



SYSTEMS WITH RELIABILITY, LTD.
Broadcast Antenna and Transmission Systems

PATTERN CERTIFICATION

DIRECTIONAL FM ANTENNA WRXV June 23, 2004

Call Sign	:	WRXV
Location	:	State College, PA
Frequency	:	89.1 MHz
Channel	:	206
Antenna Model	:	FMEV/2-DA-EP
Maximum Antenna Gain	:	
Horizontal	:	.002/ -28.01 dB
Vertical	:	6.960/ 8.426 dB

ANTENNA DESCRIPTION

A custom designed **FMEV/2-DA-EP** antenna was used to produce the required directional azimuth pattern. Each antenna bay consists of a vertically polarized dipole-radiating element with a vertical parasitic system. The array is comprised of **two** bays, that are spaced a full wavelength apart, mounted to a tower pointing **55** degrees true north. The horizontal component of this antenna was incorporated by offsetting the dipole .028° off of vertical. The horizontal azimuth pattern is calculated to have a directivity of 1.000.

DESCRIPTION OF TEST PROCEDURE

The test antenna consists of a third-scale antenna and parasitic system. This antenna was mounted to an 8-inch third-scale model tower with the use of mounting brackets supplied with the finalized antenna. The tower was 20 ft. on a platform. All feed cables are properly grounded during pattern testing. Vertical parasitic elements were used to obtain the desired directional pattern.

The source antenna, a vertical/horizontal 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 267.3 MHz. The antenna under test was rotated in a clockwise direction. A gain reference was taken using a dipole tuned to 267.3 MHz. Nowhere does the received signal exceed a maximum to minimum ratio of 15 dB.

DOCUMENT EXHIBITS

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

Exhibit 1	Measured Vertical Polarized Azimuth Pattern Measured Field Strength Tabulations (Vertical)
Exhibit 2	Elevation Pattern Elevation Tabulations
Exhibit 3	Antenna Data Sheet

TEST EQUIPMENT

Network Analyzer	:	Hewlett Packard Model # 8753C Serial Number : 08753 – 69138 Calibrated 4/26/04, SWR, Inc.
Computer	:	White Mountain 366 Computer
Plotter	:	Hewlett-Packard 7550A
Positioner	:	Orbit Positioner Calibrated 1/06/04, SWR, Inc.

Prepared by:



Jason Duncan
SWR, Inc.

TEST RESULTS

The attached calculations verify that the **RMS** value of this antenna is **92.12 %** of the **RMS** value of the pattern authorized in the related construction permit **BPED-19981022MC**. The vertical component **RMS** value is **0.525**.

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

Measured horizontal polarized directivity	:	1.000 / .001 dB
Measured vertical polarized directivity	:	3.6317/ 5.6 dB
Measured composite azimuth pattern directivity	:	3.6317 / 5.6 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:

H-Pol. Gain = (1.000)(1.918)(.000825) = **.002 / -28.01 dB**

V-Pol. Gain = (3.6317)(1.918)(.999175) = **6.96 / 8.426 dB**

INSTALLATION AND MOUNTING

The antenna is to be mounted in accordance with the supplied drawings. The antenna center of radiation is to be **52 meters** above ground level. The antenna (parasitic system included) aperture is **11.05 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 **55 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
0122D00	ORIENTATION WITH PARASITICS
2105A10	TEST RANGE SCHEMATIC

The array shall be mounted according to **DWG. 0122D00**. The parasitic assembly is shown in **DWG. 0122D00**. The antenna elements shall be aligned at the same heading as in **DWG. 0122D00**. This will ensure that the antenna is oriented properly at **55 degrees** true north.



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Broadcast Antennas and Transmission Systems

WRXV Antenna RMS Comparison

PROPOSED ANTENNA

Azimuth Heading	Relative Field
0	0.501
10	0.631
20	0.794
30	1.000
40	1.000
50	1.000
60	1.000
70	1.000
80	1.000
90	0.794
100	0.631
110	0.501
120	0.398
130	0.316
140	0.299
150	0.299
160	0.316
170	0.398
180	0.398
190	0.398
200	0.376
210	0.399
220	0.447
230	0.447
240	0.447
250	0.398
260	0.398

DESIGNED ANTENNA

Azimuth Heading	Relative Field
0	0.464
10	0.573
20	0.715
30	0.875
40	0.940
50	1.000
60	1.000
70	0.940
80	0.875
90	0.790
100	0.629
110	0.500
120	0.398
130	0.316
140	0.296
150	0.290
160	0.300
170	0.310
180	0.303
190	0.313
200	0.300
210	0.307
220	0.303
230	0.310
240	0.313
250	0.310
260	0.307

PROPOSED ANTENNA

Azimuth Heading	Relative Field
270	0.350
280	0.316
290	0.316
300	0.316
310	0.316
320	0.316
330	0.316
340	0.316
350	0.398

Sum of Relative Field Squared : 11.768

Sum Divided by 36 (Readings) : 0.327

Square Root : 0.572

Percentage of Construction Permit Antenna Filled :

DESIGNED ANTENNA

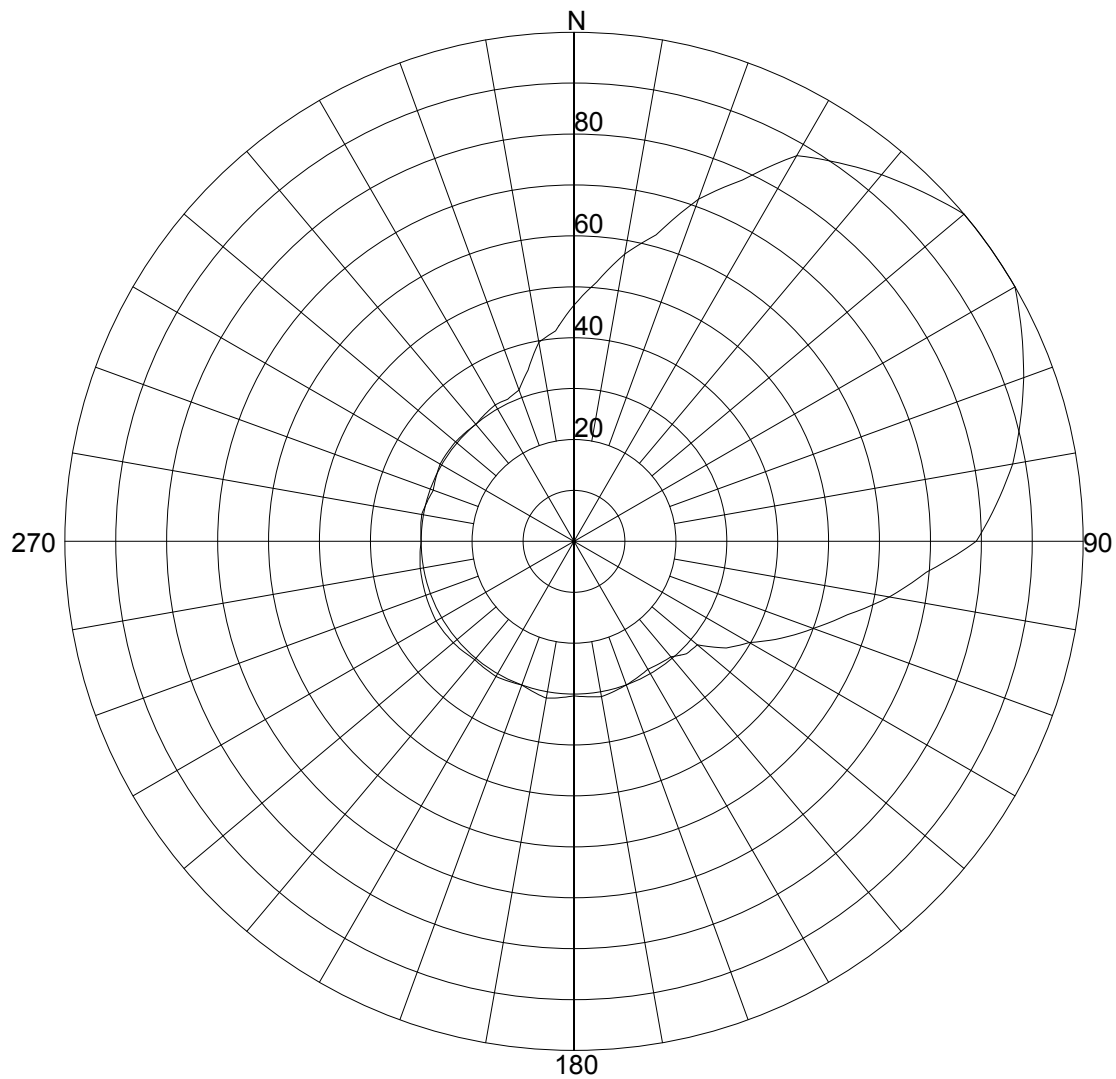
Azimuth Heading	Relative Field
270	0.300
280	0.304
290	0.294
300	0.304
310	0.304
320	0.300
330	0.310
340	0.316
350	0.397

Sum of Relative Field Squared : 9.986

Sum Divided by 36 (Readings) : 0.277

Square Root : 0.527

92.12%



Azimuth Pattern

Scale: Linear

Unit: Relative Field

Systems With Reliability

CLIENT: *WRXV*

Date: 6/23/2004

ANTENNA TYPE: FMEV/2-DA EP

FREQUENCY: 89.1

PATTERN POL.: Vertical

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 3.6317 / 5.6dB

PATTERN RMS: 0.525

Relative Field Tabulation(Azimuth)

Azimuth Heading	Relative Field(dB)	Azimuth Heading	Relative Field(dB)
0	.4640 (-6.65)	180	.3034 (-10.33)
5	.5110 (-5.81)	185	.3081 (-10.2)
10	.5730 (-4.82)	190	.3128 (-10.07)
15	.6230 (-4.1)	195	.3065 (-10.24)
20	.7150 (-2.9)	200	.3002 (-10.42)
25	.7830 (-2.11)	205	.3034 (-10.33)
30	.8750 (-1.15)	210	.3065 (-10.24)
35	.9075 (-0.83)	215	.3049 (-10.29)
40	.9400 (-0.53)	220	.3034 (-10.33)
45	.9700 (-0.26)	225	.3065 (-10.24)
50	1.0000 (0.01)	230	.3097 (-10.15)
55	1.0000 (0.01)	235	.3113 (-10.11)
60	1.0000 (0.01)	240	.3128 (-10.07)
65	.9700 (-0.26)	245	.3113 (-10.11)
70	.9400 (-0.53)	250	.3097 (-10.15)
75	.9075 (-0.83)	255	.3081 (-10.2)
80	.8750 (-1.15)	260	.3066 (-10.24)
85	.8325 (-1.58)	265	.3035 (-10.33)
90	.7900 (-2.04)	270	.3004 (-10.42)
95	.6947 (-3.15)	275	.3021 (-10.37)
100	.6290 (-4.01)	280	.3038 (-10.32)
105	.5561 (-5.08)	285	.2989 (-10.46)
110	.5000 (-6)	290	.2940 (-10.6)
115	.4500 (-6.92)	295	.2989 (-10.46)
120	.3975 (-7.99)	300	.3038 (-10.32)
125	.3651 (-8.73)	305	.3038 (-10.32)
130	.3160 (-9.98)	310	.3038 (-10.32)
135	.3124 (-10.08)	315	.3019 (-10.37)
140	.2960 (-10.54)	320	.3000 (-10.43)
145	.2930 (-10.63)	325	.3048 (-10.29)
150	.2900 (-10.72)	330	.3097 (-10.15)
155	.2951 (-10.57)	335	.3081 (-10.2)
160	.3002 (-10.42)	340	.3160 (-9.98)
165	.3049 (-10.29)	345	.3483 (-9.14)
170	.3097 (-10.15)	350	.3970 (-8)
175	.3065 (-10.24)	355	.4150 (-7.62)

Systems With Reliability

CLIENT: *WRXV*

Date: 6/23/2004

ANTENNA TYPE: FMEV/2-DA EP

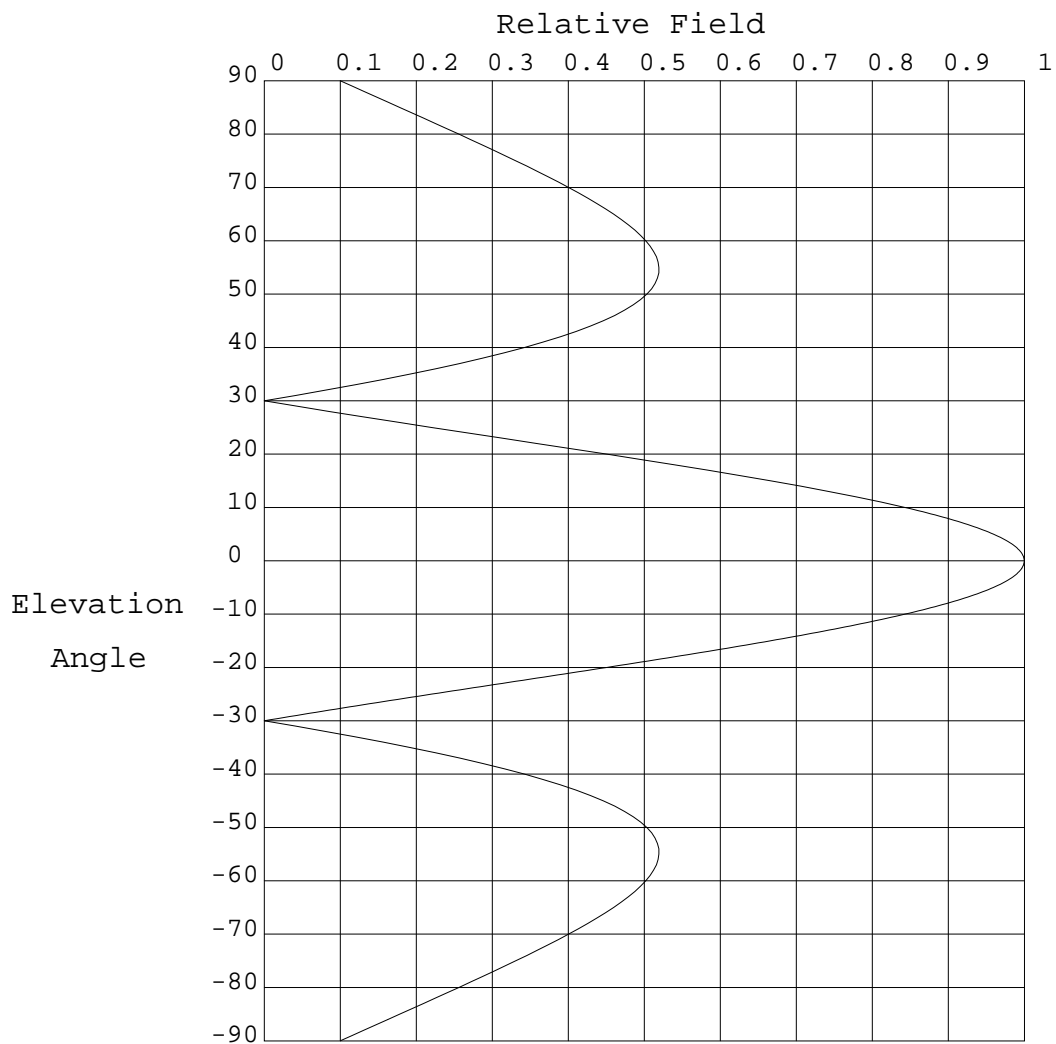
FREQUENCY: 89.1

PATTERN POL.: Vertical

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 3.6317 / 5.6dB

PATTERN RMS: 0.525



Elevation Pattern

Scale: Linear

Systems With Reliability Inc.

Units: Field, Relative

CLIENT: WRXV

Date: 3/26/04

ANTENNA TYPE: FMEV/2-DA EP

FREQUENCY: 89.1

PATTERN POL.: Elliptical

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
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)	

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CLIENT: WRXV

Date: 3/26/04

ANTENNA TYPE: FMEV/2-DA EP

FREQUENCY: 89.1

PATTERN POL.: Elliptical

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		
-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 Inc.

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CLIENT: WRXV

Date: 3/26/04

ANTENNA TYPE: FMEV/2-DA EP

FREQUENCY: 89.1

PATTERN POL.: Elliptical

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, Inc.
Broadcast Antenna & Transmission Systems

SYSTEM DATA SHEET

Customer	WRXV
Contact	Unknown
Location	State College, PA
Antenna Model	FMEV/2-DA EP
Channel / Frequency	89.1 MHz

ELECTRICAL SPECIFICATION

Polarization Type	Elliptical		
Polarization Ratio			
H-Pol. (PRH)	0.0825	%	
V-Pol. (PRV)	99.9175	%	
Elevation Directivity (ED)	1.918		
Azimuth Directivity (AD) H-Pol.	1.000		
Azimuth Directivity (AD) V-Pol.	3.632		
Antenna Gain (GH)			
H-Pol. (GH)	0.002		
V-Pol. (GV)	6.960		
dB Gain (AG)			
H-Pol (AGH)	-28.009		
V-Pol (AGV)	8.426		
ERP			
H-Pol. (ERPH)	0.001	kW	
V-Pol. (ERPV)	4.400	kW	
Line Type	7/8" 50 OHM Foam	LDF5-50A	
Attenuation per 100 ft.	0.35	dB/100ft	
Line Length (LL)	220.00	ft.	
Total Line Attenuation	0.77	dB	
Line Efficiency (LE)	83.75	%	
Line Loss (LPL)	0.12	kW	
Antenna Input Power (AIP)	0.63	kW	
Req'd. Transmitter Output Power	0.75	kW	

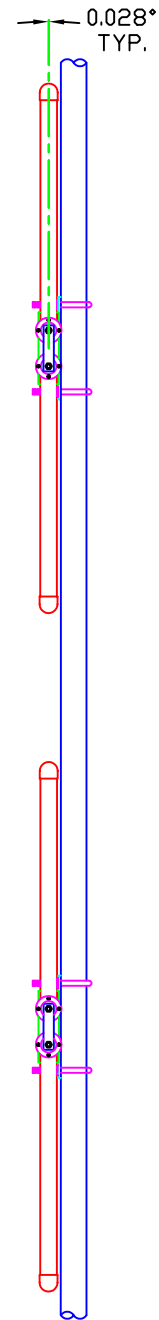
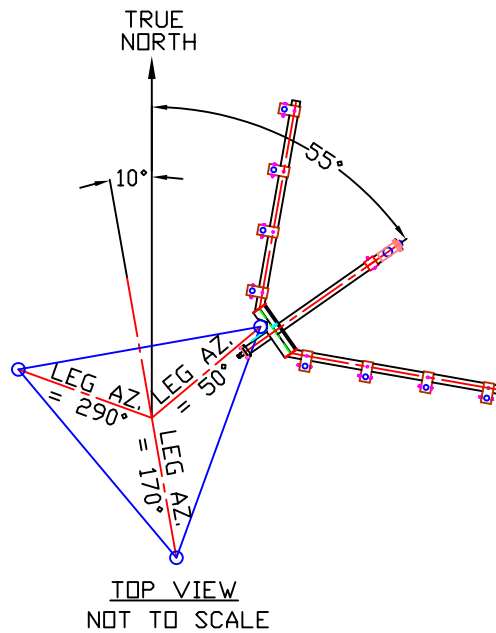
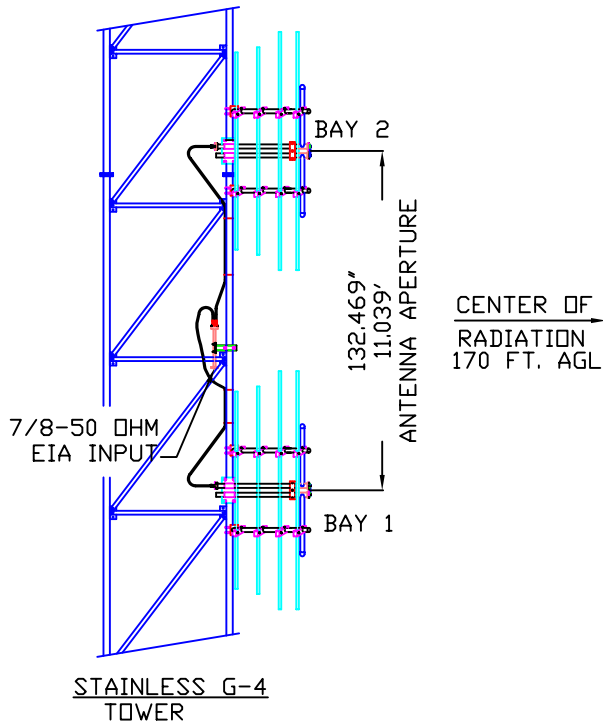
MECHANICAL SPECIFICATION

No. Of Bays	2			
Antenna Aperture	11.05	ft.	3.37	m
Center of Radiation AGL	170.56	ft.	52.00	m
Antenna Weight	26.40	lbs.	12.00	kg
Windload (50/33)	54.00	lbs.	24.55	kg

Note: Preliminary values can be used for planning system.

Prepared by:

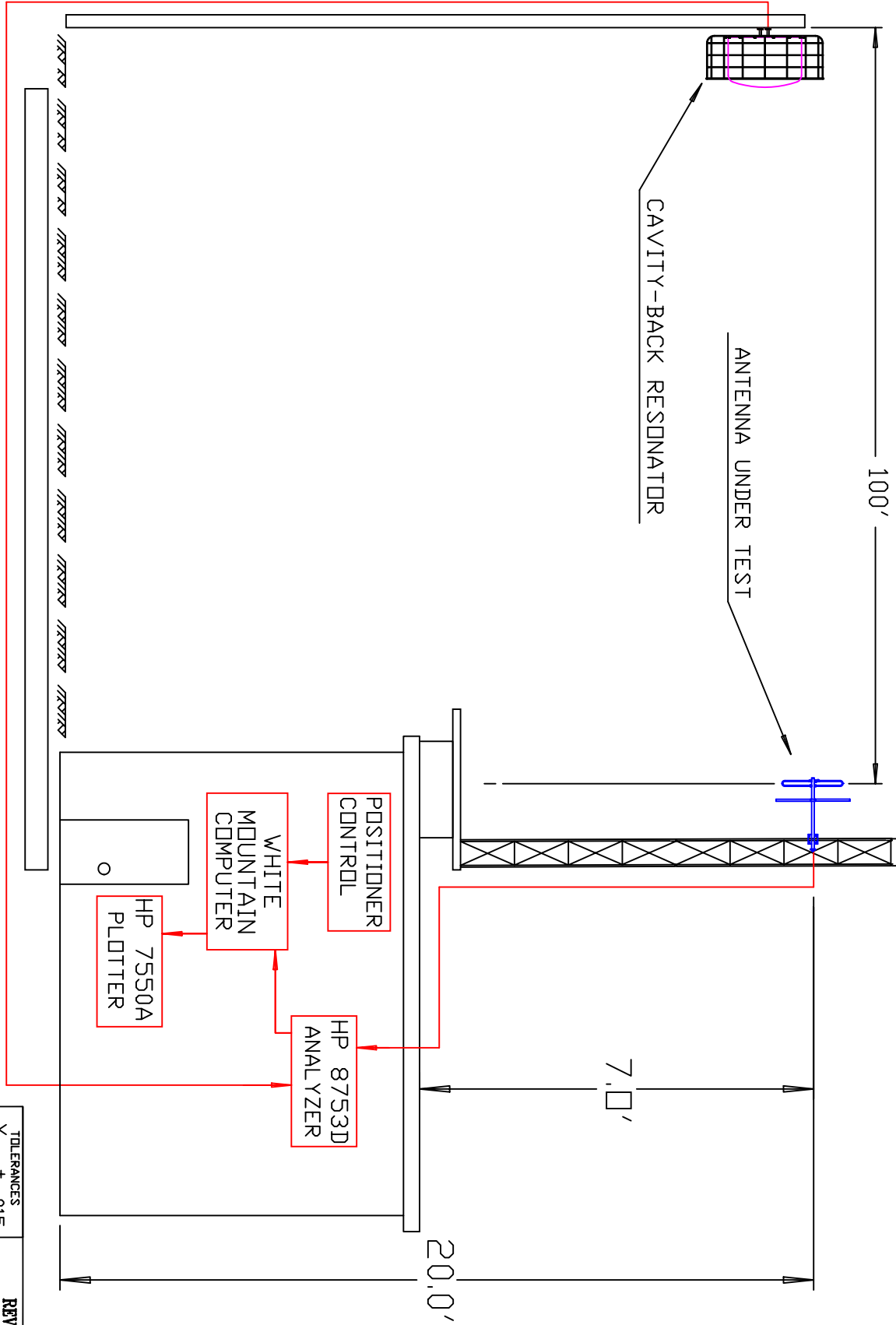
Jason Duncan



ANTENNA FRONT VIEW
WITHOUT PARASITICS
NOT TO SCALE



NOTE:



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

TITLE: TEST RANGE SCHEMATIC		SIZE: A	PARTS MADE BY THIS DRAWING		DRAWING NUMBER: 2105A10
MATERIAL:			SCALE: NTS	NAME: JRM	DATE: 11/1/98
					SHEET 1 OF 1