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 WJMJ, Hartford, Connecticut

April 23, 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 WJMJ.

The antenna is the ERI model 1193-1CP-DA configuration. The circular polarized system consists of one level using three driven circular polarized radiating element attached to three passive panels. The antenna was mounted on the North 339 degrees East tower face with bracketry to provide an antenna orientation of North 347 degrees East. The antenna was tested on a 12' face tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 88.9 megahertz, which is the center of the FM broadcast channel assigned to WJMJ.

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
WJMJ, Hartford, Connecticut

(Continued)

DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of a full-scale model of the complete 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 12' 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.

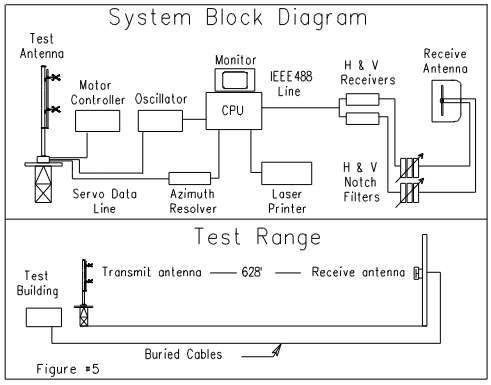

Figure #5

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 88.9 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.

(Continued)

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 one level using three driven circular polarized radiating element attached to three passive panels. 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 1193-1CP-DA array is to be mounted on the North 339 degrees East tower face of the 12' face tower at a bearing of North 347 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.

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 2.3 kilowatts (3.617 dBk).

The power at North 190-200 degrees East does not exceed 0.075 kilowatts (-11.249 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 that 85% of the filed composite pattern.

The clear vertical length of the structure required to support the antenna is 20 feet.

(Continued)

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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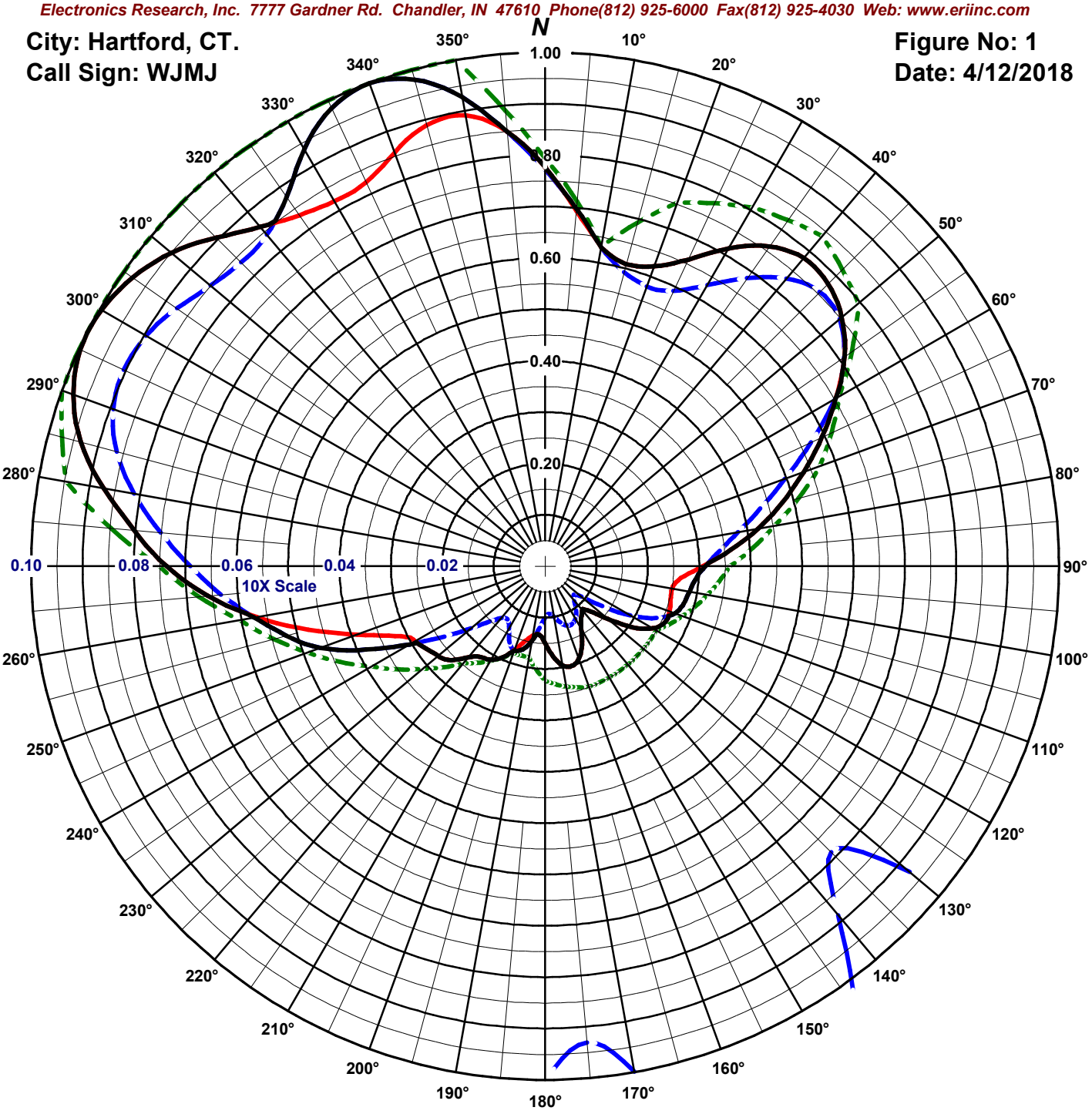
City: Hartford, CT.
Call Sign: WJMJ

Figure No: 1
Date: 4/12/2018



Antenna Orientation: 347° True

Frequency: 88.9 MHz
Antenna Type: 1193-1CP-DA

Antenna Mounting: Custom
Tower Type: 12' Tower

HORIZONTAL	VERTICAL	COMPOSITE	FCC ENVELOPE
RMS: .584	RMS: .569	RMS: .599	RMS: .639
Maximum: 1 @ 297°	Maximum: 1 @ 340°	Maximum: 1 @ 297°	Maximum: 1 @ 290°
Minimum: .111 @ 139°	Minimum: .079 @ 135°	Minimum: .111 @ 139°	Minimum: .18 @ 190°

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-20170831AAU.

ERI® Horizontal Plane Relative Field Pattern

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Figure# 1 **Date: 4/12/2018**
Station: WJMJ **Antenna: 1193-1CP-DA**
Location: Hartford, CT. **Antenna Orientation: 347° True**
Frequency: 88.9 MHz **Number of Bays: 1**

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.777	1.388	1.425	Horizontal	180°	0.150	0.052	-12.860	Horizontal
5°	0.699	1.122	0.502	Vertical	185°	0.134	0.041	-13.852	Horizontal
10°	0.630	0.914	-0.390	Horizontal	190°	0.148	0.050	-12.989	Vertical
15°	0.609	0.853	-0.693	Horizontal	195°	0.167	0.064	-11.906	Vertical
20°	0.621	0.888	-0.518	Horizontal	200°	0.174	0.070	-11.556	Vertical
25°	0.658	0.997	-0.012	Horizontal	205°	0.196	0.088	-10.539	Horizontal
30°	0.714	1.174	0.696	Horizontal	210°	0.210	0.101	-9.936	Horizontal
35°	0.760	1.328	1.234	Horizontal	215°	0.216	0.108	-9.679	Horizontal
40°	0.783	1.410	1.491	Horizontal	220°	0.231	0.123	-9.103	Horizontal
45°	0.778	1.393	1.440	Horizontal	225°	0.258	0.154	-8.135	Horizontal
50°	0.754	1.306	1.160	Horizontal	230°	0.272	0.170	-7.691	Horizontal
55°	0.711	1.163	0.655	Horizontal	235°	0.281	0.181	-7.412	Horizontal
60°	0.653	0.981	-0.082	Horizontal	240°	0.304	0.213	-6.725	Vertical
65°	0.595	0.814	-0.896	Horizontal	245°	0.384	0.340	-4.690	Vertical
70°	0.535	0.658	-1.815	Horizontal	250°	0.465	0.497	-3.034	Vertical
75°	0.478	0.525	-2.802	Horizontal	255°	0.521	0.625	-2.038	Vertical
80°	0.421	0.408	-3.894	Horizontal	260°	0.575	0.760	-1.190	Vertical
85°	0.363	0.303	-5.188	Horizontal	265°	0.659	0.999	-0.005	Horizontal
90°	0.312	0.223	-6.512	Vertical	270°	0.737	1.249	0.964	Horizontal
95°	0.293	0.198	-7.032	Vertical	275°	0.802	1.481	1.705	Horizontal
100°	0.285	0.187	-7.281	Vertical	280°	0.871	1.745	2.419	Horizontal
105°	0.280	0.180	-7.455	Vertical	285°	0.935	2.011	3.035	Horizontal
110°	0.268	0.165	-7.815	Vertical	290°	0.977	2.194	3.413	Horizontal
115°	0.258	0.153	-8.156	Horizontal	295°	0.998	2.289	3.596	Horizontal
120°	0.242	0.135	-8.708	Horizontal	300°	0.997	2.285	3.588	Horizontal
125°	0.207	0.098	-10.074	Horizontal	305°	0.980	2.208	3.440	Horizontal
130°	0.160	0.059	-12.326	Horizontal	310°	0.949	2.071	3.162	Horizontal
135°	0.125	0.036	-14.457	Horizontal	315°	0.904	1.880	2.742	Horizontal
140°	0.112	0.029	-15.391	Horizontal	320°	0.862	1.709	2.328	Horizontal
145°	0.122	0.034	-14.631	Horizontal	325°	0.877	1.770	2.480	Vertical
150°	0.140	0.045	-13.434	Horizontal	330°	0.937	2.020	3.053	Vertical
155°	0.169	0.066	-11.802	Horizontal	335°	0.983	2.223	3.470	Vertical
160°	0.192	0.085	-10.716	Horizontal	340°	1.000	2.300	3.617	Vertical
165°	0.201	0.093	-10.321	Horizontal	345°	0.980	2.211	3.446	Vertical
170°	0.196	0.088	-10.540	Horizontal	350°	0.927	1.976	2.959	Vertical
175°	0.176	0.072	-11.451	Horizontal	355°	0.850	1.660	2.202	Vertical

Horizontal Polarization:
Maximum: 1.317 (1.196 dB)
Horizontal Plane: 1.317 (1.196 dB)
Maximum ERP: 2.300 kW

Vertical Polarization:
Maximum: 1.317 (1.196 dB)
Horizontal Plane: 1.317 (1.196 dB)
Maximum ERP: 2.300 kW

Total Input Power: 1.746 kW
Reference: WJMJ1M.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: 4/12/2018**
Station: WJMJ | **Antenna: 1193-1CP-DA**
Location: Hartford, CT. | **Antenna Orientation: 347° True**
Frequency: 88.9 MHz | **Number of Bays: 1**

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.777	1.388	1.425	0.772	1.371	1.370	180°	0.150	0.052	-12.860	0.100	0.023	-16.360
5°	0.695	1.111	0.456	0.699	1.122	0.502	185°	0.134	0.041	-13.852	0.120	0.033	-14.786
10°	0.630	0.914	-0.390	0.630	0.914	-0.391	190°	0.137	0.043	-13.629	0.148	0.050	-12.989
15°	0.609	0.853	-0.693	0.593	0.809	-0.922	195°	0.151	0.053	-12.783	0.167	0.064	-11.906
20°	0.621	0.888	-0.518	0.580	0.772	-1.121	200°	0.174	0.070	-11.577	0.174	0.070	-11.556
25°	0.658	0.997	-0.012	0.591	0.804	-0.947	205°	0.196	0.088	-10.539	0.164	0.062	-12.100
30°	0.714	1.174	0.696	0.632	0.918	-0.371	210°	0.210	0.101	-9.936	0.140	0.045	-13.443
35°	0.760	1.328	1.234	0.685	1.078	0.327	215°	0.216	0.108	-9.679	0.127	0.037	-14.324
40°	0.783	1.410	1.491	0.731	1.229	0.894	220°	0.231	0.123	-9.103	0.132	0.040	-13.992
45°	0.778	1.393	1.440	0.756	1.313	1.183	225°	0.258	0.154	-8.135	0.152	0.053	-12.722
50°	0.754	1.306	1.160	0.748	1.287	1.095	230°	0.272	0.170	-7.691	0.188	0.081	-10.896
55°	0.711	1.163	0.655	0.710	1.160	0.644	235°	0.281	0.181	-7.412	0.239	0.131	-8.829
60°	0.653	0.981	-0.082	0.652	0.976	-0.104	240°	0.292	0.196	-7.067	0.304	0.213	-6.725
65°	0.595	0.814	-0.896	0.571	0.751	-1.245	245°	0.322	0.238	-6.239	0.384	0.340	-4.690
70°	0.535	0.658	-1.815	0.497	0.568	-2.455	250°	0.390	0.349	-4.569	0.465	0.497	-3.034
75°	0.478	0.525	-2.802	0.434	0.433	-3.639	255°	0.477	0.522	-2.820	0.521	0.625	-2.038
80°	0.421	0.408	-3.894	0.382	0.335	-4.749	260°	0.570	0.749	-1.258	0.575	0.760	-1.190
85°	0.363	0.303	-5.188	0.341	0.267	-5.729	265°	0.659	0.999	-0.005	0.633	0.921	-0.357
90°	0.307	0.217	-6.644	0.312	0.223	-6.512	270°	0.737	1.249	0.964	0.691	1.097	0.403
95°	0.265	0.162	-7.903	0.293	0.198	-7.032	275°	0.802	1.481	1.705	0.751	1.297	1.130
100°	0.251	0.145	-8.386	0.285	0.187	-7.281	280°	0.871	1.745	2.419	0.812	1.515	1.805
105°	0.253	0.147	-8.329	0.280	0.180	-7.455	285°	0.935	2.011	3.035	0.863	1.711	2.333
110°	0.258	0.153	-8.158	0.268	0.165	-7.815	290°	0.977	2.194	3.413	0.894	1.840	2.648
115°	0.258	0.153	-8.156	0.239	0.131	-8.818	295°	0.998	2.289	3.596	0.904	1.880	2.742
120°	0.242	0.135	-8.708	0.191	0.084	-10.747	300°	0.997	2.285	3.588	0.896	1.848	2.667
125°	0.207	0.098	-10.074	0.136	0.042	-13.718	305°	0.980	2.208	3.440	0.875	1.760	2.456
130°	0.160	0.059	-12.326	0.093	0.020	-17.051	310°	0.949	2.071	3.162	0.850	1.660	2.202
135°	0.125	0.036	-14.457	0.079	0.014	-18.464	315°	0.904	1.880	2.742	0.836	1.608	2.064
140°	0.112	0.029	-15.391	0.089	0.018	-17.427	320°	0.862	1.709	2.328	0.842	1.632	2.126
145°	0.122	0.034	-14.631	0.105	0.025	-15.954	325°	0.834	1.600	2.041	0.877	1.770	2.480
150°	0.140	0.045	-13.434	0.118	0.032	-14.938	330°	0.820	1.546	1.893	0.937	2.020	3.053
155°	0.169	0.066	-11.802	0.124	0.036	-14.498	335°	0.825	1.564	1.943	0.983	2.223	3.470
160°	0.192	0.085	-10.716	0.123	0.035	-14.605	340°	0.857	1.688	2.274	1.000	2.300	3.617
165°	0.201	0.093	-10.321	0.113	0.029	-15.302	345°	0.889	1.816	2.592	0.980	2.211	3.446
170°	0.196	0.088	-10.540	0.100	0.023	-16.392	350°	0.891	1.825	2.612	0.927	1.976	2.959
175°	0.176	0.072	-11.451	0.093	0.020	-17.003	355°	0.850	1.660	2.201	0.850	1.660	2.202

Horizontal Polarization:
Maximum: 1.317 (1.196 dB)
Horizontal Plane: 1.317 (1.196 dB)
Maximum ERP: 2.300 kW

Vertical Polarization:
Maximum: 1.317 (1.196 dB)
Horizontal Plane: 1.317 (1.196 dB)
Maximum ERP: 2.300 kW

Total Input Power: 1.746 kW
Reference: WJMJ1M.FIG
This list shows the azimuth values for the horizontal and vertical components.

Vertical Plane Relative Field Pattern

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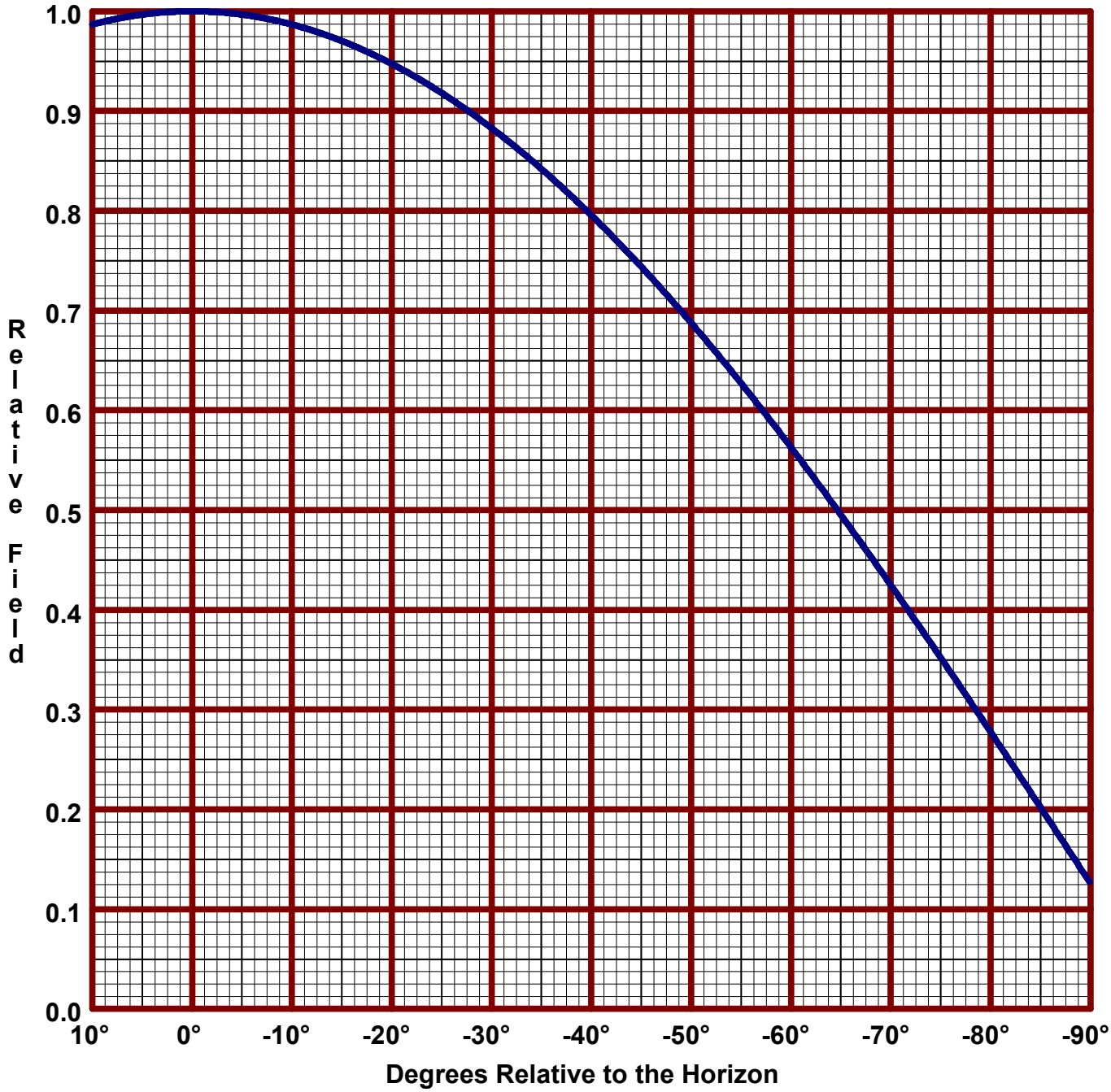
Figure No: 3
Call Sign: WJMJ
Location: Hartford, CT.
Frequency: 88.9 MHz
Antenna: 1 bay 1193-1CP-DA

Date: 4/12/2018
H/V Power Ratio: 1
1 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 1.317 (1.196 dB)
Horizontal Plane: 1.317 (1.196 dB)
Maximum ERP: 2.300 kW

Vertical Polarization:
Maximum: 1.317 (1.196 dB)
Horizontal Plane: 1.317 (1.196 dB)
Maximum ERP: 2.300 kW

Directional Antenna System
for
WJMJ, Hartford, Connecticut

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	1193-1CP-DA
Frequency:	88.9 MHz
Number of Bays:	One

MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	6’
Aperture length required:	20’
Orientation:	347° true

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

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	2.300 kW (3.617 dBk)
Horizontal maximum power gain:	1.317 (1.196 dB)
Maximum vertical ERP:	2.300 kW (3.617 dBk)
Vertical maximum power gain:	1.317 (1.196 dB)
Total input power:	1.746 kW (2.420 dBk