



**SYSTEMS WITH RELIABILITY, LLP**  
**BROADCAST ANTENNAS AND TRANSMISSION LINE**

## **PATTERN CERTIFICATION**

**DIRECTIONAL FM ANTENNA**  
**KSSO**  
**July 17, 2012**

Call Sign	:	KSSO
Location	:	Norman, OK
Frequency	:	89.3 MHz
Channel	:	207A
Antenna Model	:	FM3/3 DA
Maximum Antenna Gain	:	
Horizontal	:	2.501 / 3.982 dB
Vertical	:	2.501 / 3.982 dB

### **ANTENNA DESCRIPTION**

A custom designed **FM3/3-DA** antenna was used to produce the required directional azimuth pattern. Each antenna bay consists of a circularly polarized cross-V dipole-radiating element with a horizontal parasitic at each bay. The array is comprised of three bays, that are spaced a wavelength apart, mounted to a 2.0" schedule 40 support pipe and mounted to a 24" inch face tower pointing 107 degrees true north.

### **DESCRIPTION OF TEST PROCEDURE**

The test antenna consists of a single bay third-scale model antenna. This antenna was mounted to a third scaled pipe and attached to an exact replicated third scale model tower with the use of mounting brackets supplied with the finalized antenna. The tower was placed on a 20 ft. high platform. All feed cables are properly grounded during pattern testing. The azimuth pattern was achieved by adjusting the separation distance of the antenna from the tower and a horizontal parasitic behind each bay to obtain the desired directional pattern.

The source antenna, a vertical/horizontal dipole Cavity Back Resonator antenna configuration was mounted approximately 100 feet from the test antenna. The source's height was adjusted to provide a uniform field at the test antenna location. The CBR antenna was operated in the transmit mode at a frequency of 267.9 MHz. The antenna under test was rotated in a clockwise direction. A gain reference was taken using a dipole tuned to 267.9 MHz. Nowhere, does the received signal exceed a maximum to minimum ratio of 15 dB.

619 Industrial Park Road, Ebensburg, PA 15931 Tel. 800 762 7743 / 814 472 5436 ♦ Fax 814 472 5552

## TEST RESULTS

The attached calculations verify that the **RMS** value of this antenna is **89.05%** of the **RMS** value of the pattern authorized in the related construction permit **BMPED-20120130AGW**. The vertical component **RMS** value is **0.719**. The horizontal component **RMS** value is **0.824**. The circular polarized component **RMS** value is **0.835**.

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

Measured vertical polarized directivity:	1.937 / 2.871 dB
Measured horizontal polarized directivity:	1.472 / 1.679 dB
Measured circular polarized pattern directivity:	1.436 / 1.571 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 = (1.937)(.432)(2.991)	= 2.501 / 3.982 dB
H-Pol. Gain = (1.472)(.568)(2.991)	= 2.501 / 3.982 dB

## INSTALLATION AND MOUNTING

The antenna is to be mounted in accordance with the supplied drawings. The antenna center of radiation is to be **45.09 meters (147.94 ft.)** above ground level. The antenna aperture is **22.03 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 **107 degrees** true North.

The parasitic system is custom designed to shape and direct the antenna pattern as required. The systems orientation and the mounting details are described in the following drawings:

DRAWING NO.	TITLE
1661D00	ELEVATION
1661D01	ANTENNA ORIENTATION
1661D02	PARASITIC DETAIL FOR EACH BAY
2105A10	TEST RANGE SCHEMATIC

The array shall be mounted according to **DWG. 1661D00**. The antenna elements shall be aligned at the same heading as in **DWG. 1661D01**. This will ensure that the antenna is oriented properly at 107 degrees true north. Parasitics should be mounted as detailed in **DWG. 1661D02**. The test range schematic shows the mounting configuration of the antenna setup on our range.

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## 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, Range Program
Printer	:	Hewlett-Packard Laser Jet 6L
Positioner	:	Orbit Positioner

All equipment is calibrated to ANSI/NCSL Z540-1-1994 specs

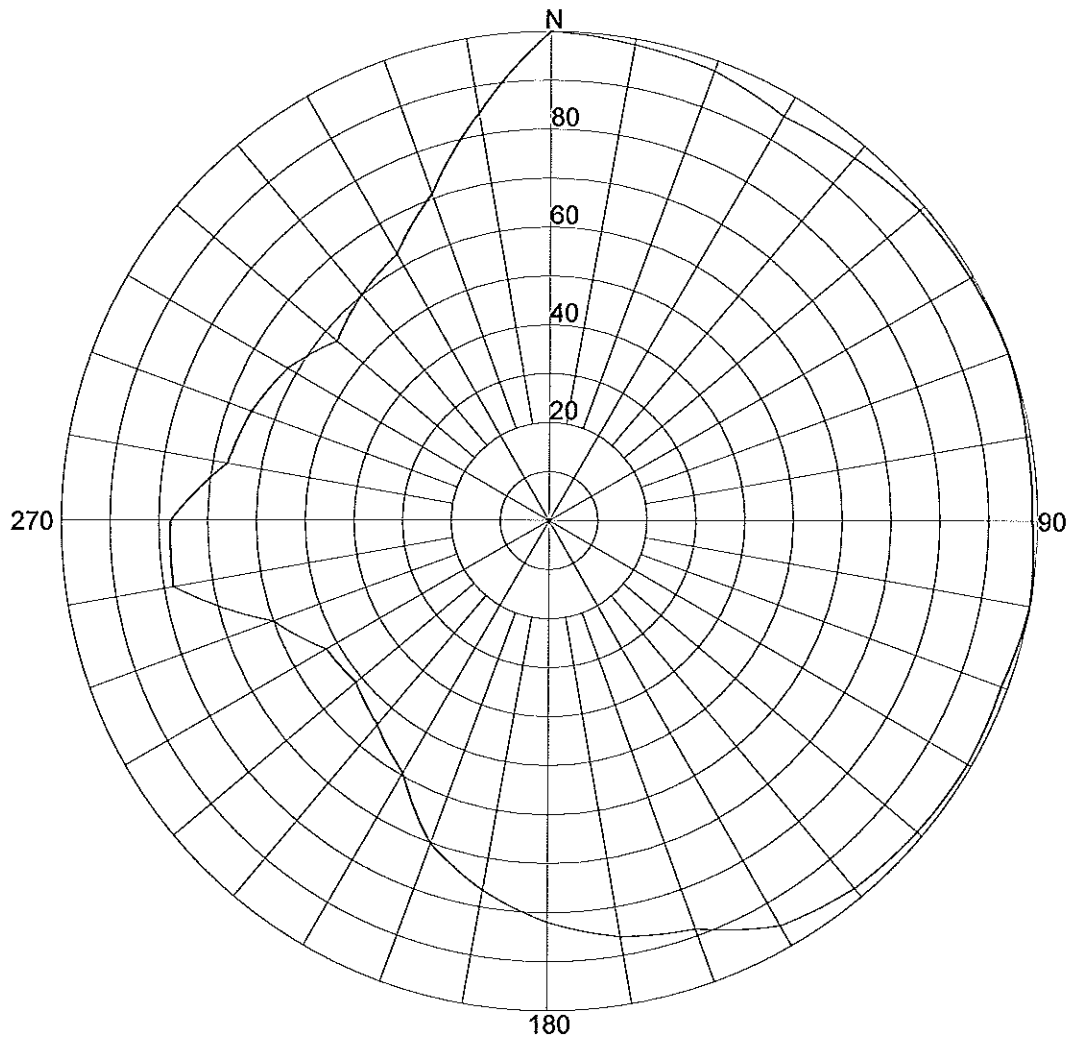
Prepared by:



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**Mark A. Gergely**  
Electrical Engineer  
Systems With Reliability LLP

## Exhibit 1: Circular Polarized Azimuth Pattern COMPOSITE



Azimuth Pattern

### Systems With Reliability

Scale: Linear

Unit: Relative Field

CLIENT: KSSO

Date: 7/17/2012

ANTENNA TYPE: FM3/3 DA

FREQUENCY: 89.3 MHz

PATTERN POL.: Circular

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.43572 / 1.57dB

PATTERN RMS: 0.835

# Exhibit 1 (Cont'd): Circular Polarized Azimuth Pattern COMPOSITE Tabulations

## Relative Field Tabulation(Azimuth)

Azimuth Heading	Relative Field(dB)	Azimuth Heading	Relative Field(dB)
0	1.0000 ( 0.01 )	180	.8200 (-1.71 )
5	.9935 (-0.05 )	185	.7930 (-2 )
10	.9870 (-0.1 )	190	.7660 (-2.3 )
15	.9825 (-0.14 )	195	.7335 (-2.68 )
20	.9780 (-0.18 )	200	.7010 (-3.07 )
25	.9660 (-0.29 )	205	.6475 (-3.76 )
30	.9540 (-0.4 )	210	.5940 (-4.51 )
35	.9610 (-0.34 )	215	.5690 (-4.88 )
40	.9680 (-0.27 )	220	.5440 (-5.27 )
45	.9775 (-0.19 )	225	.5290 (-5.51 )
50	.9870 (-0.1 )	230	.5140 (-5.76 )
55	.9905 (-0.07 )	235	.5195 (-5.67 )
60	.9940 (-0.04 )	240	.5250 (-5.58 )
65	.9970 (-0.02 )	245	.5630 (-4.97 )
70	1.0000 ( 0.01 )	250	.6010 (-4.41 )
75	.9960 (-0.03 )	255	.6910 (-3.2 )
80	.9920 (-0.06 )	260	.7810 (-2.14 )
85	.9910 (-0.07 )	265	.7785 (-2.16 )
90	.9900 (-0.08 )	270	.7760 (-2.19 )
95	.9950 (-0.03 )	275	.7230 (-2.81 )
100	1.0000 ( 0.01 )	280	.6700 (-3.47 )
105	.9935 (-0.05 )	285	.6600 (-3.6 )
110	.9870 (-0.1 )	290	.6500 (-3.73 )
115	.9895 (-0.08 )	295	.6350 (-3.93 )
120	.9920 (-0.06 )	300	.6200 (-4.14 )
125	.9895 (-0.08 )	305	.5945 (-4.5 )
130	.9870 (-0.1 )	310	.5690 (-4.88 )
135	.9825 (-0.14 )	315	.5850 (-4.64 )
140	.9780 (-0.18 )	320	.6010 (-4.41 )
145	.9660 (-0.29 )	325	.6145 (-4.22 )
150	.9540 (-0.4 )	330	.6280 (-4.03 )
155	.9200 (-0.71 )	335	.6690 (-3.48 )
160	.8860 (-1.04 )	340	.7100 (-2.96 )
165	.8740 (-1.16 )	345	.7775 (-2.17 )
170	.8620 (-1.28 )	350	.8450 (-1.45 )
175	.8410 (-1.49 )	355	.9225 (-0.69 )

## Systems With Reliability

CLIENT: KSSO

Date: 7/17/2012

ANTENNA TYPE: FM3/3 DA

FREQUENCY: 89.3 MHz

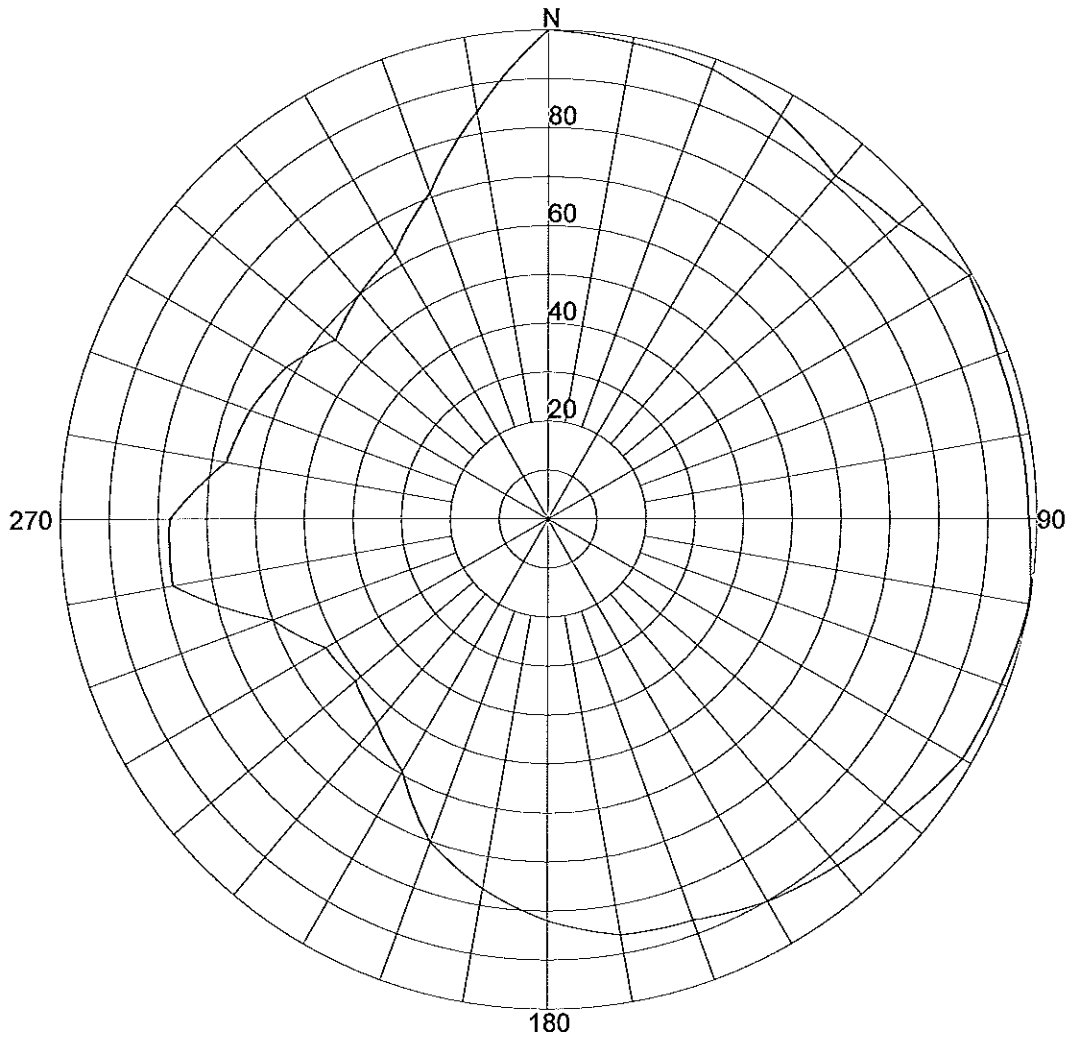
PATTERN POL.: Circular

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.43572 / 1.57dB

PATTERN RMS: 0.835

## Exhibit 2: Measured Horizontal Polarized Azimuth Pattern



Azimuth Pattern

Scale: Linear

Unit: Relative Field

### Systems With Reliability

CLIENT: KSSO

Date: 7/17/2012

ANTENNA TYPE: FM3/3 DA

FREQUENCY: 105.3 MHz

PATTERN POL.: Horizontal

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.47193 / 1.68dB

PATTERN RMS: 0.824

## Exhibit 2 (cont'd): Measured Horizontal Polarized Azimuth Pattern Tabulations

### Relative Field Tabulation(Azimuth)

Azimuth Heading	Relative Field(dB)	Azimuth Heading	Relative Field(dB)
0	1.0000 ( 0.01 )	180	.8200 (-1.71 )
5	.9935 (-0.05 )	185	.7930 (-2 )
10	.9870 (-0.1 )	190	.7660 (-2.3 )
15	.9825 (-0.14 )	195	.7335 (-2.68 )
20	.9780 (-0.18 )	200	.7010 (-3.07 )
25	.9645 (-0.3 )	205	.6475 (-3.76 )
30	.9510 (-0.43 )	210	.5940 (-4.51 )
35	.9325 (-0.6 )	215	.5690 (-4.88 )
40	.9140 (-0.77 )	220	.5440 (-5.27 )
45	.9255 (-0.66 )	225	.5290 (-5.51 )
50	.9370 (-0.56 )	230	.5140 (-5.76 )
55	.9655 (-0.3 )	235	.5195 (-5.67 )
60	.9940 (-0.04 )	240	.5250 (-5.58 )
65	.9865 (-0.11 )	245	.5630 (-4.97 )
70	.9790 (-0.18 )	250	.6010 (-4.41 )
75	.9795 (-0.17 )	255	.6910 (-3.2 )
80	.9800 (-0.17 )	260	.7810 (-2.14 )
85	.9820 (-0.15 )	265	.7785 (-2.16 )
90	.9840 (-0.13 )	270	.7760 (-2.19 )
95	.9920 (-0.06 )	275	.7230 (-2.81 )
100	1.0000 ( 0.01 )	280	.6700 (-3.47 )
105	.9935 (-0.05 )	285	.6600 (-3.6 )
110	.9870 (-0.1 )	290	.6500 (-3.73 )
115	.9835 (-0.14 )	295	.6350 (-3.93 )
120	.9800 (-0.17 )	300	.6200 (-4.14 )
125	.9620 (-0.33 )	305	.5945 (-4.5 )
130	.9440 (-0.49 )	310	.5690 (-4.88 )
135	.9335 (-0.59 )	315	.5850 (-4.64 )
140	.9230 (-0.69 )	320	.6010 (-4.41 )
145	.9120 (-0.79 )	325	.6145 (-4.22 )
150	.9010 (-0.9 )	330	.6280 (-4.03 )
155	.8860 (-1.04 )	335	.6690 (-3.48 )
160	.8710 (-1.19 )	340	.7100 (-2.96 )
165	.8665 (-1.23 )	345	.7775 (-2.17 )
170	.8620 (-1.28 )	350	.8450 (-1.45 )
175	.8410 (-1.49 )	355	.9225 (-0.69 )

### Systems With Reliability

CLIENT: KSSO

Date: 7/17/2012

ANTENNA TYPE: FM3/3 DA

FREQUENCY: 105.3 MHz

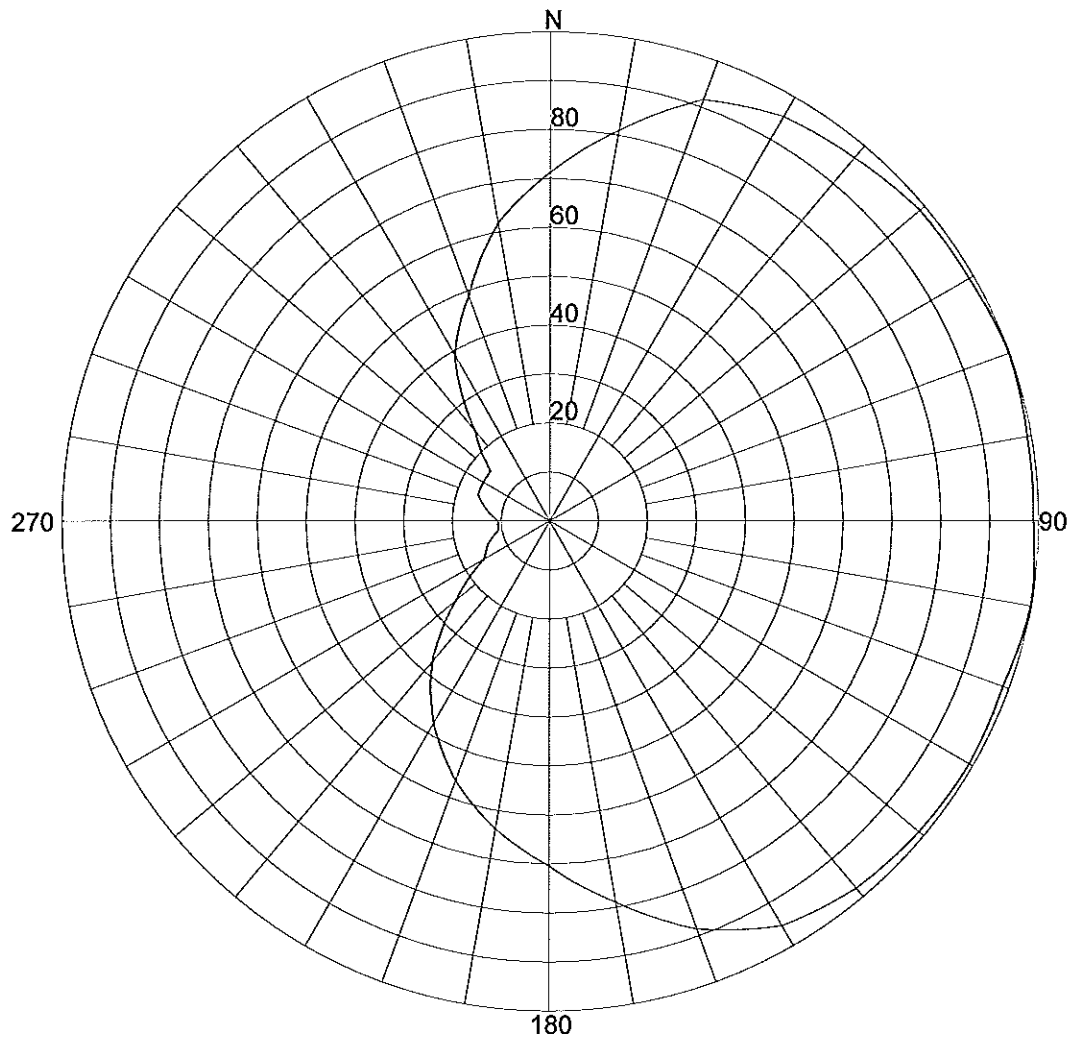
PATTERN POL.: Horizontal

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.47193 / 1.68dB

PATTERN RMS: 0.824

### Exhibit 3: Measured Vertical Polarized Azimuth Pattern



Azimuth Pattern

Scale: Linear

Unit: Relative Field

### Systems With Reliability

CLIENT: KSSO

Date: 7/17/2012

ANTENNA TYPE: FM3/3 DA

FREQUENCY: 89.3 MHz

PATTERN POL.: Vertical

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.93675 / 2.87dB

PATTERN RMS: 0.719

# Exhibit 3 (cont'd): Measured Vertical Polarized Azimuth Pattern Tabulations

## Relative Field Tabulation(Azimuth)

Azimuth Heading	Relative Field(dB)	Azimuth Heading	Relative Field(dB)
0	.7120 (-2.94 )	180	.7040 (-3.04 )
5	.7610 (-2.36 )	185	.6710 (-3.45 )
10	.8100 (-1.82 )	190	.6380 (-3.89 )
15	.8630 (-1.27 )	195	.6005 (-4.42 )
20	.9160 (-0.75 )	200	.5630 (-4.97 )
25	.9350 (-0.57 )	205	.5190 (-5.68 )
30	.9540 (-0.4 )	210	.4750 (-6.45 )
35	.9610 (-0.34 )	215	.4250 (-7.41 )
40	.9680 (-0.27 )	220	.3750 (-8.5 )
45	.9775 (-0.19 )	225	.3130 (-10.06 )
50	.9870 (-0.1 )	230	.2510 (-11.97 )
55	.9885 (-0.09 )	235	.2035 (-13.79 )
60	.9900 (-0.08 )	240	.1560 (-16.08 )
65	.9950 (-0.03 )	245	.1450 (-16.71 )
70	1.0000 ( 0.01 )	250	.1340 (-17.39 )
75	.9960 (-0.03 )	255	.1205 (-18.31 )
80	.9920 (-0.06 )	260	.1070 (-19.33 )
85	.9910 (-0.07 )	265	.1065 (-19.37 )
90	.9900 (-0.08 )	270	.1060 (-19.41 )
95	.9950 (-0.03 )	275	.1190 (-18.42 )
100	1.0000 ( 0.01 )	280	.1320 (-17.52 )
105	.9935 (-0.05 )	285	.1445 (-16.74 )
110	.9870 (-0.1 )	290	.1570 (-16.03 )
115	.9895 (-0.08 )	295	.1575 (-16 )
120	.9920 (-0.06 )	300	.1580 (-15.97 )
125	.9895 (-0.08 )	305	.1585 (-15.94 )
130	.9870 (-0.1 )	310	.1590 (-15.92 )
135	.9825 (-0.14 )	315	.1985 (-14 )
140	.9780 (-0.18 )	320	.2380 (-12.43 )
145	.9660 (-0.29 )	325	.3155 (-9.99 )
150	.9540 (-0.4 )	330	.3930 (-8.09 )
155	.9200 (-0.71 )	335	.4415 (-7.08 )
160	.8860 (-1.04 )	340	.4900 (-6.18 )
165	.8380 (-1.52 )	345	.5540 (-5.11 )
170	.7900 (-2.04 )	350	.6180 (-4.17 )
175	.7470 (-2.52 )	355	.6650 (-3.53 )

## Systems With Reliability

CLIENT: KSSO

Date: 7/17/2012

ANTENNA TYPE: FM3/3 DA

FREQUENCY: 89.3 MHz

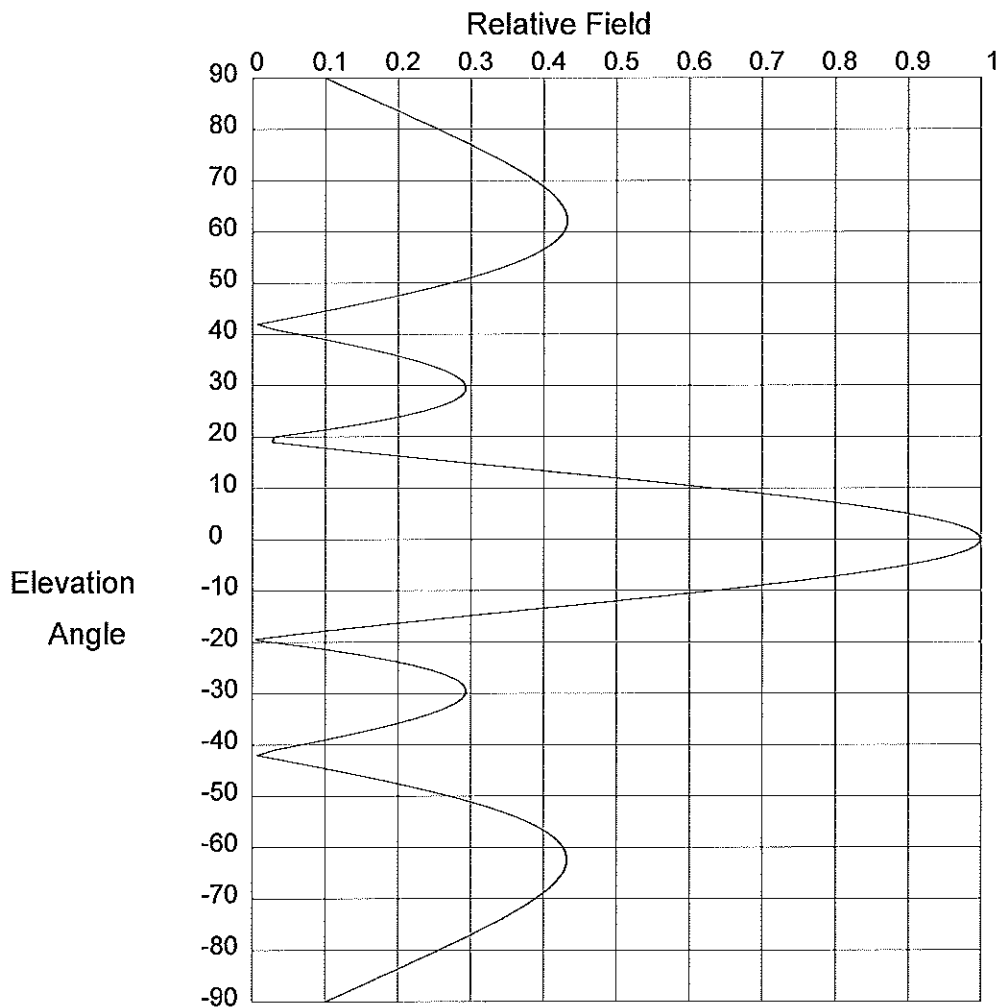
PATTERN POL.: Vertical

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.93675 / 2.87dB

PATTERN RMS: 0.719

## Exhibit 4: Elevation Pattern



### Elevation Pattern

Scale: Linear

Units: Field, Relative

### Systems With Reliability

CLIENT: KSSO / Family Worship Center

Date: 7/17/2012

ANTENNA TYPE: FM3/3 DA

FREQUENCY: 89.3 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 2.991/4.758 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 2.991/4.758 dBd

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

# Exhibit 4 (cont'd): Elevation Pattern Tabulations

## Relative Field Tabulation

Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)
90.0	.10 (-20)	52.0	.321 (-9.865)	14.0	.357 (-8.938)
89.0	.116 (-18.733)	51.0	.298 (-10.529)	13.0	.428 (-7.377)
88.0	.131 (-17.628)	50.0	.272 (-11.318)	12.0	.498 (-6.062)
87.0	.147 (-16.648)	49.0	.244 (-12.26)	11.0	.566 (-4.942)
86.0	.163 (-15.769)	48.0	.214 (-13.395)	10.0	.632 (-3.982)
85.0	.178 (-14.972)	47.0	.182 (-14.784)	9.8	.645 (-3.807)
84.0	.194 (-14.244)	46.0	.149 (-16.526)	9.6	.658 (-3.637)
83.0	.21 (-13.575)	45.0	.115 (-18.805)	9.4	.671 (-3.472)
82.0	.225 (-12.957)	44.0	.079 (-22.01)	9.2	.683 (-3.312)
81.0	.24 (-12.385)	43.0	.043 (-27.275)	9.0	.695 (-3.157)
80.0	.256 (-11.852)	42.0	.007 (-43.22)	8.8	.707 (-3.006)
79.0	.271 (-11.356)	41.0	.029 (-30.637)	8.6	.719 (-2.86)
78.0	.285 (-10.893)	40.0	.065 (-23.719)	8.4	.731 (-2.719)
77.0	.30 (-10.462)	39.0	.10 (-19.999)	8.2	.743 (-2.582)
76.0	.314 (-10.06)	38.0	.133 (-17.494)	8.0	.754 (-2.449)
75.0	.328 (-9.686)	37.0	.165 (-15.651)	7.8	.766 (-2.321)
74.0	.341 (-9.339)	36.0	.194 (-14.237)	7.6	.777 (-2.196)
73.0	.354 (-9.018)	35.0	.22 (-13.132)	7.4	.787 (-2.076)
72.0	.366 (-8.724)	34.0	.243 (-12.271)	7.2	.798 (-1.959)
71.0	.378 (-8.455)	33.0	.263 (-11.612)	7.0	.808 (-1.847)
70.0	.389 (-8.211)	32.0	.278 (-11.131)	6.8	.819 (-1.738)
69.0	.398 (-7.995)	31.0	.288 (-10.815)	6.6	.829 (-1.633)
68.0	.407 (-7.804)	30.0	.293 (-10.658)	6.4	.838 (-1.532)
67.0	.415 (-7.642)	29.0	.293 (-10.662)	6.2	.848 (-1.434)
66.0	.421 (-7.507)	28.0	.287 (-10.834)	6.0	.857 (-1.34)
65.0	.426 (-7.403)	27.0	.276 (-11.192)	5.8	.866 (-1.249)
64.0	.43 (-7.329)	26.0	.258 (-11.764)	5.6	.875 (-1.162)
63.0	.432 (-7.287)	25.0	.234 (-12.598)	5.4	.883 (-1.078)
62.0	.432 (-7.281)	24.0	.205 (-13.772)	5.2	.891 (-0.998)
61.0	.431 (-7.31)	23.0	.169 (-15.43)	5.0	.899 (-0.921)
60.0	.428 (-7.38)	22.0	.128 (-17.86)	4.8	.907 (-0.847)
59.0	.422 (-7.491)	21.0	.081 (-21.813)	4.6	.914 (-0.777)
58.0	.415 (-7.648)	20.0	.029 (-30.657)	4.4	.922 (-0.709)
57.0	.405 (-7.856)	19.0	.027 (-31.323)	4.2	.928 (-0.645)
56.0	.393 (-8.119)	18.0	.088 (-21.139)	4.0	.935 (-0.584)
55.0	.378 (-8.442)	17.0	.152 (-16.379)	3.8	.941 (-0.527)
54.0	.362 (-8.835)	16.0	.219 (-13.21)	3.6	.947 (-0.472)
53.0	.343 (-9.305)	15.0	.287 (-10.833)	3.4	.953 (-0.421)

## Systems With Reliability

Page 1 of 3

CLIENT: KSSO / Family Worship Center

Date: 7/17/2012

ANTENNA TYPE: FM3/3 DA

FREQUENCY: 89.3 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 2.991/4.758 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 2.991/4.758 dBd

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

# Exhibit 4 (cont'd): Elevation Pattern Tabulations

## Relative Field Tabulation

Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)
3.2	.958 (-0.372)	-4.4	.922 (-0.709)	-12.0	.498 (-6.062)
3.0	.963 (-0.327)	-4.6	.914 (-0.777)	-12.2	.484 (-6.308)
2.8	.968 (-0.284)	-4.8	.907 (-0.847)	-12.4	.47 (-6.562)
2.6	.972 (-0.245)	-5.0	.899 (-0.921)	-12.6	.456 (-6.825)
2.4	.976 (-0.208)	-5.2	.891 (-0.998)	-12.8	.442 (-7.096)
2.2	.98 (-0.175)	-5.4	.883 (-1.078)	-13.0	.428 (-7.377)
2.0	.983 (-0.145)	-5.6	.875 (-1.162)	-13.2	.414 (-7.667)
1.8	.987 (-0.117)	-5.8	.866 (-1.249)	-13.4	.40 (-7.968)
1.6	.989 (-0.092)	-6.0	.857 (-1.34)	-13.6	.385 (-8.28)
1.4	.992 (-0.071)	-6.2	.848 (-1.434)	-13.8	.371 (-8.603)
1.2	.994 (-0.052)	-6.4	.838 (-1.532)	-14.0	.357 (-8.938)
1.0	.996 (-0.036)	-6.6	.829 (-1.633)	-14.2	.343 (-9.287)
.8	.997 (-0.023)	-6.8	.819 (-1.738)	-14.4	.329 (-9.65)
.6	.999 (-0.013)	-7.0	.808 (-1.847)	-14.6	.315 (-10.027)
.4	.999 (-0.006)	-7.2	.798 (-1.959)	-14.8	.301 (-10.421)
.2	1.00 (-0.001)	-7.4	.787 (-2.076)	-15.0	.287 (-10.833)
.0	1.00 (0)	-7.6	.777 (-2.196)	-15.2	.273 (-11.263)
-.2	1.00 (-0.001)	-7.8	.766 (-2.321)	-15.4	.26 (-11.714)
-.4	.999 (-0.006)	-8.0	.754 (-2.449)	-15.6	.246 (-12.187)
-.6	.999 (-0.013)	-8.2	.743 (-2.582)	-15.8	.232 (-12.685)
-.8	.997 (-0.023)	-8.4	.731 (-2.719)	-16.0	.219 (-13.21)
-1.0	.996 (-0.036)	-8.6	.719 (-2.86)	-16.2	.205 (-13.766)
-1.2	.994 (-0.052)	-8.8	.707 (-3.006)	-16.4	.192 (-14.356)
-1.4	.992 (-0.071)	-9.0	.695 (-3.157)	-16.6	.178 (-14.984)
-1.6	.989 (-0.092)	-9.2	.683 (-3.312)	-16.8	.165 (-15.656)
-1.8	.987 (-0.117)	-9.4	.671 (-3.472)	-17.0	.152 (-16.379)
-2.0	.983 (-0.145)	-9.6	.658 (-3.637)	-17.2	.139 (-17.16)
-2.2	.98 (-0.175)	-9.8	.645 (-3.807)	-17.4	.126 (-18.01)
-2.4	.976 (-0.208)	-10.0	.632 (-3.982)	-17.6	.113 (-18.943)
-2.6	.972 (-0.245)	-10.2	.619 (-4.163)	-17.8	.10 (-19.978)
-2.8	.968 (-0.284)	-10.4	.606 (-4.349)	-18.0	.088 (-21.139)
-3.0	.963 (-0.327)	-10.6	.593 (-4.541)	-18.2	.075 (-22.464)
-3.2	.958 (-0.372)	-10.8	.58 (-4.739)	-18.4	.063 (-24.008)
-3.4	.953 (-0.421)	-11.0	.566 (-4.942)	-18.6	.051 (-25.862)
-3.6	.947 (-0.472)	-11.2	.553 (-5.153)	-18.8	.039 (-28.188)
-3.8	.941 (-0.527)	-11.4	.539 (-5.37)	-19.0	.027 (-31.323)
-4.0	.935 (-0.584)	-11.6	.525 (-5.593)	-19.2	.016 (-36.185)
-4.2	.928 (-0.645)	-11.8	.511 (-5.824)	-19.4	.004 (-47.865)

## Systems With Reliability

Page 2 of 3

CLIENT: KSSO / Family Worship Center

Date: 7/17/2012

ANTENNA TYPE: FM3/3 DA

FREQUENCY: 89.3 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 2.991/4.758 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 2.991/4.758 dBd

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

# Exhibit 4 (cont'd): Elevation Pattern Tabulations

## Relative Field Tabulation

Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)
-19.6	.007 (-42.787)	-27.2	.278 (-11.104)	-54.0	.362 (-8.835)
-19.8	.018 (-34.715)	-27.4	.281 (-11.025)	-55.0	.378 (-8.442)
-20.0	.029 (-30.657)	-27.6	.283 (-10.953)	-56.0	.393 (-8.119)
-20.2	.04 (-27.943)	-27.8	.285 (-10.89)	-57.0	.405 (-7.856)
-20.4	.051 (-25.91)	-28.0	.287 (-10.834)	-58.0	.415 (-7.648)
-20.6	.061 (-24.292)	-28.2	.289 (-10.785)	-59.0	.422 (-7.491)
-20.8	.071 (-22.952)	-28.4	.29 (-10.744)	-60.0	.428 (-7.38)
-21.0	.081 (-21.813)	-28.6	.291 (-10.71)	-61.0	.431 (-7.31)
-21.2	.091 (-20.825)	-28.8	.292 (-10.682)	-62.0	.432 (-7.281)
-21.4	.101 (-19.956)	-29.0	.293 (-10.662)	-63.0	.432 (-7.287)
-21.6	.11 (-19.183)	-29.2	.293 (-10.648)	-64.0	.43 (-7.329)
-21.8	.119 (-18.489)	-29.4	.294 (-10.641)	-65.0	.426 (-7.403)
-22.0	.128 (-17.86)	-29.6	.294 (-10.64)	-66.0	.421 (-7.507)
-22.2	.137 (-17.288)	-29.8	.294 (-10.646)	-67.0	.415 (-7.642)
-22.4	.145 (-16.765)	-30.0	.293 (-10.658)	-68.0	.407 (-7.804)
-22.6	.153 (-16.284)	-31.0	.288 (-10.815)	-69.0	.398 (-7.995)
-22.8	.161 (-15.84)	-32.0	.278 (-11.131)	-70.0	.389 (-8.211)
-23.0	.169 (-15.43)	-33.0	.263 (-11.612)	-71.0	.378 (-8.455)
-23.2	.177 (-15.049)	-34.0	.243 (-12.271)	-72.0	.366 (-8.724)
-23.4	.184 (-14.695)	-35.0	.22 (-13.132)	-73.0	.354 (-9.018)
-23.6	.191 (-14.366)	-36.0	.194 (-14.237)	-74.0	.341 (-9.339)
-23.8	.198 (-14.059)	-37.0	.165 (-15.651)	-75.0	.328 (-9.686)
-24.0	.205 (-13.772)	-38.0	.133 (-17.494)	-76.0	.314 (-10.06)
-24.2	.211 (-13.505)	-39.0	.10 (-19.999)	-77.0	.30 (-10.462)
-24.4	.217 (-13.254)	-40.0	.065 (-23.719)	-78.0	.285 (-10.893)
-24.6	.223 (-13.021)	-41.0	.029 (-30.637)	-79.0	.271 (-11.356)
-24.8	.229 (-12.802)	-42.0	.007 (-43.22)	-80.0	.256 (-11.852)
-25.0	.234 (-12.598)	-43.0	.043 (-27.275)	-81.0	.24 (-12.385)
-25.2	.24 (-12.407)	-44.0	.079 (-22.01)	-82.0	.225 (-12.957)
-25.4	.245 (-12.229)	-45.0	.115 (-18.805)	-83.0	.21 (-13.575)
-25.6	.249 (-12.063)	-46.0	.149 (-16.526)	-84.0	.194 (-14.244)
-25.8	.254 (-11.908)	-47.0	.182 (-14.784)	-85.0	.178 (-14.972)
-26.0	.258 (-11.764)	-48.0	.214 (-13.395)	-86.0	.163 (-15.769)
-26.2	.262 (-11.63)	-49.0	.244 (-12.26)	-87.0	.147 (-16.648)
-26.4	.266 (-11.507)	-50.0	.272 (-11.318)	-88.0	.131 (-17.628)
-26.6	.269 (-11.393)	-51.0	.298 (-10.529)	-89.0	.116 (-18.733)
-26.8	.273 (-11.288)	-52.0	.321 (-9.865)	-90.0	.10 (-20)
-27.0	.276 (-11.192)	-53.0	.343 (-9.305)	90.0	.00 (-50)

## Systems With Reliability

Page 3 of 3

CLIENT: KSSO / Family Worship Center

Date: 7/17/2012

ANTENNA TYPE: FM3/3 DA

FREQUENCY: 89.3 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 2.991/4.758 dBd

Beam Tilt (Deg.): 0

DIRECTIVITY(Horiz): 2.991/4.758 dBd

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

## Exhibit 5: Antenna Data Sheet



SYSTEMS WITH RELIABILITY, LLP

BROADCAST ANTENNAS AND TRANSMISSION LINE

# SYSTEM DATA SHEET

Customer	KSSO
Contact	Tyson Evans
Location	Norman, OK
Antenna Model	FM3/3 DA
Channel / Frequency	207A / 89.3 MHz

### ELECTRICAL SPECIFICATIONS

#### Antenna Specifications:

	H-POL			V. Pol.	
License ERP ( KW)	5.600	7.482	dB	5.600	7.482 dB
FCC Limit Pattern Directivity	1.138	0.563	dB	1.138	0.563 dB
Elevation Directivity	2.991	4.758	dB	2.991	4.758 dB
Azimuth Directivity	1.472	1.679	dB	1.937	2.871 dB
Composite Pattern	1.436	1.571	dB	1.436	1.571 dB
Polarization Ratio	0.568	-2.455	dB	0.432	-3.647 dB
RMS Comp./RMS Limit	89.05 %				
Antenna Efficiency %	100			100	
Power Ratio ( Pol. Ratio X Efficiency)	0.5682			0.4318	
Antenna Gain	2.501	3.982	dB	2.501	3.982 dB

Antenna Input Power (KW)	2.239 kW	3.500 (dBK)
--------------------------	----------	-------------

#### Feed Line Specifications:

Line Type	1 5/8" Air 50 $\Omega$ HJ7-50A
Attenuation Per 100 ft (dB)	0.195 dB
Line Length (ft) AGL + 50' Horizontal Run	197.94 ft.
Total Line Attenuation (dB)	0.3860 dB
Line Efficiency	91.50 %
Power Input to the Line (KW)	2.447 kW 3.886 (dBK)

### MECHANICAL SPECIFICATIONS

No. Of Bays	3		
Antenna Aperture	22.03 ft.	6.72	meter
Center of Radiation AGL	147.94 ft.	45.09	meter
Antenna Weight	150.00 lbs.	68.18	kg
Windload (50/33)	325.00 lbs.	Windload CaAc	9.50 ft <sup>2</sup>

Prepared by:

*David K. Edmiston Jr.*

David K. Edmiston Jr.  
SWR, LLP

## Exhibit 6: RMS Caculations



**SYSTEMS WITH RELIABILITY, INC.**  
Broadcast Antennas and Transmission Systems

# KSSO Antenna RMS Comparison

### PROPOSED ANTENNA

Azimuth  
Heading      Relative  
Field

0	1.000
10	1.000
20	1.000
30	1.000
40	1.000
50	1.000
60	1.000
70	1.000
80	1.000
90	1.000
100	1.000
110	1.000
120	1.000
130	1.000
140	1.000
150	1.000
160	1.000
170	1.000
180	1.000
190	1.000
200	1.000
210	1.000
220	1.000
230	1.000
240	1.000
250	1.000
260	1.000
270	0.841
280	0.670
290	0.650
300	0.620
310	0.620
320	0.700
330	0.710
340	0.710
350	0.891

### DESIGNED ANTENNA

Azimuth  
Heading      Relative  
Field

0	1.000
10	0.987
20	0.978
30	0.954
40	0.968
50	0.987
60	0.994
70	1.000
80	0.992
90	0.990
100	1.000
110	0.987
120	0.992
130	0.987
140	0.978
150	0.954
160	0.886
170	0.862
180	0.820
190	0.766
200	0.701
210	0.594
220	0.544
230	0.514
240	0.525
250	0.601
260	0.781
270	0.776
280	0.670
290	0.650
300	0.620
310	0.569
320	0.601
330	0.628
340	0.710
350	0.845

Sum of Relative Field Squared :      31.640  
Sum Divided by 36 (Readings) :      0.879  
Square Root :      0.937

Sum of Relative Field Squared :      25.097  
Sum Divided by 36 (Readings) :      0.697  
Square Root :      0.835

Percentage of Construction Permit Antenna Filled :

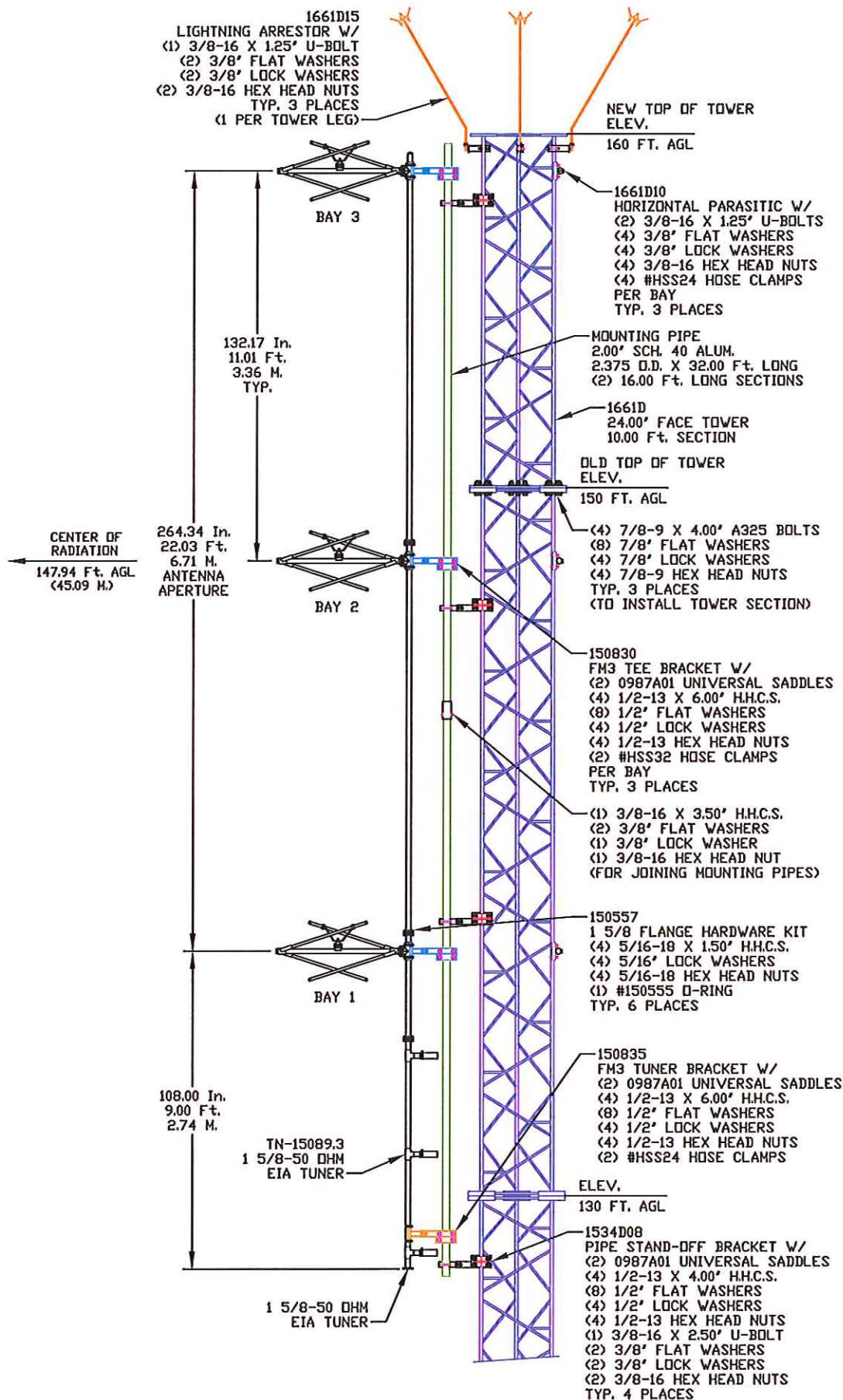
**89.1%**

# NOTES:

1. REFERENCE DWG. 1661D01 FOR ANTENNA ORIENTATION.
2. REFERENCE DWG. 1661D02 FOR PARASITIC PLACEMENT.

## Exhibit 7: Drawings

DRAWING NUMBER: 1661D00



SYSTEMS WITH RELIABILITY, INC.  
619 INDUSTRIAL PARK ROAD  
EBENSBURG, PENNSYLVANIA 15931

TITLE: FM3/3-DA, FREQ. 89.3  
KSSO, NORMAN, OK

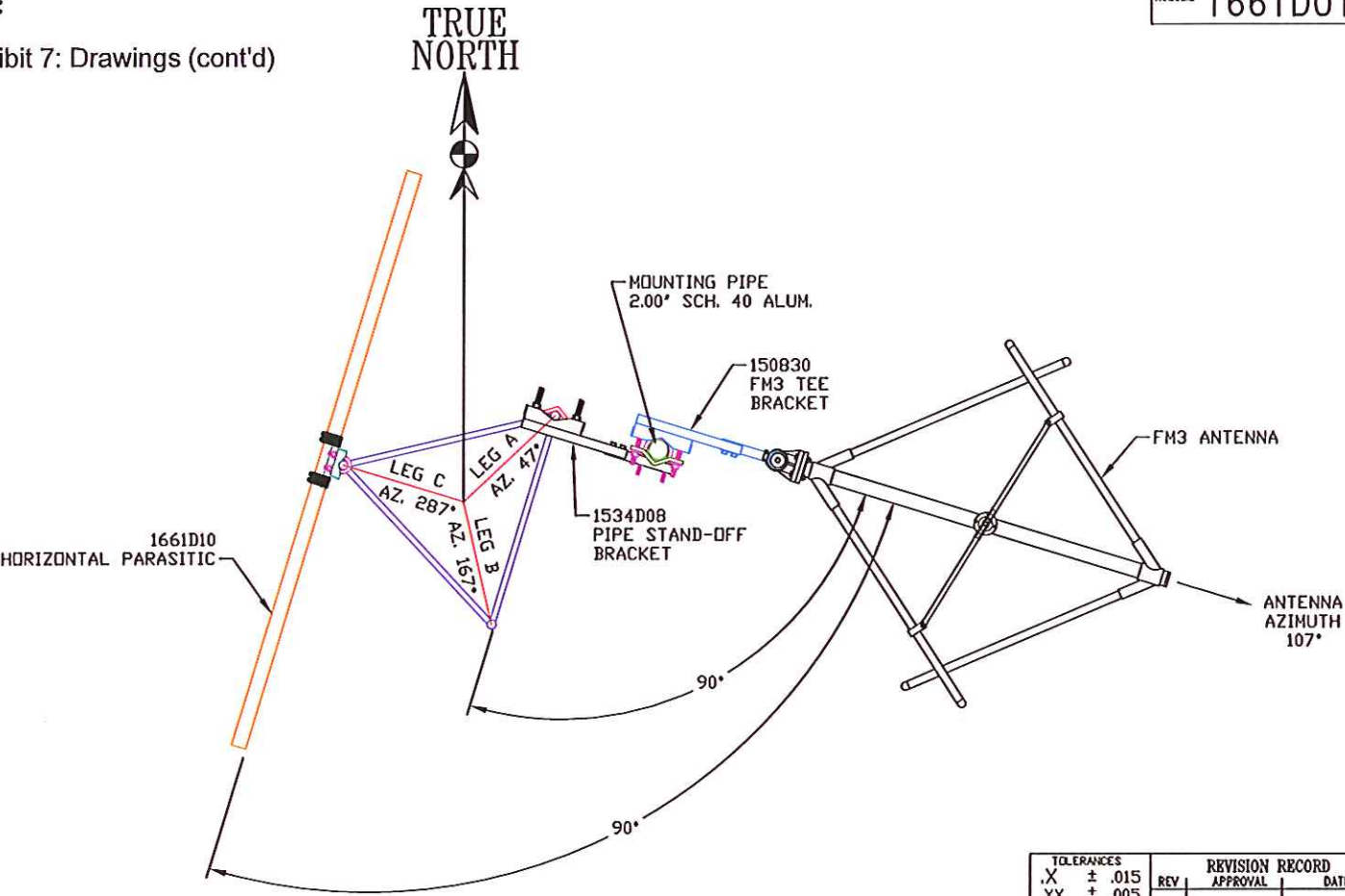
SIZE: REM APPR. DATE: ENGINEER:  
C 1 2 3

SCALE: NTS NAME: RAC DATE: 7/17/12 SHEET: 1 OF 1

DRAWING NUMBER: 1661D00

NOTE:  
Exhibit 7: Drawings (cont'd)

DRAWING  
NUMBER: 1661D01



TOP VIEW

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, INC  
619 INDUSTRIAL PARK ROAD  
EBENSBURG, PENNSYLVANIA 15931

TITLE: FM3/3-DA, FREQ. 89.3  
KSSO, NORMAN, OK  
MATERIAL: ANTENNA ORIENTATION  
FROM TRUE NORTH

SIZE

A

PARTS MADE BY THIS DRAWING

SCALE: NTS

NAME: RAC

DATE: 7/17/12

SHEET 1 OF 1

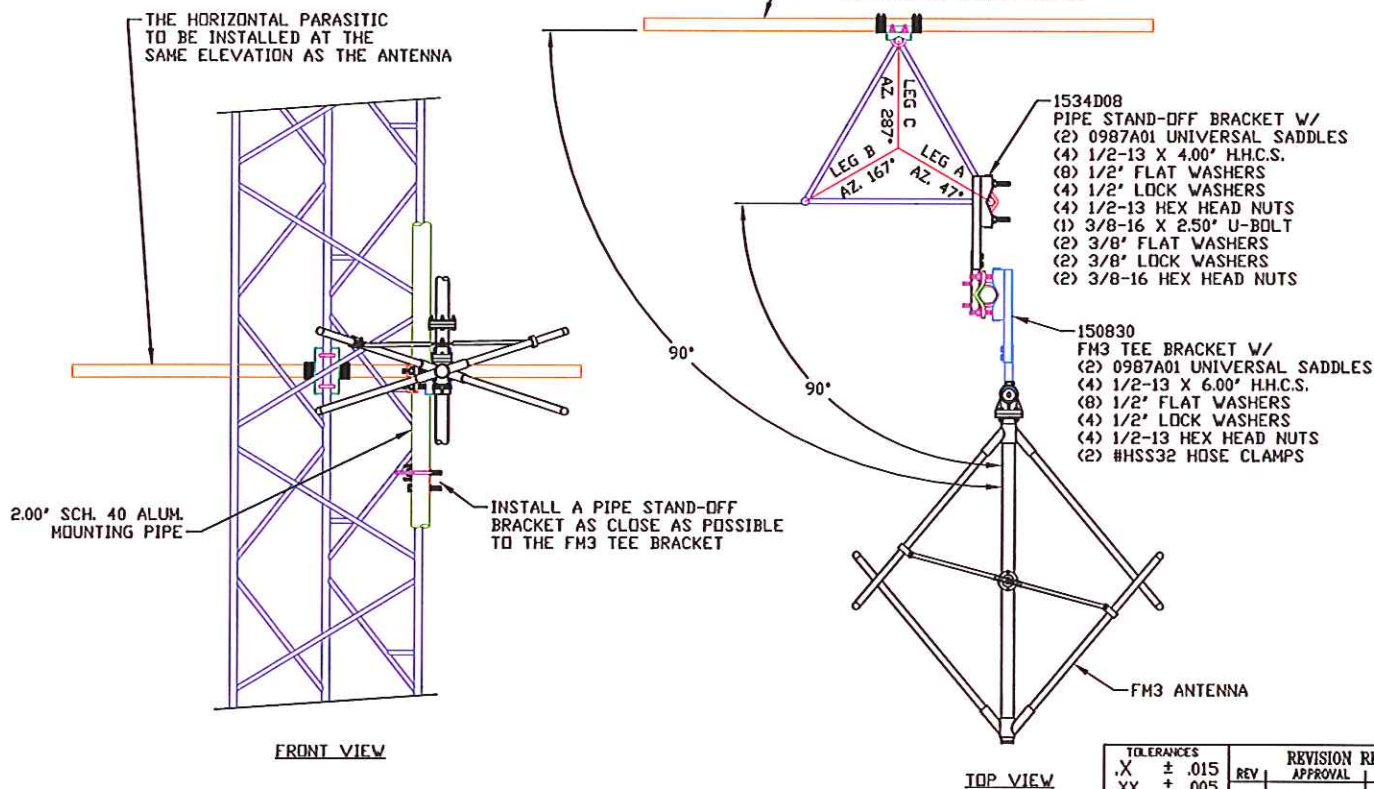
DRAWING  
NUMBER: 1661D01

NOTE:

THIS INSTALLATION IS TYPICAL FOR ALL 3 BAYS.

Exhibit 7: Drawings (cont'd)

DRAWING NUMBER: 1661D02



TOLERANCES		REVISION RECORD		
		REV	APPROVAL	DATE
.X	± .015			
.XX	± .005			
.XXX	± .002			
X/X	± 1/32			
DEG.	± 1/2			
UNLESS OTHERWISE SPECIFIED				
PARTS MADE BY THIS DRAWING		DRAWING NUMBER: 1661D02		
SCALE: NTS	NAME: RAC	DATE: 7/17/12	SHEET 1 OF 1	



SYSTEMS WITH RELIABILITY, INC.  
619 INDUSTRIAL PARK ROAD  
EBENSBURG, PENNSYLVANIA 15931

TITLE: FM3/3-DA, FREQ. 89.3  
KSSO, NORMAN, OK

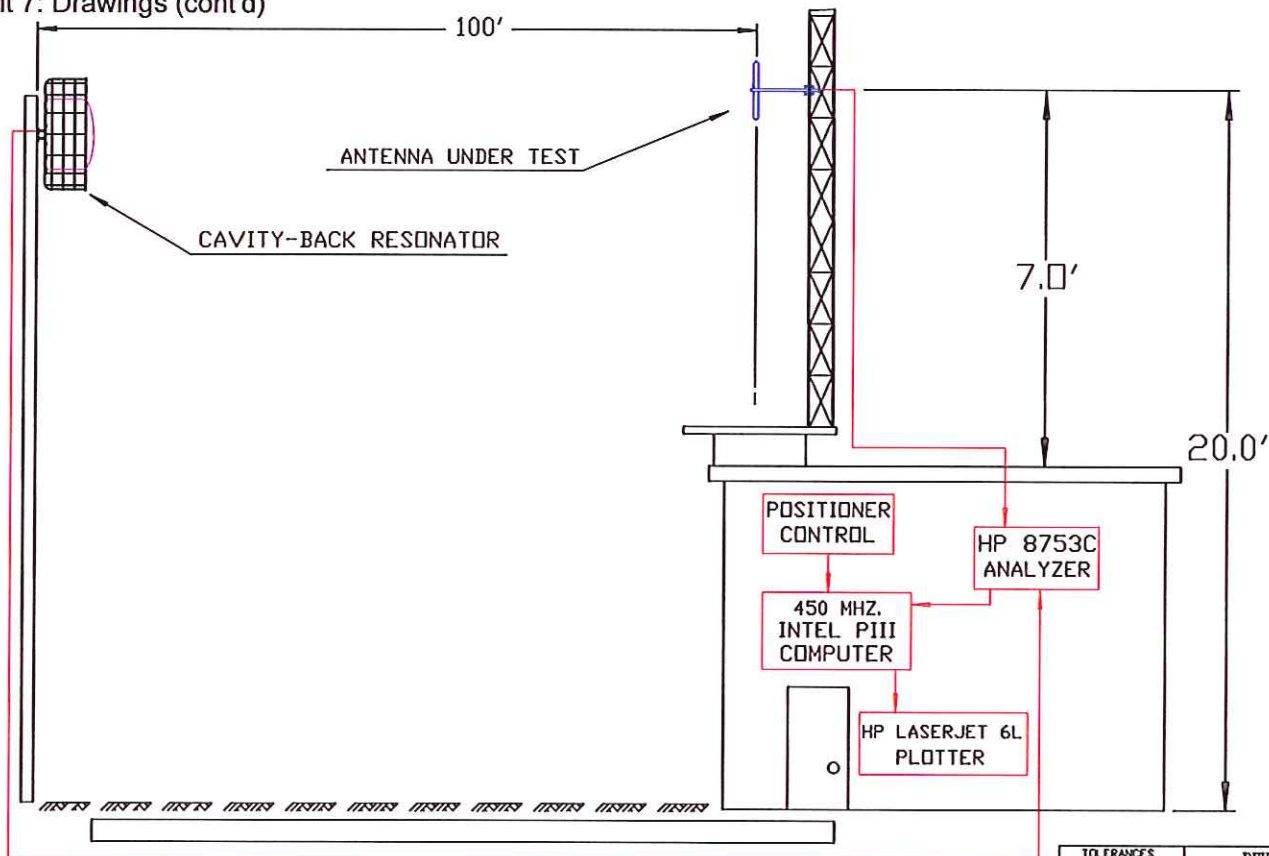
MATERIAL:

SIZE  
A

NOTE:

Exhibit 7: Drawings (cont'd)

DRAWING NUMBER: 2105A10



TOLERANCES		REVISION RECORD		
		REV	APPROVAL	DATE
.X	± .015			
.XX	± .005			
.XXX	± .002			
X/X	± 1/32			
DEG.	± 1/2			
UNLESS OTHERWISE SPECIFIED				
		2		10/7/05
		1		4/30/02
PARTS MADE BY THIS DRAWING		DRAWING NUMBER: 2105A10		
SCALE: NTS	NAME: JRM	DATE: 11/1/98	SHEET 1 OF 1	



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

TITLE: TEST RANGE SCHEMATIC

MATERIAL:

SIZE  
A