



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

**PATTERN CERTIFICATION**  
**DIRECTIONAL FM ANTENNA**  
**WBLD**

**August 30, 2015**

Call Sign	:	WBLD
Location	:	Orchard Lake, MI
Frequency	:	89.3 MHz
Channel	:	207D
Antenna Model	:	FMECD/1-DA
Maximum Antenna Gain	:	
Horizontal	:	1.117 / 0.479 dB
Vertical	:	1.117 / 0.479 dB

**ANTENNA DESCRIPTION**

A custom designed FMECD/1-DA antenna was fabricated to conform to the prescribed directional azimuth pattern. The antenna consists of one (1) circularly polarized, cross-V dipole radiating element mounted to a fifty-four (54)" (inch) face tower. The antenna array points 267 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. A parasitic element was added 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 267.9 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 267.9 MHz. Nowhere did the received signal, or resultant documentation, exceed a maximum to minimum ratio of 15dB (decibels).

619 Industrial Park Road, Ebensburg, PA 15931 Tel: 800 782 7743 / 814 472 5436 • Fax 814 472 5552

8/30/2015

WBLD PATTERN CERTIFICATION

## TEST RESULTS

The attached calculations verify that the RMS value of this antenna is 88.4% of the RMS value of the pattern authorized in the related FCC file BPED-20150318AAS. The vertical component RMS value is 0.653. The horizontal component RMS value is 0.604. 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:	2.345 / 3.70 dB
Measured horizontal polarized directivity:	2.745 / 4.39 dB
Measured circular polarized pattern directivity:	1.693 / 2.29 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 = (2.34460)(.5394)(0.883)	= 1.117 / 0.479 dB
H-Pol. Gain = (2.74535)(.4606)(0.883)	= 1.117 / 0.479 dB

## INSTALLATION AND MOUNTING

The antenna is to be mounted in accordance with the supplied drawings. The antenna center of radiation is to be 34 meters (111.55 ft.) above ground level. The antenna aperture is 0.0 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 antenna is to be oriented 267 degrees true North.

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

DRAWING NO.	TITLE
1975D00	ELEVATION
1975D01	ANTENNA ORIENTATION
2105A10	TEST RANGE SCHEMATIC

The array shall be mounted according to all details outlined in DWG. 1975D00. The antenna elements shall be aligned at the same heading as in DWG. 1975D01. This will ensure that the antenna is oriented properly at 267 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:

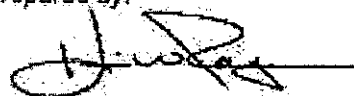
Exhibit 1	Circular Polarized Azimuth Pattern Field Strength Tabulations (Composite)
Exhibit 2	Measured Horizontal Polarized Azimuth Pattern Measured Field Strength Tabulations (Horizontal)
Exhibit 3	Measured Vertical Polarized Azimuth Pattern Measured Field Strength Tabulations (Vertical)
Exhibit 4	Elevation 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

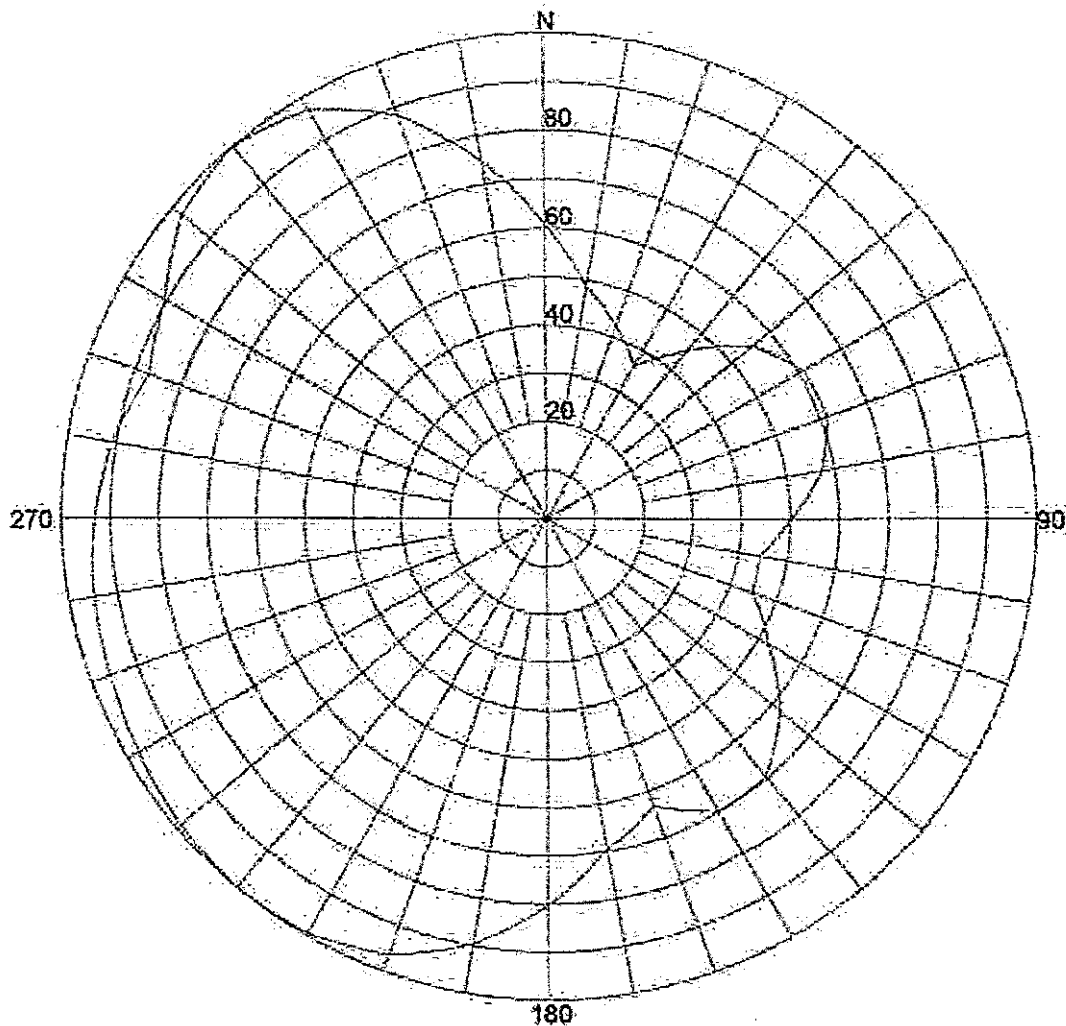
All equipment is calibrated to ANSI/NCSS Z540-1-1994 specs

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: WBLD

Date: 8/30/2015

ANTENNA TYPE: FMECD/1-DA

FREQUENCY: 89.3 MHz

PATTERN POL.: Circular

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.69266 / 2.29dB

PATTERN RMS: 0.769

## Relative Field Tabulation(Azimuth)

Azimuth Heading	Normalized Field(dB)	Azimuth Heading	Normalized Field(dB)
0	.6070 (-4.34)	180	.8020 (-1.92)
5	.5465 (-5.25)	185	.8495 (-1.42)
10	.4860 (-6.27)	190	.8970 (-0.94)
15	.4555 (-6.83)	195	.9305 (-0.63)
20	.4250 (-7.43)	200	.9640 (-0.32)
25	.3935 (-8.1)	205	.9795 (-0.18)
30	.3620 (-8.83)	210	.9950 (-0.04)
35	.4065 (-7.82)	215	.9975 (-0.02)
40	.4510 (-6.92)	220	1.0000 (0)
45	.5025 (-5.98)	225	.9945 (-0.05)
50	.5540 (-5.13)	230	.9890 (-0.1)
55	.5820 (-4.7)	235	.9815 (-0.16)
60	.6100 (-4.29)	240	.9740 (-0.23)
65	.6125 (-4.26)	245	.9670 (-0.29)
70	.6150 (-4.22)	250	.9600 (-0.35)
75	.5945 (-4.52)	255	.9540 (-0.41)
80	.5740 (-4.82)	260	.9480 (-0.46)
85	.5380 (-5.38)	265	.9400 (-0.54)
90	.5020 (-5.99)	270	.9320 (-0.61)
95	.4730 (-6.5)	275	.9205 (-0.72)
100	.4440 (-7.05)	280	.9090 (-0.83)
105	.4460 (-7.01)	285	.8895 (-1.02)
110	.4480 (-6.97)	290	.8700 (-1.21)
115	.4860 (-6.27)	295	.8875 (-1.04)
120	.5240 (-5.61)	300	.9050 (-0.87)
125	.5735 (-4.83)	305	.9405 (-0.53)
130	.6230 (-4.11)	310	.9760 (-0.21)
135	.6595 (-3.62)	315	.9880 (-0.1)
140	.6960 (-3.15)	320	1.0000 (0)
145	.6975 (-3.13)	325	.9855 (-0.13)
150	.6990 (-3.11)	330	.9710 (-0.26)
155	.6660 (-3.53)	335	.9275 (-0.65)
160	.6330 (-3.97)	340	.8840 (-1.07)
165	.6640 (-3.56)	345	.8155 (-1.77)
170	.6950 (-3.16)	350	.7470 (-2.53)
175	.7465 (-2.52)	355	.6770 (-3.39)

## Systems With Reliability LP

CLIENT: WBLD

Date: 8/30/2015

ANTENNA TYPE: FMEGD/1-DA

FREQUENCY: 89.3 MHz

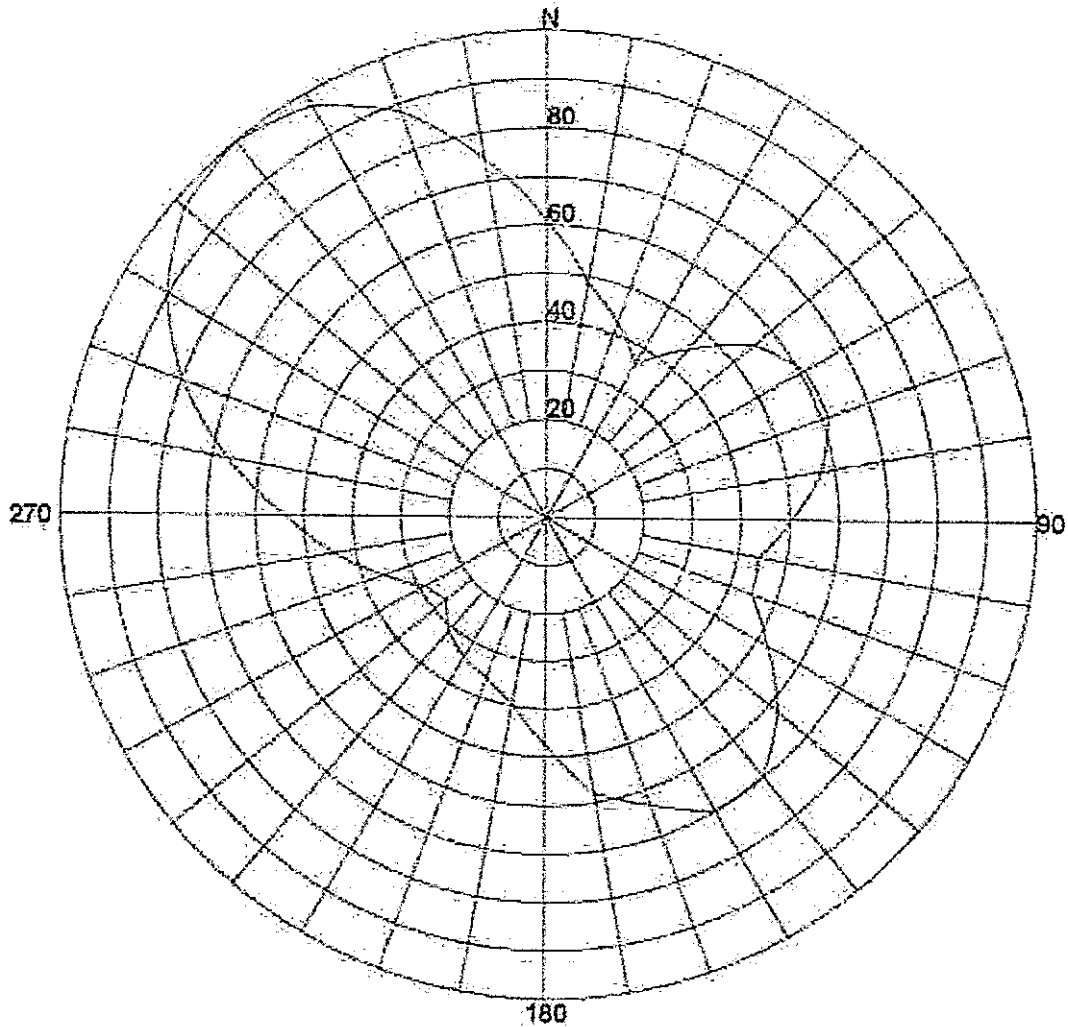
PATTERN POL: Circular

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.69266 / 2.29dB

PATTERN RMS: 0.769

Exhibit 2: Measured Horizontal Polarized Azimuth Pattern



Azimuth Pattern

Systems With Reliability LP

Scale: Linear

Unit: Relative Field

CLIENT: WBLD

Date: 8/30/2015

ANTENNA TYPE: FMECD/1-DA

FREQUENCY: 89.3 MHz

PATTERN POL.: Horizontal

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.74535 / 4.39dB

PATTERN RMS: 0.604

## Relative Field Tabulation(Azimuth)

Azimuth Heading	Normalized Field(dB)	Azimuth Heading	Normalized Field(dB)
0	.6070 (-4.34)	180	.4740 (-6.48)
5	.5485 (-5.25)	185	.4335 (-7.26)
10	.4860 (-6.27)	190	.3930 (-8.11)
15	.4555 (-6.83)	195	.3745 (-8.53)
20	.4250 (-7.43)	200	.3560 (-8.97)
25	.3935 (-8.1)	205	.3465 (-9.21)
30	.3820 (-8.83)	210	.3370 (-9.45)
35	.4065 (-7.82)	215	.3240 (-9.79)
40	.4510 (-6.92)	220	.3110 (-10.14)
45	.5025 (-5.98)	225	.2890 (-10.78)
50	.5540 (-5.13)	230	.2670 (-11.47)
55	.5820 (-4.7)	235	.2770 (-11.15)
60	.6100 (-4.29)	240	.2870 (-10.84)
65	.6125 (-4.26)	245	.3210 (-9.87)
70	.6150 (-4.22)	250	.3550 (-9)
75	.5945 (-4.52)	255	.3995 (-7.97)
80	.5740 (-4.82)	260	.4440 (-7.05)
85	.5380 (-5.38)	265	.4910 (-6.18)
90	.5020 (-5.99)	270	.5380 (-5.38)
95	.4730 (-6.5)	275	.6030 (-4.39)
100	.4440 (-7.05)	280	.6680 (-3.5)
105	.4460 (-7.01)	285	.7335 (-2.69)
110	.4480 (-6.97)	290	.7990 (-1.95)
115	.4860 (-6.27)	295	.8520 (-1.39)
120	.5240 (-5.61)	300	.9050 (-0.87)
125	.5735 (-4.83)	305	.9405 (-0.53)
130	.6230 (-4.11)	310	.9760 (-0.21)
135	.6595 (-3.62)	315	.9880 (-0.1)
140	.6960 (-3.15)	320	1.0000 (0)
145	.6975 (-3.13)	325	.9855 (-0.13)
150	.6990 (-3.11)	330	.9710 (-0.26)
155	.6860 (-3.53)	335	.9275 (-0.65)
160	.6330 (-3.97)	340	.8840 (-1.07)
165	.6065 (-4.34)	345	.8155 (-1.77)
170	.5800 (-4.73)	350	.7470 (-2.53)
175	.5270 (-5.56)	355	.6770 (-3.39)

## Systems With Reliability LP

CLIENT: WBLD

Date: 8/30/2015

ANTENNA TYPE: FMECD/1-DA

FREQUENCY: 89.3 MHz

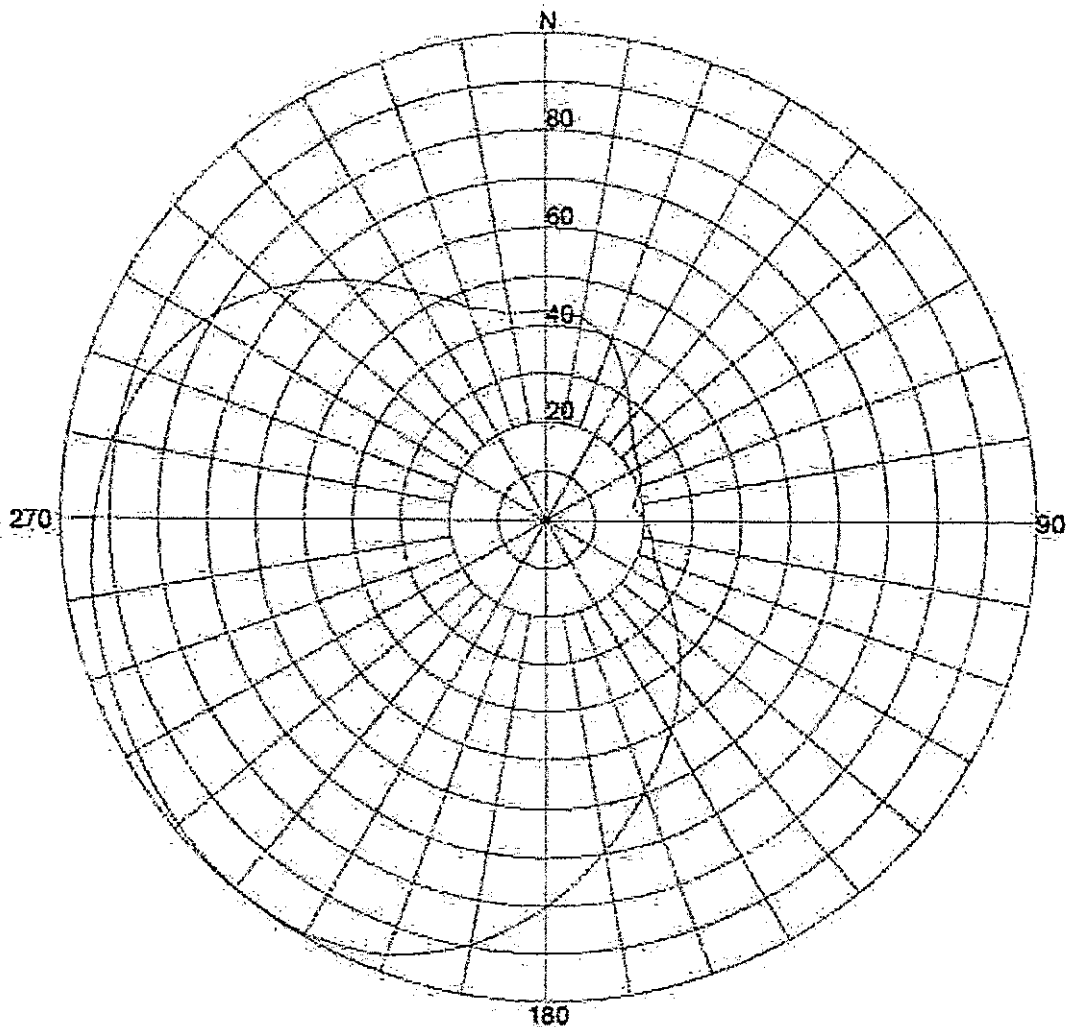
PATTERN POL.: Horizontal

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.74535 / 4.39dB

PATTERN RMS: 0.604

Exhibit 3: Measured Vertical Polarized Azimuth Pattern



Azimuth Pattern

Scale: Linear

Unit: Relative Field

Systems With Reliability LP

CLIENT: WBLD

Date: 8/30/2015

ANTENNA TYPE: FMECD/1-DA

FREQUENCY: 89.3 MHz

PATTERN POL.: Vertical

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.3446 / 3.7dB

PATTERN RMS: 0.653



## Relative Field Tabulation(Azimuth)

Azimuth Heading	Normalized Field(dB)	Azimuth Heading	Normalized Field(dB)
0	.4300 (-7.33)	180	.8020 (-1.92)
5	.4285 (-7.4)	185	.8495 (-1.42)
10	.4230 (-7.47)	190	.8970 (-0.94)
15	.4075 (-7.8)	195	.9305 (-0.63)
20	.3920 (-8.13)	200	.9640 (-0.32)
25	.3595 (-8.89)	205	.9795 (-0.18)
30	.3270 (-9.71)	210	.9950 (-0.04)
35	.2970 (-10.54)	215	.9975 (-0.02)
40	.2670 (-11.47)	220	1.0000 (0)
45	.2500 (-12.04)	225	.9945 (-0.05)
50	.2330 (-12.65)	230	.9890 (-0.1)
55	.2260 (-12.92)	235	.9815 (-0.16)
60	.2190 (-13.19)	240	.9740 (-0.23)
65	.2125 (-13.45)	245	.9670 (-0.29)
70	.2060 (-13.72)	250	.9600 (-0.35)
75	.1930 (-14.29)	255	.9540 (-0.41)
80	.1800 (-14.89)	260	.9480 (-0.46)
85	.1915 (-14.36)	265	.9400 (-0.54)
90	.2020 (-13.85)	270	.9320 (-0.61)
95	.2115 (-13.49)	275	.9205 (-0.72)
100	.2200 (-13.15)	280	.9090 (-0.83)
105	.2270 (-12.88)	285	.8895 (-1.02)
110	.2340 (-12.62)	290	.8700 (-1.21)
115	.2570 (-11.8)	295	.8425 (-1.49)
120	.2800 (-11.06)	300	.8150 (-1.78)
125	.3135 (-10.08)	305	.7760 (-2.2)
130	.3470 (-9.19)	310	.7370 (-2.65)
135	.3870 (-8.25)	315	.6900 (-3.22)
140	.4270 (-7.39)	320	.6430 (-3.84)
145	.4680 (-6.6)	325	.5925 (-4.55)
150	.5090 (-5.87)	330	.5420 (-5.32)
155	.5515 (-5.17)	335	.5025 (-5.98)
160	.5940 (-4.52)	340	.4630 (-6.69)
165	.6445 (-3.82)	345	.4485 (-7)
170	.6950 (-3.16)	350	.4300 (-7.33)
175	.7485 (-2.52)	355	.4300 (-7.33)

## Systems With Reliability LP

CLIENT: WBLD

Date: 8/30/2015

ANTENNA TYPE: FMECD/1-DA

FREQUENCY: 89.3 MHz

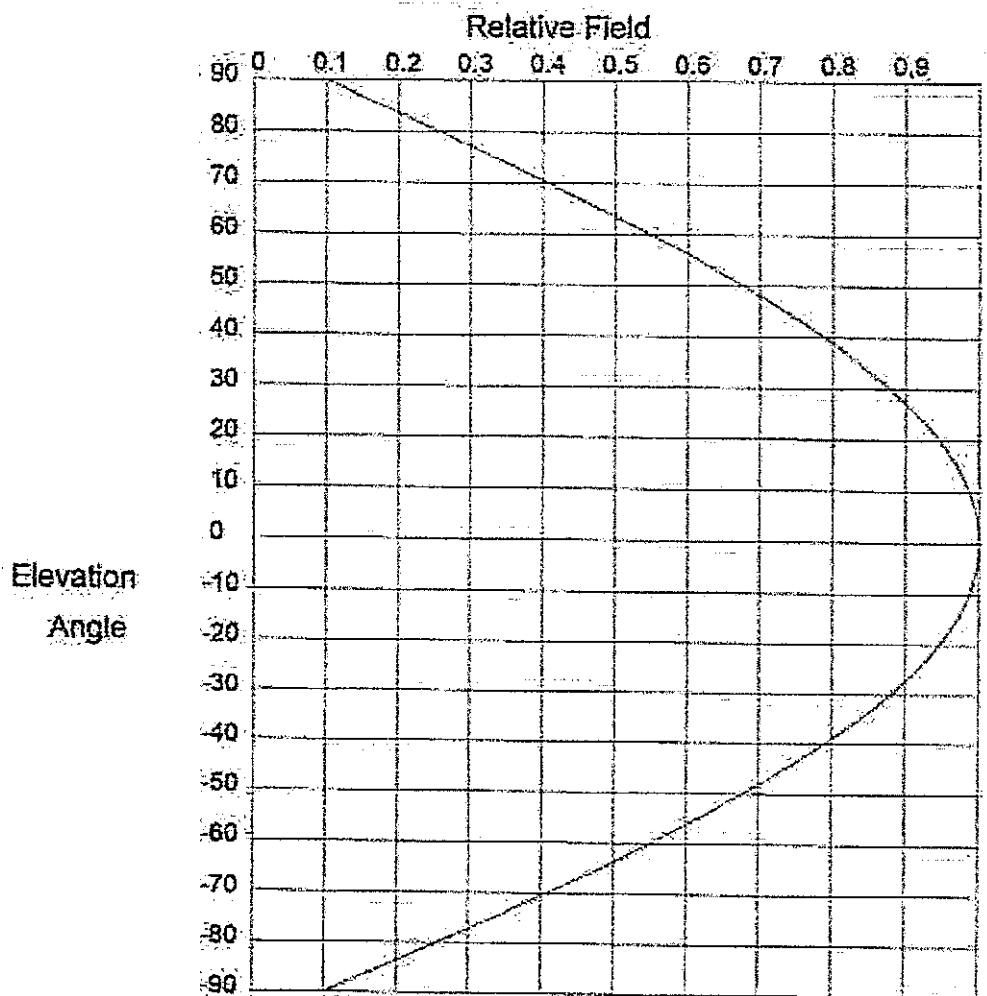
PATTERN POL: Vertical

CIRCULARITY(+/-dB):

AZ DIRECTIVITY: 2.3446 / 3.7dB

PATTERN RMS: 0.653

Exhibit 4: Elevation Pattern



## Elevation Pattern

### Systems With Reliability LP

Scale: Linear

Units: Field, Relative

CLIENT: WBLD

Date: 4/21/2015

ANTENNA TYPE: FMECD/1-DA

FREQUENCY: 89.3 MHz

PATTERN POL: Circular

DIRECTIVITY(Peak): 0.883/-0.539 dBd

Beam Tilt (Deg.): 0

DIRECTIVITY(Horiz): 0.883/-0.539 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	.654 (-3.687)	14.0	.973 (-0.235)
89.0	.116 (-18.733)	51.0	.666 (-3.525)	13.0	.977 (-0.203)
88.0	.131 (-17.627)	50.0	.678 (-3.369)	12.0	.98 (-0.173)
87.0	.147 (-16.648)	49.0	.69 (-3.217)	11.0	.983 (-0.145)
86.0	.163 (-15.768)	48.0	.702 (-3.071)	10.0	.986 (-0.12)
85.0	.178 (-14.97)	47.0	.714 (-2.928)	9.8	.987 (-0.115)
84.0	.194 (-14.241)	46.0	.725 (-2.791)	9.6	.987 (-0.11)
83.0	.21 (-13.569)	45.0	.736 (-2.659)	9.4	.988 (-0.106)
82.0	.225 (-12.946)	44.0	.747 (-2.529)	9.2	.988 (-0.101)
81.0	.241 (-12.367)	43.0	.758 (-2.404)	9.0	.989 (-0.097)
80.0	.256 (-11.826)	42.0	.769 (-2.283)	8.8	.989 (-0.093)
79.0	.272 (-11.317)	41.0	.779 (-2.167)	8.6	.99 (-0.088)
78.0	.287 (-10.839)	40.0	.789 (-2.054)	8.4	.99 (-0.084)
77.0	.302 (-10.387)	39.0	.799 (-1.944)	8.2	.991 (-0.08)
76.0	.318 (-9.959)	38.0	.809 (-1.839)	8.0	.991 (-0.076)
75.0	.333 (-9.553)	37.0	.819 (-1.737)	7.8	.992 (-0.073)
74.0	.348 (-9.167)	36.0	.828 (-1.638)	7.6	.992 (-0.069)
73.0	.363 (-8.799)	35.0	.837 (-1.543)	7.4	.993 (-0.065)
72.0	.378 (-8.448)	34.0	.846 (-1.451)	7.2	.993 (-0.062)
71.0	.393 (-8.112)	33.0	.855 (-1.363)	7.0	.993 (-0.058)
70.0	.408 (-7.791)	32.0	.863 (-1.277)	6.8	.994 (-0.055)
69.0	.423 (-7.483)	31.0	.871 (-1.195)	6.6	.994 (-0.052)
68.0	.437 (-7.187)	30.0	.879 (-1.116)	6.4	.994 (-0.049)
67.0	.452 (-6.904)	29.0	.887 (-1.04)	6.2	.995 (-0.046)
66.0	.466 (-6.631)	28.0	.895 (-0.967)	6.0	.995 (-0.043)
65.0	.48 (-6.369)	27.0	.902 (-0.897)	5.8	.995 (-0.04)
64.0	.495 (-6.116)	26.0	.909 (-0.83)	5.6	.996 (-0.037)
63.0	.509 (-5.873)	25.0	.916 (-0.765)	5.4	.996 (-0.035)
62.0	.523 (-5.638)	24.0	.922 (-0.704)	5.2	.996 (-0.032)
61.0	.536 (-5.411)	23.0	.928 (-0.645)	5.0	.997 (-0.03)
60.0	.55 (-5.193)	22.0	.934 (-0.589)	4.8	.997 (-0.027)
59.0	.564 (-4.982)	21.0	.94 (-0.535)	4.6	.997 (-0.025)
58.0	.577 (-4.778)	20.0	.946 (-0.485)	4.4	.997 (-0.023)
57.0	.59 (-4.58)	19.0	.951 (-0.437)	4.2	.998 (-0.021)
56.0	.603 (-4.39)	18.0	.956 (-0.391)	4.0	.998 (-0.019)
55.0	.616 (-4.205)	17.0	.961 (-0.348)	3.8	.998 (-0.017)
54.0	.629 (-4.027)	16.0	.965 (-0.308)	3.6	.998 (-0.015)
53.0	.642 (-3.854)	15.0	.969 (-0.271)	3.4	.998 (-0.014)

## Systems With Reliability LP

Page 1 of 3

CLIENT: WBLD

Date: 4/21/2015

ANTENNA TYPE: FMECD/1-DA

FREQUENCY: 89.3 MHz

PATTERN POL: Circular

DIRECTIVITY(Peak): 0.883/-0.539 dBd

Beam Tilt (Deg.): 0

DIRECTIVITY(Horiz): 0.883/-0.539 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	.999 (-0.012)	-4.4	.997 (-0.023)	-12.0	.98 (-0.173)
3.0	.999 (-0.011)	-4.6	.997 (-0.025)	-12.2	.98 (-0.178)
2.8	.999 (-0.009)	-4.8	.997 (-0.027)	-12.4	.979 (-0.184)
2.6	.999 (-0.008)	-5.0	.997 (-0.03)	-12.6	.978 (-0.19)
2.4	.999 (-0.007)	-5.2	.996 (-0.032)	-12.8	.978 (-0.196)
2.2	.999 (-0.006)	-5.4	.996 (-0.035)	-13.0	.977 (-0.203)
2.0	.999 (-0.005)	-5.6	.996 (-0.037)	-13.2	.976 (-0.209)
1.8	1.00 (-0.004)	-5.8	.995 (-0.04)	-13.4	.975 (-0.215)
1.6	1.00 (-0.003)	-6.0	.995 (-0.043)	-13.6	.975 (-0.222)
1.4	1.00 (-0.002)	-6.2	.995 (-0.046)	-13.8	.974 (-0.229)
1.2	1.00 (-0.002)	-6.4	.994 (-0.049)	-14.0	.973 (-0.235)
1.0	1.00 (-0.001)	-6.6	.994 (-0.052)	-14.2	.973 (-0.242)
.8	1.00 (-0.001)	-6.8	.994 (-0.055)	-14.4	.972 (-0.249)
.6	1.00 (0)	-7.0	.993 (-0.058)	-14.6	.971 (-0.256)
.4	1.00 (0)	-7.2	.993 (-0.062)	-14.8	.97 (-0.263)
.2	1.00 (0)	-7.4	.993 (-0.065)	-15.0	.969 (-0.271)
.0	1.00 (0)	-7.6	.992 (-0.069)	-15.2	.969 (-0.278)
-.2	1.00 (0)	-7.8	.992 (-0.073)	-15.4	.968 (-0.285)
-.4	1.00 (0)	-8.0	.991 (-0.076)	-15.6	.967 (-0.293)
-.6	1.00 (0)	-8.2	.991 (-0.08)	-15.8	.966 (-0.3)
-.8	1.00 (-0.001)	-8.4	.99 (-0.084)	-16.0	.965 (-0.308)
-1.0	1.00 (-0.001)	-8.6	.99 (-0.088)	-16.2	.964 (-0.316)
-1.2	1.00 (-0.002)	-8.8	.989 (-0.093)	-16.4	.963 (-0.324)
-1.4	1.00 (-0.002)	-9.0	.989 (-0.097)	-16.6	.962 (-0.332)
-1.6	1.00 (-0.003)	-9.2	.988 (-0.101)	-16.8	.962 (-0.34)
-1.8	1.00 (-0.004)	-9.4	.988 (-0.106)	-17.0	.961 (-0.348)
-2.0	.999 (-0.005)	-9.6	.987 (-0.11)	-17.2	.96 (-0.357)
-2.2	.999 (-0.006)	-9.8	.987 (-0.115)	-17.4	.959 (-0.365)
-2.4	.999 (-0.007)	-10.0	.986 (-0.12)	-17.6	.958 (-0.374)
-2.6	.999 (-0.008)	-10.2	.986 (-0.124)	-17.8	.957 (-0.383)
-2.8	.999 (-0.009)	-10.4	.985 (-0.129)	-18.0	.956 (-0.391)
-3.0	.999 (-0.011)	-10.6	.985 (-0.134)	-18.2	.955 (-0.4)
-3.2	.999 (-0.012)	-10.8	.984 (-0.14)	-18.4	.954 (-0.409)
-3.4	.998 (-0.014)	-11.0	.983 (-0.145)	-18.6	.953 (-0.418)
-3.6	.998 (-0.015)	-11.2	.983 (-0.15)	-18.8	.952 (-0.427)
-3.8	.998 (-0.017)	-11.4	.982 (-0.156)	-19.0	.951 (-0.437)
-4.0	.998 (-0.019)	-11.6	.982 (-0.161)	-19.2	.95 (-0.446)
-4.2	.998 (-0.021)	-11.8	.981 (-0.167)	-19.4	.949 (-0.456)

## Systems With Reliability LP

Page 2 of 3

CLIENT: WBLD  
 ANTENNA TYPE: FMECD/1-DA  
 FREQUENCY: 89.3 MHz  
 PATTERN POL.: Circular  
 DIRECTIVITY(Peak): 0.883/-0.539 dBd  
 DIRECTIVITY(Horiz): 0.883/-0.539 dBd

Date: 4/21/2015  
 Beam Tilt (Deg.): 0  
 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	.948 (-0.465)	-27.2	.90 (-0.911)	-54.0	.629 (-4.027)
-19.8	.947 (-0.475)	-27.4	.899 (-0.924)	-55.0	.616 (-4.205)
-20.0	.946 (-0.485)	-27.6	.898 (-0.939)	-56.0	.603 (-4.39)
-20.2	.945 (-0.495)	-27.8	.896 (-0.953)	-57.0	.59 (-4.58)
-20.4	.944 (-0.505)	-28.0	.895 (-0.967)	-58.0	.577 (-4.778)
-20.6	.942 (-0.515)	-28.2	.893 (-0.981)	-59.0	.564 (-4.982)
-20.8	.941 (-0.525)	-28.4	.892 (-0.996)	-60.0	.55 (-5.193)
-21.0	.94 (-0.535)	-28.6	.89 (-1.01)	-61.0	.536 (-5.411)
-21.2	.939 (-0.546)	-28.8	.889 (-1.025)	-62.0	.523 (-5.638)
-21.4	.938 (-0.556)	-29.0	.887 (-1.04)	-63.0	.509 (-5.873)
-21.6	.937 (-0.567)	-29.2	.886 (-1.055)	-64.0	.495 (-6.116)
-21.8	.936 (-0.578)	-29.4	.884 (-1.07)	-65.0	.48 (-6.369)
-22.0	.934 (-0.589)	-29.6	.883 (-1.085)	-66.0	.466 (-6.631)
-22.2	.933 (-0.6)	-29.8	.881 (-1.101)	-67.0	.452 (-6.904)
-22.4	.932 (-0.611)	-30.0	.879 (-1.116)	-68.0	.437 (-7.187)
-22.6	.931 (-0.622)	-31.0	.871 (-1.195)	-69.0	.423 (-7.483)
-22.8	.93 (-0.633)	-32.0	.863 (-1.277)	-70.0	.408 (-7.791)
-23.0	.928 (-0.645)	-33.0	.855 (-1.363)	-71.0	.393 (-8.112)
-23.2	.927 (-0.656)	-34.0	.846 (-1.451)	-72.0	.378 (-8.448)
-23.4	.926 (-0.668)	-35.0	.837 (-1.543)	-73.0	.363 (-8.799)
-23.6	.925 (-0.68)	-36.0	.828 (-1.638)	-74.0	.348 (-9.167)
-23.8	.923 (-0.692)	-37.0	.819 (-1.737)	-75.0	.333 (-9.553)
-24.0	.922 (-0.704)	-38.0	.809 (-1.839)	-76.0	.318 (-9.959)
-24.2	.921 (-0.716)	-39.0	.799 (-1.944)	-77.0	.302 (-10.387)
-24.4	.92 (-0.728)	-40.0	.789 (-2.054)	-78.0	.287 (-10.839)
-24.6	.918 (-0.74)	-41.0	.779 (-2.167)	-79.0	.272 (-11.317)
-24.8	.917 (-0.753)	-42.0	.769 (-2.283)	-80.0	.256 (-11.826)
-25.0	.916 (-0.765)	-43.0	.758 (-2.404)	-81.0	.241 (-12.367)
-25.2	.914 (-0.778)	-44.0	.747 (-2.529)	-82.0	.225 (-12.946)
-25.4	.913 (-0.791)	-45.0	.736 (-2.659)	-83.0	.21 (-13.569)
-25.6	.912 (-0.803)	-46.0	.725 (-2.791)	-84.0	.194 (-14.241)
-25.8	.91 (-0.816)	-47.0	.714 (-2.928)	-85.0	.178 (-14.97)
-26.0	.909 (-0.83)	-48.0	.702 (-3.071)	-86.0	.163 (-15.768)
-26.2	.908 (-0.843)	-49.0	.69 (-3.217)	-87.0	.147 (-16.648)
-26.4	.906 (-0.856)	-50.0	.679 (-3.369)	-88.0	.131 (-17.627)
-26.6	.905 (-0.87)	-51.0	.666 (-3.525)	-89.0	.115 (-18.733)
-26.8	.903 (-0.883)	-52.0	.654 (-3.687)	-90.0	.10 (-20)
-27.0	.902 (-0.897)	-53.0	.642 (-3.854)	90.0	.00 (-50)

## Systems With Reliability LP

Page 3 of 3

CLIENT: WBLD  
 ANTENNA TYPE: FMECD/1-DA  
 FREQUENCY: 89.3 MHz  
 PATTERN POL.: Circular  
 DIRECTIVITY(Peak): 0.883/-0.539 dBd  
 DIRECTIVITY(Horiz): 0.883/-0.539 dBd

Date: 4/21/2015  
 Beam Tilt (Deg.): 0  
 Null Fill(s)(%): 0, 0, 0

# Exhibit 5: Antenna Data Sheet



SYSTEMS WITH RELIABILITY, LP  
BROADCAST ANTENNAS AND TRANSMISSION LINE

## SYSTEM DATA SHEET

Customer	WBLD
Contact	Dave Scott
Location	Orchard Lake, MI
Antenna Model	FMECD/1-DA
Channel / Frequency	89.3 MHz

### ELECTRICAL SPECIFICATIONS

#### Antenna Specifications:

	H-POL			V. Pol.	
		dB			dB
License ERP (KW)	0.044			0.044	
FCC Limit Pattern Directivity	1.323	1.214	dB	1.323	1.214
Elevation Directivity	0.863	-0.540	dB	0.863	-0.540
Azimuth Directivity	2.745	4.385	dB	2.345	3.701
Composite Pattern	1.693	2.286	dB	1.693	2.286
Polarization Ratio	0.451			0.539	
RMS Comp/RMS Limit	88.4 %				
Antenna Efficiency %	100			100	
Power Ratio (Pol. Ratio X Efficiency)	0.4606			0.5394	
Antenna Gain	1.117	0.479	dB	1.117	0.479
Antenna Input Power (KW)	0.039 KW	-14.045	(dBK)		

#### Feed Line Specifications:

Line Type: RFS	1/2" Foam 50 $\Omega$ LCF12-50J
Attenuation Per 100 ft (dB)	0.52 dB
Line Length (ft) AGL + Horizontal Run	200.00 ft.
Total Line Attenuation (dB)	1.2400 dB
Line Efficiency	75.16 %
Power Input to the Line (KW)	0.052 KW -12.805 (dBK)

### MECHANICAL SPECIFICATIONS

No. Of Bays	1		
Antenna Aperture	0.00	ft.	0.00 meter
Center of Radiation AGL	111.55	ft.	34.00 meter
Antenna Weight (Everything)	78.00	lbs.	35.45 kg
Windload (50/33)	187.00	lbs.	Windload CaAc 5.34 ft <sup>2</sup>

Prepared by:

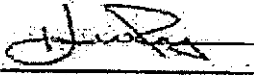
  
Kevin W. Rager  
SWR, LP

Exhibit 6: RMS Calculations



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

## WBLD Antenna RMS Comparison

### PROPOSED ANTENNA

Azimuth Heading	Relative Field
0	1
10	0.938
20	0.745
30	0.65
40	0.65
50	0.615
60	0.65
70	0.745
80	0.65
90	0.558
100	0.558
110	0.632
120	0.756
130	0.756
140	0.756
150	0.737
160	0.655
170	0.756
180	0.952
190	1
200	1
210	1
220	1
230	1
240	1
250	1
260	1
270	1
280	1
290	1
300	1
310	1
320	1
330	1
340	1
350	1

Sum of Relative Field Squared : 27.245  
Sum Divided by 36 (Readings) : 0.757  
Square Root : 0.870

### DESIGNED ANTENNA

Azimuth Heading	Relative Field
0	0.607
10	0.486
20	0.425
30	0.362
40	0.451
50	0.554
60	0.61
70	0.615
80	0.574
90	0.502
100	0.444
110	0.448
120	0.524
130	0.623
140	0.696
150	0.699
160	0.633
170	0.695
180	0.802
190	0.897
200	0.964
210	0.995
220	1
230	0.989
240	0.974
250	0.96
260	0.946
270	0.932
280	0.909
290	0.87
300	0.905
310	0.975
320	1
330	0.971
340	0.884
350	0.747

Sum of Relative Field Squared : 21.296  
Sum Divided by 36 (Readings) : 0.592  
Square Root : 0.769

Percentage of Construction Permit Antenna Filled :

**88.4%**

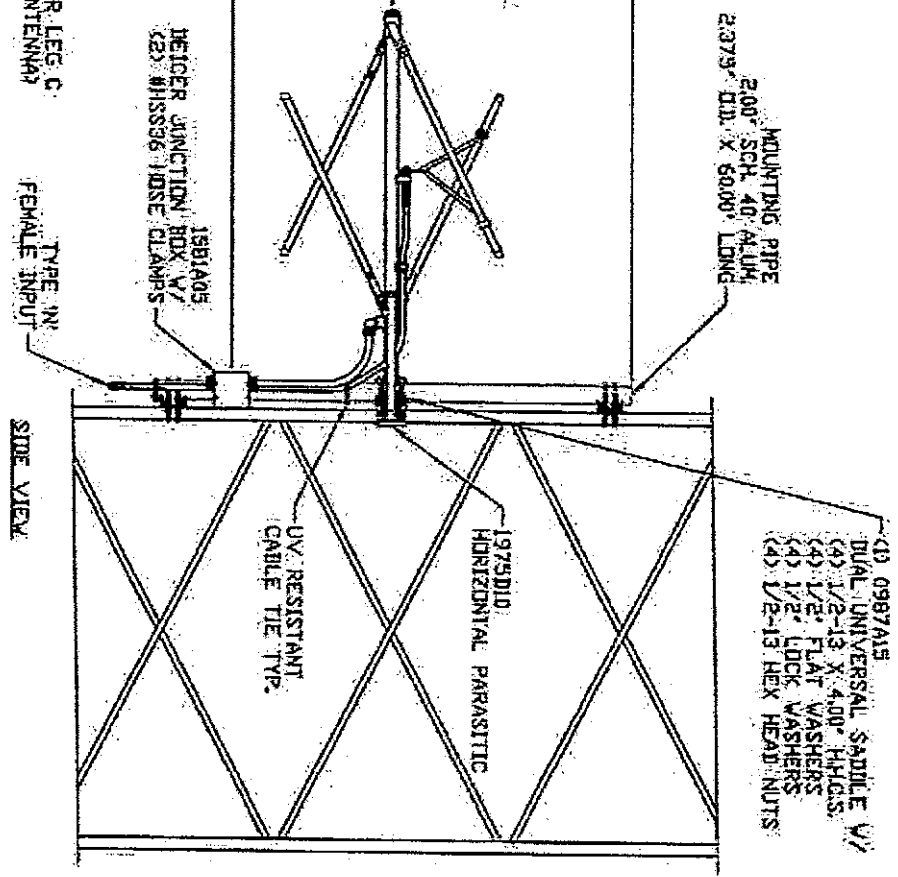
NOTE:  
1. REFERENCE DWG. 1975D01 FOR ANTENNA ORIENTATION.

1975D01  
NUMBER: 1975D000

- (2) 3/8-16 X 250" U-BOLTS
- (4) 3/8" FLAT WASHERS
- (4) 3/8" LOCK WASHERS
- (4) 3/8-16 HEX HEAD NUTS
- PER FACE MOUNT CHANNEL
- TYP. 2 PLACES

- 1975D05
- FACE MOUNT
- PIPE SUPPORT CHANNEL W/
- (4) 3/8-16 X 175" U-BOLTS
- (8) 3/8" FLAT WASHERS
- (8) 3/8" LOCK WASHERS
- (8) 3/8-16 HEX HEAD NUTS
- TYP. 2 PLACES

- 1975D10
- HORIZONTAL PARASITIC W/
- (2) 3/8-16 X 175" U-BOLTS
- (4) 3/8" FLAT WASHERS
- (4) 3/8" LOCK WASHERS
- (4) 3/8-16 HEX HEAD NUTS
- (MOUNT ON THE 207° AZIMUTH TOWER LEG C.
- AT THE SAME ELEVATION AS THE ANTENNA)



FRONT VIEW

SIDE VIEW

Exhibit 7: Drawings

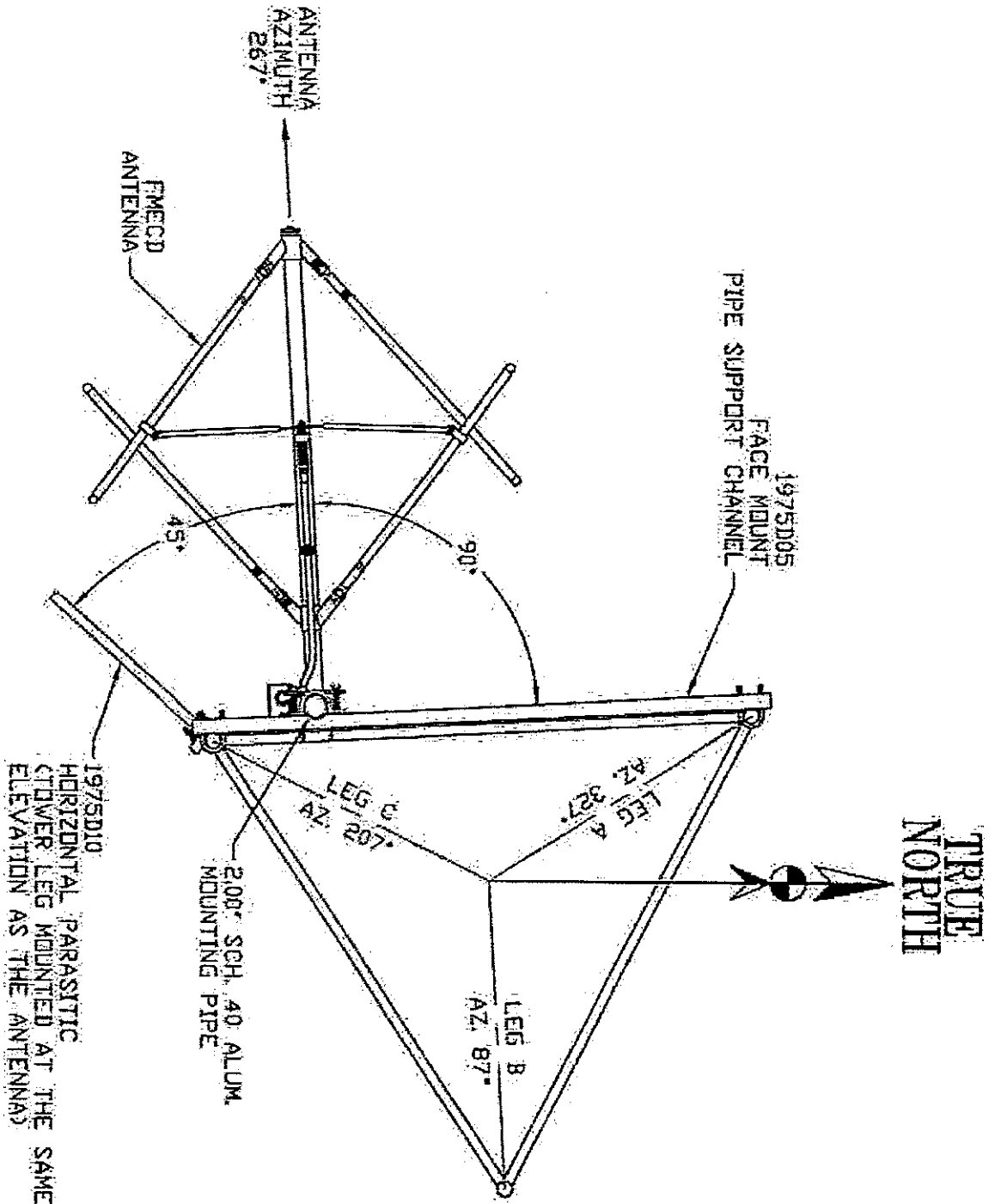
		STATUS: WITH REVISION, UP 618 INDUSTRIAL PARK ROAD DEERFIELD, PENNSYLVANIA 15031	
TITLE:		FACED/1-DA. FREQ. 89.3 WELD. ORCHARD LAKE, MI	
MATERIAL:		SIZE:	
1.		REQ. APPROVAL DATE: 8/21/15	
2.		DATE: 8/21/15	
3.		DATE: 8/21/15	
4.		DATE: 8/21/15	
5.		DATE: 8/21/15	
6.		DATE: 8/21/15	
7.		DATE: 8/21/15	
8.		DATE: 8/21/15	
9.		DATE: 8/21/15	
10.		DATE: 8/21/15	
11.		DATE: 8/21/15	
12.		DATE: 8/21/15	
13.		DATE: 8/21/15	
14.		DATE: 8/21/15	
15.		DATE: 8/21/15	
16.		DATE: 8/21/15	
17.		DATE: 8/21/15	
18.		DATE: 8/21/15	
19.		DATE: 8/21/15	
20.		DATE: 8/21/15	
21.		DATE: 8/21/15	
22.		DATE: 8/21/15	
23.		DATE: 8/21/15	
24.		DATE: 8/21/15	
25.		DATE: 8/21/15	
26.		DATE: 8/21/15	
27.		DATE: 8/21/15	
28.		DATE: 8/21/15	
29.		DATE: 8/21/15	
30.		DATE: 8/21/15	
31.		DATE: 8/21/15	
32.		DATE: 8/21/15	
33.		DATE: 8/21/15	
34.		DATE: 8/21/15	
35.		DATE: 8/21/15	
36.		DATE: 8/21/15	
37.		DATE: 8/21/15	
38.		DATE: 8/21/15	
39.		DATE: 8/21/15	
40.		DATE: 8/21/15	
41.		DATE: 8/21/15	
42.		DATE: 8/21/15	
43.		DATE: 8/21/15	
44.		DATE: 8/21/15	
45.		DATE: 8/21/15	
46.		DATE: 8/21/15	
47.		DATE: 8/21/15	
48.		DATE: 8/21/15	
49.		DATE: 8/21/15	
50.		DATE: 8/21/15	
51.		DATE: 8/21/15	
52.		DATE: 8/21/15	
53.		DATE: 8/21/15	
54.		DATE: 8/21/15	
55.		DATE: 8/21/15	
56.		DATE: 8/21/15	
57.		DATE: 8/21/15	
58.		DATE: 8/21/15	
59.		DATE: 8/21/15	
60.		DATE: 8/21/15	
61.		DATE: 8/21/15	
62.		DATE: 8/21/15	
63.		DATE: 8/21/15	
64.		DATE: 8/21/15	
65.		DATE: 8/21/15	
66.		DATE: 8/21/15	
67.		DATE: 8/21/15	
68.		DATE: 8/21/15	
69.		DATE: 8/21/15	
70.		DATE: 8/21/15	
71.		DATE: 8/21/15	
72.		DATE: 8/21/15	
73.		DATE: 8/21/15	
74.		DATE: 8/21/15	
75.		DATE: 8/21/15	
76.		DATE: 8/21/15	
77.		DATE: 8/21/15	
78.		DATE: 8/21/15	
79.		DATE: 8/21/15	
80.		DATE: 8/21/15	
81.		DATE: 8/21/15	
82.		DATE: 8/21/15	
83.		DATE: 8/21/15	
84.		DATE: 8/21/15	
85.		DATE: 8/21/15	
86.		DATE: 8/21/15	
87.		DATE: 8/21/15	
88.		DATE: 8/21/15	
89.		DATE: 8/21/15	
90.		DATE: 8/21/15	
91.		DATE: 8/21/15	
92.		DATE: 8/21/15	
93.		DATE: 8/21/15	
94.		DATE: 8/21/15	
95.		DATE: 8/21/15	
96.		DATE: 8/21/15	
97.		DATE: 8/21/15	
98.		DATE: 8/21/15	
99.		DATE: 8/21/15	
100.		DATE: 8/21/15	



NOTE:

1975D01

Exhibit 7 (cont'd): Drawings



TOP VIEW



SYSTEMS WITH RELIABILITY, INC.  
618 INDUSTRIAL PARK ROAD  
BRIDGEBURG, PENNSYLVANIA 15031

FILE: FMECD/1-DA, FREQ. 89.3  
WBLD, ORCHARD LAKE, MI  
ANTENNA ORIENTATION  
FROM TRUE NORTH

SHEET: A

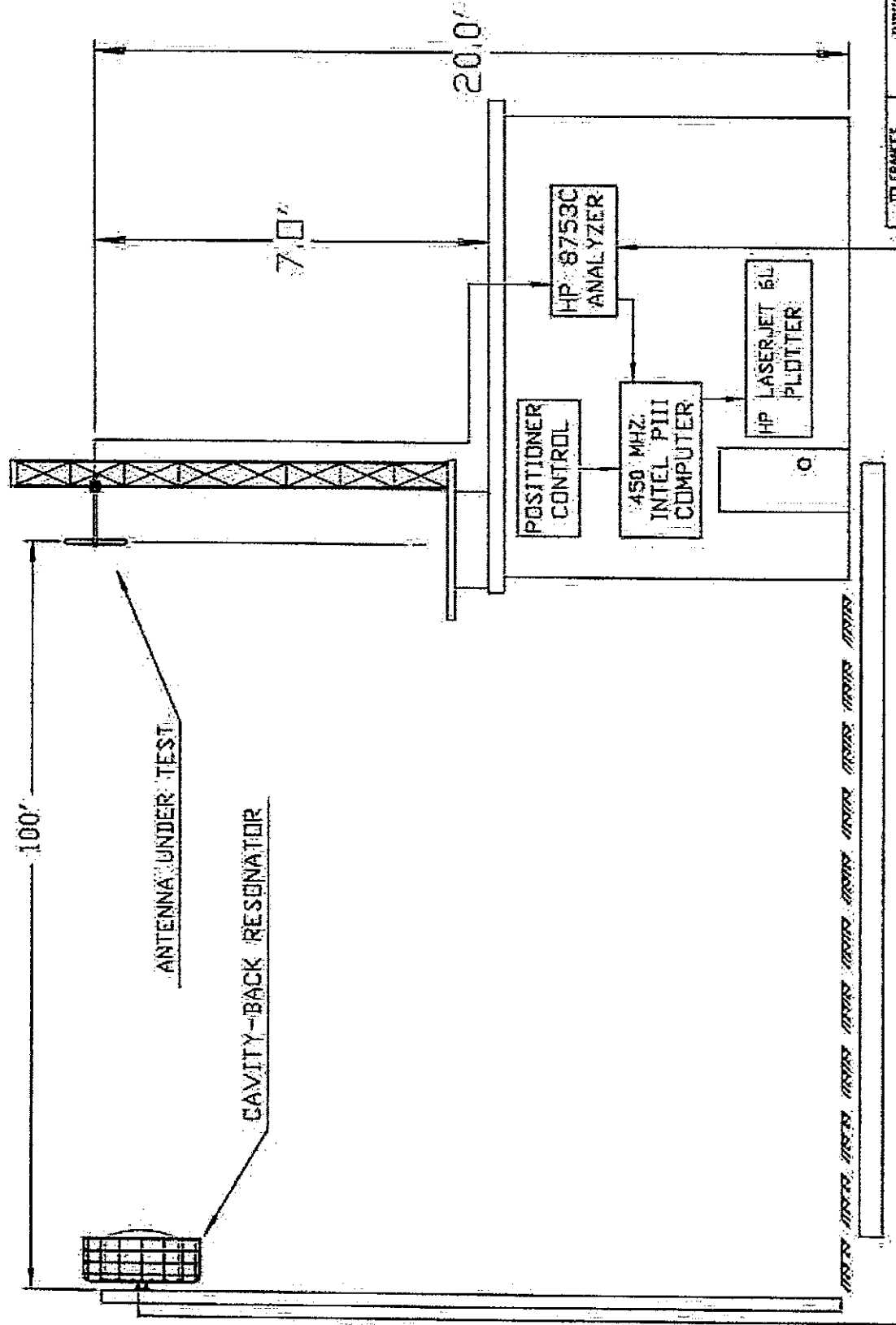
PARTS MADE BY THIS DRAWING  
SCALE: NTS  
DATE: 8/21/15  
RAC: 1 OF 1

REVISION RECORD  
REV. APPROVAL DATE

1 8/31/15

1975D01

2105A10

[illegible]