SYSTEMS WITH RELIABILITY, LP

BROADCAST ANTENNAS AND TRANSMISSION SYSTEMS

PATTERN CERTIFICATION

DIRECTIONAL FM ANTENNA
WNPW
February 12 , 2024

Call Sign	:	WTUL
Location	:	New Orleans, LA
Frequency	:	91.5 MHz
Channel	:	218
Antenna Model	:	FM3/2-HWS-DA
Composite Gain	:	1.215 / 0.847 dB

ANTENNA DESCRIPTION

A custom designed FM3/2-HWS-DA antenna was used to produce the required directional azimuth pattern. This antenna bay is a circularly polarized dipole-radiating element and horizontal and vertical parasitic elements that are used for directing the signal. The array is mounted to the tower and orientated at 225 degrees from true north.

DESCRIPTION OF TEST PROCEDURE

The antenna under test consists of an exactly replicated third scale single bay model that is circular polarized. The antenna test model was mounted to an exact replicated third-scale model tower in accordance with tower drawings supplied by the customer. Mounting brackets that were us ed in the modeling were supplied with the finalized antenna. The tower was placed on 20 ft. high on a wooden platform. All feed cables are properly grounded during pattern testing. Horizontal and vertical readings were taken. The desired directional pattern was obtained by adjusting the distance between the tower and the antenna, modifying the direction of the azimuth heading. Parasitic elements were used for performance enhancement.

DESCRIPTION OF TEST EQUIPMENT AND PARAMETERS

The antenna under test was operated in the transmit mode at a frequency of 274.5 MHz (91.5 MHz x 3 = 274.5 MHz). Horizontal and vertical pattern readings were taken by mounting a source antenna – a vertical/horizontal dipole, Cavity Back Resonator (CBR) antenna bay - approximately 30’ (feet) fro m the third-scale antenna model. The source antenna’s height was adjusted to achieve a unifo rm field at the third-scale test antenna location. The CBR antenna was operated in receive mode at frequency 274.5 MHZ. The third-scale test antenna was then rotated clockwise to achieve 360° (degree) pattern readings. A gain reference was taken using a dipole

tuned to 274.5 MHz.

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

TEST EQUIPMENT

Network Analyzer	:	Hewlett Packard Model # 8753C Serial Number: 08753 – 69138
Computer	:	450 MHz Intel PIII
Plotter	:	Hewlett-Packard Laser Jet 6L
Positioner	:	Antenna Positioner Orbit AL-860-1 Position Controller Orbit AL-4901-3A

The test equipment is calibrated in accordance with ANSI / NCSL Z540-1-1994

Prepared by:

TEST RESULTS

The attached calculations verify that the RMS value of this antenna is 85.1 % of the RMS value of the pattern authorized in the related FCC file 0000202676. The vertical component RMS value is 0.676. The horizontal component RMS value is 0.564. The circular polarized component RMS value is 0.756.

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

Measured horizontal polarized directivity	**:**	**3.14439 / 4.98 dB.**
Measured vertical polarized directivity	**:**	**2.18918 / 3.4 dB.**
Measured composite azimuth pattern directivity	**:**	***1.74862 / 2.43* 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:

Composite Gain (H, V) = 1.74862*1.39*0.50 = 1.215 / 0.847 dB

INSTALLATION AND MOUNTING

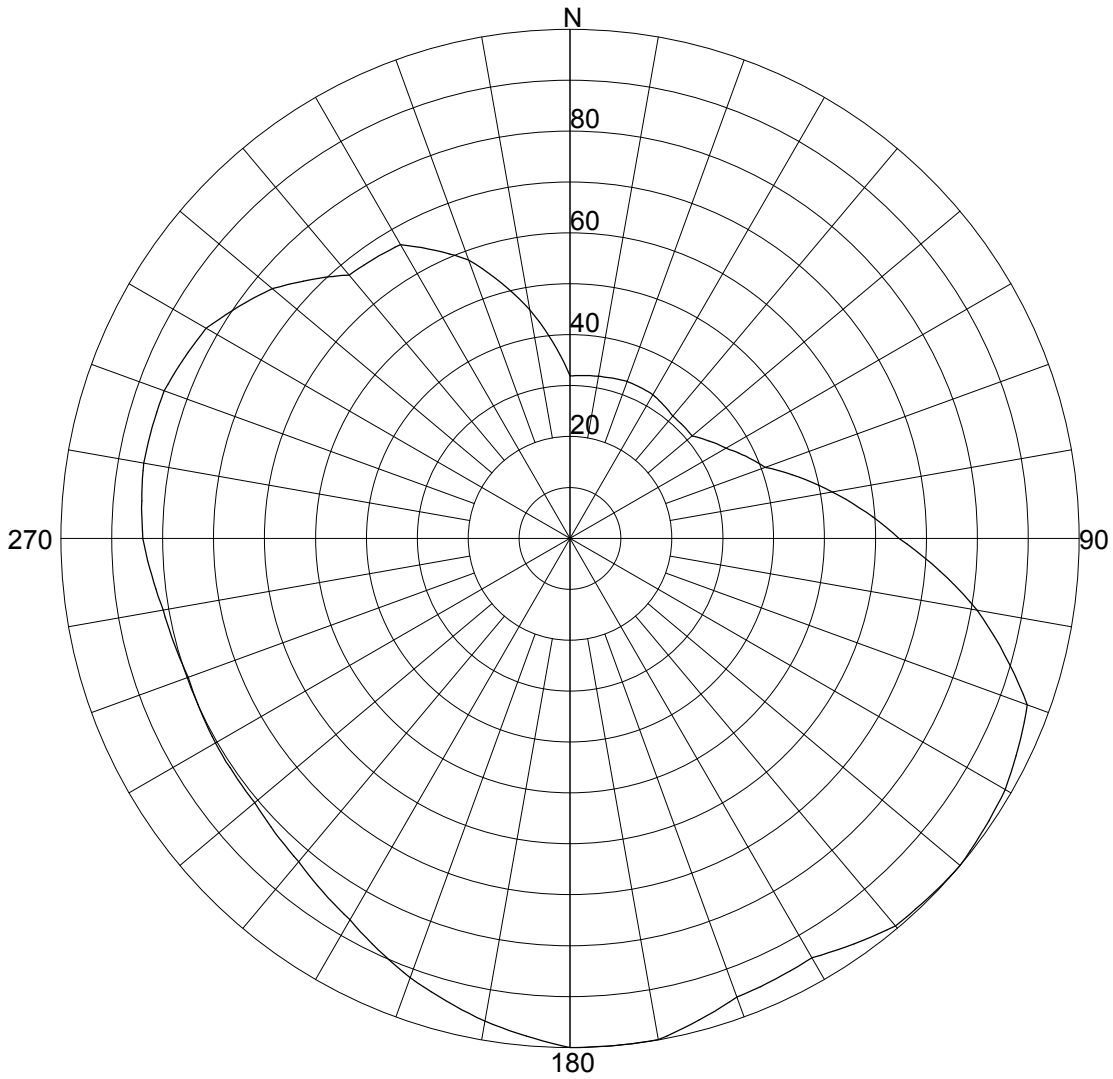
The antenna is to be mounted in accordance with the supplied drawings. The antenna center of radiation is to be **394 feet (120.09 *meters)*** above ground level. The antenna aperture (Parasitic System included) is **5.37 Feet**. No other antennas are to be mounted within ***10 feet*** of the antenna. 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 **225 *degrees*** true North.

The system is custom designed to shape and direct the antenna pattern as required. The systems orientation and the mounting details are described in the following drawings:

DRAWING NO.	**TITLE**
2410D00	ANTENNA ASSEMBLY
2410D01	ANTENNA ORIENTATION
2410D02	PARASITIC PLACEMENT BAY 1 FRONT VIEW
2410D03	PARASITIC PLACEMENT BAY 1 TOP VIEW
2410D04	PARASITIC PLACEMENT BAY 2 FRONT VIEW
2410D05	PARASITIC PLACEMENT BAY 2 TOP VIEW
1500D210	CHAIN MOUNT BRACKET ASSEMBLY
1500D210A	MEDIUM OR LIGHT DUTY CHAIN MOUNT
2105A15	TEST RANGE SCHEMATIC SYSTEM BLOCK DIAGRAM

The array shall be mounted according to **DWG. 2410D00.** The antenna elements shall be aligned at the same heading as in **DWG. 2410D01** to ensure that the antenna is oriented properly at **225** degrees true north.

EXHIBIT -1 (COMPOSITE PATTERN)



Azimuth Pattern

Scale: Linear

Unit: Relative Field

Systems With Reliability (SWR, L.P.)

CLIENT: *WTUL(Composite)*

Date: 2/12/2024

ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 91.5

PATTERN POL.: Circular

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.74862 / 2.43dB

PATTERN RMS: *0.756*

Relative Field Tabulation(Azimuth)

Azimuth Heading	Normalized Field(dB)	Azimuth Heading	Normalized Field(dB)
0	.3190 (-9.92)	180	1.0000 (0)
5	.3210 (-9.87)	185	.9815 (-0.16)
10	.3230 (-9.82)	190	.9630 (-0.33)
15	.3255 (-9.75)	195	.9405 (-0.53)
20	.3280 (-9.68)	200	.9180 (-0.74)
25	.3270 (-9.71)	205	.8915 (-1)
30	.3260 (-9.74)	210	.8650 (-1.26)
35	.3200 (-9.9)	215	.8470 (-1.44)
40	.3140 (-10.06)	220	.8290 (-1.63)
45	.3135 (-10.08)	225	.8185 (-1.74)
50	.3130 (-10.09)	230	.8080 (-1.85)
55	.3335 (-9.54)	235	.8060 (-1.87)
60	.3540 (-9.02)	240	.8040 (-1.89)
65	.3810 (-8.38)	245	.8010 (-1.93)
70	.4080 (-7.79)	250	.7980 (-1.96)
75	.4655 (-6.64)	255	.8045 (-1.89)
80	.5230 (-5.63)	260	.8110 (-1.82)
85	.5845 (-4.66)	265	.8250 (-1.67)
90	.6460 (-3.8)	270	.8390 (-1.52)
95	.7290 (-2.75)	275	.8445 (-1.47)
100	.8120 (-1.81)	280	.8500 (-1.41)
105	.8840 (-1.07)	285	.8490 (-1.42)
110	.9560 (-0.39)	290	.8480 (-1.43)
115	.9715 (-0.25)	295	.8365 (-1.55)
120	.9870 (-0.11)	300	.8250 (-1.67)
125	.9935 (-0.06)	305	.7940 (-2)
130	1.0000 (0)	310	.7630 (-2.35)
135	.9970 (-0.03)	315	.7190 (-2.87)
140	.9940 (-0.05)	320	.6750 (-3.41)
145	.9725 (-0.24)	325	.6705 (-3.47)
150	.9510 (-0.44)	330	.6660 (-3.53)
155	.9550 (-0.4)	335	.6240 (-4.1)
160	.9590 (-0.36)	340	.5820 (-4.7)
165	.9795 (-0.18)	345	.5190 (-5.7)
170	1.0000 (0)	350	.4560 (-6.82)
175	1.0000 (0)	355	.3875 (-8.23)

Systems With Reliability (SWR, L.P.)

CLIENT: *WTUL(Composite)* Date: 2/12/2024

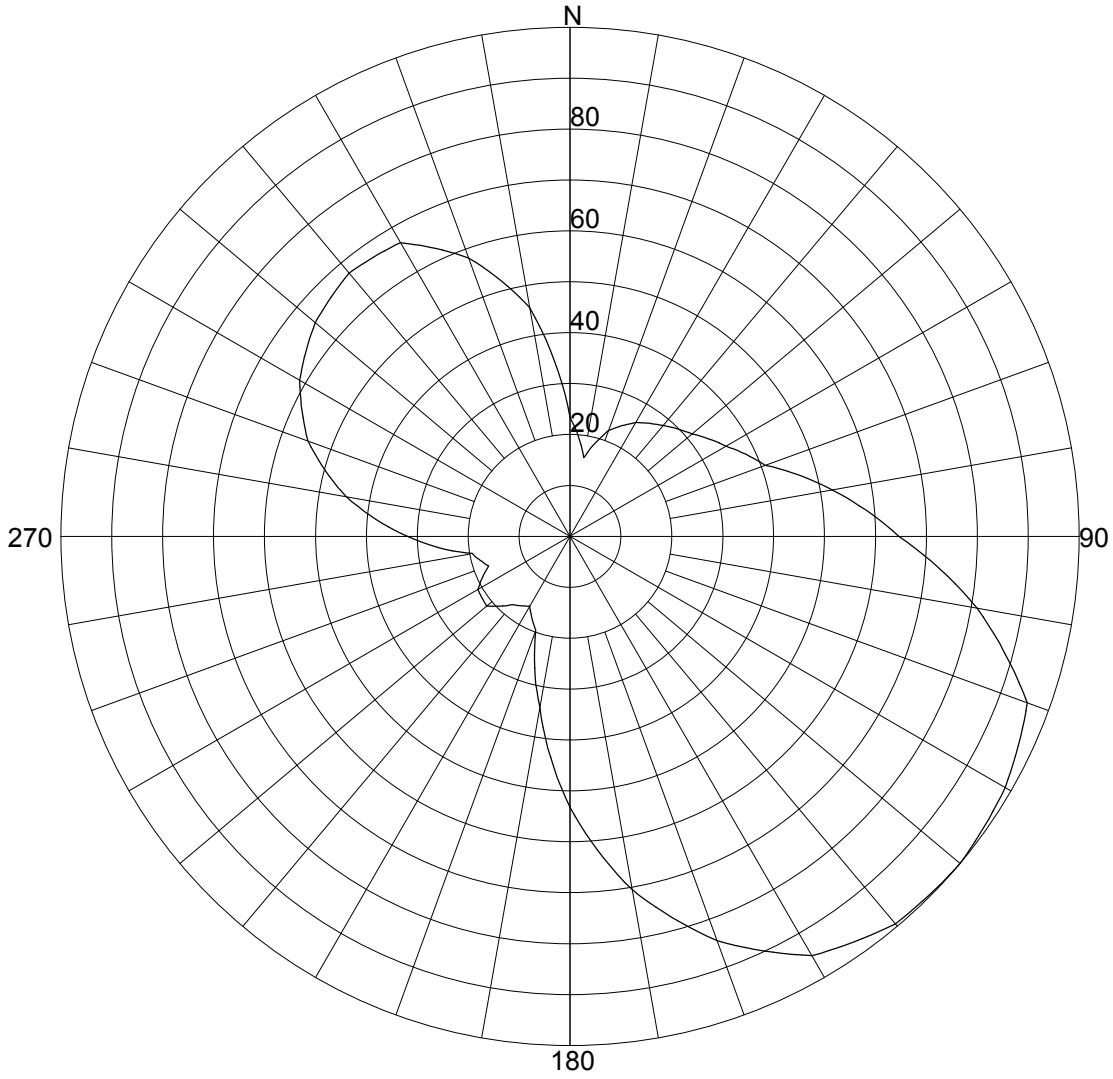
ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 91.5

PATTERN POL.: Circular CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.74862 / 2.43dB PATTERN RMS: *0.756*

EXHIBIT -2 (HORIZONTAL PATTERN)



Azimuth Pattern

Scale: Linear

Unit: Relative Field

Systems With Reliability (SWR, L.P.)

CLIENT: *WTUL(HORIZONTAL)*

Date: 2/12/2024

ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 91.5

PATTERN POL.: Horizontal

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 3.14439 / 4.98dB

PATTERN RMS: *0.564*

Relative Field Tabulation(Azimuth)

Azimuth Heading	Normalized Field(dB)	Azimuth Heading	Normalized Field(dB)
0	.2340 (-12.62)	180	.5320 (-5.48)
5	.1955 (-14.18)	185	.4365 (-7.2)
10	.1570 (-16.08)	190	.3410 (-9.34)
15	.1890 (-14.47)	195	.2685 (-11.42)
20	.2210 (-13.11)	200	.1960 (-14.15)
25	.2395 (-12.41)	205	.1770 (-15.04)
30	.2580 (-11.77)	210	.1580 (-16.03)
35	.2710 (-11.34)	215	.1665 (-15.57)
40	.2840 (-10.93)	220	.1750 (-15.14)
45	.2985 (-10.5)	225	.1940 (-14.24)
50	.3130 (-10.09)	230	.2130 (-13.43)
55	.3335 (-9.54)	235	.2110 (-13.51)
60	.3540 (-9.02)	240	.2090 (-13.6)
65	.3810 (-8.38)	245	.1895 (-14.45)
70	.4080 (-7.79)	250	.1700 (-15.39)
75	.4655 (-6.64)	255	.1825 (-14.77)
80	.5230 (-5.63)	260	.1950 (-14.2)
85	.5845 (-4.66)	265	.2570 (-11.8)
90	.6460 (-3.8)	270	.3190 (-9.92)
95	.7290 (-2.75)	275	.3825 (-8.35)
100	.8120 (-1.81)	280	.4460 (-7.01)
105	.8840 (-1.07)	285	.4970 (-6.07)
110	.9560 (-0.39)	290	.5480 (-5.22)
115	.9715 (-0.25)	295	.5805 (-4.72)
120	.9870 (-0.11)	300	.6130 (-4.25)
125	.9935 (-0.06)	305	.6330 (-3.97)
130	1.0000 (0)	310	.6530 (-3.7)
135	.9970 (-0.03)	315	.6640 (-3.56)
140	.9940 (-0.05)	320	.6750 (-3.41)
145	.9725 (-0.24)	325	.6705 (-3.47)
150	.9510 (-0.44)	330	.6660 (-3.53)
155	.8980 (-0.93)	335	.6240 (-4.1)
160	.8450 (-1.46)	340	.5820 (-4.7)
165	.7750 (-2.21)	345	.5190 (-5.7)
170	.7050 (-3.04)	350	.4560 (-6.82)
175	.6185 (-4.17)	355	.3450 (-9.24)

Systems With Reliability (SWR, L.P.)

CLIENT: *WTUL(HORIZONTAL)* Date: 2/12/2024

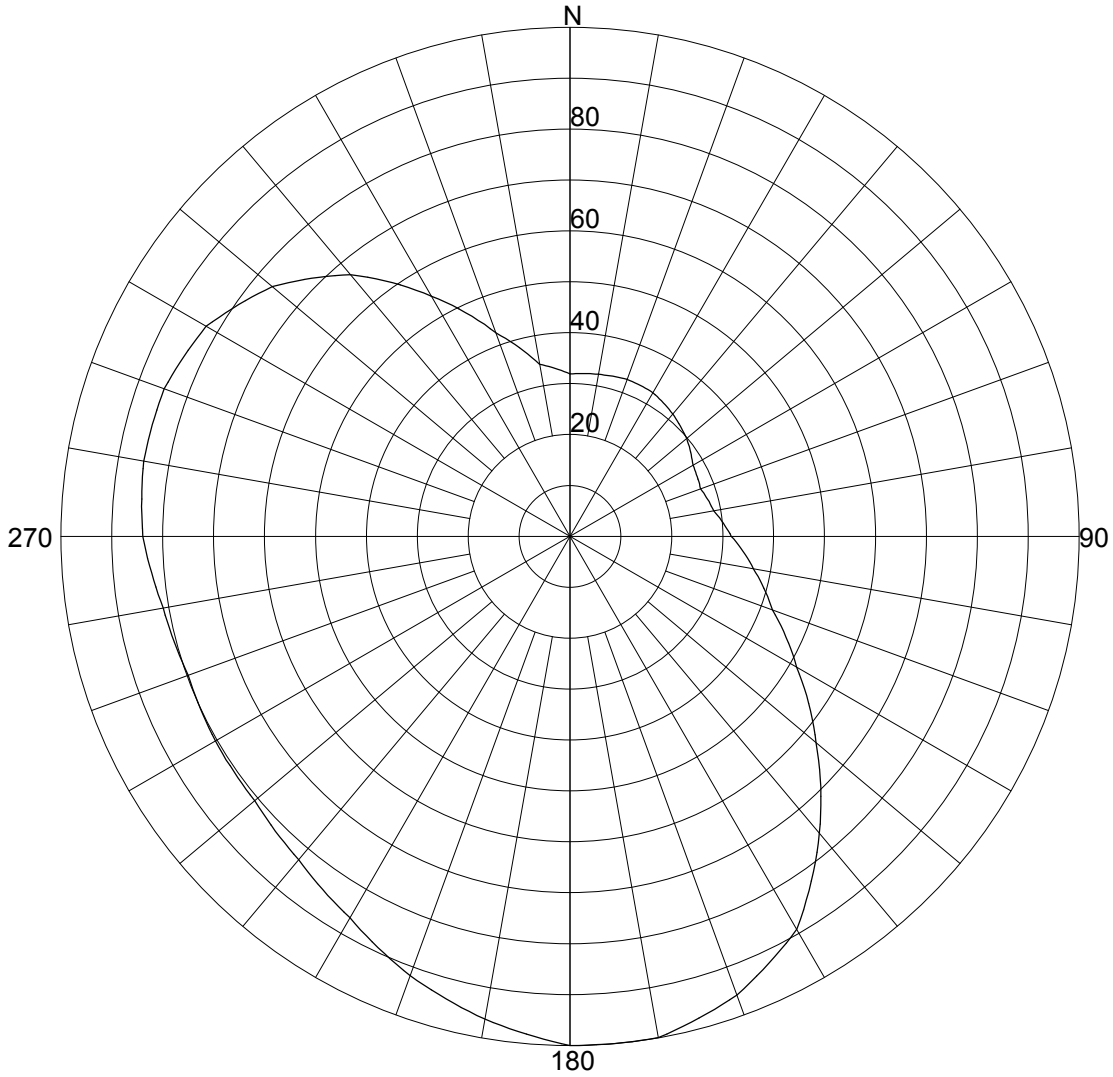
ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 91.5

PATTERN POL.: Horizontal CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 3.14439 / 4.98dB PATTERN RMS: *0.564*

EXHIBIT -3 (VERTICAL PATTERN)



Azimuth Pattern

Scale: Linear

Unit: Relative Field

Systems With Reliability (SWR, L.P.)

CLIENT: *WTUL(VERTICAL)*

Date: 2/12/2024

ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 91.5

PATTERN POL.: Vertical

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.18918 / 3.4dB

PATTERN RMS: *0.676*

Relative Field Tabulation(Azimuth)

Azimuth Heading	Normalized Field(dB)	Azimuth Heading	Normalized Field(dB)
0	.3190 (-9.92)	180	1.0000 (0)
5	.3210 (-9.87)	185	.9815 (-0.16)
10	.3230 (-9.82)	190	.9630 (-0.33)
15	.3255 (-9.75)	195	.9405 (-0.53)
20	.3280 (-9.68)	200	.9180 (-0.74)
25	.3270 (-9.71)	205	.8915 (-1)
30	.3260 (-9.74)	210	.8650 (-1.26)
35	.3200 (-9.9)	215	.8470 (-1.44)
40	.3140 (-10.06)	220	.8290 (-1.63)
45	.3065 (-10.27)	225	.8185 (-1.74)
50	.2990 (-10.49)	230	.8080 (-1.85)
55	.2890 (-10.78)	235	.8060 (-1.87)
60	.2790 (-11.09)	240	.8040 (-1.89)
65	.2760 (-11.18)	245	.8010 (-1.93)
70	.2730 (-11.28)	250	.7980 (-1.96)
75	.2800 (-11.06)	255	.8045 (-1.89)
80	.2870 (-10.84)	260	.8110 (-1.82)
85	.3020 (-10.4)	265	.8250 (-1.67)
90	.3170 (-9.98)	270	.8390 (-1.52)
95	.3415 (-9.33)	275	.8445 (-1.47)
100	.3660 (-8.73)	280	.8500 (-1.41)
105	.3945 (-8.08)	285	.8490 (-1.42)
110	.4230 (-7.47)	290	.8480 (-1.43)
115	.4685 (-6.59)	295	.8365 (-1.55)
120	.5140 (-5.78)	300	.8250 (-1.67)
125	.5725 (-4.84)	305	.7940 (-2)
130	.6310 (-4)	310	.7630 (-2.35)
135	.6965 (-3.14)	315	.7170 (-2.89)
140	.7620 (-2.36)	320	.6710 (-3.47)
145	.8265 (-1.66)	325	.6080 (-4.32)
150	.8910 (-1)	330	.5450 (-5.27)
155	.9250 (-0.68)	335	.4850 (-6.29)
160	.9590 (-0.36)	340	.4250 (-7.43)
165	.9795 (-0.18)	345	.3840 (-8.31)
170	1.0000 (0)	350	.3430 (-9.29)
175	1.0000 (0)	355	.3310 (-9.6)

Systems With Reliability (SWR, L.P.)

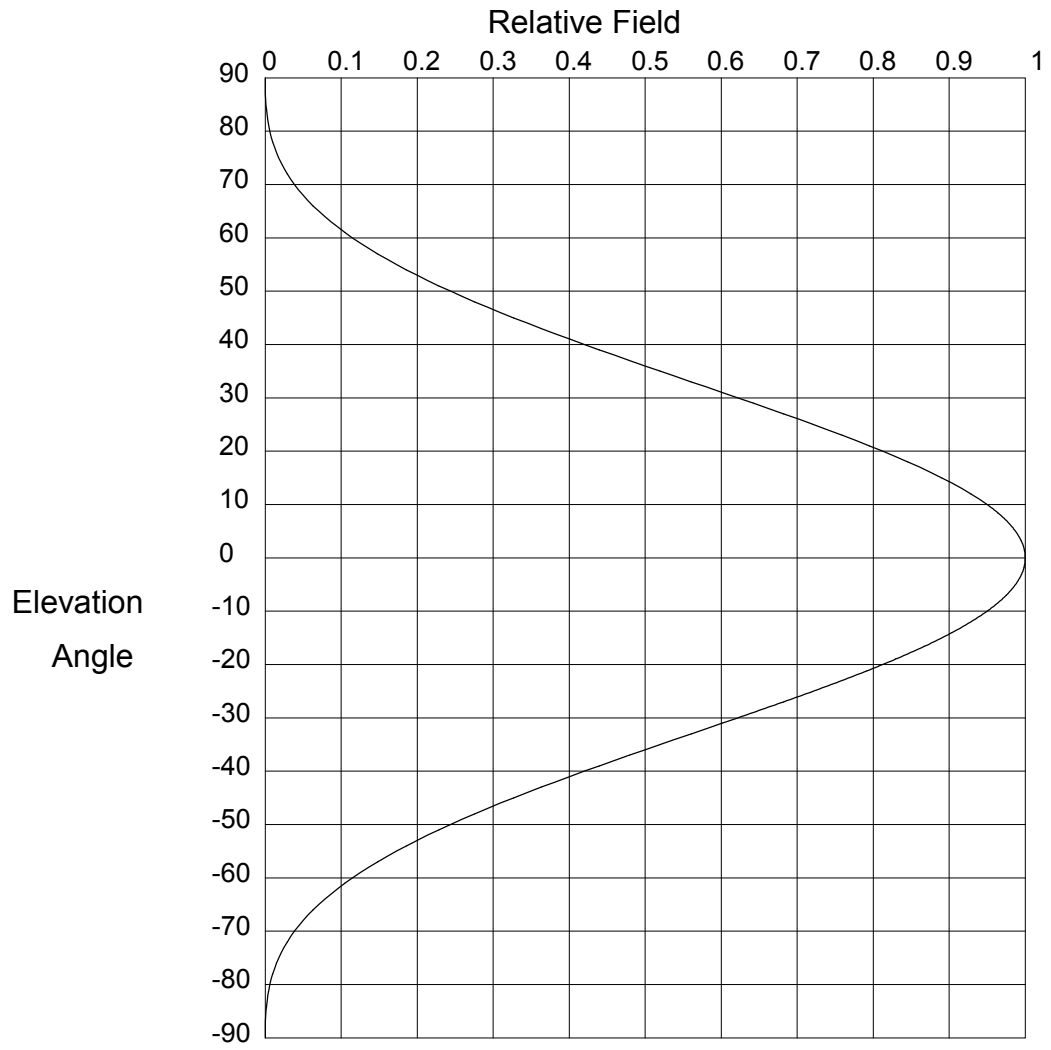
CLIENT: *WTUL(VERTICAL)* Date: 2/12/2024

ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 91.5

PATTERN POL.: Vertical CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.18918 / 3.4dB PATTERN RMS: *0.676*



Elevation Pattern

Scale: Linear

Units: Field, Relative

Systems With Reliability (SWR, L.P.)

CLIENT: *WTUL*

Date: 2/12/2024

ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 91.5

PATTERN POL.: Circular

DIRECTIVITY(Peak): 1.39/1.43 dBd

Beam Tilt (Deg.) : *0*

DIRECTIVITY(Horiz): 1.39/1.43 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	.00 (-50)	52.0	.214 (-13.4)	14.0	.904 (-0.878)
89.0	.00 (-91.156)	51.0	.229 (-12.821)	13.0	.917 (-0.757)
88.0	.00 (-78.01)	50.0	.244 (-12.26)	12.0	.929 (-0.644)
87.0	.00 (-69.988)	49.0	.259 (-11.717)	11.0	.94 (-0.541)
86.0	.001 (-64.112)	48.0	.276 (-11.191)	10.0	.95 (-0.447)
85.0	.001 (-59.44)	47.0	.292 (-10.682)	9.8	.952 (-0.429)
84.0	.002 (-55.546)	46.0	.309 (-10.188)	9.6	.954 (-0.412)
83.0	.002 (-52.199)	45.0	.327 (-9.71)	9.4	.956 (-0.395)
82.0	.003 (-49.26)	44.0	.345 (-9.246)	9.2	.957 (-0.378)
81.0	.005 (-46.639)	43.0	.363 (-8.797)	9.0	.959 (-0.362)
80.0	.006 (-44.272)	42.0	.382 (-8.362)	8.8	.961 (-0.346)
79.0	.008 (-42.113)	41.0	.401 (-7.941)	8.6	.963 (-0.33)
78.0	.01 (-40.128)	40.0	.42 (-7.533)	8.4	.964 (-0.315)
77.0	.012 (-38.292)	39.0	.44 (-7.138)	8.2	.966 (-0.3)
76.0	.015 (-36.583)	38.0	.459 (-6.756)	8.0	.968 (-0.286)
75.0	.018 (-34.986)	37.0	.479 (-6.387)	7.8	.969 (-0.272)
74.0	.021 (-33.487)	36.0	.50 (-6.029)	7.6	.971 (-0.258)
73.0	.025 (-32.074)	35.0	.52 (-5.683)	7.4	.972 (-0.244)
72.0	.029 (-30.74)	34.0	.54 (-5.349)	7.2	.974 (-0.231)
71.0	.034 (-29.475)	33.0	.561 (-5.027)	7.0	.975 (-0.219)
70.0	.039 (-28.274)	32.0	.581 (-4.716)	6.8	.977 (-0.206)
69.0	.044 (-27.13)	31.0	.601 (-4.416)	6.6	.978 (-0.194)
68.0	.05 (-26.039)	30.0	.622 (-4.126)	6.4	.979 (-0.183)
67.0	.056 (-24.997)	29.0	.642 (-3.848)	6.2	.98 (-0.171)
66.0	.063 (-24)	28.0	.662 (-3.58)	6.0	.982 (-0.161)
65.0	.07 (-23.044)	27.0	.682 (-3.323)	5.8	.983 (-0.15)
64.0	.078 (-22.126)	26.0	.702 (-3.076)	5.6	.984 (-0.14)
63.0	.087 (-21.245)	25.0	.721 (-2.839)	5.4	.985 (-0.13)
62.0	.096 (-20.397)	24.0	.74 (-2.612)	5.2	.986 (-0.121)
61.0	.105 (-19.581)	23.0	.759 (-2.395)	5.0	.987 (-0.111)
60.0	.115 (-18.794)	22.0	.777 (-2.188)	4.8	.988 (-0.103)
59.0	.125 (-18.036)	21.0	.795 (-1.991)	4.6	.989 (-0.094)
58.0	.136 (-17.304)	20.0	.812 (-1.804)	4.4	.99 (-0.086)
57.0	.148 (-16.597)	19.0	.829 (-1.626)	4.2	.991 (-0.079)
56.0	.16 (-15.914)	18.0	.846 (-1.457)	4.0	.992 (-0.071)
55.0	.173 (-15.254)	17.0	.861 (-1.299)	3.8	.993 (-0.064)
54.0	.186 (-14.615)	16.0	.876 (-1.149)	3.6	.993 (-0.058)
53.0	.20 (-13.998)	15.0	.89 (-1.009)	3.4	.994 (-0.052)

Systems With Reliability (SWR, L.P.)

Date: 2/12/2024

CLIENT: *WTUL*
ANTENNA TYPE: FM3/2-HWS-DA
FREQUENCY: 91.5
PATTERN POL.: Circular
DIRECTIVITY(Peak): 1.39/1.43 dBd
DIRECTIVITY(Horiz): 1.39/1.43 dBd

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)
3.2	.995 (-0.046)	-4.4	.99 (-0.086)	-12.0	.929 (-0.644)
3.0	.995 (-0.04)	-4.6	.989 (-0.094)	-12.2	.926 (-0.666)
2.8	.996 (-0.035)	-4.8	.988 (-0.103)	-12.4	.924 (-0.688)
2.6	.997 (-0.03)	-5.0	.987 (-0.111)	-12.6	.921 (-0.711)
2.4	.997 (-0.026)	-5.2	.986 (-0.121)	-12.8	.919 (-0.733)
2.2	.998 (-0.022)	-5.4	.985 (-0.13)	-13.0	.917 (-0.757)
2.0	.998 (-0.018)	-5.6	.984 (-0.14)	-13.2	.914 (-0.78)
1.8	.998 (-0.014)	-5.8	.983 (-0.15)	-13.4	.912 (-0.804)
1.6	.999 (-0.011)	-6.0	.982 (-0.161)	-13.6	.909 (-0.828)
1.4	.999 (-0.009)	-6.2	.98 (-0.171)	-13.8	.906 (-0.853)
1.2	.999 (-0.006)	-6.4	.979 (-0.183)	-14.0	.904 (-0.878)
1.0	.999 (-0.004)	-6.6	.978 (-0.194)	-14.2	.901 (-0.904)
.8	1.00 (-0.003)	-6.8	.977 (-0.206)	-14.4	.899 (-0.929)
.6	1.00 (-0.002)	-7.0	.975 (-0.219)	-14.6	.896 (-0.956)
.4	1.00 (-0.001)	-7.2	.974 (-0.231)	-14.8	.893 (-0.982)
.2	1.00 (0)	-7.4	.972 (-0.244)	-15.0	.89 (-1.009)
.0	1.00 (0)	-7.6	.971 (-0.258)	-15.2	.888 (-1.036)
-.2	1.00 (0)	-7.8	.969 (-0.272)	-15.4	.885 (-1.064)
-.4	1.00 (-0.001)	-8.0	.968 (-0.286)	-15.6	.882 (-1.092)
-.6	1.00 (-0.002)	-8.2	.966 (-0.3)	-15.8	.879 (-1.12)
-.8	1.00 (-0.003)	-8.4	.964 (-0.315)	-16.0	.876 (-1.149)
-1.0	.999 (-0.004)	-8.6	.963 (-0.33)	-16.2	.873 (-1.178)
-1.2	.999 (-0.006)	-8.8	.961 (-0.346)	-16.4	.87 (-1.208)
-1.4	.999 (-0.009)	-9.0	.959 (-0.362)	-16.6	.867 (-1.238)
-1.6	.999 (-0.011)	-9.2	.957 (-0.378)	-16.8	.864 (-1.268)
-1.8	.998 (-0.014)	-9.4	.956 (-0.395)	-17.0	.861 (-1.299)
-2.0	.998 (-0.018)	-9.6	.954 (-0.412)	-17.2	.858 (-1.33)
-2.2	.998 (-0.022)	-9.8	.952 (-0.429)	-17.4	.855 (-1.361)
-2.4	.997 (-0.026)	-10.0	.95 (-0.447)	-17.6	.852 (-1.393)
-2.6	.997 (-0.03)	-10.2	.948 (-0.465)	-17.8	.849 (-1.425)
-2.8	.996 (-0.035)	-10.4	.946 (-0.483)	-18.0	.846 (-1.457)
-3.0	.995 (-0.04)	-10.6	.944 (-0.502)	-18.2	.842 (-1.49)
-3.2	.995 (-0.046)	-10.8	.942 (-0.521)	-18.4	.839 (-1.524)
-3.4	.994 (-0.052)	-11.0	.94 (-0.541)	-18.6	.836 (-1.557)
-3.6	.993 (-0.058)	-11.2	.937 (-0.561)	-18.8	.833 (-1.591)
-3.8	.993 (-0.064)	-11.4	.935 (-0.581)	-19.0	.829 (-1.626)
-4.0	.992 (-0.071)	-11.6	.933 (-0.602)	-19.2	.826 (-1.661)
-4.2	.991 (-0.079)	-11.8	.931 (-0.623)	-19.4	.823 (-1.696)

Systems With Reliability (SWR, L.P.)

Date: 2/12/2024

CLIENT: *WTUL*
ANTENNA TYPE: FM3/2-HWS-DA
FREQUENCY: 91.5
PATTERN POL.: Circular
DIRECTIVITY(Peak): 1.39/1.43 dBd
DIRECTIVITY(Horiz): 1.39/1.43 dBd

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	.819 (-1.731)	-27.2	.678 (-3.373)	-54.0	.186 (-14.615)
-19.8	.816 (-1.767)	-27.4	.674 (-3.424)	-55.0	.173 (-15.254)
-20.0	.812 (-1.804)	-27.6	.67 (-3.476)	-56.0	.16 (-15.914)
-20.2	.809 (-1.84)	-27.8	.666 (-3.528)	-57.0	.148 (-16.597)
-20.4	.806 (-1.877)	-28.0	.662 (-3.58)	-58.0	.136 (-17.304)
-20.6	.802 (-1.915)	-28.2	.658 (-3.633)	-59.0	.125 (-18.036)
-20.8	.799 (-1.953)	-28.4	.654 (-3.686)	-60.0	.115 (-18.794)
-21.0	.795 (-1.991)	-28.6	.65 (-3.739)	-61.0	.105 (-19.581)
-21.2	.792 (-2.03)	-28.8	.646 (-3.793)	-62.0	.096 (-20.397)
-21.4	.788 (-2.069)	-29.0	.642 (-3.848)	-63.0	.087 (-21.245)
-21.6	.784 (-2.108)	-29.2	.638 (-3.903)	-64.0	.078 (-22.126)
-21.8	.781 (-2.148)	-29.4	.634 (-3.958)	-65.0	.07 (-23.044)
-22.0	.777 (-2.188)	-29.6	.63 (-4.014)	-66.0	.063 (-24)
-22.2	.774 (-2.229)	-29.8	.626 (-4.07)	-67.0	.056 (-24.997)
-22.4	.77 (-2.27)	-30.0	.622 (-4.126)	-68.0	.05 (-26.039)
-22.6	.766 (-2.311)	-31.0	.601 (-4.416)	-69.0	.044 (-27.13)
-22.8	.763 (-2.353)	-32.0	.581 (-4.716)	-70.0	.039 (-28.274)
-23.0	.759 (-2.395)	-33.0	.561 (-5.027)	-71.0	.034 (-29.475)
-23.2	.755 (-2.438)	-34.0	.54 (-5.349)	-72.0	.029 (-30.74)
-23.4	.752 (-2.481)	-35.0	.52 (-5.683)	-73.0	.025 (-32.074)
-23.6	.748 (-2.524)	-36.0	.50 (-6.029)	-74.0	.021 (-33.487)
-23.8	.744 (-2.568)	-37.0	.479 (-6.387)	-75.0	.018 (-34.986)
-24.0	.74 (-2.612)	-38.0	.459 (-6.756)	-76.0	.015 (-36.583)
-24.2	.737 (-2.657)	-39.0	.44 (-7.138)	-77.0	.012 (-38.292)
-24.4	.733 (-2.701)	-40.0	.42 (-7.533)	-78.0	.01 (-40.128)
-24.6	.729 (-2.747)	-41.0	.401 (-7.941)	-79.0	.008 (-42.113)
-24.8	.725 (-2.793)	-42.0	.382 (-8.362)	-80.0	.006 (-44.272)
-25.0	.721 (-2.839)	-43.0	.363 (-8.797)	-81.0	.005 (-46.639)
-25.2	.717 (-2.885)	-44.0	.345 (-9.246)	-82.0	.003 (-49.26)
-25.4	.713 (-2.932)	-45.0	.327 (-9.71)	-83.0	.002 (-52.199)
-25.6	.71 (-2.98)	-46.0	.309 (-10.188)	-84.0	.002 (-55.546)
-25.8	.706 (-3.027)	-47.0	.292 (-10.682)	-85.0	.001 (-59.44)
-26.0	.702 (-3.076)	-48.0	.276 (-11.191)	-86.0	.001 (-64.112)
-26.2	.698 (-3.124)	-49.0	.259 (-11.717)	-87.0	.00 (-69.988)
-26.4	.694 (-3.173)	-50.0	.244 (-12.26)	-88.0	.00 (-78.01)
-26.6	.69 (-3.223)	-51.0	.229 (-12.821)	-89.0	.00 (-91.156)
-26.8	.686 (-3.272)	-52.0	.214 (-13.4)	-90.0	.00 (-50)
-27.0	.682 (-3.323)	-53.0	.20 (-13.998)	90.0	.00 (-50)

Systems With Reliability (SWR, L.P.)

CLIENT: *WTUL*

Date: 2/12/2024

ANTENNA TYPE: FM3/2-HWS-DA

FREQUENCY: 91.5

PATTERN POL.: Circular

DIRECTIVITY(Peak): 1.39/1.43 dBd

Beam Tilt (Deg.) : *0*

DIRECTIVITY(Horiz): 1.39/1.43 dBd

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

SYSTEMS WITH RELIABILITY, LP

Broadcast Antennas & Transmission Systems

Digital Transmission Systems ®

SYSTEM DATA SHEET

CALL SIGN / CUSTOMER	WTUL / Tulane University (Audiomedia Associates)
FACILITY ID	68321
FILE NUMBER	202676
LOCATION	New Orleans, LA
CONTACT	Corey Meyer
ANTENNA MODEL	FM3/2-HWS-DA (Composite)
FREQUENCY	91.5 MHz

ELECTRICAL SPECIFICATIONS

Polarization Type		Circular	
Polarization Ratio			
	H-Pol. (PRH)	50.00	**%**
	V-Pol. (PRV)	50.00	**%**
Elevation Directivity (ED)		1.390	
Azimuth Directivity (AD) H-Pol.		1.749	
Azimuth Directivity (AD) V-Pol.		1.749	
Antenna Efficiency		100.00	**%**
Antenna Gain (GH)			
	H-Pol. (GH)	1.215	
	V-Pol. (GV)	1.215	
dB Gain (AG)			
	H-Pol (AGH)	0.847	**dB**
	V-Pol (AGV)	0.847	**dB**
ERP			
	H-Pol. (ERPH)	0.950	**kW**
	V-Pol. (ERPV)	0.950	**kW**
Line Type		7/8" Air	**HCA78-50J**
Attenuation		0.340	**dB/100'**
Line length (LL) (Given)		250.00	**ft.**
Total line attenuation		0.850	**dB**
Line Efficiency (LE)		82.22	**%**
Line Loss (LPL)		0.169	**kW**
Antenna Input Power (AIP)		0.782	**kW**
Req'd. Transmitter Output Power		0.951	**kW**

MECHANICAL SPECIFICATIONS

No. Of Bays	2	**#**	DA	
Center of Radiation AGL	394	**ft.**	120.09	**m**
Antenna Aperture	5.37	**ft.**	1.64	**m**
Antenna Total Length	15.38	**ft.**	4.69	**m**
Antenna Weight Excluding Brackets	156.45	**lbs.**	71.11	**kg**
Windload: 50/33 psf / CaAc	340.00	**lbs.**	9.35	**ft.^2**

Specifications will be certified upon final construction and testing.
The given values can be used for system planning.

Prepared by:

UMESH MANEDI
SWR, LP
UNITED STATES OF AMERICA
CERTIFIED BROADCAST RADIO ENGINEER

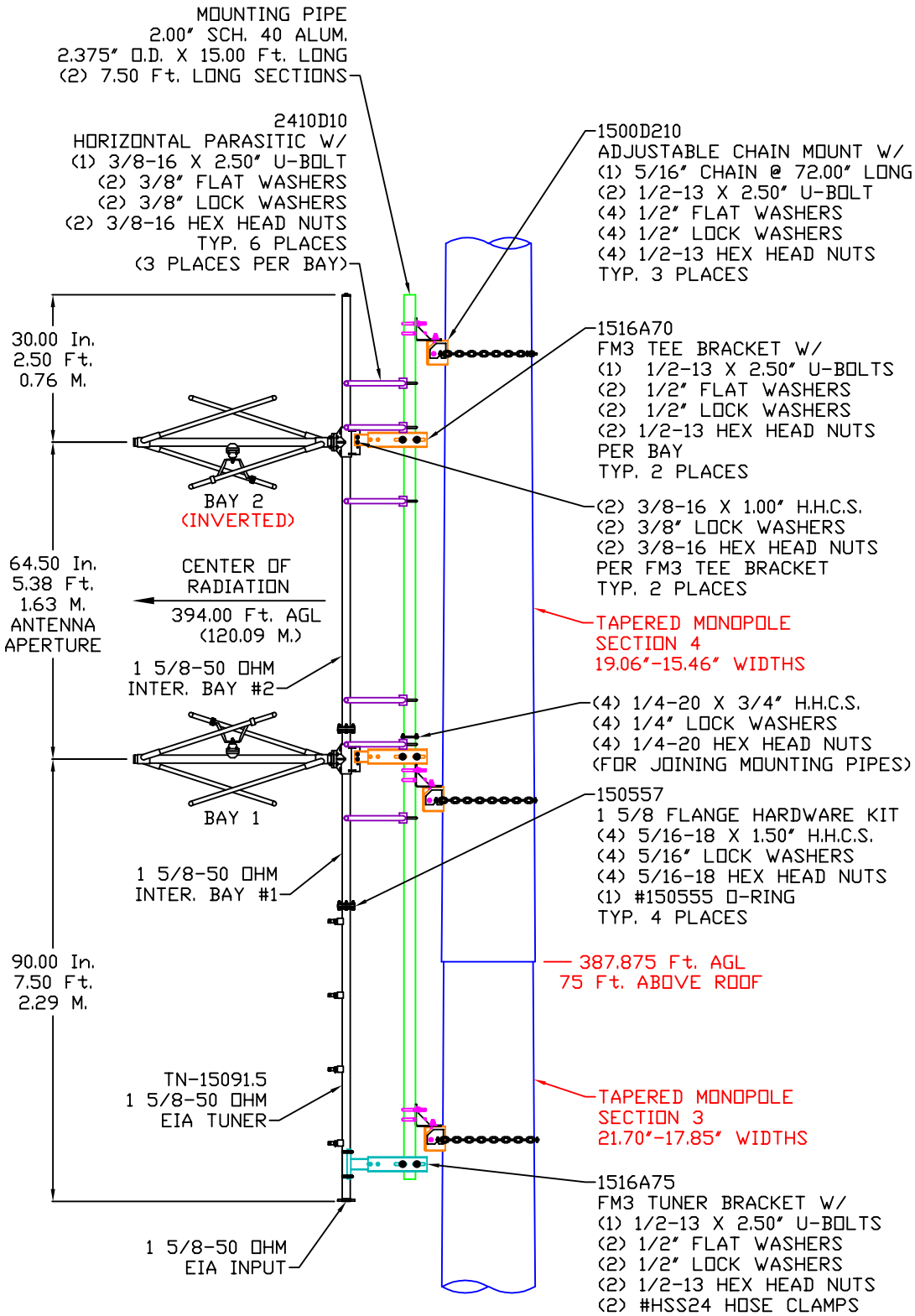
APPENDIX

S.O. #23303

DRAWING NUMBER: 2410D00

NOTES:

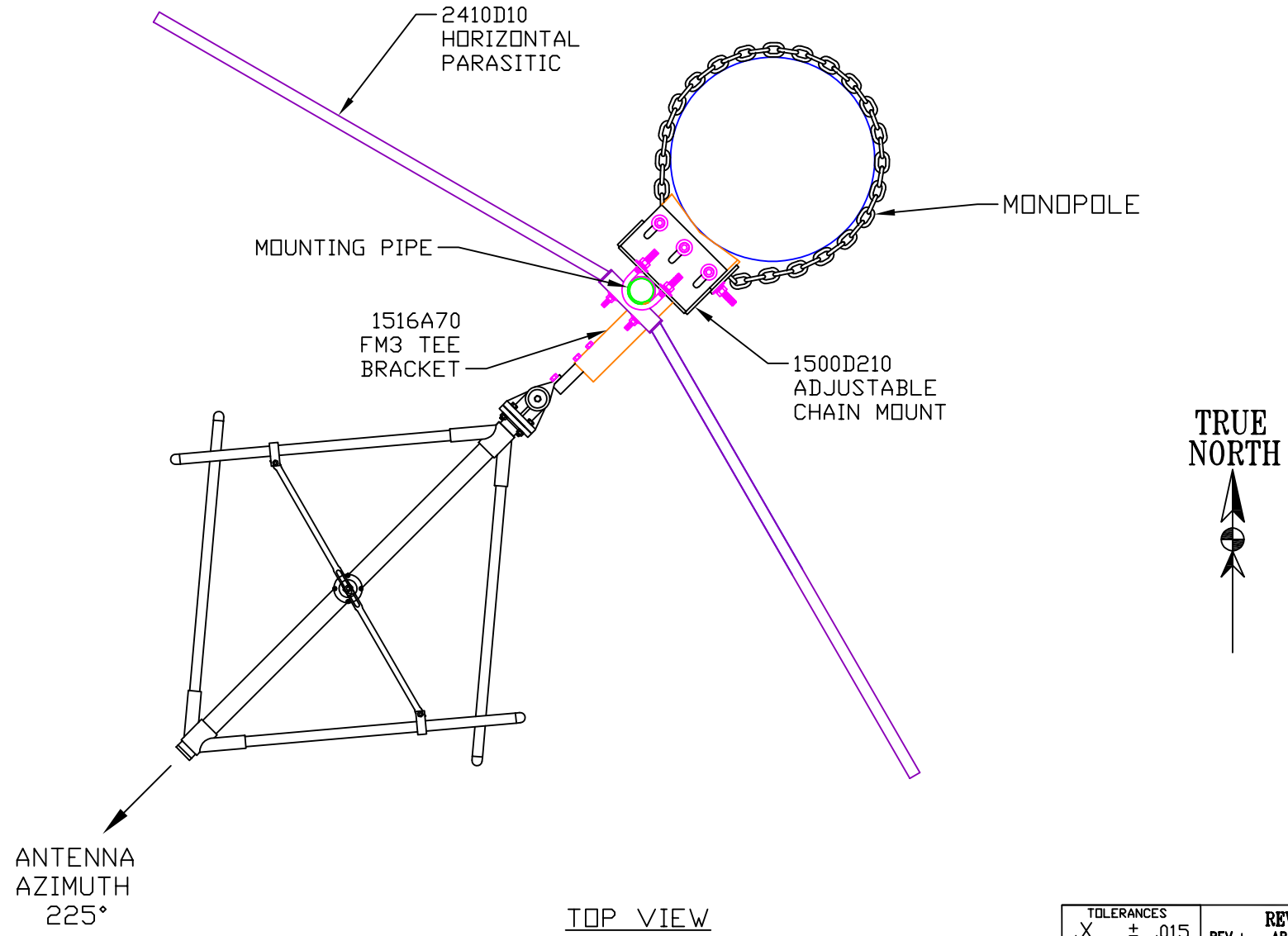
1. REFERENCE DWG. 2410D01 FOR ANTENNA ORIENTATION.
2. REFERENCE DWG. 2410D02 FOR BAY 1 PARASITIC PLACEMENT - FRONT VIEW
3. REFERENCE DWG. 2410D03 FOR BAY 1 PARASITIC PLACEMENT - TOP VIEW
4. REFERENCE DWG. 2410D04 FOR BAY 2 PARASITIC PLACEMENT - FRONT VIEW
5. REFERENCE DWG. 2410D05 FOR BAY 2 PARASITIC PLACEMENT - TOP VIEW
6. ITEMS ROTATED IN THIS VIEW FOR CLARITY ONLY.



SYSTEMS WITH RELIABILITY, LP 619 INDUSTRIAL PARK ROAD EBENSBURG, PENNSYLVANIA 15931	TITLE: FM3/2-HWS-DA, FREQ. 91.5 WTUL, NEW ORLEANS, LA MATERIAL:	SIZE C	REV	APPR.	DATE	ENGINEER:	DRAWING NUMBER: 2410D00	
			1			SCALE: NTS	NAME: BJH	DATE: 12/21/23 SHEET 1 OF 1
			2					
			3					

NOTE:

DRAWING NUMBER: 2410D01



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: FM3/2-HWS-DA, FREQ. 91.5
WTUL, NEW ORLEANS, LA

MATERIAL: ANTENNA
ORIENTATION

SIZE A

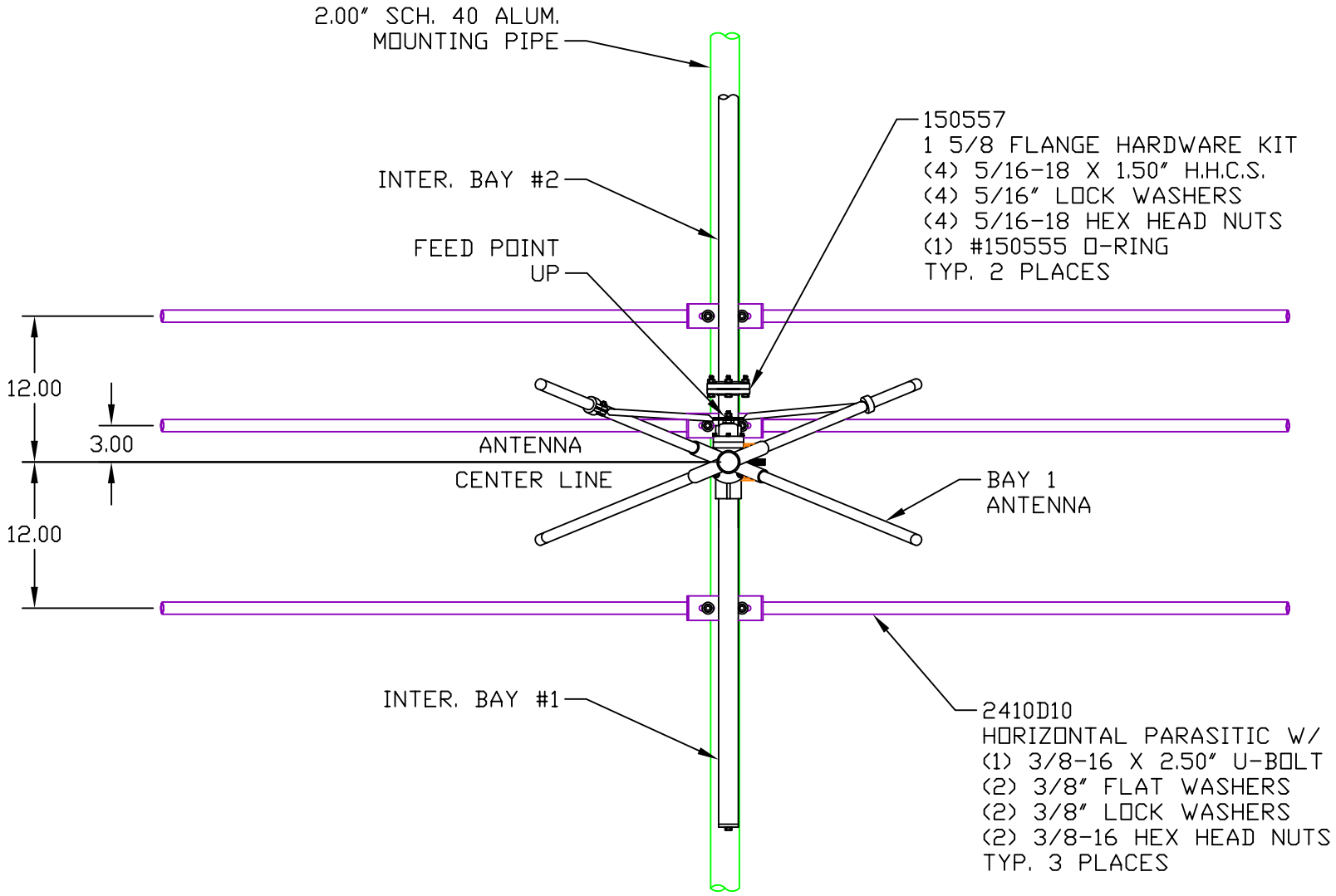
PARTS MADE BY THIS DRAWING

DRAWING NUMBER: 2410D01

SCALE: NTS | NAME: BJH | DATE: 12/21/23 | SHEET 1 OF 1

NOTE:

DRAWING NUMBER: 2410D02



FRONT 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: FM3/2-HWS-DA, FREQ. 91.5
WTUL, NEW ORLEANS, LA

MATERIAL: BAY 1 PARASITIC PLACEMENT
FRONT VIEW

SIZE A

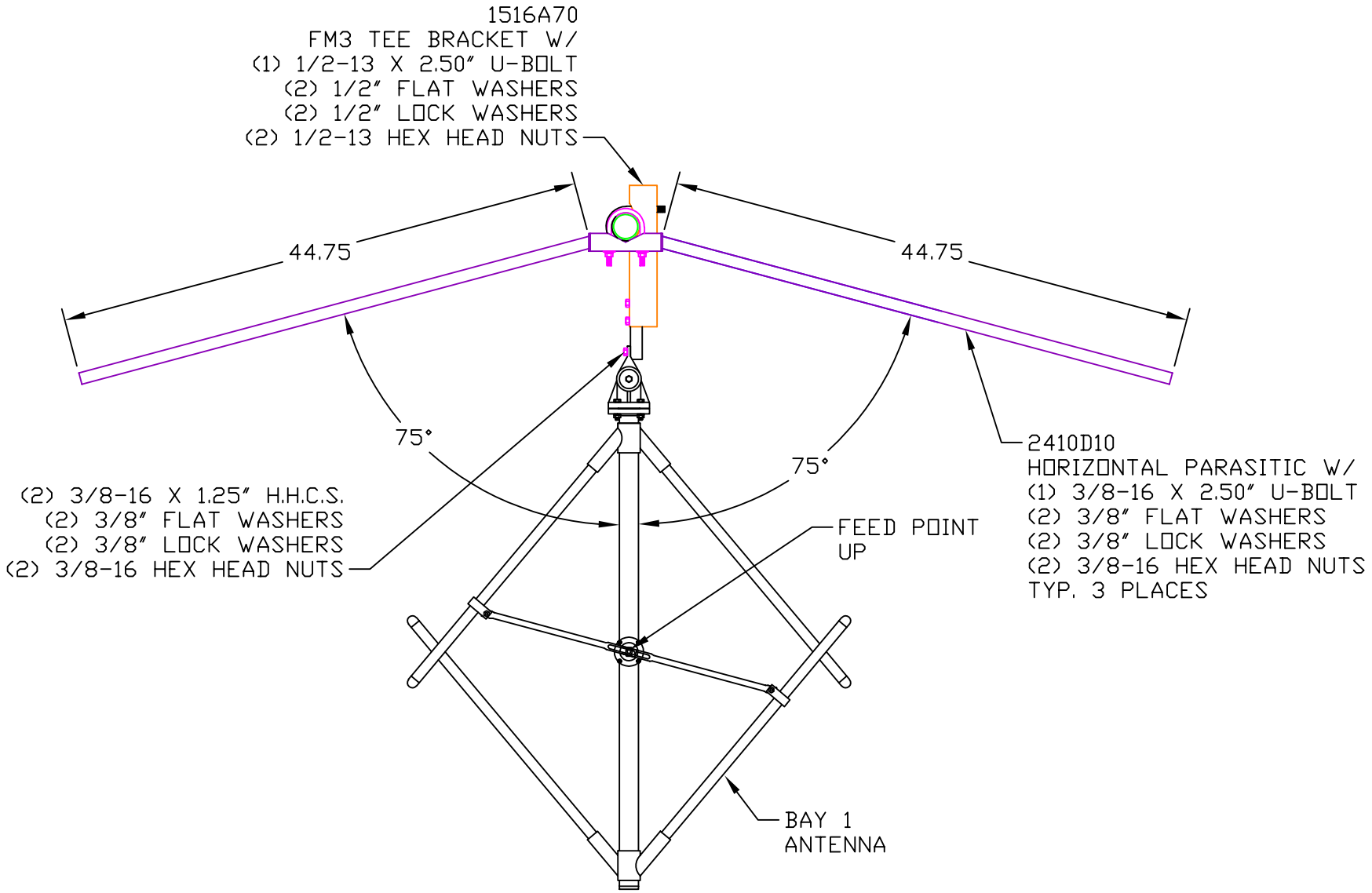
PARTS MADE BY THIS DRAWING

DRAWING NUMBER: 2410D02

SCALE: NTS | NAME: BJH | DATE: 12/21/23 | SHEET 1 OF 1

NOTE:

DRAWING NUMBER: 2410D03



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: FM3/2-HWS-DA, FREQ. 91.5
WTUL, NEW ORLEANS, LA

MATERIAL: BAY 1 PARASITIC PLACEMENT
TOP VIEW

SIZE A

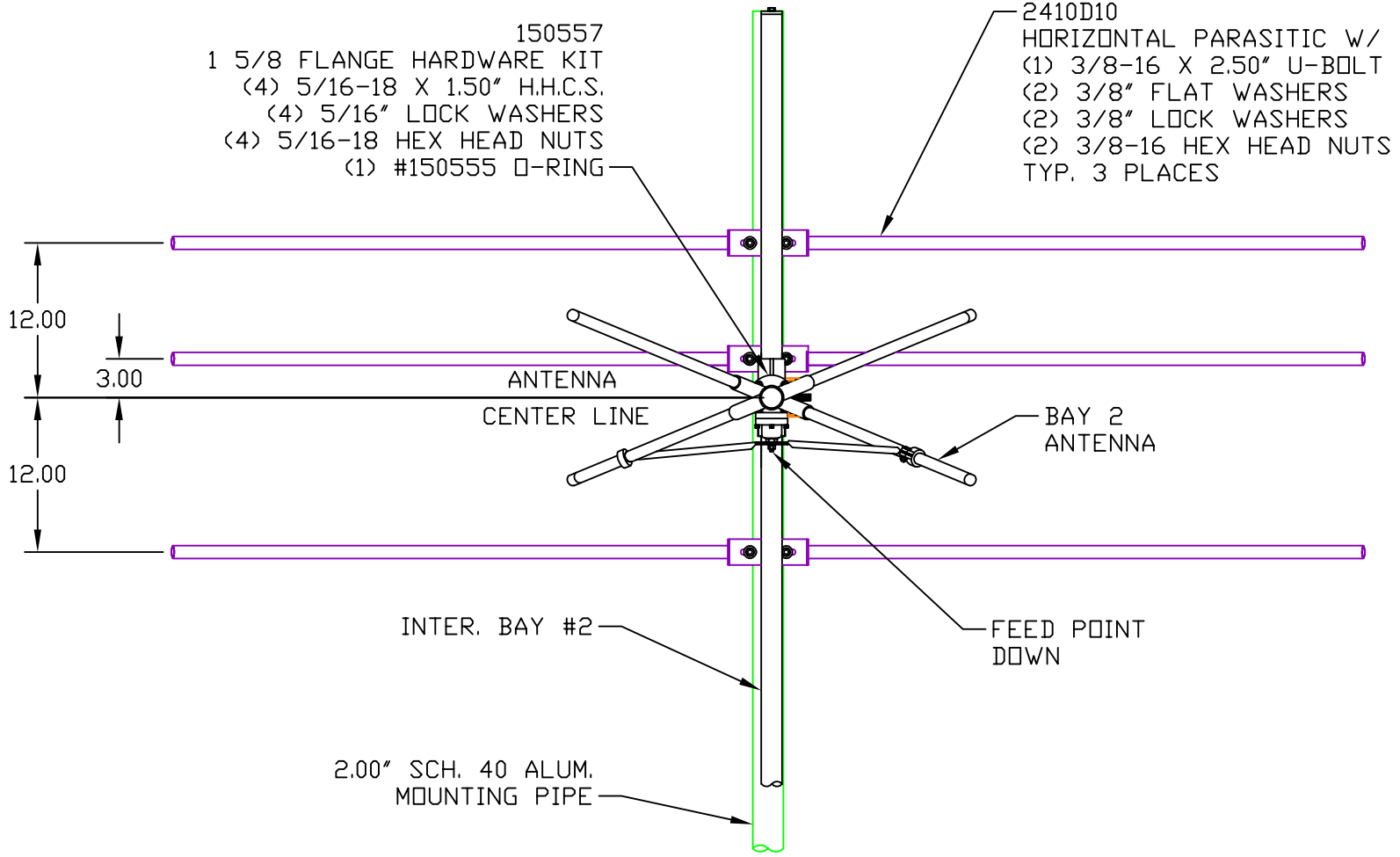
PARTS MADE BY THIS DRAWING

DRAWING NUMBER: 2410D03

SCALE: NTS | NAME: BJH | DATE: 12/21/23 | SHEET 1 OF 1

NOTE:

DRAWING NUMBER: 2410D04



FRONT 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: FM3/2-HWS-DA, FREQ. 91.5
WTUL, NEW ORLEANS, LA

MATERIAL: BAY 2 PARASITIC PLACEMENT
FRONT VIEW

SIZE: A

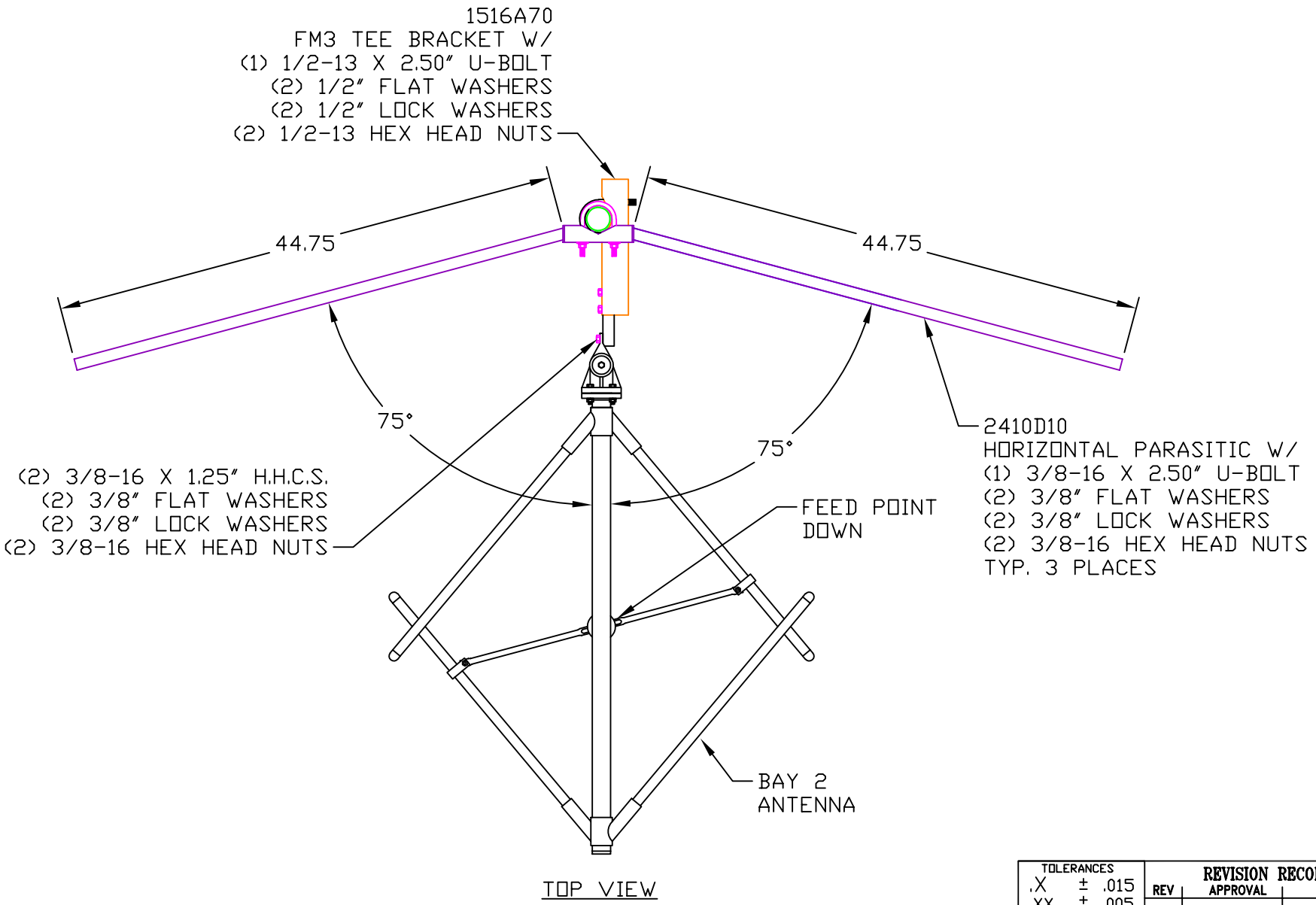
PARTS MADE BY THIS DRAWING

DRAWING NUMBER: 2410D04

SCALE: NTS | NAME: BJH | DATE: 12/21/23 | SHEET 1 OF 1

NOTE:

DRAWING NUMBER: 2410D05



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: FM3/2-HWS-DA, FREQ. 91.5
WTUL, NEW ORLEANS, LA

MATERIAL: BAY 2 PARASITIC PLACEMENT
TOP VIEW

SIZE A

PARTS MADE BY THIS DRAWING

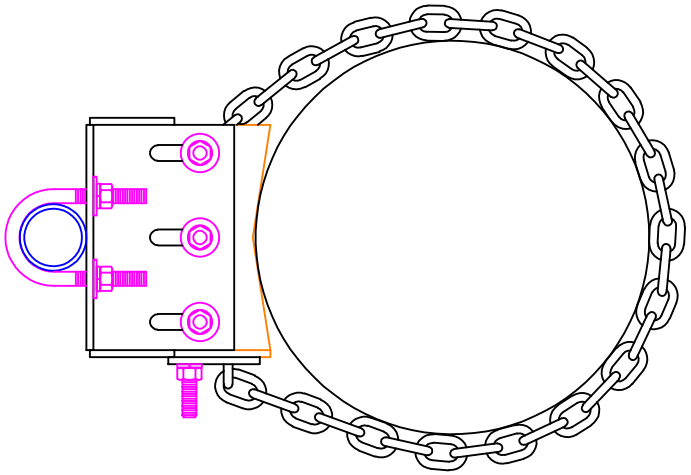
DRAWING NUMBER: 2410D05

SCALE: NTS | NAME: BJH | DATE: 12/21/23 | SHEET 1 OF 1

NOTE:

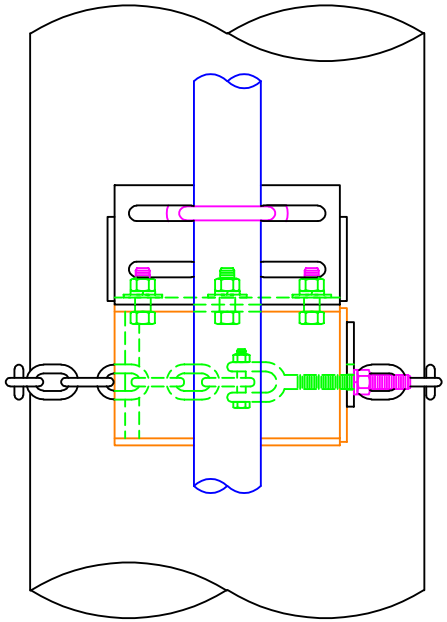
BRACKET WEIGHT: 15 Lbs.
CHAIN WEIGHT: 1.0 Lbs./Ft.

DRAWING NUMBER: 1500D210

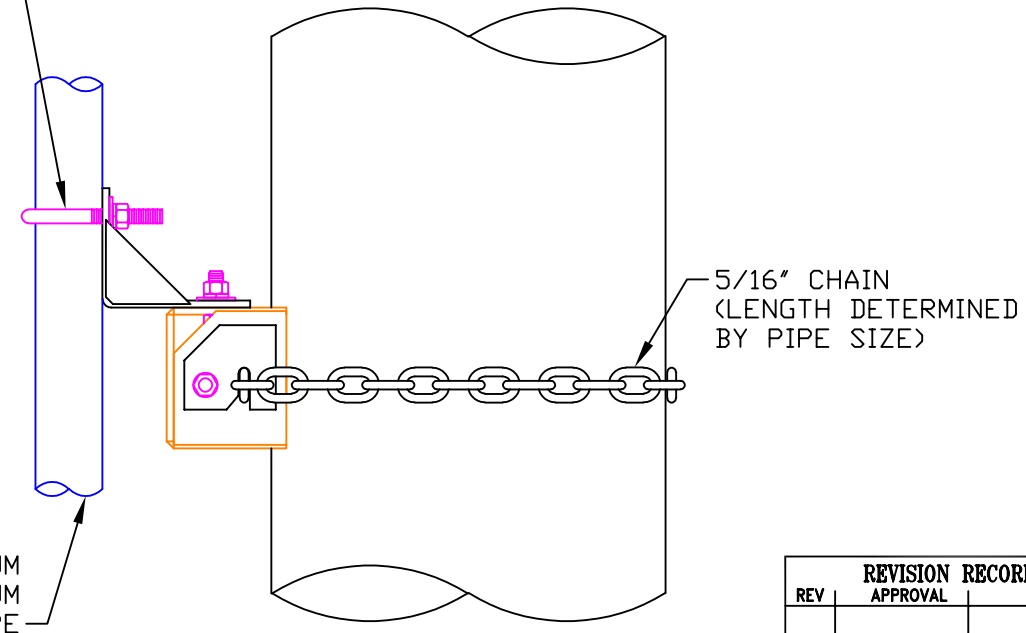


TOP VIEW

(1) 1/2-13 U-BOLT
(2) 1/2" FLAT WASHERS
(2) 1/2" LOCK WASHERS
(2) 1/2-13 HEX HEAD NUTS
(U-BOLT SIZE DETERMINED
BY MOUNTING PIPE DIAMETER)



FRONT VIEW



SIDE VIEW

REVISION RECORD		
REV	APPROVAL	DATE

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

TITLE: CHAIN MOUNT BRACKET ASSEMBLY

MATERIAL:

SIZE A

PARTS MADE BY THIS DRAWING

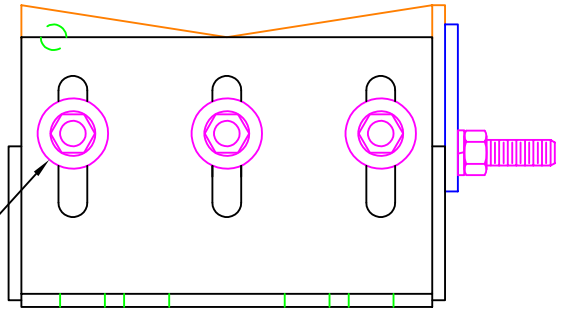
DRAWING NUMBER: 1500D210

SCALE: NTS | NAME: RAC | DATE: 7/7/14 | SHEET 1 OF 1

NOTE:

DRAWING NUMBER: 1500D210A

(1) 1/2-13 X 1.50" H.H.C.S.
(1) 1/2" FLAT WASHER
(1) 1/2" LOCK WASHER
(1) 1/2-13 HEX HEAD NUT
TYP. 3 PLACES

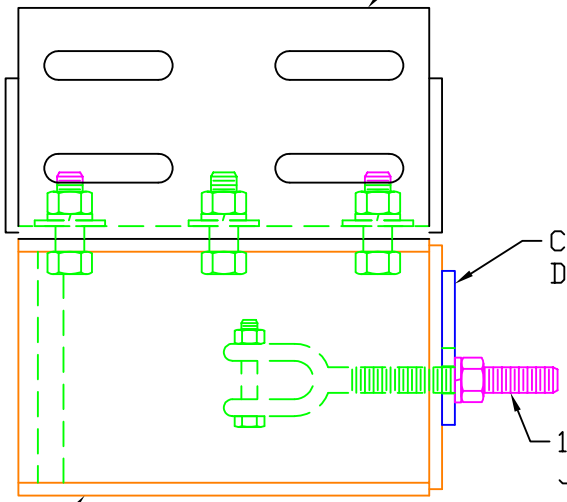


TOP VIEW

STAND-OFF ASSEMBLY
DWG. 1500D227

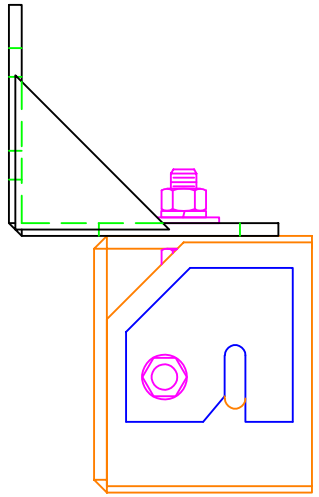
CHAIN LOCKING PLATE
DWG. 1500D215

1/2 X 6"
JAW BOLT



FRONT VIEW

CHAIN MOUNT BRACKET
DWG. 1500D210B



SIDE VIEW

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

UNLESS OTHERWISE SPECIFIED

REVISION RECORD

REV	APPROVAL	DATE
1		11/2/16

DRAWING NUMBER: 1500D210A

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

TITLE: MEDIUM OR LIGHT DUTY CHAIN MOUNT

MATERIAL:

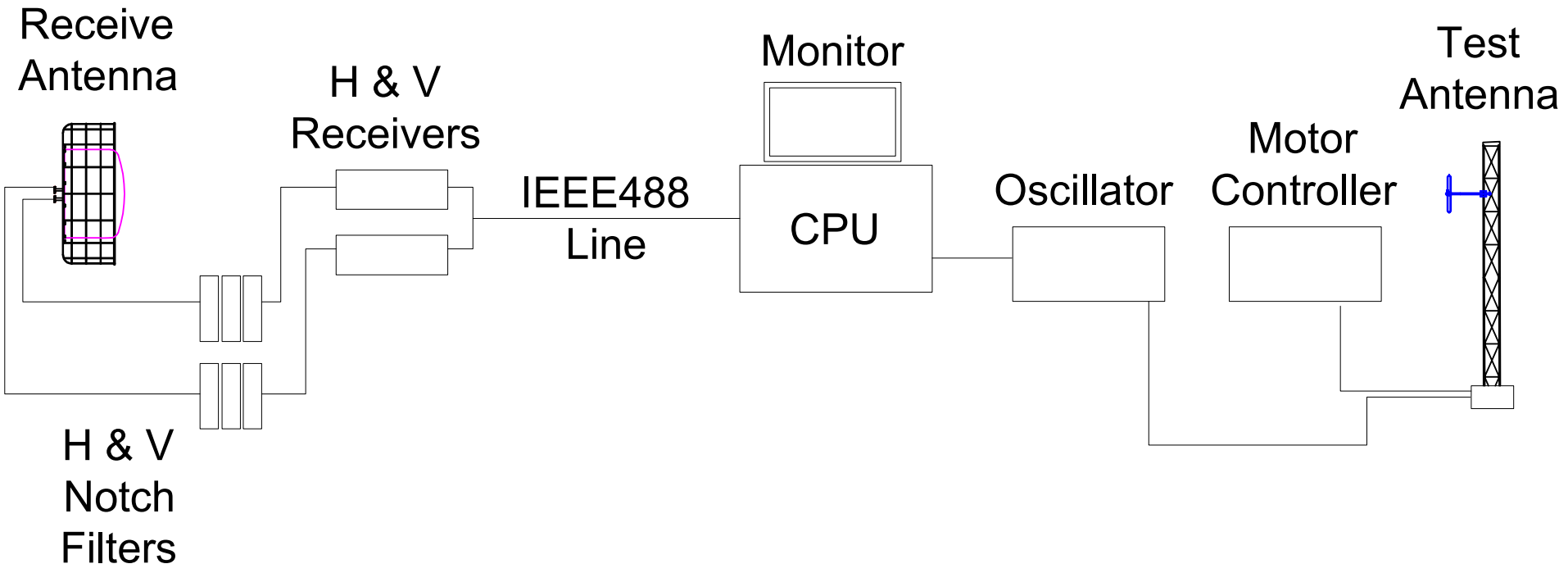
SIZE A

CM-LXX-XX

PARTS MADE BY THIS DRAWING

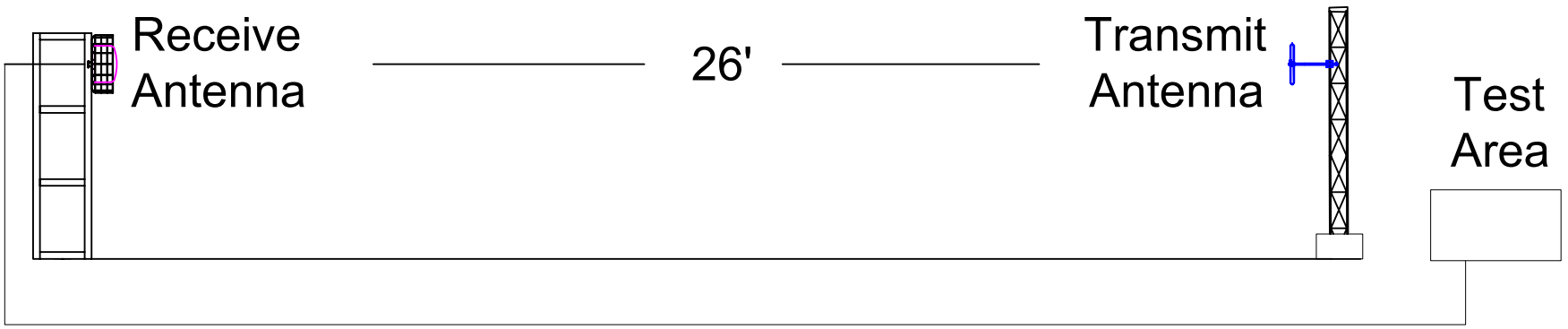
SCALE: NTS | NAME: RAC | DATE: 7/7/14 | SHEET 1 OF 1

SYSTEM BLOCK DIAGRAM



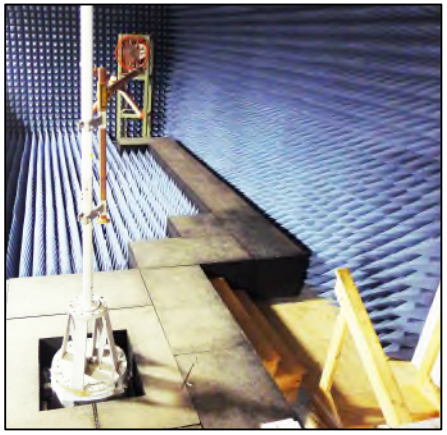
1/3 SCALE TEST RANGE

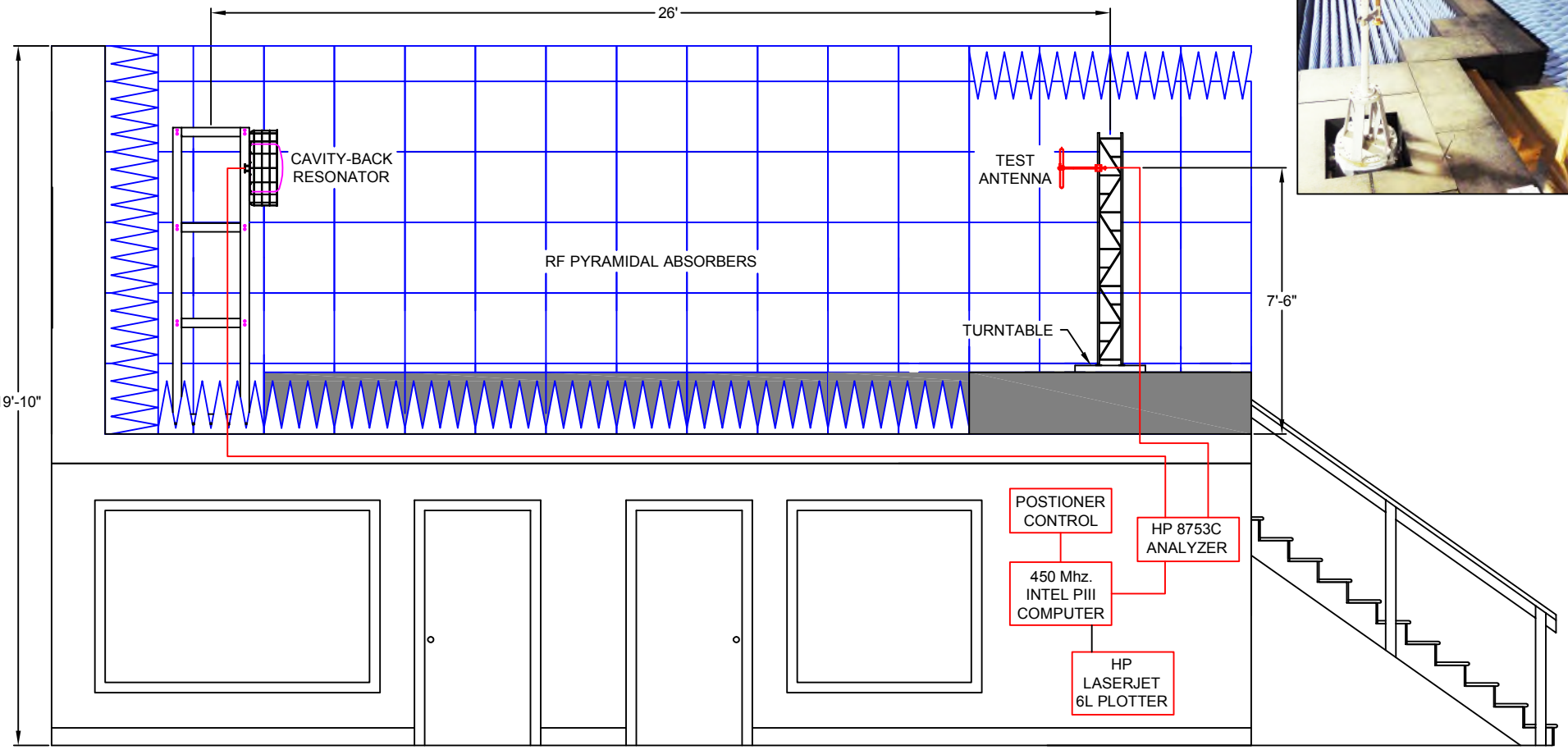
Anechoic Chamber



NOTE:

DRAWING NUMBER: 2105A15





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: TEST RANGE SCHEMATIC

MATERIAL:

SIZE A

PARTS MADE BY THIS DRAWING

DRAWING NUMBER: 2105A15

SCALE: NTS | NAME: BJH | DATE: 10/21/20 | SHEET 1 OF 1