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**S.O. 38289**

**Report of Test 6025-1/4**

**for**

**MAINE PUBLIC BROADCASTING**

**WBQF 91.7 MHz FRYEBURG, ME**

## OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6025-1/4 to meet the needs of WBQF and to comply with the requirements of the FCC construction permit, file number 0000156008. This test characterizes only the radiation characteristics of the antenna when mounted on the tower as described. It does not represent or imply any guarantee of specific coverage which can be influenced by factors beyond the scope of this test.

## RESULTS:

The following Figures are the results of the measurements from our pattern range:

Figure 1A - Measured Azimuth Pattern with the FCC Composite
Figure 1B - Measured Composite Azimuth Pattern with the FCC Composite
Figure 1C - Tabulation of the Horizontal Polarization for the Measured Azimuth Pattern
Figure 1D - Tabulation of the Vertical Polarization for the Measured Azimuth Pattern
Figure 1E - Tabulation of the Measured Composite Azimuth Pattern
Figure 1F - Tabulation of the FCC Composite

The calculated elevation pattern of the antenna is shown in Figure 3.

Construction permit file number 0000156008 indicates that the Horizontal radiation component shall not exceed 0.250 kW at any azimuth and is restricted to the following values at the azimuths specified:

190-220 Degrees True: 0.0105 kilowatts

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From Figure 1A, the maximum radiation of the Horizontal component occurs at 20 Degrees True and 300 Degrees True. At the restricted azimuth of 190-220 Degrees True the highest vertical component is 13.979 dB down from the maximum of 0.250 kW, or 0.010 kW.

The R.M.S. of the Horizontal component is 0.621. The total Horizontal power gain is 1.672. The R.M.S. of the Vertical component is 0.530. The total Vertical power gain is 1.333. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.737. The R.M.S. of the measured composite pattern is 0.641. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.626. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

**METHOD OF DIRECTIONALIZATION:**

The array of the 6025-1/4 was mounted on a tower of precise scale to the10 foot face X braced tower at the WBQF site. The orientation and spacing of the antennas to the tower and the addition of a 4-way unequal power split and unequal phasing, was used to achieve the horizontal and vertical pattern shown in Figure 1A. See Figure 2 for mechanical details.

**METHOD OF MEASUREMENT:**

As allowed by the construction permit, file number 0000156008, a single level of the 6025-1/4 was set up on the Shively Labs scale model antenna pattern measuring range. A scale of 4.5:1 was used.

**EQUIPMENT:**

The 4.5:1 scale model pattern range consists of a wooden rotating pedestal equipped with a position indicator. The scale model bay is placed on the top of this pedestal and is used in the transmission mode at approximately 20 feet above ground level. The receiving parabolic dish is spaced 50 feet away from the rotating pedestal at the same level above ground as the transmitting model. The transmitting and receiving signals are carried to a control building by means of Hypercell Superflex and Cellflex lCF cabling respectively.

The control building is equipped with:

Hewlett Packard Model 4395-A Network Analyzer

PC Based Controller

Output Standard Printer or ‘pdf’

All testing is carried out in strict accordance with approved procedures under our ISO9001.

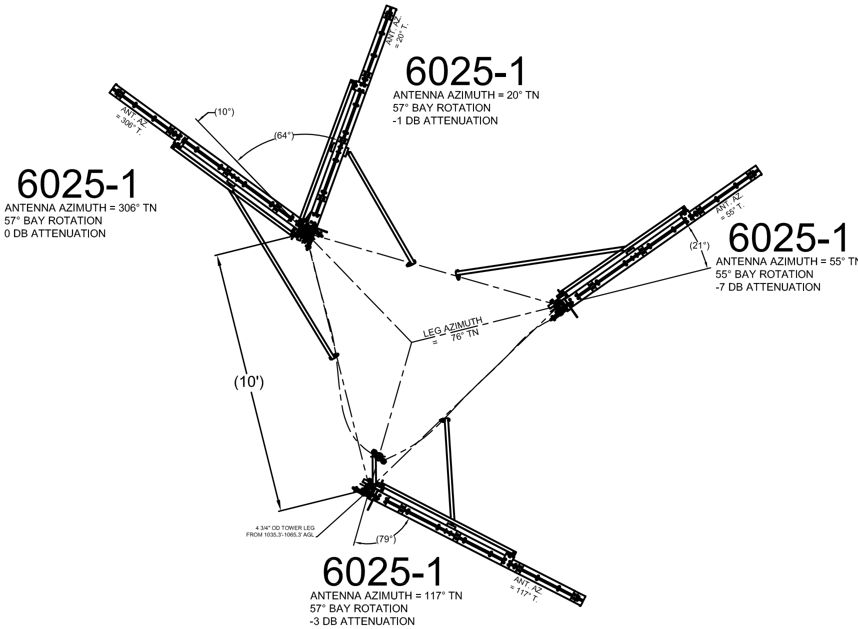
**TEST PROCEDURES:**

The receiving antenna system is mounted so that the horizontal and vertical azimuth patterns are measured independently. The network analyzer was set to 412.65 MHz Calibrated pads are used to check the linearity of the measuring system. For example, 6 dB padding yields a scale reading of 50 from an unpadded reading of 100 in voltage. From the recorded patterns, the R.M.S. values are calculated and recorded as shown in Figure 1A.

Respectfully submitted by:

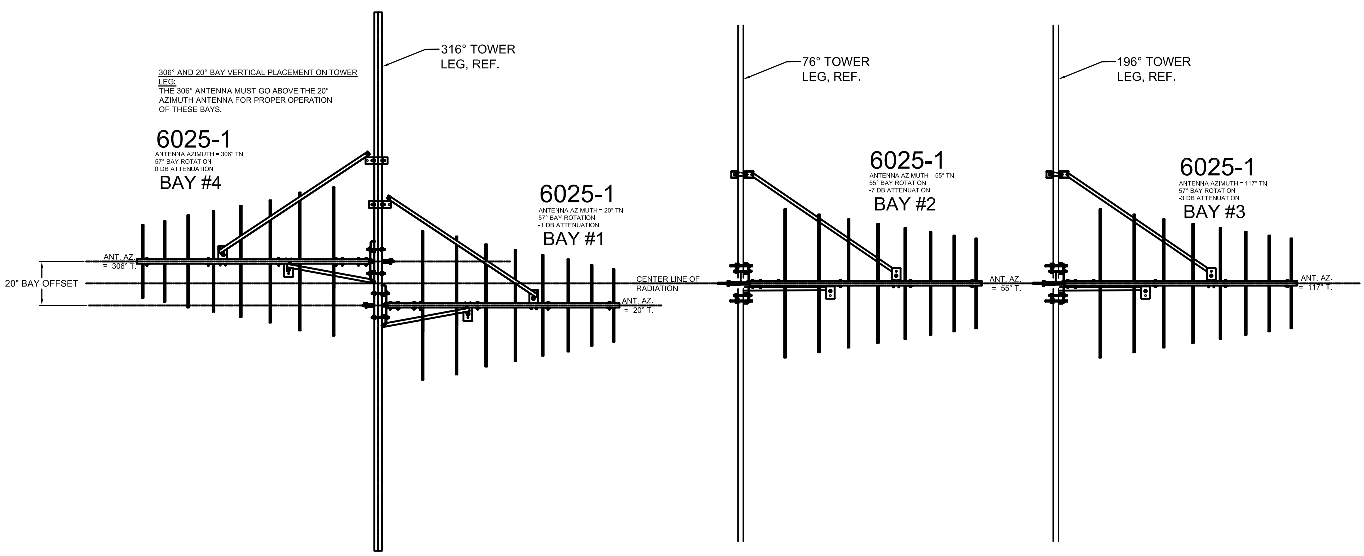
Sean C. Edwards
Director RF Engineering, Shively Labs

S/O: 38289
Date: 4 April, 2022



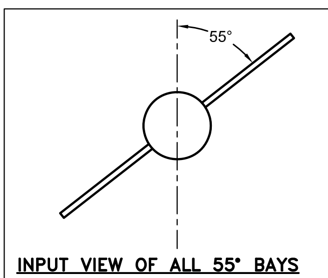

**TOP VIEW OF ANTENNA ON TOWER**

**TOWER MAKE: UNKNOWN 10' FACE**

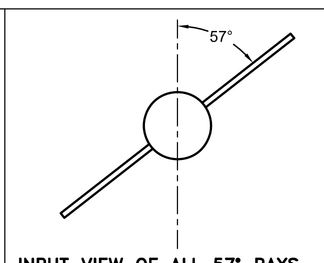



**ELEVATION VIEW**

| AZIMUTH | ATTENUATION | BAY ROTATION | PHASE |
|---|---|---|---|
| (BAY 1) 20° | -1 db | 57° | 0° |
| (BAY 2) 55° | -7 db | 55° | 0° |
| (BAY 3) 117° | -3 db | 57° | 0° |
| (BAY 4) 306° | 0 db | 57° | 0° |




**INPUT VIEW OF ALL 55° BAYS**




**INPUT VIEW OF ALL 57° BAYS**

SHIVELY LABS ®

A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE

| SHOP ORDER: | FREQUENCY: | SCALE: | DRAWN BY: ASP |
|---|---|---|---|
| 38289 | 91.7 | N.T.S. | APPROVED BY: – |

TITLE:

FIGURE 2, WBQF, 91.7MHz
MODEL 6025-1/4-1/1/1/1, SLANT ELEMENTS

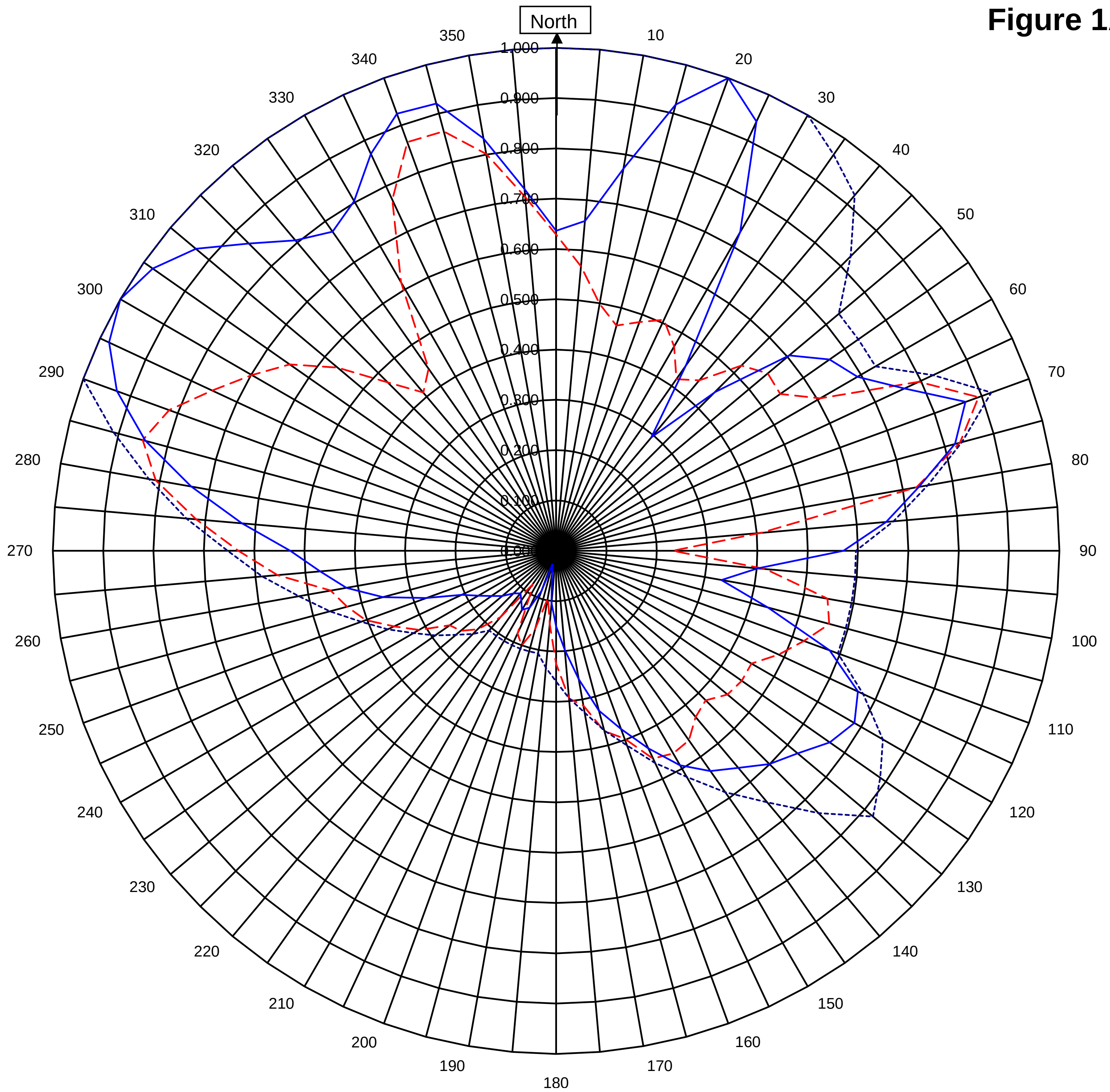
DATE: 4/12/22

# FIGURE 2

# Shively Labs

Shively Labs, a division of Howell Laboratories, Inc. Bridgton, ME (207)647-3327

**Figure 1A**




## WBQF FRYEBURG, ME

38289

April 1, 2022

| | |
|---|---|
| ____________ Horizontal RMS | 0.621 |
| _ _ _ _ _ _ _ _ _ Vertical RMS | 0.530 |
| H/V Composite RMS | 0.641 |
| ...............FCC Composite RMS | 0.737 |

| | |
|---|---|
| Frequency | 91.7 / 412.65 mHz |
| Plot | Relative Field |
| Scale | 4.5 : 1 |
| | See Figure 2 for Mechanical Details |

| | |
|---|---|
| Antenna Model | 6025-1/4 |
| Pattern Type | Directional Azimuth |

# Shively Labs

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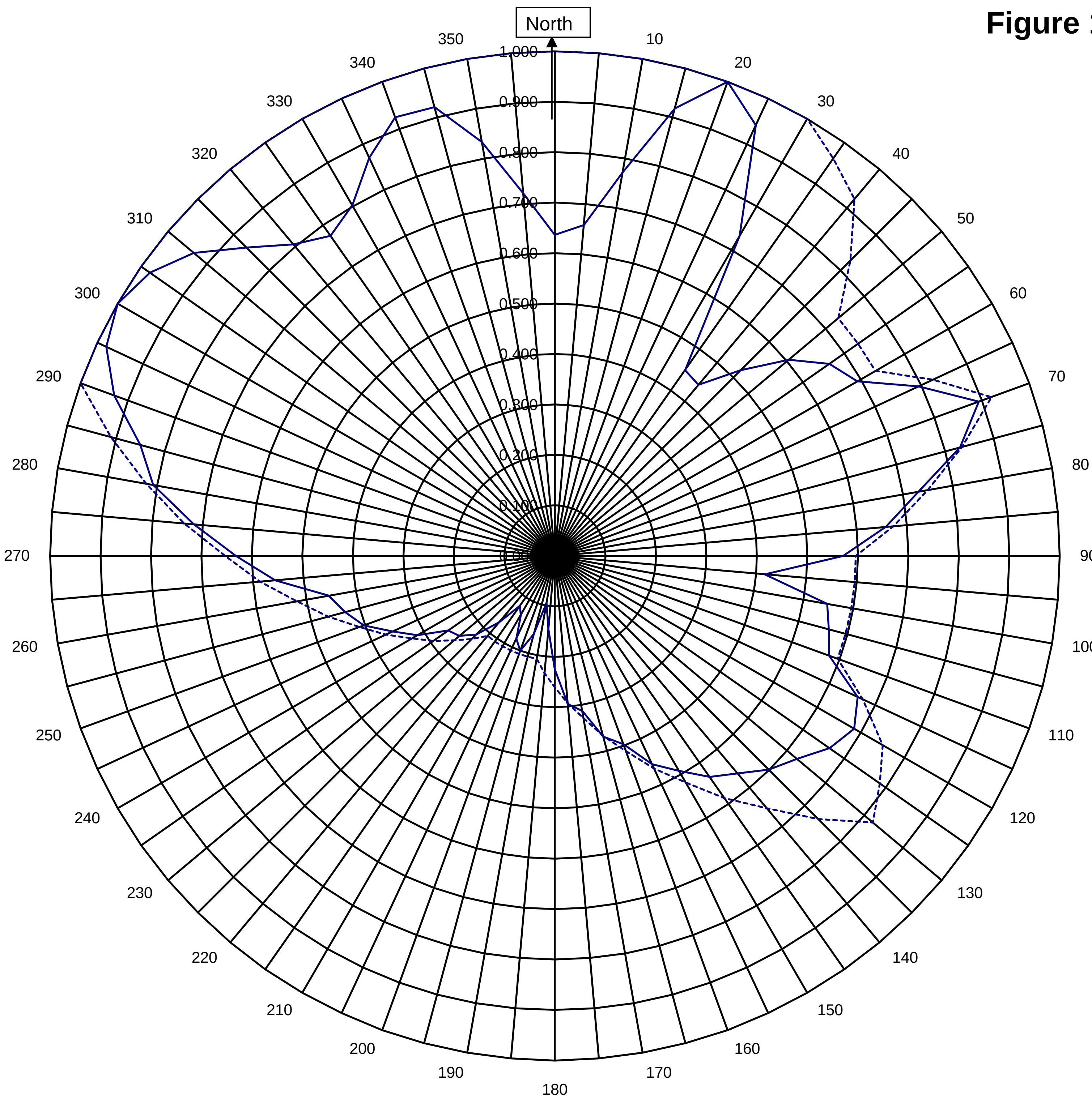
**Figure 1B**




**WBQF FRYEBURG, ME**

38289

April 1, 2022

| | |
|---|---|
| __________H/VComposite RMS | 0.641 |
| ……………FCC Composite RMS | 0.737 |

| | |
|---|---|
| Frequency | 91.7 / 412.65 mHz |
| Plot | Relative Field |
| Scale | 4.5 : 1 |
| | See Figure 2 for Mechanical Details |

| | |
|---|---|
| Antenna Model | 6025-1/4 |
| Pattern Type | Directional H/V Composite |

Figure 1C

Tabulation of Horizontal Azimuth Pattern
WBQF FRYEBURG, ME

| Azimuth | Rel Field | Azimuth | Rel Field |
|---|---|---|---|
| 0 | 0.636 | 180 | 0.150 |
| 10 | 0.771 | 190 | 0.046 |
| 20 | 1.000 | 200 | 0.085 |
| 30 | 0.732 | 210 | 0.136 |
| 40 | 0.294 | 220 | 0.110 |
| 45 | 0.447 | 225 | 0.120 |
| 50 | 0.604 | 230 | 0.140 |
| 60 | 0.692 | 240 | 0.178 |
| 70 | 0.866 | 250 | 0.275 |
| 80 | 0.732 | 260 | 0.423 |
| 90 | 0.571 | 270 | 0.528 |
| 100 | 0.334 | 280 | 0.737 |
| 110 | 0.578 | 290 | 0.929 |
| 120 | 0.685 | 300 | 1.000 |
| 130 | 0.626 | 310 | 0.934 |
| 135 | 0.599 | 315 | 0.864 |
| 140 | 0.563 | 320 | 0.806 |
| 150 | 0.492 | 330 | 0.803 |
| 160 | 0.377 | 340 | 0.925 |
| 170 | 0.259 | 350 | 0.833 |

Figure 1D

Tabulation of Vertical Azimuth Pattern
WBQF FRYEBURG, ME

| Azimuth | Rel Field | Azimuth | Rel Field |
|---|---|---|---|
| 0 | 0.629 | 180 | 0.224 |
| 10 | 0.498 | 190 | 0.094 |
| 20 | 0.484 | 200 | 0.200 |
| 30 | 0.469 | 210 | 0.105 |
| 40 | 0.442 | 220 | 0.172 |
| 45 | 0.521 | 225 | 0.221 |
| 50 | 0.549 | 230 | 0.247 |
| 60 | 0.606 | 240 | 0.315 |
| 70 | 0.893 | 250 | 0.403 |
| 80 | 0.727 | 260 | 0.455 |
| 90 | 0.231 | 270 | 0.632 |
| 100 | 0.548 | 280 | 0.808 |
| 110 | 0.524 | 290 | 0.818 |
| 120 | 0.448 | 300 | 0.699 |
| 130 | 0.445 | 310 | 0.567 |
| 135 | 0.420 | 315 | 0.473 |
| 140 | 0.432 | 320 | 0.411 |
| 150 | 0.465 | 330 | 0.617 |
| 160 | 0.397 | 340 | 0.864 |
| 170 | 0.312 | 350 | 0.801 |

Figure 1E

Tabulation of Composite Azimuth Pattern
WBQF FRYEBURG, ME

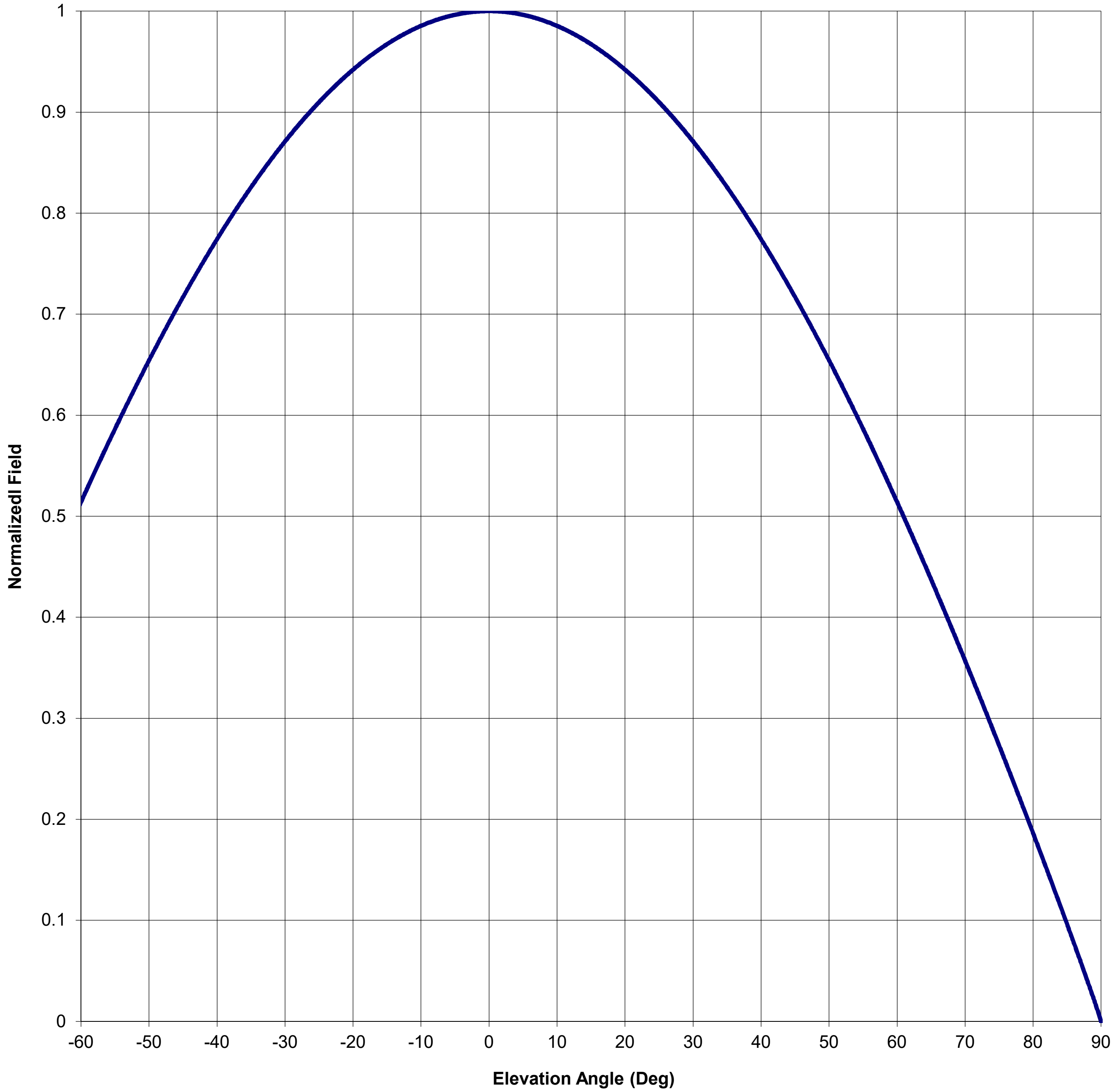
| Azimuth | Rel Field | Azimuth | Rel Field |
|---|---|---|---|
| 0 | 0.636 | 180 | 0.224 |
| 10 | 0.771 | 190 | 0.094 |
| 20 | 1.000 | 200 | 0.200 |
| 30 | 0.732 | 210 | 0.136 |
| 40 | 0.442 | 220 | 0.172 |
| 45 | 0.521 | 225 | 0.221 |
| 50 | 0.604 | 230 | 0.247 |
| 60 | 0.692 | 240 | 0.315 |
| 70 | 0.893 | 250 | 0.403 |
| 80 | 0.732 | 260 | 0.455 |
| 90 | 0.571 | 270 | 0.632 |
| 100 | 0.548 | 280 | 0.808 |
| 110 | 0.578 | 290 | 0.929 |
| 120 | 0.685 | 300 | 1.000 |
| 130 | 0.626 | 310 | 0.934 |
| 135 | 0.599 | 315 | 0.864 |
| 140 | 0.563 | 320 | 0.806 |
| 150 | 0.492 | 330 | 0.803 |
| 160 | 0.397 | 340 | 0.925 |
| 170 | 0.312 | 350 | 0.833 |

Figure 1F

Tabulation of FCC Directional Composite
WBQF FRYEBURG, ME

| Azimuth | Rel Field | Azimuth | Rel Field |
|---|---|---|---|
| 0 | 1.000 | 180 | 0.260 |
| 10 | 1.000 | 190 | 0.207 |
| 20 | 1.000 | 200 | 0.207 |
| 30 | 1.000 | 210 | 0.207 |
| 40 | 0.923 | 220 | 0.207 |
| 50 | 0.733 | 230 | 0.260 |
| 60 | 0.733 | 240 | 0.327 |
| 70 | 0.920 | 250 | 0.412 |
| 80 | 0.750 | 260 | 0.519 |
| 90 | 0.596 | 270 | 0.653 |
| 100 | 0.596 | 280 | 0.822 |
| 110 | 0.596 | 290 | 1.000 |
| 120 | 0.750 | 300 | 1.000 |
| 130 | 0.822 | 310 | 1.000 |
| 140 | 0.653 | 320 | 1.000 |
| 150 | 0.519 | 330 | 1.000 |
| 160 | 0.412 | 340 | 1.000 |
| 170 | 0.327 | 350 | 1.000 |

| | | | | | |
|---|---|---|---|---|---|
| Antenna Mfg.: | Shively Labs | | | | Date: 4/7/2022 |
| Antenna Type: | 6025-1/4 | | | | |
| Station: | WBQF | Beam Tilt | 0 | | |
| Frequency: | 91.7 | Gain (Max) | 1.672 | 2.233 dB | |
| Channel #: | 219 | Gain (Horizon) | 1.672 | 2.233 dB | |
| Figure: | Figure 3 | | | | |



| | | | | |
|---|---|---|---|---|
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| Frequency: | 91.7 | Gain (Max) | 1.672 | 2.233 dB |
| Channel #: | 219 | Gain (Horizon) | 1.672 | 2.233 dB |
| Figure: | Figure 3 | | | |

| Angle of Depression (Deg) | Relative Field | Angle of Depression (Deg) | Relative Field | Angle of Depression (Deg) | Relative Field | Angle of Depression (Deg) | Relative Field |
|---|---|---|---|---|---|---|---|
| -90 | 0.000 | -44 | 0.729 | 0 | 1.000 | 46 | 0.705 |
| -89 | 0.021 | -43 | 0.741 | 1 | 1.000 | 47 | 0.693 |
| -88 | 0.040 | -42 | 0.752 | 2 | 0.999 | 48 | 0.680 |
| -87 | 0.059 | -41 | 0.763 | 3 | 0.999 | 49 | 0.667 |
| -86 | 0.078 | -40 | 0.774 | 4 | 0.998 | 50 | 0.654 |
| -85 | 0.096 | -39 | 0.785 | 5 | 0.996 | 51 | 0.641 |
| -84 | 0.114 | -38 | 0.796 | 6 | 0.995 | 52 | 0.628 |
| -83 | 0.133 | -37 | 0.806 | 7 | 0.993 | 53 | 0.614 |
| -82 | 0.151 | -36 | 0.816 | 8 | 0.991 | 54 | 0.600 |
| -81 | 0.168 | -35 | 0.826 | 9 | 0.988 | 55 | 0.586 |
| -80 | 0.186 | -34 | 0.835 | 10 | 0.985 | 56 | 0.572 |
| -79 | 0.204 | -33 | 0.845 | 11 | 0.982 | 57 | 0.558 |
| -78 | 0.221 | -32 | 0.854 | 12 | 0.979 | 58 | 0.544 |
| -77 | 0.239 | -31 | 0.862 | 13 | 0.975 | 59 | 0.529 |
| -76 | 0.256 | -30 | 0.871 | 14 | 0.971 | 60 | 0.514 |
| -75 | 0.273 | -29 | 0.879 | 15 | 0.967 | 61 | 0.499 |
| -74 | 0.290 | -28 | 0.887 | 16 | 0.963 | 62 | 0.484 |
| -73 | 0.307 | -27 | 0.895 | 17 | 0.958 | 63 | 0.469 |
| -72 | 0.324 | -26 | 0.903 | 18 | 0.953 | 64 | 0.453 |
| -71 | 0.341 | -25 | 0.910 | 19 | 0.948 | 65 | 0.437 |
| -70 | 0.357 | -24 | 0.917 | 20 | 0.942 | 66 | 0.422 |
| -69 | 0.373 | -23 | 0.924 | 21 | 0.936 | 67 | 0.406 |
| -68 | 0.390 | -22 | 0.930 | 22 | 0.930 | 68 | 0.390 |
| -67 | 0.406 | -21 | 0.936 | 23 | 0.924 | 69 | 0.373 |
| -66 | 0.422 | -20 | 0.942 | 24 | 0.917 | 70 | 0.357 |
| -65 | 0.437 | -19 | 0.948 | 25 | 0.910 | 71 | 0.341 |
| -64 | 0.453 | -18 | 0.953 | 26 | 0.903 | 72 | 0.324 |
| -63 | 0.469 | -17 | 0.958 | 27 | 0.895 | 73 | 0.307 |
| -62 | 0.484 | -16 | 0.963 | 28 | 0.887 | 74 | 0.290 |
| -61 | 0.499 | -15 | 0.967 | 29 | 0.879 | 75 | 0.273 |
| -60 | 0.514 | -14 | 0.971 | 30 | 0.871 | 76 | 0.256 |
| -59 | 0.529 | -13 | 0.975 | 31 | 0.862 | 77 | 0.239 |
| -58 | 0.544 | -12 | 0.979 | 32 | 0.854 | 78 | 0.221 |
| -57 | 0.558 | -11 | 0.982 | 33 | 0.845 | 79 | 0.204 |
| -56 | 0.572 | -10 | 0.985 | 34 | 0.835 | 80 | 0.186 |
| -55 | 0.586 | -9 | 0.988 | 35 | 0.826 | 81 | 0.168 |
| -54 | 0.600 | -8 | 0.991 | 36 | 0.816 | 82 | 0.151 |
| -53 | 0.614 | -7 | 0.993 | 37 | 0.806 | 83 | 0.133 |
| -52 | 0.628 | -6 | 0.995 | 38 | 0.796 | 84 | 0.114 |
| -51 | 0.641 | -5 | 0.996 | 39 | 0.785 | 85 | 0.096 |
| -50 | 0.654 | -4 | 0.998 | 40 | 0.774 | 86 | 0.078 |
| -49 | 0.667 | -3 | 0.999 | 41 | 0.763 | 87 | 0.059 |
| -48 | 0.680 | -2 | 0.999 | 42 | 0.752 | 88 | 0.040 |
| -47 | 0.693 | -1 | 1.000 | 43 | 0.741 | 89 | 0.021 |
| -46 | 0.705 | 0 | 1.000 | 44 | 0.729 | 90 | 0.000 |
| -45 | 0.717 | | | 45 | 0.717 | | |

S.O. 38289 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WBQF FRYEBURG, ME

MODEL 6025-1/4

Elevation Gain of Antenna 0.55

Horizontal RMS value divided by the Vertical RMS value equals the Horiz. - Vert. Ratio

| | | | | | |
|---|---|---|---|---|---|
| H RMS | 0.621294 | V RMS | 0.529569 | H/V Ratio | 1.173 |

Elevation Gain of Horizontal Component 0.645

Elevation Gain of Vertical Component 0.469

Horizontal Azimuth Gain equals $1/(RMS)^2$. 2.591

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 2.844
Max. Vertical 0.893

***Total Horizontal Power Gain is the Elevation Gain Times the Azimuth Gain**

Total Horizontal Power Gain = **1.672**

***Total Vertical Power Gain is the Elevation Gain Times the Azimuth Gain**

Total Vertical Power Gain = **1.333**

**=======================================================================**

ERP divided by Horizontal Power Gain equals Antenna Input Power

0.25 kW ERP Divided by H Gain 1.672 equals 0.150 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

0.150 kW Times V Gain 1.333 equals 0.199 kW V ERP

Maximum Value of the Vertical Component squared times the Maximum ERP equals the Vertical ERP

(0.893)^2 Times 0.25 Equals 0.199 kW Vertical ERP

NOTE: Calculating the ERP of the Vertical Component by two methods validates the total power gain calculations