SYSTEMS WITH RELIABILITY, LP

BROADCAST ANTENNAS AND TRANSMISSION LINE

PATTERN CERTIFICATION

DIRECTIONAL FM ANTENNA
WLAB
August 11, 2014

Call Sign	:	WLAB
Location	:	Fort Wayne, IN
Frequency	:	88.3 MHz
Channel	:	202B1
Antenna Model	:	FMECD/4-PLUS-DA
Maximum Antenna Gain		
Horizontal	:	**4.133 / 6.163 dB**
Vertical	:	**4.133 / 6.163 dB**

ANTENNA DESCRIPTION

A custom designed FMECD/4-PLUS-DA antenna was fabricated to conform to the prescribed directional azimuth pattern. The antenna consists of four (4) circularly polarized, cross-V dipole radiating elements full-wave spaced mounted to a forty-two (42)" (inch) face tower. The antenna array points 180 degrees true north.

DESCRIPTION OF TEST PROCEDURE

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

DESCRIPTION OF TEST PARAMETERS AND EQUIPMENT

Horizontal and vertical pattern readings were taken by mounting a source antenna - a vertical/horizontal dipole, Cavity Back Resonator (CBR) antenna bay - approximately 100' (feet) from the third-scale antenna model. The source antenna's height was adjusted to achieve a uniform field at the third-scale test antenna location. The CBR antenna was operated in receive mode, at frequency 264.9 MHz. The third-scale test antenna was then rotated clockwise in order to achieve 360° (degree) pattern readings. A gain reference was taken using a dipole tuned to 264.9 MHz. Nowhere did the received signal, or resultant documentation, exceed a maximum to minimum ratio of 15dB (decibels).

TEST RESULTS

The attached calculations verify that the **RMS** value of this antenna is ***94.8%*** of the **RMS** value of the pattern authorized in the related construction permit **BPED-20140310AAW.** The vertical component **RMS** value is **0.733**. The horizontal component **RMS** value is **0.673**. The circular polarized component **RMS** value is **0.746**.

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

Measured vertical polarized directivity:	**1.863 / 2.700 dB**
Measured horizontal polarized directivity:	**2.210 / 3.440 dB**
Measured circular polarized pattern directivity:	**1.797 / 2.550 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 = (1.863)(.5425)(4.088) **= 4.133 / 6.163 dB**
H-Pol. Gain = (2.210)(.4575)(4.088) **= 4.133 / 6.163 dB**

INSTALLATION AND MOUNTING

The antenna is to be mounted in accordance with the supplied drawings. The antenna center of radiation is to be **107** ***meters (351.07 ft.)*** above ground level. The antenna aperture is **33.42 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 ***180 degrees*** true North.

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

DRAWING NO.	**TITLE**
1918D00	ELEVATION
1918D01	ANTENNA ORENTATION
2105A10	TEST RANGE SCHEMATIC

The array shall be mounted according to all details outlined in **DWG. 1918D00**. The antenna elements shall be aligned at the same heading as in **DWG. 1918D01**.This will ensure that the antenna is oriented properly at 180 degrees true north. The test range schematic **DWG. 2105A10** shows the mounting configuration of the antenna setup on our range.

DOCUMENT EXHIBITS

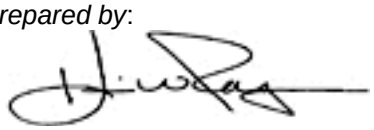
The following exhibits are included as part of this Certificate of Compliance:

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

TEST EQUIPMENT

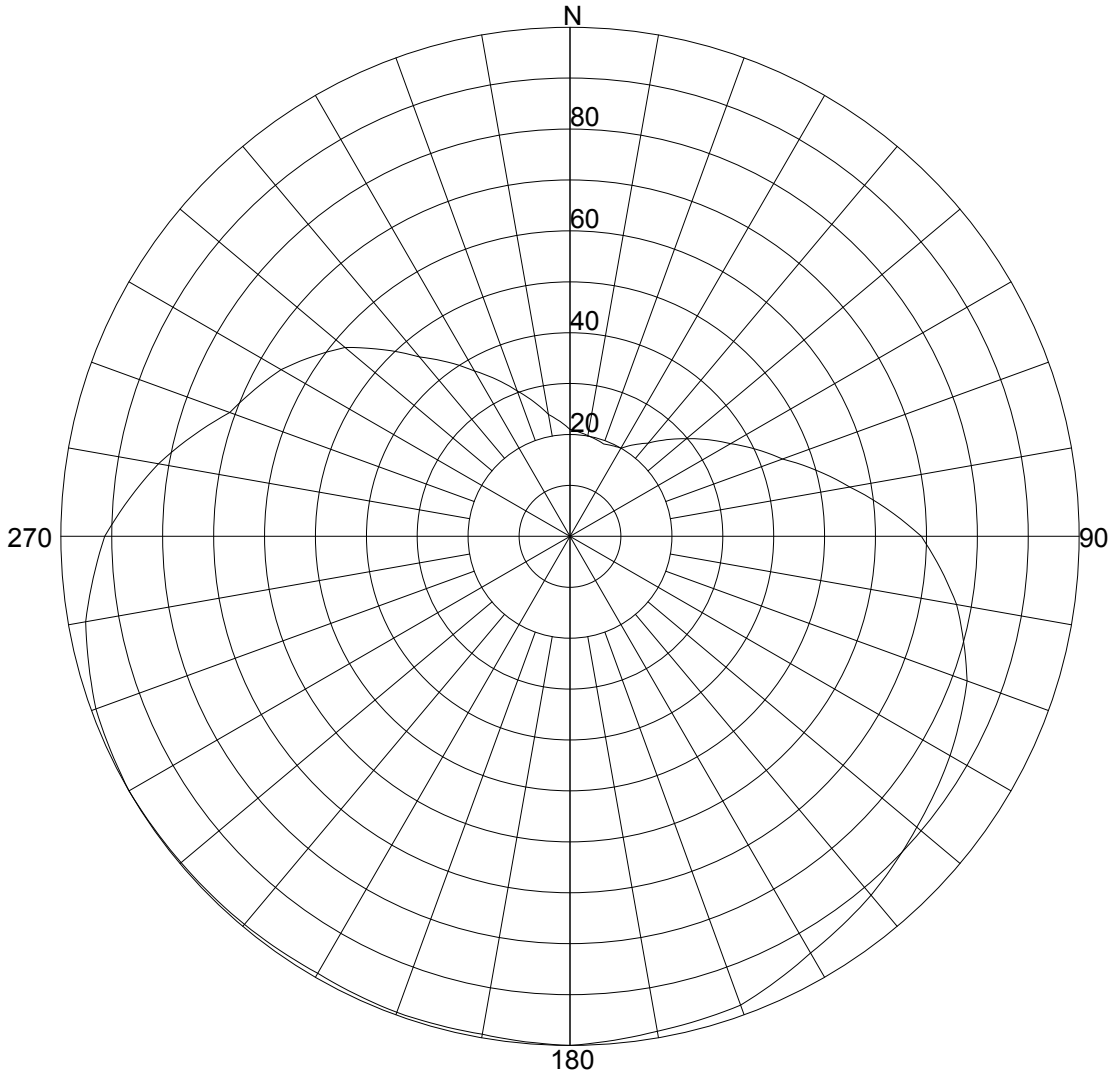
Network Analyzer	:	Hewlett Packard Model # 8753C Serial Number: 08753 – 69138
Computer	:	Pentium 3, 450 MHz, SAMS Range Program
Printer	:	Hewlett-Packard Laser Jet 6L
Positioner	:	Orbit Positioner
		All equipment is calibrated to ANSI/NCSL Z540-1-1994 specs

Prepared by:



Kevin W. Rager
Antenna Engineer
Systems With Reliability LP

Exhibit 1: Circular Polarized Azimuth Pattern



Azimuth Pattern

Scale: Linear

Unit: Relative Field

Systems With Reliability LP

CLIENT: *WLAB / Greg Case*

Date: 8/11/2014

ANTENNA TYPE: FMECD/4-PLUS-DA

FREQUENCY: 88.3 MHz

PATTERN POL.: Circular

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.79705 / 2.55dB

PATTERN RMS: *0.746*

Micro-Tek Eng. Ver. 2.5

Exhibit 1 (cont'd): Circular Polarized Azimuth Pattern Tabulations

Relative Field Tabulation(Azimuth)

Azimuth Heading	Relative Field(dB)	Azimuth Heading	Relatve Field(dB)
0	.2100 (-13.51)	180	1.0000 (0.01)
5	.2055 (-13.7)	185	.9965 (-0.02)
10	.2010 (-13.89)	190	.9930 (-0.05)
15	.1970 (-14.07)	195	.9940 (-0.04)
20	.1930 (-14.24)	200	.9950 (-0.03)
25	.1965 (-14.09)	205	.9930 (-0.05)
30	.2000 (-13.94)	210	.9910 (-0.07)
35	.2195 (-13.13)	215	.9930 (-0.05)
40	.2390 (-12.4)	220	.9950 (-0.03)
45	.2685 (-11.39)	225	.9960 (-0.03)
50	.2980 (-10.49)	230	.9970 (-0.02)
55	.3310 (-9.58)	235	.9985 (0)
60	.3640 (-8.75)	240	1.0000 (0.01)
65	.4040 (-7.85)	245	.9955 (-0.03)
70	.4440 (-7.03)	250	.9910 (-0.07)
75	.5010 (-5.99)	255	.9785 (-0.18)
80	.5580 (-5.05)	260	.9660 (-0.29)
85	.6240 (-4.08)	265	.9400 (-0.53)
90	.6900 (-3.21)	270	.9140 (-0.77)
95	.7305 (-2.72)	275	.8675 (-1.22)
100	.7710 (-2.25)	280	.8210 (-1.7)
105	.8005 (-1.92)	285	.7660 (-2.3)
110	.8300 (-1.61)	290	.7110 (-2.95)
115	.8460 (-1.44)	295	.6830 (-3.3)
120	.8620 (-1.28)	300	.6550 (-3.66)
125	.8755 (-1.14)	305	.6160 (-4.19)
130	.8890 (-1.01)	310	.5770 (-4.76)
135	.9045 (-0.86)	315	.5185 (-5.69)
140	.9200 (-0.71)	320	.4600 (-6.73)
145	.9325 (-0.6)	325	.4175 (-7.57)
150	.9450 (-0.48)	330	.3750 (-8.5)
155	.9625 (-0.32)	335	.3395 (-9.36)
160	.9800 (-0.17)	340	.3040 (-10.31)
165	.9835 (-0.14)	345	.2735 (-11.23)
170	.9870 (-0.1)	350	.2430 (-12.25)
175	.9935 (-0.05)	355	.2265 (-12.86)

Systems With Reliability LP

CLIENT: *WLAB / Greg Case*

Date: 8/11/2014

ANTENNA TYPE: FMECD/4-PLUS-DA

FREQUENCY: 88.3 MHz

PATTERN POL.: Circular

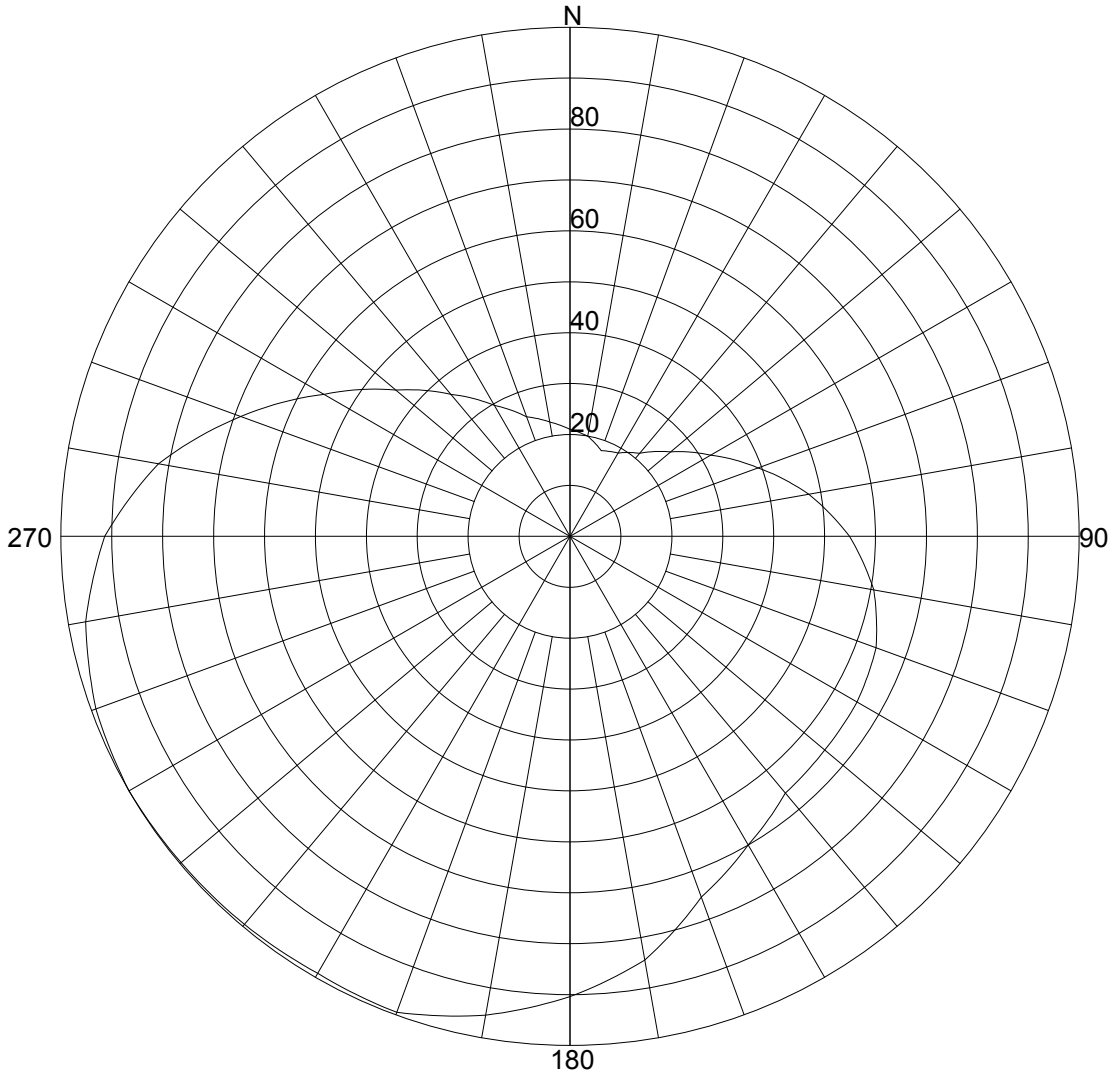
CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.79705 / 2.55dB

PATTERN RMS: *0.746*

Micro-Tek Eng. Ver. 2.5

Exhibit 2: Measured Horizontal Polarized Azimuth Pattern



Azimuth Pattern

Scale: Linear

Unit: Relative Field

Systems With Reliability LP

CLIENT: *WLAB / Greg Case*

Date: 8/11/2014

ANTENNA TYPE: FMECD/4-PLUS-DA

FREQUENCY: 88.3 MHz

PATTERN POL.: Horizontal

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.20995 / 3.44dB

PATTERN RMS: *0.673*

Micro-Tek Eng. Ver. 2.5

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

Relative Field Tabulation(Azimuth)

Azimuth Heading	Relative Field(dB)	Azimuth Heading	Relatve Field(dB)
0	.2100 (-13.51)	180	.9040 (-0.87)
5	.2050 (-13.72)	185	.9295 (-0.63)
10	.2000 (-13.94)	190	.9550 (-0.39)
15	.1895 (-14.4)	195	.9750 (-0.21)
20	.1790 (-14.89)	200	.9950 (-0.03)
25	.1840 (-14.66)	205	.9930 (-0.05)
30	.1890 (-14.42)	210	.9910 (-0.07)
35	.2010 (-13.89)	215	.9930 (-0.05)
40	.2130 (-13.39)	220	.9950 (-0.03)
45	.2355 (-12.52)	225	.9960 (-0.03)
50	.2580 (-11.73)	230	.9970 (-0.02)
55	.2885 (-10.77)	235	.9985 (0)
60	.3190 (-9.9)	240	1.0000 (0.01)
65	.3560 (-8.95)	245	.9955 (-0.03)
70	.3930 (-8.09)	250	.9910 (-0.07)
75	.4345 (-7.22)	255	.9785 (-0.18)
80	.4760 (-6.43)	260	.9660 (-0.29)
85	.5125 (-5.79)	265	.9400 (-0.53)
90	.5490 (-5.19)	270	.9140 (-0.77)
95	.5775 (-4.75)	275	.8675 (-1.22)
100	.6060 (-4.34)	280	.8210 (-1.7)
105	.6230 (-4.1)	285	.7545 (-2.44)
110	.6400 (-3.86)	290	.6880 (-3.24)
115	.6455 (-3.79)	295	.6230 (-4.1)
120	.6510 (-3.72)	300	.5580 (-5.05)
125	.6520 (-3.7)	305	.5025 (-5.96)
130	.6530 (-3.69)	310	.4470 (-6.97)
135	.6555 (-3.66)	315	.4055 (-7.82)
140	.6580 (-3.62)	320	.3640 (-8.75)
145	.6790 (-3.35)	325	.3305 (-9.59)
150	.7000 (-3.09)	330	.2970 (-10.52)
155	.7270 (-2.76)	335	.2735 (-11.23)
160	.7540 (-2.44)	340	.2500 (-12.01)
165	.7995 (-1.93)	345	.2390 (-12.4)
170	.8450 (-1.45)	350	.2280 (-12.8)
175	.8745 (-1.15)	355	.2190 (-13.15)

Systems With Reliability LP

CLIENT: *WLAB / Greg Case*

Date: 8/11/2014

ANTENNA TYPE: FMECD/4-PLUS-DA

FREQUENCY: 88.3 MHz

PATTERN POL.: Horizontal

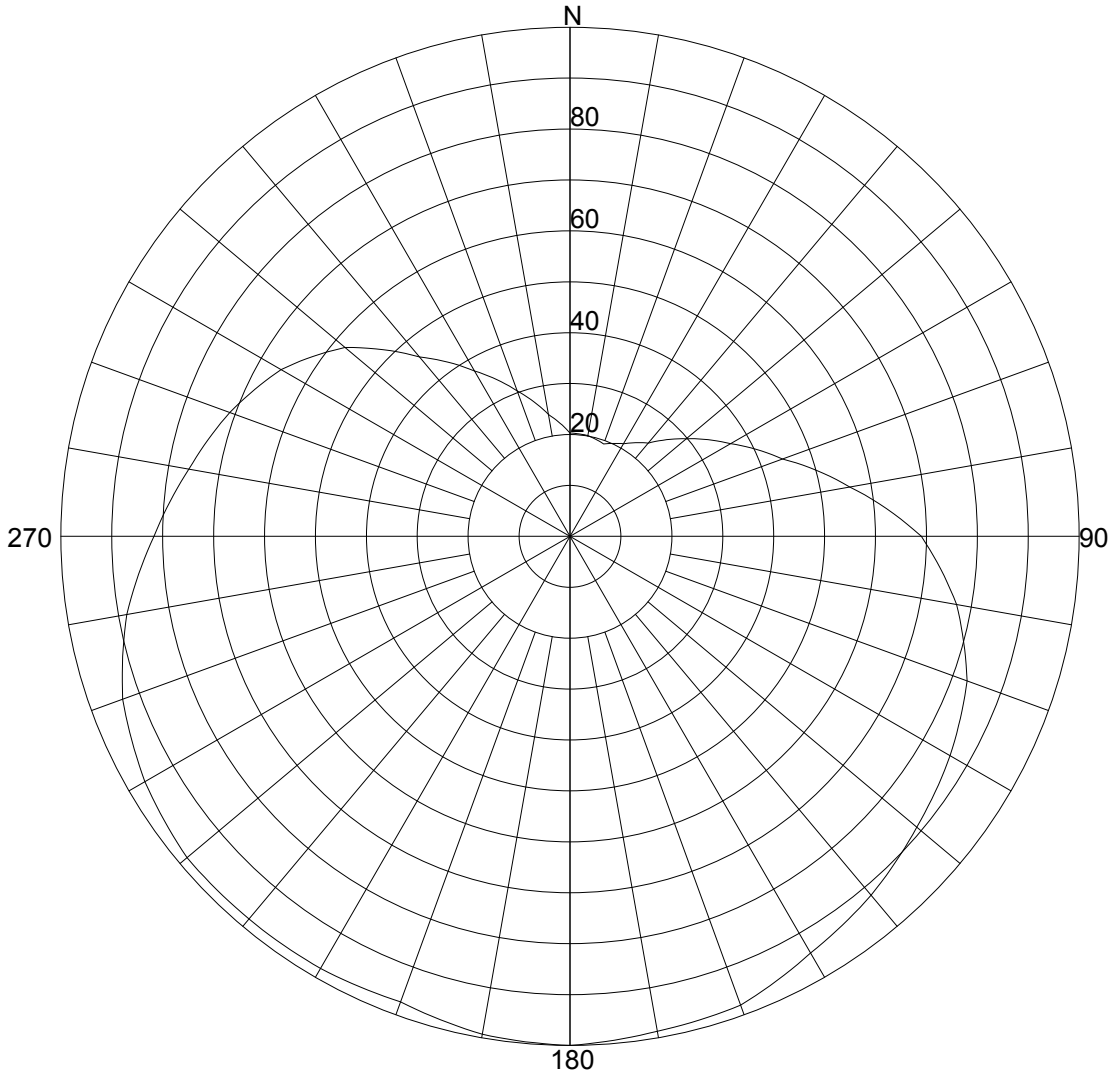
CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.20995 / 3.44dB

PATTERN RMS: *0.673*

Micro-Tek Eng. Ver. 2.5

Exhibit 3: Measured Vertical Polarized Azimuth Pattern



Azimuth Pattern

Scale: Linear

Unit: Relative Field

Systems With Reliability LP

CLIENT: *WLAB / Greg Case*

Date: 8/11/2014

ANTENNA TYPE: FMECD/4-PLUS-DA

FREQUENCY: 88.3 MHz

PATTERN POL.: Vertical

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.86348 / 2.7dB

PATTERN RMS: *0.733*

Micro-Tek Eng. Ver. 2.5

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

Relative Field Tabulation(Azimuth)

Azimuth Heading	Relative Field(dB)	Azimuth Heading	Relatve Field(dB)
0	.2030 (-13.81)	180	1.0000 (0.01)
5	.2020 (-13.85)	185	.9965 (-0.02)
10	.2010 (-13.89)	190	.9930 (-0.05)
15	.1970 (-14.07)	195	.9830 (-0.14)
20	.1930 (-14.24)	200	.9730 (-0.23)
25	.2015 (-13.87)	205	.9765 (-0.2)
30	.2100 (-13.51)	210	.9800 (-0.17)
35	.2245 (-12.94)	215	.9805 (-0.16)
40	.2390 (-12.4)	220	.9810 (-0.16)
45	.2685 (-11.39)	225	.9815 (-0.15)
50	.2980 (-10.49)	230	.9820 (-0.15)
55	.3310 (-9.58)	235	.9730 (-0.23)
60	.3640 (-8.75)	240	.9640 (-0.31)
65	.4040 (-7.85)	245	.9495 (-0.44)
70	.4440 (-7.03)	250	.9350 (-0.57)
75	.5010 (-5.99)	255	.9095 (-0.81)
80	.5580 (-5.05)	260	.8840 (-1.06)
85	.6240 (-4.08)	265	.8505 (-1.4)
90	.6900 (-3.21)	270	.8170 (-1.74)
95	.7305 (-2.72)	275	.7885 (-2.05)
100	.7710 (-2.25)	280	.7600 (-2.37)
105	.8005 (-1.92)	285	.7355 (-2.66)
110	.8300 (-1.61)	290	.7110 (-2.95)
115	.8460 (-1.44)	295	.6830 (-3.3)
120	.8620 (-1.28)	300	.6550 (-3.66)
125	.8755 (-1.14)	305	.6160 (-4.19)
130	.8890 (-1.01)	310	.5770 (-4.76)
135	.9045 (-0.86)	315	.5185 (-5.69)
140	.9200 (-0.71)	320	.4600 (-6.73)
145	.9325 (-0.6)	325	.4175 (-7.57)
150	.9450 (-0.48)	330	.3750 (-8.5)
155	.9625 (-0.32)	335	.3395 (-9.36)
160	.9800 (-0.17)	340	.3040 (-10.31)
165	.9835 (-0.14)	345	.2735 (-11.23)
170	.9870 (-0.1)	350	.2430 (-12.25)
175	.9935 (-0.05)	355	.2230 (-13)

Systems With Reliability LP

CLIENT: *WLAB / Greg Case*

Date: 8/11/2014

ANTENNA TYPE: FMECD/4-PLUS-DA

FREQUENCY: 88.3 MHz

PATTERN POL.: Vertical

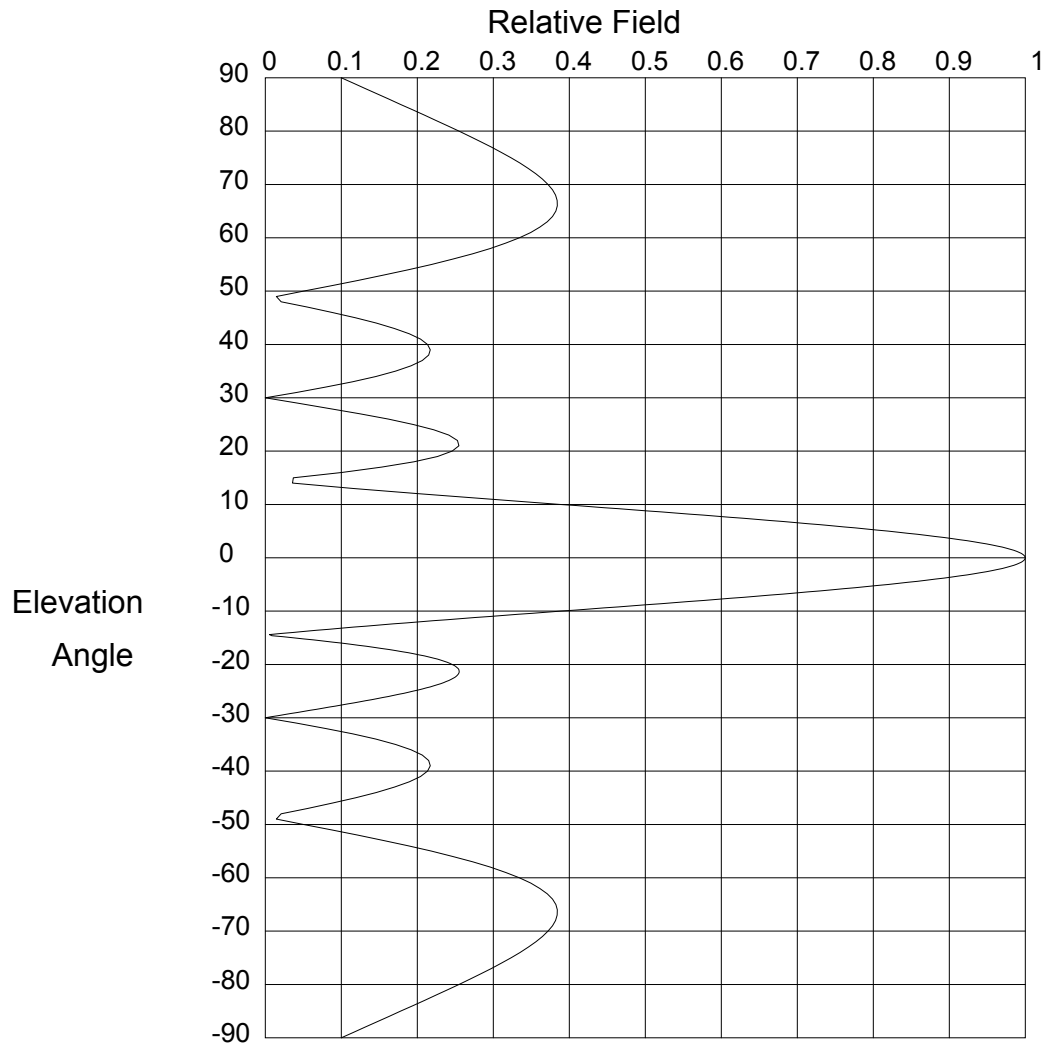
CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.86348 / 2.7dB

PATTERN RMS: *0.733*

Micro-Tek Eng. Ver. 2.5

Exhibit 4: Elevation Pattern



Elevation Pattern

Scale: Linear

Units: Field, Relative

Systems With Reliability LP

CLIENT: *WLAB / Greg Case*

Date: 4/18/2014

ANTENNA TYPE: FMECD/4-PLUS-DA

FREQUENCY: 88.3 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 4.088/6.115 dBd

Beam Tilt (Deg.) : *0*

DIRECTIVITY(Horiz): 4.088/6.115 dBd

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

Micro-Tek Eng. Ver. 2.5

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	.122 (-18.296)	14.0	.036 (-28.925)
89.0	.116 (-18.733)	51.0	.087 (-21.259)	13.0	.116 (-18.677)
88.0	.131 (-17.628)	50.0	.051 (-25.907)	12.0	.203 (-13.829)
87.0	.147 (-16.648)	49.0	.015 (-36.679)	11.0	.295 (-10.601)
86.0	.163 (-15.769)	48.0	.021 (-33.591)	10.0	.389 (-8.198)
85.0	.178 (-14.973)	47.0	.055 (-25.123)	9.8	.408 (-7.785)
84.0	.194 (-14.247)	46.0	.088 (-21.083)	9.6	.427 (-7.391)
83.0	.209 (-13.581)	45.0	.119 (-18.507)	9.4	.446 (-7.015)
82.0	.225 (-12.967)	44.0	.146 (-16.7)	9.2	.465 (-6.656)
81.0	.24 (-12.4)	43.0	.17 (-15.39)	9.0	.484 (-6.311)
80.0	.255 (-11.875)	42.0	.19 (-14.446)	8.8	.502 (-5.981)
79.0	.269 (-11.39)	41.0	.204 (-13.798)	8.6	.521 (-5.665)
78.0	.284 (-10.941)	40.0	.214 (-13.409)	8.4	.539 (-5.362)
77.0	.298 (-10.528)	39.0	.217 (-13.261)	8.2	.558 (-5.071)
76.0	.311 (-10.149)	38.0	.215 (-13.353)	8.0	.576 (-4.792)
75.0	.323 (-9.803)	37.0	.207 (-13.7)	7.8	.594 (-4.524)
74.0	.335 (-9.491)	36.0	.192 (-14.331)	7.6	.612 (-4.266)
73.0	.346 (-9.212)	35.0	.172 (-15.306)	7.4	.63 (-4.019)
72.0	.356 (-8.968)	34.0	.146 (-16.728)	7.2	.647 (-3.782)
71.0	.365 (-8.759)	33.0	.115 (-18.8)	7.0	.664 (-3.554)
70.0	.372 (-8.587)	32.0	.08 (-21.983)	6.8	.681 (-3.335)
69.0	.378 (-8.453)	31.0	.041 (-27.75)	6.6	.698 (-3.125)
68.0	.382 (-8.359)	30.0	.00 (-50)	6.4	.714 (-2.924)
67.0	.384 (-8.309)	29.0	.042 (-27.509)	6.2	.73 (-2.731)
66.0	.384 (-8.305)	28.0	.084 (-21.504)	6.0	.746 (-2.546)
65.0	.382 (-8.352)	27.0	.125 (-18.095)	5.8	.761 (-2.368)
64.0	.378 (-8.452)	26.0	.162 (-15.813)	5.6	.776 (-2.199)
63.0	.371 (-8.611)	25.0	.195 (-14.205)	5.4	.791 (-2.036)
62.0	.362 (-8.836)	24.0	.222 (-13.076)	5.2	.805 (-1.881)
61.0	.349 (-9.134)	23.0	.242 (-12.335)	5.0	.819 (-1.733)
60.0	.334 (-9.515)	22.0	.253 (-11.938)	4.8	.833 (-1.591)
59.0	.317 (-9.989)	21.0	.255 (-11.878)	4.6	.846 (-1.457)
58.0	.296 (-10.571)	20.0	.246 (-12.177)	4.4	.858 (-1.329)
57.0	.273 (-11.282)	19.0	.226 (-12.899)	4.2	.87 (-1.207)
56.0	.247 (-12.148)	18.0	.196 (-14.173)	4.0	.882 (-1.092)
55.0	.219 (-13.205)	17.0	.153 (-16.282)	3.8	.893 (-0.983)
54.0	.188 (-14.511)	16.0	.10 (-19.974)	3.6	.904 (-0.88)
53.0	.156 (-16.155)	15.0	.037 (-28.661)	3.4	.914 (-0.783)

Systems With Reliability LP

CLIENT: *WLAB / Greg Case*
Date: 4/18/2014
ANTENNA TYPE: FMECD/4-PLUS-DA
FREQUENCY: 88.3 MHz
PATTERN POL.: Circular
DIRECTIVITY(Peak): 4.088/6.115 dBd
Beam Tilt (Deg.) : *0*
DIRECTIVITY(Horiz): 4.088/6.115 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	.923 (-0.692)	-4.4	.858 (-1.329)	-12.0	.203 (-13.829)
3.0	.933 (-0.607)	-4.6	.846 (-1.457)	-12.2	.186 (-14.626)
2.8	.941 (-0.528)	-4.8	.833 (-1.591)	-12.4	.168 (-15.493)
2.6	.949 (-0.454)	-5.0	.819 (-1.733)	-12.6	.151 (-16.444)
2.4	.956 (-0.386)	-5.2	.805 (-1.881)	-12.8	.133 (-17.497)
2.2	.963 (-0.324)	-5.4	.791 (-2.036)	-13.0	.116 (-18.677)
2.0	.97 (-0.268)	-5.6	.776 (-2.199)	-13.2	.10 (-20.021)
1.8	.975 (-0.216)	-5.8	.761 (-2.368)	-13.4	.083 (-21.584)
1.6	.981 (-0.171)	-6.0	.746 (-2.546)	-13.6	.067 (-23.455)
1.4	.985 (-0.131)	-6.2	.73 (-2.731)	-13.8	.051 (-25.792)
1.2	.989 (-0.096)	-6.4	.714 (-2.924)	-14.0	.036 (-28.925)
1.0	.992 (-0.067)	-6.6	.698 (-3.125)	-14.2	.021 (-33.736)
.8	.995 (-0.043)	-6.8	.681 (-3.335)	-14.4	.006 (-44.914)
.6	.997 (-0.024)	-7.0	.664 (-3.554)	-14.6	.009 (-41.043)
.4	.999 (-0.011)	-7.2	.647 (-3.782)	-14.8	.023 (-32.742)
.2	1.00 (-0.003)	-7.4	.63 (-4.019)	-15.0	.037 (-28.661)
.0	1.00 (0)	-7.6	.612 (-4.266)	-15.2	.05 (-25.959)
-.2	1.00 (-0.003)	-7.8	.594 (-4.524)	-15.4	.063 (-23.954)
-.4	.999 (-0.011)	-8.0	.576 (-4.792)	-15.6	.076 (-22.37)
-.6	.997 (-0.024)	-8.2	.558 (-5.071)	-15.8	.088 (-21.07)
-.8	.995 (-0.043)	-8.4	.539 (-5.362)	-16.0	.10 (-19.974)
-1.0	.992 (-0.067)	-8.6	.521 (-5.665)	-16.2	.112 (-19.034)
-1.2	.989 (-0.096)	-8.8	.502 (-5.981)	-16.4	.123 (-18.214)
-1.4	.985 (-0.131)	-9.0	.484 (-6.311)	-16.6	.133 (-17.493)
-1.6	.981 (-0.171)	-9.2	.465 (-6.656)	-16.8	.144 (-16.854)
-1.8	.975 (-0.216)	-9.4	.446 (-7.015)	-17.0	.153 (-16.282)
-2.0	.97 (-0.268)	-9.6	.427 (-7.391)	-17.2	.163 (-15.77)
-2.2	.963 (-0.324)	-9.8	.408 (-7.785)	-17.4	.172 (-15.308)
-2.4	.956 (-0.386)	-10.0	.389 (-8.198)	-17.6	.18 (-14.891)
-2.6	.949 (-0.454)	-10.2	.37 (-8.63)	-17.8	.188 (-14.514)
-2.8	.941 (-0.528)	-10.4	.351 (-9.085)	-18.0	.196 (-14.173)
-3.0	.933 (-0.607)	-10.6	.333 (-9.563)	-18.2	.203 (-13.864)
-3.2	.923 (-0.692)	-10.8	.314 (-10.068)	-18.4	.209 (-13.584)
-3.4	.914 (-0.783)	-11.0	.295 (-10.601)	-18.6	.215 (-13.331)
-3.6	.904 (-0.88)	-11.2	.276 (-11.166)	-18.8	.221 (-13.103)
-3.8	.893 (-0.983)	-11.4	.258 (-11.767)	-19.0	.226 (-12.899)
-4.0	.882 (-1.092)	-11.6	.24 (-12.407)	-19.2	.231 (-12.716)
-4.2	.87 (-1.207)	-11.8	.222 (-13.092)	-19.4	.236 (-12.553)

Systems With Reliability LP

CLIENT: *WLAB / Greg Case*
Date: 4/18/2014
ANTENNA TYPE: FMECD/4-PLUS-DA
FREQUENCY: 88.3 MHz
PATTERN POL.: Circular
DIRECTIVITY(Peak): 4.088/6.115 dBd
Beam Tilt (Deg.) : *0*
DIRECTIVITY(Horiz): 4.088/6.115 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	.24 (-12.41)	-27.2	.117 (-18.664)	-54.0	.188 (-14.511)
-19.8	.243 (-12.285)	-27.4	.109 (-19.281)	-55.0	.219 (-13.205)
-20.0	.246 (-12.177)	-27.6	.101 (-19.954)	-56.0	.247 (-12.148)
-20.2	.249 (-12.087)	-27.8	.092 (-20.691)	-57.0	.273 (-11.282)
-20.4	.251 (-12.012)	-28.0	.084 (-21.504)	-58.0	.296 (-10.571)
-20.6	.253 (-11.952)	-28.2	.076 (-22.408)	-59.0	.317 (-9.989)
-20.8	.254 (-11.908)	-28.4	.067 (-23.424)	-60.0	.334 (-9.515)
-21.0	.255 (-11.878)	-28.6	.059 (-24.581)	-61.0	.349 (-9.134)
-21.2	.255 (-11.862)	-28.8	.051 (-25.921)	-62.0	.362 (-8.836)
-21.4	.255 (-11.861)	-29.0	.042 (-27.509)	-63.0	.371 (-8.611)
-21.6	.255 (-11.873)	-29.2	.034 (-29.455)	-64.0	.378 (-8.452)
-21.8	.254 (-11.899)	-29.4	.025 (-31.965)	-65.0	.382 (-8.352)
-22.0	.253 (-11.938)	-29.6	.017 (-35.502)	-66.0	.384 (-8.305)
-22.2	.251 (-11.99)	-29.8	.008 (-41.542)	-67.0	.384 (-8.309)
-22.4	.25 (-12.056)	-30.0	.00 (-50)	-68.0	.382 (-8.359)
-22.6	.247 (-12.136)	-31.0	.041 (-27.75)	-69.0	.378 (-8.453)
-22.8	.245 (-12.228)	-32.0	.08 (-21.983)	-70.0	.372 (-8.587)
-23.0	.242 (-12.335)	-33.0	.115 (-18.8)	-71.0	.365 (-8.759)
-23.2	.238 (-12.455)	-34.0	.146 (-16.728)	-72.0	.356 (-8.968)
-23.4	.235 (-12.588)	-35.0	.172 (-15.306)	-73.0	.346 (-9.212)
-23.6	.231 (-12.737)	-36.0	.192 (-14.331)	-74.0	.335 (-9.491)
-23.8	.226 (-12.899)	-37.0	.207 (-13.7)	-75.0	.323 (-9.803)
-24.0	.222 (-13.076)	-38.0	.215 (-13.353)	-76.0	.311 (-10.149)
-24.2	.217 (-13.269)	-39.0	.217 (-13.261)	-77.0	.298 (-10.528)
-24.4	.212 (-13.478)	-40.0	.214 (-13.409)	-78.0	.284 (-10.941)
-24.6	.206 (-13.703)	-41.0	.204 (-13.798)	-79.0	.269 (-11.39)
-24.8	.201 (-13.945)	-42.0	.19 (-14.446)	-80.0	.255 (-11.875)
-25.0	.195 (-14.205)	-43.0	.17 (-15.39)	-81.0	.24 (-12.4)
-25.2	.189 (-14.484)	-44.0	.146 (-16.7)	-82.0	.225 (-12.967)
-25.4	.182 (-14.783)	-45.0	.119 (-18.507)	-83.0	.209 (-13.581)
-25.6	.176 (-15.103)	-46.0	.088 (-21.083)	-84.0	.194 (-14.247)
-25.8	.169 (-15.446)	-47.0	.055 (-25.123)	-85.0	.178 (-14.973)
-26.0	.162 (-15.813)	-48.0	.021 (-33.591)	-86.0	.163 (-15.769)
-26.2	.155 (-16.207)	-49.0	.015 (-36.679)	-87.0	.147 (-16.648)
-26.4	.147 (-16.629)	-50.0	.051 (-25.907)	-88.0	.131 (-17.628)
-26.6	.14 (-17.082)	-51.0	.087 (-21.259)	-89.0	.116 (-18.733)
-26.8	.132 (-17.569)	-52.0	.122 (-18.296)	-90.0	.10 (-20)
-27.0	.125 (-18.095)	-53.0	.156 (-16.155)	90.0	.00 (-50)

Systems With Reliability LP

CLIENT: *WLAB / Greg Case*
Date: 4/18/2014
ANTENNA TYPE: FMECD/4-PLUS-DA
FREQUENCY: 88.3 MHz
PATTERN POL.: Circular
DIRECTIVITY(Peak): 4.088/6.115 dBd
Beam Tilt (Deg.) : *0*
DIRECTIVITY(Horiz): 4.088/6.115 dBd
Null Fill(s)(%) : *0, 0, 0*

Exhibit 5: Antenna Data Sheet

SYSTEMS WITH RELIABILITY, LP

BROADCAST ANTENNAS AND TRANSMISSION LINE

SYSTEM DATA SHEET

Customer	WLAB
Contact	Greg Case
Location	Fort Wayne, IN
Antenna Model	FMECD/4-PLUS-DA
Channel / Frequency	202B1 / 88.3 MHz

ELECTRICAL SPECIFICATIONS

Antenna Specifications:

		H-POL	dB		V. Pol.	dB	
License ERP (KW)		7.500			7.500		
FCC Limit Pattern Directivity		1.615	2.081	**dB**	1.615	2.081	**dB**
Elevation Directivity		4.088	6.115	**dB**	4.088	6.115	**dB**
Azimuth Directivity		2.210	3.444	**dB**	1.863	2.703	**dB**
Composite Pattern		1.797	2.546	**dB**	1.797	2.546	**dB**
Polarization Ratio		0.457			0.543		
RMS Comp./RMS Limit	94.8 **%**						
Antenna Efficiency %		100			100		
Power Ratio (Pol. Ratio X Efficiency)		0.4575			0.5425		
Antenna Gain		4.133	6.163	**dB**	4.133	6.163	**dB**

Antenna Input Power (KW)	1.815 **kW**	2.588 **(dBK)**	

Feed Line Specifications:

Line Type:Cablewave	7/8" Foam **50 Ω**	**LCF78-50JA**
Attenuation Per 100 ft (dB)	0.34 **dB**	
Line Length (ft) AGL + Horizontal Run	376.07 **ft.**	
Total Line Attenuation (dB)	1.2786 **dB**	
Line Efficiency	74.50 **%**	
Power Input to the Line (KW)	2.436 **kW**	3.867 **(dBK)**

MECHANICAL SPECIFICATIONS

No. Of Bays	4					
Antenna Aperture	33.42	**ft.**			10.19	**meter**
Center of Radiation AGL	351.07	**ft.**			107.00	**meter**
Antenna Weight (Everything)	230.00	**lbs.**			104.55	**kg**
Windload (50/33)	610.00	**lbs.**	**Windload CaAc**		17.90	**ft^2**

Prepared by:

Kevin W. Rager
SWR, LP

Exhibit 6: RMS Calculations

SYSTEMS WITH RELIABILITY, LP
Broadcast Antennas and Transmission Systems

WLAB Antenna RMS Comparison

PROPOSED ANTENNA		DESIGNED ANTENNA	
Azimuth Heading	Relative Field	Azimuth Heading	Relative Field
0	0.215	0	0.21
10	0.205	10	0.201
20	0.203	20	0.193
30	0.208	30	0.2
40	0.241	40	0.239
50	0.304	50	0.298
60	0.365	60	0.364
70	0.459	70	0.444
80	0.578	80	0.558
90	0.727	90	0.69
100	0.916	100	0.771
110	1	110	0.83
120	1	120	0.862
130	1	130	0.889
140	1	140	0.92
150	1	150	0.945
160	1	160	0.98
170	1	170	0.987
180	1	180	1
190	1	190	0.993
200	1	200	0.995
210	1	210	0.991
220	1	220	0.995
230	1	230	0.997
240	1	240	1
250	1	250	0.991
260	1	260	0.966
270	1	270	0.914
280	0.917	280	0.821
290	0.817	290	0.711
300	0.729	300	0.655
310	0.613	310	0.577
320	0.487	320	0.46
330	0.387	330	0.375
340	0.307	340	0.304
350	0.244	350	0.243

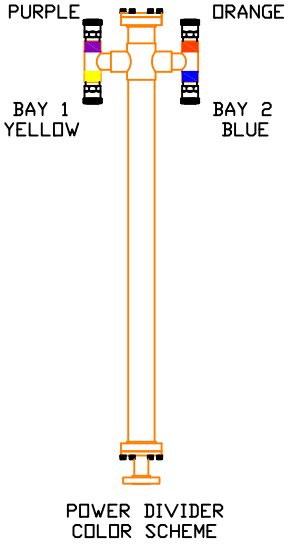
Sum of Relative Field Squared :	**22.325**	**Sum of Relative Field Squared :**	**20.053**
Sum Divided by 36 (Readings) :	**0.620**	**Sum Divided by 36 (Readings) :**	**0.557**
Square Root :	**0.787**	**Square Root :**	**0.746**

Percentage of Construction Permit Antenna Filled : **94.8%**

NOTES:
1. REFERENCE DWG. 1918D01 FOR ANTENNA ORIENTATION.
2. REFERENCE DWG. 1918D02 FOR PARASITIC PLACEMENT.

DRAWING NUMBER: 1918D00

Exhibit 7: Drawings



POWER DIVIDER
COLOR SCHEME

1918D05
HORIZONTAL PARASITIC W/
(1) 3/8-16 X 2.50" U-BOLT
(2) 3/8" FLAT WASHERS
(2) 3/8" LOCK WASHERS
(2) 3/8-16 HEX HEAD NUTS
TYP. 8 PLACES TOTAL
(2 PLACES PER BAY)

(2) 0987A01
UNIVERSAL SADDLES W/
(4) 1/2-13 X 4.00" H.H.C.S.
(8) 1/2" FLAT WASHERS
(4) 1/2" LOCK WASHERS
(4) 1/2-13 HEX HEAD NUITS
PER BAY
TYP. 4 PLACES

UV RESISTANT
CABLE TIE TYP.

ELEV.
360 Ft.

1/2" FOAM CABLE W/
(2) 7-16 DIN MALE CONNECTORS
TYP. 4 PLACES

PD4W-780DF
7/8-50 OHM TO
7-16 DIN FEMALE
4 WAY POWER DIVIDER

1300D00
POWER DIVIDER BRACKET W/
(2) 0987A01 UNIVERSAL SADDLES
(4) 1/2-13 X 4.00" H.H.C.S.
(8) 1/2" FLAT WASHERS
(4) 1/2" LOCK WASHERS
(4) 1/2-13 HEX HEAD NUITS
(2) #HSS24 HOSE CLAMPS

(INSULATED)
GUY WIRE
ELEV.
350 Ft.

7/8-50 OHM
EIA INPUT

1500D230
PIPE MOUNT BRACKET W/
(2) 3/8-16 X 1.75" U-BOLTS
(2) 3/8-16 X 2.50" U-BOLTS
(8) 3/8" FLAT WASHERS
(8) 3/8" LOCK WASHERS
(8) 3/8-16 HEX HEAD NUTS
TYP. 5 PLACES

ELEV.
340 Ft.

1500D234
KNEE BRACE W/
(2) 1/2-13 X 1.25" H.H.C.S.
(2) 1/2" LOCK WASHERS
(2) 1/2-13 HEX HEAD NUTS
TYP. 2 PLACES

1500D235
KNEE BRACE BRACKET W/
(1) 3/8-16 X 1.75" U-BOLTS
(2) 3/8" FLAT WASHERS
(2) 3/8" LOCK WASHERS
(2) 3/8-16 HEX HEAD NUTS
TYP. 2 PLACES

VALMONT/PI-ROD
#42 TOWER

MOUNTING PIPE
2.00" SCH. 40 ALUM.
2.375" O.D. X 38.50 Ft. LONG
(1) 20.00 Ft. LONG TOP SECTION
(1) 18.50 Ft. LONG BOTTOM SECTION

30.00 In.
2.50 Ft.
0.76 M.

BAY 4

133.67 In.
11.14 Ft.
3.40 M.
TYP.

BAY 3

CENTER OF
RADIATION
351.07 Ft. AGL
(107.00 M.)

401.01 In.
33.42 Ft.
10.19 M.
ANTENNA
APERTURE

(4) 1/4-20 X 3/4" H.H.C.S.
(4) 1/4" LOCK WASHERS
(4) 1/4-20 HEX HEAD NUTS
(FOR JOINING MOUNTING PIPES)

20.00 In.
TYP.

BAY 2

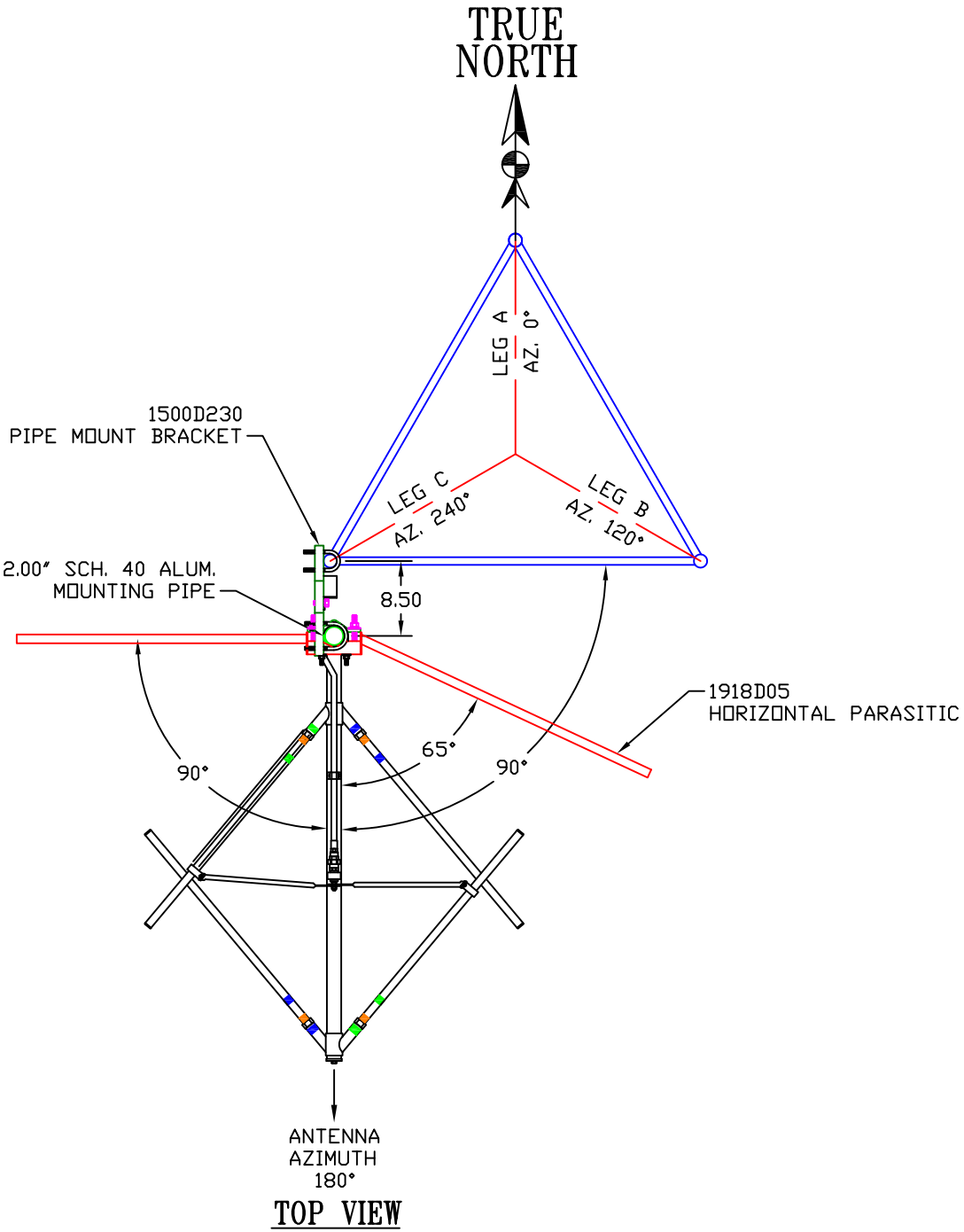
DEICER JUNCTION BOX W/
(2) #HSS40 HOSE CLAMPS
TYP. 4 PLACES
(1 PLACE PER BAY)

BAY 1

SYSTEMS WITH RELIABILITY, LP 619 INDUSTRIAL PARK ROAD EBENSBURG, PENNSYLVANIA 15931	TITLE: FMECD/4-PLUS-DA, FREQ. 88.3 WLAB, FORT WAYNE, IN MATERIAL:	SIZE C	REV	APPR.	DATE	ENGINEER:	DRAWING NUMBER: 1918D00
			1		10/29/14		
			2			SCALE: NTS NAME: RAC DATE: 8/15/14	SHEET 1 OF 1
			3				

NOTE: Exhibit 7 (cont'd): Drawings

DRAWING NUMBER: 1918D01



TOP VIEW

REVISION RECORD		
REV	APPROVAL	DATE

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

TITLE: FMECD/4-PLUS-DA, FREQ. 88.3 WLAB, FORT WAYNE, IN

MATERIAL: ANTENNA ORIENTATION FROM TRUE NORTH

SIZE: A

PARTS MADE BY THIS DRAWING

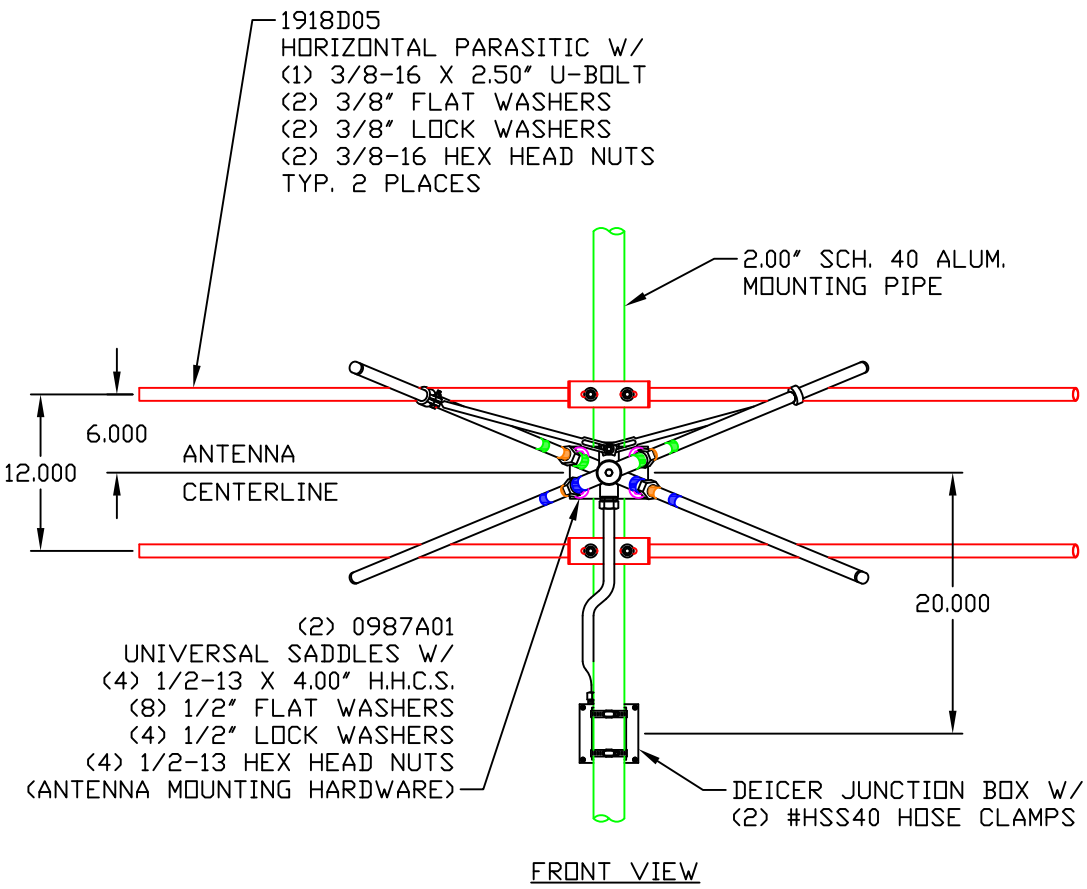
DRAWING NUMBER: 1918D01

SCALE: NTS | NAME: RAC | DATE: 8/15/14 | SHEET 1 OF 1

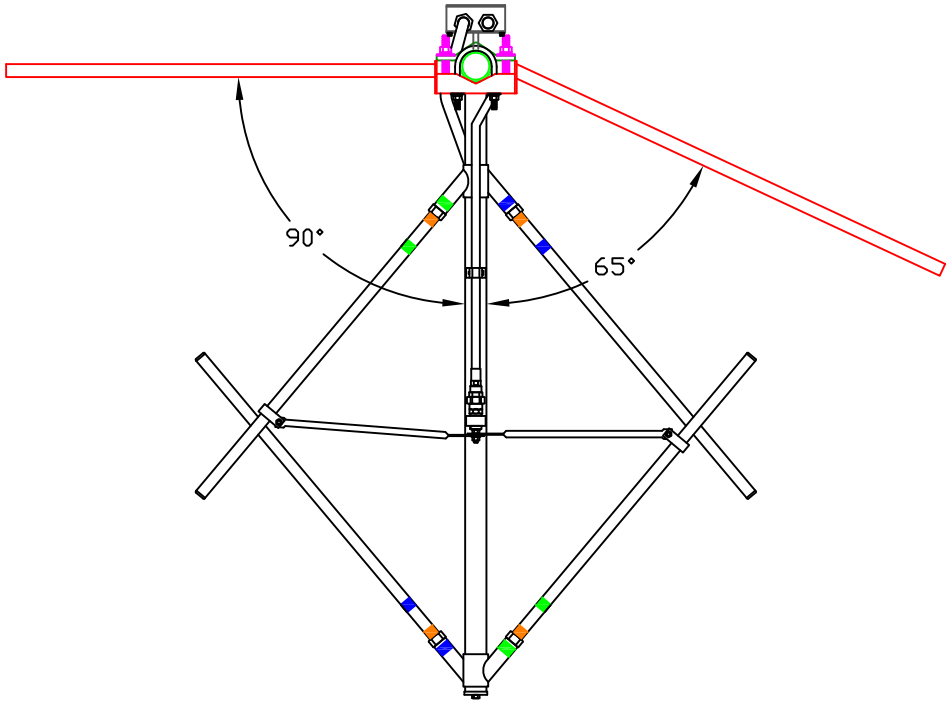
NOTE: Exhibit 7 (cont'd): Drawings

THIS INSTALLATION IS TYPICAL FOR ALL BAYS.

DRAWING NUMBER: 1918D02



FRONT VIEW



TOP VIEW

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

UNLESS OTHERWISE SPECIFIED

REVISION RECORD

REV	APPROVAL	DATE

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

TITLE: FMECD/4-PLUS-DA, FREQ, 88.3
WLAB, FORT WAYNE, IN

MATERIAL: PARASITIC
PLACEMENT

SIZE: A

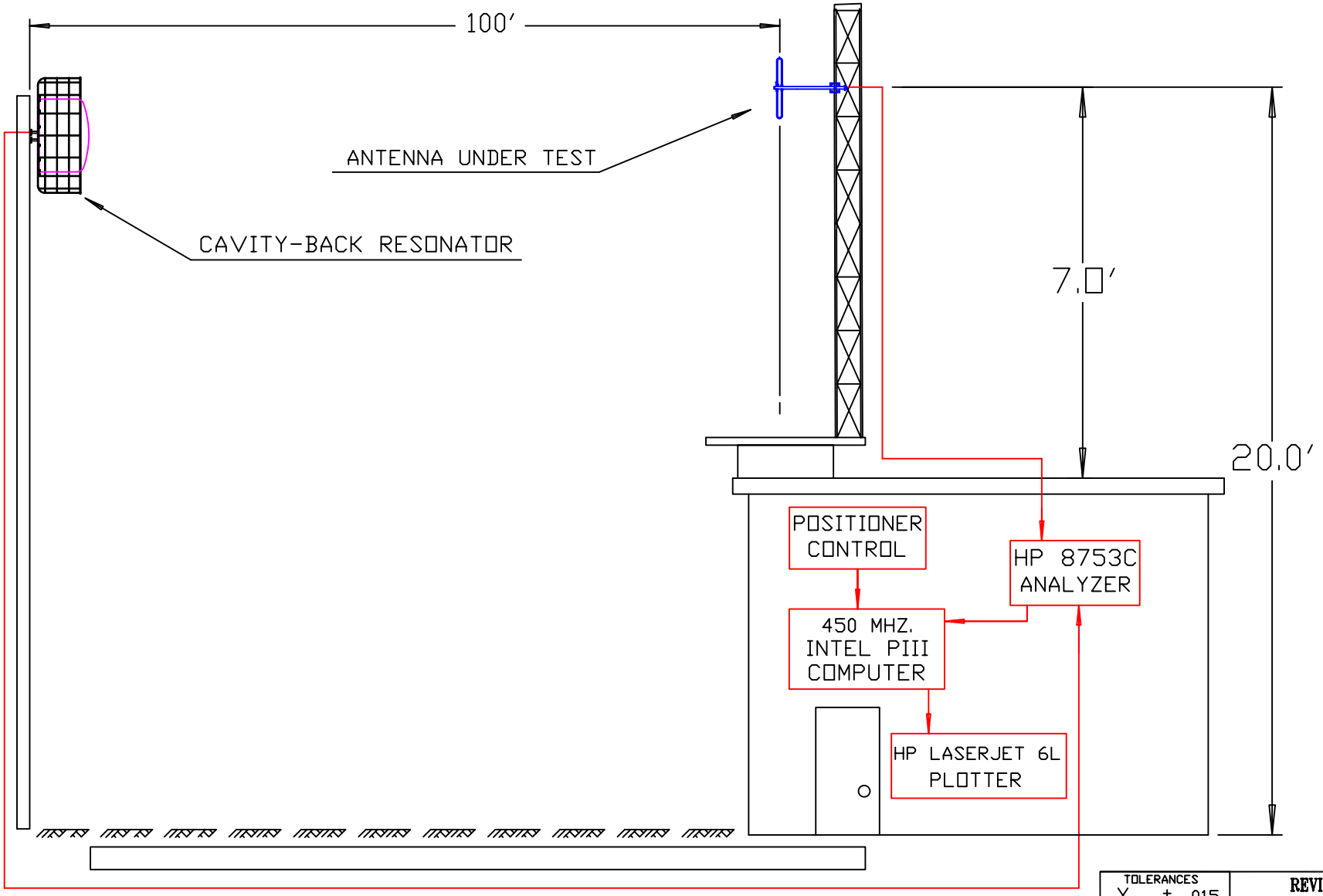
PARTS MADE BY THIS DRAWING

DRAWING NUMBER: 1918D02

SCALE: NTS | NAME: RAC | DATE: 8/15/14 | SHEET 1 OF 1

NOTE: Exhibit 7 (cont'd): 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

DRAWING NUMBER: 2105A10

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