

Directional Antenna System for WRTI, Philadelphia, Pennsylvania

May 21, 2010

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 WRTI.

The antenna is the ERI model 1084-2CP-DA configuration. The circular polarized system consists of 2 full-wavelength spaced bays using four driven circular polarized radiating elements per bay and one vertical parasitic element per bay. The antenna was mounted on a 6' face tower with bracketry to provide an antenna orientation of North 96 degrees East. The antenna was tested on a 6' face tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 90.1 megahertz, which is the center of the FM broadcast channel assigned to WRTI.

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 WRTI, Philadelphia, Pennsylvania

(Continued)

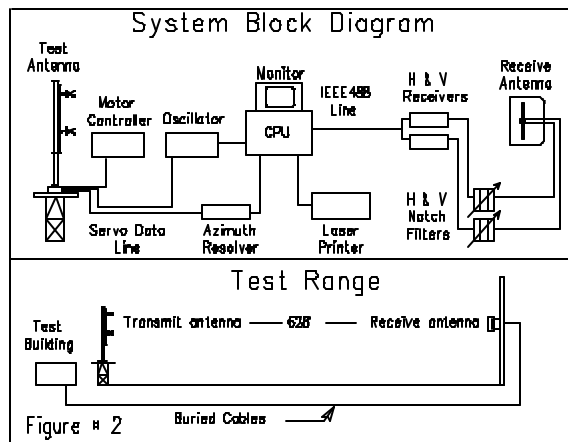
DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of one bay level of the circular polarized system with the associated vertical parasitic element. 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 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 90.1 MHz and was constantly monitored by a Rohde & Schwarz ESVD measuring receiver.



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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 Heliac 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.

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 consists of 2 full-wavelength spaced bays using four driven circular polarized radiating element per bay and one vertical parasitic 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 1084-2CP-DA array is to be mounted on the 6' face tower at a bearing of North 96 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 7.7 kilowatts (8.865 dBk).

The power at North 230 degrees East does not exceed 1.25 kilowatts (0.969 dBk).

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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 11 inches.

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 Scharf". The signature is fluid and cursive, with a large initial "T" and a long, sweeping underline.

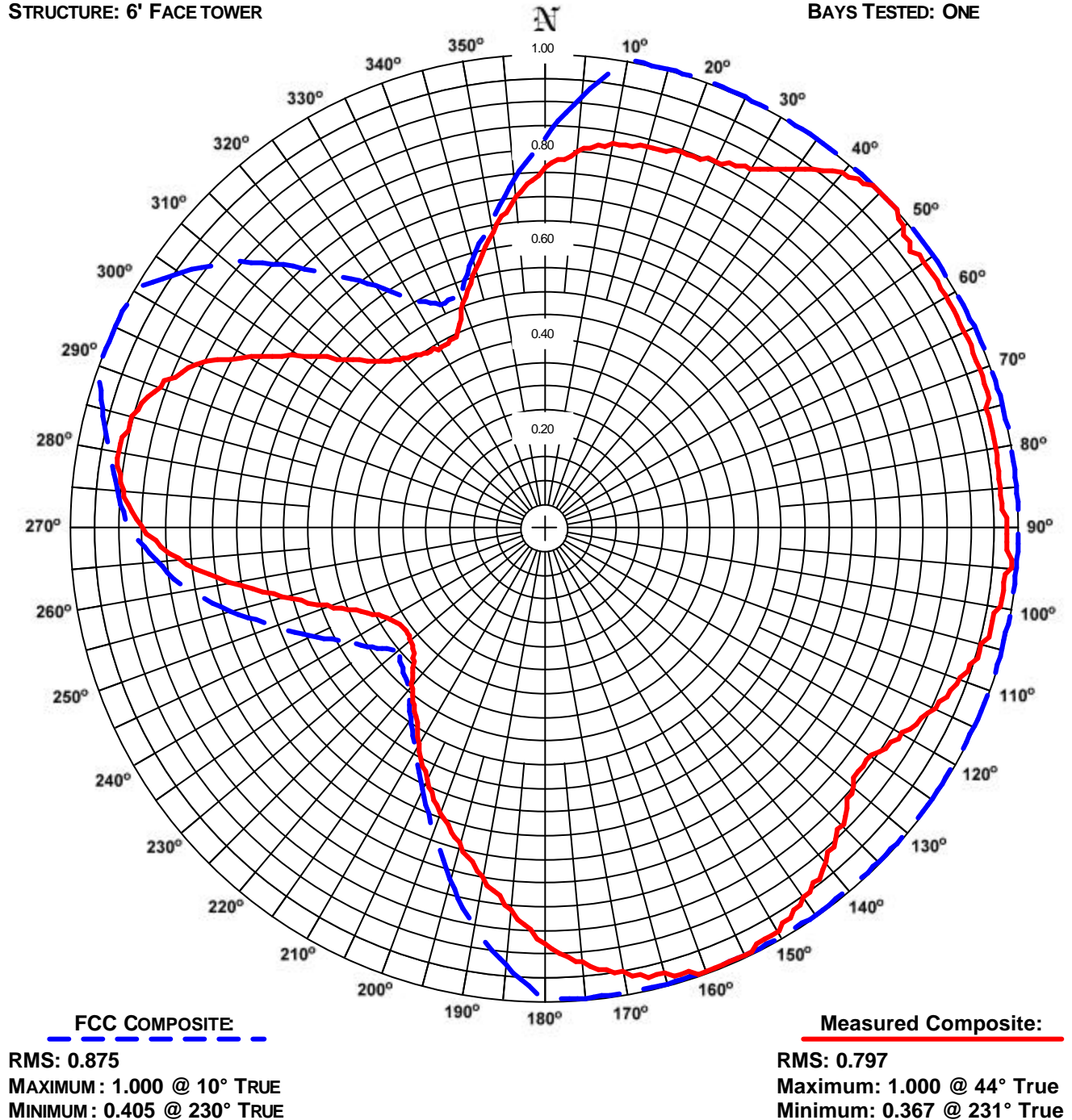
The Microsoft Word document on file electronically at Electronic Research, Inc. governs the specifications, scope, and configuration of the product described. All other representations whether verbal, printed, or electronic are subordinate to the master copy of this document on file at ERI.

ERI® *Horizontal Plane Relative Field Pattern*

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

FIGURE NO: 154M
STATION: WRTI
LOCATION: PHILADELPHIA, PA
ANTENNA: 1084-2CP-DA
STRUCTURE: 6' FACE TOWER

DATE: 5/19/2010
FREQUENCY: 90.1 MHz
ORIENTATION: 96° TRUE
MOUNTING: CUSTOM
BAYS TESTED: ONE



COMMENTS: COMPOSITE PATTERN: THIS PATTERN SHOWS THE MAXIMUM OF EITHER THE H OR V AZIMUTH VALUES. THIS PATTERN IS GREATER THAT 85% OF THE FCC FILED COMPOSITE PATTERN BPED-20070824AGY.

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Station: WRTI

Location: Philadelphia, PA

Frequency: 90.1 MHz

Antenna: 1084-2CP-DA

Orientation: 96° True

Tower: 6' Face tower

Figure: 154M

Date: 5/19/2010

Reference: wrti154m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.759	4.43	6.46	Horizontal	180°	0.881	5.98	7.76	Horizontal
5°	0.794	4.86	6.86	Horizontal	185°	0.813	5.09	7.06	Horizontal
10°	0.822	5.21	7.16	Horizontal	190°	0.750	4.33	6.36	Horizontal
15°	0.832	5.33	7.26	Horizontal	195°	0.692	3.69	5.66	Horizontal
20°	0.841	5.45	7.36	Horizontal	200°	0.646	3.21	5.06	Horizontal
25°	0.851	5.58	7.46	Vertical	205°	0.589	2.67	4.26	Horizontal
30°	0.871	5.84	7.66	Vertical	210°	0.531	2.17	3.36	Horizontal
35°	0.923	6.55	8.16	Vertical	215°	0.479	1.76	2.46	Vertical
40°	0.977	7.35	8.66	Vertical	220°	0.437	1.47	1.66	Vertical
45°	1.000	7.70	8.86	Vertical	225°	0.394	1.19	0.76	Vertical
50°	0.989	7.52	8.76	Vertical	230°	0.372	1.06	0.26	Vertical
55°	0.977	7.35	8.66	Horizontal	235°	0.367	1.04	0.16	Vertical
60°	0.977	7.35	8.66	Horizontal	240°	0.385	1.14	0.56	Vertical
65°	0.977	7.35	8.66	Horizontal	245°	0.427	1.40	1.46	Vertical
70°	0.977	7.35	8.66	Horizontal	250°	0.490	1.85	2.66	Vertical
75°	0.966	7.19	8.56	Horizontal	255°	0.575	2.55	4.06	Vertical
80°	0.966	7.19	8.56	Horizontal	260°	0.676	3.52	5.46	Vertical
85°	0.966	7.19	8.56	Horizontal	265°	0.776	4.64	6.66	Vertical
90°	0.977	7.35	8.66	Vertical	270°	0.851	5.58	7.46	Vertical
95°	0.989	7.52	8.76	Vertical	275°	0.891	6.12	7.86	Vertical
100°	0.977	7.35	8.66	Vertical	280°	0.912	6.40	8.06	Horizontal
105°	0.955	7.02	8.46	Vertical	285°	0.902	6.26	7.96	Vertical
110°	0.933	6.71	8.26	Vertical	290°	0.861	5.71	7.56	Vertical
115°	0.912	6.40	8.06	Vertical	295°	0.813	5.09	7.06	Vertical
120°	0.871	5.84	7.66	Vertical	300°	0.716	3.95	5.96	Vertical
125°	0.841	5.45	7.36	Vertical	305°	0.624	3.00	4.76	Vertical
130°	0.851	5.58	7.46	Horizontal	310°	0.550	2.33	3.66	Vertical
135°	0.891	6.12	7.86	Horizontal	315°	0.495	1.89	2.76	Vertical
140°	0.923	6.55	8.16	Horizontal	320°	0.462	1.65	2.16	Vertical
145°	0.955	7.02	8.46	Horizontal	325°	0.447	1.54	1.86	Vertical
150°	0.989	7.52	8.76	Horizontal	330°	0.437	1.47	1.66	Vertical
155°	1.000	7.70	8.86	Horizontal	335°	0.442	1.50	1.76	Vertical
160°	1.000	7.70	8.86	Horizontal	340°	0.501	1.93	2.86	Horizontal
165°	0.977	7.35	8.66	Horizontal	345°	0.562	2.43	3.86	Horizontal
170°	0.955	7.02	8.46	Horizontal	350°	0.631	3.07	4.86	Horizontal
175°	0.923	6.55	8.16	Horizontal	355°	0.700	3.77	5.76	Horizontal

Polarization:

Maximum Field:

Minimum Field:

RMS:

Maximum ERP:

Maximum Power Gain:

Envelope

1.000 @ 44° True

0.367 @ 231° True

0.797

7.700 kW

1.602 (2.045 dB)

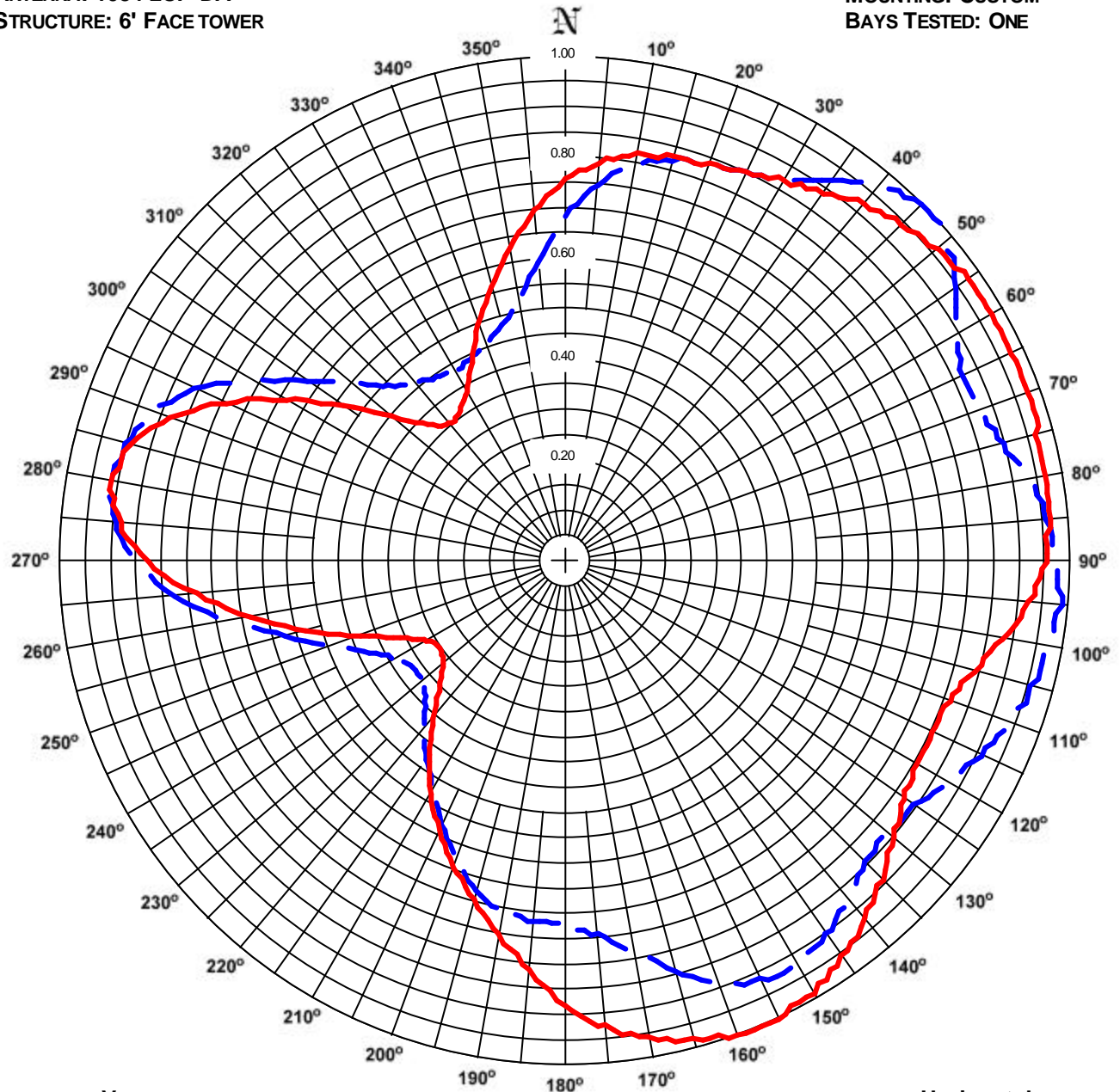
Total Input Power: 4.808 kW

ERI® *Horizontal Plane Relative Field Pattern*

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FIGURE NO: 154M
STATION: WRTI
LOCATION: PHILADELPHIA, PA
ANTENNA: 1084-2CP-DA
STRUCTURE: 6' FACE TOWER

DATE: 5/19/2010
FREQUENCY: 90.1 MHz
ORIENTATION: 96° TRUE
MOUNTING: CUSTOM
BAYS TESTED: ONE



VERTICAL

RMS: 0.765
MAXIMUM: 1.000 @ 44° TRUE
MINIMUM: 0.367 @ 231° TRUE

Horizontal

RMS: 0.773
Maximum: 1.000 @ 154° True
Minimum: 0.302 @ 234° True

COMMENTS: MEASURED PATTERNS OF THE HORIZONTAL AND VERTICAL COMPONENTS.

ERI® *Horizontal Plane Relative Field List*

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Station: WRTI
Location: Philadelphia, PA
Frequency: 90.1 MHz

Antenna: 1084-2CP-DA
Orientation: 96° True
Tower: 6' Face tower

Figure: 154M
Date: 5/19/2010
Reference: wrti154m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.759	4.43	6.46	0.684	3.60	5.56	180°	0.881	5.98	7.76	0.724	4.04	6.06
5°	0.794	4.86	6.86	0.750	4.33	6.36	185°	0.813	5.09	7.06	0.716	3.95	5.96
10°	0.822	5.21	7.16	0.794	4.86	6.86	190°	0.750	4.33	6.36	0.708	3.86	5.86
15°	0.832	5.33	7.26	0.822	5.21	7.16	195°	0.692	3.69	5.66	0.676	3.52	5.46
20°	0.841	5.45	7.36	0.841	5.45	7.36	200°	0.646	3.21	5.06	0.631	3.07	4.86
25°	0.851	5.58	7.46	0.851	5.58	7.46	205°	0.589	2.67	4.26	0.575	2.55	4.06
30°	0.871	5.84	7.66	0.871	5.84	7.66	210°	0.531	2.17	3.36	0.525	2.12	3.26
35°	0.891	6.12	7.86	0.923	6.55	8.16	215°	0.468	1.68	2.26	0.479	1.76	2.46
40°	0.923	6.55	8.16	0.977	7.35	8.66	220°	0.407	1.28	1.06	0.437	1.47	1.66
45°	0.944	6.86	8.36	1.000	7.70	8.86	225°	0.351	0.95	-0.24	0.394	1.19	0.76
50°	0.966	7.19	8.56	0.989	7.52	8.76	230°	0.316	0.77	-1.14	0.372	1.06	0.26
55°	0.977	7.35	8.66	0.944	6.86	8.36	235°	0.302	0.70	-1.54	0.367	1.04	0.16
60°	0.977	7.35	8.66	0.891	6.12	7.86	240°	0.316	0.77	-1.14	0.385	1.14	0.56
65°	0.977	7.35	8.66	0.871	5.84	7.66	245°	0.359	0.99	-0.04	0.427	1.40	1.46
70°	0.977	7.35	8.66	0.881	5.98	7.76	250°	0.432	1.43	1.56	0.490	1.85	2.66
75°	0.966	7.19	8.56	0.902	6.26	7.96	255°	0.531	2.17	3.36	0.575	2.55	4.06
80°	0.966	7.19	8.56	0.933	6.71	8.26	260°	0.631	3.07	4.86	0.676	3.52	5.46
85°	0.966	7.19	8.56	0.955	7.02	8.46	265°	0.733	4.14	6.16	0.776	4.64	6.66
90°	0.955	7.02	8.46	0.977	7.35	8.66	270°	0.822	5.21	7.16	0.851	5.58	7.46
95°	0.923	6.55	8.16	0.989	7.52	8.76	275°	0.881	5.98	7.76	0.891	6.12	7.86
100°	0.881	5.98	7.76	0.977	7.35	8.66	280°	0.912	6.40	8.06	0.912	6.40	8.06
105°	0.841	5.45	7.36	0.955	7.02	8.46	285°	0.891	6.12	7.86	0.902	6.26	7.96
110°	0.813	5.09	7.06	0.933	6.71	8.26	290°	0.832	5.33	7.26	0.861	5.71	7.56
115°	0.804	4.97	6.96	0.912	6.40	8.06	295°	0.741	4.23	6.26	0.813	5.09	7.06
120°	0.804	4.97	6.96	0.871	5.84	7.66	300°	0.638	3.14	4.96	0.716	3.95	5.96
125°	0.822	5.21	7.16	0.841	5.45	7.36	305°	0.537	2.22	3.46	0.624	3.00	4.76
130°	0.851	5.58	7.46	0.832	5.33	7.26	310°	0.447	1.54	1.86	0.550	2.33	3.66
135°	0.891	6.12	7.86	0.841	5.45	7.36	315°	0.385	1.14	0.56	0.495	1.89	2.76
140°	0.923	6.55	8.16	0.871	5.84	7.66	320°	0.359	0.99	-0.04	0.462	1.65	2.16
145°	0.955	7.02	8.46	0.902	6.26	7.96	325°	0.363	1.02	0.06	0.447	1.54	1.86
150°	0.989	7.52	8.76	0.923	6.55	8.16	330°	0.389	1.17	0.66	0.437	1.47	1.66
155°	1.000	7.70	8.86	0.912	6.40	8.06	335°	0.437	1.47	1.66	0.442	1.50	1.76
160°	1.000	7.70	8.86	0.891	6.12	7.86	340°	0.501	1.93	2.86	0.457	1.61	2.06
165°	0.977	7.35	8.66	0.841	5.45	7.36	345°	0.562	2.43	3.86	0.484	1.81	2.56
170°	0.955	7.02	8.46	0.785	4.75	6.76	350°	0.631	3.07	4.86	0.519	2.07	3.16
175°	0.923	6.55	8.16	0.741	4.23	6.26	355°	0.700	3.77	5.76	0.596	2.73	4.36

Polarization:	Horizontal	Vertical
Maximum Field:	1.000 @ 154° True	1.000 @ 44° True
Minimum Field:	0.302 @ 234° True	0.367 @ 231° True
RMS:	0.773	0.765
Maximum ERP:	7.700 kW	7.700 kW
Maximum Power Gain:	1.602 (2.045 dB)	1.602 (2.045 dB)

Total Input Power: 4.808 kW

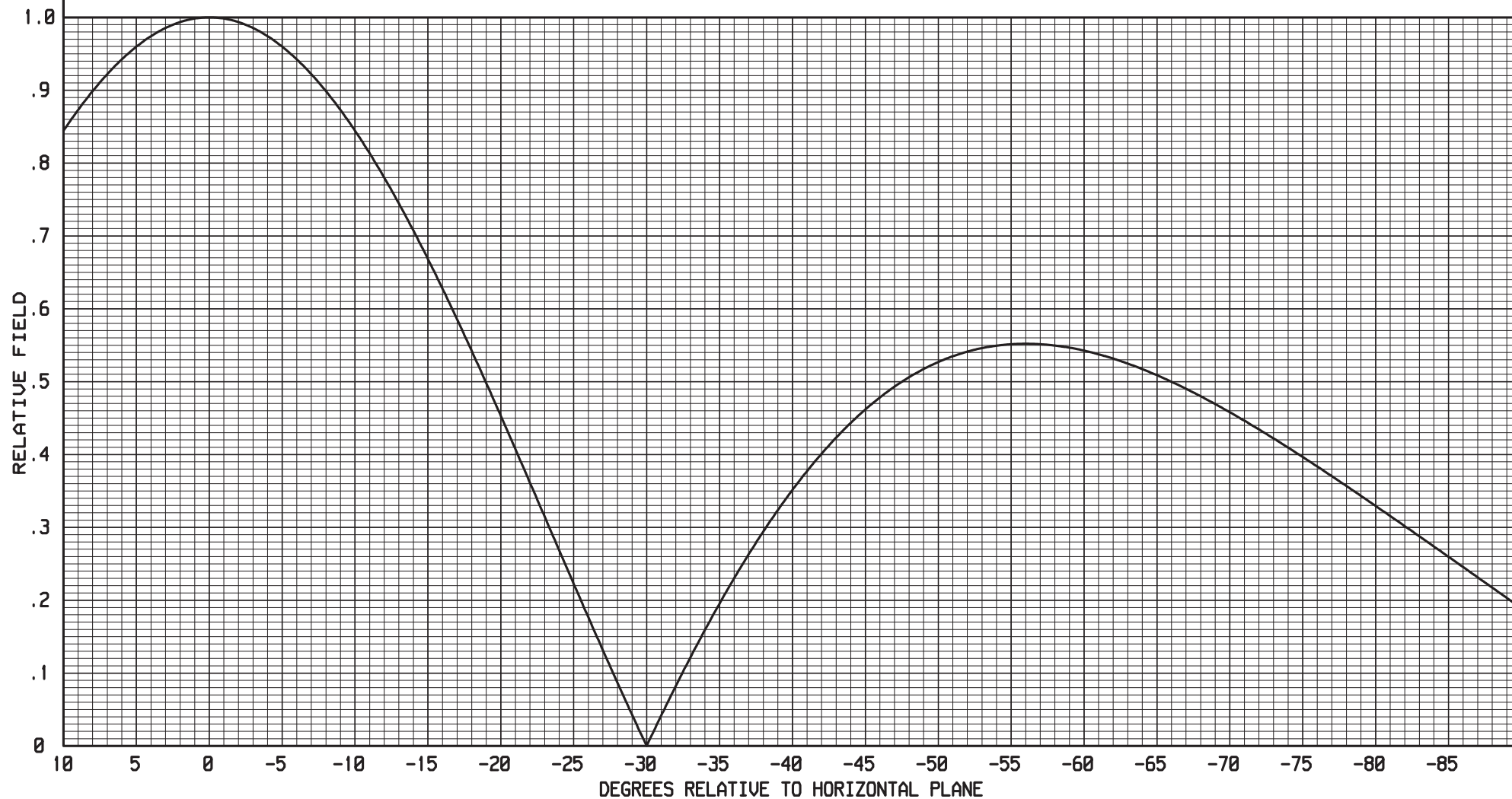
ELECTRONICS RESEARCH, INC.
7777 GARDNER ROAD
CHANDLER, IN. 47610

FIGURE 3

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

2 LEVELS OF ERI CP PANEL ELEMENTS
+0.00 DEGREE(S) BEAM TILT
0 PERCENT NULL FILL

BAY SPACING:
ONE-WAVELENGTH



Directional Antenna System for WRTI, Philadelphia, Pennsylvania

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	1084-2CP-DA
Frequency:	90.1 MHz
Number of Bays:	Two

MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	21 ft 9 in
Aperture length required:	30 ft 11 in
Orientation:	96° true

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

ELECTRICAL SPECIFICATIONS (For directional use)

Maximum horizontal ERP:	7.7 kW (8.865 dBk)
Horizontal maximum power gain:	1.602 (2.045 dB)
Maximum vertical ERP:	7.7 kW (8.865 dBk)
Vertical maximum power gain:	1.602 (2.045 dB)
Total input power:	4.808 kW (6.82 dBk)

