



SYSTEMS WITH RELIABILITY, LP
BROADCAST ANTENNAS AND TRANSMISSION LINE

PATTERN CERTIFICATION
DIRECTIONAL FM ANTENNA
KRCK
March 3, 2015

Call Sign	:	KRCK
Location	:	Mecca, CA
Frequency	:	97.7 MHz
Channel	:	249A
Antenna Model	:	FM3/2-HWS-DA
Maximum Antenna Gain	:	
Horizontal	:	2.014 / 3.041 dB
Vertical	:	2.014 / 3.041 dB

ANTENNA DESCRIPTION

A custom designed FM3/2-HWS-DA antenna was fabricated to conform to the prescribed directional azimuth pattern. The antenna consists of two (2) circularly polarized, cross-V dipole radiating elements half-wave spaced mounted to a forty-one (41)" (inch) face tower. The antenna array points 140 degrees true north.

DESCRIPTION OF TEST PROCEDURE

The test antenna consisted of a single third-scale bay. The antenna was mounted to a third-scale pipe, which was mounted to a third-scale tower by use of third-scale brackets identical to those shipped with the final, full-scale antenna. For testing, the entire third-scale model was then mounted atop a 20' (foot) high platform, and all feed cables were properly grounded. Horizontal and vertical readings were taken. The desired directional pattern was obtained by adjusting the distance between the tower and the antenna, and modifying the direction of the azimuth heading. Parasitic elements were used for performance enhancement.

DESCRIPTION OF TEST PARAMETERS AND EQUIPMENT

Horizontal and vertical pattern readings were taken by mounting a source antenna - a vertical/horizontal dipole, Cavity Back Resonator (CBR) antenna bay - approximately 100' (feet) from the third-scale antenna model. The source antenna's height was adjusted to achieve a uniform field at the third-scale test antenna location. The CBR antenna was operated in receive mode, at frequency 293.1 MHz. The third-scale test antenna was then rotated clockwise in order to achieve 360° (degree) pattern readings. A gain reference was taken using a dipole tuned to 293.1 MHz. Nowhere did the received signal, or resultant documentation, exceed a maximum to minimum ratio of 15dB (decibels).

TEST RESULTS

The attached calculations verify that the **RMS** value of this antenna is **86.0%** of the **RMS** value of the pattern authorized in the related FCC file **BPH-20150129AGB**. The vertical component **RMS** value is **0.563**. The horizontal component **RMS** value is **0.611**. The circular polarized component **RMS** value is **0.657**.

Azimuth and elevation plots and associated tabulations of this antenna are included with this package.

Measured vertical polarized directivity:	3.158 / 4.99 dB
Measured horizontal polarized directivity:	2.677 / 4.28 dB
Measured circular polarized pattern directivity:	2.316 / 3.65 dB

Gain in each polarization was calculated using the following relation:

GAIN = *Azimuth Directivity x Power Ratio Between Polarizations x Elevation Directivity*

Using this relationship along with ratio measured at our testing facilities:

V-Pol. Gain	= (3.158)(.4588)(1.390)	= 2.014 / 3.041 dB
H-Pol. Gain	= (2.677)(.5412)(1.390)	= 2.014 / 3.041 dB

INSTALLATION AND MOUNTING

The antenna is to be mounted in accordance with the supplied drawings. The antenna center of radiation is to be **35 meters (114.8 ft.)** above ground level. The antenna aperture is **5.03 feet**. No other antennas are to be mounted within **10 feet** of the antenna. No other obstructions other than those specified by original drawings supplied are to be mounted at the same level as the antenna. The antenna is to be oriented **140 degrees** true North.

The system's orientation and the mounting details are described in the following drawings:

DRAWING NO.	TITLE
1088D00	ELEVATION
1088D01	ANTENNA ORIENTATION
1088D02/1088D03	PARASITIC PLACEMENT
2105A10	TEST RANGE SCHEMATIC

The array shall be mounted according to all details outlined in **DWG. 1088D00**. The antenna elements shall be aligned at the same heading as in **DWG. 1088D01**. This will ensure that the antenna is oriented properly at 140 degrees true north. The parasitic placement is shown on **DWG. 1088D02** and **1088D03**. The test range schematic **DWG. 2105A10** shows the mounting configuration of the antenna setup on our range.

DOCUMENT EXHIBITS

The following exhibits are included as part of this Certificate of Compliance:

Exhibit 1	Circular Polarized Azimuth Pattern Field Strength Tabulations (Composite)
Exhibit 2	Measured Horizontal Polarized Azimuth Pattern Measured Field Strength Tabulations (Horizontal)
Exhibit 3	Measured Vertical Polarized Azimuth Pattern Measured Field Strength Tabulations (Vertical)
Exhibit 4	Elevation Pattern Elevation Tabulations
Exhibit 5	Antenna Data Sheet
Exhibit 6	RMS Calculations
Exhibit 7	Drawings

TEST EQUIPMENT

Network Analyzer	:	Hewlett Packard Model # 8753C Serial Number: 08753 – 69138
Computer	:	Pentium 3, 450 MHz, SAMS Range Program
Printer	:	Hewlett-Packard Laser Jet 6L
Positioner	:	Orbit Positioner
All equipment is calibrated to ANSI/NCSS Z540-1-1994 specs		

Prepared by:



Kevin W. Rager
Antenna Engineer
Systems With Reliability, LP

Surveyor's Declaration

I, _____, subject to the penalties of perjury, do declare the following:

- 1.) I am a licensed surveyor in the state(s) of _____,
_____ and _____.
- 2.) I have provided professional services to _____
(permit tee name), permit tee of KRCK-FM, Mecca (city of license), CA
(state), during the installation of the KRCK-FM directional antenna.
- 3.) I certify that the KRCK-FM directional antenna has been oriented at the
proper azimuth as authorized in the drawings section (Exhibit 7) of the
Proof of Performance for KRCK-FM. Namely Drawing #1088D01 shows
the proper heading to be 140 degrees from true North.

Sign _____

Dated: _____mm/dd/yy

Engineer's Declaration

I, _____, subject to the penalties of perjury, do declare the following:

1.) I am the holder of a valid General Radio Telephone Operators License, Number _____ (FCC License No.)

2.) I have been a member of the Society of Broadcast Engineer's since _____ (year)

3.) That I have been employed as a technical consultant with the firm of:

_____ (firm name), of

_____ (city state)

4.) That _____ (Firm's Name) was retained by _____ (Permit tee's Name) for the purpose of preparing its application for the construction permit of KRCK-FM Mecca (City), California (State), from which the underlying Construction Permit (FCC File Number BPH-20150129AGB) was granted by the Commission.

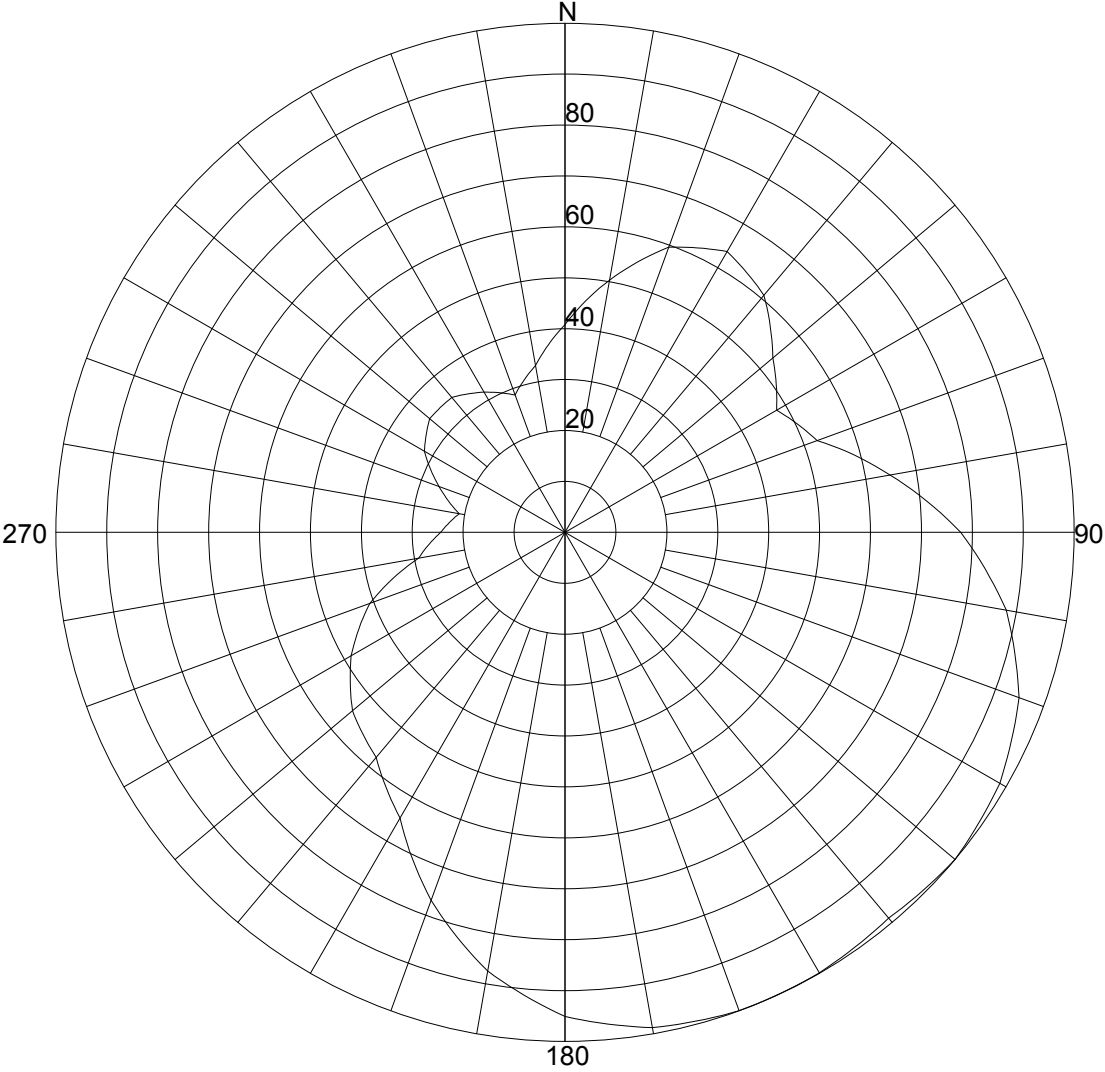
1.) That I am familiar with the terms and conditions of the KRCK-FM Construction Permit.

2.) I hereby certify that I have overseen the installation of the KRCK-FM directional antenna and that the installation was complete to the manufacturer's instructions outlined in the Proof of Performance Drawings section (Exhibit 7) for KRCK-FM.

Sign _____

Dated: _____ mm/dd/yy

Exhibit 1: Circular Polarized Azimuth Pattern



Azimuth Pattern

Systems With Reliability LP

Scale: Linear
Unit: Relative Field

CLIENT: <i>KRCK</i>	Date: 2/20/2015
ANTENNA TYPE: FM3/2-HWS-DA	
FREQUENCY: 97.7 MHz	
PATTERN POL.: Circular	CIRCULARITY(+/-dB):
AZ. DIRECTIVITY: 2.31562 / 3.65dB	PATTERN RMS: 0.657

Relative Field Tabulation(Azimuth)

Azimuth Heading	Normalized Field(dB)	Azimuth Heading	Normalized Field(dB)
0	.4080 (-7.79)	180	.9510 (-0.44)
5	.4555 (-6.83)	185	.9130 (-0.79)
10	.5030 (-5.97)	190	.8750 (-1.16)
15	.5495 (-5.2)	195	.8220 (-1.7)
20	.5960 (-4.5)	200	.7690 (-2.28)
25	.6165 (-4.2)	205	.7085 (-2.99)
30	.6370 (-3.92)	210	.6480 (-3.77)
35	.6225 (-4.12)	215	.6125 (-4.26)
40	.6080 (-4.32)	220	.5770 (-4.78)
45	.5705 (-4.87)	225	.5610 (-5.02)
50	.5330 (-5.47)	230	.5450 (-5.27)
55	.5065 (-5.91)	235	.5150 (-5.76)
60	.4800 (-6.38)	240	.4850 (-6.29)
65	.5035 (-5.96)	245	.4465 (-7)
70	.5270 (-5.56)	250	.4080 (-7.79)
75	.5875 (-4.62)	255	.3500 (-9.12)
80	.6480 (-3.77)	260	.2920 (-10.69)
85	.7125 (-2.94)	265	.2680 (-11.44)
90	.7770 (-2.19)	270	.2440 (-12.25)
95	.8285 (-1.63)	275	.2275 (-12.86)
100	.8800 (-1.11)	280	.2110 (-13.51)
105	.9145 (-0.78)	285	.2370 (-12.51)
110	.9490 (-0.45)	290	.2630 (-11.6)
115	.9675 (-0.29)	295	.2910 (-10.72)
120	.9860 (-0.12)	300	.3190 (-9.92)
125	.9930 (-0.06)	305	.3330 (-9.55)
130	1.0000 (0)	310	.3470 (-9.19)
135	.9945 (-0.05)	315	.3465 (-9.21)
140	.9890 (-0.1)	320	.3460 (-9.22)
145	.9940 (-0.05)	325	.3320 (-9.58)
150	.9990 (-0.01)	330	.3180 (-9.95)
155	.9995 (0)	335	.3025 (-10.39)
160	1.0000 (0)	340	.2870 (-10.84)
165	.9940 (-0.05)	345	.3100 (-10.17)
170	.9880 (-0.1)	350	.3330 (-9.55)
175	.9695 (-0.27)	355	.3705 (-8.62)

Systems With Reliability LP

CLIENT: *KRCK*

Date: 2/20/2015

ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 97.7 MHz

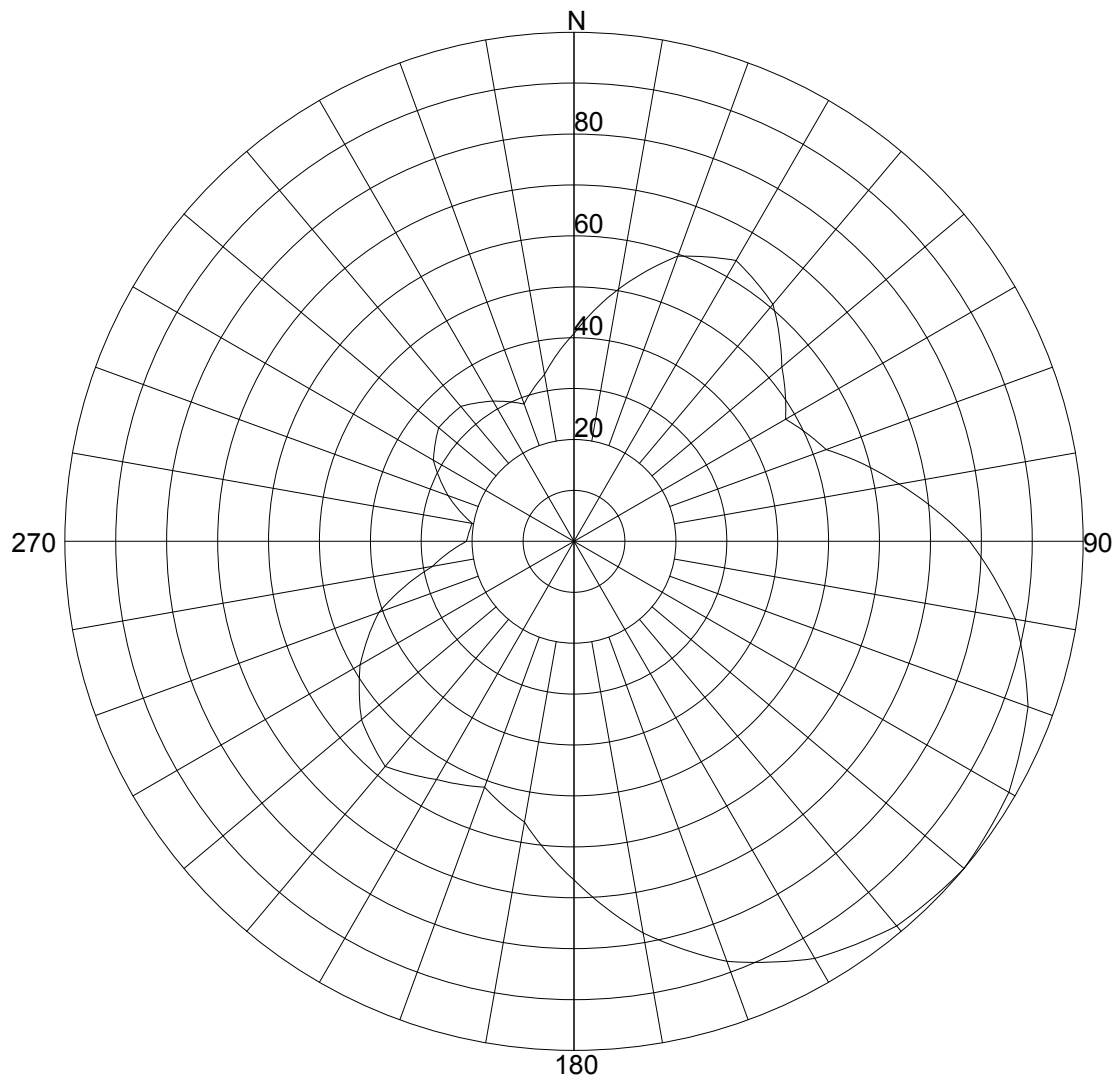
PATTERN POL.: Circular

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.31562 / 3.65dB

PATTERN RMS: 0.657

Exhibit 2: Measured Horizontal Polarized Azimuth Pattern



Azimuth Pattern

Systems With Reliability LP

Scale: Linear

Unit: Relative Field

CLIENT: *KRCK*

Date: 2/18/2015

ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 97.7 MHz

PATTERN POL.: Horizontal

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.67724 / 4.28dB

PATTERN RMS: 0.611

Relative Field Tabulation(Azimuth)

Azimuth Heading	Normalized Field(dB)	Azimuth Heading	Normalized Field(dB)
0	.4080 (-7.79)	180	.6650 (-3.54)
5	.4555 (-6.83)	185	.6125 (-4.26)
10	.5030 (-5.97)	190	.5600 (-5.04)
15	.5495 (-5.2)	195	.5370 (-5.4)
20	.5960 (-4.5)	200	.5140 (-5.78)
25	.6165 (-4.2)	205	.5270 (-5.56)
30	.6370 (-3.92)	210	.5400 (-5.35)
35	.6225 (-4.12)	215	.5585 (-5.06)
40	.6080 (-4.32)	220	.5770 (-4.78)
45	.5705 (-4.87)	225	.5610 (-5.02)
50	.5330 (-5.47)	230	.5450 (-5.27)
55	.5065 (-5.91)	235	.5150 (-5.76)
60	.4800 (-6.38)	240	.4850 (-6.29)
65	.5035 (-5.96)	245	.4465 (-7)
70	.5270 (-5.56)	250	.4080 (-7.79)
75	.5875 (-4.62)	255	.3450 (-9.24)
80	.6480 (-3.77)	260	.2820 (-11)
85	.7125 (-2.94)	265	.2465 (-12.16)
90	.7770 (-2.19)	270	.2110 (-13.51)
95	.8285 (-1.63)	275	.2070 (-13.68)
100	.8800 (-1.11)	280	.2030 (-13.85)
105	.9145 (-0.78)	285	.2330 (-12.65)
110	.9490 (-0.45)	290	.2630 (-11.6)
115	.9675 (-0.29)	295	.2910 (-10.72)
120	.9860 (-0.12)	300	.3190 (-9.92)
125	.9930 (-0.06)	305	.3330 (-9.55)
130	1.0000 (0)	310	.3470 (-9.19)
135	.9930 (-0.06)	315	.3465 (-9.21)
140	.9860 (-0.12)	320	.3460 (-9.22)
145	.9660 (-0.3)	325	.3320 (-9.58)
150	.9460 (-0.48)	330	.3180 (-9.95)
155	.9120 (-0.8)	335	.3025 (-10.39)
160	.8780 (-1.13)	340	.2870 (-10.84)
165	.8295 (-1.62)	345	.3100 (-10.17)
170	.7810 (-2.15)	350	.3330 (-9.55)
175	.7230 (-2.82)	355	.3705 (-8.62)

Systems With Reliability LP

CLIENT: *KRCK*

Date: 2/18/2015

ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 97.7 MHz

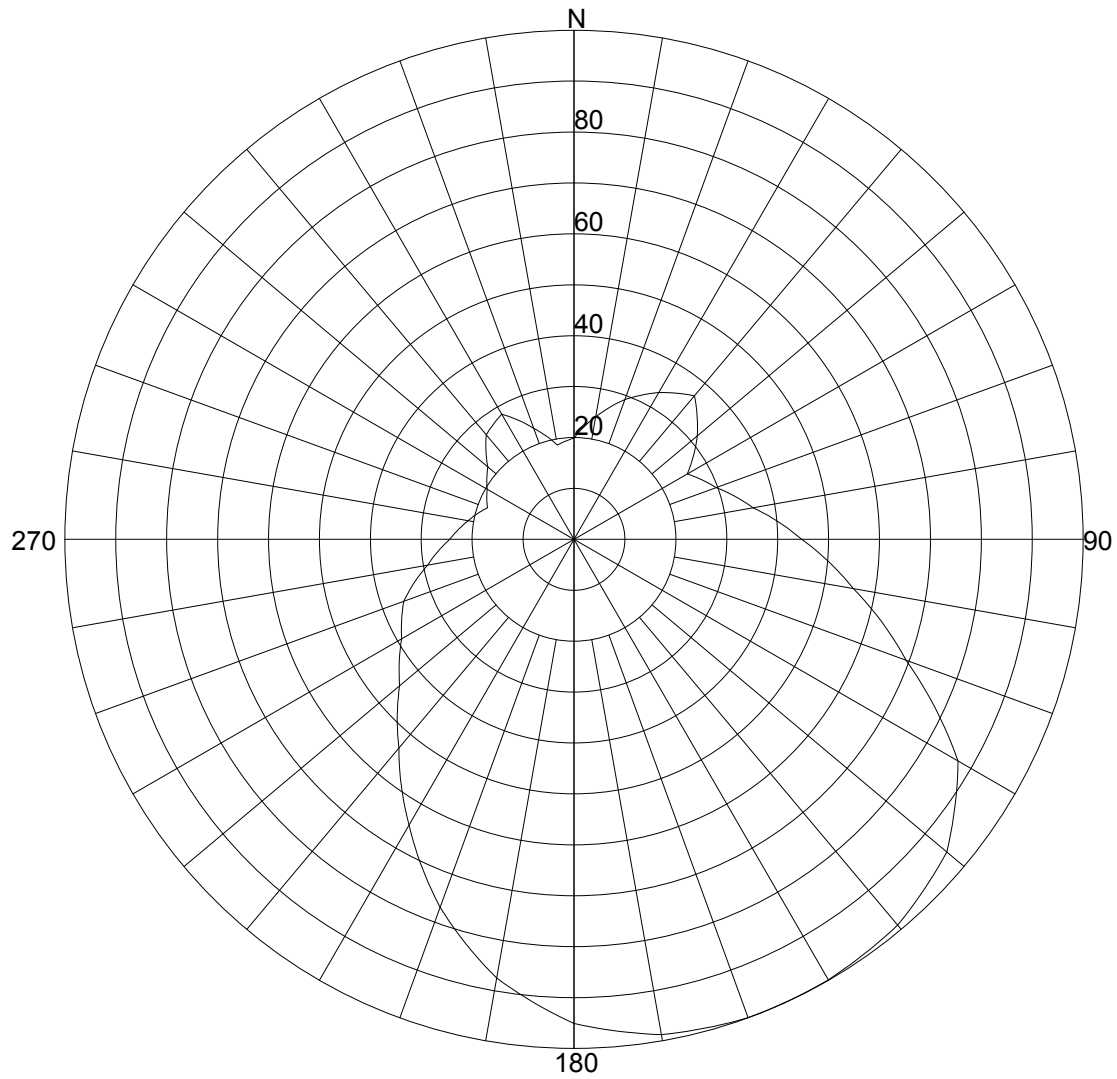
PATTERN POL.: Horizontal

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.67724 / 4.28dB

PATTERN RMS: 0.611

Exhibit 3: Measured Vertical Polarized Azimuth Pattern



Azimuth Pattern

Systems With Reliability LP

Scale: Linear

Unit: Relative Field

CLIENT: *KRCK*

Date: 2/18/2015

ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 97.7 MHz

PATTERN POL.: Vertical

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 3.15823 / 4.99dB

PATTERN RMS: 0.563

Relative Field Tabulation(Azimuth)

Azimuth Heading	Normalized Field(dB)	Azimuth Heading	Normalized Field(dB)
0	.1990 (-14.02)	180	.9510 (-0.44)
5	.2215 (-13.09)	185	.9130 (-0.79)
10	.2440 (-12.25)	190	.8750 (-1.16)
15	.2680 (-11.44)	195	.8220 (-1.7)
20	.2920 (-10.69)	200	.7690 (-2.28)
25	.3125 (-10.1)	205	.7085 (-2.99)
30	.3330 (-9.55)	210	.6480 (-3.77)
35	.3505 (-9.11)	215	.5915 (-4.56)
40	.3680 (-8.68)	220	.5350 (-5.43)
45	.3420 (-9.32)	225	.4910 (-6.18)
50	.3160 (-10.01)	230	.4470 (-6.99)
55	.2865 (-10.86)	235	.4190 (-7.56)
60	.2570 (-11.8)	240	.3910 (-8.16)
65	.2770 (-11.15)	245	.3735 (-8.55)
70	.2970 (-10.54)	250	.3560 (-8.97)
75	.3270 (-9.71)	255	.3240 (-9.79)
80	.3570 (-8.95)	260	.2920 (-10.69)
85	.4020 (-7.92)	265	.2680 (-11.44)
90	.4470 (-6.99)	270	.2440 (-12.25)
95	.5020 (-5.99)	275	.2275 (-12.86)
100	.5570 (-5.08)	280	.2110 (-13.51)
105	.6255 (-4.08)	285	.1960 (-14.15)
110	.6940 (-3.17)	290	.1810 (-14.85)
115	.7825 (-2.13)	295	.1890 (-14.47)
120	.8710 (-1.2)	300	.1970 (-14.11)
125	.9135 (-0.79)	305	.2090 (-13.6)
130	.9560 (-0.39)	310	.2210 (-13.11)
135	.9725 (-0.24)	315	.2445 (-12.23)
140	.9890 (-0.1)	320	.2680 (-11.44)
145	.9940 (-0.05)	325	.2760 (-11.18)
150	.9990 (-0.01)	330	.2840 (-10.93)
155	.9995 (0)	335	.2580 (-11.77)
160	1.0000 (0)	340	.2320 (-12.69)
165	.9940 (-0.05)	345	.2100 (-13.56)
170	.9880 (-0.1)	350	.1880 (-14.52)
175	.9695 (-0.27)	355	.1935 (-14.27)

Systems With Reliability LP

CLIENT: *KRCK*

Date: 2/18/2015

ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 97.7 MHz

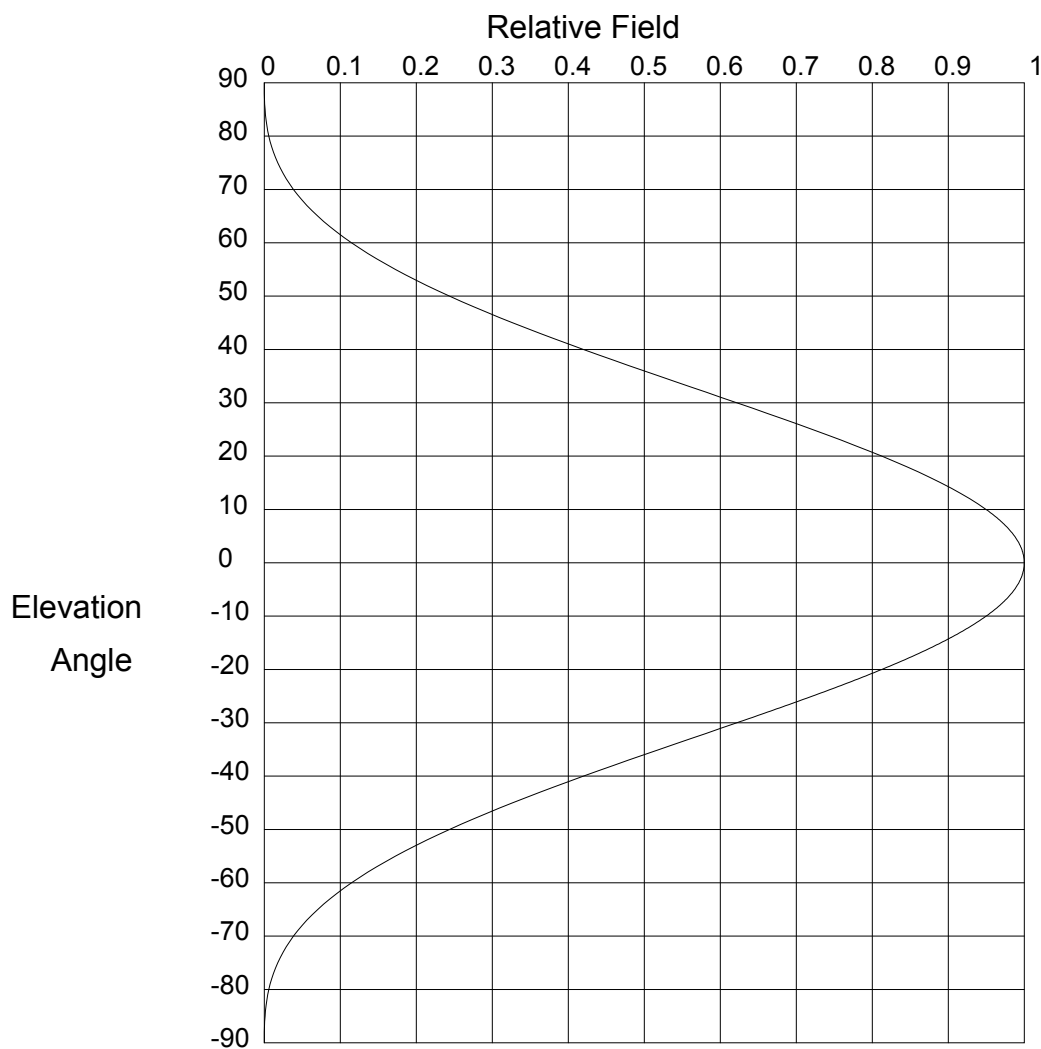
PATTERN POL.: Vertical

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 3.15823 / 4.99dB

PATTERN RMS: 0.563

Exhibit 4: Elevation Pattern



Elevation Pattern

Scale: Linear

Units: Field, Relative

Systems With Reliability LP

CLIENT: *KRCK*

Date: 1/8/2015

ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 97.7 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 1.39/1.43 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 1.39/1.43 dBd

Null Fill(s)(%) : 0, 0, 0

Relative Field Tabulation

Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)
90.0	.00 (-50)	52.0	.214 (-13.4)	14.0	.904 (-0.878)
89.0	.00 (-91.156)	51.0	.229 (-12.821)	13.0	.917 (-0.757)
88.0	.00 (-78.01)	50.0	.244 (-12.26)	12.0	.929 (-0.644)
87.0	.00 (-69.988)	49.0	.259 (-11.717)	11.0	.94 (-0.541)
86.0	.001 (-64.112)	48.0	.276 (-11.191)	10.0	.95 (-0.447)
85.0	.001 (-59.44)	47.0	.292 (-10.682)	9.8	.952 (-0.429)
84.0	.002 (-55.546)	46.0	.309 (-10.188)	9.6	.954 (-0.412)
83.0	.002 (-52.199)	45.0	.327 (-9.71)	9.4	.956 (-0.395)
82.0	.003 (-49.26)	44.0	.345 (-9.246)	9.2	.957 (-0.378)
81.0	.005 (-46.639)	43.0	.363 (-8.797)	9.0	.959 (-0.362)
80.0	.006 (-44.272)	42.0	.382 (-8.362)	8.8	.961 (-0.346)
79.0	.008 (-42.113)	41.0	.401 (-7.941)	8.6	.963 (-0.33)
78.0	.01 (-40.128)	40.0	.42 (-7.533)	8.4	.964 (-0.315)
77.0	.012 (-38.292)	39.0	.44 (-7.138)	8.2	.966 (-0.3)
76.0	.015 (-36.583)	38.0	.459 (-6.756)	8.0	.968 (-0.286)
75.0	.018 (-34.986)	37.0	.479 (-6.387)	7.8	.969 (-0.272)
74.0	.021 (-33.487)	36.0	.50 (-6.029)	7.6	.971 (-0.258)
73.0	.025 (-32.074)	35.0	.52 (-5.683)	7.4	.972 (-0.244)
72.0	.029 (-30.74)	34.0	.54 (-5.349)	7.2	.974 (-0.231)
71.0	.034 (-29.475)	33.0	.561 (-5.027)	7.0	.975 (-0.219)
70.0	.039 (-28.274)	32.0	.581 (-4.716)	6.8	.977 (-0.206)
69.0	.044 (-27.13)	31.0	.601 (-4.416)	6.6	.978 (-0.194)
68.0	.05 (-26.039)	30.0	.622 (-4.126)	6.4	.979 (-0.183)
67.0	.056 (-24.997)	29.0	.642 (-3.848)	6.2	.98 (-0.171)
66.0	.063 (-24)	28.0	.662 (-3.58)	6.0	.982 (-0.161)
65.0	.07 (-23.044)	27.0	.682 (-3.323)	5.8	.983 (-0.15)
64.0	.078 (-22.126)	26.0	.702 (-3.076)	5.6	.984 (-0.14)
63.0	.087 (-21.245)	25.0	.721 (-2.839)	5.4	.985 (-0.13)
62.0	.096 (-20.397)	24.0	.74 (-2.612)	5.2	.986 (-0.121)
61.0	.105 (-19.581)	23.0	.759 (-2.395)	5.0	.987 (-0.111)
60.0	.115 (-18.794)	22.0	.777 (-2.188)	4.8	.988 (-0.103)
59.0	.125 (-18.036)	21.0	.795 (-1.991)	4.6	.989 (-0.094)
58.0	.136 (-17.304)	20.0	.812 (-1.804)	4.4	.99 (-0.086)
57.0	.148 (-16.597)	19.0	.829 (-1.626)	4.2	.991 (-0.079)
56.0	.16 (-15.914)	18.0	.846 (-1.457)	4.0	.992 (-0.071)
55.0	.173 (-15.254)	17.0	.861 (-1.299)	3.8	.993 (-0.064)
54.0	.186 (-14.615)	16.0	.876 (-1.149)	3.6	.993 (-0.058)
53.0	.20 (-13.998)	15.0	.89 (-1.009)	3.4	.994 (-0.052)

Systems With Reliability LP

Page 1 of 3

CLIENT: *KRCK*

Date: 1/8/2015

ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 97.7 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 1.39/1.43 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 1.39/1.43 dBd

Null Fill(s)(%) : 0, 0, 0

Relative Field Tabulation

Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)
3.2	.995 (-0.046)	-4.4	.99 (-0.086)	-12.0	.929 (-0.644)
3.0	.995 (-0.04)	-4.6	.989 (-0.094)	-12.2	.926 (-0.666)
2.8	.996 (-0.035)	-4.8	.988 (-0.103)	-12.4	.924 (-0.688)
2.6	.997 (-0.03)	-5.0	.987 (-0.111)	-12.6	.921 (-0.711)
2.4	.997 (-0.026)	-5.2	.986 (-0.121)	-12.8	.919 (-0.733)
2.2	.998 (-0.022)	-5.4	.985 (-0.13)	-13.0	.917 (-0.757)
2.0	.998 (-0.018)	-5.6	.984 (-0.14)	-13.2	.914 (-0.78)
1.8	.998 (-0.014)	-5.8	.983 (-0.15)	-13.4	.912 (-0.804)
1.6	.999 (-0.011)	-6.0	.982 (-0.161)	-13.6	.909 (-0.828)
1.4	.999 (-0.009)	-6.2	.98 (-0.171)	-13.8	.906 (-0.853)
1.2	.999 (-0.006)	-6.4	.979 (-0.183)	-14.0	.904 (-0.878)
1.0	.999 (-0.004)	-6.6	.978 (-0.194)	-14.2	.901 (-0.904)
.8	1.00 (-0.003)	-6.8	.977 (-0.206)	-14.4	.899 (-0.929)
.6	1.00 (-0.002)	-7.0	.975 (-0.219)	-14.6	.896 (-0.956)
.4	1.00 (-0.001)	-7.2	.974 (-0.231)	-14.8	.893 (-0.982)
.2	1.00 (0)	-7.4	.972 (-0.244)	-15.0	.89 (-1.009)
.0	1.00 (0)	-7.6	.971 (-0.258)	-15.2	.888 (-1.036)
-.2	1.00 (0)	-7.8	.969 (-0.272)	-15.4	.885 (-1.064)
-.4	1.00 (-0.001)	-8.0	.968 (-0.286)	-15.6	.882 (-1.092)
-.6	1.00 (-0.002)	-8.2	.966 (-0.3)	-15.8	.879 (-1.12)
-.8	1.00 (-0.003)	-8.4	.964 (-0.315)	-16.0	.876 (-1.149)
-1.0	.999 (-0.004)	-8.6	.963 (-0.33)	-16.2	.873 (-1.178)
-1.2	.999 (-0.006)	-8.8	.961 (-0.346)	-16.4	.87 (-1.208)
-1.4	.999 (-0.009)	-9.0	.959 (-0.362)	-16.6	.867 (-1.238)
-1.6	.999 (-0.011)	-9.2	.957 (-0.378)	-16.8	.864 (-1.268)
-1.8	.998 (-0.014)	-9.4	.956 (-0.395)	-17.0	.861 (-1.299)
-2.0	.998 (-0.018)	-9.6	.954 (-0.412)	-17.2	.858 (-1.33)
-2.2	.998 (-0.022)	-9.8	.952 (-0.429)	-17.4	.855 (-1.361)
-2.4	.997 (-0.026)	-10.0	.95 (-0.447)	-17.6	.852 (-1.393)
-2.6	.997 (-0.03)	-10.2	.948 (-0.465)	-17.8	.849 (-1.425)
-2.8	.996 (-0.035)	-10.4	.946 (-0.483)	-18.0	.846 (-1.457)
-3.0	.995 (-0.04)	-10.6	.944 (-0.502)	-18.2	.842 (-1.49)
-3.2	.995 (-0.046)	-10.8	.942 (-0.521)	-18.4	.839 (-1.524)
-3.4	.994 (-0.052)	-11.0	.94 (-0.541)	-18.6	.836 (-1.557)
-3.6	.993 (-0.058)	-11.2	.937 (-0.561)	-18.8	.833 (-1.591)
-3.8	.993 (-0.064)	-11.4	.935 (-0.581)	-19.0	.829 (-1.626)
-4.0	.992 (-0.071)	-11.6	.933 (-0.602)	-19.2	.826 (-1.661)
-4.2	.991 (-0.079)	-11.8	.931 (-0.623)	-19.4	.823 (-1.696)

Systems With Reliability LP

Page 2 of 3

CLIENT: *KRCK*

Date: 1/8/2015

ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 97.7 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 1.39/1.43 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 1.39/1.43 dBd

Null Fill(s)(%) : 0, 0, 0

Relative Field Tabulation

Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)
-19.6	.819 (-1.731)	-27.2	.678 (-3.373)	-54.0	.186 (-14.615)
-19.8	.816 (-1.767)	-27.4	.674 (-3.424)	-55.0	.173 (-15.254)
-20.0	.812 (-1.804)	-27.6	.67 (-3.476)	-56.0	.16 (-15.914)
-20.2	.809 (-1.84)	-27.8	.666 (-3.528)	-57.0	.148 (-16.597)
-20.4	.806 (-1.877)	-28.0	.662 (-3.58)	-58.0	.136 (-17.304)
-20.6	.802 (-1.915)	-28.2	.658 (-3.633)	-59.0	.125 (-18.036)
-20.8	.799 (-1.953)	-28.4	.654 (-3.686)	-60.0	.115 (-18.794)
-21.0	.795 (-1.991)	-28.6	.65 (-3.739)	-61.0	.105 (-19.581)
-21.2	.792 (-2.03)	-28.8	.646 (-3.793)	-62.0	.096 (-20.397)
-21.4	.788 (-2.069)	-29.0	.642 (-3.848)	-63.0	.087 (-21.245)
-21.6	.784 (-2.108)	-29.2	.638 (-3.903)	-64.0	.078 (-22.126)
-21.8	.781 (-2.148)	-29.4	.634 (-3.958)	-65.0	.07 (-23.044)
-22.0	.777 (-2.188)	-29.6	.63 (-4.014)	-66.0	.063 (-24)
-22.2	.774 (-2.229)	-29.8	.626 (-4.07)	-67.0	.056 (-24.997)
-22.4	.77 (-2.27)	-30.0	.622 (-4.126)	-68.0	.05 (-26.039)
-22.6	.766 (-2.311)	-31.0	.601 (-4.416)	-69.0	.044 (-27.13)
-22.8	.763 (-2.353)	-32.0	.581 (-4.716)	-70.0	.039 (-28.274)
-23.0	.759 (-2.395)	-33.0	.561 (-5.027)	-71.0	.034 (-29.475)
-23.2	.755 (-2.438)	-34.0	.54 (-5.349)	-72.0	.029 (-30.74)
-23.4	.752 (-2.481)	-35.0	.52 (-5.683)	-73.0	.025 (-32.074)
-23.6	.748 (-2.524)	-36.0	.50 (-6.029)	-74.0	.021 (-33.487)
-23.8	.744 (-2.568)	-37.0	.479 (-6.387)	-75.0	.018 (-34.986)
-24.0	.74 (-2.612)	-38.0	.459 (-6.756)	-76.0	.015 (-36.583)
-24.2	.737 (-2.657)	-39.0	.44 (-7.138)	-77.0	.012 (-38.292)
-24.4	.733 (-2.701)	-40.0	.42 (-7.533)	-78.0	.01 (-40.128)
-24.6	.729 (-2.747)	-41.0	.401 (-7.941)	-79.0	.008 (-42.113)
-24.8	.725 (-2.793)	-42.0	.382 (-8.362)	-80.0	.006 (-44.272)
-25.0	.721 (-2.839)	-43.0	.363 (-8.797)	-81.0	.005 (-46.639)
-25.2	.717 (-2.885)	-44.0	.345 (-9.246)	-82.0	.003 (-49.26)
-25.4	.713 (-2.932)	-45.0	.327 (-9.71)	-83.0	.002 (-52.199)
-25.6	.71 (-2.98)	-46.0	.309 (-10.188)	-84.0	.002 (-55.546)
-25.8	.706 (-3.027)	-47.0	.292 (-10.682)	-85.0	.001 (-59.44)
-26.0	.702 (-3.076)	-48.0	.276 (-11.191)	-86.0	.001 (-64.112)
-26.2	.698 (-3.124)	-49.0	.259 (-11.717)	-87.0	.00 (-69.988)
-26.4	.694 (-3.173)	-50.0	.244 (-12.26)	-88.0	.00 (-78.01)
-26.6	.69 (-3.223)	-51.0	.229 (-12.821)	-89.0	.00 (-91.156)
-26.8	.686 (-3.272)	-52.0	.214 (-13.4)	-90.0	.00 (-50)
-27.0	.682 (-3.323)	-53.0	.20 (-13.998)	90.0	.00 (-50)

Systems With Reliability LP

Page 3 of 3

CLIENT: *KRCK*

Date: 1/8/2015

ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 97.7 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 1.39/1.43 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 1.39/1.43 dBd

Null Fill(s)(%) : 0, 0, 0

Exhibit 5: Antenna Data Sheet



SYSTEMS WITH RELIABILITY, LP
BROADCAST ANTENNAS AND TRANSMISSION LINE

SYSTEM DATA SHEET

Customer	KRCK
Contact	Edward Stolz
Location	Mecca, CA
Antenna Model	FM3/2-HWS-DA
Channel / Frequency	97.7 MHz

ELECTRICAL SPECIFICATIONS

Antenna Specifications:

	H-POL			V. Pol.	
License ERP (KW)	1.600			1.600	
FCC Limit Pattern Directivity	1.710	2.329	dB	1.710	2.329 dB
Elevation Directivity	1.390	1.430	dB	1.390	1.430 dB
Azimuth Directivity	2.677	4.277	dB	3.158	4.994 dB
Composite Pattern	2.316	3.647	dB	2.316	3.647 dB
Polarization Ratio	0.541			0.459	
RMS Comp./RMS Limit	85.9 %				
Antenna Efficiency %	100			100	
Power Ratio (Pol. Ratio X Efficiency)	0.5412			0.4588	
Antenna Gain	2.014	3.041	dB	2.014	3.041 dB

Antenna Input Power (KW)	0.794 kW	-1.000 (dBK)
---------------------------------	----------	--------------

Feed Line Specifications:

Line Type: Andrew	1 5/8" Air	50 Ω HJ7-50A
Attenuation Per 100 ft (dB)	0.20	dB
Line Length (ft) AGL + 50' Horizontal Run	164.84	ft.
Total Line Attenuation (dB)	0.3363	dB
Line Efficiency	92.55 %	
Power Input to the Line (KW)	0.858 kW	-0.663 (dBK)

MECHANICAL SPECIFICATIONS

No. Of Bays	2		
Antenna Aperture	5.03	ft.	1.53 meter
Center of Radiation AGL	114.84	ft.	35.00 meter
Antenna Weight (Everything)	201.00	lbs.	91.36 kg
Windload (50/33)	438.00	lbs.	Windload CaAc 12.50 ft^2

Prepared by:

Kevin W. Rager
SWR, LP

Exhibit 6: RMS Calculations



SYSTEMS WITH RELIABILITY, INC.
Broadcast Antennas and Transmission Systems

KRCK Antenna RMS Comparison

PROPOSED ANTENNA

Azimuth Heading	Relative Field
0	0.555
10	0.6
20	0.648
30	0.7
40	0.756
50	0.816
60	0.881
70	0.952
80	1
90	1
100	1
110	1
120	1
130	1
140	1
150	1
160	1
170	1
180	1
190	1
200	1
210	0.89
220	0.706
230	0.567
240	0.493
250	0.43
260	0.386
270	0.327
280	0.282
290	0.291
300	0.35
310	0.378
320	0.408
330	0.441
340	0.476
350	0.514

DESIGNED ANTENNA

Azimuth Heading	Relative Field
0	0.408
10	0.503
20	0.596
30	0.637
40	0.608
50	0.533
60	0.48
70	0.527
80	0.648
90	0.777
100	0.88
110	0.949
120	0.986
130	1
140	0.989
150	0.999
160	1
170	0.988
180	0.951
190	0.875
200	0.769
210	0.648
220	0.577
230	0.545
240	0.485
250	0.408
260	0.292
270	0.244
280	0.211
290	0.263
300	0.319
310	0.347
320	0.346
330	0.318
340	0.287
350	0.333

Sum of Relative Field Squared : 21.075
Sum Divided by 36 (Readings) : 0.585
Square Root : 0.765

Sum of Relative Field Squared : 15.573
Sum Divided by 36 (Readings) : 0.433
Square Root : 0.658

Percentage of Construction Permit Antenna Filled :

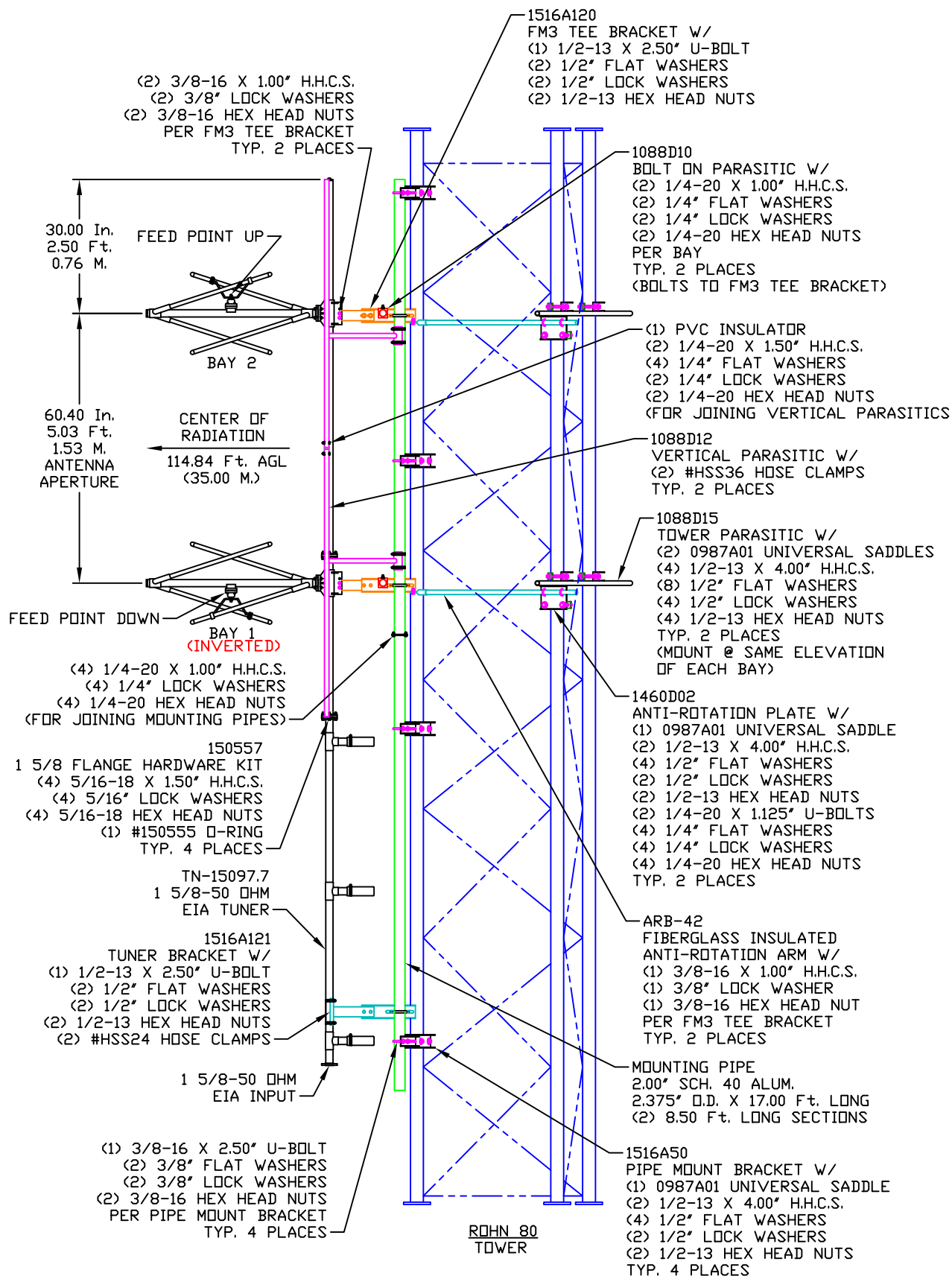
86.0%

NOTES:

1. REFERENCE DWG. 1088D01 FOR ANTENNA ORIENTATION.
2. REFERENCE DWG. 1088D02 FOR BAY 1 PARASITIC PLACEMENT.
3. REFERENCE DWG. 1088D03 FOR BAY 2 PARASITIC PLACEMENT.

DRAWING NUMBER: 1088D00

Exhibit 7: Drawings



SYSTEMS WITH RELIABILITY, LP
619 INDUSTRIAL PARK ROAD
EBensburg, PENNSYLVANIA 15931

TITLE: FM3/2-HWS-DA, FREQ. 97.7
KRCK, MECCA, CA

MATERIAL:

SIZE REV APPR. DATE
C 1
2
3

ENGINEER:

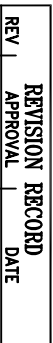
SCALE: NTS

NAME: RAC

DATE: 3/3/15

SHEET 1 OF 1

DRAWING NUMBER: 1088D00



NOTE:

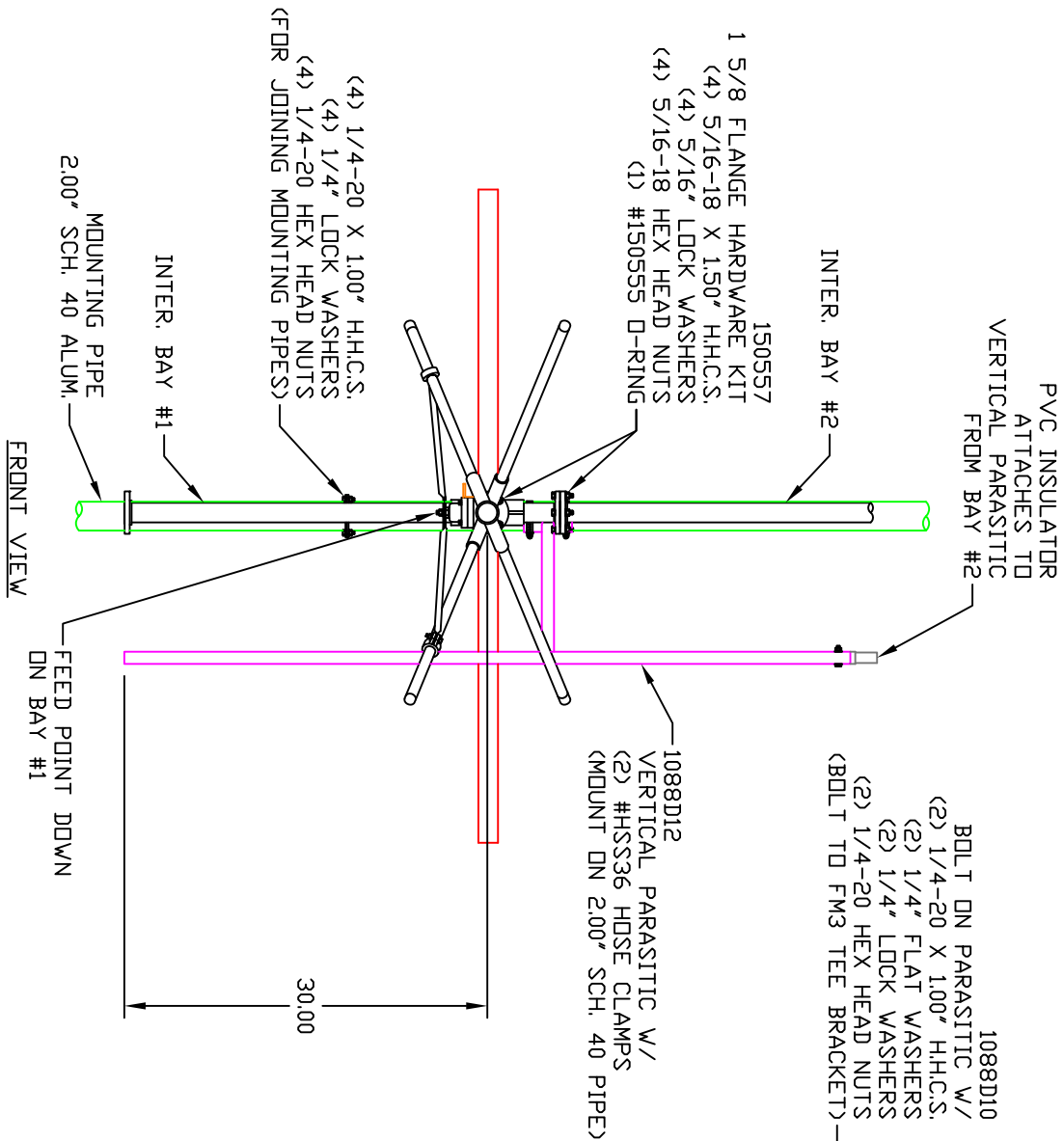
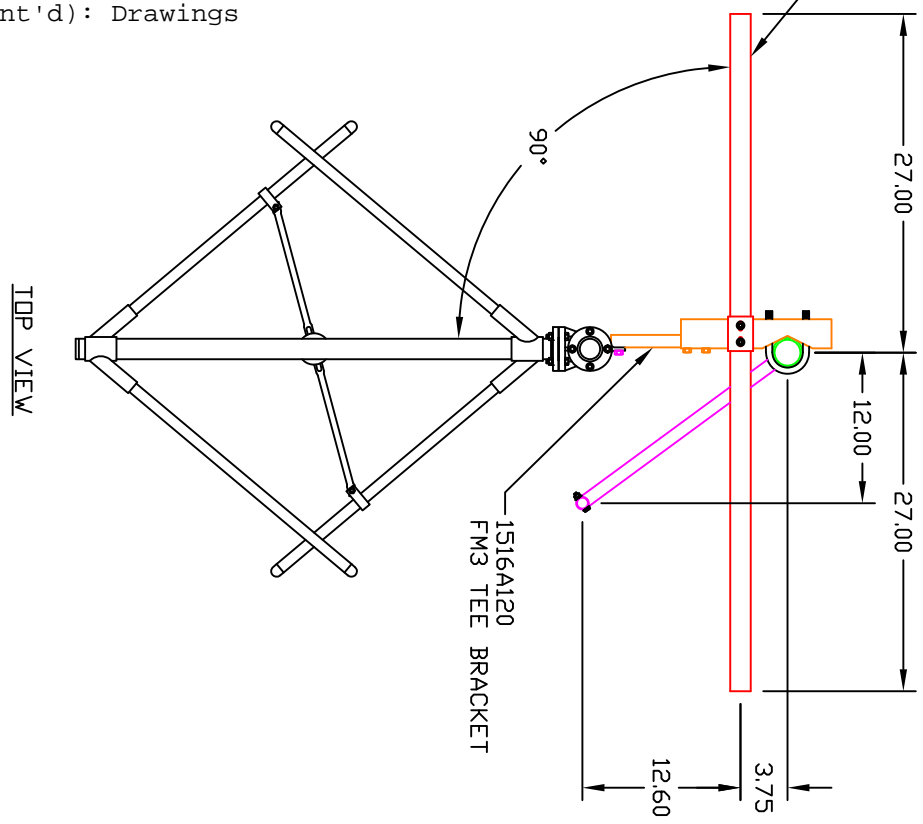



Exhibit 7 (cont'd): Drawings



TOLERANCES		REVISION RECORD	
'X	± .015	REV	APPROVAL DATE
.XX	± .005		
.XXX	± .002		
X/X	± 1/32		
DEG.	± 1/2		
UNLESS OTHERWISE SPECIFIED			



SYSTEMS WITH RELIABILITY, LP
619 INDUSTRIAL PARK ROAD
EBENSBURG, PENNSYLVANIA 15931

TITLE: FM3/2-HWS-DA, FREQ. 97.7
KRCK, MECCA, CA
PARASITIC PLACEMENT
BAY 1

SIZE: A

PARTS MADE BY THIS DRAWING

SCALE: NTS

NAME: RAC

DATE: 3/3/15

DRAWING NUMBER: 1088D02

SHEET 1 OF 1

Exhibit 7 (cont'd): D

1 5/8 FLANGE HARDWARE KIT
(4) 5/16-18 X 1.50" HHCS.
(4) 5/16" LOCK WASHERS
(4) 5/16-18 HEX HEAD NUTS
(1) #150555 D-RING

INTER. BAY #2

FEED POINT UP
DN BAY #2

150557

30.00

1088D12
VERTICAL PARASTIC W/
(2) #HSS36 HOSE CLAMPS
(MOUNT DN 2.00" SCH. 40 PIPE)

ATTACH THIS END TO
PVC INSULATOR
OF BAY #1 VERTICAL PARASTIC

2.00" SCH. 40 ALUM.

FRONT VIEW

90°

FEED POINT UP
DN BAY #2

1516A120
FM3 TEE BRACKET

3.75

12.60

TOP VIEW

TOLERANCES	REVISION RECORD	
	APPROVAL	DATE
X .015	REV	
.XX ± .005		
.XXX ± .002		
X/X ± 1/32		
DEG. ± 1/2		
UNLESS OTHERWISE SPECIFIED		

FM3/2-HWS-DA, FREQ. 97.7

**SYSTEMS WITH RELIABILITY, LP
619 INDUSTRIAL PARK ROAD**

MATERIAL:

KRCK, MECCA, CA

BAY 2

SIZE

A

PARTS MADE BY THIS DRAWING

SCALL

ENTS

NAME _____

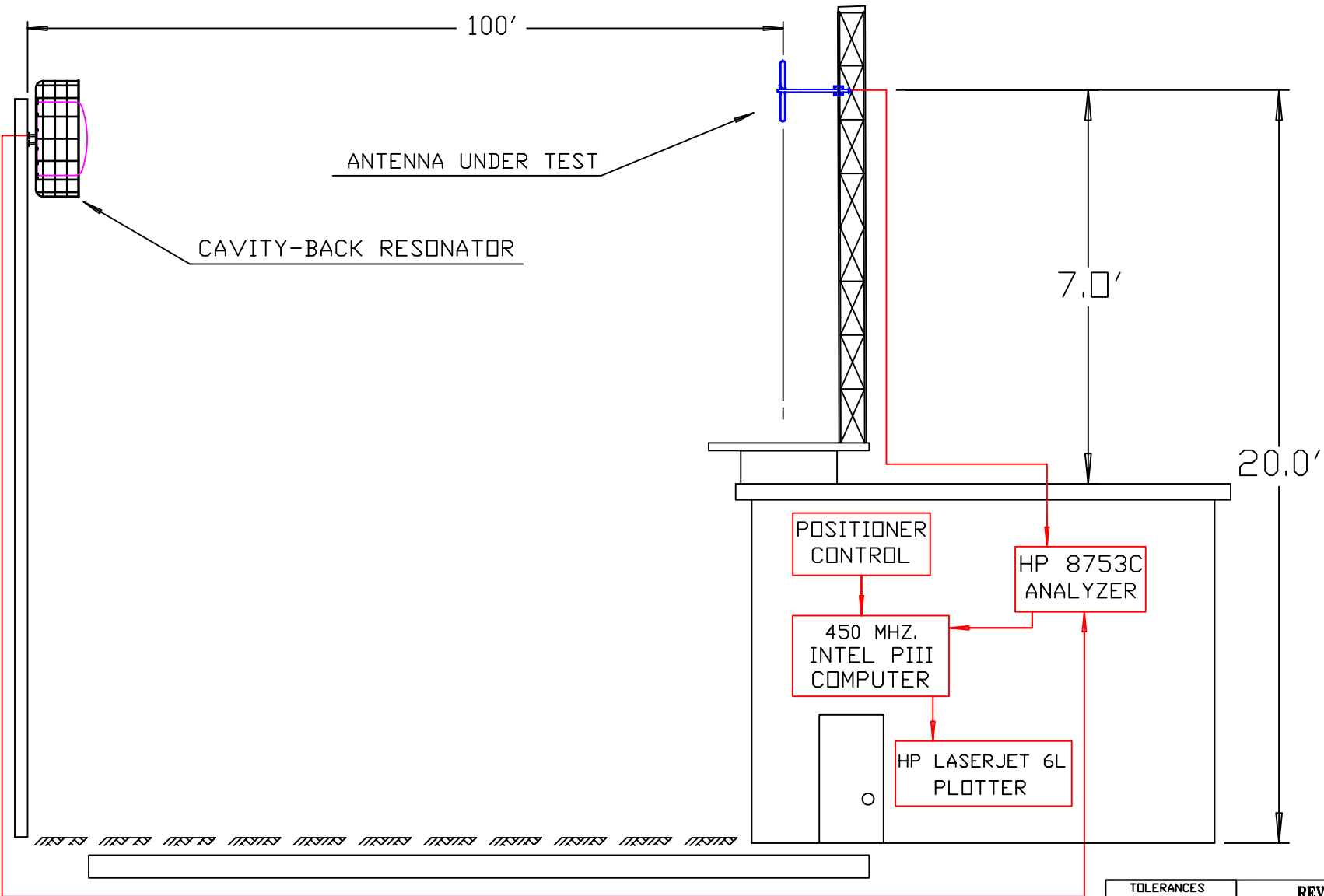
NAME: RAC

DATE:

3/3/

SHEEP

SHEET 1 OF 1



TOLERANCES			REVISION RECORD		
.X	± .015		REV	APPROVAL	DATE
.XX	± .005				
.XXX	± .002				
X/X	± 1/32				
DEG.	± 1/2				
UNLESS OTHERWISE SPECIFIED					
			2		10/7/05
			1		4/30/02
			DRAWING NUMBER: 2105A10		
			SHEET 1 OF 1		