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 WBVM, Tampa, Florida

June 17, 2016

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 WBVM.

The antenna is the ERI model MP-4E-DA configuration. The circular polarized system consists of 4 full-wavelength spaced bays using one driven circular polarized radiating element and one horizontal parasitic element placed one-quarter wave above and below each bay. The antenna was mounted on the North 241 degrees East tower face with bracketry to provide an antenna orientation of North 255 degrees East. The antenna was tested on a 7' 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 WBVM.

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
WBVM, Tampa, Florida

(Continued)

DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of two bay levels of the 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 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 7' 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.

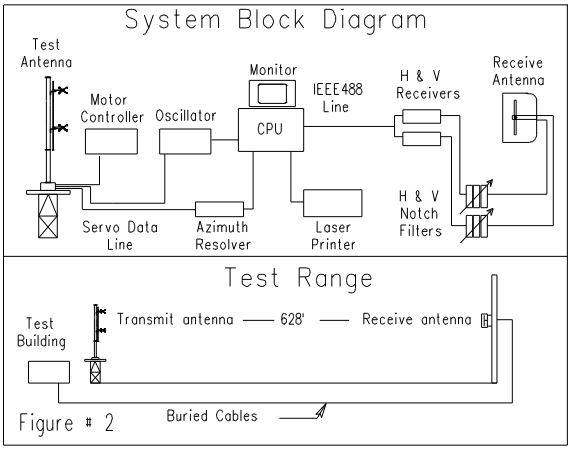

Figure # 2

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 90.5 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.

(Continued)

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 4 full-wavelength spaced bays using one driven circular polarized radiating element and one horizontal parasitic element placed one-quarter wave above and below each 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.

The MP-4E-DA array is to be mounted on the North 241 degrees East tower face of the 7' face tower at a bearing of North 255 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 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 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 100 kilowatts (20.000 dBk).

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

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(Continued)

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 48 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

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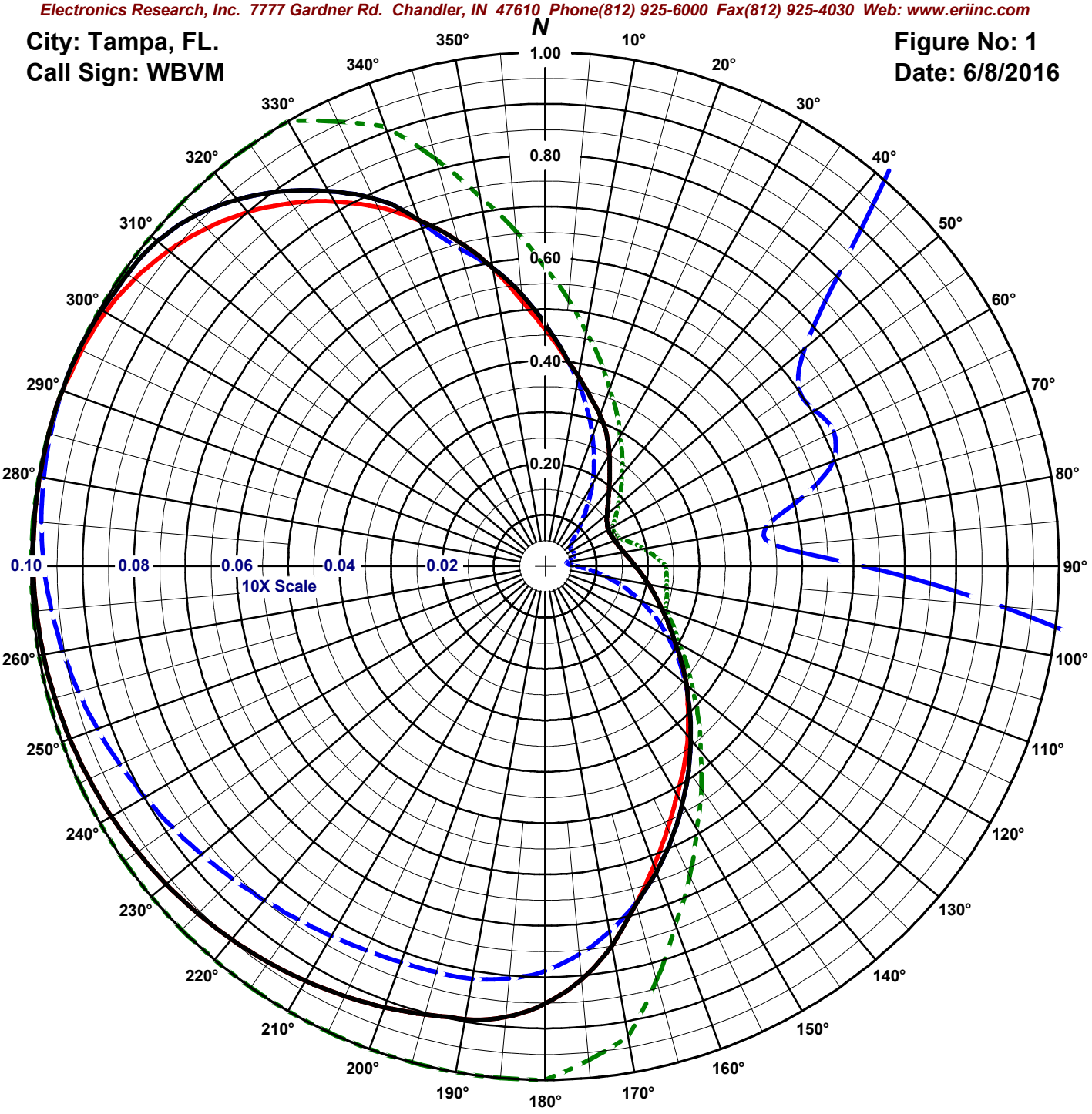
City: Tampa, FL.
Call Sign: WBVM

Figure No: 1
Date: 6/8/2016



Antenna Orientation: 255° True

Frequency: 90.5 MHz
Antenna Type: MP-4E-DA

Antenna Mounting: Custom
Tower Type: 7' Tower

HORIZONTAL	VERTICAL	COMPOSITE	FCC ENVELOPE
RMS: .698	RMS: .671	RMS: .703	RMS: .758
Maximum: 1 @ 288°	Maximum: 1 @ 295°	Maximum: 1 @ 288°	Maximum: 1 @ 180°
Minimum: .141 @ 62°	Minimum: .043 @ 82°	Minimum: .141 @ 62°	Minimum: .15 @ 60°

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 BPED-20160523AAP.

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: 6/8/2016**
Station: WBVM **Antenna: MP-4E-DA**
Location: Tampa, FL. **Antenna Orientation: 255° True**
Frequency: 90.5 MHz **Number of Bays: 4**

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.472	22.284	13.480	Vertical	180°	0.852	72.539	18.606	Horizontal
5°	0.416	17.332	12.389	Vertical	185°	0.881	77.599	18.899	Horizontal
10°	0.375	14.051	11.477	Horizontal	190°	0.896	80.193	19.041	Horizontal
15°	0.340	11.588	10.640	Horizontal	195°	0.904	81.646	19.119	Horizontal
20°	0.313	9.772	9.900	Horizontal	200°	0.914	83.479	19.216	Horizontal
25°	0.283	8.007	9.035	Horizontal	205°	0.923	85.229	19.306	Horizontal
30°	0.251	6.279	7.979	Horizontal	210°	0.932	86.893	19.390	Horizontal
35°	0.219	4.817	6.828	Horizontal	215°	0.941	88.468	19.468	Horizontal
40°	0.194	3.751	5.741	Horizontal	220°	0.948	89.950	19.540	Horizontal
45°	0.173	2.994	4.762	Horizontal	225°	0.956	91.337	19.606	Horizontal
50°	0.158	2.482	3.948	Horizontal	230°	0.962	92.627	19.667	Horizontal
55°	0.147	2.167	3.359	Horizontal	235°	0.969	93.818	19.723	Horizontal
60°	0.142	2.018	3.049	Horizontal	240°	0.974	94.907	19.773	Horizontal
65°	0.142	2.015	3.042	Horizontal	245°	0.979	95.892	19.818	Horizontal
70°	0.144	2.088	3.197	Horizontal	250°	0.984	96.772	19.858	Horizontal
75°	0.149	2.226	3.475	Horizontal	255°	0.988	97.546	19.892	Horizontal
80°	0.156	2.434	3.863	Horizontal	260°	0.991	98.211	19.922	Horizontal
85°	0.165	2.721	4.347	Horizontal	265°	0.994	98.767	19.946	Horizontal
90°	0.176	3.099	4.912	Horizontal	270°	0.996	99.213	19.966	Horizontal
95°	0.189	3.581	5.541	Horizontal	275°	0.998	99.549	19.980	Horizontal
100°	0.205	4.186	6.218	Horizontal	280°	0.999	99.773	19.990	Horizontal
105°	0.222	4.931	6.929	Horizontal	285°	0.999	99.885	19.995	Horizontal
110°	0.242	5.840	7.664	Horizontal	290°	0.999	99.885	19.995	Horizontal
115°	0.265	7.033	8.472	Horizontal	295°	1.000	100.000	20.000	Vertical
120°	0.291	8.470	9.279	Horizontal	300°	0.996	99.242	19.967	Vertical
125°	0.324	10.468	10.199	Horizontal	305°	0.992	98.370	19.929	Vertical
130°	0.360	12.938	11.119	Horizontal	310°	0.984	96.917	19.864	Vertical
135°	0.398	15.816	11.991	Vertical	315°	0.964	92.994	19.685	Vertical
140°	0.441	19.422	12.883	Vertical	320°	0.931	86.692	19.380	Vertical
145°	0.487	23.673	13.743	Vertical	325°	0.891	79.330	18.994	Vertical
150°	0.534	28.555	14.557	Vertical	330°	0.843	71.103	18.519	Vertical
155°	0.584	34.102	15.328	Vertical	335°	0.790	62.379	17.950	Vertical
160°	0.633	40.086	16.030	Vertical	340°	0.716	51.288	17.100	Horizontal
165°	0.681	46.404	16.666	Horizontal	345°	0.655	42.956	16.330	Horizontal
170°	0.749	56.171	17.495	Horizontal	350°	0.590	34.762	15.411	Vertical
175°	0.808	65.268	18.147	Horizontal	355°	0.532	28.305	14.519	Vertical

Horizontal Polarization:
Maximum: 4.324 (6.359 dB)
Horizontal Plane: 4.324 (6.359 dB)
Maximum ERP: 100.000 kW

Vertical Polarization:
Maximum: 4.324 (6.359 dB)
Horizontal Plane: 4.324 (6.359 dB)
Maximum ERP: 100.000 kW

Total Input Power: 23.127 kW
Reference: WBVM1M.FIG
This list shows the the maximum azimuth values of either the horizontal or vertical components.

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# 1A **Date: 6/8/2016**
Station: WBVM **Antenna: MP-4E-DA**
Location: Tampa, FL. **Antenna Orientation: 255° True**
Frequency: 90.5 MHz **Number of Bays: 4**

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.462	21.301	13.284	0.472	22.284	13.480	180°	0.852	72.539	18.606	0.788	62.093	17.930
5°	0.413	17.038	12.314	0.416	17.332	12.389	185°	0.881	77.599	18.899	0.806	64.917	18.124
10°	0.375	14.051	11.477	0.365	13.338	11.251	190°	0.896	80.193	19.041	0.816	66.525	18.230
15°	0.340	11.588	10.640	0.316	10.008	10.003	195°	0.904	81.646	19.119	0.818	66.929	18.256
20°	0.313	9.772	9.900	0.269	7.263	8.611	200°	0.914	83.479	19.216	0.820	67.306	18.281
25°	0.283	8.007	9.035	0.225	5.078	7.057	205°	0.923	85.229	19.306	0.825	68.063	18.329
30°	0.251	6.279	7.979	0.183	3.350	5.250	210°	0.932	86.893	19.390	0.831	69.006	18.389
35°	0.219	4.817	6.828	0.143	2.045	3.106	215°	0.941	88.468	19.468	0.839	70.392	18.475
40°	0.194	3.751	5.741	0.108	1.173	0.692	220°	0.948	89.950	19.540	0.849	72.097	18.579
45°	0.173	2.994	4.762	0.081	0.658	-1.817	225°	0.956	91.337	19.606	0.861	74.063	18.696
50°	0.158	2.482	3.948	0.066	0.435	-3.618	230°	0.962	92.627	19.667	0.872	76.004	18.808
55°	0.147	2.167	3.359	0.060	0.363	-4.396	235°	0.969	93.818	19.723	0.885	78.376	18.942
60°	0.142	2.018	3.049	0.061	0.367	-4.354	240°	0.974	94.907	19.773	0.899	80.874	19.078
65°	0.142	2.015	3.042	0.062	0.384	-4.158	245°	0.979	95.892	19.818	0.914	83.466	19.215
70°	0.144	2.088	3.197	0.060	0.356	-4.480	250°	0.984	96.772	19.858	0.926	85.785	19.334
75°	0.149	2.226	3.475	0.052	0.268	-5.719	255°	0.988	97.546	19.892	0.940	88.360	19.463
80°	0.156	2.434	3.863	0.044	0.191	-7.200	260°	0.991	98.211	19.922	0.953	90.821	19.582
85°	0.165	2.721	4.347	0.045	0.206	-6.865	265°	0.994	98.767	19.946	0.965	93.123	19.691
90°	0.176	3.099	4.912	0.062	0.382	-4.178	270°	0.996	99.213	19.966	0.974	94.946	19.775
95°	0.189	3.581	5.541	0.089	0.792	-1.012	275°	0.998	99.549	19.980	0.984	96.727	19.855
100°	0.205	4.186	6.218	0.122	1.488	1.726	280°	0.999	99.773	19.990	0.991	98.168	19.920
105°	0.222	4.931	6.929	0.160	2.554	4.072	285°	0.999	99.885	19.995	0.996	99.202	19.965
110°	0.242	5.840	7.664	0.199	3.954	5.971	290°	0.999	99.885	19.995	0.999	99.780	19.990
115°	0.265	7.033	8.472	0.238	5.660	7.528	295°	0.995	98.982	19.956	1.000	100.000	20.000
120°	0.291	8.470	9.279	0.277	7.659	8.842	300°	0.988	97.565	19.893	0.996	99.242	19.967
125°	0.324	10.468	10.199	0.317	10.032	10.014	305°	0.975	94.993	19.777	0.992	98.370	19.929
130°	0.360	12.938	11.119	0.357	12.722	11.046	310°	0.956	91.315	19.605	0.984	96.917	19.864
135°	0.393	15.458	11.892	0.398	15.816	11.991	315°	0.931	86.596	19.375	0.964	92.994	19.685
140°	0.432	18.660	12.709	0.441	19.422	12.883	320°	0.900	80.928	19.081	0.931	86.692	19.380
145°	0.472	22.286	13.480	0.487	23.673	13.743	325°	0.863	74.421	18.717	0.891	79.330	18.994
150°	0.515	26.475	14.228	0.534	28.555	14.557	330°	0.820	67.206	18.274	0.843	71.103	18.519
155°	0.564	31.813	15.026	0.584	34.102	15.328	335°	0.771	59.437	17.741	0.790	62.379	17.950
160°	0.620	38.422	15.846	0.633	40.086	16.030	340°	0.716	51.288	17.100	0.715	51.152	17.089
165°	0.681	46.404	16.666	0.680	46.194	16.646	345°	0.655	42.956	16.330	0.640	40.900	16.117
170°	0.749	56.171	17.495	0.722	52.189	17.176	350°	0.589	34.657	15.398	0.590	34.762	15.411
175°	0.808	65.268	18.147	0.759	57.546	17.600	355°	0.519	26.930	14.302	0.532	28.305	14.519

Horizontal Polarization:
Maximum: 4.324 (6.359 dB)
Horizontal Plane: 4.324 (6.359 dB)
Maximum ERP: 100.000 kW

Vertical Polarization:
Maximum: 4.324 (6.359 dB)
Horizontal Plane: 4.324 (6.359 dB)
Maximum ERP: 100.000 kW

Total Input Power: 23.127 kW
Reference: WBVM1M.FIG
This list shows the azimuth values for the horizontal and vertical components.

Vertical Plane Relative Field Pattern

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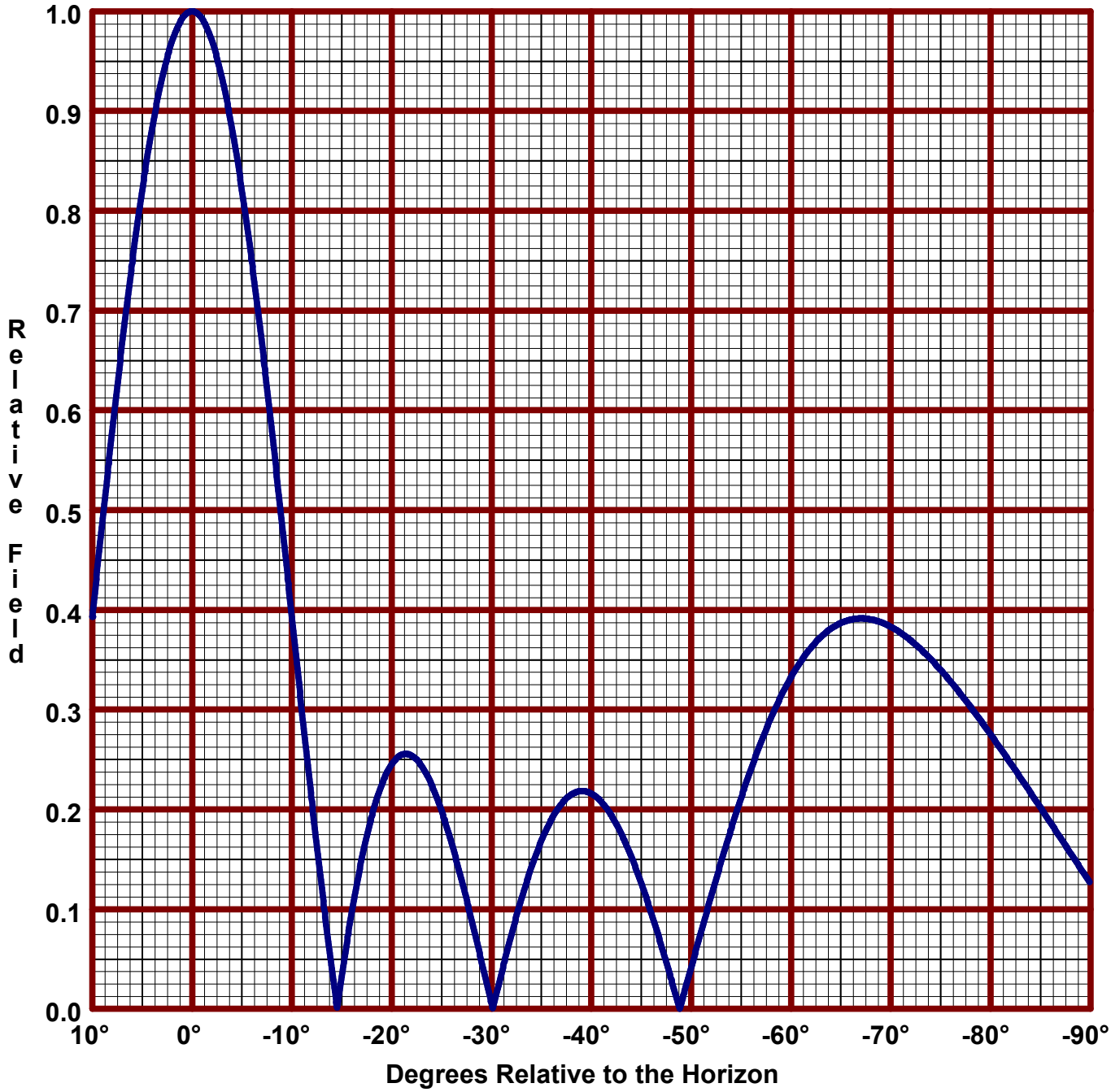
Figure No: 3
Call Sign: WBVM
Location: Tampa, FL.
Frequency: 90.5 MHz
Antenna: 4 bay MP-4E-DA

Date: 6/8/2016
H/V Power Ratio: 1
1 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 4.324 (6.359 dB)
Horizontal Plane: 4.324 (6.359 dB)
Maximum ERP: 100.000 kW

Vertical Polarization:
Maximum: 4.324 (6.359 dB)
Horizontal Plane: 4.324 (6.359 dB)
Maximum ERP: 100.000 kW

Directional Antenna System
for
WBVM, Tampa, Florida

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	MP-4E-DA
Frequency:	90.5 MHz
Number of Bays:	Four

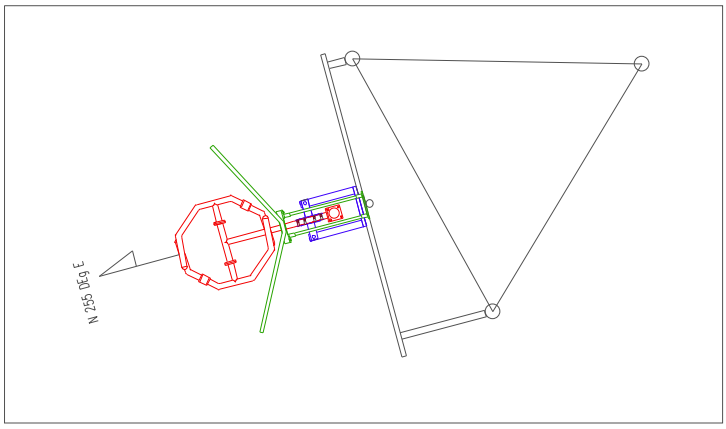
MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	41 ft 4 in
Aperture length required:	52 ft 6 in [1]
Orientation:	255° true

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

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	100 kW (20 dBk)
Horizontal maximum power gain:	4.324 (6.359 dB)
Maximum vertical ERP:	100 kW (20 dBk)
Vertical maximum power gain:	4.324 (6.359 dB)
Total input power:	23.127 kW (13.641 dBk)



WBVM FM Directional Antenna Installation

Christopher G Sampson
12404 Eclipse Court
New Port Richey, Florida 34654

This letter is to certify that the antenna for WBVM F 90.5, ERI model MP-4E-DA was installed at the authorized site in August of 2016 by Electronics Research Incorporated.

The antenna was assembled and installed by the manufacturer in order to ensure proper operation and compliance to factory specifications. The installation of the antenna complies with the pattern set forth in the FCC Construction permit; **BPED-20160523AAP**.

I have 30 years of experience in the field of Broadcast Engineering. I have worked in all phases of the industry and have overseen multiple directional FM antenna installations.

General Radiotelephone License # PG00013453

Christopher G Sampson

Phoenix Surveying
of Brandon, LLC

610 E. Morgan St.
Brandon, FL 33510

December 8, 2016

WUSF Public Radio
Attn: Christopher G. Sampson
Assistant Director of Engineering & Operations
University of South Florida

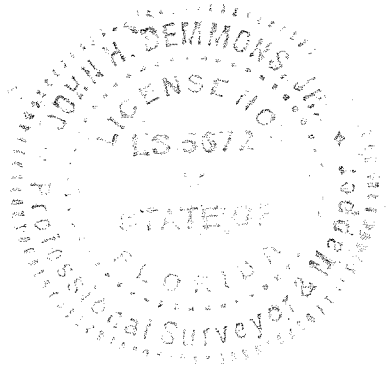
On December 8, 2016, Phoenix Surveying of Brandon LLC dispatched a field crew to the site to verify the installation of a directional antenna located at 14205 Boyette Road, Riverview, Florida for the Radio Station WBVM FM 90.5. The specific purpose of this survey was to determine the direction of the antenna.

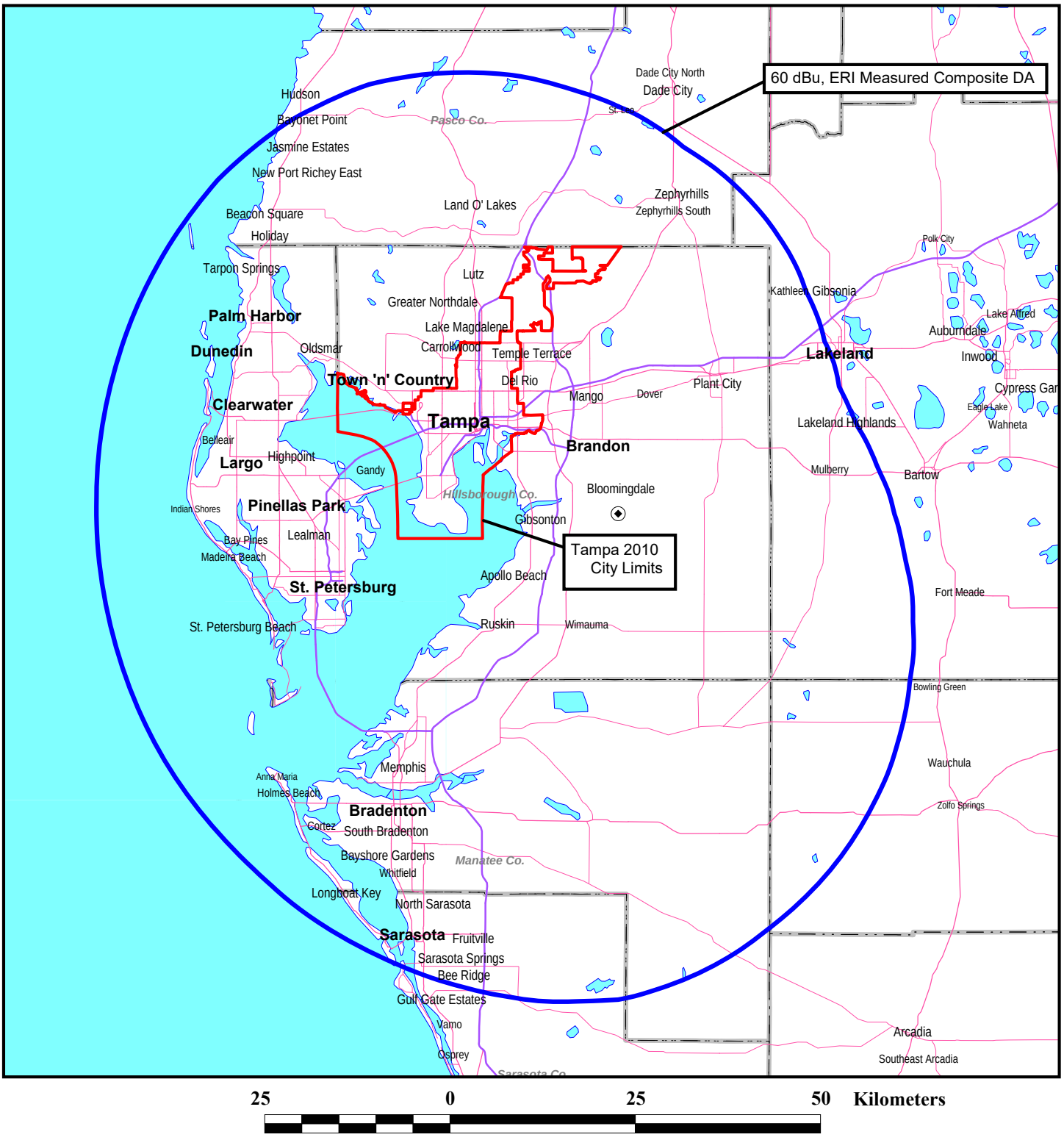
A base line was established by GPS observation based upon the Florida West Zone Horizontal Control Network (NAD 1983-1990 Re-Adjustment) and were established to Third-Order Class I accuracy as defined by the Standards and Specifications for Geodetic Control Networks as published by the Federal Geodetic Control Committee dated September 1984 or latest addition.

As the actual antenna is not accessible the information shown is based on the position of the base structure and related to the drawing by Electronics Research, Inc. supplied by the client. We found the directions shown on the drawing to be consistent with our measurements.

The centerline direction from the south base support leg is at an azimuth of 181 degrees, the centerline direction from the easterly support leg is at an azimuth of 301 degrees. The orientation of the base positions the antenna at an azimuth of 255 degrees.

John H. Demmons, Jr. PSM
Phoenix Surveying of Brandon LLC





SECTION 73.515 COMPLIANCE

STATION WBVM
TAMPA, FLORIDA
CH 213C1 (90.5 MHZ) 100 KW (DA) 262 M

du Treil, Lundin & Rackley, Inc. Sarasota, Florida