ELECTRONICS RESEARCH, INC. ERI®

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 WLVV, Midland, Maryland

July 20, 2018

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 WLVV.

The antenna is the ERI model LP-2E-DA-HW configuration. The circular polarized system consists of two half-wavelength spaced bays using one driven circular polarized radiating element per bay and one horizontal parasitic element per bay. The antenna was mounted on the North 318 degrees East tower leg with bracketry to provide an antenna orientation of North 345 degrees East. The antenna was tested on a self-support tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 88.3 megahertz, which is the center of the FM broadcast channel assigned to WLVV.

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
WLVV, Midland, Maryland

(Continued)

DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of a full-scale model of the complete circular polarized system with the associated horizontal 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 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 self support 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.

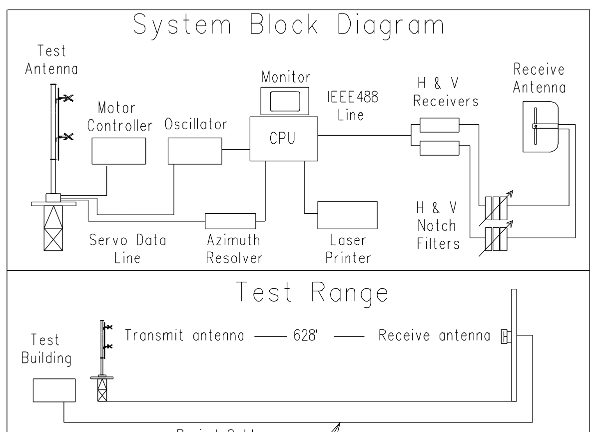

Figure # 2

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 88.3 MHz and was constantly monitored by a Rohde & Schwarz ESVD measuring receiver.

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 Heliax 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 two half-wavelength spaced bays using one driven circular polarized radiating element per bay and one horizontal parasitic element per bay. The power distribution and phase relationship will be fixed when the antenna is manufactured. Proper maintenance of the elements should be all that is required to maintain the pattern in adjustment.

Figure #1 represents the measured individual horizontal and vertical components, the composite maximum of either the horizontal or vertical component at any azimuth and the FCC filed envelope pattern. The horizontal plane relative field list for the composite pattern and the individual H & V components are shown as Figure #1 & 1A respectively. 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 0.490 kilowatts (-3.098 dBk).

Directional Antenna System
For
WLVV, Midland, Maryland

(Continued)

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 that 85% of the filed composite pattern.

The clear vertical length of the structure required to support the antenna is 25 feet 7 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.

Horizontal Plane Relative Field Pattern

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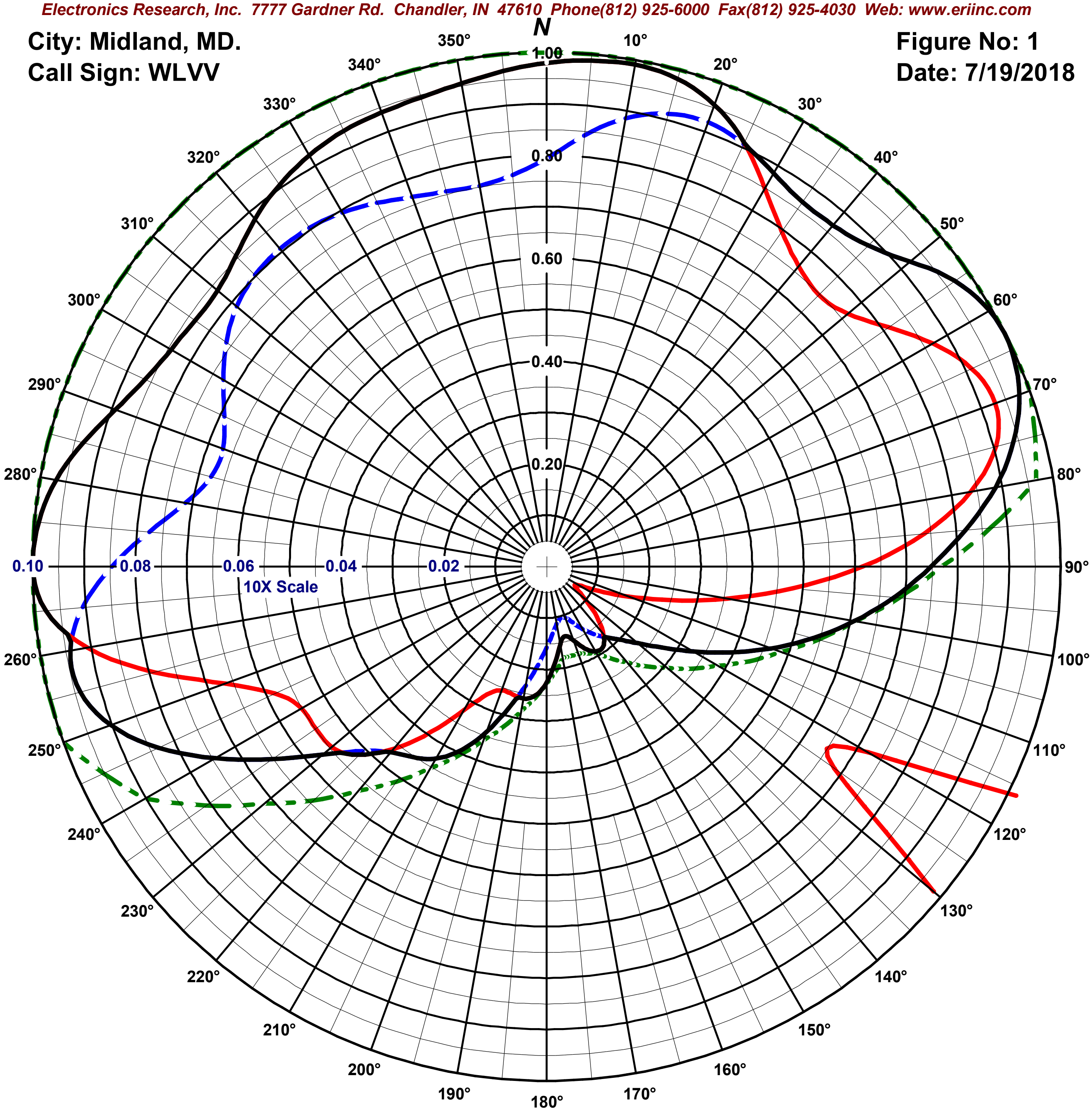
City: Midland, MD.
Call Sign: WLVV

Figure No: 1
Date: 7/19/2018



Antenna Orientation: 345° True

Frequency: 88.3 MHz
Antenna Type: LP-2E-DA-HW

Antenna Mounting: Custom
Tower Type: S.S. Tower

HORIZONTAL	VERTICAL	COMPOSITE	FCC ENVELOPE
RMS: .701	RMS: .691	RMS: .749	RMS: .81
Maximum: 1 @ 270°	Maximum: 1 @ 63°	Maximum: 1 @ 63°	Maximum: 1 @ 0°
Minimum: .065 @ 123°	Minimum: .103 @ 163°	Minimum: .14 @ 165°	Minimum: .18 @ 160°

Measured patterns of the horizontal and vertical components. The composite pattern shows the maximum of either the H or V azimuth values. This patterns is greater than 85% of the FCC filed composite pattern BLED-20100818AAI.

ERI® Horizontal Plane Relative Field Pattern

Electronics Research, Inc. 7777 Gardner Rd. Chandler, IN 47610 Phone(812) 925-6000 Fax(812) 925-4030 Web: www.eriinc.com

Figure# 1 | **Date: 7/19/2018**
Station: WLVV | **Antenna: LP-2E-DA-HW**
Location: Midland, MD. | **Antenna Orientation: 345° True**
Frequency: 88.3 MHz | **Number of Bays: 2**

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.980	0.470	-3.275	Horizontal	180°	0.225	0.025	-16.046	Horizontal
5°	0.988	0.478	-3.203	Horizontal	185°	0.252	0.031	-15.076	Horizontal
10°	0.991	0.481	-3.175	Horizontal	190°	0.260	0.033	-14.788	Horizontal
15°	0.982	0.473	-3.252	Horizontal	195°	0.285	0.040	-14.000	Vertical
20°	0.956	0.447	-3.493	Horizontal	200°	0.342	0.057	-12.420	Vertical
25°	0.910	0.405	-3.921	Horizontal	205°	0.394	0.076	-11.196	Vertical
30°	0.883	0.382	-4.174	Vertical	210°	0.431	0.091	-10.408	Vertical
35°	0.866	0.368	-4.343	Vertical	215°	0.452	0.100	-9.986	Vertical
40°	0.867	0.368	-4.339	Vertical	220°	0.471	0.109	-9.630	Vertical
45°	0.884	0.383	-4.168	Vertical	225°	0.518	0.131	-8.816	Horizontal
50°	0.923	0.417	-3.797	Vertical	230°	0.569	0.158	-8.003	Vertical
55°	0.969	0.460	-3.371	Vertical	235°	0.652	0.208	-6.811	Vertical
60°	0.995	0.485	-3.143	Vertical	240°	0.745	0.272	-5.654	Vertical
65°	0.998	0.488	-3.118	Vertical	245°	0.833	0.340	-4.682	Vertical
70°	0.979	0.469	-3.286	Vertical	250°	0.902	0.399	-3.996	Vertical
75°	0.940	0.433	-3.631	Vertical	255°	0.940	0.433	-3.639	Vertical
80°	0.887	0.385	-4.142	Vertical	260°	0.941	0.434	-3.629	Vertical
85°	0.818	0.328	-4.845	Vertical	265°	0.978	0.469	-3.289	Horizontal
90°	0.748	0.274	-5.620	Vertical	270°	1.000	0.490	-3.098	Horizontal
95°	0.679	0.226	-6.458	Vertical	275°	0.992	0.482	-3.167	Horizontal
100°	0.608	0.181	-7.415	Vertical	280°	0.969	0.460	-3.372	Horizontal
105°	0.536	0.141	-8.507	Vertical	285°	0.933	0.427	-3.700	Horizontal
110°	0.465	0.106	-9.755	Vertical	290°	0.893	0.391	-4.082	Horizontal
115°	0.395	0.076	-11.173	Vertical	295°	0.862	0.364	-4.386	Horizontal
120°	0.330	0.053	-12.731	Vertical	300°	0.844	0.349	-4.570	Horizontal
125°	0.274	0.037	-14.328	Vertical	305°	0.835	0.342	-4.664	Horizontal
130°	0.232	0.026	-15.804	Vertical	310°	0.836	0.342	-4.655	Horizontal
135°	0.201	0.020	-17.040	Vertical	315°	0.855	0.358	-4.462	Horizontal
140°	0.179	0.016	-18.044	Vertical	320°	0.883	0.382	-4.183	Horizontal
145°	0.191	0.018	-17.488	Horizontal	325°	0.906	0.402	-3.953	Horizontal
150°	0.190	0.018	-17.510	Horizontal	330°	0.924	0.418	-3.789	Horizontal
155°	0.175	0.015	-18.225	Horizontal	335°	0.935	0.428	-3.683	Horizontal
160°	0.153	0.011	-19.406	Horizontal	340°	0.940	0.433	-3.638	Horizontal
165°	0.140	0.010	-20.166	Horizontal	345°	0.945	0.437	-3.591	Horizontal
170°	0.153	0.011	-19.397	Horizontal	350°	0.954	0.446	-3.507	Horizontal
175°	0.187	0.017	-17.640	Horizontal	355°	0.967	0.458	-3.387	Horizontal

Horizontal Polarization:
Maximum: 1.378 (1.391 dB)
Horizontal Plane: 1.378 (1.391 dB)
Maximum ERP: 0.490 kW

Vertical Polarization:
Maximum: 1.378 (1.391 dB)
Horizontal Plane: 1.378 (1.391 dB)
Maximum ERP: 0.490 kW

Total Input Power: 0.356 kW
Reference: WLVV1M.FIG
This list shows the the maximum azimuth values of either the horizontal or vertical components.

ERI® Horizontal Plane Relative Field Pattern

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Figure# 1A — **Date: 7/19/2018**
Station: WLVV — **Antenna: LP-2E-DA-HW**
Location: Midland, MD. — **Antenna Orientation: 345° True**
Frequency: 88.3 MHz — **Number of Bays: 2**

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.980	0.470	-3.275	0.794	0.309	-5.102	180°	0.225	0.025	-16.046	0.157	0.012	-19.154
5°	0.988	0.478	-3.203	0.842	0.347	-4.594	185°	0.252	0.031	-15.076	0.192	0.018	-17.440
10°	0.991	0.481	-3.175	0.885	0.384	-4.156	190°	0.260	0.033	-14.788	0.234	0.027	-15.701
15°	0.982	0.473	-3.252	0.912	0.407	-3.899	195°	0.257	0.032	-14.907	0.285	0.040	-14.000
20°	0.956	0.447	-3.493	0.919	0.414	-3.830	200°	0.256	0.032	-14.936	0.342	0.057	-12.420
25°	0.910	0.405	-3.921	0.907	0.403	-3.948	205°	0.274	0.037	-14.330	0.394	0.076	-11.196
30°	0.849	0.354	-4.516	0.883	0.382	-4.174	210°	0.323	0.051	-12.920	0.431	0.091	-10.408
35°	0.797	0.311	-5.068	0.866	0.368	-4.343	215°	0.393	0.076	-11.218	0.452	0.100	-9.986
40°	0.763	0.285	-5.451	0.867	0.368	-4.339	220°	0.462	0.105	-9.804	0.471	0.109	-9.630
45°	0.748	0.274	-5.617	0.884	0.383	-4.168	225°	0.518	0.131	-8.816	0.507	0.126	-8.998
50°	0.765	0.287	-5.423	0.923	0.417	-3.797	230°	0.546	0.146	-8.360	0.569	0.158	-8.003
55°	0.812	0.323	-4.909	0.969	0.460	-3.371	235°	0.549	0.147	-8.313	0.652	0.208	-6.811
60°	0.868	0.369	-4.331	0.995	0.485	-3.143	240°	0.551	0.149	-8.282	0.745	0.272	-5.654
65°	0.913	0.408	-3.893	0.998	0.488	-3.118	245°	0.584	0.167	-7.774	0.833	0.340	-4.682
70°	0.929	0.423	-3.737	0.979	0.469	-3.286	250°	0.665	0.217	-6.637	0.902	0.399	-3.996
75°	0.905	0.401	-3.966	0.940	0.433	-3.631	255°	0.791	0.307	-5.133	0.940	0.433	-3.639
80°	0.838	0.344	-4.636	0.887	0.385	-4.142	260°	0.907	0.403	-3.942	0.941	0.434	-3.629
85°	0.738	0.267	-5.740	0.818	0.328	-4.845	265°	0.978	0.469	-3.289	0.906	0.402	-3.953
90°	0.614	0.185	-7.328	0.748	0.274	-5.620	270°	1.000	0.490	-3.098	0.846	0.351	-4.548
95°	0.481	0.113	-9.453	0.679	0.226	-6.458	275°	0.992	0.482	-3.167	0.776	0.295	-5.301
100°	0.357	0.063	-12.040	0.608	0.181	-7.415	280°	0.969	0.460	-3.372	0.714	0.249	-6.030
105°	0.252	0.031	-15.082	0.536	0.141	-8.507	285°	0.933	0.427	-3.700	0.676	0.224	-6.502
110°	0.170	0.014	-18.470	0.465	0.106	-9.755	290°	0.893	0.391	-4.082	0.670	0.220	-6.579
115°	0.111	0.006	-22.170	0.395	0.076	-11.173	295°	0.862	0.364	-4.386	0.692	0.235	-6.296
120°	0.072	0.003	-25.931	0.330	0.053	-12.731	300°	0.844	0.349	-4.570	0.726	0.258	-5.878
125°	0.068	0.002	-26.401	0.274	0.037	-14.328	305°	0.835	0.342	-4.664	0.761	0.283	-5.475
130°	0.098	0.005	-23.256	0.232	0.026	-15.804	310°	0.836	0.342	-4.655	0.787	0.303	-5.179
135°	0.138	0.009	-20.295	0.201	0.020	-17.040	315°	0.855	0.358	-4.462	0.802	0.315	-5.011
140°	0.172	0.015	-18.364	0.179	0.016	-18.044	320°	0.883	0.382	-4.183	0.807	0.319	-4.961
145°	0.191	0.018	-17.488	0.160	0.013	-19.008	325°	0.906	0.402	-3.953	0.804	0.317	-4.989
150°	0.190	0.018	-17.510	0.140	0.010	-20.153	330°	0.924	0.418	-3.789	0.795	0.310	-5.086
155°	0.175	0.015	-18.225	0.120	0.007	-21.525	335°	0.935	0.428	-3.683	0.781	0.299	-5.251
160°	0.153	0.011	-19.406	0.105	0.005	-22.635	340°	0.940	0.433	-3.638	0.765	0.287	-5.423
165°	0.140	0.010	-20.166	0.104	0.005	-22.748	345°	0.945	0.437	-3.591	0.755	0.279	-5.538
170°	0.153	0.011	-19.397	0.113	0.006	-22.007	350°	0.954	0.446	-3.507	0.752	0.277	-5.570
175°	0.187	0.017	-17.640	0.131	0.008	-20.732	355°	0.967	0.458	-3.387	0.764	0.286	-5.434

Horizontal Polarization:
Maximum: 1.378 (1.391 dB)
Horizontal Plane: 1.378 (1.391 dB)
Maximum ERP: 0.490 kW

Vertical Polarization:
Maximum: 1.378 (1.391 dB)
Horizontal Plane: 1.378 (1.391 dB)
Maximum ERP: 0.490 kW

Total Input Power: 0.356 kW
Reference: WLVV1M.FIG
This list shows the azimuth values for the horizontal and vertical components.

Vertical Plane Relative Field Pattern

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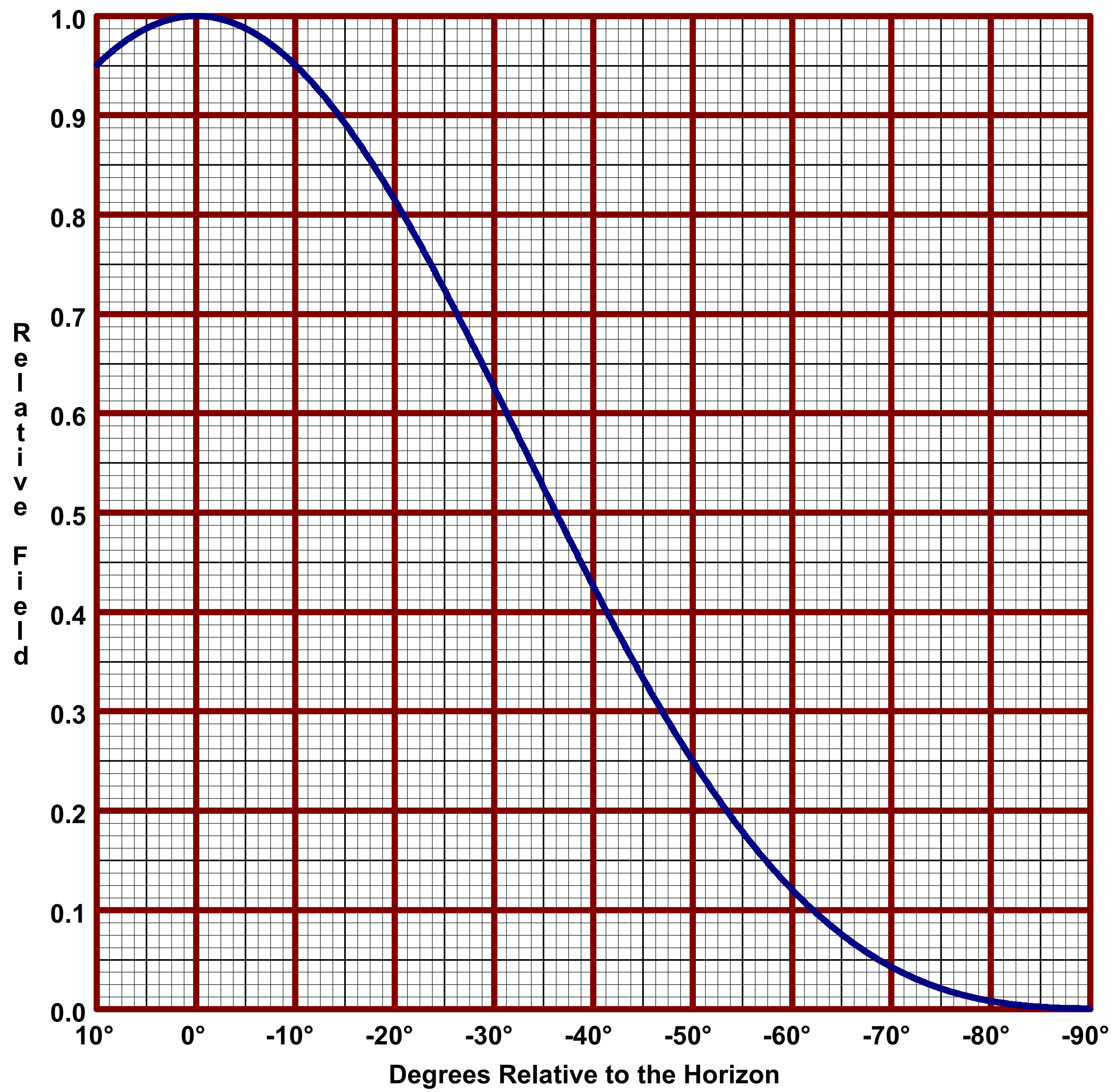
Figure No: 3
Call Sign: WLVV
Location: Midland, MD.
Frequency: 88.3 MHz
Antenna: 2 bay LP-2E-DA-HW

Date: 7/19/2018
H/V Power Ratio: 1
.5 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 1.378 (1.391 dB)
Horizontal Plane: 1.378 (1.391 dB)
Maximum ERP: 0.490 kW

Vertical Polarization:
Maximum: 1.378 (1.391 dB)
Horizontal Plane: 1.378 (1.391 dB)
Maximum ERP: 0.490 kW

Directional Antenna System
for
WLVV, Midland, Maryland

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	LP-2E-DA-HW
Frequency:	88.3 MHz
Number of Bays:	Two

MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	14 ft 5 in
Aperture length required:	25 ft 7 in
Orientation:	345° true

Input flange to the antenna 1 5/8” female.

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	0.490 kW (3.098 dBk)
Horizontal maximum power gain:	1.378 (1.391 dB)
Maximum vertical ERP:	0.490 kW (3.098 dBk)
Vertical maximum power gain:	1.378 (1.391 dB)
Total input power:	0.356 kW (-4.486 dBk)