



SYSTEMS WITH RELIABILITY, LLP
BROADCAST ANTENNAS AND TRANSMISSION LINE

PATTERN CERTIFICATION

DIRECTIONAL FM ANTENNA WZXH

February 24, 2009

Station	:	WZXH
Location	:	Hagerstown, MD
Frequency	:	91.7 MHz
Channel	:	219A
Antenna Model	:	FMEC/2 DA
Maximum Antenna Gain	:	
Vertical	:	2.686 / 4.292 dB
Horizontal	:	2.686 / 4.292 dB

ANTENNA DESCRIPTION

A custom designed FMEC/2 DA antenna was used to produce the required directional azimuth pattern. Each antenna bay consists of a circularly polarized Slant V dipole-radiating element with a horizontal and vertical parasitic system. The array is comprised of two bays, that are spaced a full wavelength apart, mounted to a pole that is mounted to a Rohn 80 tower pointing 328 degrees true north.

DESCRIPTION OF TEST PROCEDURE

The test antenna consists of a third-scale model antenna and parasitic system. This antenna was mounted to an 8-inch fully loaded in detail and scaled model tower with the use of mounting brackets supplied with the finalized antenna. The tower was 20 ft. on a platform. All feed cables were properly grounded during pattern testing. Horizontal and vertical parasitic elements were used 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 275.1 MHz. The antenna under test was rotated in a clockwise direction. A gain reference was taken using a dipole tuned to 275.1 MHz. Nowhere, does the received signal exceed a maximum to minimum ratio of 15 dB.

TEST RESULTS

The attached calculations verify that the **RMS** value of this antenna is **90.78 %** of the **RMS** value of the pattern authorized in the related construction permit **BMPED-20070806AFK**. The vertical component **RMS** value is **0.635**. The horizontal component **RMS** value is **0.557**. The circular polarized component **RMS** value is **0.769**.

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

Measured vertical polarized directivity:	2.478 / 3.940 dB
Measured horizontal polarized directivity:	3.221 / 5.080 dB
Measured circular polarized pattern directivity:	2.054 / 3.130 dB

Gain in each polarization was calculated using the following relation:

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

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

V-Pol. Gain =	(2.478)(.565)(1.918)	= 2.685/ 4.292 dB
H-Pol. Gain =	(3.221)(.435)(1.918)	= 2.685/ 4.292 dB

INSTALLATION AND MOUNTING

The antenna is to be mounted in accordance with the supplied drawings. The antenna center of radiation is to be **32 meters** above ground level. The antenna (parasitic system included) aperture is **16 feet**. No other antennas are to be mounted within **10 feet** of the radiating elements 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 **328 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
1278D00	ANTENNA ELEVATION
1278D01	ANTENNA ORIENTATION WITH PARASITICS
1278D02	PARASITIC MOUNTING PLACEMENT
2105A10	TEST RANGE SCHEMATIC

The array shall be mounted according to **DWG. 1278D00**. The parasitic assembly is shown in **DWG. 1278D00**, **DWG. 1278D01**, and **DWG. 1278D02**. The antenna elements shall be aligned at the same heading as in **DWG. 1278D01**. This will ensure that the antenna is oriented properly at 328 degrees true north.

DOCUMENT EXHIBITS

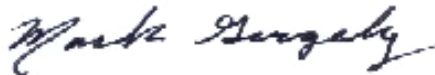
The following exhibits are included as part of this Certificate of Compliance:

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

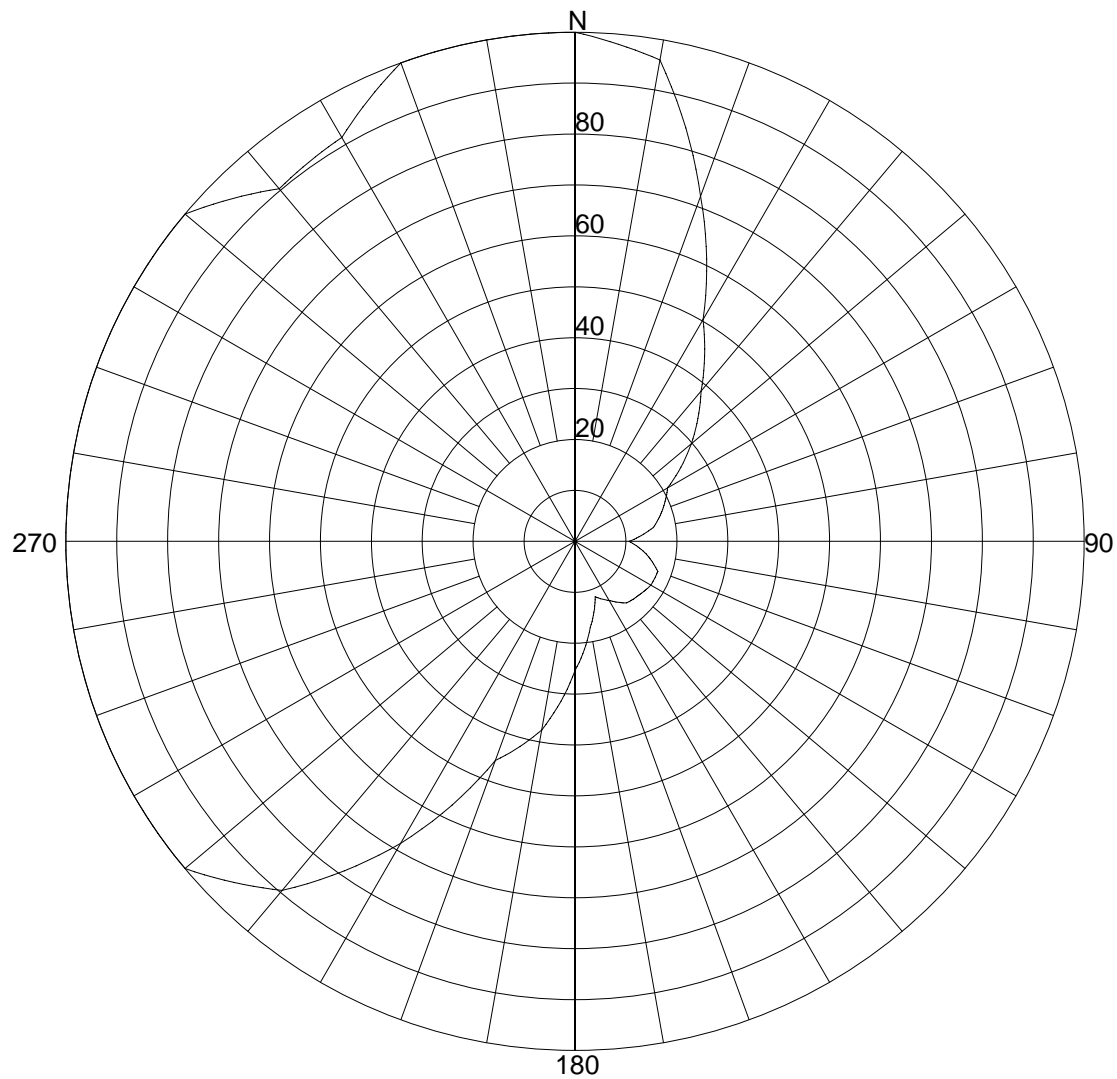
TEST EQUIPMENT

Network Analyzer	:	Hewlett Packard Model # 8753C Serial Number : 08753 – 69138 Calibrated 4/26/08, SWR, Inc.
Computer	:	Pentium 3, 450 MHz, Range Program
Printer	:	Hewlett-Packard Laser Jet 6L
Positioner	:	Orbit Positioner Calibrated 1/12/09, SWR, Inc.

Prepared by:



Mark A. Gergely
Electrical Engineer
Systems With Reliability LLP



Azimuth Pattern

Systems With Reliability (SWR) LLP

Scale: Linear

Unit: Relative Field

CLIENT: WZXH / Charles Loughery

Date: 2/12/2009

ANTENNA TYPE: FMEC/2 DA

FREQUENCY: 91.7 MHz

PATTERN POL.: Circular

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.05359 / 3.13dB

PATTERN RMS: 0.698

Relative Field Tabulation(Azimuth)

Azimuth Heading	Relative Field(dB)	Azimuth Heading	Relative Field(dB)
0	1.0000 (0.01)	180	.2540 (-11.87)
5	.9800 (-0.17)	185	.3150 (-10.01)
10	.9600 (-0.35)	190	.3760 (-8.47)
15	.8405 (-1.5)	195	.4170 (-7.58)
20	.7210 (-2.83)	200	.4580 (-6.76)
25	.6120 (-4.25)	205	.5715 (-4.84)
30	.5030 (-5.95)	210	.6850 (-3.27)
35	.4440 (-7.03)	215	.7900 (-2.04)
40	.3850 (-8.27)	220	.8950 (-0.95)
45	.3415 (-9.31)	225	.9475 (-0.46)
50	.2980 (-10.49)	230	1.0000 (0.01)
55	.2540 (-11.87)	235	1.0000 (0.01)
60	.2100 (-13.51)	240	1.0000 (0.01)
65	.1965 (-14.09)	245	1.0000 (0.01)
70	.1830 (-14.7)	250	1.0000 (0.01)
75	.1695 (-15.37)	255	1.0000 (0.01)
80	.1560 (-16.08)	260	1.0000 (0.01)
85	.1310 (-17.59)	265	1.0000 (0.01)
90	.1060 (-19.41)	270	1.0000 (0.01)
95	.1240 (-18.06)	275	1.0000 (0.01)
100	.1420 (-16.89)	280	1.0000 (0.01)
105	.1575 (-16)	285	1.0000 (0.01)
110	.1730 (-15.19)	290	1.0000 (0.01)
115	.1725 (-15.21)	295	1.0000 (0.01)
120	.1720 (-15.24)	300	1.0000 (0.01)
125	.1680 (-15.44)	305	1.0000 (0.01)
130	.1640 (-15.65)	310	1.0000 (0.01)
135	.1610 (-15.81)	315	.9520 (-0.42)
140	.1580 (-15.97)	320	.9040 (-0.87)
145	.1460 (-16.65)	325	.9100 (-0.81)
150	.1340 (-17.39)	330	.9160 (-0.75)
155	.1250 (-17.99)	335	.9580 (-0.36)
160	.1160 (-18.64)	340	1.0000 (0.01)
165	.1440 (-16.77)	345	1.0000 (0.01)
170	.1720 (-15.24)	350	1.0000 (0.01)
175	.2130 (-13.39)	355	1.0000 (0.01)

Systems With Reliability (SWR) LLP

CLIENT: WZXH / Charles Loughery

Date: 2/12/2009

ANTENNA TYPE: FMEC/2 DA

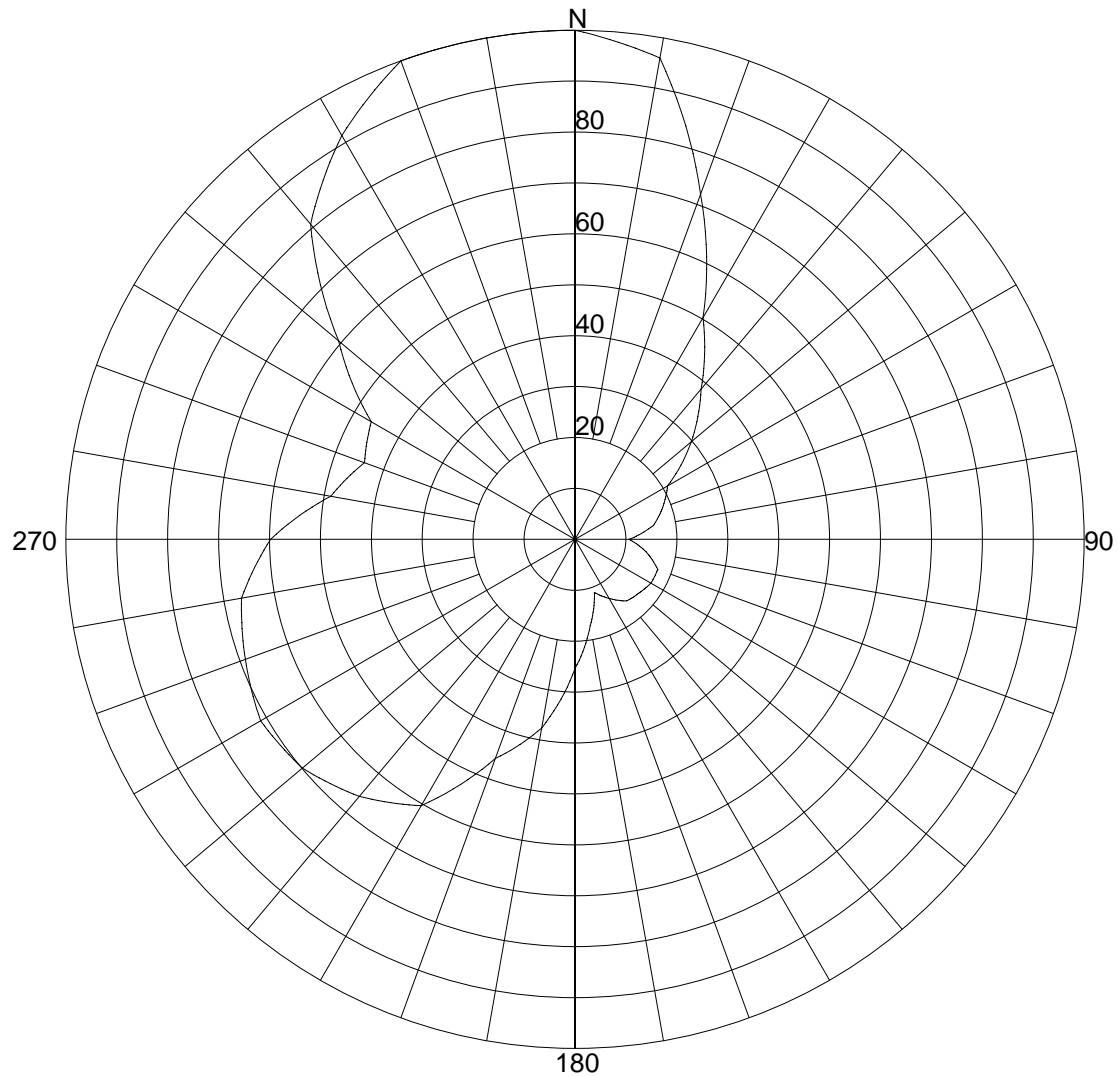
FREQUENCY: 91.7 MHz

PATTERN POL.: Circular

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.05359 / 3.13dB

PATTERN RMS: 0.698



Azimuth Pattern

Systems With Reliability (SWR) LLP

Scale: Linear

Unit: Relative Field

CLIENT: WZXH / Charles Loughery

Date: 2/12/2009

ANTENNA TYPE: FMEC/2 DA

FREQUENCY: 91.7 MHz

PATTERN POL.: Horizontal

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 3.22123 / 5.08dB

PATTERN RMS: 0.557

Relative Field Tabulation(Azimuth)

Azimuth Heading	Relative Field(dB)	Azimuth Heading	Relative Field(dB)
0	1.0000 (0.01)	180	.2540 (-11.87)
5	.9800 (-0.17)	185	.3150 (-10.01)
10	.9600 (-0.35)	190	.3760 (-8.47)
15	.8405 (-1.5)	195	.4170 (-7.58)
20	.7210 (-2.83)	200	.4580 (-6.76)
25	.6120 (-4.25)	205	.5310 (-5.48)
30	.5030 (-5.95)	210	.6040 (-4.36)
35	.4440 (-7.03)	215	.6315 (-3.98)
40	.3850 (-8.27)	220	.6590 (-3.61)
45	.3415 (-9.31)	225	.6790 (-3.35)
50	.2980 (-10.49)	230	.6990 (-3.1)
55	.2540 (-11.87)	235	.7060 (-3.01)
60	.2100 (-13.51)	240	.7130 (-2.93)
65	.1965 (-14.09)	245	.7010 (-3.07)
70	.1830 (-14.7)	250	.6890 (-3.22)
75	.1695 (-15.37)	255	.6770 (-3.38)
80	.1560 (-16.08)	260	.6650 (-3.53)
85	.1310 (-17.59)	265	.6315 (-3.98)
90	.1060 (-19.41)	270	.5980 (-4.45)
95	.1240 (-18.06)	275	.5425 (-5.3)
100	.1420 (-16.89)	280	.4870 (-6.23)
105	.1575 (-16)	285	.4635 (-6.66)
110	.1730 (-15.19)	290	.4400 (-7.11)
115	.1725 (-15.21)	295	.4510 (-6.9)
120	.1720 (-15.24)	300	.4620 (-6.69)
125	.1680 (-15.44)	305	.5340 (-5.43)
130	.1640 (-15.65)	310	.6060 (-4.34)
135	.1610 (-15.81)	315	.7070 (-3)
140	.1580 (-15.97)	320	.8080 (-1.84)
145	.1460 (-16.65)	325	.8620 (-1.28)
150	.1340 (-17.39)	330	.9160 (-0.75)
155	.1225 (-18.17)	335	.9580 (-0.36)
160	.1110 (-19.02)	340	1.0000 (0.01)
165	.1415 (-16.92)	345	1.0000 (0.01)
170	.1720 (-15.24)	350	1.0000 (0.01)
175	.2130 (-13.39)	355	1.0000 (0.01)

Systems With Reliability (SWR) LLP

CLIENT: WZXH / Charles Loughery

Date: 2/12/2009

ANTENNA TYPE: FMEC/2 DA

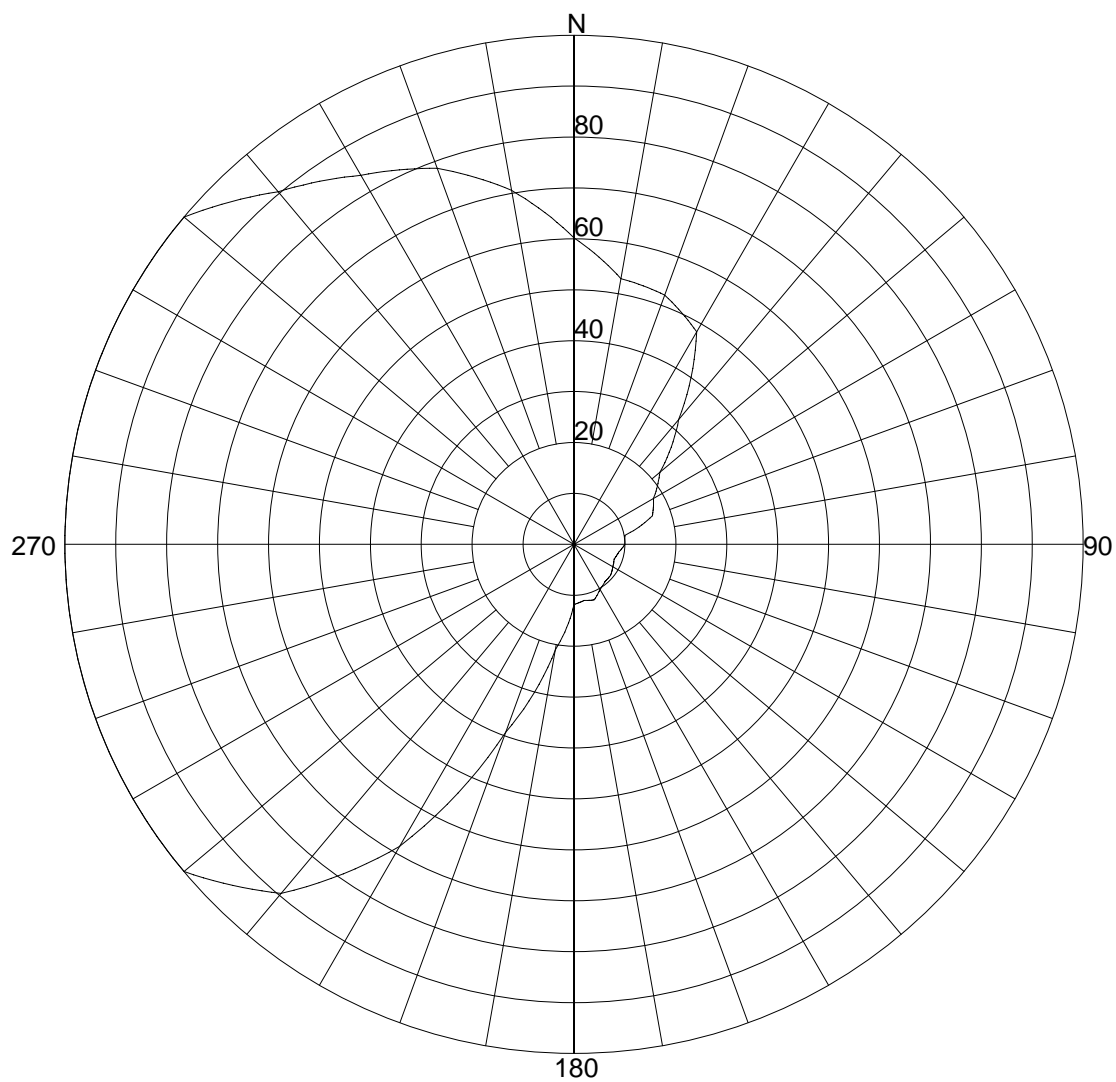
FREQUENCY: 91.7 MHz

PATTERN POL.: Horizontal

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 3.22123 / 5.08dB

PATTERN RMS: 0.557



Azimuth Pattern

Systems With Reliability (SWR) LLP

Scale: Linear

Unit: Relative Field

CLIENT: WZXH / Charles Loughery

Date: 2/12/2009

ANTENNA TYPE: FMEC/2 DA

FREQUENCY: 91.7 MHz

PATTERN POL.: Vertical

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.47809 / 3.94dB

PATTERN RMS: 0.635

Relative Field Tabulation(Azimuth)

Azimuth Heading	Relative Field(dB)	Azimuth Heading	Relative Field(dB)
0	.6020 (-4.39)	180	.1180 (-18.49)
5	.5660 (-4.93)	185	.1640 (-15.65)
10	.5300 (-5.5)	190	.2100 (-13.51)
15	.5255 (-5.57)	195	.3015 (-10.39)
20	.5210 (-5.65)	200	.3930 (-8.09)
25	.5015 (-5.98)	205	.5390 (-5.35)
30	.4820 (-6.32)	210	.6850 (-3.27)
35	.4010 (-7.92)	215	.7900 (-2.04)
40	.3200 (-9.87)	220	.8950 (-0.95)
45	.2700 (-11.34)	225	.9475 (-0.46)
50	.2200 (-13.11)	230	1.0000 (0.01)
55	.2000 (-13.94)	235	1.0000 (0.01)
60	.1800 (-14.85)	240	1.0000 (0.01)
65	.1720 (-15.24)	245	1.0000 (0.01)
70	.1640 (-15.65)	250	1.0000 (0.01)
75	.1325 (-17.49)	255	1.0000 (0.01)
80	.1010 (-19.83)	260	1.0000 (0.01)
85	.1005 (-19.87)	265	1.0000 (0.01)
90	.1000 (-19.91)	270	1.0000 (0.01)
95	.0945 (-20.4)	275	1.0000 (0.01)
100	.0890 (-20.92)	280	1.0000 (0.01)
105	.0865 (-21.16)	285	1.0000 (0.01)
110	.0840 (-21.41)	290	1.0000 (0.01)
115	.0860 (-21.21)	295	1.0000 (0.01)
120	.0880 (-21.01)	300	1.0000 (0.01)
125	.0910 (-20.72)	305	1.0000 (0.01)
130	.0940 (-20.45)	310	1.0000 (0.01)
135	.0945 (-20.4)	315	.9520 (-0.42)
140	.0950 (-20.35)	320	.9040 (-0.87)
145	.0985 (-20.04)	325	.8705 (-1.19)
150	.1020 (-19.74)	330	.8370 (-1.54)
155	.1090 (-19.17)	335	.8115 (-1.8)
160	.1160 (-18.64)	340	.7860 (-2.08)
165	.1140 (-18.79)	345	.7460 (-2.53)
170	.1120 (-18.94)	350	.7060 (-3.01)
175	.1150 (-18.71)	355	.6540 (-3.68)

Systems With Reliability (SWR) LLP

CLIENT: WZXH / Charles Loughery

Date: 2/12/2009

ANTENNA TYPE: FMEC/2 DA

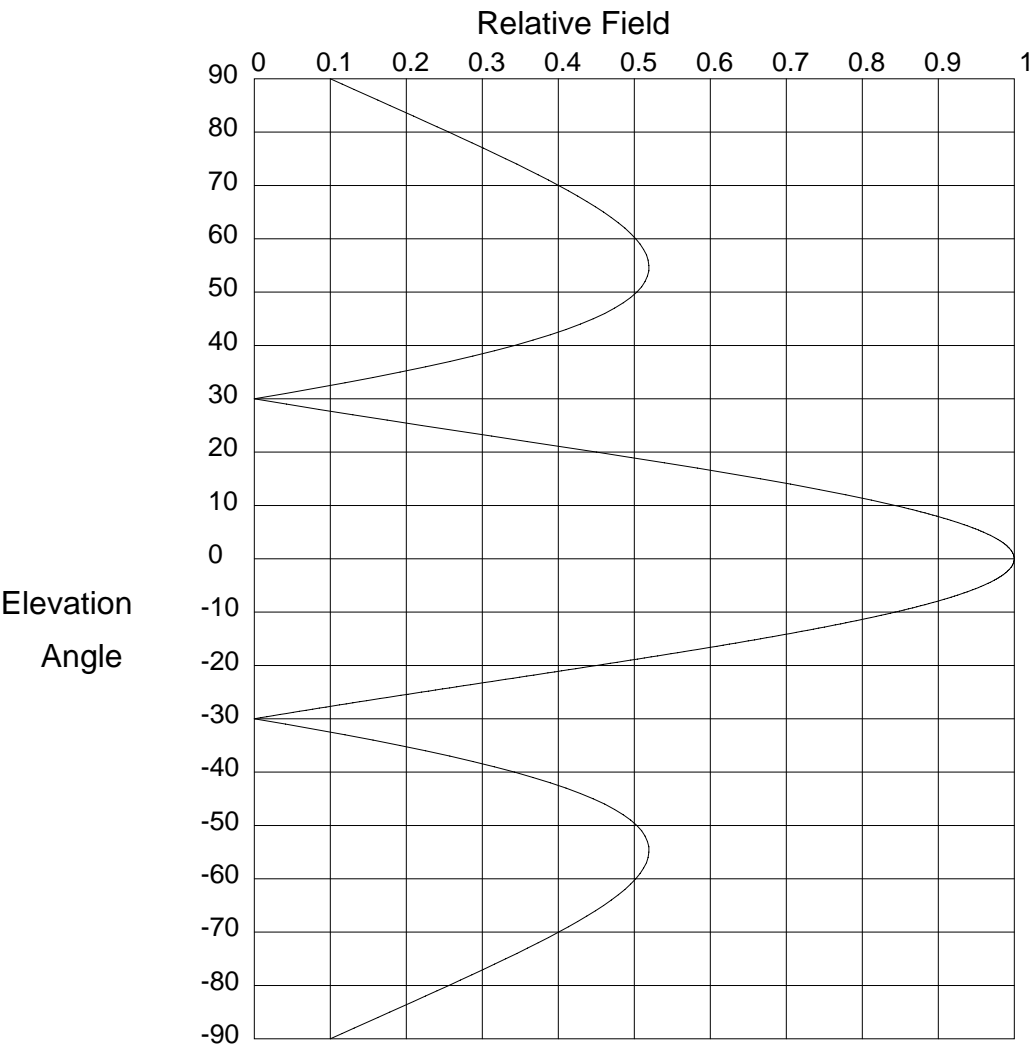
FREQUENCY: 91.7 MHz

PATTERN POL.: Vertical

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.47809 / 3.94dB

PATTERN RMS: 0.635



Elevation Pattern

Scale: Linear

Units: Field, Relative

Systems With Reliability (SWR) LLP

CLIENT: WZXH-FM / Charles Loughery		Date: 12/16/2008
ANTENNA TYPE: FMEC/2 DA		
FREQUENCY: 91.7 MHz		
PATTERN POL.: Circular		
DIRECTIVITY(Peak): 1.918/2.828 dBd	Beam Tilt (Deg.) :	0
DIRECTIVITY(Horiz): 1.918/2.828 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	.10 (-20)	52.0	.514 (-5.775)	14.0	.705 (-3.031)
89.0	.116 (-18.733)	51.0	.51 (-5.855)	13.0	.743 (-2.581)
88.0	.131 (-17.627)	50.0	.503 (-5.963)	12.0	.779 (-2.174)
87.0	.147 (-16.648)	49.0	.495 (-6.101)	11.0	.812 (-1.809)
86.0	.163 (-15.768)	48.0	.486 (-6.272)	10.0	.843 (-1.482)
85.0	.178 (-14.971)	47.0	.474 (-6.479)	9.8	.849 (-1.421)
84.0	.194 (-14.242)	46.0	.461 (-6.724)	9.6	.855 (-1.361)
83.0	.21 (-13.571)	45.0	.446 (-7.013)	9.4	.861 (-1.303)
82.0	.225 (-12.951)	44.0	.429 (-7.349)	9.2	.866 (-1.246)
81.0	.241 (-12.374)	43.0	.41 (-7.738)	9.0	.872 (-1.191)
80.0	.256 (-11.836)	42.0	.39 (-8.189)	8.8	.877 (-1.137)
79.0	.271 (-11.332)	41.0	.367 (-8.709)	8.6	.883 (-1.084)
78.0	.286 (-10.859)	40.0	.342 (-9.31)	8.4	.888 (-1.033)
77.0	.301 (-10.415)	39.0	.316 (-10.008)	8.2	.893 (-0.983)
76.0	.316 (-9.997)	38.0	.288 (-10.824)	8.0	.898 (-0.935)
75.0	.331 (-9.603)	37.0	.257 (-11.786)	7.8	.903 (-0.887)
74.0	.345 (-9.231)	36.0	.225 (-12.937)	7.6	.908 (-0.841)
73.0	.36 (-8.881)	35.0	.192 (-14.343)	7.4	.912 (-0.797)
72.0	.374 (-8.551)	34.0	.156 (-16.113)	7.2	.917 (-0.753)
71.0	.387 (-8.24)	33.0	.119 (-18.454)	7.0	.921 (-0.711)
70.0	.401 (-7.948)	32.0	.081 (-21.828)	6.8	.926 (-0.67)
69.0	.413 (-7.673)	31.0	.041 (-27.712)	6.6	.93 (-0.631)
68.0	.426 (-7.417)	30.0	.00 (-50)	6.4	.934 (-0.593)
67.0	.438 (-7.178)	29.0	.042 (-27.469)	6.2	.938 (-0.556)
66.0	.449 (-6.956)	28.0	.086 (-21.343)	6.0	.942 (-0.52)
65.0	.46 (-6.751)	27.0	.13 (-17.727)	5.8	.946 (-0.485)
64.0	.47 (-6.563)	26.0	.175 (-15.145)	5.6	.949 (-0.452)
63.0	.479 (-6.392)	25.0	.22 (-13.135)	5.4	.953 (-0.42)
62.0	.488 (-6.239)	24.0	.266 (-11.491)	5.2	.956 (-0.389)
61.0	.495 (-6.103)	23.0	.312 (-10.103)	5.0	.959 (-0.36)
60.0	.502 (-5.986)	22.0	.359 (-8.906)	4.8	.963 (-0.331)
59.0	.508 (-5.887)	21.0	.405 (-7.858)	4.6	.966 (-0.304)
58.0	.512 (-5.807)	20.0	.45 (-6.929)	4.4	.969 (-0.278)
57.0	.516 (-5.747)	19.0	.495 (-6.1)	4.2	.971 (-0.253)
56.0	.518 (-5.708)	18.0	.54 (-5.356)	4.0	.974 (-0.229)
55.0	.519 (-5.69)	17.0	.583 (-4.685)	3.8	.976 (-0.207)
54.0	.519 (-5.694)	16.0	.625 (-4.078)	3.6	.979 (-0.186)
53.0	.517 (-5.722)	15.0	.666 (-3.528)	3.4	.981 (-0.165)

Systems With Reliability (SWR) LLP

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CLIENT: WZXH-FM / Charles Loughery

Date: 12/16/2008

ANTENNA TYPE: FMEC/2 DA

FREQUENCY: 91.7 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 1.918/2.828 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 1.918/2.828 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	.983 (-0.146)	-4.4	.969 (-0.278)	-12.0	.779 (-2.174)
3.0	.985 (-0.129)	-4.6	.966 (-0.304)	-12.2	.772 (-2.252)
2.8	.987 (-0.112)	-4.8	.963 (-0.331)	-12.4	.765 (-2.332)
2.6	.989 (-0.097)	-5.0	.959 (-0.36)	-12.6	.757 (-2.413)
2.4	.991 (-0.082)	-5.2	.956 (-0.389)	-12.8	.75 (-2.496)
2.2	.992 (-0.069)	-5.4	.953 (-0.42)	-13.0	.743 (-2.581)
2.0	.993 (-0.057)	-5.6	.949 (-0.452)	-13.2	.736 (-2.667)
1.8	.995 (-0.046)	-5.8	.946 (-0.485)	-13.4	.728 (-2.755)
1.6	.996 (-0.037)	-6.0	.942 (-0.52)	-13.6	.721 (-2.845)
1.4	.997 (-0.028)	-6.2	.938 (-0.556)	-13.8	.713 (-2.937)
1.2	.998 (-0.021)	-6.4	.934 (-0.593)	-14.0	.705 (-3.031)
1.0	.998 (-0.014)	-6.6	.93 (-0.631)	-14.2	.698 (-3.126)
.8	.999 (-0.009)	-6.8	.926 (-0.67)	-14.4	.69 (-3.224)
.6	.999 (-0.005)	-7.0	.921 (-0.711)	-14.6	.682 (-3.323)
.4	1.00 (-0.002)	-7.2	.917 (-0.753)	-14.8	.674 (-3.425)
.2	1.00 (-0.001)	-7.4	.912 (-0.797)	-15.0	.666 (-3.528)
.0	1.00 (0)	-7.6	.908 (-0.841)	-15.2	.658 (-3.634)
-.2	1.00 (-0.001)	-7.8	.903 (-0.887)	-15.4	.65 (-3.742)
-.4	1.00 (-0.002)	-8.0	.898 (-0.935)	-15.6	.642 (-3.851)
-.6	.999 (-0.005)	-8.2	.893 (-0.983)	-15.8	.634 (-3.963)
-.8	.999 (-0.009)	-8.4	.888 (-1.033)	-16.0	.625 (-4.078)
-1.0	.998 (-0.014)	-8.6	.883 (-1.084)	-16.2	.617 (-4.194)
-1.2	.998 (-0.021)	-8.8	.877 (-1.137)	-16.4	.609 (-4.313)
-1.4	.997 (-0.028)	-9.0	.872 (-1.191)	-16.6	.60 (-4.435)
-1.6	.996 (-0.037)	-9.2	.866 (-1.246)	-16.8	.592 (-4.558)
-1.8	.995 (-0.046)	-9.4	.861 (-1.303)	-17.0	.583 (-4.685)
-2.0	.993 (-0.057)	-9.6	.855 (-1.361)	-17.2	.575 (-4.814)
-2.2	.992 (-0.069)	-9.8	.849 (-1.421)	-17.4	.566 (-4.945)
-2.4	.991 (-0.082)	-10.0	.843 (-1.482)	-17.6	.557 (-5.079)
-2.6	.989 (-0.097)	-10.2	.837 (-1.544)	-17.8	.549 (-5.216)
-2.8	.987 (-0.112)	-10.4	.831 (-1.608)	-18.0	.54 (-5.356)
-3.0	.985 (-0.129)	-10.6	.825 (-1.674)	-18.2	.531 (-5.499)
-3.2	.983 (-0.146)	-10.8	.818 (-1.74)	-18.4	.522 (-5.644)
-3.4	.981 (-0.165)	-11.0	.812 (-1.809)	-18.6	.513 (-5.793)
-3.6	.979 (-0.186)	-11.2	.805 (-1.879)	-18.8	.504 (-5.945)
-3.8	.976 (-0.207)	-11.4	.799 (-1.95)	-19.0	.495 (-6.1)
-4.0	.974 (-0.229)	-11.6	.792 (-2.023)	-19.2	.486 (-6.259)
-4.2	.971 (-0.253)	-11.8	.785 (-2.098)	-19.4	.477 (-6.421)

Systems With Reliability (SWR) LLP

Page 2 of 3

CLIENT: WZXH-FM / Charles Loughery

Date: 12/16/2008

ANTENNA TYPE: FMEC/2 DA

FREQUENCY: 91.7 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 1.918/2.828 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 1.918/2.828 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	.468 (-6.587)	-27.2	.121 (-18.344)	-54.0	.519 (-5.694)
-19.8	.459 (-6.756)	-27.4	.112 (-19.006)	-55.0	.519 (-5.69)
-20.0	.45 (-6.929)	-27.6	.103 (-19.721)	-56.0	.518 (-5.708)
-20.2	.441 (-7.106)	-27.8	.094 (-20.496)	-57.0	.516 (-5.747)
-20.4	.432 (-7.288)	-28.0	.086 (-21.343)	-58.0	.512 (-5.807)
-20.6	.423 (-7.473)	-28.2	.077 (-22.278)	-59.0	.508 (-5.887)
-20.8	.414 (-7.663)	-28.4	.068 (-23.322)	-60.0	.502 (-5.986)
-21.0	.405 (-7.858)	-28.6	.06 (-24.503)	-61.0	.495 (-6.103)
-21.2	.396 (-8.057)	-28.8	.051 (-25.863)	-62.0	.488 (-6.239)
-21.4	.386 (-8.261)	-29.0	.042 (-27.469)	-63.0	.479 (-6.392)
-21.6	.377 (-8.471)	-29.2	.034 (-29.429)	-64.0	.47 (-6.563)
-21.8	.368 (-8.686)	-29.4	.025 (-31.951)	-65.0	.46 (-6.751)
-22.0	.359 (-8.906)	-29.6	.017 (-35.496)	-66.0	.449 (-6.956)
-22.2	.349 (-9.132)	-29.8	.008 (-41.54)	-67.0	.438 (-7.178)
-22.4	.34 (-9.365)	-30.0	.00 (-50)	-68.0	.426 (-7.417)
-22.6	.331 (-9.604)	-31.0	.041 (-27.712)	-69.0	.413 (-7.673)
-22.8	.322 (-9.85)	-32.0	.081 (-21.828)	-70.0	.401 (-7.948)
-23.0	.312 (-10.103)	-33.0	.119 (-18.454)	-71.0	.387 (-8.24)
-23.2	.303 (-10.364)	-34.0	.156 (-16.113)	-72.0	.374 (-8.551)
-23.4	.294 (-10.632)	-35.0	.192 (-14.343)	-73.0	.36 (-8.881)
-23.6	.285 (-10.909)	-36.0	.225 (-12.937)	-74.0	.345 (-9.231)
-23.8	.276 (-11.195)	-37.0	.257 (-11.786)	-75.0	.331 (-9.603)
-24.0	.266 (-11.491)	-38.0	.288 (-10.824)	-76.0	.316 (-9.997)
-24.2	.257 (-11.797)	-39.0	.316 (-10.008)	-77.0	.301 (-10.415)
-24.4	.248 (-12.113)	-40.0	.342 (-9.31)	-78.0	.286 (-10.859)
-24.6	.239 (-12.441)	-41.0	.367 (-8.709)	-79.0	.271 (-11.332)
-24.8	.23 (-12.781)	-42.0	.39 (-8.189)	-80.0	.256 (-11.836)
-25.0	.22 (-13.135)	-43.0	.41 (-7.738)	-81.0	.241 (-12.374)
-25.2	.211 (-13.503)	-44.0	.429 (-7.349)	-82.0	.225 (-12.951)
-25.4	.202 (-13.887)	-45.0	.446 (-7.013)	-83.0	.21 (-13.571)
-25.6	.193 (-14.287)	-46.0	.461 (-6.724)	-84.0	.194 (-14.242)
-25.8	.184 (-14.706)	-47.0	.474 (-6.479)	-85.0	.178 (-14.971)
-26.0	.175 (-15.145)	-48.0	.486 (-6.272)	-86.0	.163 (-15.768)
-26.2	.166 (-15.606)	-49.0	.495 (-6.101)	-87.0	.147 (-16.648)
-26.4	.157 (-16.092)	-50.0	.503 (-5.963)	-88.0	.131 (-17.627)
-26.6	.148 (-16.605)	-51.0	.51 (-5.855)	-89.0	.116 (-18.733)
-26.8	.139 (-17.149)	-52.0	.514 (-5.775)	-90.0	.10 (-20)
-27.0	.13 (-17.727)	-53.0	.517 (-5.722)	90.0	.00 (-50)

Systems With Reliability (SWR) LLP

Page 3 of 3

CLIENT: WZXH-FM / Charles Loughery

Date: 12/16/2008

ANTENNA TYPE: FMEC/2 DA

FREQUENCY: 91.7 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 1.918/2.828 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 1.918/2.828 dBd

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



SYSTEMS WITH RELIABILITY, LLP

BROADCAST ANTENNAS AND TRANSMISSION LINE

SYSTEM DATA SHEET

Customer : WZXH
Contact : Charles Loughery
Location : Hagerstown, MD
Antenna Model : FMEC/2 DA
Channel / Frequency : 219A / 91.7 MHz

ELECTRICAL SPECIFICATIONS

Antenna Specifications:

	H-POL	dB	V. Pol.	dB
License ERP (KW)	0.900	-0.458 dB	0.900	-0.458 dB
FCC Limit Pattern Directivity	1.693	2.286 dB	1.693	2.286 dB
Elevation Directivity	1.918	2.828 dB	1.918	2.828 dB
Azimuth Directivity	3.221	5.080 dB	2.478	3.941 dB
Composite Pattern	2.054	3.125 dB	2.054	3.125 dB
Polarization Ratio	0.435	-3.617 dB	0.565	-2.478 dB
RMS Comp./RMS Limit	90.80 %			
Antenna Efficiency %	100		100	
Power Ratio (Pol. Ratio X Efficiency)	0.4348		0.5652	
Antenna Gain	2.686	4.292 dB	2.686	4.292 dB

Antenna Input Power (KW) 0.335 kW -4.749 (dBK)

Feed Line Specifications:

Line Type	1/2" Foam	50 Ω LDF4-50A
Attenuation Per 100 ft (dB)	0.632	dB
Line Length (ft) AGL + 15.008'	120.00	ft.
Total Line Attenuation (dB)	0.7584	dB
Line Efficiency	83.98	%
Power Input to the Line (KW)	0.399 kW	-3.991 (dBK)

MECHANICAL SPECIFICATIONS

No. Of Bays	2		
Antenna Aperture	10.73	ft.	3.27 meters
Center of Radiation AGL	104.99	ft.	32.00 meters
Antenna Weight with Pole and parasitics	165.00	lbs.	75.00 kg
Windload (50/33) with Pole and parasitics	375.00	lbs.	Windload CaAc 10.60 ft^2

Prepared by:

David K. Edmiston Jr.
SWR, LLP



SYSTEMS WITH RELIABILITY, INC.
Broadcast Antennas and Transmission Systems

WZXH Antenna RMS Comparison

PROPOSED ANTENNA

Azimuth Heading	Relative Field
0	1.000
10	1.000
20	1.000
30	1.000
40	0.794
50	0.442
60	0.355
70	0.282
80	0.224
90	0.224
100	0.200
110	0.200
120	0.178
130	0.178
140	0.178
150	0.178
160	0.200
170	0.251
180	0.316
190	0.398
200	0.794
210	1.000
220	1.000
230	1.000
240	1.000
250	1.000
260	1.000
270	1.000
280	1.000
290	1.000
300	1.000
310	1.000
320	1.000
330	1.000
340	1.000
350	1.000

DESIGNED ANTENNA

Azimuth Heading	Relative Field
0	1.000
10	0.960
20	0.721
30	0.503
40	0.385
50	0.298
60	0.210
70	0.183
80	0.156
90	0.106
100	0.142
110	0.173
120	0.172
130	0.164
140	0.158
150	0.134
160	0.116
170	0.172
180	0.254
190	0.376
200	0.458
210	0.685
220	0.895
230	1.000
240	1.000
250	1.000
260	1.000
270	1.000
280	1.000
290	1.000
300	1.000
310	1.000
320	0.904
330	0.916
340	1.000
350	1.000

Sum of Relative Field Squared : 21.330
Sum Divided by 36 (Readings) : 0.593
Square Root : 0.770

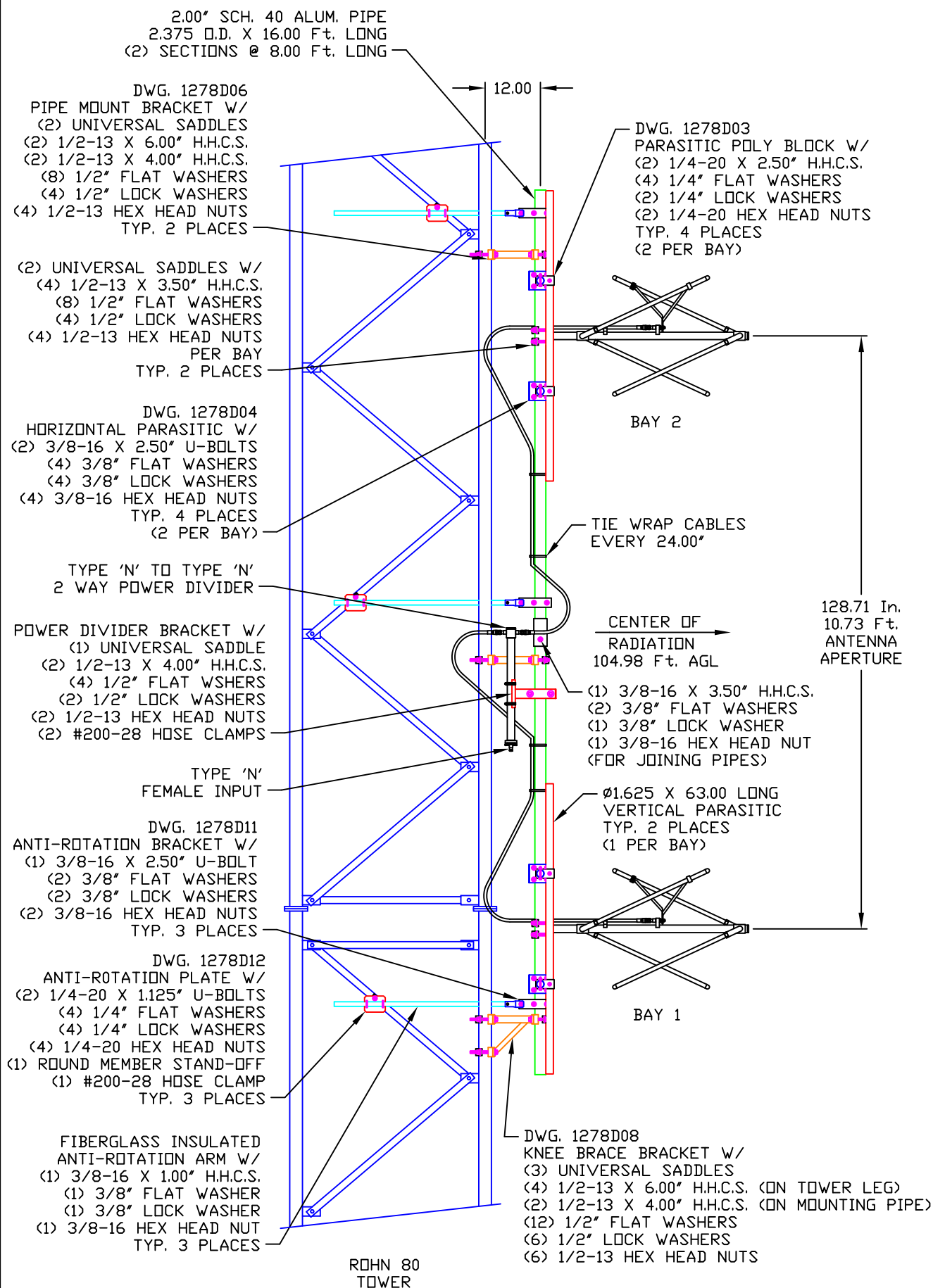
Sum of Relative Field Squared : 17.579
Sum Divided by 36 (Readings) : 0.488
Square Root : 0.699

Percentage of Construction Permit Antenna Filled :

90.78%

NOTES:

1. REFERENCE DWG. 1278D01 FOR ANTENNA ORIENTATION.
2. REFERENCE DWG. 1278D02 FOR PARASITIC PLACEMENT.



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

TITLE: FMEC/2-DA, FREQ. 91.7
WZXX, HAGERSTOWN, MD

MATERIAL:

SIZE REV APPR. DATE
C 1
2
3

ENGINEER:

SCALE: NTS

NAME: RAC

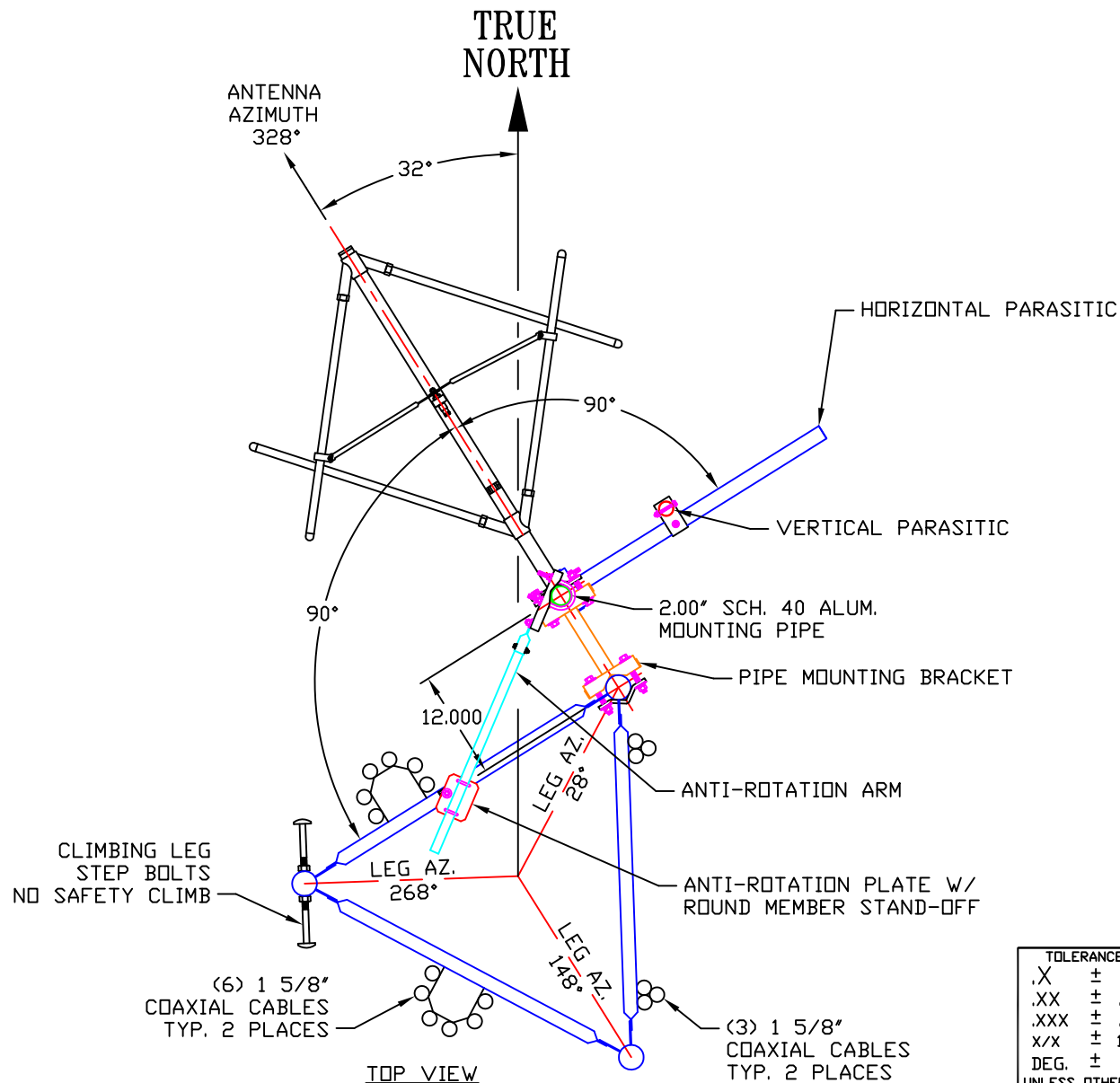
DATE: 2/24/09

SHEET 1 OF 1

DRAWING NUMBER: 1278D00

NOTE:

1. REFERENCE DWG. 1278D00 FOR ANTENNA ELEVATION.
2. REFERENCE DWG. 1278D02 FOR PARASITIC PLACEMENT.



TOLERANCES	
.X	± .015
.XX	± .005
.XXX	± .002
X/X	± 1/32
DEG.	± 1/2
UNLESS OTHERWISE SPECIFIED	

REVISION RECORD		
REV	APPROVAL	DATE
DRAWING NUMBER: 1278D01		
SCALE: NTS	NAME: RAC	DATE: 2/17/09 SHEET 1 OF 1



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

TITLE:

FMEC/2-DA, FREQ. 91.7
WZXH, HAGERSTOWN, MD

MATERIAL:

ANTENNA
ORIENTATION

SIZE

A

PARTS MADE BY THIS DRAWING

SCALE: NTS

NAME: RAC

DATE: 2/17/09

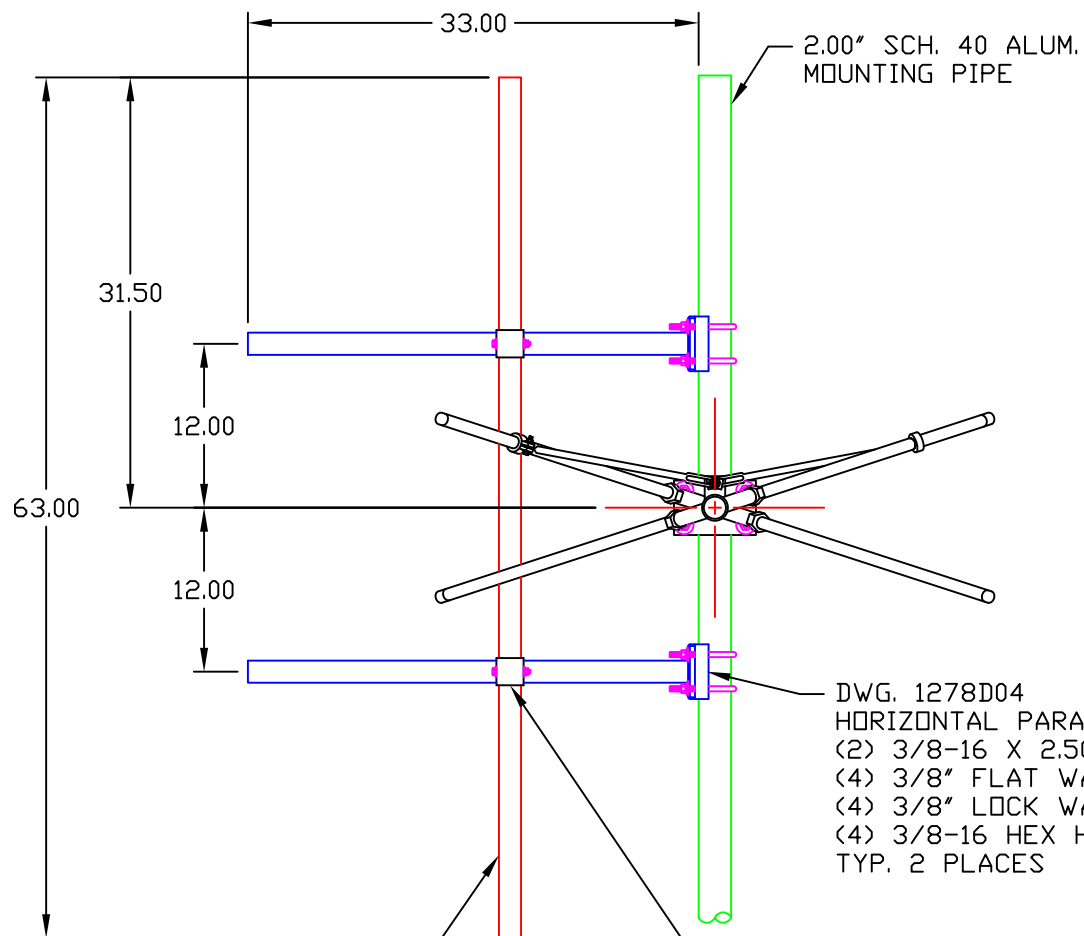
SHEET 1 OF 1

NOTE:

1. THIS ASSEMBLY TYPICAL FOR BOTH BAYS.
2. REFERENCE DWG. 1278D00 FOR ANTENNA ELEVATION.
3. REFERENCE DWG. 1278D01 FOR ANTENNA ORIENTATION.

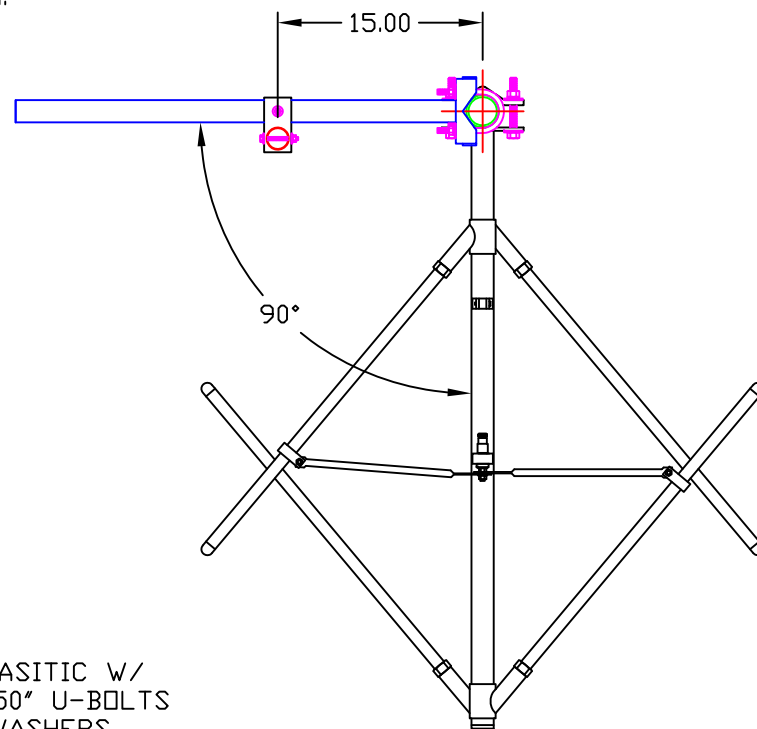
Exhibit 7: Drawings (cont'd)

DRAWING NUMBER: 1278D02



DWG. 1278D04
HORIZONTAL PARASITIC W/
(2) 3/8-16 X 2.50" U-BOLTS
(4) 3/8" FLAT WASHERS
(4) 3/8" LOCK WASHERS
(4) 3/8-16 HEX HEAD NUTS
TYP. 2 PLACES

DWG. 1278D03
PARASITIC POLY BLOCK W/
(2) 1/4-20 X 2.50" H.H.C.S.
(4) 1/4" FLAT WASHERS
(2) 1/4" LOCK WASHERS
(2) 1/4-20 HEX HEAD NUTS
TYP. 2 PLACES



TOP VIEW

TOLERANCES	
.X	± .015
.XX	± .005
.XXX	± .002
X/X	± 1/32
DEG.	± 1/2
UNLESS OTHERWISE SPECIFIED	

REVISION RECORD		
REV	APPROVAL	DATE
DRAWING NUMBER: 1278D02		
SCALE: NTS	NAME: RAC	DATE: 2/17/09
SHEET 1 OF 1		



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

TITLE:

FMEC/2-DA, FREQ. 91.7
WZXH, HAGERSTOWN, MD

MATERIAL:

PARASITIC
PLACEMENT

SIZE

A

PARTS MADE BY THIS DRAWING

SCALE: NTS

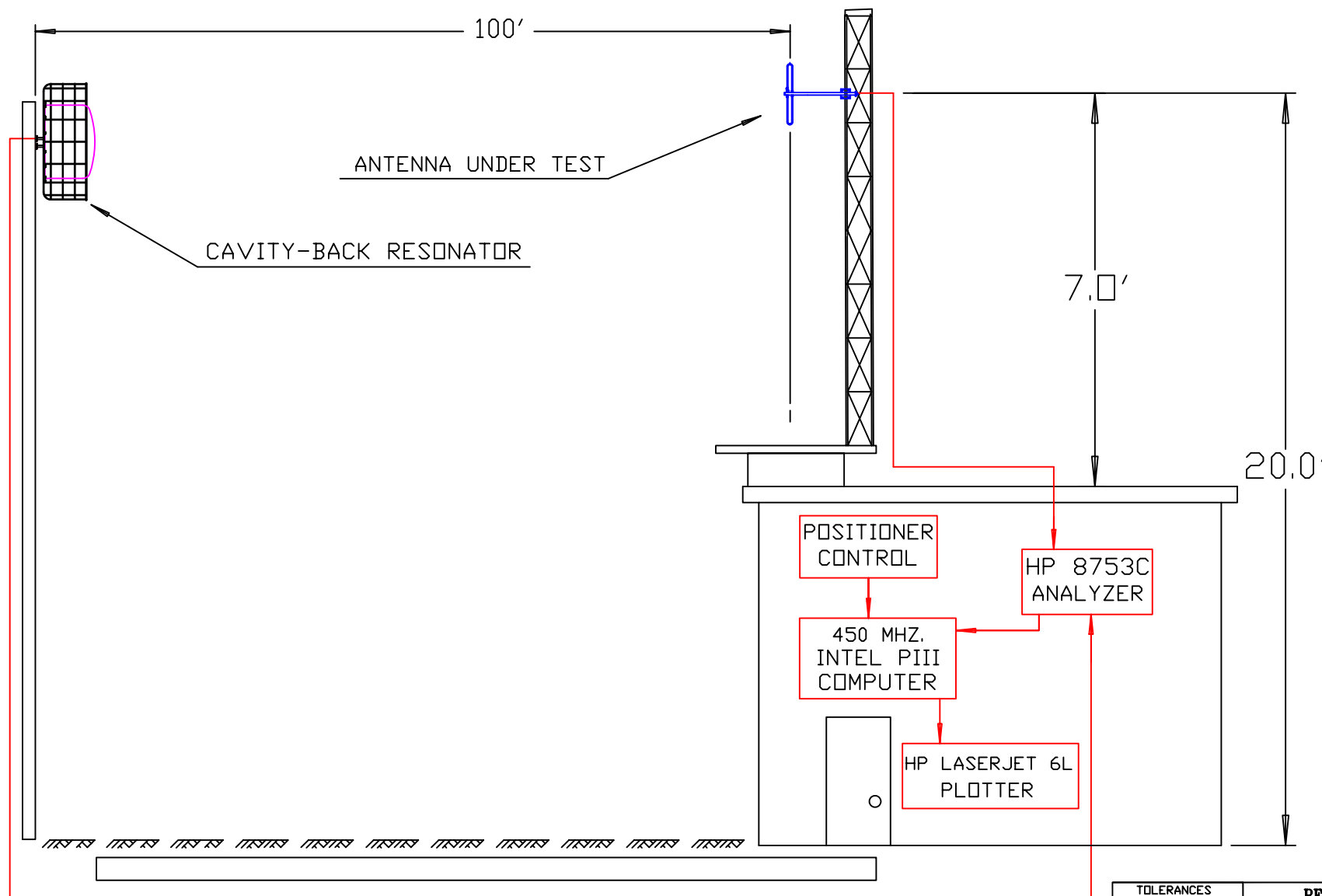
NAME: RAC

DATE: 2/17/09

SHEET 1 OF 1

NOTE: Exhibit 7 (cont'd) Test Range Schematic Overview

DRAWING
NUMBER: 2105A10



TOLERANCES	
.X	± .015
.XX	± .005
.XXX	± .002
X/X	± 1/32
DEG.	± 1/2
UNLESS OTHERWISE SPECIFIED	

REVISION RECORD		
REV	APPROVAL	DATE
2		10/7/05
1		4/30/02



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

TITLE: TEST RANGE SCHEMATIC

MATERIAL:

SIZE

A

PARTS MADE BY THIS DRAWING

SCALE: NTS

NAME: JRM

DATE: 11/1/98

SHEET 1 OF 1

DRAWING
NUMBER: 2105A10