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 KBAQ, Phoenix, Arizona

November 14, 2016

Electronics Research Inc. is providing modifications to an existing directional antenna to meet the FCC requirements and the general needs of radio station KBAQ.

The antenna is the ERI model MP-10C-DA-HW-SP configuration. The circular polarized system consists of 10 half-wavelength spaced bays using one driven circular polarized radiating element per bay and three horizontal parasitic elements per bay. The antenna was mounted on the North 359 degrees East tower leg with bracketry to provide an antenna orientation of North 351 degrees East. The antenna was tested on a 60" face tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 89.5 megahertz, which is the center of the FM broadcast channel assigned to KBAQ. The system includes –0.585 degrees of beam tilt.

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
KBAQ, Phoenix, Arizona

(Continued)

DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of two bay levels of the circular polarized system with the associated horizontal 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 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 60" 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.

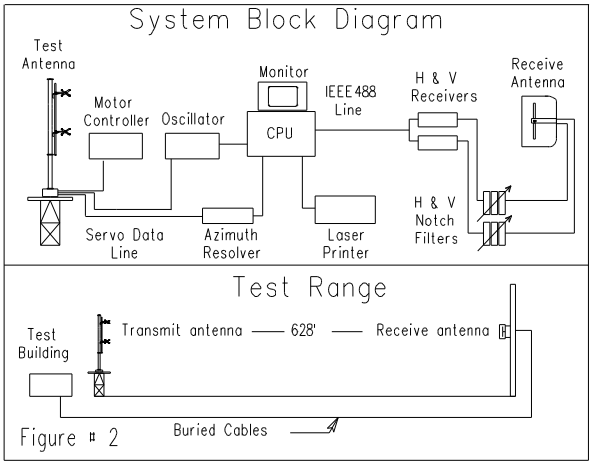

Figure # 2

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

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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 10 half-wavelength spaced bays using one driven circular polarized radiating element per bay and three horizontal parasitic elements 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.

The MP-10C-DA-HW-SP array is to be mounted on the North 359 degrees East tower leg of the 60" face tower at a bearing of North 351 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 30 kilowatts (14.771 dBk).

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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 69 ft 3 in.

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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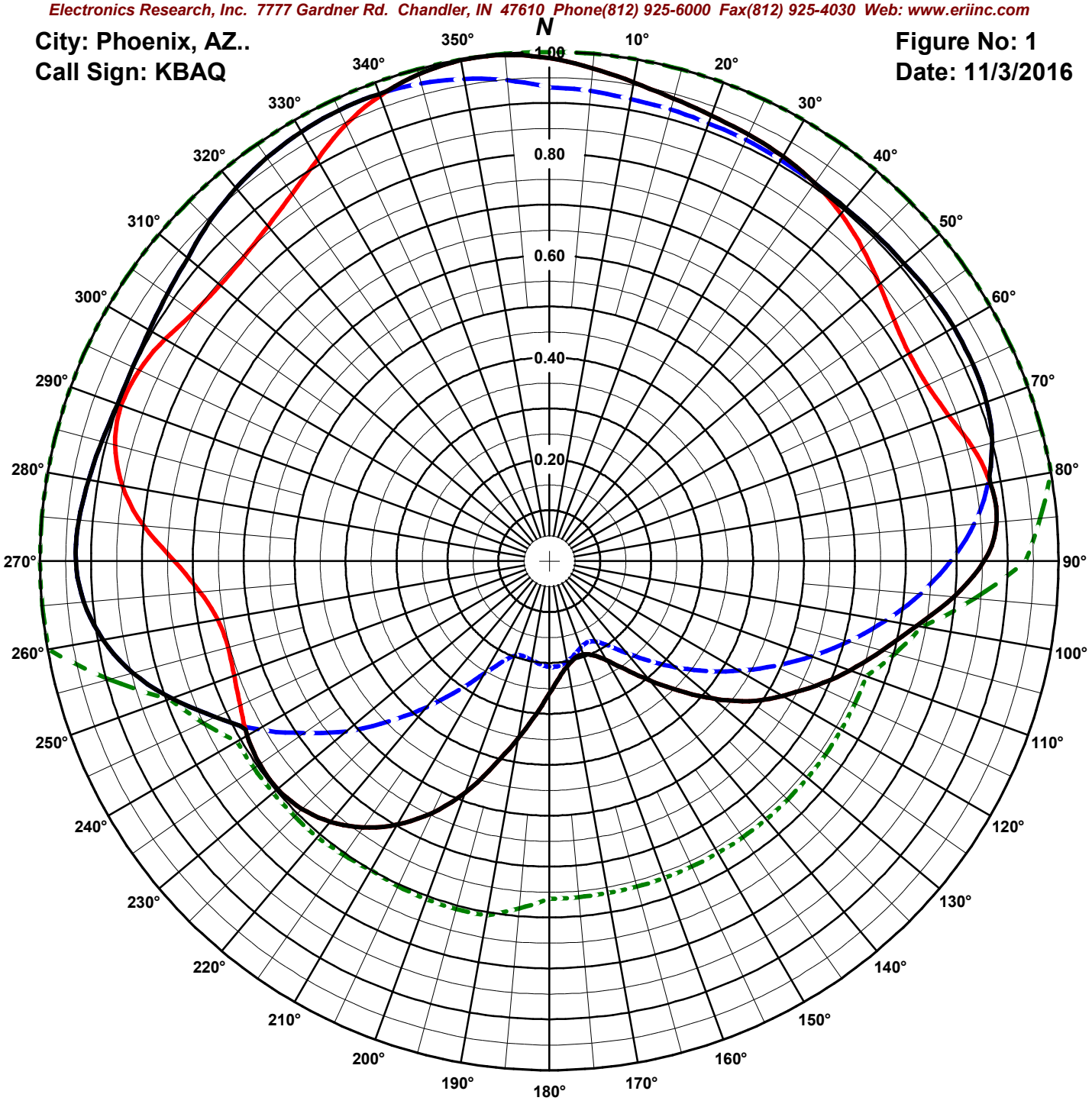
City: Phoenix, AZ..
Call Sign: KBAQ

Figure No: 1
Date: 11/3/2016



Antenna Orientation: 351° True

Frequency: 89.5 MHz
Antenna Type: MP-10AC-DA-HW-SP

Antenna Mounting: Custom
Tower Type: 5' Tower

HORIZONTAL	VERTICAL	COMPOSITE	FCC ENVELOPE
RMS: .74	RMS: .74	RMS: .776	RMS: .875
Maximum: 1 @ 352°	Maximum: .977 @ 337°	Maximum: 1 @ 352°	Maximum: 1 @ 0°
Minimum: .195 @ 162°	Minimum: .176 @ 155°	Minimum: .195 @ 162°	Minimum: .662 @ 110°

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-20160909ABG.

ERI® Horizontal Plane Relative Field Pattern

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Figure# 1 **Date: 11/2/2016**
Station: KBAQ **Antenna: MP-10AC-DA-HW-SP**
Location: Phoenix, AZ.. **Antenna Orientation: 351° True**
Frequency: 89.5 MHz **Number of Bays: 10**

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.988	29.270	14.664	Horizontal	180°	0.260	2.033	3.081	Horizontal
5°	0.972	28.331	14.523	Horizontal	185°	0.302	2.739	4.376	Horizontal
10°	0.955	27.354	14.370	Horizontal	190°	0.354	3.751	5.742	Horizontal
15°	0.941	26.557	14.242	Horizontal	195°	0.414	5.154	7.122	Horizontal
20°	0.931	26.013	14.152	Horizontal	200°	0.484	7.034	8.472	Horizontal
25°	0.925	25.645	14.090	Horizontal	205°	0.546	8.952	9.519	Horizontal
30°	0.918	25.268	14.026	Horizontal	210°	0.598	10.718	10.301	Horizontal
35°	0.907	24.686	13.925	Horizontal	215°	0.638	12.229	10.874	Horizontal
40°	0.905	24.591	13.908	Vertical	220°	0.668	13.406	11.273	Horizontal
45°	0.907	24.673	13.922	Vertical	225°	0.688	14.192	11.520	Horizontal
50°	0.909	24.790	13.943	Vertical	230°	0.696	14.545	11.627	Horizontal
55°	0.914	25.069	13.991	Vertical	235°	0.694	14.464	11.603	Horizontal
60°	0.918	25.274	14.027	Vertical	240°	0.685	14.074	11.484	Horizontal
65°	0.917	25.234	14.020	Vertical	245°	0.724	15.734	11.968	Vertical
70°	0.914	25.042	13.987	Vertical	250°	0.789	18.660	12.709	Vertical
75°	0.900	24.305	13.857	Vertical	255°	0.847	21.517	13.328	Vertical
80°	0.879	23.200	13.655	Horizontal	260°	0.890	23.753	13.757	Vertical
85°	0.882	23.333	13.680	Horizontal	265°	0.917	25.249	14.022	Vertical
90°	0.854	21.866	13.398	Horizontal	270°	0.930	25.928	14.138	Vertical
95°	0.798	19.086	12.807	Horizontal	275°	0.927	25.790	14.115	Vertical
100°	0.733	16.097	12.068	Horizontal	280°	0.919	25.315	14.034	Vertical
105°	0.677	13.754	11.384	Horizontal	285°	0.910	24.821	13.948	Vertical
110°	0.628	11.832	10.731	Horizontal	290°	0.902	24.431	13.879	Vertical
115°	0.578	10.029	10.012	Horizontal	295°	0.902	24.409	13.876	Vertical
120°	0.529	8.406	9.246	Horizontal	300°	0.906	24.646	13.918	Vertical
125°	0.479	6.892	8.383	Horizontal	305°	0.916	25.151	14.005	Vertical
130°	0.420	5.294	7.238	Horizontal	310°	0.926	25.745	14.107	Vertical
135°	0.360	3.892	5.902	Horizontal	315°	0.943	26.692	14.264	Vertical
140°	0.305	2.799	4.470	Horizontal	320°	0.957	27.461	14.387	Vertical
145°	0.259	2.018	3.049	Horizontal	325°	0.967	28.046	14.479	Vertical
150°	0.225	1.520	1.819	Horizontal	330°	0.974	28.439	14.539	Vertical
155°	0.204	1.247	0.960	Horizontal	335°	0.977	28.636	14.569	Vertical
160°	0.195	1.141	0.572	Horizontal	340°	0.976	28.599	14.564	Vertical
165°	0.197	1.163	0.654	Horizontal	345°	0.990	29.405	14.684	Horizontal
170°	0.208	1.301	1.143	Horizontal	350°	0.999	29.936	14.762	Horizontal
175°	0.229	1.575	1.973	Horizontal	355°	0.998	29.877	14.753	Horizontal

Horizontal Polarization:
Maximum: 5.418 (7.338 dB)
Horizontal Plane: 5.371 (7.248 dB)
Maximum ERP: 30.000 kW

Vertical Polarization:
Maximum: 5.176 (7.140 dB)
Horizontal Plane: 5.131 (7.102 dB)
Maximum ERP: 28.660 kW

Total Input Power: 5.538 kW
Reference: KBAQ1M.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: 11/2/2016**
Station: KBAQ **Antenna: MP-10AC-DA-HW-SP**
Location: Phoenix, AZ.. **Antenna Orientation: 351° True**
Frequency: 89.5 MHz **Number of Bays: 10**

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.988	29.270	14.664	0.930	25.945	14.141	180°	0.260	2.033	3.081	0.208	1.294	1.119
5°	0.972	28.331	14.523	0.927	25.783	14.113	185°	0.302	2.739	4.376	0.204	1.243	0.945
10°	0.955	27.354	14.370	0.922	25.476	14.061	190°	0.354	3.751	5.742	0.198	1.173	0.692
15°	0.941	26.557	14.242	0.919	25.317	14.034	195°	0.414	5.154	7.122	0.193	1.120	0.491
20°	0.931	26.013	14.152	0.915	25.101	13.997	200°	0.484	7.034	8.472	0.198	1.175	0.699
25°	0.925	25.645	14.090	0.913	25.028	13.984	205°	0.546	8.952	9.519	0.218	1.432	1.560
30°	0.918	25.268	14.026	0.910	24.822	13.948	210°	0.598	10.718	10.301	0.255	1.945	2.889
35°	0.907	24.686	13.925	0.907	24.682	13.924	215°	0.638	12.229	10.874	0.309	2.872	4.581
40°	0.891	23.809	13.767	0.905	24.591	13.908	220°	0.668	13.406	11.273	0.374	4.200	6.232
45°	0.870	22.685	13.557	0.907	24.673	13.922	225°	0.688	14.192	11.520	0.446	5.955	7.749
50°	0.846	21.481	13.321	0.909	24.790	13.943	230°	0.696	14.545	11.627	0.521	8.140	9.106
55°	0.826	20.479	13.113	0.914	25.069	13.991	235°	0.694	14.464	11.603	0.589	10.392	10.167
60°	0.816	19.972	13.004	0.918	25.274	14.027	240°	0.685	14.074	11.484	0.660	13.080	11.166
65°	0.819	20.107	13.034	0.917	25.234	14.020	245°	0.670	13.469	11.293	0.724	15.734	11.968
70°	0.835	20.914	13.204	0.914	25.042	13.987	250°	0.658	12.995	11.138	0.789	18.660	12.709
75°	0.861	22.233	13.470	0.900	24.305	13.857	255°	0.653	12.789	11.069	0.847	21.517	13.328
80°	0.879	23.200	13.655	0.875	22.945	13.607	260°	0.661	13.109	11.176	0.890	23.753	13.757
85°	0.882	23.333	13.680	0.838	21.055	13.233	265°	0.689	14.226	11.531	0.917	25.249	14.022
90°	0.854	21.866	13.398	0.788	18.648	12.706	270°	0.736	16.248	12.108	0.930	25.928	14.138
95°	0.798	19.086	12.807	0.732	16.079	12.063	275°	0.800	19.191	12.831	0.927	25.790	14.115
100°	0.733	16.097	12.068	0.671	13.504	11.305	280°	0.851	21.730	13.371	0.919	25.315	14.034
105°	0.677	13.754	11.384	0.609	11.133	10.466	285°	0.883	23.370	13.687	0.910	24.821	13.948
110°	0.628	11.832	10.731	0.548	9.001	9.543	290°	0.894	24.001	13.802	0.902	24.431	13.879
115°	0.578	10.029	10.012	0.488	7.135	8.534	295°	0.888	23.660	13.740	0.902	24.409	13.876
120°	0.529	8.406	9.246	0.431	5.563	7.453	300°	0.871	22.763	13.572	0.906	24.646	13.918
125°	0.479	6.892	8.383	0.377	4.254	6.288	305°	0.852	21.780	13.381	0.916	25.151	14.005
130°	0.420	5.294	7.238	0.325	3.164	5.002	310°	0.844	21.347	13.293	0.926	25.745	14.107
135°	0.360	3.892	5.902	0.277	2.306	3.629	315°	0.847	21.506	13.326	0.943	26.692	14.264
140°	0.305	2.799	4.470	0.235	1.655	2.188	320°	0.859	22.144	13.453	0.957	27.461	14.387
145°	0.259	2.018	3.049	0.203	1.233	0.908	325°	0.880	23.258	13.666	0.967	28.046	14.479
150°	0.225	1.520	1.819	0.182	0.998	-0.009	330°	0.911	24.884	13.959	0.974	28.439	14.539
155°	0.204	1.247	0.960	0.176	0.927	-0.330	335°	0.946	26.822	14.285	0.977	28.636	14.569
160°	0.195	1.141	0.572	0.181	0.981	-0.082	340°	0.972	28.357	14.527	0.976	28.599	14.564
165°	0.197	1.163	0.654	0.190	1.084	0.351	345°	0.990	29.405	14.684	0.971	28.298	14.518
170°	0.208	1.301	1.143	0.200	1.198	0.784	350°	0.999	29.936	14.762	0.962	27.750	14.433
175°	0.229	1.575	1.973	0.207	1.284	1.086	355°	0.998	29.877	14.753	0.948	26.962	14.308

Horizontal Polarization:
Maximum: 5.418 (7.338 dB))
Horizontal Plane: 5.371 (7.248 dB)
Maximum ERP: 30.000 kW

Vertical Polarization:
Maximum: 5.176 (7.140 dB)
Horizontal Plane: 5.131 (7.102 dB)
Maximum ERP: 28.660 kW

Total Input Power: 5.538 kW
Reference: KBAQ1M.FIG
This list shows the azimuth values for the horizontal and vertical components.

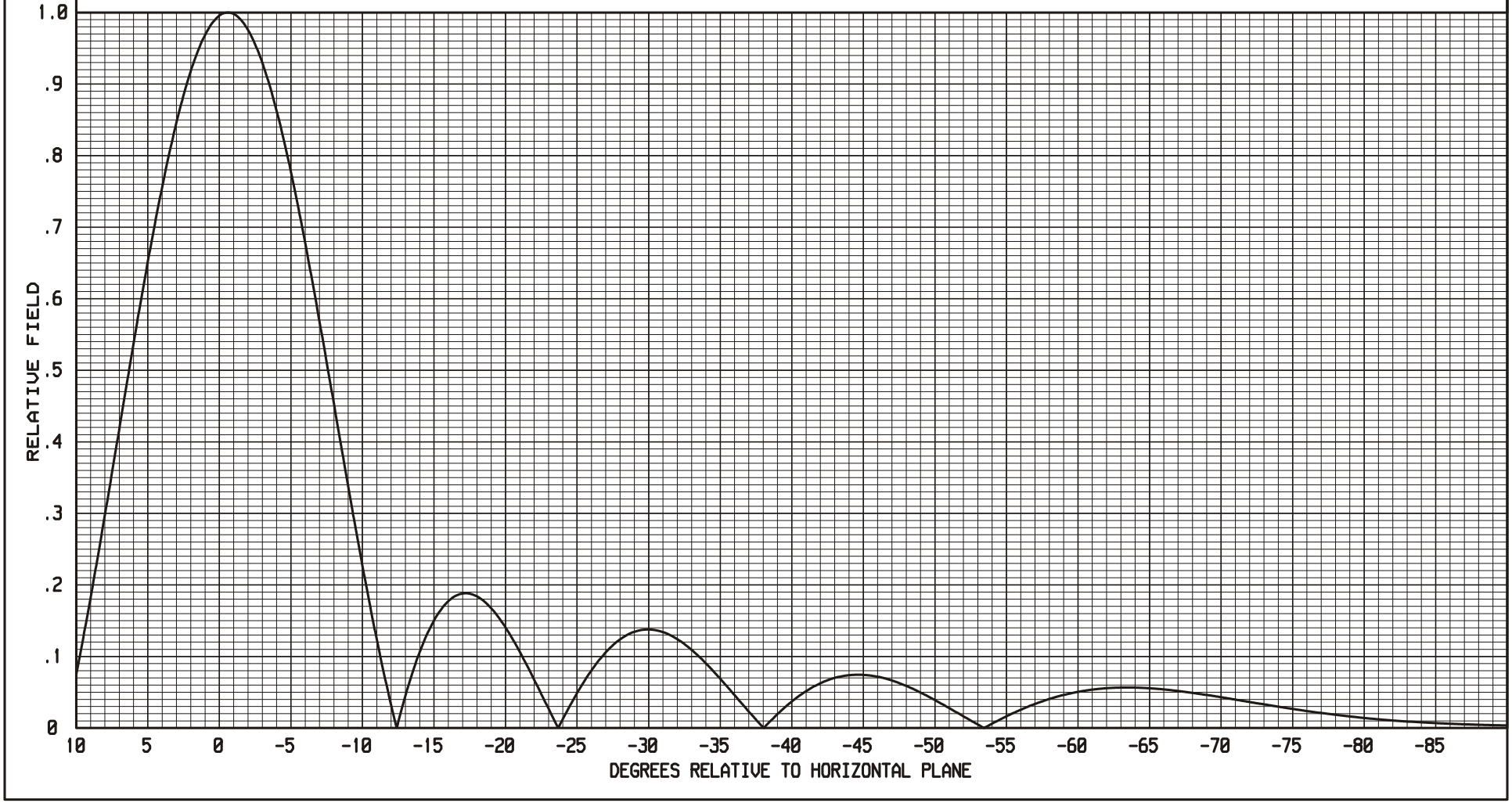
ELECTRONICS RESEARCH,INC.
7777 GARDNER ROAD
CHANDLER, IN. 47610

FIGURE 3

----THEORETICAL----
VERTICAL PLANE RELATIVE FIELD

ERI TYPE MP-10AC-DA-HW BROADCAST ANTENNA
-0.585 DEGREE ELECTRICAL BEAM TILT
0 PERCENT FIRST NULL FILL
0 PERCENT SECOND NULL FILL

ELEMENT SPACING:
HALF-WAVE



Directional Antenna System
for
KBAQ, Phoenix, Arizona

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	MP-10C-DA-HW-SP
Frequency:	89.5 MHz
Number of Bays:	Ten

MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	53 ft 5 in
Aperture length required:	69 ft 3 in
Orientation:	351° true

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

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	30.000 kW (14.771 dBk)
Horizontal maximum power gain:	5.418 (7.338 dB)
H Pol H Plane power gain:	5.371 (7.248 dB)
Maximum vertical ERP:	28.660 kW (14.573 dBk)
Vertical maximum power gain:	5.176 (7.14 dB)
V Pol H Plane power gain:	5.131 (7.102 dB)
Beam Tilt:	-0.585°
Total input power:	5.538 kW (7.433 dBk)