ELECTRONICS RESEARCH, INC.

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 KQMT, Denver, Colorado

July 7, 2017

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

The antenna is the ERI model 1051-2CP-DA-SP configuration. The circular polarized system consists of two 60" spaced bays using one driven circular polarized radiating element per bay. The antenna was mounted on the North 60 degrees East tower leg with bracketry to provide an antenna orientation of North 70 degrees East. The antenna was tested on a Stainless G 8 tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 99.5 megahertz, which is the center of the FM broadcast channel assigned to KQMT. The antenna system is diplexed with KQKS, Lakewood, Colorado at 107.5 MHz.

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
KQMT, Denver, Colorado

(Continued)

DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of one bay level 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 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 Stainless G 8 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.

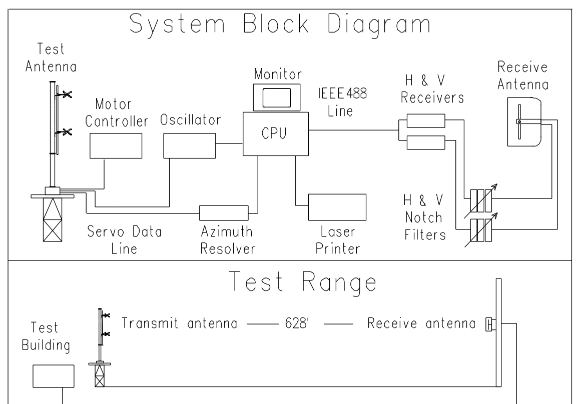

Figure # 2

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 99.5 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. 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 60” spaced bays using one driven circular polarized radiating 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.

The 1051-2CP-DA-SP array is to be mounted on the North 60 degrees East tower leg of the Stainless G 8 tower at a bearing of North 70 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 33.000 kilowatts (15.185 dBk).

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

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

Tom Scharf

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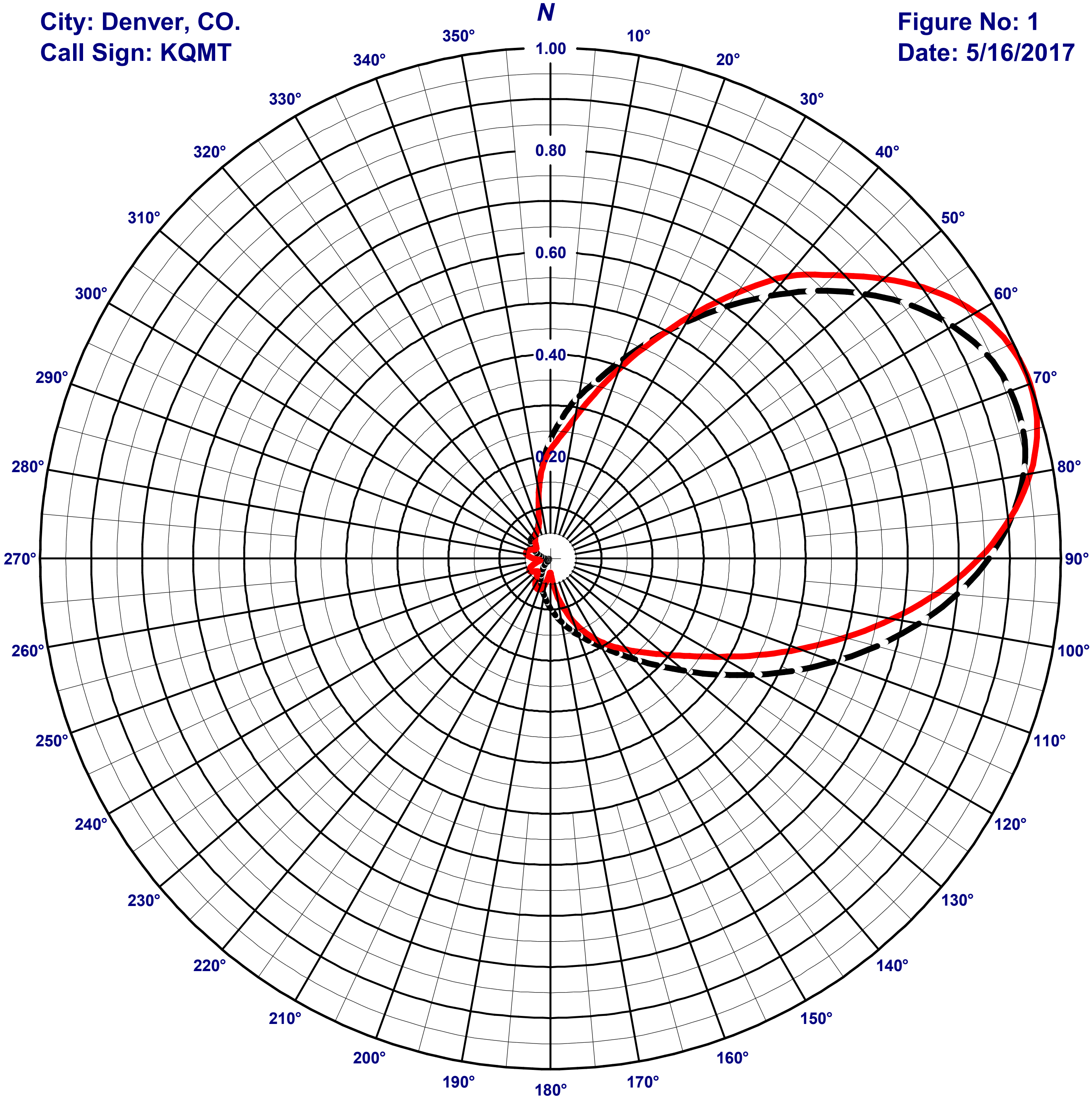
ERI® Horizontal Plane Relative Field Pattern

City: Denver, CO.
Call Sign: KQMT

Figure No: 1
Date: 5/16/2017



Frequency: 99.5 MHz
Antenna Type: 1051-2CP-DA-SP
Antenna Orientation: 70° True
Antenna Mounting: Custom
Tower Type Stainless G 8 tower

VERTICAL	HORIZONTAL
RMS: .425	RMS: .425
Maximum: .961 @ 73°	Maximum: 1 @ 69°
Minimum: .003 @ 253°	Minimum: .021 @ 261°

Measured patterns of the horizontal and vertical components.

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ERI® Horizontal Plane Relative Field Pattern

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Figure# 1
Station: KQMT
Location: Denver, CO.
Frequency: 99.5 MHz

Date: 5/16/2017
Antenna: 1051-2CP-DA-SP
Antenna Orientation: 70° True
Number of Bays: 2

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk	Maximum		Field	kW	dBk	Maximum
0°	0.233	1.788	2.523	Vertical	180°	0.097	0.313	-5.046	Vertical
5°	0.278	2.553	4.070	Vertical	185°	0.084	0.234	-6.301	Vertical
10°	0.323	3.452	5.380	Vertical	190°	0.073	0.174	-7.597	Vertical
15°	0.363	4.358	6.393	Vertical	195°	0.063	0.131	-8.814	Vertical
20°	0.415	5.675	7.540	Vertical	200°	0.064	0.137	-8.638	Horizontal
25°	0.473	7.374	8.677	Vertical	205°	0.065	0.138	-8.613	Horizontal
30°	0.548	9.895	9.954	Horizontal	210°	0.059	0.115	-9.379	Horizontal
35°	0.634	13.260	11.225	Horizontal	215°	0.049	0.080	-10.962	Horizontal
40°	0.721	17.173	12.349	Horizontal	220°	0.040	0.052	-12.881	Horizontal
45°	0.784	20.297	13.074	Horizontal	225°	0.036	0.042	-13.799	Horizontal
50°	0.852	23.962	13.795	Horizontal	230°	0.039	0.050	-12.994	Horizontal
55°	0.914	27.584	14.407	Horizontal	235°	0.045	0.067	-11.756	Horizontal
60°	0.963	30.578	14.854	Horizontal	240°	0.047	0.074	-11.307	Horizontal
65°	0.992	32.453	15.113	Horizontal	245°	0.044	0.064	-11.909	Horizontal
70°	1.000	32.993	15.184	Horizontal	250°	0.037	0.044	-13.532	Horizontal
75°	0.987	32.161	15.073	Horizontal	255°	0.027	0.024	-16.166	Horizontal
80°	0.955	30.084	14.783	Horizontal	260°	0.021	0.014	-18.403	Horizontal
85°	0.906	27.090	14.328	Vertical	265°	0.024	0.019	-17.313	Horizontal
90°	0.859	24.340	13.863	Vertical	270°	0.033	0.035	-14.552	Horizontal
95°	0.800	21.127	13.248	Vertical	275°	0.042	0.058	-12.386	Horizontal
100°	0.733	17.732	12.488	Vertical	280°	0.048	0.076	-11.212	Horizontal
105°	0.663	14.487	11.610	Vertical	285°	0.049	0.080	-10.992	Horizontal
110°	0.591	11.519	10.614	Vertical	290°	0.046	0.070	-11.536	Horizontal
115°	0.522	8.980	9.533	Vertical	295°	0.040	0.054	-12.684	Horizontal
120°	0.456	6.868	8.368	Vertical	300°	0.040	0.052	-12.852	Vertical
125°	0.396	5.177	7.141	Vertical	305°	0.046	0.069	-11.599	Vertical
130°	0.342	3.865	5.872	Vertical	310°	0.051	0.084	-10.746	Vertical
135°	0.296	2.893	4.614	Vertical	315°	0.054	0.095	-10.221	Vertical
140°	0.258	2.195	3.415	Vertical	320°	0.055	0.099	-10.064	Vertical
145°	0.226	1.681	2.255	Vertical	325°	0.055	0.101	-9.975	Vertical
150°	0.200	1.315	1.189	Vertical	330°	0.057	0.109	-9.634	Vertical
155°	0.178	1.043	0.181	Vertical	335°	0.062	0.127	-8.975	Vertical
160°	0.160	0.841	-0.752	Vertical	340°	0.069	0.159	-7.993	Vertical
165°	0.143	0.675	-1.704	Vertical	345°	0.089	0.261	-5.829	Vertical
170°	0.127	0.531	-2.746	Vertical	350°	0.131	0.570	-2.439	Horizontal
175°	0.112	0.411	-3.859	Vertical	355°	0.183	1.111	0.456	Vertical

Horizontal Polarization:
Maximum: 3.735 (5.723 dB)
Horizontal Plane: 3.735 (5.723 dB)
Maximum ERP: 33.000 kW

Vertical Polarization:
Maximum: 3.450 (5.378 dB)
Horizontal Plane: 3.450 (5.378 dB)
Maximum ERP: 30.479 kW

Total Input Power: 8.835 kW
Reference: KQMT1M.FIG
This list shows the the maximum azimuth values of either the horizontal or vertical components.

Horizontal Plane Relative Field Pattern

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Figure# 1A — **Date: 5/16/2017**
Station: KQMT — **Antenna: 1051-2CP-DA-SP**
Location: Denver, CO. — **Antenna Orientation: 70° True**
Frequency: 99.5 MHz — **Number of Bays: 2**

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.213	1.497	1.752	0.233	1.788	2.523	180°	0.028	0.027	-15.761	0.097	0.313	-5.046
5°	0.242	1.930	2.855	0.278	2.553	4.070	185°	0.033	0.036	-14.466	0.084	0.234	-6.301
10°	0.281	2.605	4.158	0.323	3.452	5.380	190°	0.046	0.070	-11.525	0.073	0.174	-7.597
15°	0.334	3.673	5.650	0.363	4.358	6.393	195°	0.058	0.110	-9.579	0.063	0.131	-8.814
20°	0.396	5.172	7.136	0.415	5.675	7.540	200°	0.064	0.137	-8.638	0.054	0.096	-10.155
25°	0.467	7.202	8.575	0.473	7.374	8.677	205°	0.065	0.138	-8.613	0.045	0.067	-11.721
30°	0.548	9.895	9.954	0.535	9.457	9.758	210°	0.059	0.115	-9.379	0.036	0.043	-13.694
35°	0.634	13.260	11.225	0.602	11.972	10.782	215°	0.049	0.080	-10.962	0.027	0.023	-16.311
40°	0.721	17.173	12.349	0.672	14.896	11.731	220°	0.040	0.052	-12.881	0.018	0.010	-19.927
45°	0.784	20.297	13.074	0.741	18.128	12.583	225°	0.036	0.042	-13.799	0.009	0.003	-25.998
50°	0.852	23.962	13.795	0.806	21.429	13.310	230°	0.039	0.050	-12.994	0.004	0.000	-33.168
55°	0.914	27.584	14.407	0.864	24.624	13.914	235°	0.045	0.067	-11.756	0.004	0.000	-33.733
60°	0.963	30.578	14.854	0.910	27.342	14.368	240°	0.047	0.074	-11.307	0.005	0.001	-30.442
65°	0.992	32.453	15.113	0.944	29.396	14.683	245°	0.044	0.064	-11.909	0.005	0.001	-30.912
70°	1.000	32.993	15.184	0.959	30.351	14.822	250°	0.037	0.044	-13.532	0.003	0.000	-33.961
75°	0.987	32.161	15.073	0.959	30.373	14.825	255°	0.027	0.024	-16.166	0.003	0.000	-34.335
80°	0.955	30.084	14.783	0.941	29.211	14.655	260°	0.021	0.014	-18.403	0.005	0.001	-30.469
85°	0.904	26.984	14.311	0.906	27.090	14.328	265°	0.024	0.019	-17.313	0.008	0.002	-26.861
90°	0.840	23.293	13.672	0.859	24.340	13.863	270°	0.033	0.035	-14.552	0.011	0.004	-24.056
95°	0.763	19.220	12.838	0.800	21.127	13.248	275°	0.042	0.058	-12.386	0.014	0.007	-21.732
100°	0.681	15.289	11.844	0.733	17.732	12.488	280°	0.048	0.076	-11.212	0.018	0.010	-19.876
105°	0.598	11.809	10.722	0.663	14.487	11.610	285°	0.049	0.080	-10.992	0.022	0.015	-18.111
110°	0.519	8.906	9.497	0.591	11.519	10.614	290°	0.046	0.070	-11.536	0.028	0.026	-15.883
115°	0.448	6.617	8.206	0.522	8.980	9.533	295°	0.040	0.054	-12.684	0.034	0.037	-14.284
120°	0.385	4.885	6.889	0.456	6.868	8.368	300°	0.035	0.041	-13.822	0.040	0.052	-12.852
125°	0.333	3.664	5.639	0.396	5.177	7.141	305°	0.034	0.038	-14.162	0.046	0.069	-11.599
130°	0.293	2.828	4.515	0.342	3.865	5.872	310°	0.037	0.044	-13.550	0.051	0.084	-10.746
135°	0.260	2.237	3.497	0.296	2.893	4.614	315°	0.041	0.056	-12.490	0.054	0.095	-10.221
140°	0.234	1.799	2.551	0.258	2.195	3.415	320°	0.047	0.071	-11.458	0.055	0.099	-10.064
145°	0.209	1.446	1.602	0.226	1.681	2.255	325°	0.052	0.088	-10.572	0.055	0.101	-9.975
150°	0.185	1.126	0.515	0.200	1.315	1.189	330°	0.056	0.104	-9.846	0.057	0.109	-9.634
155°	0.158	0.828	-0.818	0.178	1.043	0.181	335°	0.060	0.120	-9.204	0.062	0.127	-8.975
160°	0.130	0.561	-2.509	0.160	0.841	-0.752	340°	0.067	0.147	-8.324	0.069	0.159	-7.993
165°	0.101	0.337	-4.730	0.143	0.675	-1.704	345°	0.088	0.254	-5.945	0.089	0.261	-5.829
170°	0.072	0.171	-7.672	0.127	0.531	-2.746	350°	0.131	0.570	-2.439	0.130	0.561	-2.509
175°	0.045	0.065	-11.839	0.112	0.411	-3.859	355°	0.179	1.053	0.224	0.183	1.111	0.456

Horizontal Polarization:
Maximum: 3.735 (5.723 dB)
Horizontal Plane: 3.735 (5.723 dB)
Maximum ERP: 33.000 kW

Vertical Polarization:
Maximum: 3.450 (5.378 dB)
Horizontal Plane: 3.450 (5.378 dB)
Maximum ERP: 30.479 kW

Total Input Power: 8.835 kW
Reference: KQMT1M.FIG
This list shows the azimuth values for the horizontal and vertical components.

ERI® Vertical Plane Relative Field Pattern

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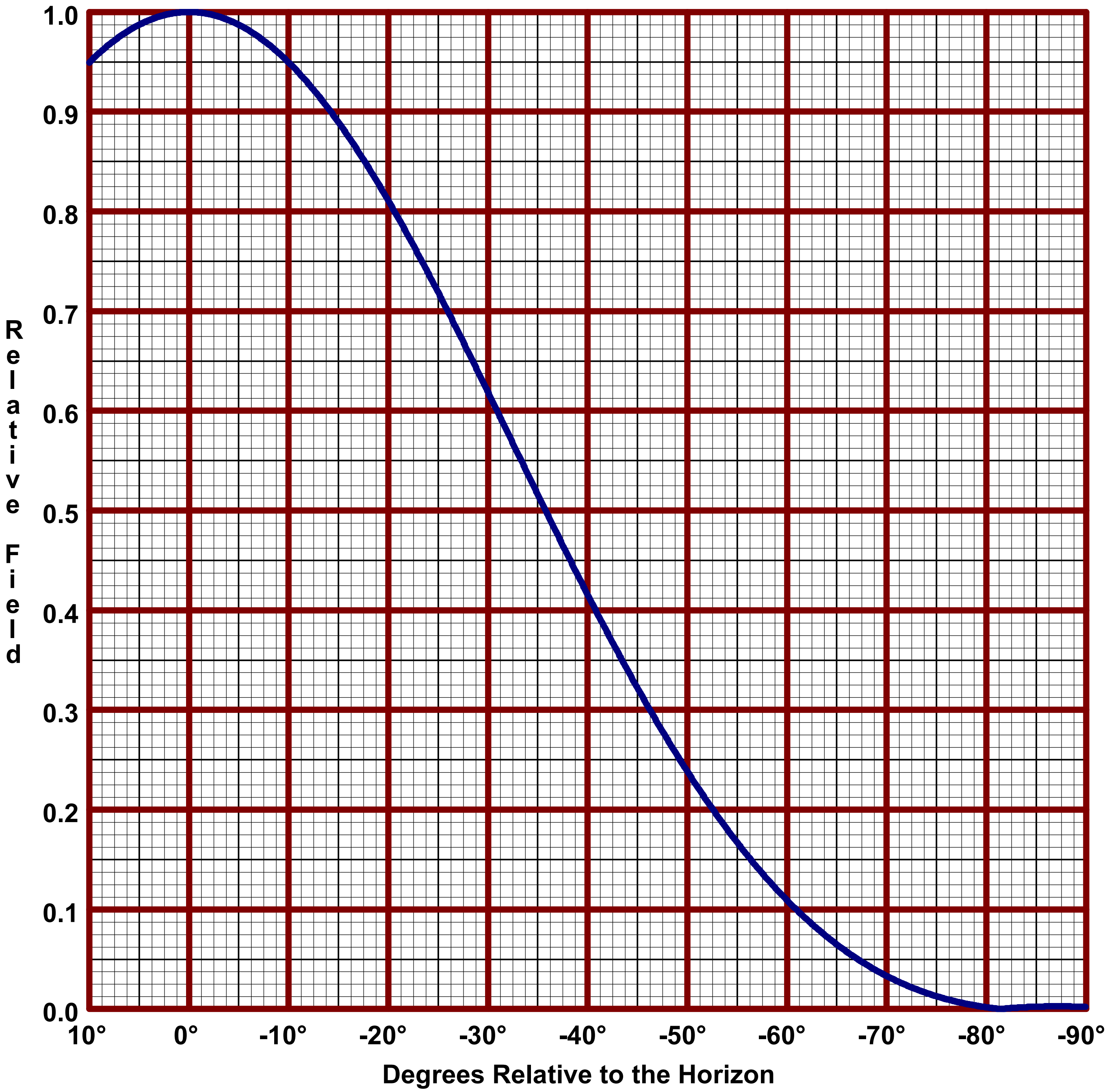
Figure No: 3	Date: 5/16/2017
Call Sign: KQMT	H/V Power Ratio: 1
Location: Denver, CO.	.508 Wave-length Spacing
Frequency: 99.5 MHz	0° Beam Tilt
Antenna: 2 bay 1051-2CP-DA-SP	0% First Null Fill



Horizontal Polarization:
Maximum: 3.735 (5.723 dB)
Horizontal Plane: 3.735 (5.723 dB)
Maximum ERP: 33.000 kW

Vertical Polarization:
Maximum: 3.450 (5.378 dB)
Horizontal Plane: 3.450 (5.378 dB)
Maximum ERP: 30.479 kW

Directional Antenna System
for
KQMT, Denver, Colorado

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	1051-2CP-DA-SP
Frequency:	99.5 MHz
Number of Bays:	Two

MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	15 ft 5 in
Aperture length required:	25
Orientation:	70° true

Input flange to the antenna 6 1/8” female.

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	33.00 kW (15.185 dBk)
Horizontal maximum power gain:	3.735 (5.723 dB)
Maximum vertical ERP:	30.479 kW (14.840 dBk)
Vertical maximum power gain:	3.450 (5.378 dB)
Total input power:	8.835 kW (9.462 dBk)