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 WMAS, Springfield, Massachusetts

11/30/21

Electronics Research Inc. is providing a custom fabricated multiplexed antenna system that is specially designed to meet the FCC requirements and the general needs of radio station WMAS.

The antenna is the ERI model MP-4E-DA configuration. The circular polarized system consists of four full wave spaced bays using one driven circular polarized radiating element and 2 horizontal parasitic elements per bay. The horizontal parasites are mounted with one ¼ wave above and below each of the antenna bays. The top two bays of the antenna were tested on a full scale model of a square self supporting tower that has a 21" face width at the top, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 94.7 megahertz, which is the center of the FM broadcast channel assigned to WMAS.

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
WMAS, Springfield, Massachusetts

(Continued)

DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of the top two bay levels of the circular polarized system. The elements and brackets that were used in this test are electrically equivalent to those that will be supplied with the 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 full scale model of a square self supporting tower with a 21" face width at the top 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.

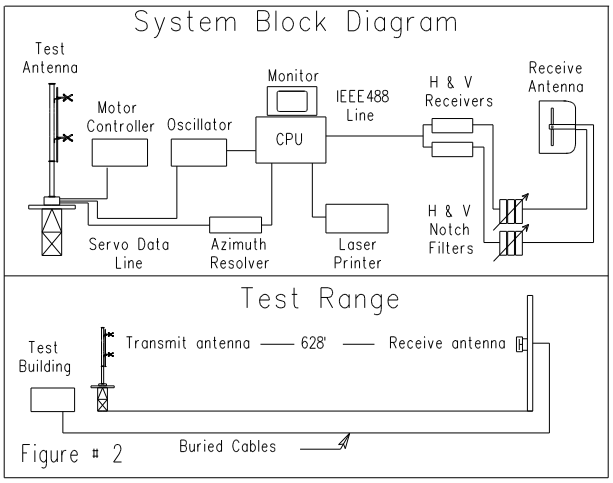


Figure # 2

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 94.7 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 four full wave spaced bays using one driven circular polarized radiating element and 2 horizontal parasitic elements per bay and a single vertical parasite that extends from ¼ wavelength above the top bay to ¼ wave length below the bottom antenna bay. The horizontal parasites are mounted with one ¼ wave above and below each of the antenna bays. 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 square self supporting tower that has a 21” face width at the top tower on a leg mounted support pole at a bearing of North 54.55 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 #49A 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 #49A. The actual measured pattern does not exceed the authorized FCC composite pattern at any azimuth.

Directional Antenna System
For
WMAS, Springfield, Massachusetts

(Continued)

A calculated vertical plane relative field pattern is shown on Figure #3 attached. The power in the maximum will reach 50 kilowatts (16.990 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 #49A 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 46 feet 7 inches with the antenna mounted near the top of the tower.

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.

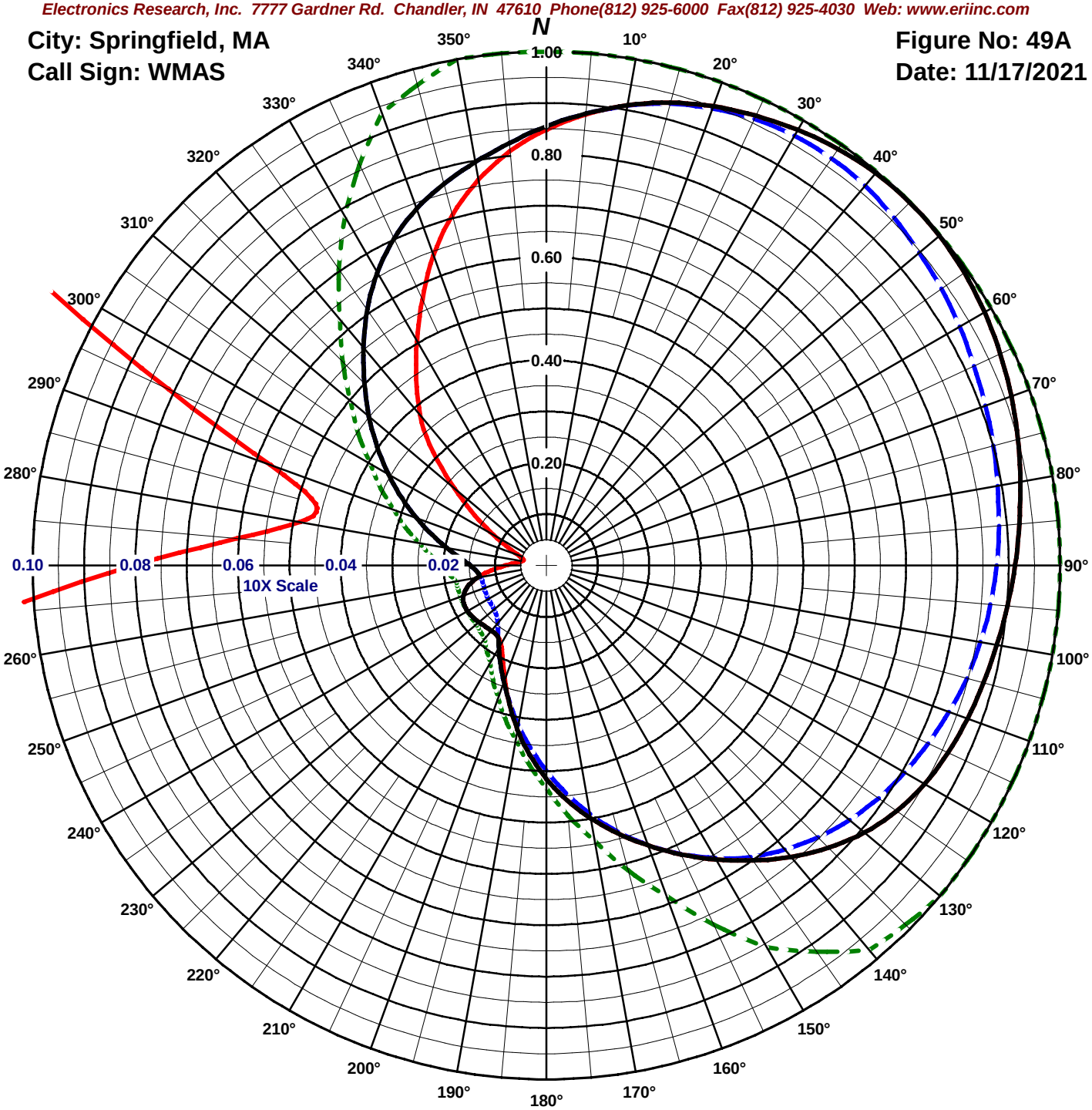
Dan Dowdle
Test Range Director ERI

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

City: Springfield, MA
Call Sign: WMAS

Figure No: 49A
Date: 11/17/2021



Antenna Orientation: 54.55° True

Frequency: 94.7 MHz
Antenna Type: MP-4E-DA

Antenna Mounting: 16" Ell
Tower Type: 21" Square SS

HORIZONTAL	VERTICAL	COMPOSITE	FCC ENVELOPE
RMS: .656	RMS: .656	RMS: .675	RMS: .755
Maximum: 1 @ 46°	Maximum: .967 @ 36°	Maximum: 1 @ 46°	Maximum: 1 @ 0°
Minimum: .046 @ 283°	Minimum: .128 @ 254°	Minimum: .132 @ 261°	Minimum: .178 @ 230°

Two-bay test. Leg mounted pole, stood off 16". Left-hand loops.

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# 49A | **Date: 11/17/2021**
Station: WMAS | **Antenna: MP-4E-DA**
Location: Springfield, MA | **Antenna Orientation: 54.55° True**
Frequency: 94.7 MHz | **Number of Bays: 4**

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.848	35.973	15.560	0.855	36.550	15.629	180°	0.415	8.618	9.354	0.400	7.988	9.024
5°	0.881	38.808	15.889	0.883	38.962	15.906	185°	0.370	6.848	8.356	0.356	6.338	8.019
10°	0.909	41.354	16.165	0.908	41.256	16.155	190°	0.324	5.251	7.203	0.315	4.956	6.951
15°	0.932	43.475	16.382	0.930	43.284	16.363	195°	0.279	3.888	5.897	0.276	3.809	5.808
20°	0.951	45.208	16.552	0.946	44.778	16.511	200°	0.237	2.801	4.474	0.241	2.912	4.642
25°	0.966	46.637	16.687	0.958	45.924	16.620	205°	0.201	2.020	3.053	0.211	2.222	3.467
30°	0.979	47.905	16.804	0.966	46.610	16.685	210°	0.177	1.565	1.944	0.185	1.708	2.325
35°	0.989	48.951	16.898	0.967	46.798	16.702	215°	0.167	1.392	1.436	0.163	1.335	1.255
40°	0.997	49.680	16.962	0.965	46.552	16.679	220°	0.166	1.377	1.388	0.147	1.083	0.345
45°	1.000	49.995	16.989	0.957	45.802	16.609	225°	0.168	1.411	1.494	0.137	0.944	-0.253
50°	0.998	49.833	16.975	0.947	44.880	16.521	230°	0.172	1.471	1.677	0.132	0.877	-0.572
55°	0.993	49.316	16.930	0.939	44.063	16.441	235°	0.175	1.532	1.851	0.131	0.859	-0.662
60°	0.985	48.512	16.859	0.929	43.166	16.351	240°	0.177	1.569	1.957	0.130	0.851	-0.702
65°	0.975	47.506	16.767	0.919	42.183	16.251	245°	0.177	1.573	1.967	0.130	0.839	-0.760
70°	0.963	46.377	16.663	0.910	41.361	16.166	250°	0.172	1.479	1.699	0.129	0.827	-0.825
75°	0.951	45.175	16.549	0.901	40.576	16.083	255°	0.159	1.257	0.995	0.128	0.824	-0.842
80°	0.937	43.872	16.422	0.892	39.761	15.995	260°	0.137	0.937	-0.285	0.130	0.841	-0.750
85°	0.924	42.683	16.303	0.884	39.088	15.920	265°	0.108	0.582	-2.354	0.136	0.922	-0.351
90°	0.912	41.603	16.191	0.877	38.413	15.845	270°	0.080	0.323	-4.905	0.148	1.092	0.381
95°	0.901	40.568	16.082	0.868	37.654	15.758	275°	0.060	0.183	-7.386	0.169	1.430	1.553
100°	0.890	39.628	15.980	0.858	36.814	15.660	280°	0.049	0.119	-9.254	0.196	1.928	2.851
105°	0.881	38.804	15.889	0.847	35.888	15.549	285°	0.047	0.108	-9.653	0.230	2.646	4.226
110°	0.872	38.013	15.799	0.834	34.787	15.414	290°	0.057	0.164	-7.858	0.268	3.592	5.554
115°	0.862	37.168	15.702	0.820	33.592	15.262	295°	0.081	0.330	-4.809	0.310	4.802	6.814
120°	0.850	36.121	15.578	0.805	32.418	15.108	300°	0.119	0.705	-1.518	0.355	6.300	7.993
125°	0.833	34.668	15.399	0.789	31.145	14.934	305°	0.170	1.437	1.576	0.402	8.062	9.064
130°	0.808	32.671	15.142	0.770	29.671	14.723	310°	0.234	2.732	4.364	0.451	10.154	10.067
135°	0.777	30.162	14.795	0.748	27.951	14.464	315°	0.311	4.845	6.853	0.501	12.532	10.980
140°	0.740	27.403	14.378	0.722	26.039	14.156	320°	0.382	7.300	8.633	0.553	15.311	11.850
145°	0.701	24.555	13.901	0.693	23.979	13.798	325°	0.442	9.753	9.891	0.608	18.476	12.666
150°	0.660	21.807	13.386	0.657	21.614	13.347	330°	0.504	12.695	11.036	0.658	21.640	13.352
155°	0.620	19.229	12.840	0.619	19.160	12.824	335°	0.571	16.326	12.129	0.702	24.614	13.912
160°	0.580	16.800	12.253	0.579	16.763	12.243	340°	0.643	20.646	13.148	0.738	27.265	14.356
165°	0.540	14.562	11.632	0.536	14.380	11.578	345°	0.706	24.955	13.972	0.769	29.567	14.708
170°	0.500	12.483	10.963	0.492	12.082	10.821	350°	0.762	29.045	14.631	0.797	31.776	15.021
175°	0.459	10.512	10.217	0.445	9.918	9.964	355°	0.809	32.760	15.153	0.825	34.038	15.320

Horizontal Polarization:
Maximum: 4.711 (6.731 dB)
Horizontal Plane: 4.711 (6.731 dB)
Maximum ERP: 50.000 kW

Vertical Polarization:
Maximum: 4.410 (6.444 dB)
Horizontal Plane: 4.410 (6.444 dB)
Maximum ERP: 46.801 kW

Total Input Power: 10.613 kW
Reference: WMAS49A.FIG
Two-bay test. Leg mounted pole, stood off 16". Left-hand loops.

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: 11/17/2021**
Station: WMAS **Antenna: MP-4E-DA**
Location: Springfield, MA **Antenna Orientation: 54.55° True**
Frequency: 94.7 MHz **Number of Bays: 4**

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.855	36.550	15.629	Vertical	180°	0.415	8.618	9.354	Horizontal
5°	0.883	38.962	15.906	Vertical	185°	0.370	6.848	8.356	Horizontal
10°	0.909	41.354	16.165	Horizontal	190°	0.324	5.251	7.203	Horizontal
15°	0.932	43.475	16.382	Horizontal	195°	0.279	3.888	5.897	Horizontal
20°	0.951	45.208	16.552	Horizontal	200°	0.241	2.912	4.642	Vertical
25°	0.966	46.637	16.687	Horizontal	205°	0.211	2.222	3.467	Vertical
30°	0.979	47.905	16.804	Horizontal	210°	0.185	1.708	2.325	Vertical
35°	0.989	48.951	16.898	Horizontal	215°	0.167	1.392	1.436	Horizontal
40°	0.997	49.680	16.962	Horizontal	220°	0.166	1.377	1.388	Horizontal
45°	1.000	49.995	16.989	Horizontal	225°	0.168	1.411	1.494	Horizontal
50°	0.998	49.833	16.975	Horizontal	230°	0.172	1.471	1.677	Horizontal
55°	0.993	49.316	16.930	Horizontal	235°	0.175	1.532	1.851	Horizontal
60°	0.985	48.512	16.859	Horizontal	240°	0.177	1.569	1.957	Horizontal
65°	0.975	47.506	16.767	Horizontal	245°	0.177	1.573	1.967	Horizontal
70°	0.963	46.377	16.663	Horizontal	250°	0.172	1.479	1.699	Horizontal
75°	0.951	45.175	16.549	Horizontal	255°	0.159	1.257	0.995	Horizontal
80°	0.937	43.872	16.422	Horizontal	260°	0.137	0.937	-0.285	Horizontal
85°	0.924	42.683	16.303	Horizontal	265°	0.136	0.922	-0.351	Vertical
90°	0.912	41.603	16.191	Horizontal	270°	0.148	1.092	0.381	Vertical
95°	0.901	40.568	16.082	Horizontal	275°	0.169	1.430	1.553	Vertical
100°	0.890	39.628	15.980	Horizontal	280°	0.196	1.928	2.851	Vertical
105°	0.881	38.804	15.889	Horizontal	285°	0.230	2.646	4.226	Vertical
110°	0.872	38.013	15.799	Horizontal	290°	0.268	3.592	5.554	Vertical
115°	0.862	37.168	15.702	Horizontal	295°	0.310	4.802	6.814	Vertical
120°	0.850	36.121	15.578	Horizontal	300°	0.355	6.300	7.993	Vertical
125°	0.833	34.668	15.399	Horizontal	305°	0.402	8.062	9.064	Vertical
130°	0.808	32.671	15.142	Horizontal	310°	0.451	10.154	10.067	Vertical
135°	0.777	30.162	14.795	Horizontal	315°	0.501	12.532	10.980	Vertical
140°	0.740	27.403	14.378	Horizontal	320°	0.553	15.311	11.850	Vertical
145°	0.701	24.555	13.901	Horizontal	325°	0.608	18.476	12.666	Vertical
150°	0.660	21.807	13.386	Horizontal	330°	0.658	21.640	13.352	Vertical
155°	0.620	19.229	12.840	Horizontal	335°	0.702	24.614	13.912	Vertical
160°	0.580	16.800	12.253	Horizontal	340°	0.738	27.265	14.356	Vertical
165°	0.540	14.562	11.632	Horizontal	345°	0.769	29.567	14.708	Vertical
170°	0.500	12.483	10.963	Horizontal	350°	0.797	31.776	15.021	Vertical
175°	0.459	10.512	10.217	Horizontal	355°	0.825	34.038	15.320	Vertical

Horizontal Polarization:
Maximum: 4.711 (6.731 dB)
Horizontal Plane: 4.711 (6.731 dB)
Maximum ERP: 50.000 kW

Vertical Polarization:
Maximum: 4.410 (6.444 dB)
Horizontal Plane: 4.410 (6.444 dB)
Maximum ERP: 46.801 kW

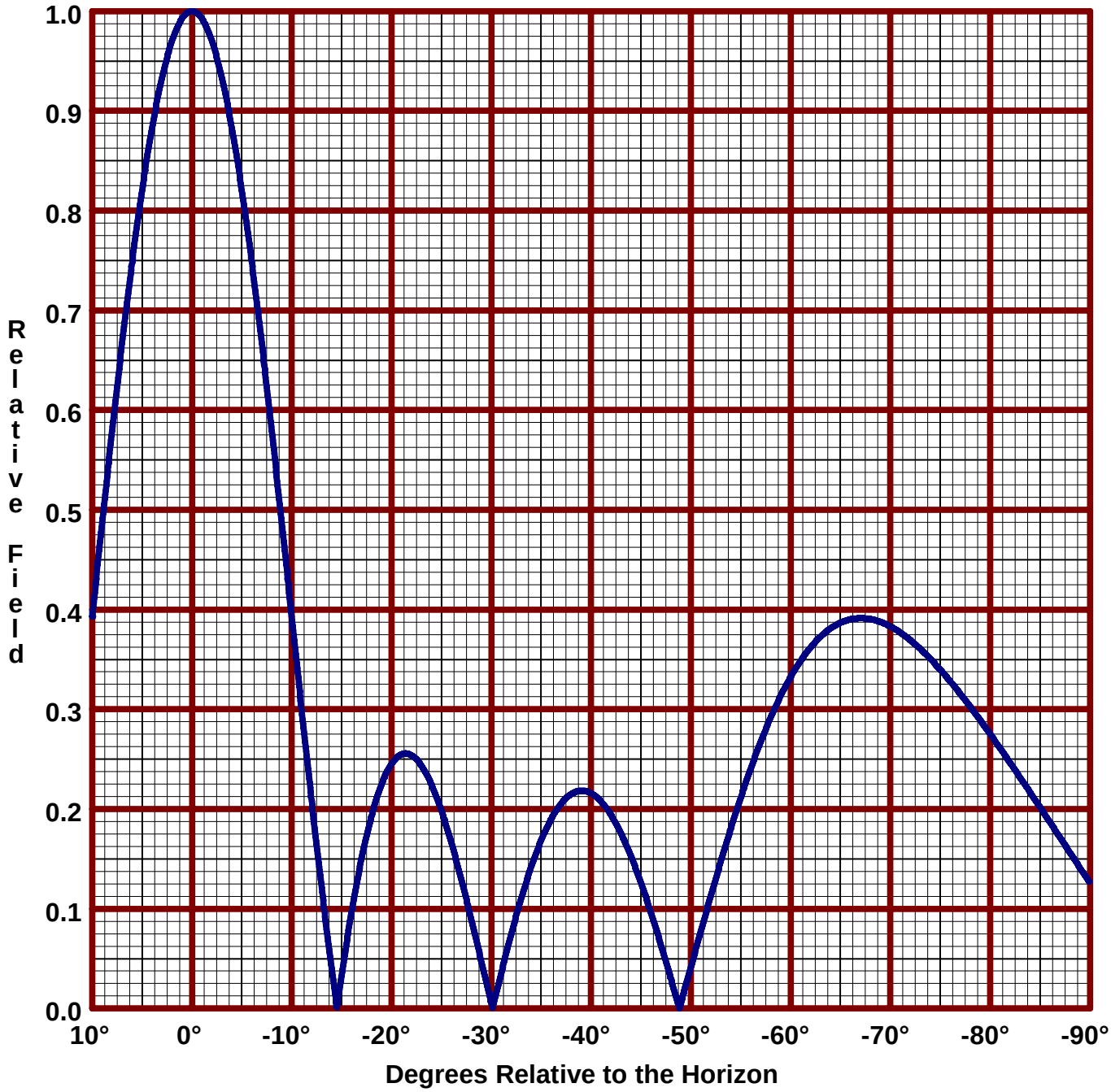
Total Input Power: 10.613 kW
Reference: WMAS49A.FIG
Two-bay test. Leg mounted pole, stood off 16". Left-hand loops.

ERI® Vertical 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 No: 3
Call Sign: WMAS
Location: Springfield, MA
Frequency: 94.7 MHz
Antenna: 4 bay MP-4E-DA

Date: 11/17/2021
H/V Power Ratio: 1
1 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 4.711 (6.731 dB)
Horizontal Plane: 4.711 (6.731 dB)
Maximum ERP: 50.000 kW

Vertical Polarization:
Maximum: 4.410 (6.444 dB)
Horizontal Plane: 4.410 (6.444 dB)
Maximum ERP: 46.801 kW

Two-bay test. Leg mounted pole, stood off 16". Left-hand loops.

Directional Antenna System
for
WMAS, Springfield, Massachusetts

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	MP-4E-DA
Frequency:	94.7 MHz
Number of Bays:	Four

MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	39 ft 6 in
Aperture length required:	46 ft 7 in
Orientation:	54.55° true

Input flange to the antenna 3-1/8-inch EIA, 50-ohm.

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum Horizontal ERP:	50.000 kW (16.990 dBk)
Horizontal Maximum Power Gain:	4.711 (6.731 dB)
Horizontal H Plane Power Gain:	4.711 (6.731 dB)
Maximum Vertical ERP:	46.801 kW (16.703 dBk)
Vertical Maximum Power Gain:	4.410 (6.444 dB)
Vertical H Plane Power Gain:	4.410 (6.444 dB)
Total input power:	10.613 kW (10.258 dBk)