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 WMVV, Griffin, Georgia

January 23, 2003

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 WMVV.

The antenna is the ERI model LP-6E-DA configuration. The circular polarized system consists of 6 full-wavelength spaced bays using one driven circular polarized radiating element, two horizontal parasitic elements placed one quarter wave above and below each bay and two vertical parasitic elements per bay. The antenna was mounted on the North 97 degrees East tower face with bracketry to provide an antenna orientation of North 97 degrees East. The antenna was tested on a 24" ERI® λ *MOUNTING SYSTEM,* which is the structure the station plans to use to support the array. All tests were performed on a frequency of 90.7 megahertz, which is the center of the FM broadcast channel assigned to WMVV.

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
WMVV, Griffin, Georgia

(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 1 5/8 inch o.d. rigid coaxial line was used to feed the test antenna, and a section of 1 5/8 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 proof-of-performance was accomplished using both horizontal and vertical polarization components. a 24" ERI® λ *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 90.7 MHz and was constantly monitored by an Anritsu Model ML521B measuring receiver.

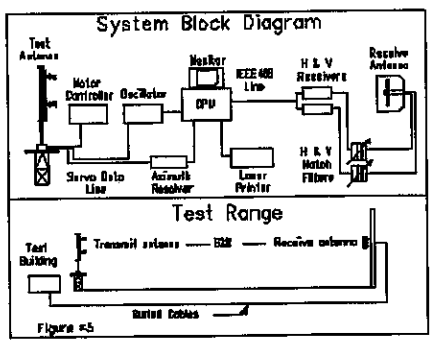

Figure #5

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 6 full-wavelength spaced bays using one driven circular polarized radiating element, two horizontal parasitic elements placed one quarter wave above and below each bay 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 LP-6E-DA array is to be mounted on the North 97 degrees East tower face of the 24" ERI®λ *MOUNTING SYSTEM,* at a bearing of North 97 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 18 kilowatts (12.553 dBk).

The power at North 270 degrees East does not exceed 0.66 kilowatts (-1.805 dBk).

The RMS of the vertically polarized horizontal plane component does not exceed the RMS of the horizontally polarized horizontal plane component.

Directional Antenna System
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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.

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. 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.

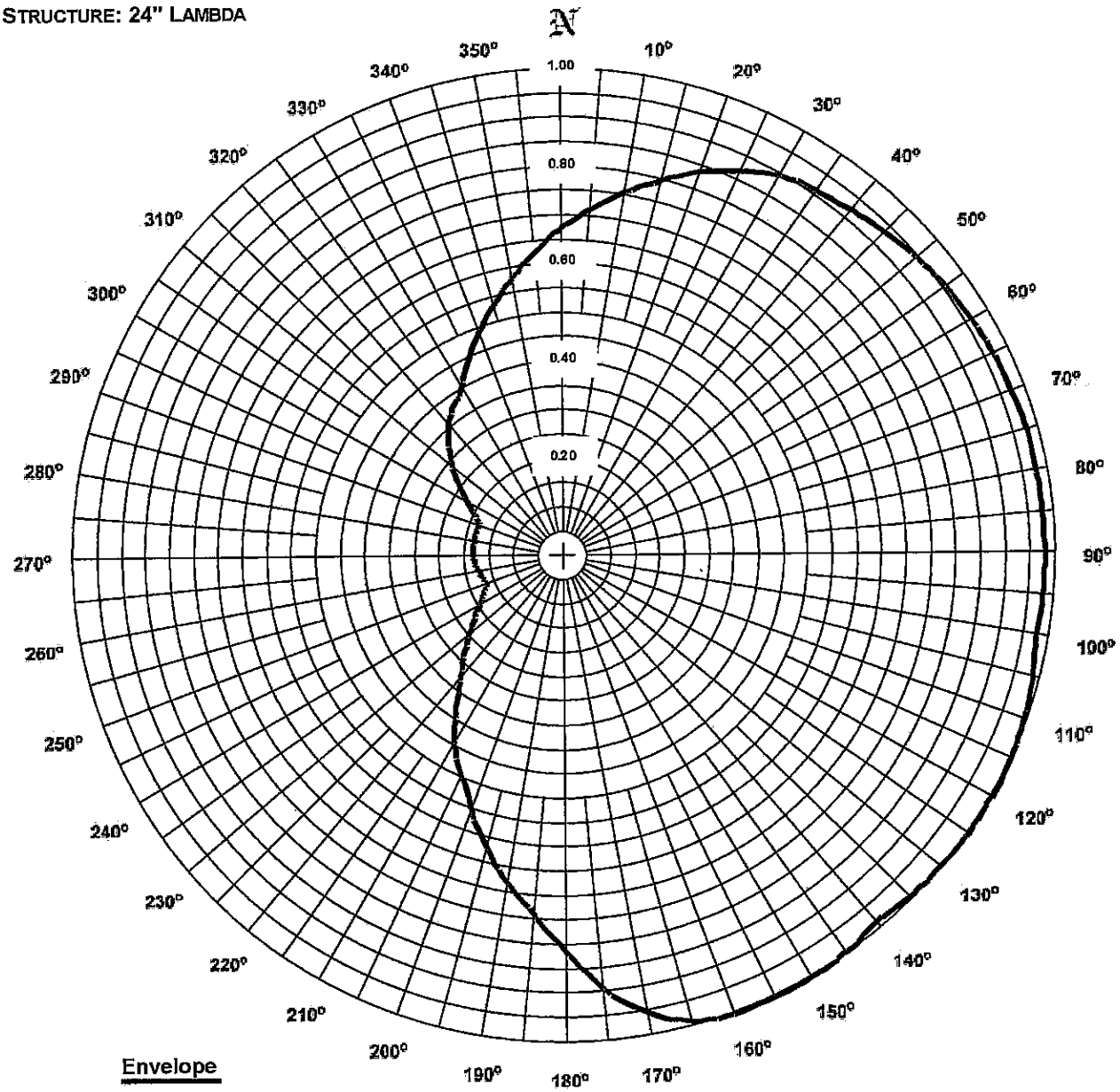
ELECTRONICS RESEARCH, INC.

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: WMVV
LOCATION: GRIFFIN, GA.
ANTENNA TYPE: LP-6E-DA
STRUCTURE: 24" LAMBDA

DATE: 1/23/03
FREQUENCY: 90.7 MHZ
ORIENTATION: 97° TRUE
MOUNTING: CUSTOM



Envelope

RMS: 0.725
Maximum: 1.000 @ 120° True
Minimum: 0.165 @ 251° 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 BMPED-20010627ABY.

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: WMVV
Location: Griffin, Ga.
Frequency: 90.7 MHz

Antenna: LP-6E-DA
Orientation: 97° True
Tower: 24" Lambda

Figure: 1
Date: 1/23/03
Reference: wmvv3m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.677	8.25	9.16	Vertical	180°	0.810	11.81	10.72	Horizontal
5°	0.719	9.30	9.68	Vertical	185°	0.737	9.77	9.90	Horizontal
10°	0.762	10.45	10.19	Vertical	190°	0.678	8.27	9.18	Vertical
15°	0.801	11.56	10.63	Vertical	195°	0.616	6.84	8.35	Vertical
20°	0.842	12.75	11.06	Vertical	200°	0.554	5.53	7.42	Vertical
25°	0.874	13.75	11.38	Vertical	205°	0.495	4.41	6.44	Horizontal
30°	0.901	14.62	11.65	Vertical	210°	0.445	3.57	5.53	Horizontal
35°	0.915	15.06	11.78	Vertical	215°	0.385	2.66	4.25	Horizontal
40°	0.926	15.42	11.88	Horizontal	220°	0.328	1.94	2.87	Horizontal
45°	0.938	15.84	12.00	Horizontal	225°	0.288	1.50	1.75	Horizontal
50°	0.949	16.20	12.10	Horizontal	230°	0.253	1.15	0.62	Horizontal
55°	0.958	16.51	12.18	Horizontal	235°	0.224	0.90	-0.45	Horizontal
60°	0.965	16.77	12.25	Horizontal	240°	0.199	0.72	-1.45	Horizontal
65°	0.971	16.97	12.30	Horizontal	245°	0.180	0.59	-2.32	Horizontal
70°	0.975	17.11	12.33	Horizontal	250°	0.165	0.49	-3.09	Horizontal
75°	0.977	17.19	12.35	Horizontal	255°	0.167	0.50	-2.98	Vertical
80°	0.978	17.22	12.36	Horizontal	260°	0.172	0.53	-2.74	Vertical
85°	0.978	17.22	12.36	Horizontal	265°	0.178	0.57	-2.45	Vertical
90°	0.978	17.22	12.36	Horizontal	270°	0.182	0.59	-2.27	Vertical
95°	0.978	17.22	12.36	Horizontal	275°	0.183	0.60	-2.18	Vertical
100°	0.975	17.12	12.33	Horizontal	280°	0.183	0.61	-2.17	Vertical
105°	0.985	17.46	12.42	Vertical	285°	0.184	0.61	-2.16	Vertical
110°	0.993	17.75	12.49	Vertical	290°	0.184	0.61	-2.14	Vertical
115°	0.998	17.93	12.54	Vertical	295°	0.193	0.67	-1.74	Horizontal
120°	1.000	18.00	12.55	Vertical	300°	0.219	0.86	-0.64	Horizontal
125°	1.000	18.00	12.55	Vertical	305°	0.253	1.15	0.60	Horizontal
130°	0.997	17.90	12.53	Vertical	310°	0.291	1.52	1.82	Horizontal
135°	0.991	17.69	12.48	Vertical	315°	0.325	1.90	2.78	Horizontal
140°	0.985	17.45	12.42	Horizontal	320°	0.359	2.32	3.65	Horizontal
145°	0.994	17.80	12.50	Horizontal	325°	0.383	2.64	4.21	Horizontal
150°	0.999	17.98	12.55	Horizontal	330°	0.407	2.99	4.75	Vertical
155°	1.000	18.00	12.55	Horizontal	335°	0.449	3.64	5.61	Vertical
160°	1.000	18.00	12.55	Horizontal	340°	0.496	4.42	6.46	Vertical
165°	0.986	17.50	12.43	Horizontal	345°	0.537	5.19	7.15	Vertical
170°	0.949	16.20	12.10	Horizontal	350°	0.582	6.10	7.85	Vertical
175°	0.887	14.16	11.51	Horizontal	355°	0.628	7.10	8.51	Vertical

Polarization: **Envelope**
Maximum Field: **1.000 @ 120° True**
Minimum Field: **0.165 @ 251° True**
RMS: **0.725**
Maximum ERP: **18.000 kW**
Maximum Power Gain: **6.245 (7.955 dB)**

Total Input Power: 2.882 kW

ERI® Horizontal Plane Relative Field Pattern

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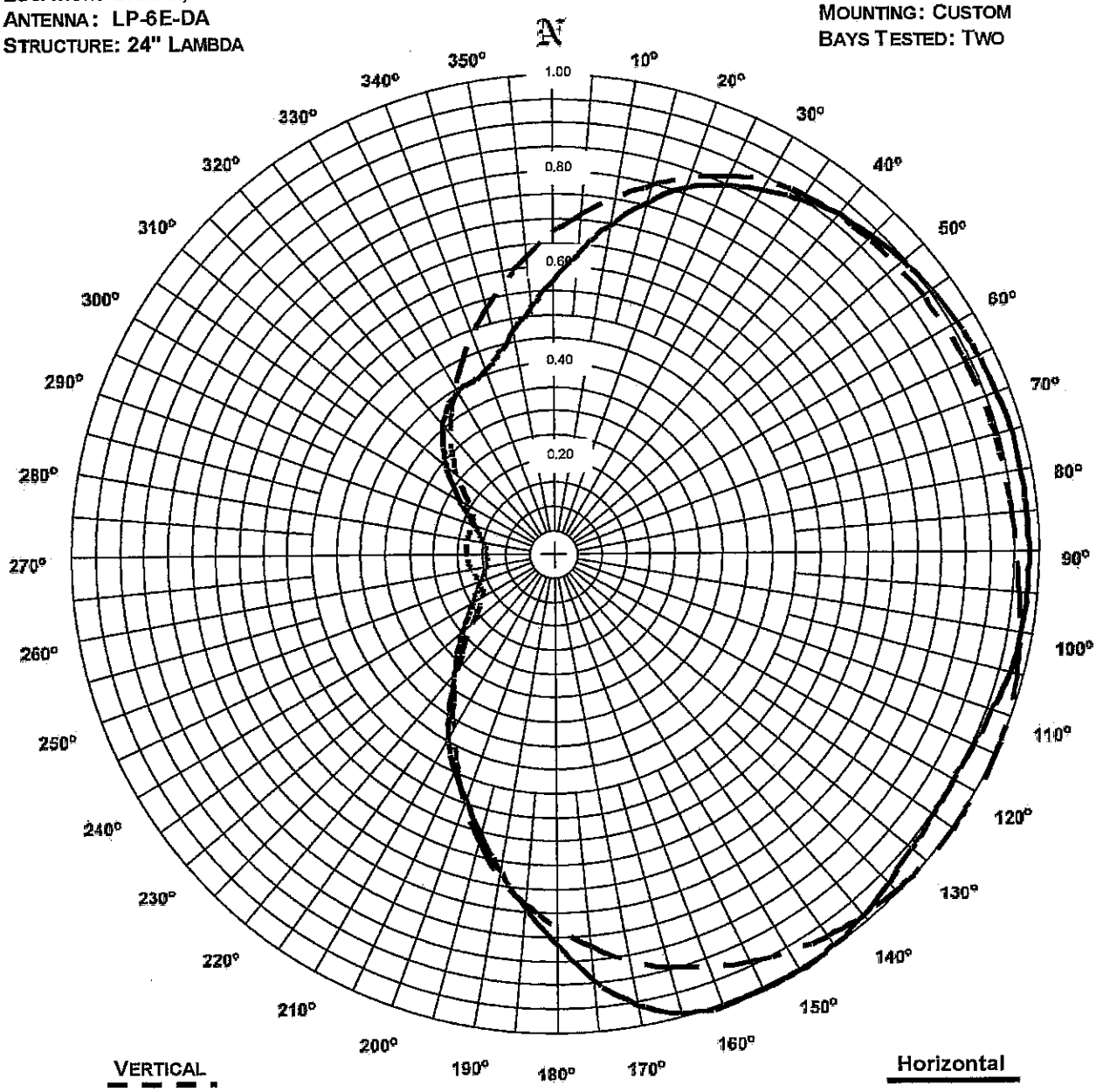
FIGURE NO: 2
STATION: WMVV
LOCATION: GRIFFIN, GA
ANTENNA: LP-6E-DA
STRUCTURE: 24" LAMBDA

DATE: 1/23/03
FREQUENCY: 90.7 MHZ
ORIENTATION: 97° TRUE
MOUNTING: CUSTOM
BAYS TESTED: TWO



VERTICAL

RMS: 0.708
MAXIMUM: 1.000 @ 120° TRUE
MINIMUM: 0.164 @ 247° TRUE

Horizontal

RMS: 0.709
Maximum: 1.000 @ 152° True
Minimum: 0.140 @ 268° True

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: WMVV
Location: Griffin, GA
Frequency: 90.7 MHz

Antenna: LP-6E-DA
Orientation: 97° True
Tower: 24" Lambda

Figure: 2
Date: 1/23/03
Reference: wmvv3m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.575	5.95	7.75	0.677	8.25	9.16	180°	0.810	11.81	10.72	0.776	10.84	10.35
5°	0.635	7.25	8.60	0.719	9.30	9.68	185°	0.737	9.77	9.90	0.728	9.54	9.80
10°	0.704	8.92	9.50	0.762	10.45	10.19	190°	0.668	8.03	9.05	0.678	8.27	9.18
15°	0.766	10.55	10.23	0.801	11.56	10.63	195°	0.602	6.53	8.15	0.616	6.84	8.35
20°	0.817	12.01	10.80	0.842	12.75	11.06	200°	0.544	5.33	7.27	0.554	5.53	7.42
25°	0.852	13.07	11.16	0.874	13.75	11.38	205°	0.495	4.41	6.44	0.484	4.22	6.25
30°	0.880	13.95	11.45	0.901	14.62	11.65	210°	0.445	3.57	5.53	0.422	3.20	5.05
35°	0.905	14.74	11.68	0.915	15.06	11.78	215°	0.385	2.66	4.25	0.369	2.46	3.90
40°	0.926	15.42	11.88	0.923	15.34	11.86	220°	0.328	1.94	2.87	0.321	1.85	2.68
45°	0.938	15.84	12.00	0.928	15.51	11.91	225°	0.288	1.50	1.75	0.271	1.32	1.21
50°	0.949	16.20	12.10	0.932	15.65	11.95	230°	0.253	1.15	0.62	0.229	0.94	-0.26
55°	0.958	16.51	12.18	0.936	15.77	11.98	235°	0.224	0.90	-0.45	0.197	0.70	-1.56
60°	0.965	16.77	12.25	0.939	15.87	12.01	240°	0.199	0.72	-1.45	0.176	0.56	-2.54
65°	0.971	16.97	12.30	0.941	15.95	12.03	245°	0.180	0.59	-2.32	0.165	0.49	-3.08
70°	0.975	17.11	12.33	0.943	16.00	12.04	250°	0.165	0.49	-3.09	0.165	0.49	-3.12
75°	0.977	17.19	12.35	0.944	16.03	12.05	255°	0.153	0.42	-3.73	0.167	0.50	-2.98
80°	0.978	17.22	12.36	0.944	16.04	12.05	260°	0.145	0.38	-4.20	0.172	0.53	-2.74
85°	0.978	17.22	12.36	0.947	16.13	12.08	265°	0.141	0.36	-4.46	0.178	0.57	-2.45
90°	0.978	17.22	12.36	0.952	16.33	12.13	270°	0.141	0.36	-4.47	0.182	0.59	-2.27
95°	0.978	17.22	12.36	0.961	16.63	12.21	275°	0.141	0.36	-4.47	0.183	0.60	-2.18
100°	0.975	17.12	12.33	0.973	17.05	12.32	280°	0.146	0.38	-4.15	0.183	0.61	-2.17
105°	0.968	16.85	12.27	0.985	17.46	12.42	285°	0.157	0.44	-3.56	0.184	0.61	-2.16
110°	0.956	16.47	12.17	0.993	17.75	12.49	290°	0.172	0.53	-2.73	0.184	0.61	-2.14
115°	0.949	16.21	12.10	0.998	17.93	12.54	295°	0.193	0.67	-1.74	0.186	0.62	-2.07
120°	0.946	16.11	12.07	1.000	18.00	12.55	300°	0.219	0.86	-0.64	0.199	0.71	-1.49
125°	0.949	16.21	12.10	1.000	18.00	12.55	305°	0.253	1.15	0.60	0.224	0.91	-0.43
130°	0.957	16.48	12.17	0.997	17.90	12.53	310°	0.291	1.52	1.82	0.261	1.22	0.88
135°	0.970	16.93	12.29	0.991	17.69	12.48	315°	0.325	1.90	2.78	0.297	1.59	2.00
140°	0.985	17.45	12.42	0.982	17.37	12.40	320°	0.359	2.32	3.65	0.335	2.02	3.05
145°	0.994	17.80	12.50	0.970	16.93	12.29	325°	0.383	2.64	4.21	0.369	2.46	3.90
150°	0.999	17.98	12.55	0.954	16.39	12.15	330°	0.397	2.84	4.54	0.407	2.99	4.75
155°	1.000	18.00	12.55	0.935	15.75	11.97	335°	0.403	2.92	4.66	0.449	3.64	5.61
160°	1.000	18.00	12.55	0.913	15.01	11.76	340°	0.413	3.06	4.86	0.496	4.42	6.46
165°	0.986	17.50	12.43	0.888	14.18	11.52	345°	0.438	3.45	5.38	0.537	5.19	7.15
170°	0.949	16.20	12.10	0.856	13.20	11.20	350°	0.478	4.11	6.14	0.582	6.10	7.85
175°	0.887	14.16	11.51	0.816	12.00	10.79	355°	0.522	4.91	6.91	0.628	7.10	8.51

	Horizontal	Vertical
Polarization:		
Maximum Field:	**1.000 @ 152° True**	**1.000 @ 120° True**
Minimum Field:	**0.140 @ 268° True**	**0.164 @ 247° True**
RMS:	**0.709**	**0.708**
Maximum ERP:	**18.000 kW**	**18.000 kW**
Maximum Power Gain:	**6.245 (7.955 dB)**	**6.245 (7.955 dB)**

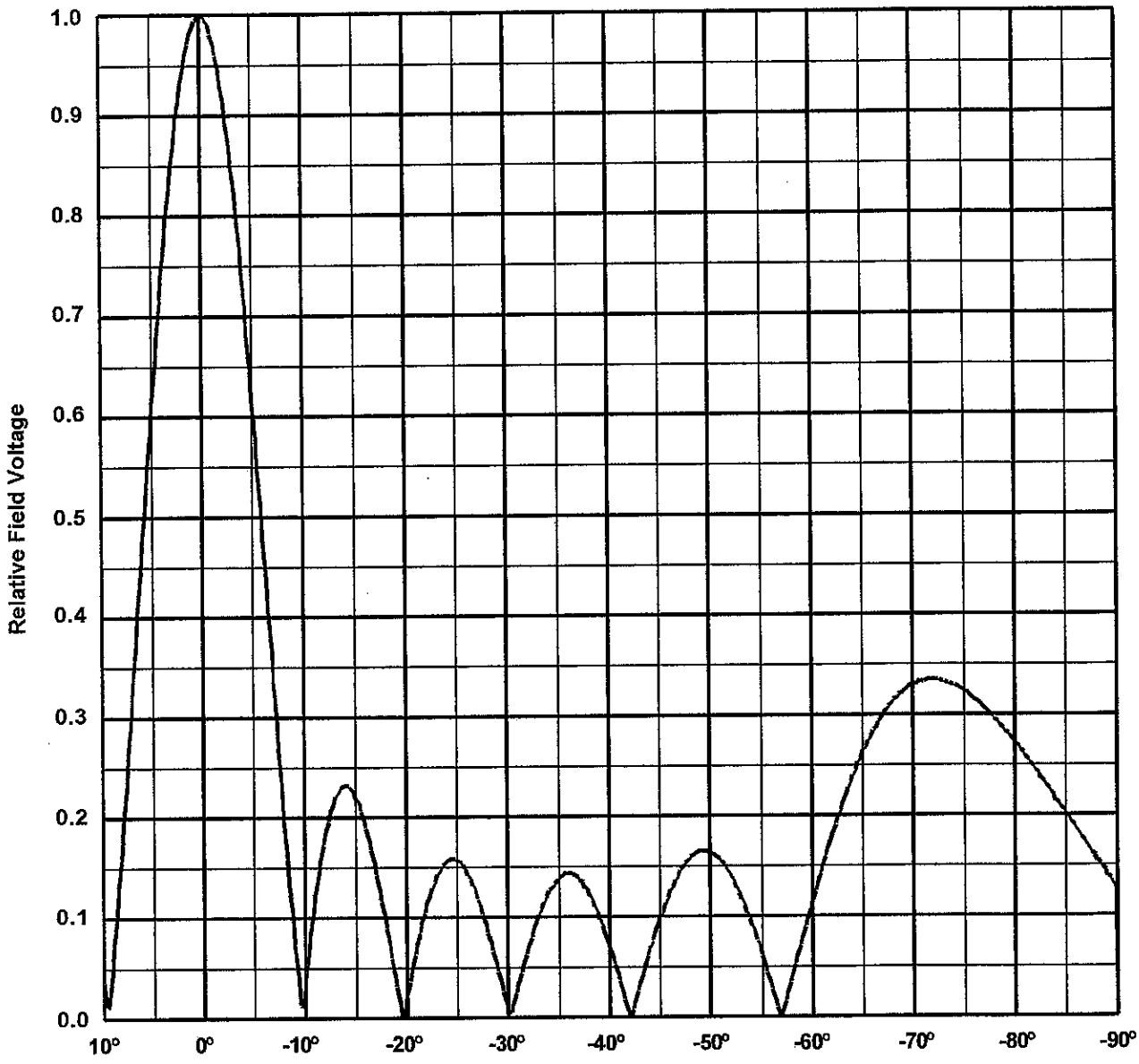
Total Input Power: 2.882 kW

ERI® Vertical Plane Relative Field Pattern

WMVV, Griffin, GA, 90.7 MHz

Figure#: 3 **Date: 1/23/03**

A 6 level, 1 wave-length spaced LP-6E-DA directional antenna with 0° beam tilt, 0% null fill and a H/V maximum power ratio of 1.000



Vertical Polarization Gain:	Horizontal Polarization Gain:
Maximum: 6.245 (7.955 dB)	Maximum: 6.245 (7.955 dB)
Horizontal Plane: 6.245 (7.955 dB)	Horizontal Plane: 6.245 (7.955 dB)

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Directional Antenna System
for
WMVV, Griffin, Georgia

(Continued)

SPECIFICATIONS

Antenna Type:	LP-6E-DA
Frequency:	90.7 MHz
Number of Bays:	6

MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	62 ft 10 in
Aperture length required:	70 ft.
Orientation:	97° true

Input flange to the antenna 1 5/8 inch female

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	18 kW (12.553 dBk)
Horizontal maximum power gain:	6.245 (7.955 dB)
Maximum vertical ERP:	18 kW (12.553 dBk)
Vertical maximum power gain:	6.245 (7.955 dB)
Total input power:	2.882 kW (4.597 dBk)