



## **SYSTEMS WITH RELIABILITY, LP**

**BROADCAST ANTENNAS AND TRANSMISSION SYSTEMS**

### **PATTERN CERTIFICATION**

#### **DIRECTIONAL FM ANTENNA WBWV**

*August 31, 2011*

<b>Station</b>	: WBWV
<b>Location</b>	: Beckley, WV
<b>Frequency</b>	: 88.7 MHz
<b>Channel</b>	: 204B1
<b>Antenna Model</b>	: FMIECD/3-DA
<b>Maximum Antenna Gain</b>	
<b>Vertical</b>	: 1.925 / 2.844 dB
<b>Horizontal</b>	: 1.925 / 2.844 dB

#### **ANTENNA DESCRIPTION**

A custom designed FMIECD/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 system. The array is comprised of three bays, that are spaced a half wavelength apart, mounted to a tower pointing 90 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 a pipe attached to a 5.583 in third scale model tower with the use of third scale 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. Horizontal parasitic elements were used to obtain the desired horizontal polarized directional pattern. The vertical polarized pattern was obtained by adjusting the mounting distance and orientation.

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 266.1 MHz. The antenna under test was rotated in a clockwise direction. A gain reference was taken using a dipole tuned to 266.1 MHz. The received signal does not exceed a maximum to minimum ratio of 15 dB.

## TEST RESULTS

The attached calculations verify that the **RMS** value of this antenna is **94.0 %** of the **RMS** value of the pattern authorized in the related construction permit **BMPED-20100707CUI**. The circular polarized component **RMS** value is **0.718**.

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

**Calculated composite azimuth pattern directivity: 1.942 / 2.883 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 = (1.995)(1.794)(0.5378) = 1.925 / 2.844 dB**

**H-Pol. Gain = (2.321)(1.794)(0.4622) = 1.925 / 2.844 dB**

## INSTALLATION AND MOUNTING

The antenna is to be mounted in accordance with the supplied drawings. The antenna center of radiation is to be **28.0 meters** (91.87 ft.) above ground level. The antenna total length is **18.0 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 system's orientation and the mounting details are described in the following drawings:

<b>DRAWING NO.</b>	<b>TITLE</b>
1507D00	ANTENNA ELEVATION
1507D01	ANTENNA ORIENTATION
1507D02	BAYS 1 & 3 PARASITIC PLACEMENT
1507D03	BAY 2 PARASITIC PLACEMENT
2105A10	TEST RANGE SCHEMATIC

The array shall be mounted according to **DWG. 1507D00**. The antenna elements shall be aligned at 90 Degrees with respect to True North as in **DWG. 1507D01**. The parasitic placement for Bays 1 & 3 is shown in **DWG. 1507D02**. The parasitic placement for Bay 2 is shown in **DWG. 1507D03**.

## DOCUMENT EXHIBITS

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


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

## TEST EQUIPMENT

<b>Network Analyzer</b>	:	Hewlett Packard Model # 8753C Serial Number: 08753 – 69138
<b>Computer</b>	:	Pentium 3, 450 MHz, Range Program
<b>Printer</b>	:	Hewlett-Packard Laser Jet 6L
<b>Positioner</b>	:	Orbit Controller and Positioner

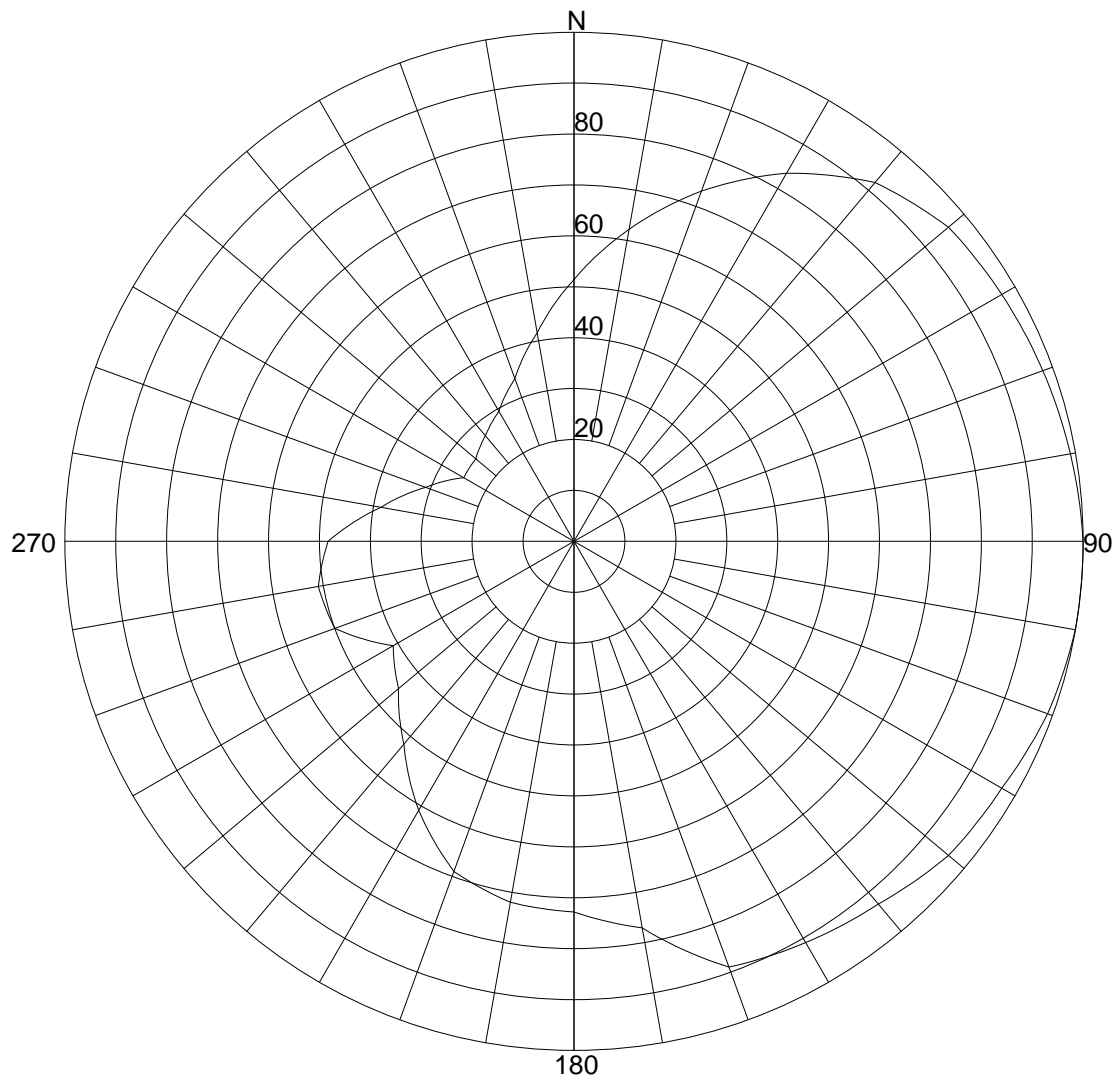
All equipment was calibrated to ANSI/NCSL Z540-1-1994 specs

*Prepared by:*



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



## Azimuth Pattern

### Systems With Reliability

Scale: Linear

Unit: Relative Field

CLIENT: *WBWV*

Date: 8/19/2011

ANTENNA TYPE: FMIECD/3-DA

FREQUENCY: 88.7 MHz

PATTERN POL.: Circular

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.94231 / 2.883dB

PATTERN RMS: 0.718

## Relative Field Tabulation(Azimuth)

Azimuth Heading	Normalized Field(dB)	Azimuth Heading	Normalized Field(dB)
0	.5140 (-5.781 )	180	.7280 (-2.757 )
5	.5680 (-4.913 )	185	.7240 (-2.805 )
10	.6220 (-4.124 )	190	.7200 (-2.853 )
15	.6770 (-3.388 )	195	.7050 (-3.036 )
20	.7320 (-2.71 )	200	.6900 (-3.223 )
25	.7835 (-2.119 )	205	.6500 (-3.742 )
30	.8350 (-1.566 )	210	.6100 (-4.293 )
35	.8775 (-1.135 )	215	.5650 (-4.959 )
40	.9200 (-0.724 )	220	.5200 (-5.68 )
45	.9400 (-0.537 )	225	.4850 (-6.285 )
50	.9600 (-0.355 )	230	.4500 (-6.936 )
55	.9650 (-0.309 )	235	.4300 (-7.331 )
60	.9700 (-0.265 )	240	.4100 (-7.744 )
65	.9750 (-0.22 )	245	.4550 (-6.84 )
70	.9800 (-0.175 )	250	.5000 (-6.021 )
75	.9850 (-0.131 )	255	.5050 (-5.934 )
80	.9900 (-0.087 )	260	.5100 (-5.849 )
85	.9950 (-0.044 )	265	.4965 (-6.082 )
90	1.0000 ( 0 )	270	.4830 (-6.321 )
95	1.0000 ( 0 )	275	.4340 (-7.25 )
100	1.0000 ( 0 )	280	.3850 (-8.291 )
105	.9950 (-0.044 )	285	.3475 (-9.181 )
110	.9900 (-0.087 )	290	.3100 (-10.173 )
115	.9800 (-0.175 )	295	.2800 (-11.057 )
120	.9700 (-0.265 )	300	.2500 (-12.041 )
125	.9650 (-0.309 )	305	.2510 (-12.007 )
130	.9600 (-0.355 )	310	.2520 (-11.972 )
135	.9450 (-0.491 )	315	.2615 (-11.651 )
140	.9300 (-0.63 )	320	.2710 (-11.341 )
145	.9200 (-0.724 )	325	.2830 (-10.964 )
150	.9100 (-0.819 )	330	.2950 (-10.604 )
155	.9000 (-0.915 )	335	.3175 (-9.965 )
160	.8900 (-1.012 )	340	.3400 (-9.37 )
165	.8305 (-1.613 )	345	.3780 (-8.45 )
170	.7710 (-2.259 )	350	.4160 (-7.618 )
175	.7495 (-2.505 )	355	.4650 (-6.651 )

## Systems With Reliability

CLIENT: *WBWV*

Date: 8/19/2011

ANTENNA TYPE: FMIECD/3-DA

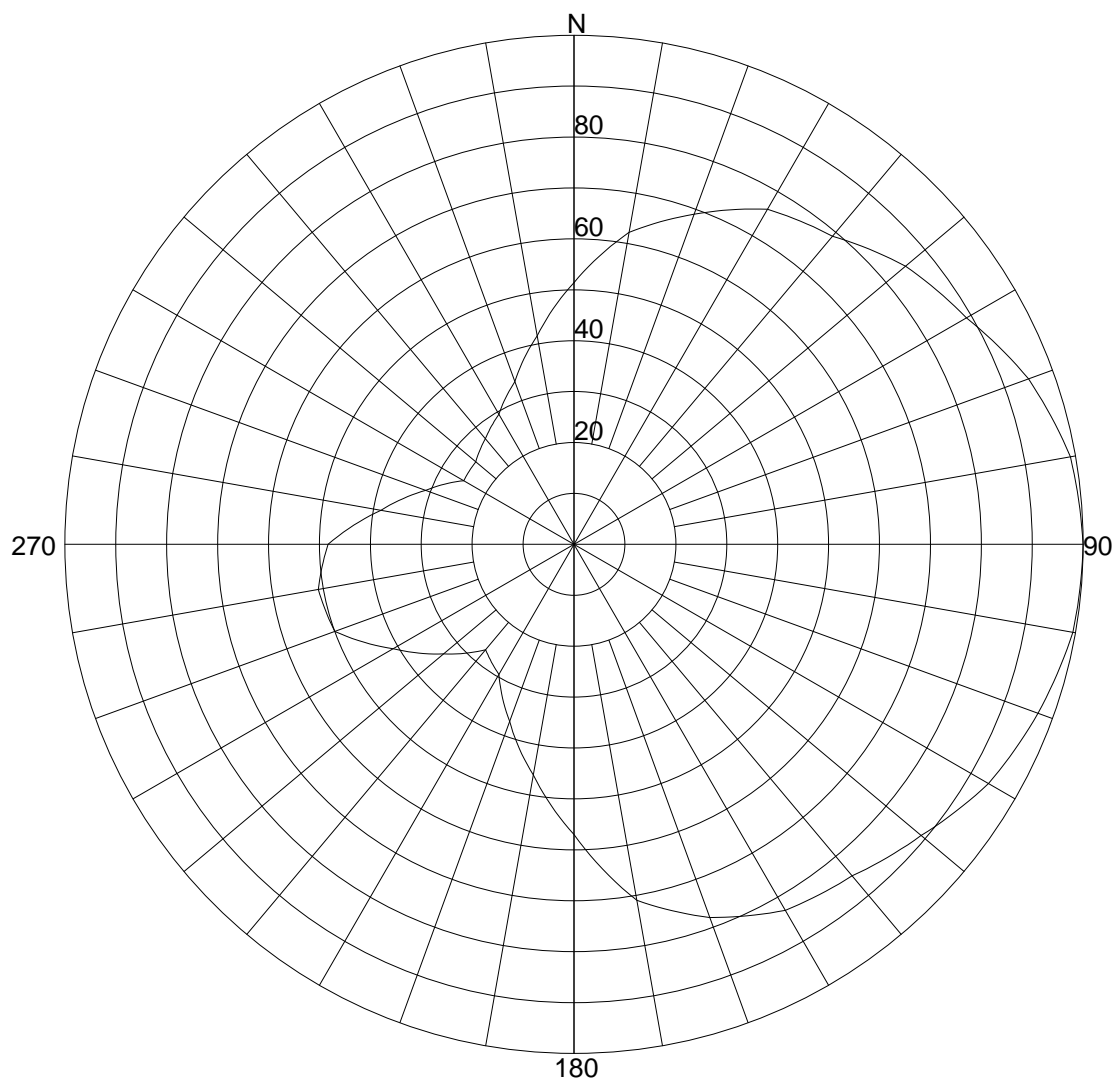
FREQUENCY: 88.7 MHz

PATTERN POL.: Circular

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.94231 / 2.883dB

PATTERN RMS: 0.718



Azimuth Pattern

## Systems With Reliability

Scale: Linear

Unit: Relative Field

CLIENT: *WBWV*

Date: 8/19/2011

ANTENNA TYPE: FMIECD/3-DA

FREQUENCY: 88.7 MHz

PATTERN POL.: Horizontal

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.32128 / 3.657dB

PATTERN RMS: 0.656

## Relative Field Tabulation(Azimuth)

Azimuth Heading	Normalized Field(dB)	Azimuth Heading	Normalized Field(dB)
0	.5140 (-5.781 )	180	.5700 (-4.883 )
5	.5680 (-4.913 )	185	.5150 (-5.764 )
10	.6220 (-4.124 )	190	.4600 (-6.745 )
15	.6560 (-3.662 )	195	.4150 (-7.639 )
20	.6900 (-3.223 )	200	.3700 (-8.636 )
25	.7250 (-2.793 )	205	.3325 (-9.564 )
30	.7600 (-2.384 )	210	.2950 (-10.604 )
35	.7750 (-2.214 )	215	.2825 (-10.98 )
40	.7900 (-2.047 )	220	.2700 (-11.373 )
45	.8200 (-1.724 )	225	.3025 (-10.385 )
50	.8500 (-1.412 )	230	.3350 (-9.499 )
55	.8700 (-1.21 )	235	.3725 (-8.577 )
60	.8900 (-1.012 )	240	.4100 (-7.744 )
65	.9200 (-0.724 )	245	.4550 (-6.84 )
70	.9500 (-0.446 )	250	.5000 (-6.021 )
75	.9700 (-0.265 )	255	.5050 (-5.934 )
80	.9900 (-0.087 )	260	.5100 (-5.849 )
85	.9950 (-0.044 )	265	.4965 (-6.082 )
90	1.0000 ( 0 )	270	.4830 (-6.321 )
95	.9975 (-0.022 )	275	.4340 (-7.25 )
100	.9950 (-0.044 )	280	.3850 (-8.291 )
105	.9825 (-0.153 )	285	.3475 (-9.181 )
110	.9700 (-0.265 )	290	.3100 (-10.173 )
115	.9550 (-0.4 )	295	.2800 (-11.057 )
120	.9400 (-0.537 )	300	.2500 (-12.041 )
125	.9150 (-0.772 )	305	.2510 (-12.007 )
130	.8900 (-1.012 )	310	.2520 (-11.972 )
135	.8700 (-1.21 )	315	.2615 (-11.651 )
140	.8500 (-1.412 )	320	.2710 (-11.341 )
145	.8400 (-1.514 )	325	.2830 (-10.964 )
150	.8300 (-1.618 )	330	.2950 (-10.604 )
155	.8050 (-1.884 )	335	.3175 (-9.965 )
160	.7800 (-2.158 )	340	.3400 (-9.37 )
165	.7450 (-2.557 )	345	.3780 (-8.45 )
170	.7100 (-2.975 )	350	.4160 (-7.618 )
175	.6400 (-3.876 )	355	.4650 (-6.651 )

## Systems With Reliability

CLIENT: *WBWV*

Date: 8/19/2011

ANTENNA TYPE: FMIECD/3-DA

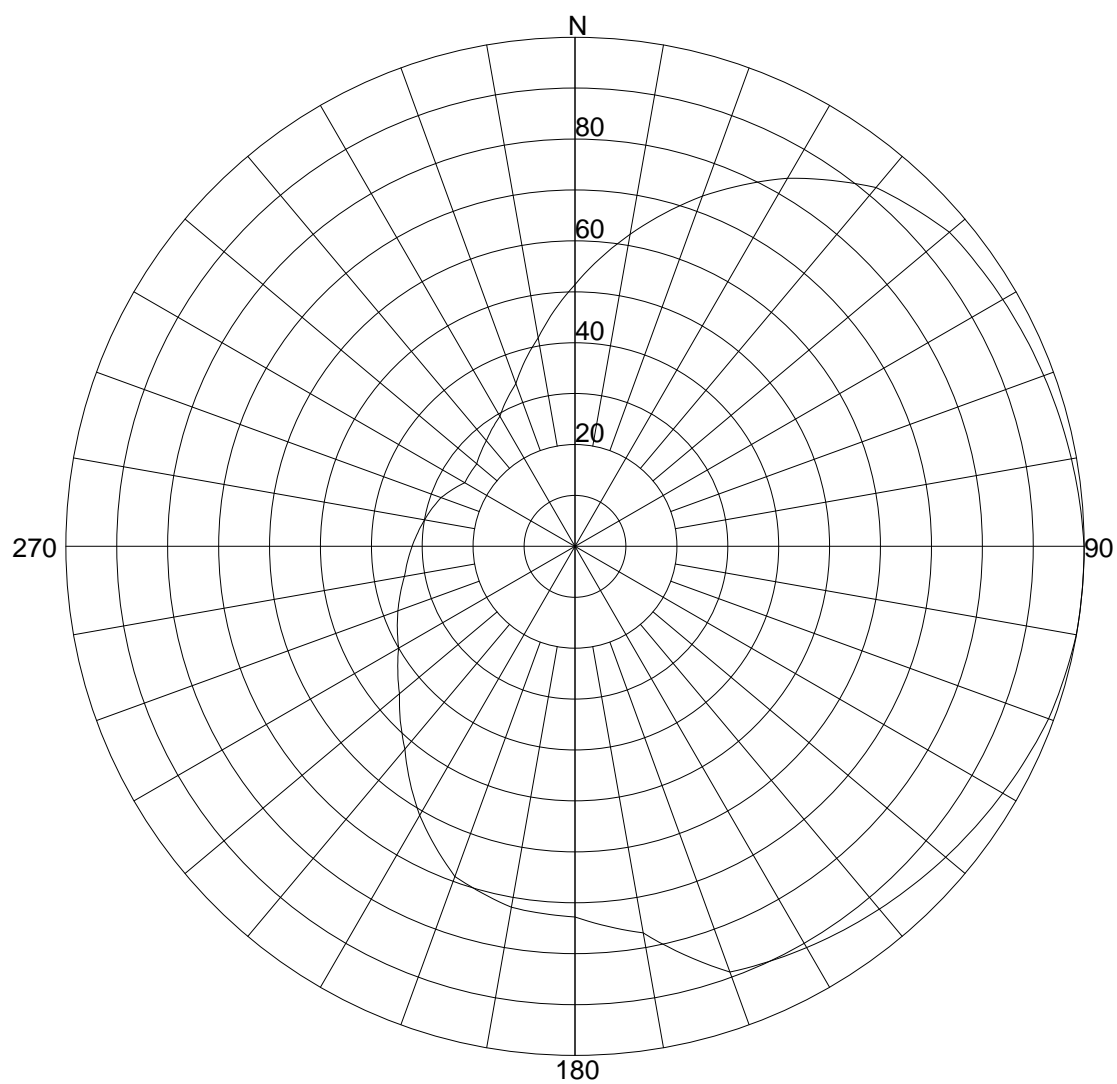
FREQUENCY: 88.7 MHz

PATTERN POL.: Horizontal

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.32128 / 3.657dB

PATTERN RMS: 0.656



Azimuth Pattern

## Systems With Reliability

Scale: Linear

Unit: Relative Field

CLIENT: *WBWV*

Date: 8/19/2011

ANTENNA TYPE: FMIECD/3-DA

FREQUENCY: 88.7 MHz

PATTERN POL.: Vertical

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.99481 / 2.999dB

PATTERN RMS: 0.708



## Relative Field Tabulation(Azimuth)

Azimuth Heading	Normalized Field(dB)	Azimuth Heading	Normalized Field(dB)
0	.5140 (-5.781 )	180	.7280 (-2.757 )
5	.5680 (-4.913 )	185	.7240 (-2.805 )
10	.6220 (-4.124 )	190	.7200 (-2.853 )
15	.6770 (-3.388 )	195	.7050 (-3.036 )
20	.7320 (-2.71 )	200	.6900 (-3.223 )
25	.7835 (-2.119 )	205	.6500 (-3.742 )
30	.8350 (-1.566 )	210	.6100 (-4.293 )
35	.8775 (-1.135 )	215	.5650 (-4.959 )
40	.9200 (-0.724 )	220	.5200 (-5.68 )
45	.9400 (-0.537 )	225	.4850 (-6.285 )
50	.9600 (-0.355 )	230	.4500 (-6.936 )
55	.9650 (-0.309 )	235	.4250 (-7.432 )
60	.9700 (-0.265 )	240	.4000 (-7.959 )
65	.9750 (-0.22 )	245	.3850 (-8.291 )
70	.9800 (-0.175 )	250	.3700 (-8.636 )
75	.9850 (-0.131 )	255	.3550 (-8.995 )
80	.9900 (-0.087 )	260	.3400 (-9.37 )
85	.9950 (-0.044 )	265	.3300 (-9.63 )
90	1.0000 ( 0 )	270	.3200 (-9.897 )
95	1.0000 ( 0 )	275	.3100 (-10.173 )
100	1.0000 ( 0 )	280	.3000 (-10.458 )
105	.9950 (-0.044 )	285	.2900 (-10.752 )
110	.9900 (-0.087 )	290	.2800 (-11.057 )
115	.9800 (-0.175 )	295	.2650 (-11.535 )
120	.9700 (-0.265 )	300	.2500 (-12.041 )
125	.9600 (-0.355 )	305	.2510 (-12.007 )
130	.9500 (-0.446 )	310	.2520 (-11.972 )
135	.9400 (-0.537 )	315	.2615 (-11.651 )
140	.9300 (-0.63 )	320	.2710 (-11.341 )
145	.9200 (-0.724 )	325	.2830 (-10.964 )
150	.9100 (-0.819 )	330	.2950 (-10.604 )
155	.9000 (-0.915 )	335	.3175 (-9.965 )
160	.8900 (-1.012 )	340	.3400 (-9.37 )
165	.8305 (-1.613 )	345	.3780 (-8.45 )
170	.7710 (-2.259 )	350	.4160 (-7.618 )
175	.7495 (-2.505 )	355	.4650 (-6.651 )

## Systems With Reliability

CLIENT: *WBWV*

Date: 8/19/2011

ANTENNA TYPE: FMIECD/3-DA

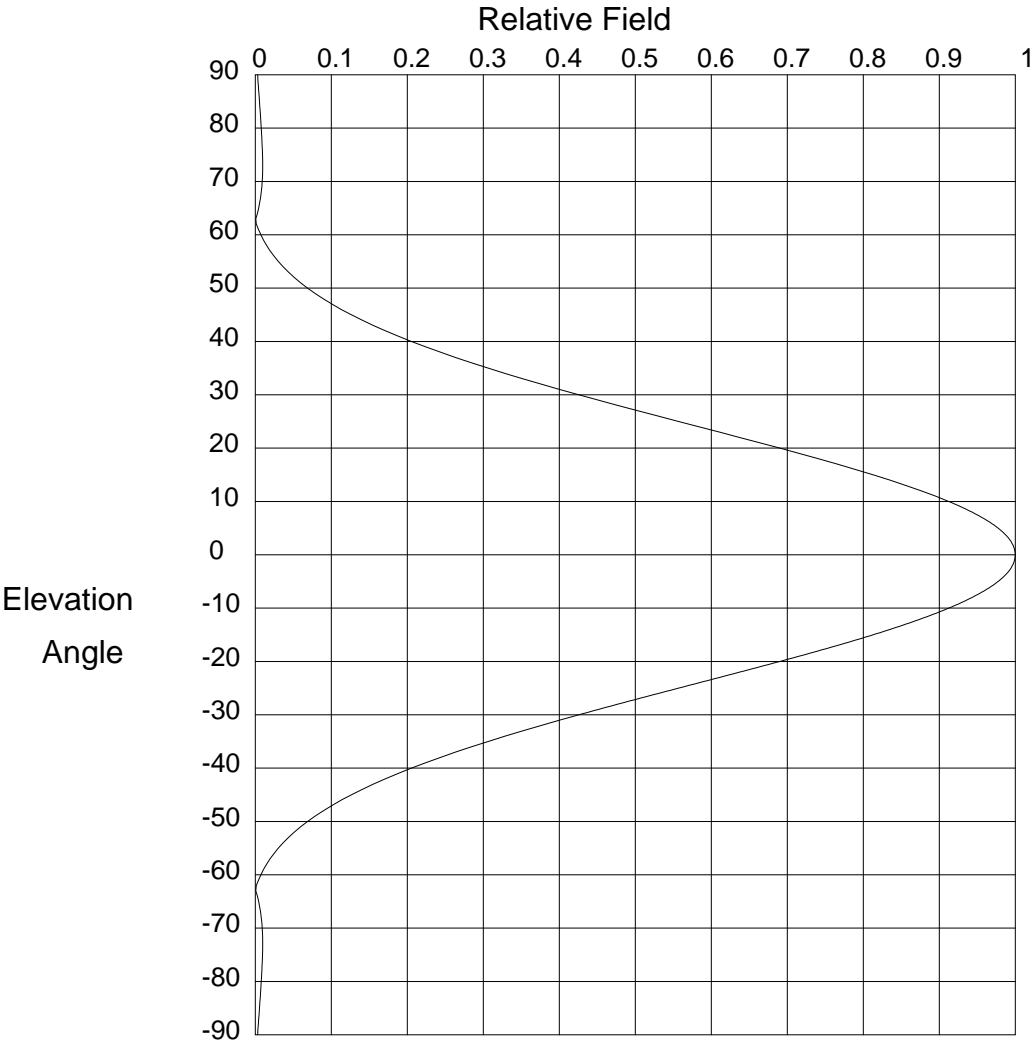
FREQUENCY: 88.7 MHz

PATTERN POL.: Vertical

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.99481 / 2.999dB

PATTERN RMS: 0.708



Elevation Pattern

Systems With Reliability

Scale: Linear  
Units: Field, Relative

CLIENT: <i>WBWV</i>		Date: 8/19/2011
ANTENNA TYPE: FMIECD/3 DA		
FREQUENCY: 88.7 MHz		
PATTERN POL.: Circular		
DIRECTIVITY(Peak): 1.794/2.539 dBd	Beam Tilt (Deg.) :	0
DIRECTIVITY(Horiz): 1.794/2.539 dBd	Null Fill(s)(%) :	-30, 0, 0

## Relative Field Tabulation

Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)
90.0	.003 (-50)	52.0	.051 (-25.779)	14.0	.835 (-1.565 )
89.0	.004 (-48.733)	51.0	.06 (-24.468)	13.0	.856 (-1.348 )
88.0	.004 (-47.628)	50.0	.069 (-23.236)	12.0	.876 (-1.147 )
87.0	.005 (-46.649)	49.0	.079 (-22.072)	11.0	.895 (-0.963 )
86.0	.005 (-45.772)	48.0	.089 (-20.968)	10.0	.912 (-0.796 )
85.0	.006 (-44.98)	47.0	.101 (-19.917)	9.8	.916 (-0.764 )
84.0	.006 (-44.262)	46.0	.113 (-18.916)	9.6	.919 (-0.733 )
83.0	.007 (-43.608)	45.0	.126 (-17.959)	9.4	.922 (-0.703 )
82.0	.007 (-43.013)	44.0	.141 (-17.044)	9.2	.925 (-0.673 )
81.0	.008 (-42.474)	43.0	.155 (-16.166)	9.0	.929 (-0.644 )
80.0	.008 (-41.988)	42.0	.171 (-15.324)	8.8	.932 (-0.616 )
79.0	.008 (-41.557)	41.0	.188 (-14.515)	8.6	.935 (-0.588 )
78.0	.009 (-41.179)	40.0	.206 (-13.738)	8.4	.937 (-0.561 )
77.0	.009 (-40.858)	39.0	.224 (-12.99)	8.2	.94 (-0.534 )
76.0	.009 (-40.598)	38.0	.243 (-12.271)	8.0	.943 (-0.508 )
75.0	.01 (-40.404)	37.0	.264 (-11.58)	7.8	.946 (-0.483 )
74.0	.01 (-40.283)	36.0	.285 (-10.914)	7.6	.949 (-0.459 )
73.0	.01 (-40.246)	35.0	.306 (-10.273)	7.4	.951 (-0.435 )
72.0	.01 (-40.304)	34.0	.329 (-9.656)	7.2	.954 (-0.412 )
71.0	.009 (-40.477)	33.0	.352 (-9.063)	7.0	.956 (-0.389 )
70.0	.009 (-40.789)	32.0	.376 (-8.492)	6.8	.959 (-0.367 )
69.0	.009 (-41.276)	31.0	.401 (-7.943)	6.6	.961 (-0.346 )
68.0	.008 (-41.993)	30.0	.426 (-7.416)	6.4	.963 (-0.325 )
67.0	.007 (-43.03)	29.0	.451 (-6.909)	6.2	.965 (-0.305 )
66.0	.006 (-44.546)	28.0	.477 (-6.423)	6.0	.968 (-0.286 )
65.0	.005 (-46.87)	27.0	.504 (-5.957)	5.8	.97 (-0.267 )
64.0	.003 (-50.893)	26.0	.53 (-5.51)	5.6	.972 (-0.249 )
63.0	.001 (-61.374)	25.0	.557 (-5.082)	5.4	.974 (-0.231 )
62.0	.001 (-56.506)	24.0	.584 (-4.673)	5.2	.976 (-0.215 )
61.0	.004 (-47.484)	23.0	.611 (-4.283)	5.0	.977 (-0.198 )
60.0	.007 (-42.654)	22.0	.637 (-3.911)	4.8	.979 (-0.183 )
59.0	.011 (-39.207)	21.0	.664 (-3.557)	4.6	.981 (-0.168 )
58.0	.015 (-36.464)	20.0	.69 (-3.221)	4.4	.982 (-0.154 )
57.0	.02 (-34.152)	19.0	.716 (-2.902)	4.2	.984 (-0.14 )
56.0	.025 (-32.133)	18.0	.741 (-2.6)	4.0	.985 (-0.127 )
55.0	.03 (-30.329)	17.0	.766 (-2.316)	3.8	.987 (-0.115 )
54.0	.037 (-28.688)	16.0	.79 (-2.049)	3.6	.988 (-0.103 )
53.0	.044 (-27.18)	15.0	.813 (-1.799)	3.4	.99 (-0.092 )

## Systems With Reliability

Page 1 of 3

CLIENT: *WBWV*

Date: 8/19/2011

ANTENNA TYPE: FMIECD/3 DA

FREQUENCY: 88.7 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 1.794/2.539 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 1.794/2.539 dBd

Null Fill(s)(%) : -30, 0, 0

## Relative Field Tabulation

Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)
3.2	.991 (-0.081)	-4.4	.982 (-0.154)	-12.0	.876 (-1.147 )
3.0	.992 (-0.071)	-4.6	.981 (-0.168)	-12.2	.872 (-1.186 )
2.8	.993 (-0.062)	-4.8	.979 (-0.183)	-12.4	.868 (-1.226 )
2.6	.994 (-0.054)	-5.0	.977 (-0.198)	-12.6	.864 (-1.266 )
2.4	.995 (-0.046)	-5.2	.976 (-0.215)	-12.8	.86 (-1.307 )
2.2	.996 (-0.038)	-5.4	.974 (-0.231)	-13.0	.856 (-1.348 )
2.0	.996 (-0.032)	-5.6	.972 (-0.249)	-13.2	.852 (-1.39 )
1.8	.997 (-0.026)	-5.8	.97 (-0.267)	-13.4	.848 (-1.433 )
1.6	.998 (-0.02)	-6.0	.968 (-0.286)	-13.6	.844 (-1.476 )
1.4	.998 (-0.016)	-6.2	.965 (-0.305)	-13.8	.839 (-1.52 )
1.2	.999 (-0.011)	-6.4	.963 (-0.325)	-14.0	.835 (-1.565 )
1.0	.999 (-0.008)	-6.6	.961 (-0.346)	-14.2	.831 (-1.61 )
.8	.999 (-0.005)	-6.8	.959 (-0.367)	-14.4	.826 (-1.656 )
.6	1.00 (-0.003)	-7.0	.956 (-0.389)	-14.6	.822 (-1.703 )
.4	1.00 (-0.001)	-7.2	.954 (-0.412)	-14.8	.817 (-1.751 )
.2	1.00 (0)	-7.4	.951 (-0.435)	-15.0	.813 (-1.799 )
.0	1.00 (0)	-7.6	.949 (-0.459)	-15.2	.808 (-1.847 )
-.2	1.00 (0)	-7.8	.946 (-0.483)	-15.4	.804 (-1.897 )
-.4	1.00 (-0.001)	-8.0	.943 (-0.508)	-15.6	.799 (-1.947 )
-.6	1.00 (-0.003)	-8.2	.94 (-0.534)	-15.8	.795 (-1.998 )
-.8	.999 (-0.005)	-8.4	.937 (-0.561)	-16.0	.79 (-2.049 )
-1.0	.999 (-0.008)	-8.6	.935 (-0.588)	-16.2	.785 (-2.101 )
-1.2	.999 (-0.011)	-8.8	.932 (-0.616)	-16.4	.78 (-2.154 )
-1.4	.998 (-0.016)	-9.0	.929 (-0.644)	-16.6	.776 (-2.207 )
-1.6	.998 (-0.02)	-9.2	.925 (-0.673)	-16.8	.771 (-2.261 )
-1.8	.997 (-0.026)	-9.4	.922 (-0.703)	-17.0	.766 (-2.316 )
-2.0	.996 (-0.032)	-9.6	.919 (-0.733)	-17.2	.761 (-2.372 )
-2.2	.996 (-0.038)	-9.8	.916 (-0.764)	-17.4	.756 (-2.428 )
-2.4	.995 (-0.046)	-10.0	.912 (-0.796)	-17.6	.751 (-2.485 )
-2.6	.994 (-0.054)	-10.2	.909 (-0.828)	-17.8	.746 (-2.542 )
-2.8	.993 (-0.062)	-10.4	.906 (-0.861)	-18.0	.741 (-2.6 )
-3.0	.992 (-0.071)	-10.6	.902 (-0.894)	-18.2	.736 (-2.659 )
-3.2	.991 (-0.081)	-10.8	.899 (-0.928)	-18.4	.731 (-2.719 )
-3.4	.99 (-0.092)	-11.0	.895 (-0.963)	-18.6	.726 (-2.779 )
-3.6	.988 (-0.103)	-11.2	.891 (-0.999)	-18.8	.721 (-2.84 )
-3.8	.987 (-0.115)	-11.4	.888 (-1.035)	-19.0	.716 (-2.902 )
-4.0	.985 (-0.127)	-11.6	.884 (-1.072)	-19.2	.711 (-2.964 )
-4.2	.984 (-0.14)	-11.8	.88 (-1.109)	-19.4	.706 (-3.027 )

## Systems With Reliability

Page 2 of 3

CLIENT: *WBWV*

Date: 8/19/2011

ANTENNA TYPE: FMIECD/3 DA

FREQUENCY: 88.7 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 1.794/2.539 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 1.794/2.539 dBd

Null Fill(s)(%) : -30, 0, 0

## Relative Field Tabulation

Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)
-19.6	.701 (-3.091)	-27.2	.498 (-6.048)	-54.0	.037 (-28.688 )
-19.8	.695 (-3.155)	-27.4	.493 (-6.141)	-55.0	.03 (-30.329 )
-20.0	.69 (-3.221)	-27.6	.488 (-6.234)	-56.0	.025 (-32.133 )
-20.2	.685 (-3.286)	-27.8	.483 (-6.328)	-57.0	.02 (-34.152 )
-20.4	.68 (-3.353)	-28.0	.477 (-6.423)	-58.0	.015 (-36.464 )
-20.6	.675 (-3.42)	-28.2	.472 (-6.519)	-59.0	.011 (-39.207 )
-20.8	.669 (-3.488)	-28.4	.467 (-6.615)	-60.0	.007 (-42.654 )
-21.0	.664 (-3.557)	-28.6	.462 (-6.712)	-61.0	.004 (-47.484 )
-21.2	.659 (-3.626)	-28.8	.457 (-6.81)	-62.0	.001 (-56.506 )
-21.4	.653 (-3.696)	-29.0	.451 (-6.909)	-63.0	.001 (-61.374 )
-21.6	.648 (-3.767)	-29.2	.446 (-7.009)	-64.0	.003 (-50.893 )
-21.8	.643 (-3.839)	-29.4	.441 (-7.109)	-65.0	.005 (-46.87 )
-22.0	.637 (-3.911)	-29.6	.436 (-7.211)	-66.0	.006 (-44.546 )
-22.2	.632 (-3.984)	-29.8	.431 (-7.313)	-67.0	.007 (-43.03 )
-22.4	.627 (-4.058)	-30.0	.426 (-7.416)	-68.0	.008 (-41.993 )
-22.6	.621 (-4.132)	-31.0	.401 (-7.943)	-69.0	.009 (-41.276 )
-22.8	.616 (-4.207)	-32.0	.376 (-8.492)	-70.0	.009 (-40.789 )
-23.0	.611 (-4.283)	-33.0	.352 (-9.063)	-71.0	.009 (-40.477 )
-23.2	.605 (-4.36)	-34.0	.329 (-9.656)	-72.0	.01 (-40.304 )
-23.4	.60 (-4.437)	-35.0	.306 (-10.273)	-73.0	.01 (-40.246 )
-23.6	.595 (-4.515)	-36.0	.285 (-10.914)	-74.0	.01 (-40.283 )
-23.8	.589 (-4.594)	-37.0	.264 (-11.58)	-75.0	.01 (-40.404 )
-24.0	.584 (-4.673)	-38.0	.243 (-12.271)	-76.0	.009 (-40.598 )
-24.2	.579 (-4.754)	-39.0	.224 (-12.99)	-77.0	.009 (-40.858 )
-24.4	.573 (-4.835)	-40.0	.206 (-13.738)	-78.0	.009 (-41.179 )
-24.6	.568 (-4.916)	-41.0	.188 (-14.515)	-79.0	.008 (-41.557 )
-24.8	.562 (-4.999)	-42.0	.171 (-15.324)	-80.0	.008 (-41.988 )
-25.0	.557 (-5.082)	-43.0	.155 (-16.166)	-81.0	.008 (-42.474 )
-25.2	.552 (-5.166)	-44.0	.141 (-17.044)	-82.0	.007 (-43.013 )
-25.4	.546 (-5.251)	-45.0	.126 (-17.959)	-83.0	.007 (-43.608 )
-25.6	.541 (-5.336)	-46.0	.113 (-18.916)	-84.0	.006 (-44.262 )
-25.8	.536 (-5.423)	-47.0	.101 (-19.917)	-85.0	.006 (-44.98 )
-26.0	.53 (-5.51)	-48.0	.089 (-20.968)	-86.0	.005 (-45.772 )
-26.2	.525 (-5.598)	-49.0	.079 (-22.072)	-87.0	.005 (-46.649 )
-26.4	.52 (-5.686)	-50.0	.069 (-23.236)	-88.0	.004 (-47.628 )
-26.6	.514 (-5.775)	-51.0	.06 (-24.468)	-89.0	.004 (-48.733 )
-26.8	.509 (-5.866)	-52.0	.051 (-25.779)	-90.0	.003 (-50 )
-27.0	.504 (-5.957)	-53.0	.044 (-27.18)	90.0	.00 (-50 )

## Systems With Reliability

Page 3 of 3

CLIENT: *WBWV*

Date: 8/19/2011

ANTENNA TYPE: FMIECD/3 DA

FREQUENCY: 88.7 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 1.794/2.539 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 1.794/2.539 dBd

Null Fill(s)(%) : -30, 0, 0

# Exhibit 5: Antenna Data Sheet



## SYSTEMS WITH RELIABILITY, LP

BROADCAST ANTENNAS AND TRANSMISSION SYSTEMS

### SYSTEM DATA SHEET

<b>Call Letters</b>	WBVV
<b>Contact</b>	Tim Hartzog
<b>Location</b>	Beckley, WV
<b>Antenna Model</b>	FMIECD/3-DA
<b>Channel / Frequency</b>	204B1 / 88.7 MHz

#### ELECTRICAL SPECIFICATIONS

##### Antenna Specifications:

	H-POL			V. Pol.		
License ERP ( KW)	0.950	-0.223	<b>dBk</b>	0.950	-0.223	<b>dBk</b>
FCC Limit Pattern Directivity	1.716	2.345	<b>dB</b>	1.716	2.345	<b>dB</b>
Elevation Directivity	1.794	2.538	<b>dB</b>	1.794	2.538	<b>dB</b>
Azimuth Directivity	2.321	3.657	<b>dB</b>	1.995	2.999	<b>dB</b>
Composite Pattern	1.942	2.883	<b>dB</b>	1.942	2.883	<b>dB</b>
Polarization Ratio	0.462	-3.352	<b>dB</b>	0.538	-2.694	<b>dB</b>
<b>RMS Comp./RMS Limit</b>	94.0	%				
Antenna Efficiency	100	%		100.0	%	
Power Ratio ( Pol. Ratio X Efficiency)	0.4622	-3.352		0.5378	-2.694	
Antenna Gain	1.925	2.844	<b>dB</b>	1.925	2.844	<b>dB</b>

<b>Antenna Input Power (KW)</b>	0.494 <b>kW</b>	-3.066 <b>dBk</b>
---------------------------------	-----------------	-------------------

##### Feed Line Specifications:

Line Type	AVA5-50 7/8" Foam	<b>50 Ω</b>
Attenuation Per 100 ft (dB)	0.318	<b>dB</b>
Line Length (ft) AGL + 20'	130.00	<b>ft.</b>
Total Line Attenuation (dB)	0.4134	<b>dB</b>
Line Efficiency	90.92	<b>%</b>
<b>Power Input to the Line (KW)</b>	0.543 <b>kW</b>	-2.653 <b>dBk</b>

#### MECHANICAL SPECIFICATIONS

<b>No. Of Bays</b>	3	
<b>Antenna Total Length</b>	18.00	<b>ft.</b>
<b>Center of Radiation AGL</b>	91.87	<b>ft.</b>
<b>Antenna Weight with Brackets</b>	125.00	<b>lbs.</b>
<b>Windload (50/33 psf) / CaAc</b>	250.00	<b>lbs.</b>
	3.38	<b>m</b>
	28.00	<b>m</b>
	56.82	<b>kg</b>
	7.50	<b>ft^2</b>

Prepared by:

Mark A. Gergely  
SWR, LP Engineering

8/31/2011



## SYSTEMS WITH RELIABILITY, LP

### Broadcast Antennas & Transmission Systems

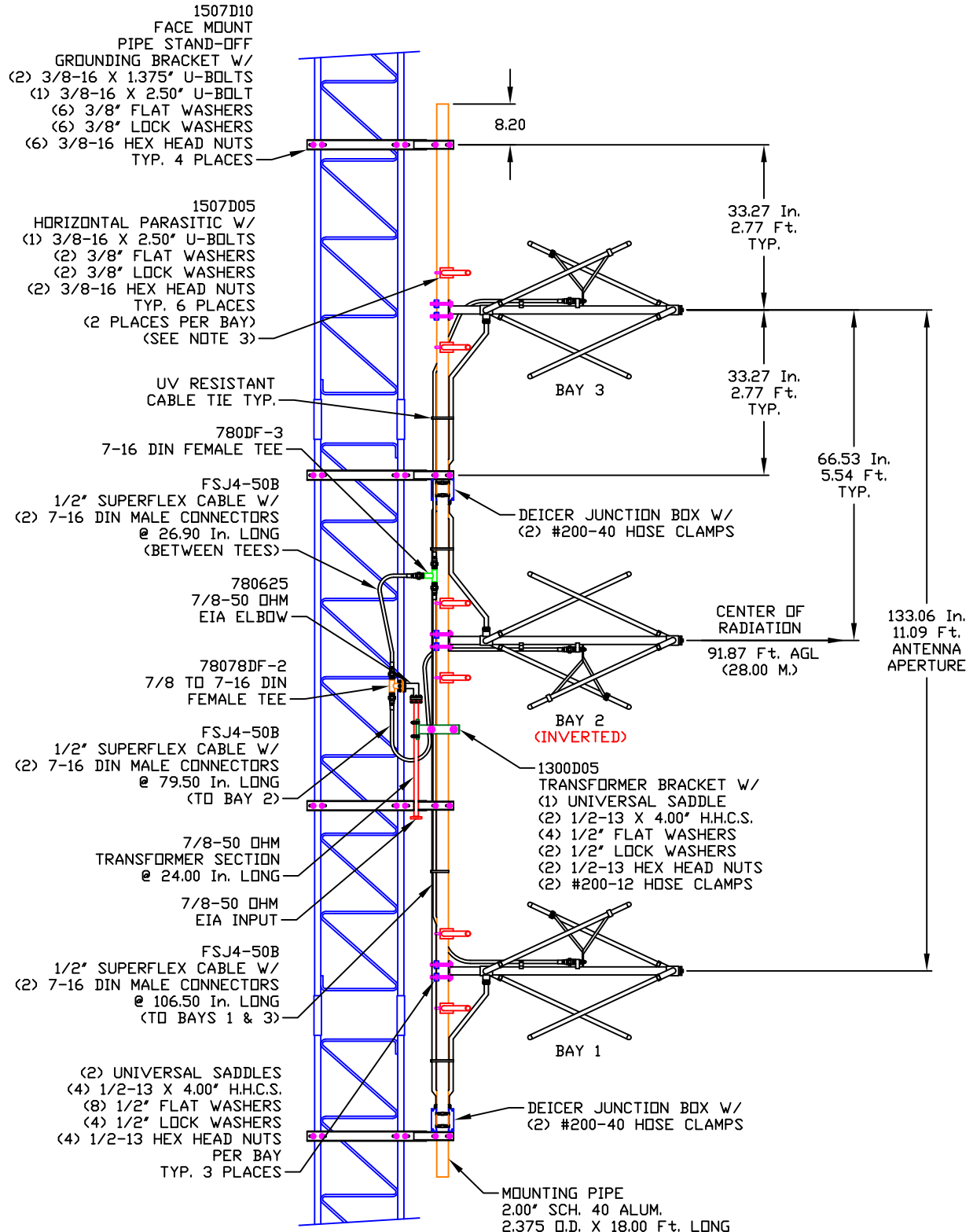
### WBWV Composite Antenna RMS Comparison

PROPOSED ANTENNA		DESIGNED ANTENNA	
Azimuth Heading	Relative Field	Azimuth Heading	Relative Field
0	0.514	0	0.514
10	0.622	10	0.622
20	0.732	20	0.732
30	0.835	30	0.835
40	0.920	40	0.920
50	0.978	50	0.960
60	1.000	60	0.970
70	1.000	70	0.980
80	1.000	80	0.990
90	1.000	90	1.000
100	1.000	100	1.000
110	1.000	110	0.990
120	1.000	120	0.970
130	1.000	130	0.950
140	1.000	140	0.930
150	1.000	150	0.910
160	0.918	160	0.890
170	0.771	170	0.771
180	0.728	180	0.728
190	0.768	190	0.720
200	0.790	200	0.690
210	0.760	210	0.610
220	0.739	220	0.520
230	0.741	230	0.450
240	0.746	240	0.410
250	0.698	250	0.500
260	0.603	260	0.510
270	0.483	270	0.483
280	0.385	280	0.385
290	0.310	290	0.310
300	0.250	300	0.250
310	0.252	310	0.252
320	0.271	320	0.271
330	0.295	330	0.295
340	0.340	340	0.340
350	0.416	350	0.416
Sum of Relative Field Squared :	21.001	Sum of Relative Field Squared :	18.537
Sum Divided by 36 (Readings) :	0.583	Sum Divided by 36 (Readings) :	0.515
Square Root :	0.764	Square Root :	0.718
Percentage of Construction Permit Antenna Filled :		94.0%	

## NOTES:

1. REFERENCE DWG. 1507D01 FOR ANTENNA ORIENTATION.
2. REFERENCE DWG. 1507D02 FOR BAYS 1 & 3 PARASITIC PLACEMENT.
3. REFERENCE DWG. 1507D03 FOR BAY 2 PARASITIC PLACEMENT.

## Exhibit 7: Drawings



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

TITLE: FMIECD/3-PLUS-DA FREQ. 88.7  
WBWV, BECKLEY, WV

MATERIAL:

SIZE REV APPR. DATE

1			
2			
3			

ENGINEER:

SCALE: NTS

NAME: RAC

DATE: 8/29/11

SHEET 1 OF 1

DRAWING NUMBER: 1507D00



**DRAWING  
NUMBER:** 1507D01

# TRUE NORTH



TOLERANCES		REVISION RECORD	
.X ± .015	REV	APPROVAL	DATE
.XX ± .005			
.XXX ± .002			
X/X ± 1/32			
DEG. ± 1/2			
UNLESS OTHERWISE SPECIFIED			
BY THIS DRAWING		DRAWING NUMBER: 1507D01	
NAME: RAC	DATE: 8/29/11	SHEET 1 OF 1	



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

TITLE:	FMIECD/3-PLUS-DA, FREQ. 88.7 WBWV, BECKLEY, WV
MATERIAL:	ANTENNA ORIENTATION FROM TRUE NORTH

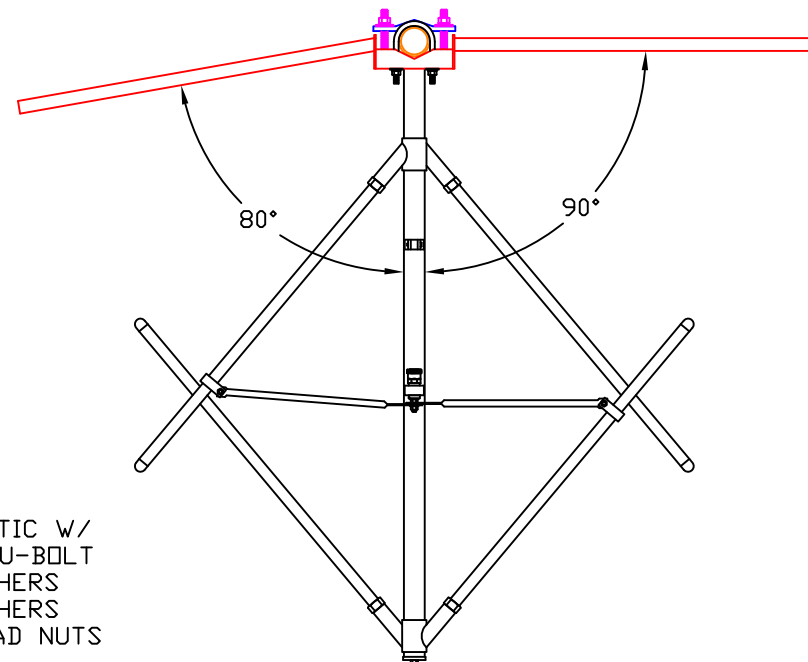
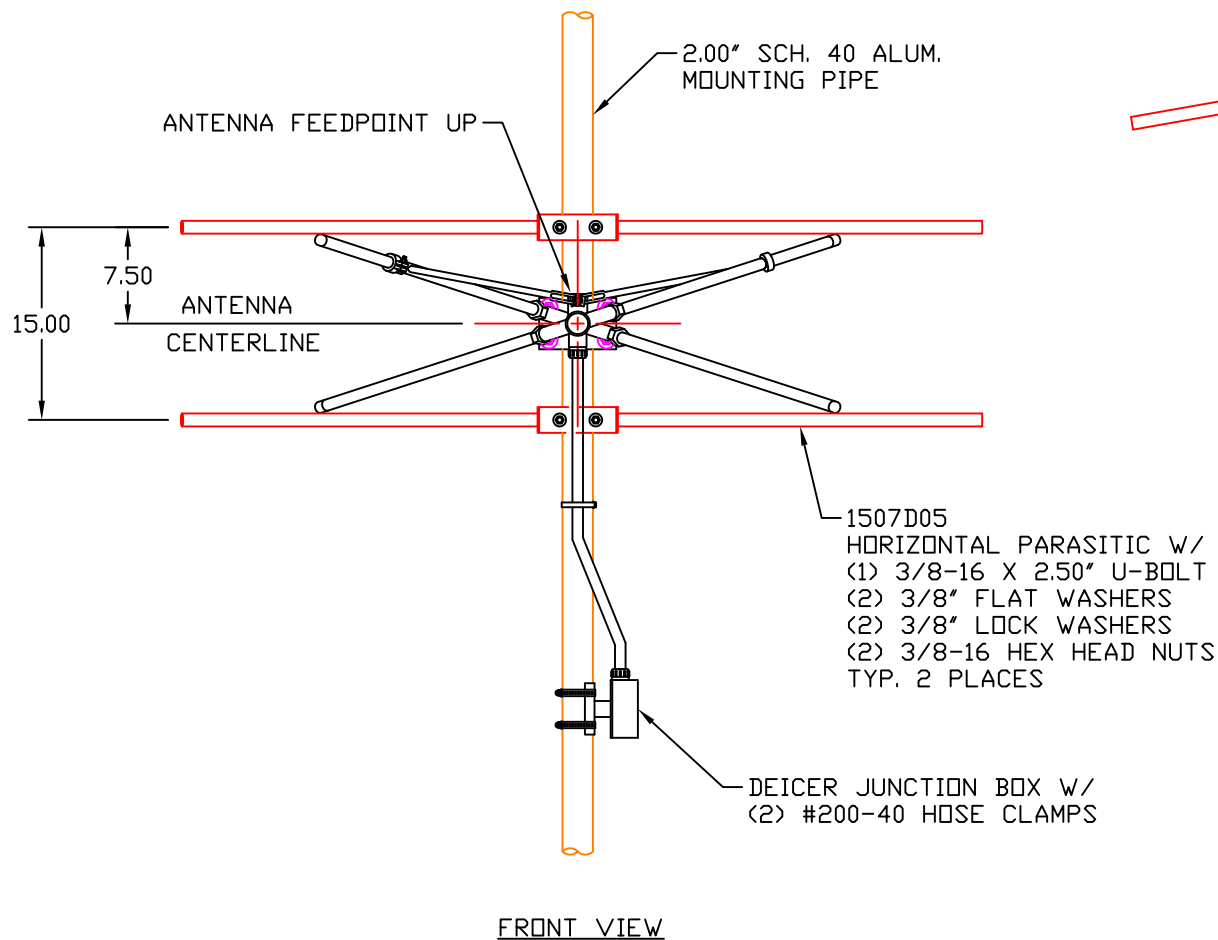
NOTE:

THIS ASSEMBLY TYPICAL FOR BAYS 1 & 3.

DRAWING  
NUMBER:

1507D02

Exhibit 7(Continued): Drawings



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

REVISION RECORD		
REV	APPROVAL	DATE
DRAWING NUMBER: 1507D02		
SCALE: NTS	NAME: RAC	DATE: 8/29/11
SHEET 1 OF 1		



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

TITLE: FMIECD/3-PLUS-DA, FREQ. 88.7  
WBWV, BECKLEY, WV  
MATERIAL: BAYS 1 & 3  
PARASITIC PLACEMENT

SIZE  
A

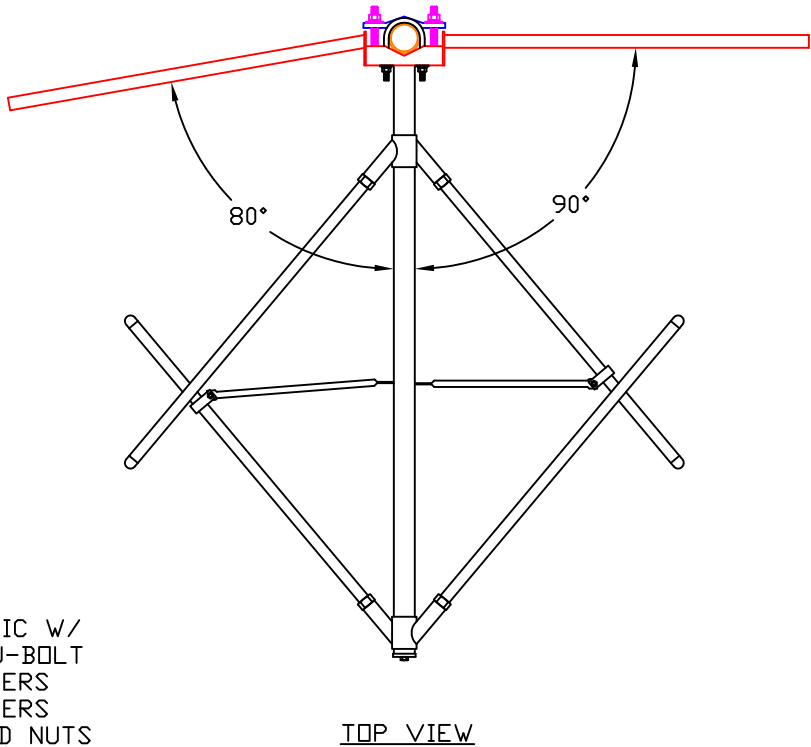
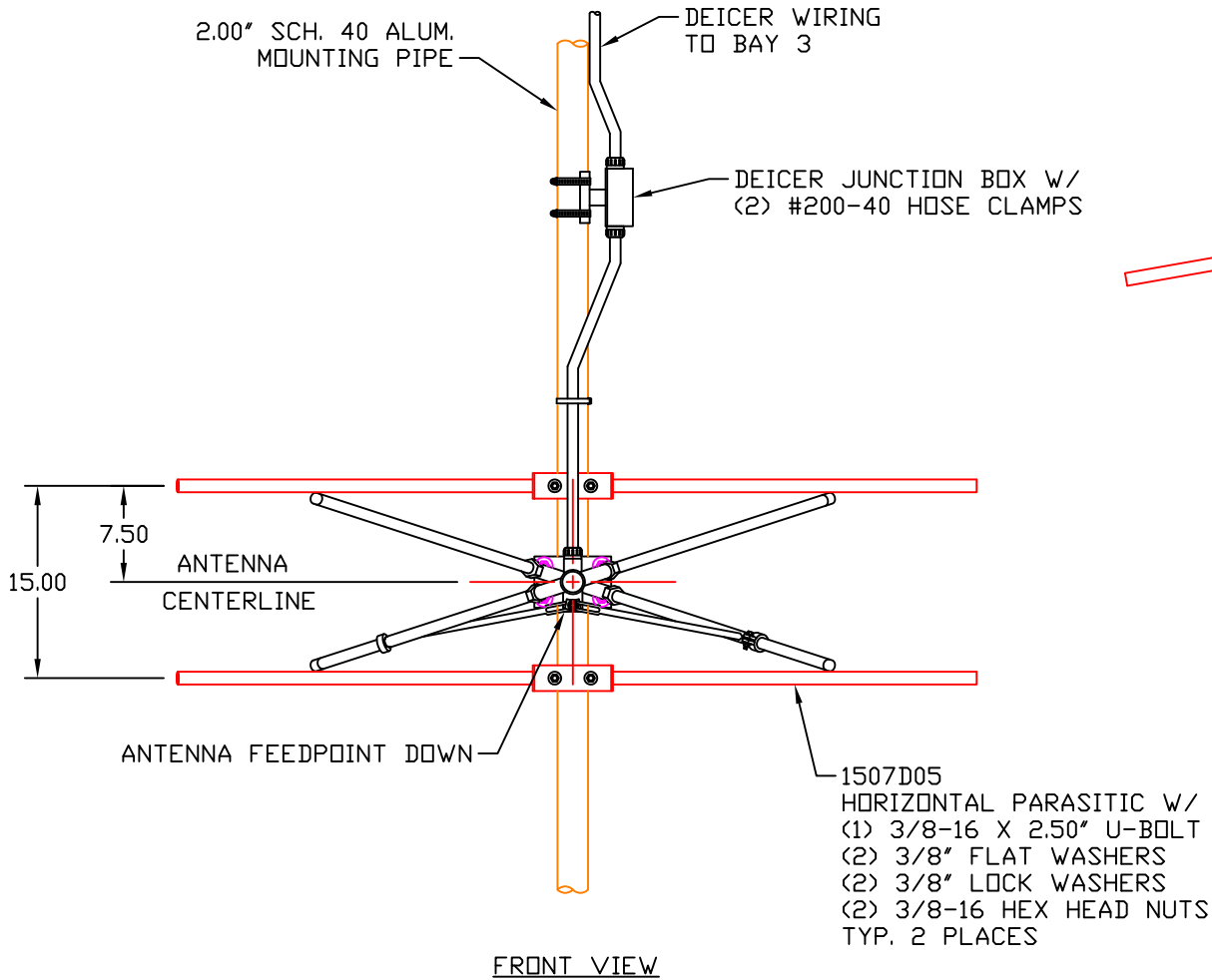
PARTS MADE BY THIS DRAWING

SCALE: NTS

NAME: RAC

DATE: 8/29/11

SHEET 1 OF 1

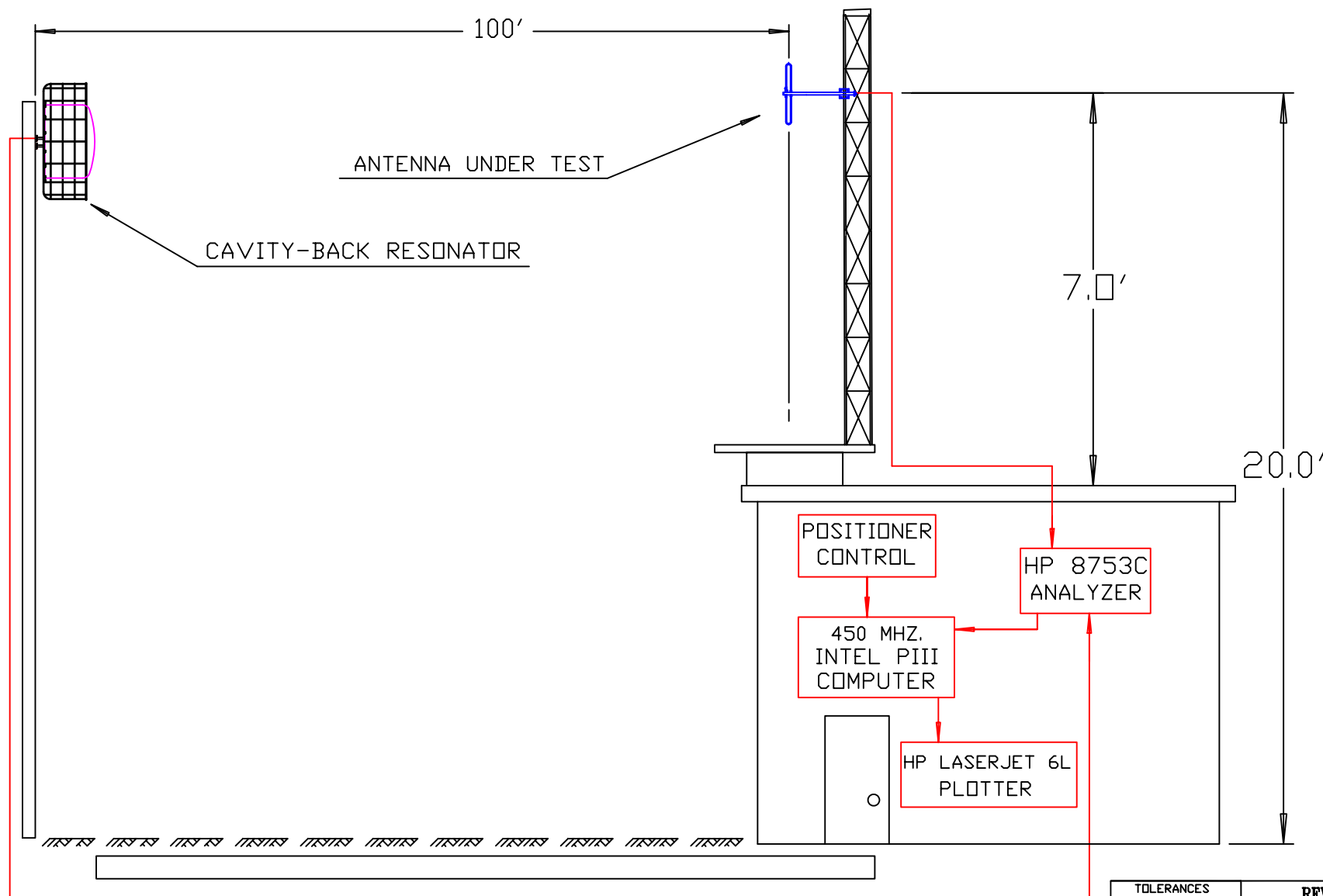


NOTE:

Exhibit 5(Continued): Drawings

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

## 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 WBWV, Beckley, WV, during the installation of the WBWV directional antenna.
- 3.) I certify that the WBWV directional antenna has been oriented at the proper azimuths as authorized in the construction permit (FCC File Number BMPED-20100707CUI).

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 WBWV Beckley, WV, from which the underlying Construction Permit (FCC File Number BMPED-20100707CUI) was granted by the Commission.
- 5.) That I am familiar with the terms and conditions of the WBWV Construction Permit.
- 6.) I hereby certify that I have overseen the installation of the WBWV directional antenna and that the installation was complete to the manufacturer's instructions.

Sign \_\_\_\_\_

Dated: \_\_\_\_\_ mm/dd/yy