	9.12	Horizontal	275°	0.940	7.33	8.65	Vertical
100°	0.990	8.14	9.11	Horizontal	280°	0.910	6.87	8.37	Vertical
105°	0.984	8.04	9.05	Horizontal	285°	0.873	6.32	8.01	Vertical
110°	0.974	7.88	8.97	Horizontal	290°	0.831	5.74	7.59	Vertical
115°	0.964	7.71	8.87	Horizontal	295°	0.797	5.28	7.22	Horizontal
120°	0.951	7.51	8.76	Horizontal	300°	0.783	5.09	7.07	Horizontal
125°	0.944	7.39	8.69	Horizontal	305°	0.774	4.98	6.97	Horizontal
130°	0.939	7.31	8.64	Horizontal	310°	0.771	4.93	6.93	Horizontal
135°	0.940	7.33	8.65	Vertical	315°	0.769	4.91	6.91	Horizontal
140°	0.952	7.53	8.77	Vertical	320°	0.764	4.84	6.85	Horizontal
145°	0.969	7.79	8.91	Vertical	325°	0.763	4.83	6.84	Horizontal
150°	0.985	8.06	9.06	Vertical	330°	0.761	4.81	6.82	Horizontal
155°	0.998	8.26	9.17	Vertical	335°	0.757	4.76	6.78	Horizontal
160°	0.999	8.28	9.18	Vertical	340°	0.753	4.70	6.72	Horizontal
165°	0.998	8.27	9.17	Horizontal	345°	0.753	4.71	6.73	Vertical
170°	0.999	8.29	9.18	Horizontal	350°	0.759	4.79	6.80	Vertical
175°	1.000	8.30	9.19	Horizontal	355°	0.764	4.84	6.85	Vertical

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

**Envelope**  
**1.000 @ 158° True**  
**0.750 @ 343° True**  
**0.928**  
**8.300 kW**  
**1.457 (1.634 dB)**

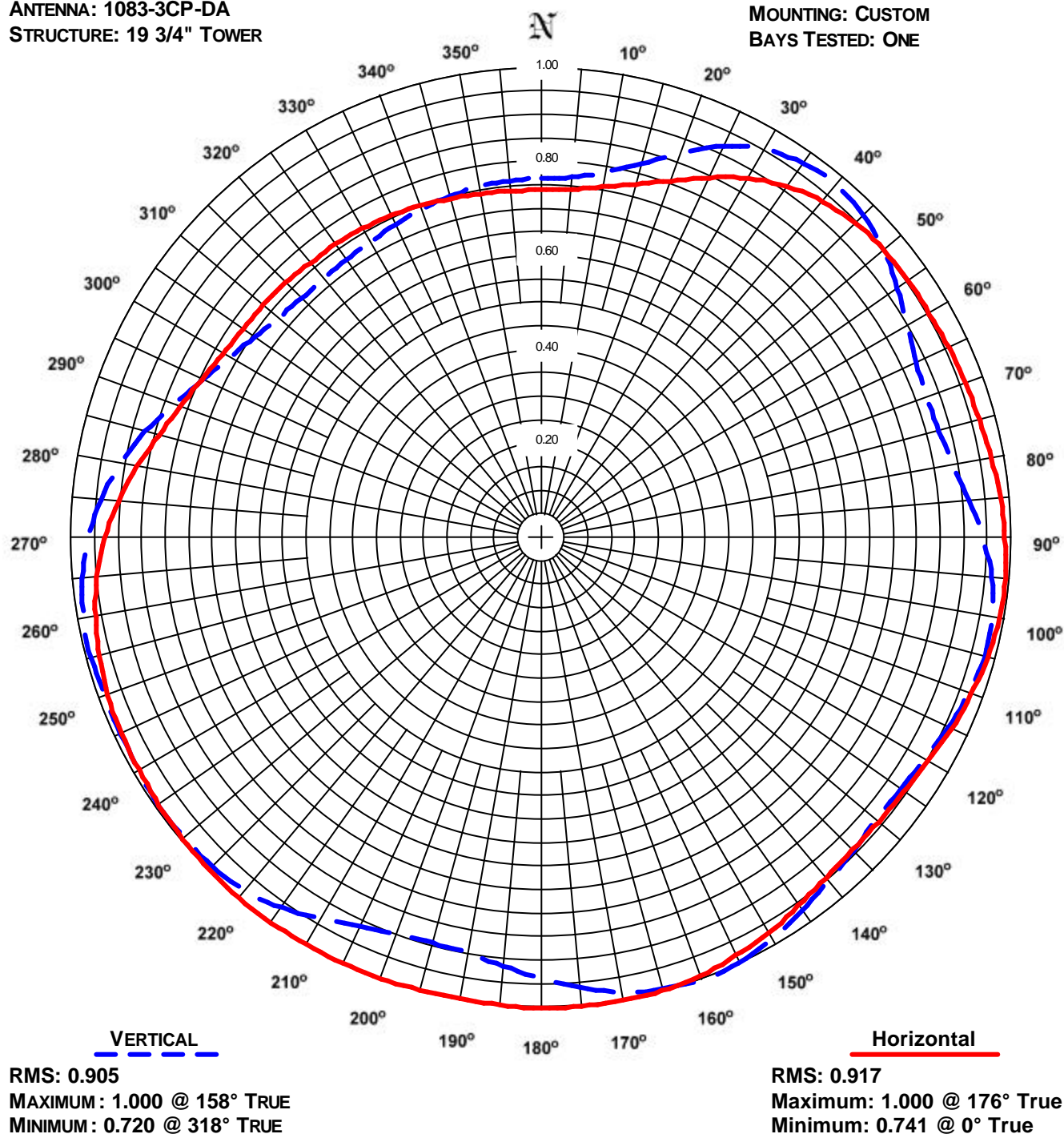
**Total Input Power: 5.697 kW**

# **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: WDRV  
LOCATION: CHICAGO, IL.  
ANTENNA: 1083-3CP-DA  
STRUCTURE: 19 3/4" TOWER

DATE: 2/4/04  
FREQUENCY: 97.1 MHz  
ORIENTATION: 322° 31' 59" TRUE  
MOUNTING: CUSTOM  
BAYS TESTED: ONE



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: WDRV**  
**Location: Chicago, IL.**  
**Frequency: 97.1 MHz**

**Antenna: 1083-3CP-DA**  
**Orientation: 322° 31' 59" True**  
**Tower: 19 3/4" Tower**

**Figure: 2**  
**Date: 2/4/04**  
**Reference: wdrv2m.fig**

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.741	4.56	6.59	0.766	4.86	6.87	180°	1.000	8.29	9.19	0.937	7.28	8.62
5°	0.746	4.62	6.64	0.771	4.94	6.94	185°	0.997	8.26	9.17	0.914	6.94	8.41
10°	0.759	4.78	6.79	0.791	5.19	7.15	190°	0.995	8.21	9.14	0.897	6.68	8.25
15°	0.780	5.05	7.03	0.825	5.65	7.52	195°	0.995	8.21	9.15	0.892	6.61	8.20
20°	0.809	5.44	7.35	0.873	6.32	8.01	200°	0.997	8.25	9.17	0.898	6.69	8.25
25°	0.847	5.95	7.75	0.921	7.04	8.47	205°	0.998	8.27	9.18	0.913	6.91	8.40
30°	0.884	6.49	8.12	0.955	7.56	8.79	210°	0.999	8.28	9.18	0.935	7.26	8.61
35°	0.914	6.93	8.41	0.974	7.88	8.96	215°	1.000	8.29	9.19	0.960	7.66	8.84
40°	0.935	7.26	8.61	0.979	7.96	9.01	220°	0.999	8.29	9.19	0.980	7.97	9.01
45°	0.948	7.46	8.73	0.971	7.83	8.94	225°	0.999	8.28	9.18	0.989	8.12	9.09
50°	0.953	7.54	8.77	0.952	7.52	8.76	230°	0.996	8.24	9.16	0.991	8.16	9.12
55°	0.955	7.57	8.79	0.927	7.14	8.54	235°	0.992	8.17	9.12	0.992	8.17	9.12
60°	0.956	7.58	8.80	0.902	6.75	8.29	240°	0.987	8.09	9.08	0.989	8.12	9.10
65°	0.959	7.63	8.82	0.882	6.46	8.10	245°	0.985	8.06	9.06	0.987	8.08	9.07
70°	0.963	7.70	8.86	0.874	6.34	8.02	250°	0.981	7.98	9.02	0.987	8.09	9.08
75°	0.968	7.77	8.91	0.878	6.39	8.06	255°	0.973	7.86	8.95	0.991	8.15	9.11
80°	0.975	7.88	8.97	0.892	6.60	8.19	260°	0.963	7.69	8.86	0.989	8.12	9.09
85°	0.982	8.01	9.04	0.915	6.95	8.42	265°	0.949	7.47	8.73	0.979	7.96	9.01
90°	0.988	8.10	9.09	0.941	7.35	8.67	270°	0.929	7.16	8.55	0.963	7.70	8.86
95°	0.992	8.17	9.12	0.964	7.71	8.87	275°	0.904	6.78	8.31	0.940	7.33	8.65
100°	0.990	8.14	9.11	0.976	7.91	8.98	280°	0.873	6.32	8.01	0.910	6.87	8.37
105°	0.984	8.04	9.05	0.978	7.93	8.99	285°	0.842	5.89	7.70	0.873	6.32	8.01
110°	0.974	7.88	8.97	0.969	7.80	8.92	290°	0.817	5.54	7.44	0.831	5.74	7.59
115°	0.964	7.71	8.87	0.955	7.57	8.79	295°	0.797	5.28	7.22	0.796	5.26	7.21
120°	0.951	7.51	8.76	0.942	7.37	8.68	300°	0.783	5.09	7.07	0.767	4.88	6.89
125°	0.944	7.39	8.69	0.935	7.25	8.60	305°	0.774	4.98	6.97	0.745	4.61	6.64
130°	0.939	7.31	8.64	0.932	7.21	8.58	310°	0.771	4.93	6.93	0.730	4.43	6.46
135°	0.939	7.32	8.65	0.940	7.33	8.65	315°	0.769	4.91	6.91	0.722	4.33	6.36
140°	0.944	7.40	8.69	0.952	7.53	8.77	320°	0.764	4.84	6.85	0.721	4.31	6.34
145°	0.956	7.58	8.80	0.969	7.79	8.91	325°	0.763	4.83	6.84	0.723	4.34	6.37
150°	0.969	7.80	8.92	0.985	8.06	9.06	330°	0.761	4.81	6.82	0.728	4.39	6.43
155°	0.981	7.98	9.02	0.998	8.26	9.17	335°	0.757	4.76	6.78	0.735	4.48	6.51
160°	0.991	8.16	9.12	0.999	8.28	9.18	340°	0.753	4.70	6.72	0.744	4.59	6.62
165°	0.998	8.27	9.17	0.994	8.20	9.14	345°	0.748	4.64	6.66	0.753	4.71	6.73
170°	0.999	8.29	9.18	0.981	7.99	9.02	350°	0.744	4.59	6.62	0.759	4.79	6.80
175°	1.000	8.30	9.19	0.960	7.64	8.83	355°	0.742	4.57	6.60	0.764	4.84	6.85

<b>Polarization:</b>	<b>Horizontal</b>	<b>Vertical</b>
<b>Maximum Field:</b>	<b>1.000 @ 176° True</b>	<b>1.000 @ 158° True</b>
<b>Minimum Field:</b>	<b>0.741 @ 0° True</b>	<b>0.720 @ 318° True</b>
<b>RMS:</b>	<b>0.917</b>	<b>0.905</b>
<b>Maximum ERP:</b>	<b>8.300 kW</b>	<b>8.300 kW</b>
<b>Maximum Power Gain:</b>	<b>1.457 (1.634 dB)</b>	<b>1.457 (1.634 dB)</b>

**Total Input Power: 5.697 kW**



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

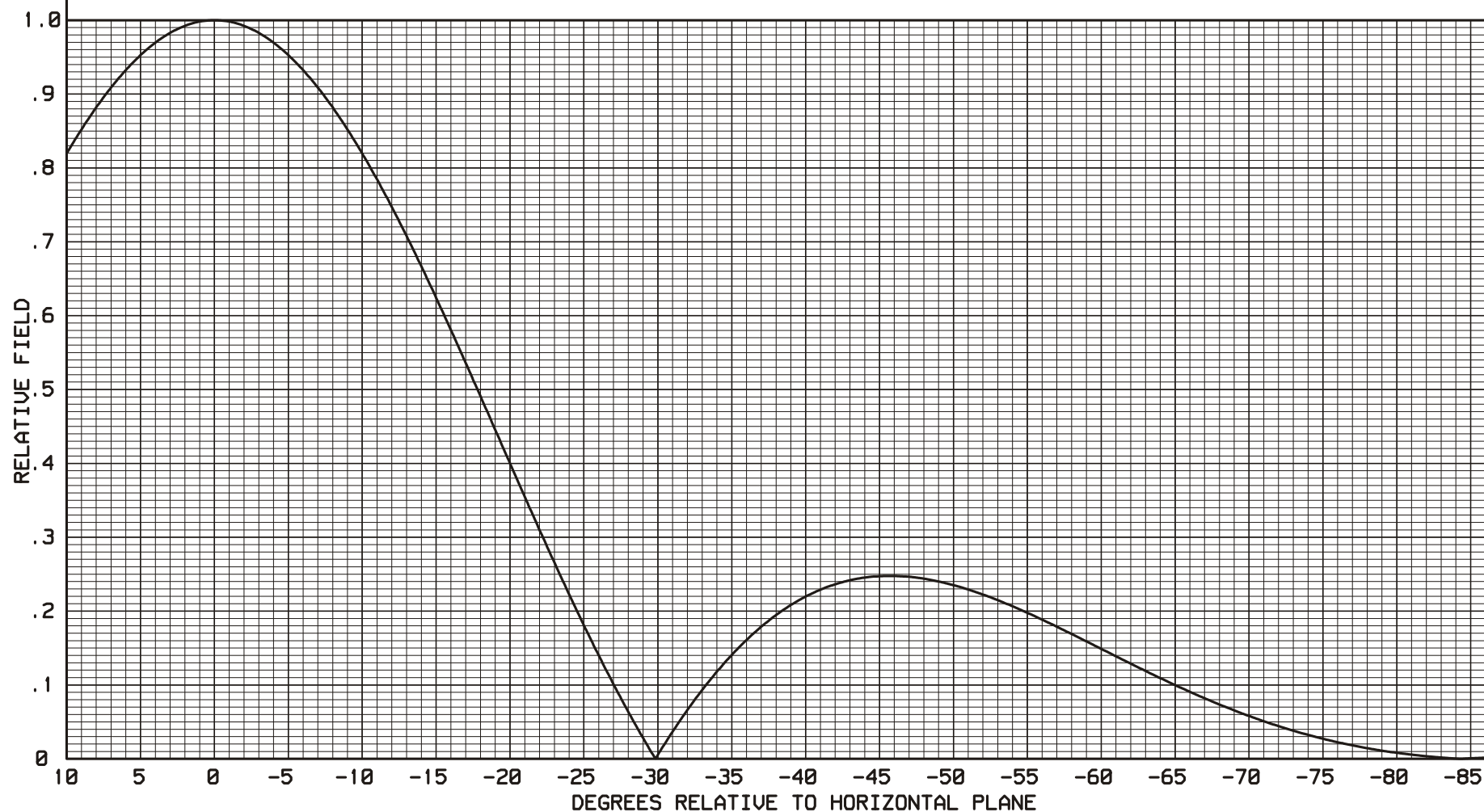
FIGURE 3

----THEORETICAL----  
VERTICAL PLANE RELATIVE FIELD  
3 LEVELS OF TYPE 1080 ELEMENTS  
+0.00 DEGREE(S) BEAM TILT  
0 PERCENT FIRST NULL FILL  
0 PERCENT SECOND NULL FILL

JANUARY 26, 2004

97.1 MHz.

BAY SPACING:  
81.44 INCHES



Directional Antenna System  
for  
WDRV, Chicago, Illinois

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	1083-3CP-DA
Frequency:	97.1 MHz
Number of Bays:	3

MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	20 ft 4in
Bay spacing:	81.44 in
Aperture length required:	30 ft. 4in
Orientation:	322° 31' 59" true
Input flange to the antenna 4 1/16 inch female	

ELECTRICAL SPECIFICATIONS  
(For directional use)

Maximum horizontal ERP:	8.3 kW (9.191 dBk)
Horizontal maximum power gain:	1.457 (1.634 dB)
Maximum vertical ERP:	8.3 kW (9.191 dBk)
Vertical maximum power gain:	1.457 (1.634 dB)
Total input power:	5.697 kW (7.556 dBk)