

Directional Antenna System for WVUM, Coral Gables, Florida

March 18, 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 WVUM.

The antenna is the ERI model LP-3E-DA configuration. The circular polarized system consists of 3 full-wavelength spaced bays using one driven circular polarized radiating element, one 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 0 degrees East tower face with bracketry to provide an antenna orientation of North 0 degrees East. The antenna was tested on a 15" face tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 90.5 megahertz, which is the center of the FM broadcast channel assigned to WVUM.

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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Directional Antenna System Proposed For WVUM, Coral Gables, Florida

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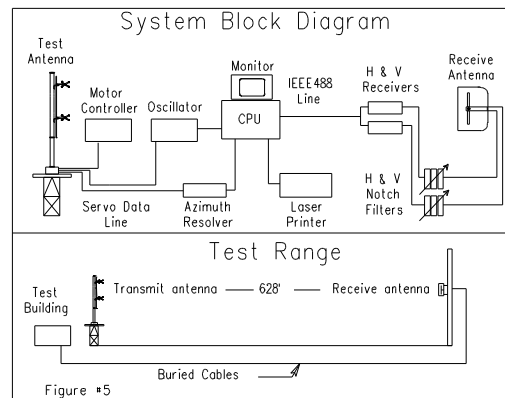
DESCRIPTION OF THE TEST PROCEDURE

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 both horizontal and vertical polarization components.

The proof-of-performance was accomplished using a 15" 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 90.5 MHz and was constantly monitored by a Rohde & Schwarz ESVD measuring receiver.



Directional Antenna System Proposed For WVUM, Coral Gables, Florida

(Continued)

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 co-ordinated graph paper in a clockwise direction. Both horizontal and vertical components were recorded separately.

CONCLUSIONS

The circular polarized system consists of 3 full-wavelength spaced bays using one driven circular polarized radiating element, one 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-3E-DA array is to be mounted on the North 0 degrees East tower face of the 14.875" face tower at a bearing of North 0 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 5.9 kilowatts (7.709 dBk).

The power at North 180 degrees East does not exceed 1.817 kilowatts (2.594 dBk).

Directional Antenna System
Proposed For
WVUM, Coral Gables, Florida

(Continued)

The power at North 190 degrees East does not exceed 1.903 kilowatts (2.794 dBk).

The power at North 200 degrees East does not exceed 1.998 kilowatts (3.006 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 37 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.



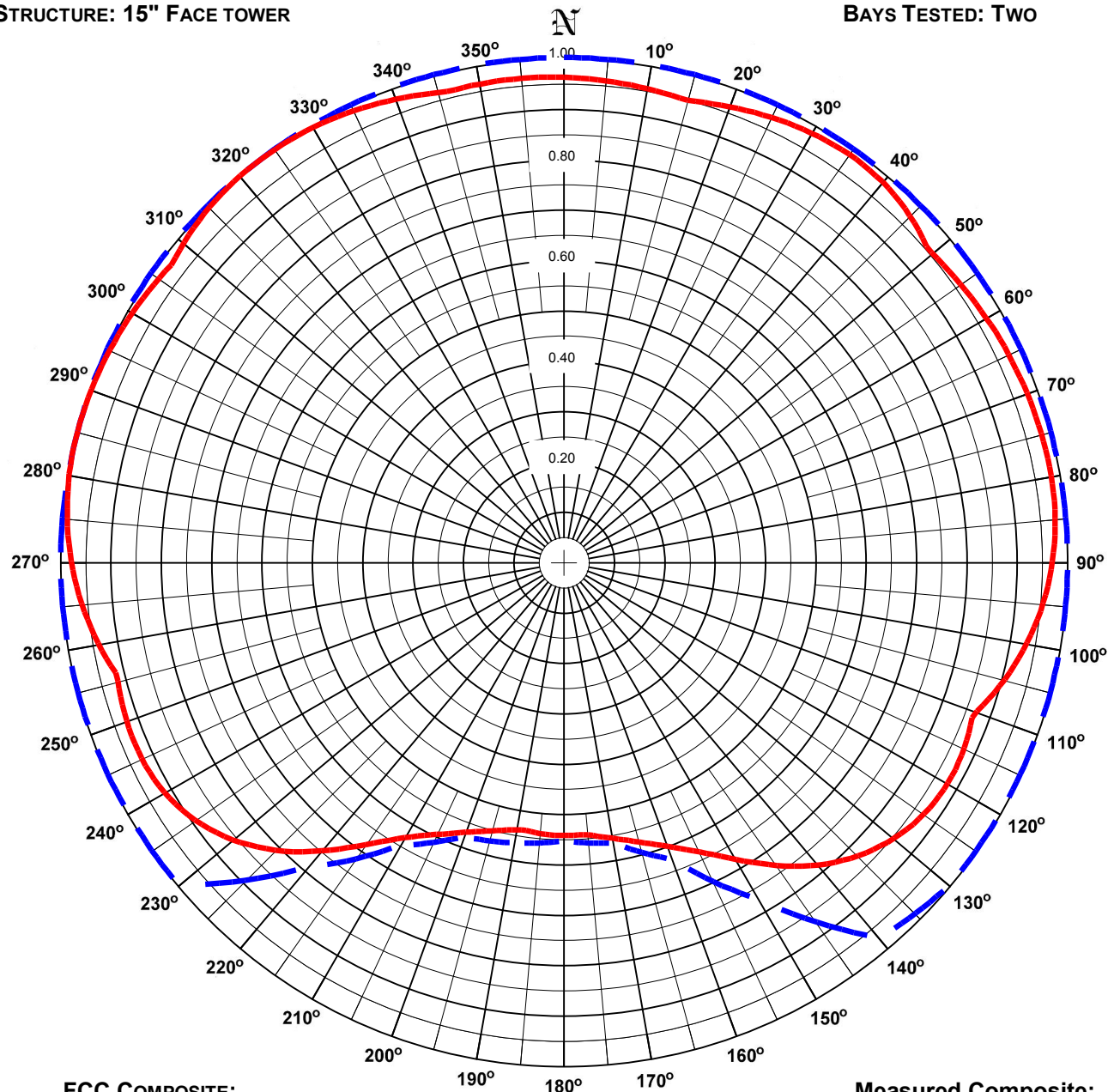
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ERI® *Horizontal Plane Relative Field Pattern*

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

FIGURE NO: 1
STATION: WVUM
LOCATION: CORAL GABLES, FL
ANTENNA: LP-3E-DA
STRUCTURE: 15" FACE TOWER

DATE: 3/16/2010
FREQUENCY: 90.5 MHz
ORIENTATION: 0° TRUE
MOUNTING: STANDARD
BAYS TESTED: TWO



FCC COMPOSITE:

RMS: 0.932
MAXIMUM: 1.000 @ 0° TRUE
MINIMUM: 0.555 @ 180° TRUE

Measured Composite:

RMS: 0.886
MAXIMUM: 1.000 @ 285° True
MINIMUM: 0.540 @ 188° True

COMMENTS: COMPOSITE PATTERN: THIS PATTERN SHOWS THE MAXIMUM OF EITHER THE H OR V AZIMUTH VALUES. THIS PATTERN IS GREATER THAN 85% OF THE FCC FILED COMPOSITE PATTERN BPED-20091027AAV.

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Station: WVUM
Location: Coral Gables, FL
Frequency: 90.5 MHz

Antenna: LP-3E-DA
Orientation: 0° True
Tower: 15" Face tower

Figure: 1
Date: 3/16/2010
Reference: wvum1m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.961	5.45	7.36	Vertical	180°	0.545	1.75	2.43	Vertical
5°	0.957	5.41	7.33	Vertical	185°	0.543	1.74	2.40	Vertical
10°	0.953	5.35	7.29	Vertical	190°	0.542	1.73	2.39	Horizontal
15°	0.948	5.30	7.24	Horizontal	195°	0.554	1.81	2.58	Horizontal
20°	0.960	5.44	7.35	Horizontal	200°	0.573	1.94	2.87	Horizontal
25°	0.972	5.58	7.47	Horizontal	205°	0.599	2.12	3.25	Horizontal
30°	0.982	5.69	7.55	Horizontal	210°	0.634	2.37	3.75	Horizontal
35°	0.986	5.74	7.59	Horizontal	215°	0.687	2.78	4.45	Horizontal
40°	0.983	5.70	7.56	Horizontal	220°	0.751	3.33	5.23	Horizontal
45°	0.971	5.56	7.45	Horizontal	225°	0.811	3.89	5.89	Horizontal
50°	0.953	5.36	7.29	Vertical	230°	0.860	4.36	6.40	Horizontal
55°	0.960	5.44	7.36	Vertical	235°	0.895	4.73	6.75	Horizontal
60°	0.967	5.52	7.42	Vertical	240°	0.917	4.96	6.96	Horizontal
65°	0.974	5.59	7.48	Vertical	245°	0.926	5.06	7.04	Horizontal
70°	0.978	5.64	7.52	Vertical	250°	0.925	5.05	7.03	Horizontal
75°	0.981	5.68	7.54	Vertical	255°	0.918	4.97	6.96	Horizontal
80°	0.982	5.69	7.55	Vertical	260°	0.940	5.21	7.17	Vertical
85°	0.979	5.65	7.52	Vertical	265°	0.962	5.46	7.37	Vertical
90°	0.970	5.55	7.44	Vertical	270°	0.979	5.65	7.52	Vertical
95°	0.955	5.38	7.31	Vertical	275°	0.991	5.79	7.63	Vertical
100°	0.934	5.14	7.11	Vertical	280°	0.998	5.87	7.69	Vertical
105°	0.906	4.85	6.85	Vertical	285°	1.000	5.90	7.71	Vertical
110°	0.873	4.49	6.52	Vertical	290°	0.999	5.88	7.70	Vertical
115°	0.877	4.54	6.57	Horizontal	295°	0.995	5.84	7.66	Vertical
120°	0.880	4.57	6.60	Horizontal	300°	0.989	5.77	7.61	Vertical
125°	0.873	4.50	6.53	Horizontal	305°	0.981	5.68	7.54	Vertical
130°	0.856	4.32	6.36	Horizontal	310°	0.985	5.72	7.58	Horizontal
135°	0.827	4.03	6.06	Horizontal	315°	0.995	5.84	7.67	Horizontal
140°	0.787	3.66	5.63	Horizontal	320°	1.000	5.90	7.71	Horizontal
145°	0.737	3.21	5.06	Horizontal	325°	0.999	5.89	7.70	Horizontal
150°	0.684	2.76	4.41	Horizontal	330°	0.995	5.84	7.66	Horizontal
155°	0.637	2.39	3.79	Horizontal	335°	0.987	5.75	7.59	Horizontal
160°	0.603	2.14	3.31	Horizontal	340°	0.976	5.62	7.50	Horizontal
165°	0.578	1.97	2.94	Horizontal	345°	0.963	5.48	7.39	Horizontal
170°	0.559	1.84	2.65	Horizontal	350°	0.962	5.46	7.37	Vertical
175°	0.546	1.76	2.45	Horizontal	355°	0.962	5.46	7.38	Vertical

Polarization:	Envelope
Maximum Field:	1.000 @ 285° True
Minimum Field:	0.540 @ 188° True
RMS:	0.886
Maximum ERP:	5.900 kW
Maximum Power Gain:	2.051 (3.119 dB)

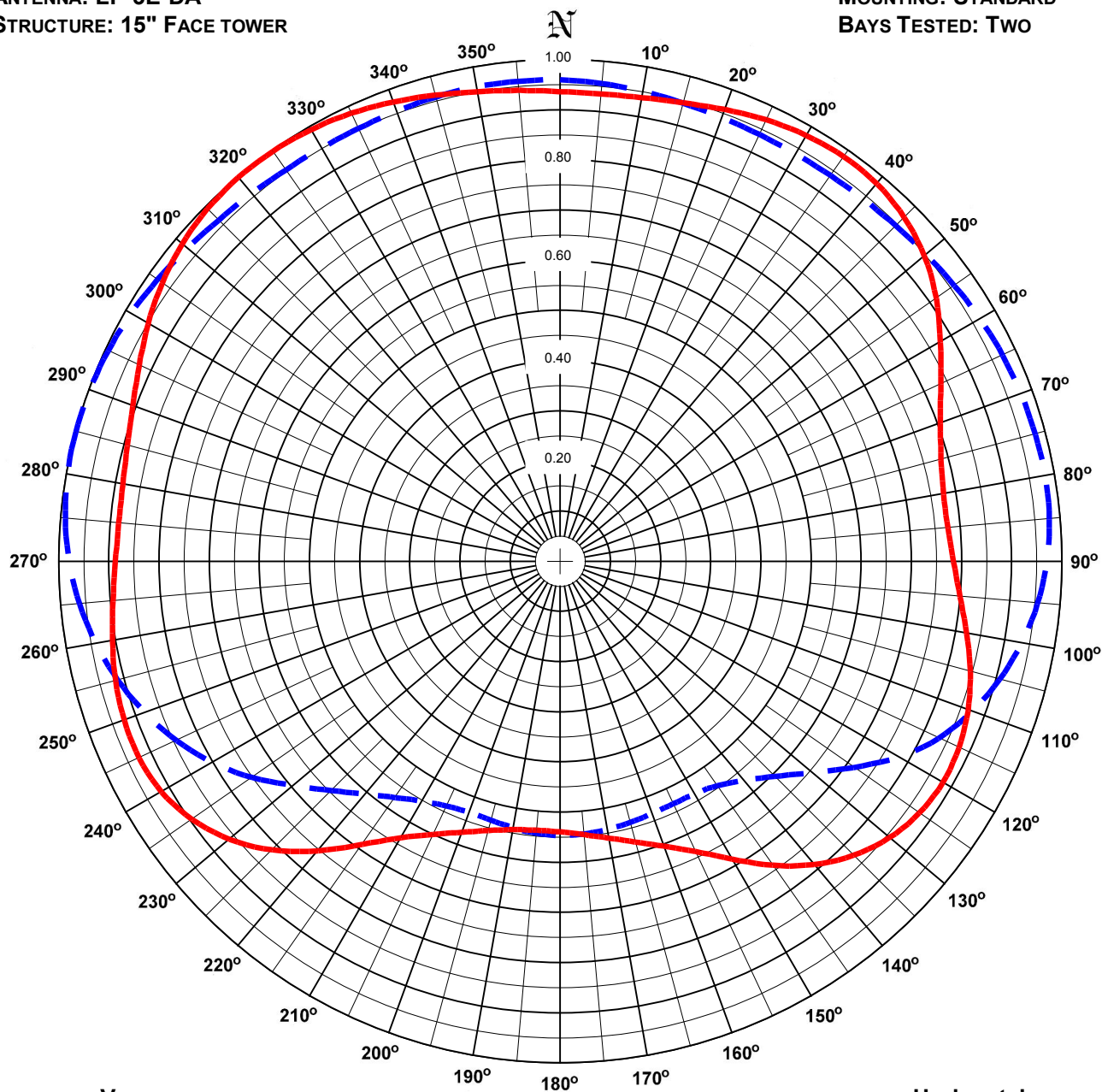
Total Input Power: 2.877 kW

ERI® *Horizontal Plane Relative Field Pattern*

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FIGURE NO: 2
STATION: WVUM
LOCATION: CORAL GABLES, FL
ANTENNA: LP-3E-DA
STRUCTURE: 15" FACE TOWER

DATE: 3/16/2010
FREQUENCY: 90.5 MHz
ORIENTATION: 0° TRUE
MOUNTING: STANDARD
BAYS TESTED: TWO



VERTICAL

RMS: 0.848
MAXIMUM: 1.000 @ 285° TRUE
MINIMUM: 0.531 @ 199° TRUE

HORIZONTAL

RMS: 0.851
Maximum: 1.000 @ 322° True
Minimum: 0.536 @ 184° True

COMMENTS: MEASURED PATTERNS OF THE HORIZONTAL AND VERTICAL COMPONENTS.

ERI® *Horizontal Plane Relative Field List*

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Station: WVUM
Location: Coral Gables, FL
Frequency: 90.5 MHz

Antenna: LP-3E-DA
Orientation: 0° True
Tower: 15" Face tower

Figure: 2
Date: 3/16/2010
Reference: wvum1m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.938	5.19	7.15	0.961	5.45	7.36	180°	0.538	1.71	2.32	0.545	1.75	2.43
5°	0.937	5.18	7.14	0.957	5.41	7.33	185°	0.536	1.70	2.30	0.543	1.74	2.40
10°	0.940	5.21	7.17	0.953	5.35	7.29	190°	0.542	1.73	2.39	0.538	1.71	2.32
15°	0.948	5.30	7.24	0.947	5.29	7.24	195°	0.554	1.81	2.58	0.532	1.67	2.23
20°	0.960	5.44	7.35	0.943	5.25	7.20	200°	0.573	1.94	2.87	0.531	1.66	2.21
25°	0.972	5.58	7.47	0.940	5.22	7.17	205°	0.599	2.12	3.25	0.536	1.70	2.30
30°	0.982	5.69	7.55	0.939	5.21	7.17	210°	0.634	2.37	3.75	0.550	1.79	2.52
35°	0.986	5.74	7.59	0.940	5.22	7.17	215°	0.687	2.78	4.45	0.573	1.94	2.87
40°	0.983	5.70	7.56	0.943	5.25	7.20	220°	0.751	3.33	5.23	0.604	2.15	3.33
45°	0.971	5.56	7.45	0.947	5.29	7.24	225°	0.811	3.89	5.89	0.644	2.45	3.89
50°	0.948	5.30	7.24	0.953	5.36	7.29	230°	0.860	4.36	6.40	0.693	2.83	4.52
55°	0.915	4.94	6.94	0.960	5.44	7.36	235°	0.895	4.73	6.75	0.749	3.31	5.19
60°	0.875	4.52	6.55	0.967	5.52	7.42	240°	0.917	4.96	6.96	0.800	3.77	5.77
65°	0.837	4.13	6.16	0.974	5.59	7.48	245°	0.926	5.06	7.04	0.843	4.19	6.22
70°	0.807	3.84	5.84	0.978	5.64	7.52	250°	0.925	5.05	7.03	0.880	4.57	6.60
75°	0.786	3.65	5.62	0.981	5.68	7.54	255°	0.918	4.97	6.96	0.912	4.91	6.91
80°	0.776	3.55	5.51	0.982	5.69	7.55	260°	0.906	4.85	6.85	0.940	5.21	7.17
85°	0.776	3.55	5.50	0.979	5.65	7.52	265°	0.895	4.73	6.75	0.962	5.46	7.37
90°	0.784	3.63	5.60	0.970	5.55	7.44	270°	0.887	4.64	6.67	0.979	5.65	7.52
95°	0.801	3.78	5.78	0.955	5.38	7.31	275°	0.883	4.61	6.63	0.991	5.79	7.63
100°	0.823	4.00	6.02	0.934	5.14	7.11	280°	0.886	4.63	6.65	0.998	5.87	7.69
105°	0.846	4.23	6.26	0.906	4.85	6.85	285°	0.894	4.71	6.73	1.000	5.90	7.71
110°	0.865	4.42	6.45	0.873	4.49	6.52	290°	0.907	4.86	6.86	0.999	5.88	7.70
115°	0.877	4.54	6.57	0.832	4.08	6.11	295°	0.926	5.06	7.04	0.995	5.84	7.66
120°	0.880	4.57	6.60	0.778	3.57	5.53	300°	0.949	5.31	7.25	0.989	5.77	7.61
125°	0.873	4.50	6.53	0.714	3.00	4.78	305°	0.969	5.54	7.44	0.981	5.68	7.54
130°	0.856	4.32	6.36	0.653	2.52	4.01	310°	0.985	5.72	7.58	0.972	5.57	7.46
135°	0.827	4.03	6.06	0.604	2.15	3.33	315°	0.995	5.84	7.67	0.964	5.48	7.39
140°	0.787	3.66	5.63	0.568	1.90	2.79	320°	1.000	5.90	7.71	0.958	5.42	7.34
145°	0.737	3.21	5.06	0.545	1.75	2.43	325°	0.999	5.89	7.70	0.954	5.37	7.30
150°	0.684	2.76	4.41	0.534	1.68	2.26	330°	0.995	5.84	7.66	0.953	5.35	7.29
155°	0.637	2.39	3.79	0.532	1.67	2.23	335°	0.987	5.75	7.59	0.953	5.36	7.29
160°	0.603	2.14	3.31	0.534	1.68	2.26	340°	0.976	5.62	7.50	0.956	5.39	7.32
165°	0.578	1.97	2.94	0.537	1.70	2.31	345°	0.963	5.48	7.39	0.960	5.43	7.35
170°	0.559	1.84	2.65	0.541	1.73	2.37	350°	0.952	5.35	7.28	0.962	5.46	7.37
175°	0.546	1.76	2.45	0.544	1.75	2.42	355°	0.944	5.25	7.21	0.962	5.46	7.38

Polarization:	Horizontal	Vertical
Maximum Field:	1.000 @ 322° True	1.000 @ 285° True
Minimum Field:	0.536 @ 184° True	0.531 @ 199° True
RMS:	0.851	0.848
Maximum ERP:	5.900 kW	5.900 kW
Maximum Power Gain:	2.051 (3.119 dB)	2.051 (3.119 dB)

Total Input Power: 2.877 kW



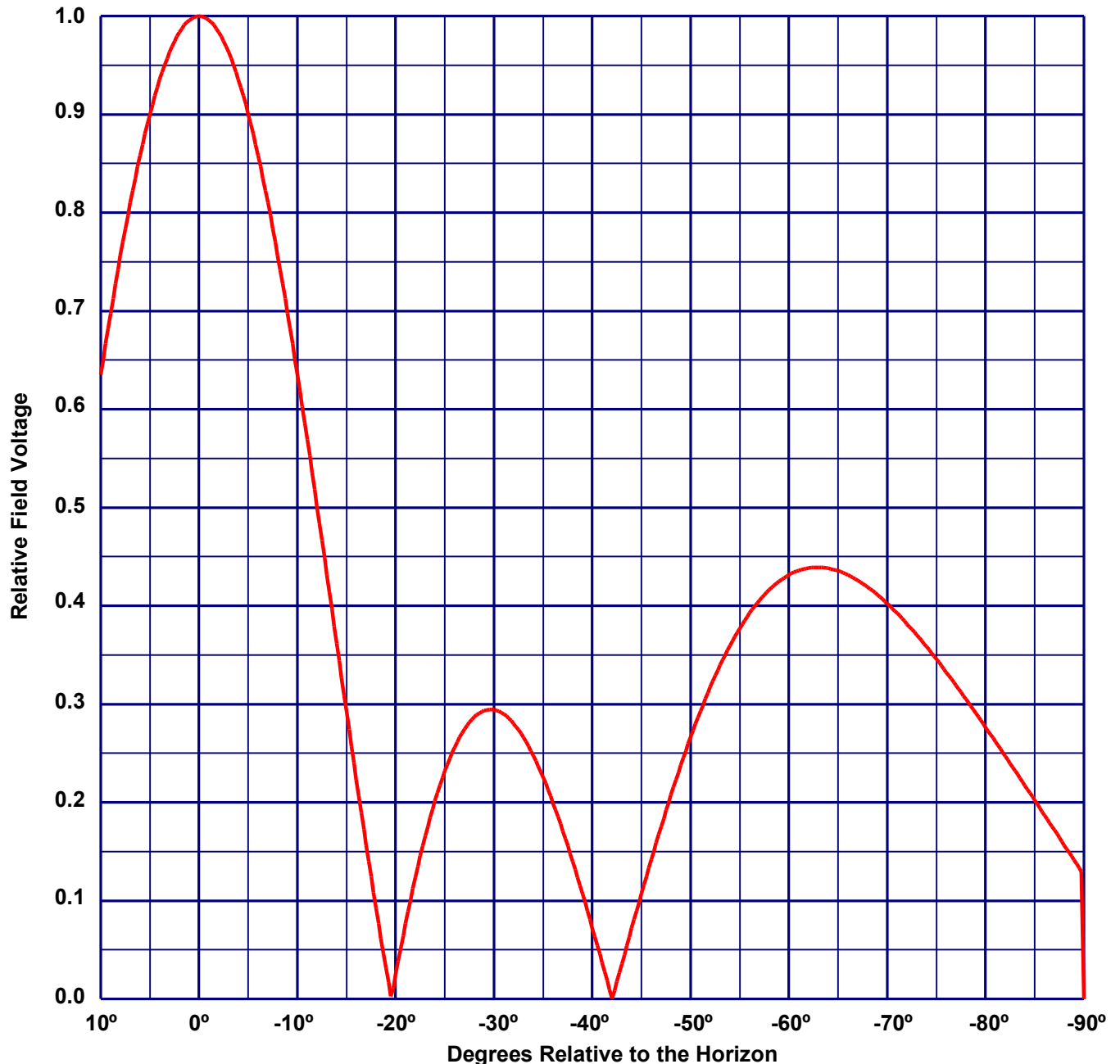
Vertical Plane Relative Field Pattern

WVUM, Coral Gables, FL, 90.5 MHz

Figure#: 3

Date: 3/17/10

*A 3 level, 1 wave-length spaced LP-3E-DA directional antenna
with 0° beam tilt, 0% null fill and a H/V maximum power ratio of 1.00*



Vertical Polarization Gain:

Maximum: 2.051 (3.119 dB)

Horizontal Plane: 2.051 (3.119 dB)

Horizontal Polarization Gain:

Maximum: 2.051 (3.119 dB)

Horizontal Plane: 2.051 (3.119 dB)

Directional Antenna System for WVUM, Coral Gables, Florida

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	LP-3E-DA
Frequency:	90.5 MHz
Number of Bays:	Three

MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	30 ft 5 in
Aperture length required:	36 ft 7 in
Orientation:	0° true
Input flange to the antenna 1 5/8" female.	

ELECTRICAL SPECIFICATIONS (For directional use)

Maximum horizontal ERP:	5.900 kW (7.709 dBk)
Horizontal maximum power gain:	2.051 (3.119 dB)
Maximum vertical ERP:	5.900 kW (7.709 dBk)
Vertical maximum power gain:	2.051 (3.119 dB)
Total input power:	2.877 kW (4.589 dBk)

