



SYSTEMS WITH RELIABILITY, LP
BROADCAST ANTENNAS AND TRANSMISSION LINE

PATTERN CERTIFICATION
DIRECTIONAL FM ANTENNA
WHQB
November 25, 2015

| | | |
|-----------------------------|---|-------------------------|
| Call Sign | : | WHQB |
| Location | : | Gray Court, SC |
| Frequency | : | 90.5 MHz |
| Channel | : | 213C2 |
| Antenna Model | : | FM3V/2-DA |
| Maximum Antenna Gain | : | |
| Vertical | : | 5.213 / 7.171 dB |

ANTENNA DESCRIPTION

A custom designed FM3V/2-DA antenna was fabricated to conform to the prescribed directional azimuth pattern. The antenna consists of two (2) vertically polarized, dipole radiating elements full wave spaced mounted to a 33 inch face tower. The antenna array points 335 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 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 utilized for performance enhancement.

DESCRIPTION OF TEST PARAMETERS AND EQUIPMENT

Horizontal 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 271.5 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 271.5 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. 800 762 7743 / 814 472 5436 ♦ Fax 814 472 5552

TEST RESULTS

The attached calculations verify that the **RMS** value of this antenna is **86.5%** of the **RMS** value of the pattern authorized in the related FCC file **BMPED-20071022BHF**. The vertical component **RMS** value is **0.607**.

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

Measured horizontal polarized directivity: 2.718 / 4.340 dB

Gain was calculated using the following relation:

GAIN = Azimuth Directivity x Elevation Directivity

Using this relationship:

H-Pol. Gain = (2.718)(1.918) = 5.213 / 7.171 dB

INSTALLATION AND MOUNTING

The antenna is to be mounted in accordance with the supplied drawings. The antenna center of radiation is to be **107.3 meters (352.07 ft.)** above ground level. The antenna aperture is **10.87 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 **335 degrees** true North.

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

| DRAWING NO. | TITLE |
|--------------------|----------------------|
| 1984D00 | ELEVATION |
| 1984D01 | ANTENNA ORIENTATION |
| 1984D02 & 1984D03 | PARASITIC PLACEMENT |
| 2105A10 | TEST RANGE SCHEMATIC |

The array shall be mounted according to all details outlined in **DWG. 1984D00**. The antenna elements shall be aligned at the same heading as in **DWG. 1984D01**. This will ensure that the antenna is oriented properly at 335 degrees true north. The parasitic placement is shown on **DWG. 1984D02** and **DWG. 1984D03**. 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 | Measured Vertical Polarized Azimuth Pattern |
| | Measured Field Strength Tabulations (Vertical) |
| Exhibit 2 | Elevation Pattern |
| | Elevation Tabulations |
| Exhibit 3 | Antenna Data Sheet |
| Exhibit 4 | RMS Calculations |
| Exhibit 5 | Drawings |

TEST EQUIPMENT

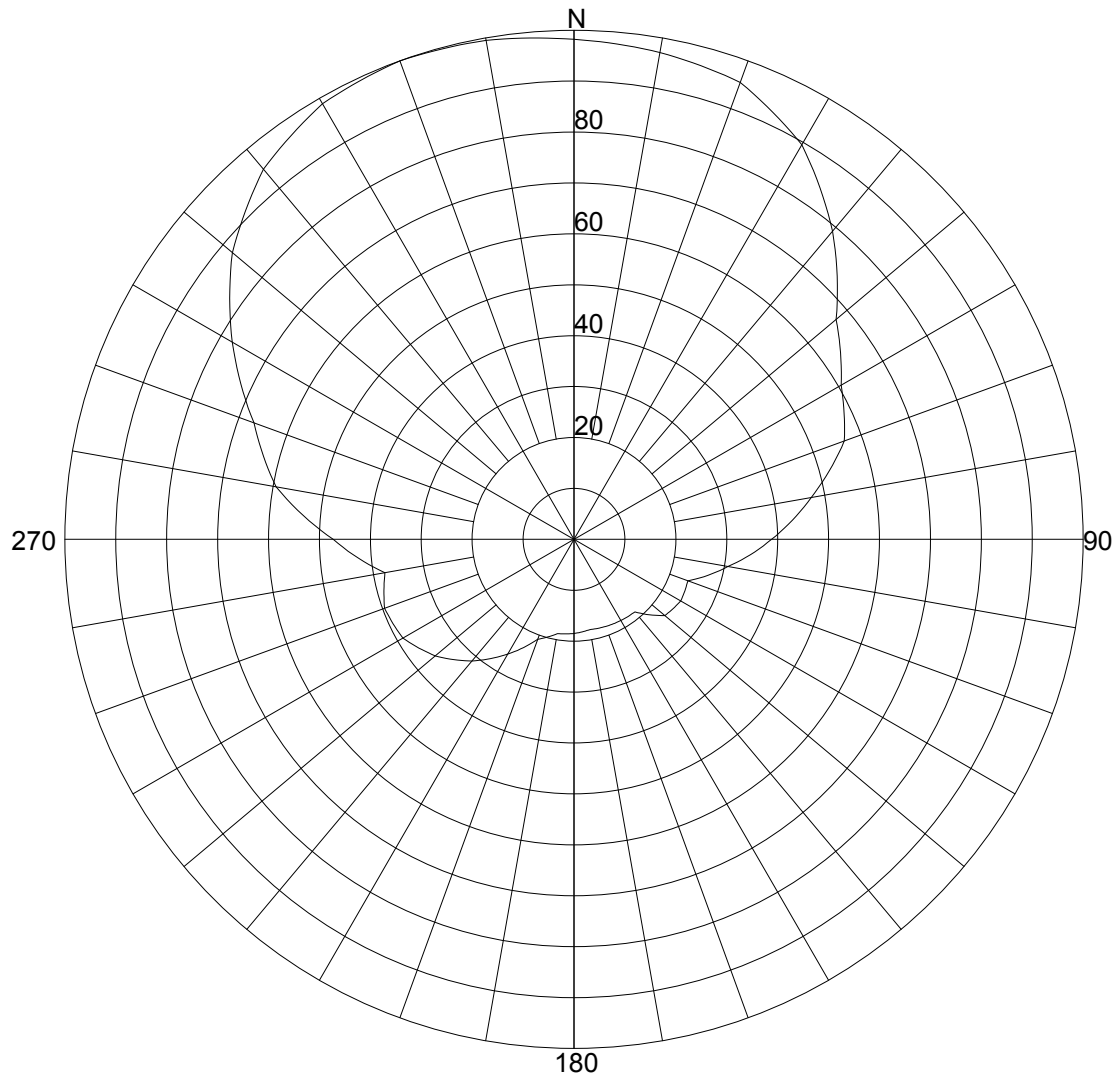
| | | |
|--|---|---|
| Network Analyzer | : | Hewlett Packard Model # 8753C Serial Number: 08753 – 69138 |
| Computer | : | Pentium 3, 450 MHz, SAMS Range Program |
| Printer | : | Hewlett-Packard Laser Jet 6L |
| Positioner | : | Orbit Positioner |
| All equipment is calibrated to ANSI/NCSL Z540-1-1994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

Prepared by:



Kevin W. Rager
Antenna Engineer
Systems With Reliability, LP

Exhibit 1: Measured Vertical Polarized Azimuth Pattern



Azimuth Pattern

Scale: Linear

Unit: Relative Field

Systems With Reliability

CLIENT: *Gray Court - WHQB*

Date: 11/25/2015

ANTENNA TYPE: FM3V/2-DA

FREQUENCY: 90.5 MHz

PATTERN POL.: Vertical

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.71781 / 4.34dB

PATTERN RMS: 0.607

Relative Field Tabulation(Azimuth)

| Azimuth Heading | Normalized Field(dB) | Azimuth Heading | Normalized Field(dB) |
|-----------------|----------------------|-----------------|----------------------|
| 0 | .9820 (-0.16) | 180 | .1850 (-14.66) |
| 5 | .9765 (-0.21) | 185 | .1865 (-14.59) |
| 10 | .9710 (-0.26) | 190 | .1880 (-14.52) |
| 15 | .9630 (-0.33) | 195 | .1985 (-14.04) |
| 20 | .9550 (-0.4) | 200 | .2090 (-13.6) |
| 25 | .9250 (-0.68) | 205 | .2345 (-12.6) |
| 30 | .8950 (-0.96) | 210 | .2600 (-11.7) |
| 35 | .8425 (-1.49) | 215 | .2860 (-10.87) |
| 40 | .7900 (-2.05) | 220 | .3120 (-10.12) |
| 45 | .7310 (-2.72) | 225 | .3340 (-9.53) |
| 50 | .6720 (-3.45) | 230 | .3560 (-8.97) |
| 55 | .6390 (-3.89) | 235 | .3720 (-8.59) |
| 60 | .6060 (-4.35) | 240 | .3880 (-8.22) |
| 65 | .5855 (-4.65) | 245 | .3920 (-8.13) |
| 70 | .5650 (-4.96) | 250 | .3960 (-8.05) |
| 75 | .5190 (-5.7) | 255 | .3865 (-8.26) |
| 80 | .4730 (-6.5) | 260 | .3770 (-8.47) |
| 85 | .4305 (-7.32) | 265 | .4250 (-7.43) |
| 90 | .3880 (-8.22) | 270 | .4730 (-6.5) |
| 95 | .3475 (-9.18) | 275 | .5335 (-5.46) |
| 100 | .3070 (-10.26) | 280 | .5940 (-4.52) |
| 105 | .2725 (-11.29) | 285 | .6315 (-3.99) |
| 110 | .2380 (-12.47) | 290 | .6690 (-3.49) |
| 115 | .2400 (-12.4) | 295 | .7220 (-2.83) |
| 120 | .2420 (-12.32) | 300 | .7750 (-2.21) |
| 125 | .2375 (-12.49) | 305 | .8255 (-1.67) |
| 130 | .2330 (-12.65) | 310 | .8760 (-1.15) |
| 135 | .2095 (-13.58) | 315 | .9125 (-0.8) |
| 140 | .1860 (-14.61) | 320 | .9490 (-0.45) |
| 145 | .1850 (-14.66) | 325 | .9685 (-0.28) |
| 150 | .1840 (-14.7) | 330 | .9880 (-0.1) |
| 155 | .1830 (-14.75) | 335 | .9940 (-0.05) |
| 160 | .1820 (-14.8) | 340 | 1.0000 (0) |
| 165 | .1810 (-14.85) | 345 | .9975 (-0.02) |
| 170 | .1800 (-14.89) | 350 | .9950 (-0.04) |
| 175 | .1825 (-14.77) | 355 | .9885 (-0.1) |

Systems With Reliability

CLIENT: *Gray Court - WHQB*

Date: 11/25/2015

ANTENNA TYPE: FM3V/2-DA

FREQUENCY: 90.5 MHz

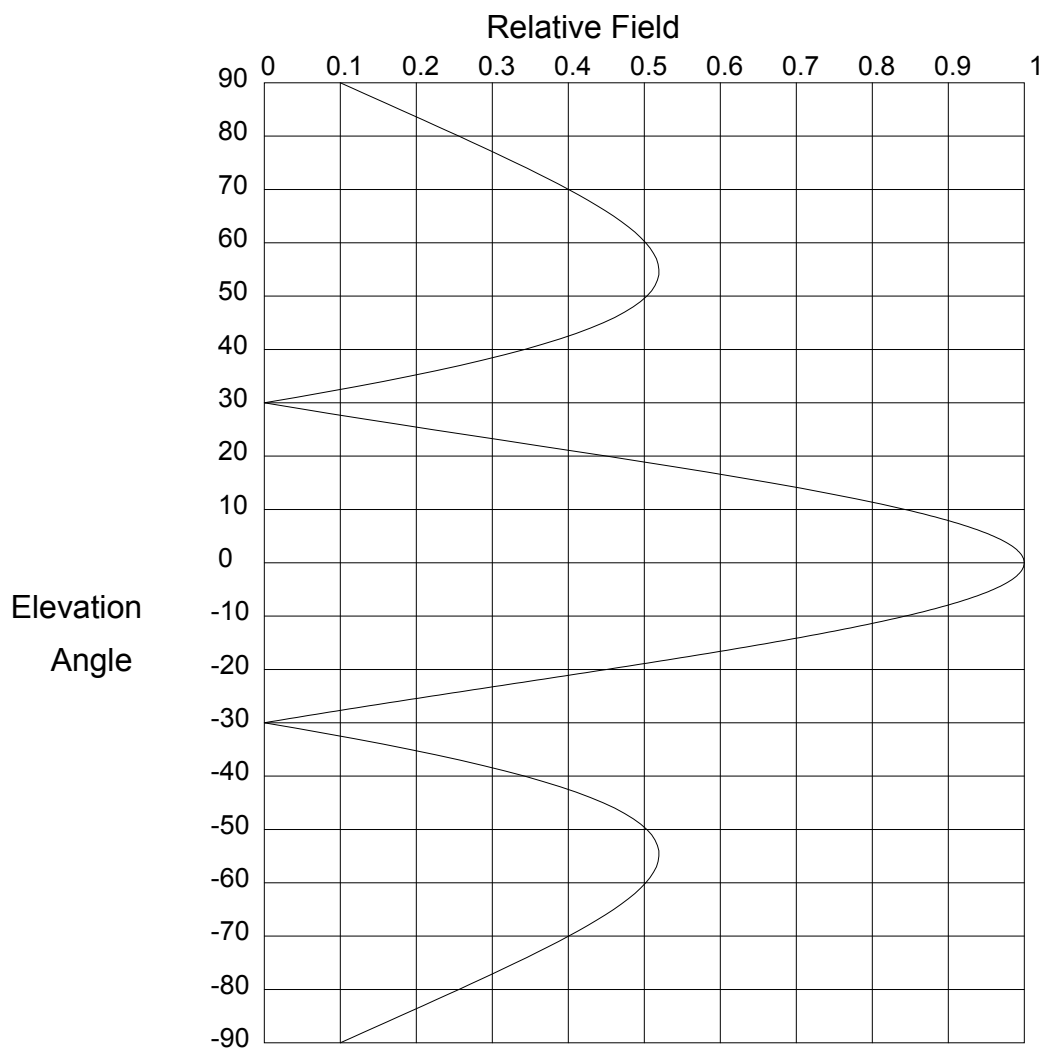
PATTERN POL.: Vertical

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.71781 / 4.34dB

PATTERN RMS: 0.607

Exhibit 2: Elevation Pattern



Elevation Pattern

Scale: Linear

Units: Field, Relative

Systems With Reliability LP

CLIENT: *WHQB*

Date: 9/14/2015

ANTENNA TYPE: FM3V/2-DA

FREQUENCY: 90.5 MHz

PATTERN POL.: Vertical

DIRECTIVITY(Peak): 1.918/2.828 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 1.918/2.828 dBd

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

Relative Field Tabulation

| Elev. Angle | Rel. Fld(dB) | Elev. Angle | Rel. Fld(dB) | Elev. Angle | Rel. Fld(dB) |
|-------------|----------------|-------------|----------------|-------------|---------------|
| 90.0 | .10 (-20) | 52.0 | .514 (-5.775) | 14.0 | .705 (-3.031) |
| 89.0 | .116 (-18.733) | 51.0 | .51 (-5.855) | 13.0 | .743 (-2.581) |
| 88.0 | .131 (-17.627) | 50.0 | .503 (-5.963) | 12.0 | .779 (-2.174) |
| 87.0 | .147 (-16.648) | 49.0 | .495 (-6.101) | 11.0 | .812 (-1.809) |
| 86.0 | .163 (-15.768) | 48.0 | .486 (-6.272) | 10.0 | .843 (-1.482) |
| 85.0 | .178 (-14.971) | 47.0 | .474 (-6.479) | 9.8 | .849 (-1.421) |
| 84.0 | .194 (-14.242) | 46.0 | .461 (-6.724) | 9.6 | .855 (-1.361) |
| 83.0 | .21 (-13.571) | 45.0 | .446 (-7.013) | 9.4 | .861 (-1.303) |
| 82.0 | .225 (-12.951) | 44.0 | .429 (-7.349) | 9.2 | .866 (-1.246) |
| 81.0 | .241 (-12.374) | 43.0 | .41 (-7.738) | 9.0 | .872 (-1.191) |
| 80.0 | .256 (-11.835) | 42.0 | .39 (-8.189) | 8.8 | .877 (-1.137) |
| 79.0 | .271 (-11.332) | 41.0 | .367 (-8.709) | 8.6 | .883 (-1.084) |
| 78.0 | .286 (-10.859) | 40.0 | .342 (-9.31) | 8.4 | .888 (-1.033) |
| 77.0 | .301 (-10.415) | 39.0 | .316 (-10.008) | 8.2 | .893 (-0.983) |
| 76.0 | .316 (-9.997) | 38.0 | .288 (-10.824) | 8.0 | .898 (-0.935) |
| 75.0 | .331 (-9.603) | 37.0 | .257 (-11.786) | 7.8 | .903 (-0.887) |
| 74.0 | .345 (-9.231) | 36.0 | .225 (-12.937) | 7.6 | .908 (-0.841) |
| 73.0 | .36 (-8.881) | 35.0 | .192 (-14.343) | 7.4 | .912 (-0.797) |
| 72.0 | .374 (-8.551) | 34.0 | .156 (-16.113) | 7.2 | .917 (-0.753) |
| 71.0 | .387 (-8.24) | 33.0 | .119 (-18.454) | 7.0 | .921 (-0.711) |
| 70.0 | .401 (-7.948) | 32.0 | .081 (-21.828) | 6.8 | .926 (-0.67) |
| 69.0 | .413 (-7.673) | 31.0 | .041 (-27.712) | 6.6 | .93 (-0.631) |
| 68.0 | .426 (-7.417) | 30.0 | .00 (-50) | 6.4 | .934 (-0.593) |
| 67.0 | .438 (-7.178) | 29.0 | .042 (-27.469) | 6.2 | .938 (-0.556) |
| 66.0 | .449 (-6.956) | 28.0 | .086 (-21.343) | 6.0 | .942 (-0.52) |
| 65.0 | .46 (-6.751) | 27.0 | .13 (-17.727) | 5.8 | .946 (-0.485) |
| 64.0 | .47 (-6.563) | 26.0 | .175 (-15.145) | 5.6 | .949 (-0.452) |
| 63.0 | .479 (-6.392) | 25.0 | .22 (-13.135) | 5.4 | .953 (-0.42) |
| 62.0 | .488 (-6.239) | 24.0 | .266 (-11.491) | 5.2 | .956 (-0.389) |
| 61.0 | .495 (-6.103) | 23.0 | .312 (-10.103) | 5.0 | .959 (-0.36) |
| 60.0 | .502 (-5.986) | 22.0 | .359 (-8.906) | 4.8 | .963 (-0.331) |
| 59.0 | .508 (-5.887) | 21.0 | .405 (-7.858) | 4.6 | .966 (-0.304) |
| 58.0 | .512 (-5.807) | 20.0 | .45 (-6.929) | 4.4 | .969 (-0.278) |
| 57.0 | .516 (-5.747) | 19.0 | .495 (-6.1) | 4.2 | .971 (-0.253) |
| 56.0 | .518 (-5.708) | 18.0 | .54 (-5.356) | 4.0 | .974 (-0.229) |
| 55.0 | .519 (-5.69) | 17.0 | .583 (-4.685) | 3.8 | .976 (-0.207) |
| 54.0 | .519 (-5.694) | 16.0 | .625 (-4.078) | 3.6 | .979 (-0.186) |
| 53.0 | .517 (-5.722) | 15.0 | .666 (-3.528) | 3.4 | .981 (-0.165) |

Systems With Reliability LP

Page 1 of 3

CLIENT: *WHQB*

Date: 9/14/2015

ANTENNA TYPE: FM3V/2-DA

FREQUENCY: 90.5 MHz

PATTERN POL.: Vertical

DIRECTIVITY(Peak): 1.918/2.828 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 1.918/2.828 dBd

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

Relative Field Tabulation

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

Systems With Reliability LP

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CLIENT: *WHQB*

Date: 9/14/2015

ANTENNA TYPE: FM3V/2-DA

FREQUENCY: 90.5 MHz

PATTERN POL.: Vertical

DIRECTIVITY(Peak): 1.918/2.828 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 1.918/2.828 dBd

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

Relative Field Tabulation

| Elev. Angle | Rel. Fld(dB) | Elev. Angle | Rel. Fld(dB) | Elev. Angle | Rel. Fld(dB) |
|-------------|----------------|-------------|----------------|-------------|-----------------|
| -19.6 | .468 (-6.587) | -27.2 | .121 (-18.344) | -54.0 | .519 (-5.694) |
| -19.8 | .459 (-6.756) | -27.4 | .112 (-19.006) | -55.0 | .519 (-5.69) |
| -20.0 | .45 (-6.929) | -27.6 | .103 (-19.721) | -56.0 | .518 (-5.708) |
| -20.2 | .441 (-7.106) | -27.8 | .094 (-20.496) | -57.0 | .516 (-5.747) |
| -20.4 | .432 (-7.288) | -28.0 | .086 (-21.343) | -58.0 | .512 (-5.807) |
| -20.6 | .423 (-7.473) | -28.2 | .077 (-22.278) | -59.0 | .508 (-5.887) |
| -20.8 | .414 (-7.663) | -28.4 | .068 (-23.322) | -60.0 | .502 (-5.986) |
| -21.0 | .405 (-7.858) | -28.6 | .06 (-24.503) | -61.0 | .495 (-6.103) |
| -21.2 | .396 (-8.057) | -28.8 | .051 (-25.863) | -62.0 | .488 (-6.239) |
| -21.4 | .386 (-8.261) | -29.0 | .042 (-27.469) | -63.0 | .479 (-6.392) |
| -21.6 | .377 (-8.471) | -29.2 | .034 (-29.429) | -64.0 | .47 (-6.563) |
| -21.8 | .368 (-8.686) | -29.4 | .025 (-31.951) | -65.0 | .46 (-6.751) |
| -22.0 | .359 (-8.906) | -29.6 | .017 (-35.496) | -66.0 | .449 (-6.956) |
| -22.2 | .349 (-9.132) | -29.8 | .008 (-41.54) | -67.0 | .438 (-7.178) |
| -22.4 | .34 (-9.365) | -30.0 | .00 (-50) | -68.0 | .426 (-7.417) |
| -22.6 | .331 (-9.604) | -31.0 | .041 (-27.712) | -69.0 | .413 (-7.673) |
| -22.8 | .322 (-9.85) | -32.0 | .081 (-21.828) | -70.0 | .401 (-7.948) |
| -23.0 | .312 (-10.103) | -33.0 | .119 (-18.454) | -71.0 | .387 (-8.24) |
| -23.2 | .303 (-10.364) | -34.0 | .156 (-16.113) | -72.0 | .374 (-8.551) |
| -23.4 | .294 (-10.632) | -35.0 | .192 (-14.343) | -73.0 | .36 (-8.881) |
| -23.6 | .285 (-10.909) | -36.0 | .225 (-12.937) | -74.0 | .345 (-9.231) |
| -23.8 | .276 (-11.195) | -37.0 | .257 (-11.786) | -75.0 | .331 (-9.603) |
| -24.0 | .266 (-11.491) | -38.0 | .288 (-10.824) | -76.0 | .316 (-9.997) |
| -24.2 | .257 (-11.797) | -39.0 | .316 (-10.008) | -77.0 | .301 (-10.415) |
| -24.4 | .248 (-12.113) | -40.0 | .342 (-9.31) | -78.0 | .286 (-10.859) |
| -24.6 | .239 (-12.441) | -41.0 | .367 (-8.709) | -79.0 | .271 (-11.332) |
| -24.8 | .23 (-12.781) | -42.0 | .39 (-8.189) | -80.0 | .256 (-11.835) |
| -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 LP

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CLIENT: *WHQB*

Date: 9/14/2015

ANTENNA TYPE: FM3V/2-DA

FREQUENCY: 90.5 MHz

PATTERN POL.: Vertical

DIRECTIVITY(Peak): 1.918/2.828 dBd

Beam Tilt (Deg.) : 0

DIRECTIVITY(Horiz): 1.918/2.828 dBd

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

Exhibit 3: Antenna Data Sheet



SYSTEMS WITH RELIABILITY, LP
BROADCAST ANTENNAS AND TRANSMISSION LINE

SYSTEM DATA SHEET

| | |
|----------------------------|----------------|
| Customer | WHQB |
| Contact | |
| Location | Gray Court, SC |
| Antenna Model | FM3V/2-DA |
| Channel / Frequency | 90.5 MHz |

ELECTRICAL SPECIFICATIONS

Antenna Specifications:

| | V-POL | | dB |
|---------------------------------|--------|-------|-------------|
| License ERP (KW) | 21.000 | | |
| FCC Limit Pattern Directivity | 2.034 | 3.083 | dB |
| Elevation Directivity | 1.918 | 2.828 | dB |
| Azimuth Directivity | 2.718 | 4.342 | dB |
| RMS Comp./RMS Limit | 86.5 | % | |
| Antenna Efficiency % | 100 | | |
| Antenna Gain | 5.213 | 7.171 | dB |
| Antenna Input Power (KW) | 4.029 | kW | 6.052 (dBK) |

Feed Line Specifications:

| | | | |
|---------------------------------------|------------|-------------|-------------|
| Line Type: Andrew | 1 5/8" Air | 50 Ω | HCA158-50J |
| Attenuation Per 100 ft (dB) | 0.18 | dB | |
| Line Length (ft) AGL + Horizontal Run | 382.07 | ft. | |
| Total Line Attenuation (dB) | 0.6877 | dB | |
| Line Efficiency | 85.35 | % | |
| Power Input to the Line (KW) | 4.720 | kW | 6.739 (dBK) |

MECHANICAL SPECIFICATIONS

| | | | |
|------------------------------------|--------|------|-------------------------|
| No. Of Bays | 2 | | |
| Antenna Aperture | 10.87 | ft. | 3.31 meter |
| Center of Radiation AGL | 352.07 | ft. | 107.31 meter |
| Antenna Weight (Everything) | 182.00 | lbs. | 82.73 kg |
| Windload (50/33) | 250.00 | lbs. | Windload CaAc 7.14 ft^2 |

Prepared by:

Kevin W. Rager
 SWR, LP

Exhibit 4: RMS Calculations



SYSTEMS WITH RELIABILITY, INC.
Broadcast Antennas and Transmission Systems

WHQB Antenna RMS Comparison

PROPOSED ANTENNA

| Azimuth Heading | Relative Field |
|-----------------|----------------|
| 0 | 1 |
| 10 | 1 |
| 20 | 1 |
| 30 | 1 |
| 40 | 1 |
| 50 | 1 |
| 60 | 0.795 |
| 70 | 0.632 |
| 80 | 0.503 |
| 90 | 0.4 |
| 100 | 0.318 |
| 110 | 0.252 |
| 120 | 0.252 |
| 130 | 0.282 |
| 140 | 0.355 |
| 150 | 0.448 |
| 160 | 0.448 |
| 170 | 0.448 |
| 180 | 0.448 |
| 190 | 0.448 |
| 200 | 0.503 |
| 210 | 0.503 |
| 220 | 0.503 |
| 230 | 0.503 |
| 240 | 0.448 |
| 250 | 0.448 |
| 260 | 0.4 |
| 270 | 0.503 |
| 280 | 0.632 |
| 290 | 0.795 |
| 300 | 1 |
| 310 | 1 |
| 320 | 1 |
| 330 | 1 |
| 340 | 1 |
| 350 | 1 |

DESIGNED ANTENNA

| Azimuth Heading | Relative Field |
|-----------------|----------------|
| 0 | 0.982 |
| 10 | 0.971 |
| 20 | 0.955 |
| 30 | 0.895 |
| 40 | 0.79 |
| 50 | 0.672 |
| 60 | 0.606 |
| 70 | 0.565 |
| 80 | 0.473 |
| 90 | 0.388 |
| 100 | 0.307 |
| 110 | 0.238 |
| 120 | 0.242 |
| 130 | 0.233 |
| 140 | 0.186 |
| 150 | 0.184 |
| 160 | 0.182 |
| 170 | 0.18 |
| 180 | 0.185 |
| 190 | 0.188 |
| 200 | 0.209 |
| 210 | 0.26 |
| 220 | 0.312 |
| 230 | 0.356 |
| 240 | 0.388 |
| 250 | 0.396 |
| 260 | 0.377 |
| 270 | 0.473 |
| 280 | 0.594 |
| 290 | 0.669 |
| 300 | 0.775 |
| 310 | 0.876 |
| 320 | 0.949 |
| 330 | 0.988 |
| 340 | 1 |
| 350 | 0.995 |

Sum of Relative Field Squared : 17.740
Sum Divided by 36 (Readings) : 0.493
Square Root : 0.702

Sum of Relative Field Squared : 13.268
Sum Divided by 36 (Readings) : 0.369
Square Root : 0.607

Percentage of Construction Permit Antenna Filled :

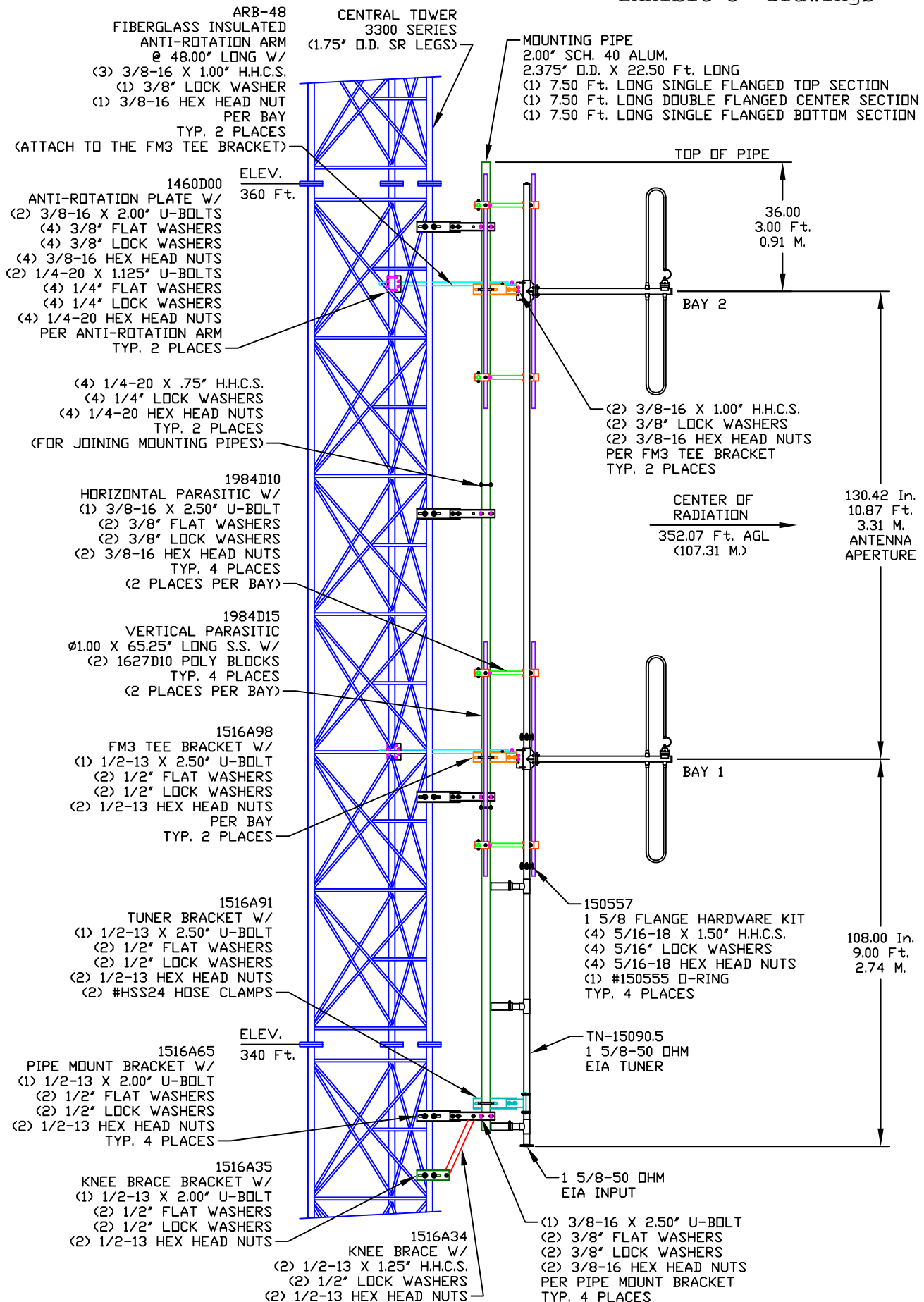
86.5%

NOTES:

1. REFERENCE DWG. 1984D01 FOR ANTENNA ORIENTATION.
2. REFERENCE DWG. 1984D02 FOR BAY 1 PARASITIC PLACEMENT.
3. REFERENCE DWG. 1984D03 FOR BAY 2 PARASITIC PLACEMENT.

DRAWING NUMBER: 1984D00

Exhibit 5: Drawings



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

TITLE: FM3V/2-DA, FREQ. 90.5
WHQB, GRAY COURT, SC

MATERIAL:

SIZE REV APPR. DATE
C 1
2
3

ENGINEER:

SCALE: NTS

NAME: RAC

DATE: 11/17/15

SHEET 1 OF 1

DRAWING NUMBER: 1984D00

NOTE:

DRAWING
NUMBER: 1984D01

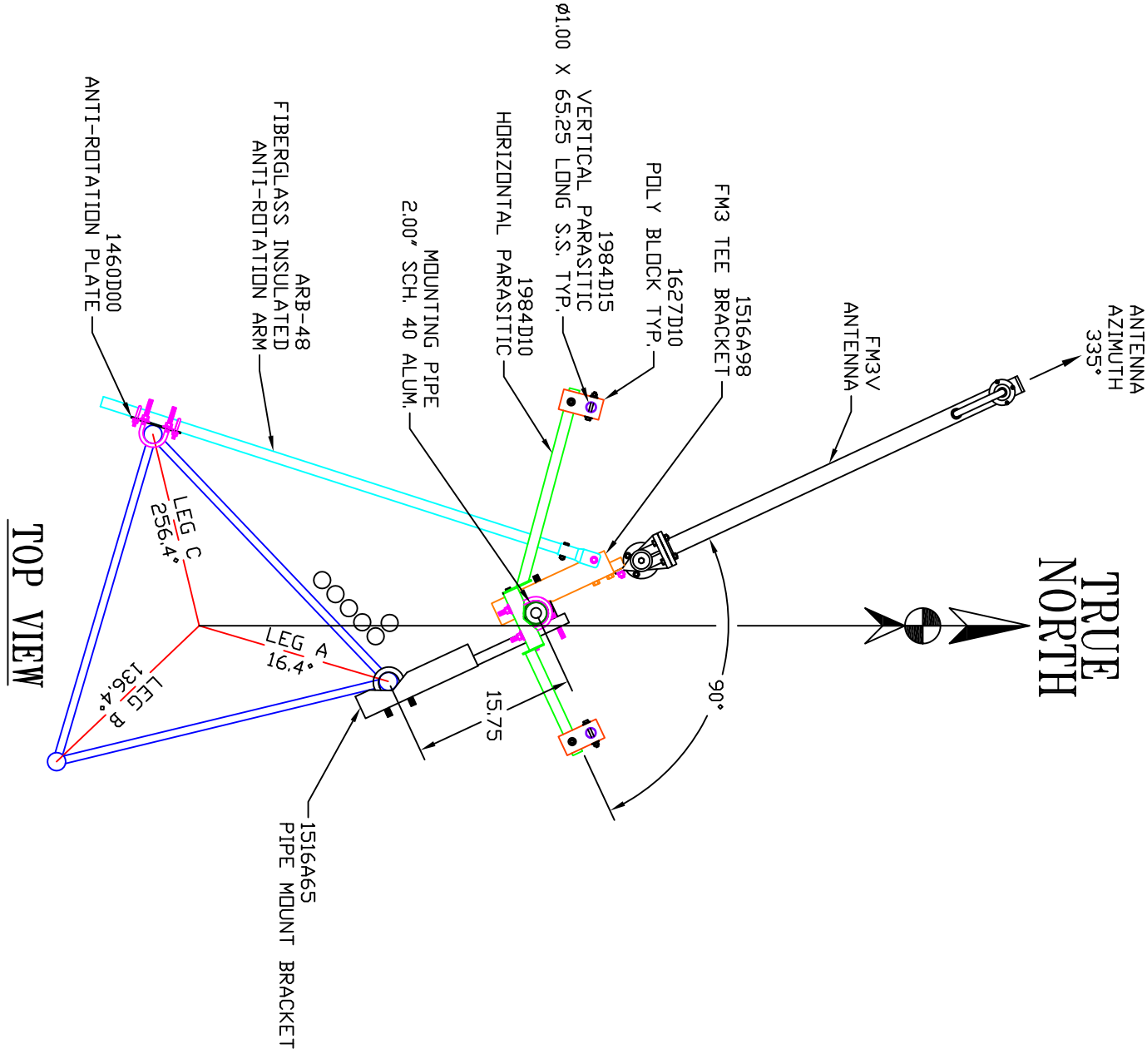



Exhibit 5 (cont'd): Drawings

| | | | | |
|---|--|---|----------|------|
|  | | SYSTEMS WITH RELIABILITY, LP 619 INDUSTRIAL PARK ROAD EBENSBURG, PENNSYLVANIA 15931 | | |
| TITLE: | | FM3V/2-DA, FREQ. 90.5 WHQB, GRAY COURT, SC | | |
| MATERIAL: | | ANTENNA ORIENTATION FROM TRUE NORTH | | |
| SIZE | | A | | |
| PARTS MADE BY THIS DRAWING | | SCALE: NTS NAME: RAC DATE: 11/17/15 SHEET 1 OF 1 | | |
| DRAWING NUMBER: 1984D01 | | REVISION RECORD | | |
| | | REV | APPROVAL | DATE |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

NOTE:

THE POLY BLOCKS, VERTICAL & HORIZONTAL PARASITICS ARE FACTORY DRILLED AND LABELED.
MATCH EACH CORRESPONDING LABELED PART DURING ASSEMBLY.

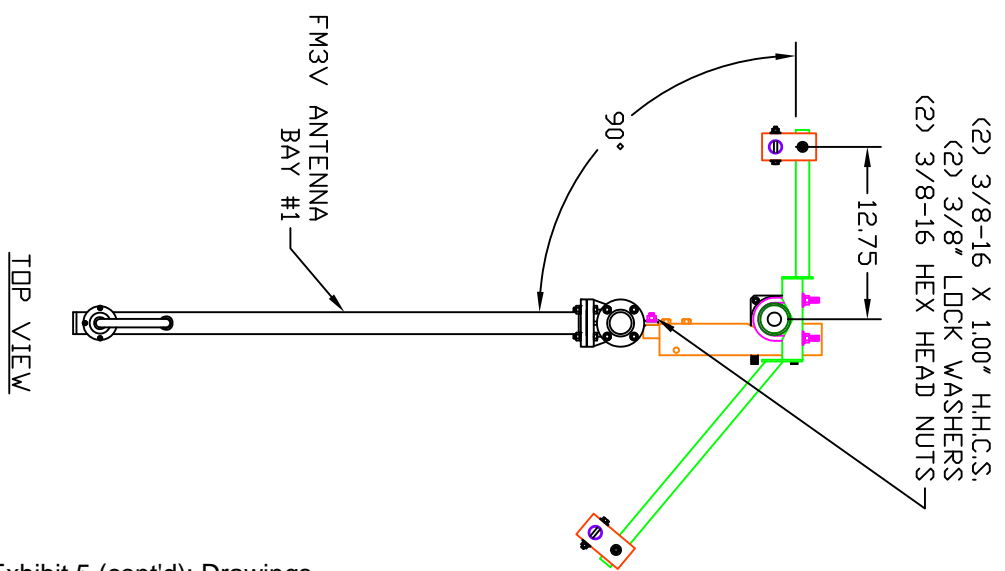
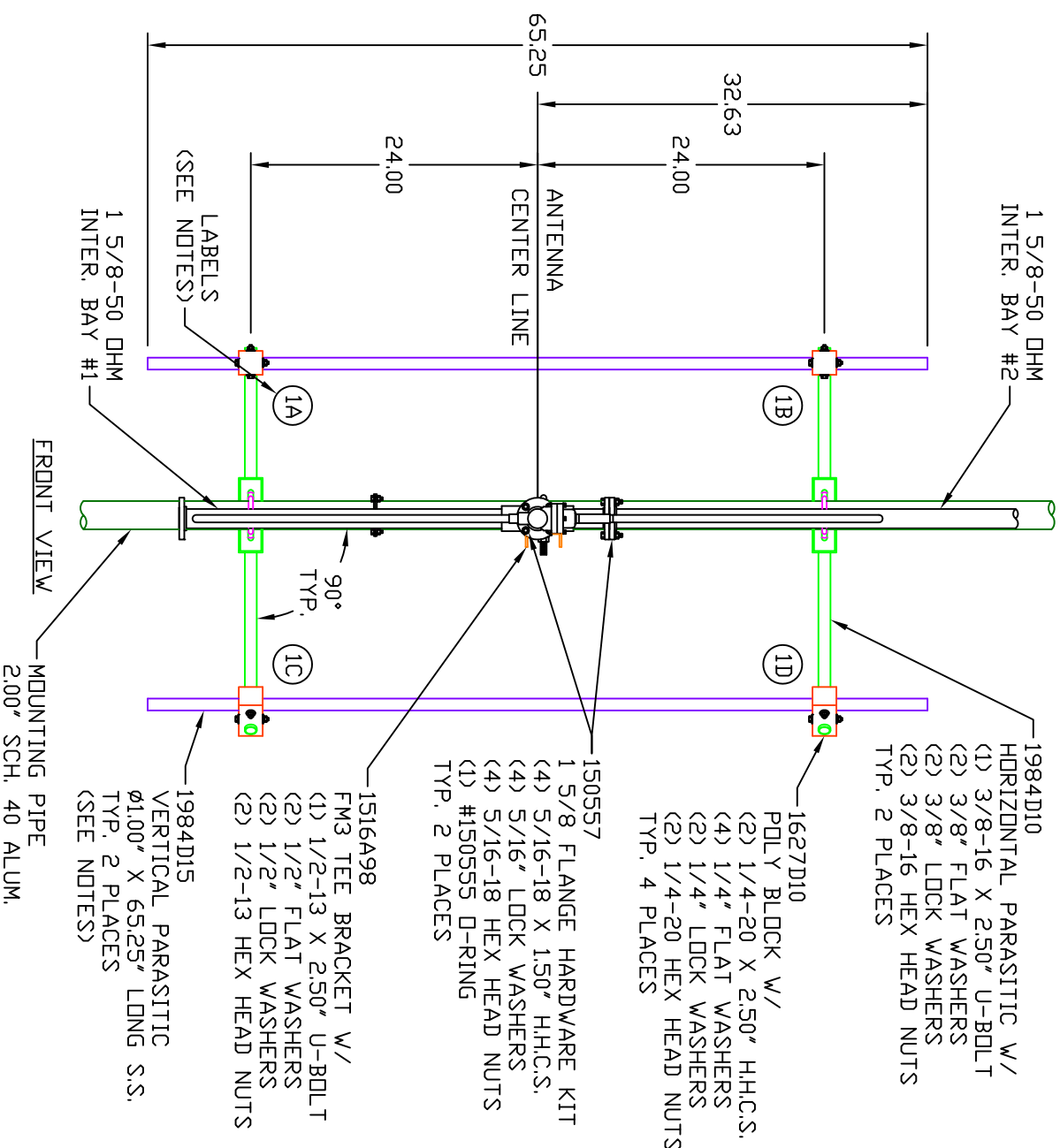



Exhibit 5 (cont'd): Drawings

| | | | | | | | | | |
|--|--|---|--|------------|--|----------------------------|--|-------------------------|--|
|  SYSTEMS WITH RELIABILITY, LP 619 INDUSTRIAL PARK ROAD EBENSBURG, PENNSYLVANIA 15931 | | TITLE: FM3V/2-DA, FREQ. 90.5 WHQB, GRAY COURT, SC | | SIZE A | | PARTS MADE BY THIS DRAWING | | DRAWING NUMBER: 1984D02 | |
| MATERIAL: BAY 1 PARASITIC PLACEMENT | | MOUNTING PIPE 2.00" SCH. 40 ALUM. | | SCALE: NTS | | NAME: RAC | | DATE: 11/17/15 | |
| | | | | | | | | SHEET 1 OF 1 | |

NOTE:

THE POLY BLOCKS, VERTICAL & HORIZONTAL PARASITICS ARE FACTORY DRILLED AND LABELED.
MATCH EACH CORRESPONDING LABELED PART DURING ASSEMBLY.

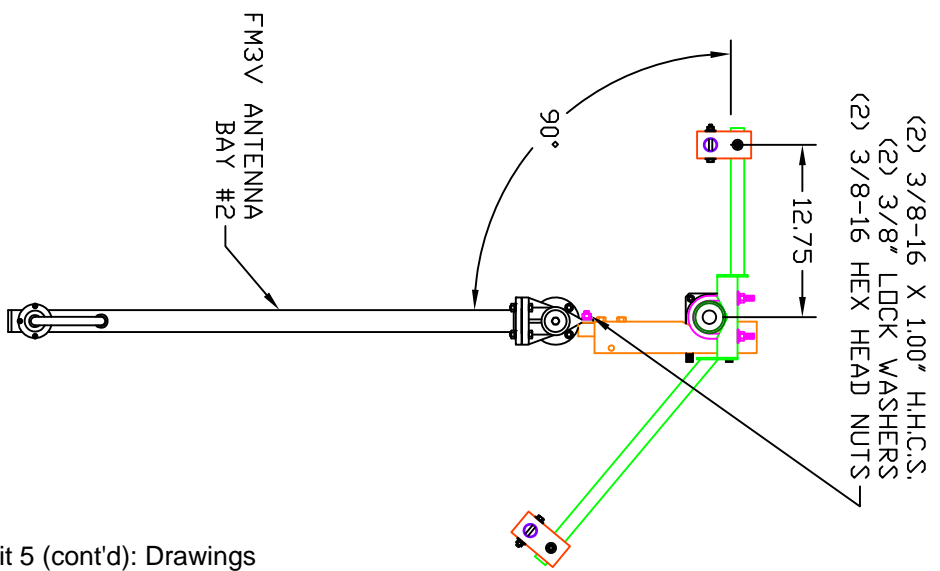
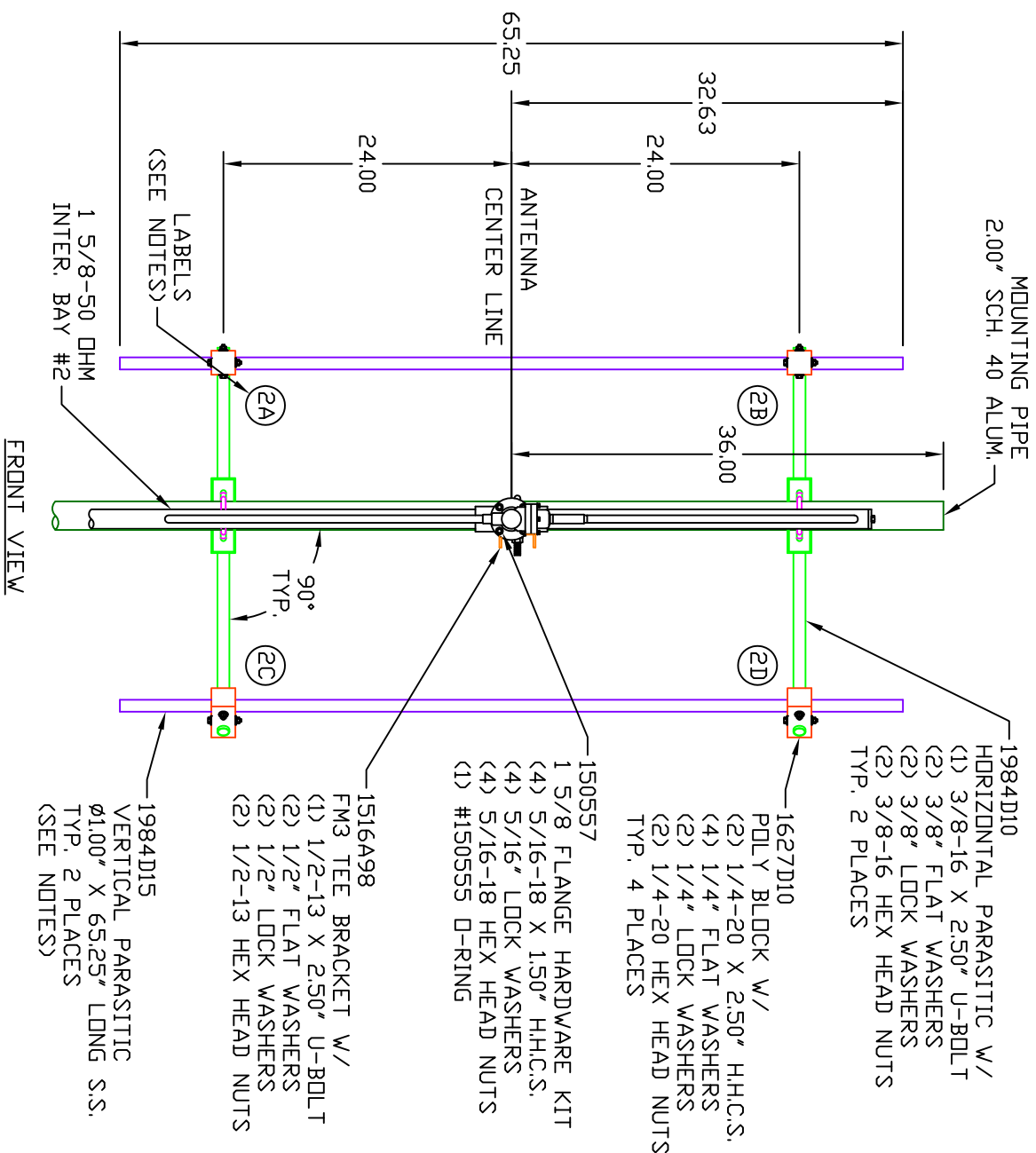



Exhibit 5 (cont'd): Drawings



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

TITLE: FM3V/2-DA, FREQ. 90.5
WHQB, GRAY COURT, SC

MATERIAL: BAY 2
PARASITIC PLACEMENT

SIZE: A

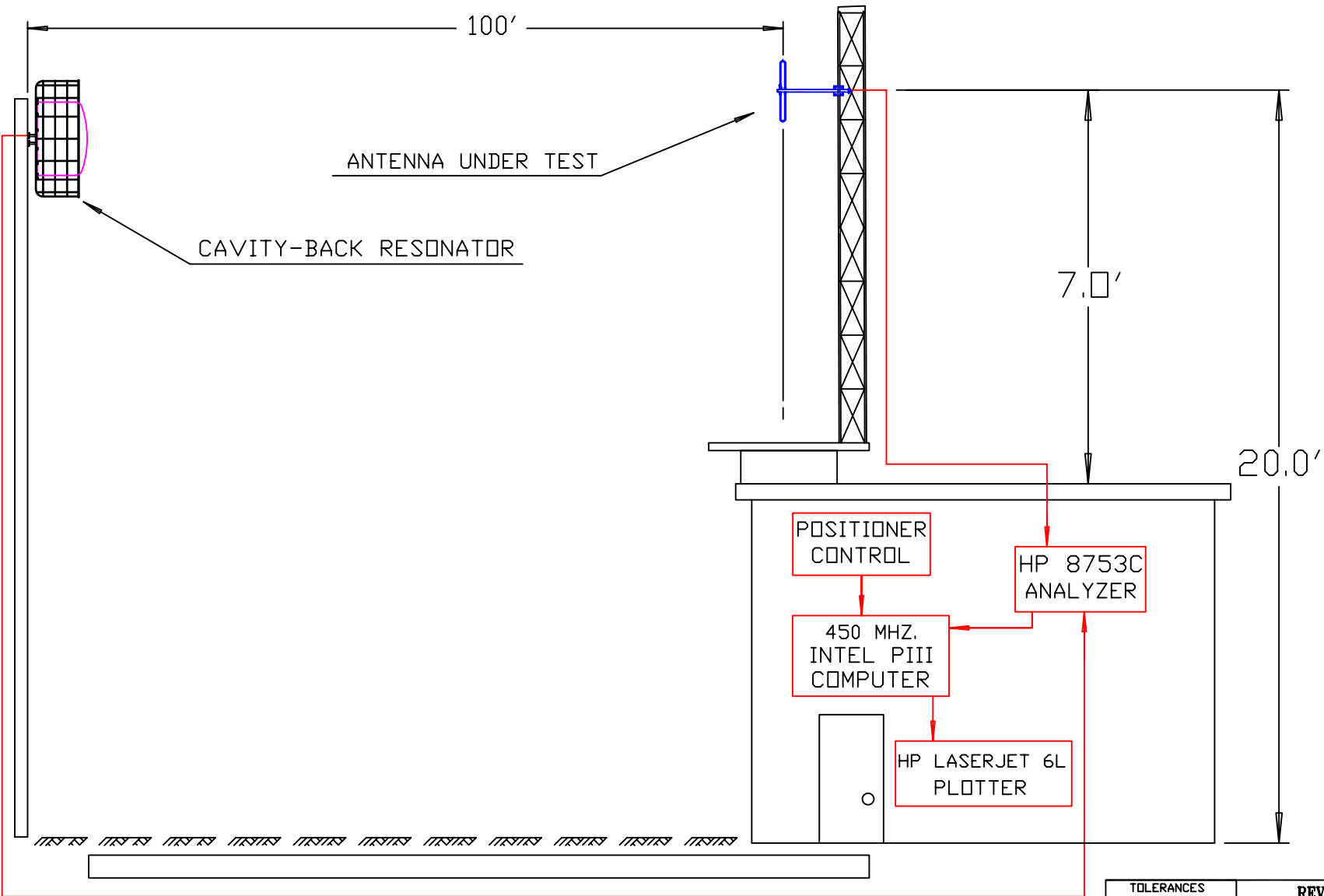
PARTS MADE BY THIS DRAWING

SCALE: NTS
NAME: RAC
DATE: 11/17/15

DRAWING NUMBER: 1984D03

SHEET 1 OF 1

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



| TOLERANCES | | | REVISION RECORD | | |
|----------------------------|-----------|---------------|-------------------------|----------|---------|
| .X | ± .015 | | REV | APPROVAL | DATE |
| .XX | ± .005 | | | | |
| .XXX | ± .002 | | | | |
| X/X | ± 1/32 | | | | |
| DEG. | ± 1/2 | | | | |
| UNLESS OTHERWISE SPECIFIED | | | | | |
| 2 | | | | | 10/7/05 |
| 1 | | | | | 4/30/02 |
| PARTS MADE BY THIS DRAWING | | | DRAWING NUMBER: 2105A10 | | |
| SCALE: NTS | NAME: JRM | DATE: 11/1/98 | SHEET 1 OF 1 | | |