

S.O. 38001
Report of Test 6014-14/1-DA
for
Pacific Radio Group, Inc.
KUMU-FM 94.7 MHz Honolulu, HI

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6014-14/1-DA to meet the needs of KUMU-FM and to comply with the requirements of the FCC construction permit, file number BLANK-0000137989. 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 BLANK-0000137989 indicates that the Horizontal radiation component shall not exceed 100 kW at any azimuth and is restricted to the following values at the azimuths specified:

220 - 320 Degrees True (clockwise): 4.0 kilowatts

From Figure 1A, the maximum radiation of the Horizontal component occurs at 84 Degrees True to 86 Degrees True. At the restricted azimuth of 20-230 Degrees True (clockwise) the Horizontal component is 16.249 dB down from the maximum of 100 kW, or 2.372 kW.

The R.M.S. of the Horizontal component is 0.473. The total Horizontal power gain is 32.103. The R.M.S. of the Vertical component is 0.471. The total Vertical power gain is 28.851. The R.M.S. of the FCC composite pattern is 0.530. The R.M.S. of the measured composite pattern is 0.484. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.451. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6014-14/1-DA was mounted on a tower of precise scale to the PI-Rod Self supported tower at the KUMU-FM site. The spacing of the antenna to the tower was varied to achieve the horizontal and vertical patterns shown in Figure 1A. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BLANK-0000137989, a single level of the 6014-14/1-DA was set up on the Shively Labs scale model antenna pattern measuring range. A scale of 4.5:1 was used.

EQUIPMENT:

The 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 corner reflector 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 RG-9/U double shielded coax cable.

Test Report 6014-14/1-DA

KUMU-FM

Page Three

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 426.15 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:

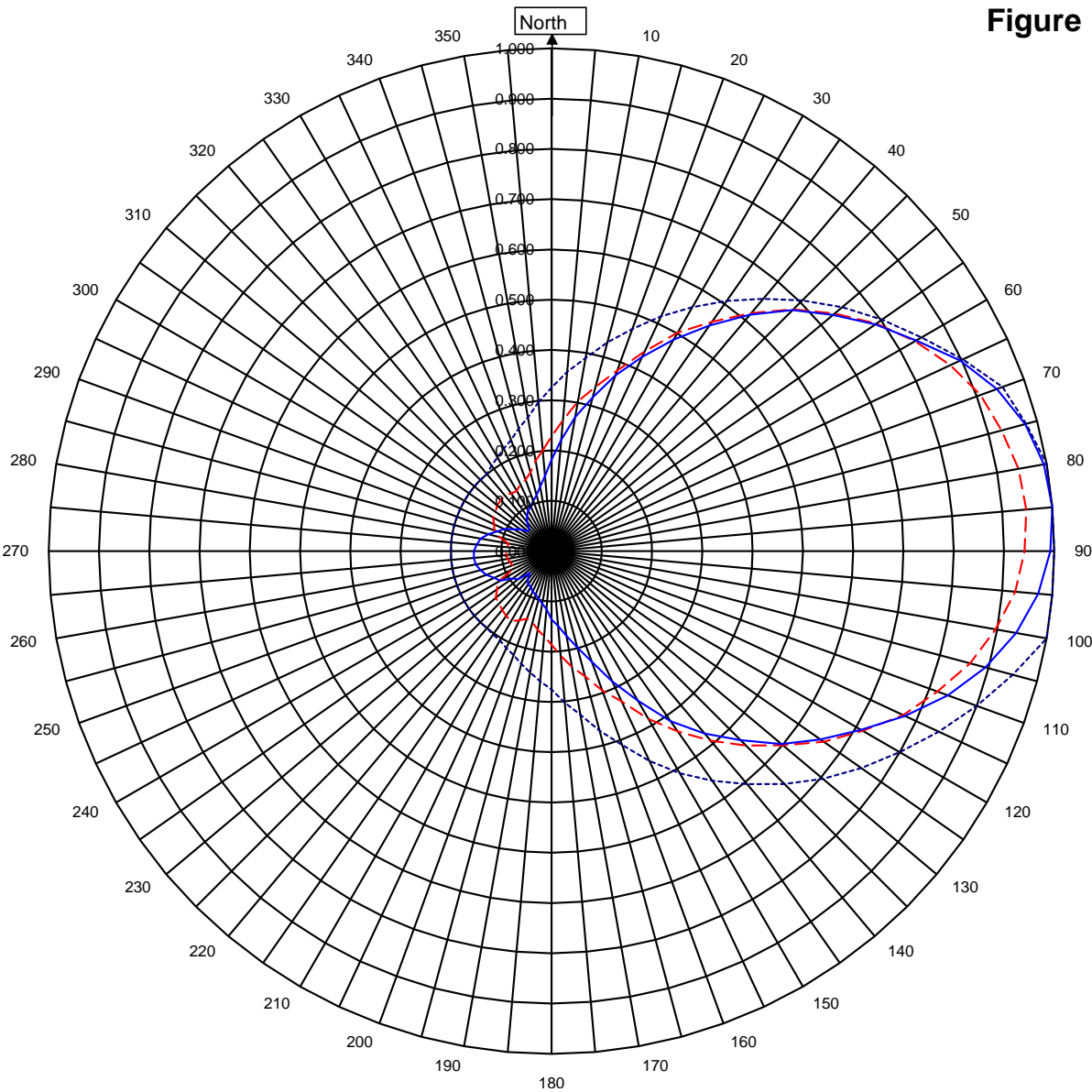
A handwritten signature in cursive script that reads "Sean C. Edwards".

Sean C Edwards
Director RF Engineering, Shively Labs
S/O 38001
Date 2/16/2022

Shively Labs

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

Figure 1A



KUMU Honolulu, Hawaii
38001
February 12, 2022

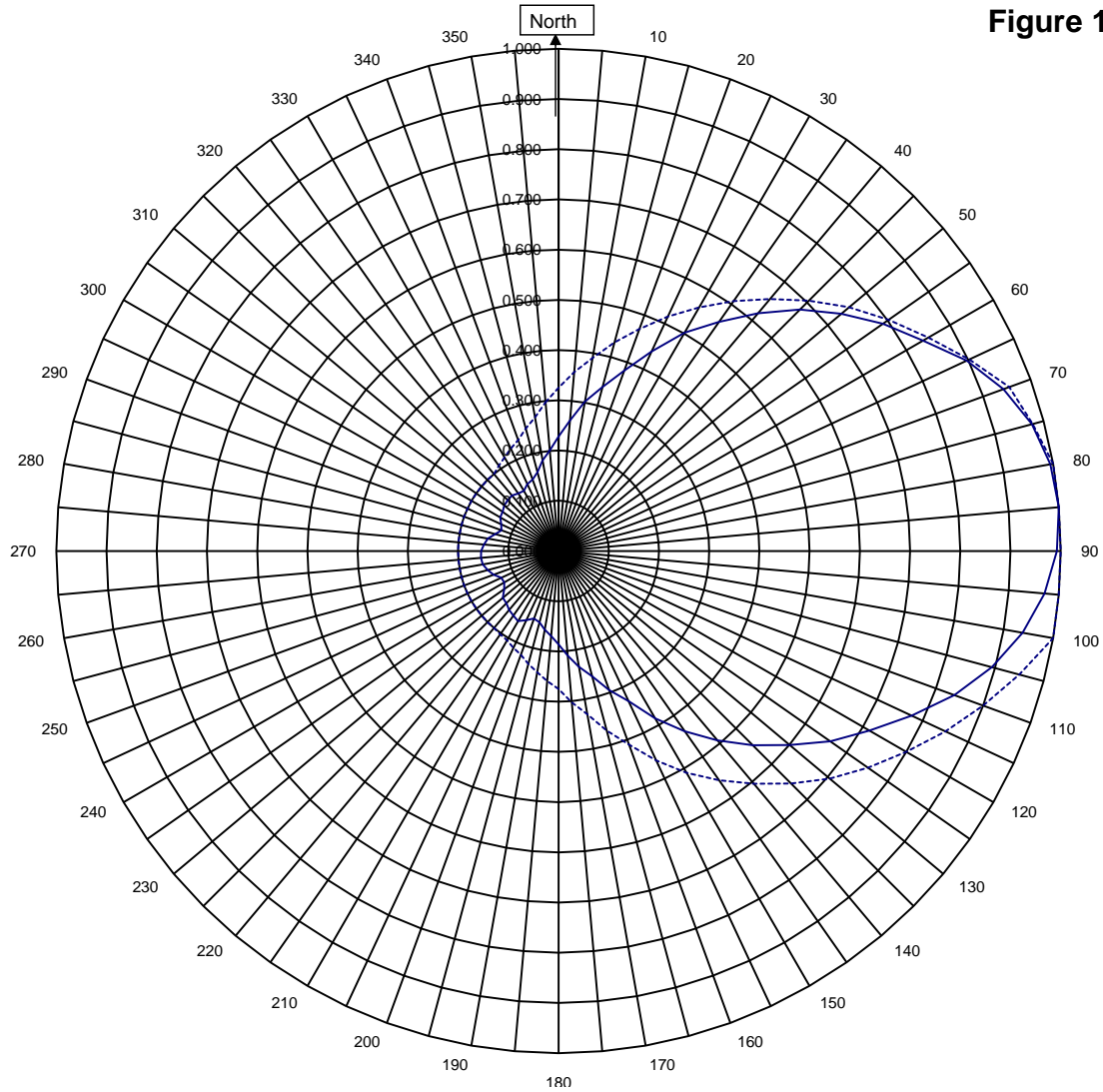
| | | | |
|-------------------|-------|-------------------------------------|-------------------|
| Horizontal RMS | 0.473 | Frequency | 94.7 / 426.15 MHz |
| Vertical RMS | 0.471 | Plot | Relative Field |
| H/V Composite RMS | 0.484 | Scale | 4.5 : 1 |
| FCC Composite RMS | 0.530 | See Figure 2 for Mechanical Details | |

| | |
|----------------|---------------------|
| Antenna Model | 6014-14/1-DA |
| Pattern Type | Directional Azimuth |
| Pattern Number | AB3 |

Shively Labs

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

Figure 1B



KUMU Honolulu, Hawaii

38001
February 12, 2022

| | |
|-------------------------|-------|
| ————— H/V Composite RMS | 0.484 |
| FCC Composite RMS | 0.530 |

| | |
|-------------------------------------|-------------------|
| Frequency | 94.7 / 426.15 MHz |
| Plot | Relative Field |
| Scale | 4.5 : 1 |
| See Figure 2 for Mechanical Details | |

| | |
|----------------|---------------------------|
| Antenna Model | 6014-14/1-DA |
| Pattern Type | Directional H/V Composite |
| Pattern Number | AB3 |

Figure 1C

Tabulation of Horizontal Azimuth Pattern
KUMU Honolulu, Hawaii

| Azimuth | Rel Field | Azimuth | Rel Field |
|---------|-----------|---------|-----------|
| 0 | 0.182 | 180 | 0.136 |
| 10 | 0.271 | 190 | 0.106 |
| 20 | 0.372 | 200 | 0.092 |
| 30 | 0.486 | 210 | 0.082 |
| 40 | 0.614 | 220 | 0.073 |
| 45 | 0.678 | 225 | 0.062 |
| 50 | 0.731 | 230 | 0.087 |
| 60 | 0.838 | 240 | 0.118 |
| 70 | 0.943 | 250 | 0.138 |
| 80 | 0.994 | 260 | 0.153 |
| 90 | 0.992 | 270 | 0.154 |
| 100 | 0.938 | 280 | 0.143 |
| 110 | 0.839 | 290 | 0.115 |
| 120 | 0.711 | 300 | 0.087 |
| 130 | 0.597 | 310 | 0.061 |
| 135 | 0.532 | 315 | 0.063 |
| 140 | 0.474 | 320 | 0.076 |
| 150 | 0.343 | 330 | 0.093 |
| 160 | 0.234 | 340 | 0.106 |
| 170 | 0.171 | 350 | 0.130 |

Figure 1D

Tabulation of Vertical Azimuth Pattern
KUMU Honolulu, Hawaii

| Azimuth | Rel Field | Azimuth | Rel Field |
|---------|-----------|---------|-----------|
| 0 | 0.228 | 180 | 0.186 |
| 10 | 0.302 | 190 | 0.159 |
| 20 | 0.382 | 200 | 0.143 |
| 30 | 0.502 | 210 | 0.161 |
| 40 | 0.618 | 220 | 0.153 |
| 45 | 0.680 | 225 | 0.147 |
| 50 | 0.735 | 230 | 0.145 |
| 60 | 0.835 | 240 | 0.125 |
| 70 | 0.908 | 250 | 0.083 |
| 80 | 0.943 | 260 | 0.088 |
| 90 | 0.941 | 270 | 0.090 |
| 100 | 0.897 | 280 | 0.087 |
| 110 | 0.817 | 290 | 0.121 |
| 120 | 0.715 | 300 | 0.134 |
| 130 | 0.601 | 310 | 0.141 |
| 135 | 0.547 | 315 | 0.143 |
| 140 | 0.492 | 320 | 0.144 |
| 150 | 0.385 | 330 | 0.138 |
| 160 | 0.295 | 340 | 0.151 |
| 170 | 0.234 | 350 | 0.183 |

Figure 1E

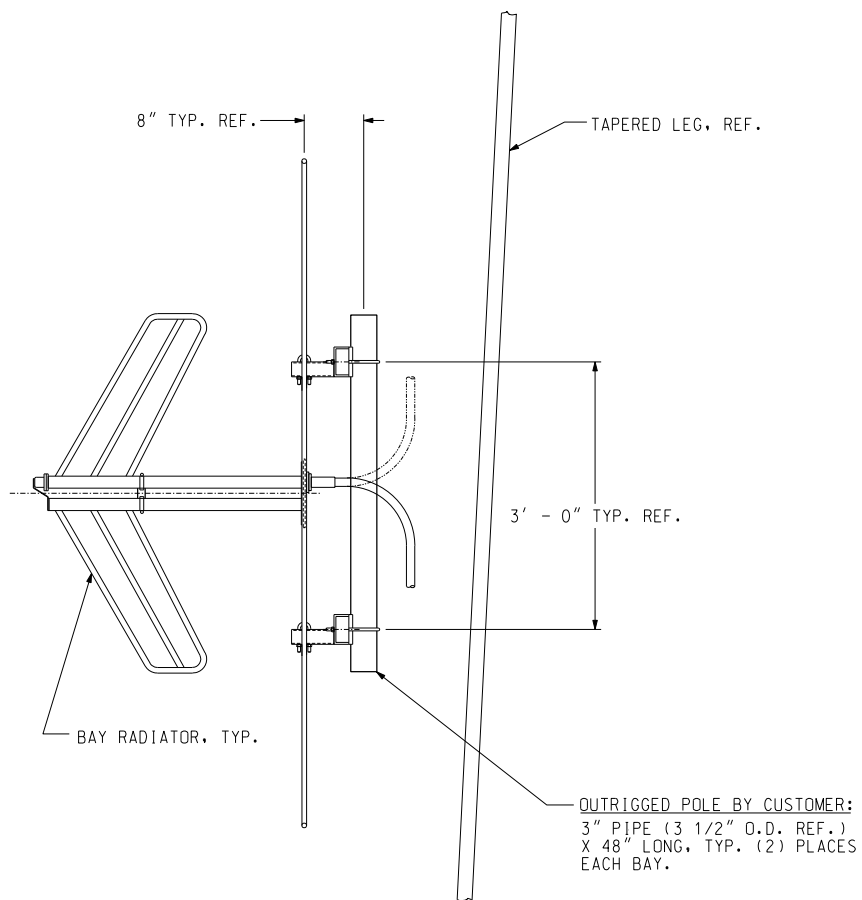
Tabulation of Composite Azimuth Pattern
KUMU Honolulu, Hawaii

| Azimuth | Rel Field | Azimuth | Rel Field |
|---------|-----------|---------|-----------|
| 0 | 0.228 | 180 | 0.186 |
| 10 | 0.302 | 190 | 0.159 |
| 20 | 0.382 | 200 | 0.143 |
| 30 | 0.502 | 210 | 0.161 |
| 40 | 0.618 | 220 | 0.153 |
| 45 | 0.680 | 225 | 0.147 |
| 50 | 0.735 | 230 | 0.145 |
| 60 | 0.838 | 240 | 0.125 |
| 70 | 0.943 | 250 | 0.138 |
| 80 | 0.994 | 260 | 0.153 |
| 90 | 0.992 | 270 | 0.154 |
| 100 | 0.938 | 280 | 0.143 |
| 110 | 0.839 | 290 | 0.121 |
| 120 | 0.715 | 300 | 0.134 |
| 130 | 0.601 | 310 | 0.141 |
| 135 | 0.547 | 315 | 0.143 |
| 140 | 0.492 | 320 | 0.144 |
| 150 | 0.385 | 330 | 0.138 |
| 160 | 0.295 | 340 | 0.151 |
| 170 | 0.234 | 350 | 0.183 |

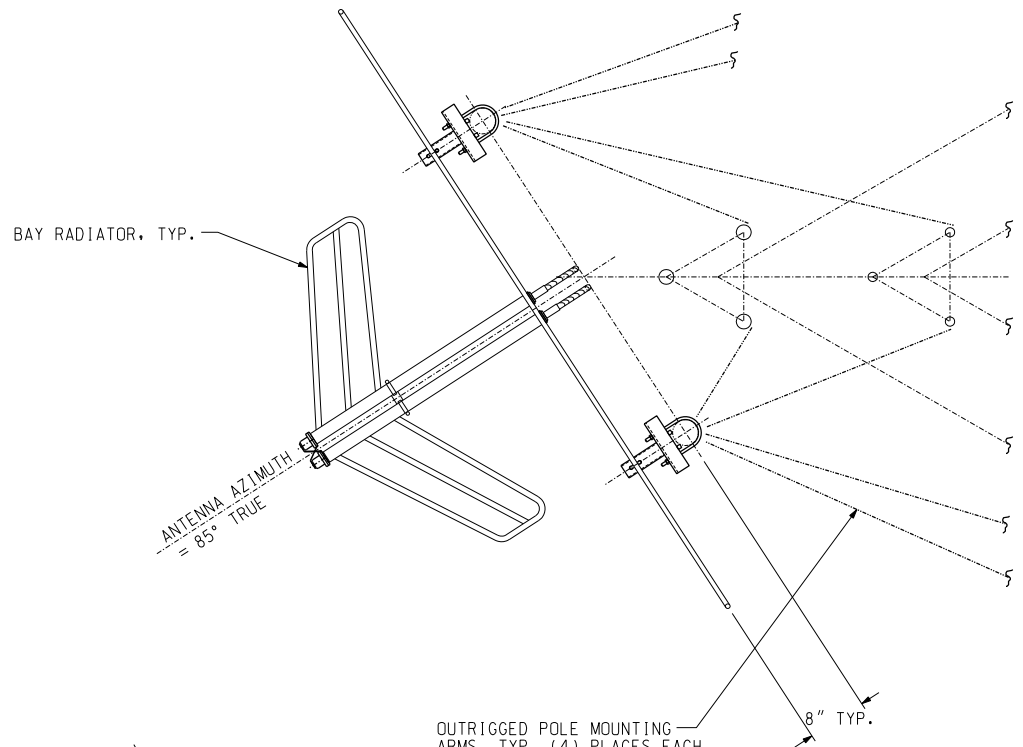
Figure 1F

Tabulation of FCC Directional Composite
KUMU Honolulu, Hawaii

| Azimuth | Rel Field | Azimuth | Rel Field |
|---------|-----------|---------|-----------|
| 0 | 0.325 | 180 | 0.275 |
| 10 | 0.390 | 190 | 0.245 |
| 20 | 0.470 | 200 | 0.220 |
| 30 | 0.560 | 210 | 0.205 |
| 40 | 0.655 | 220 | 0.200 |
| 50 | 0.755 | 230 | 0.200 |
| 60 | 0.850 | 240 | 0.200 |
| 70 | 0.955 | 250 | 0.200 |
| 80 | 1.000 | 260 | 0.200 |
| 90 | 1.000 | 270 | 0.200 |
| 100 | 1.000 | 280 | 0.200 |
| 110 | 0.900 | 290 | 0.200 |
| 120 | 0.800 | 300 | 0.200 |
| 130 | 0.705 | 310 | 0.200 |
| 140 | 0.605 | 320 | 0.200 |
| 150 | 0.510 | 330 | 0.215 |
| 160 | 0.410 | 340 | 0.235 |
| 170 | 0.330 | 350 | 0.270 |



SIDE VIEW



TOP VIEW

TOWER MAKE: PI-ROD, SELF-SUPPORTING
8' FACE WIDTH (STRAIGHT SECTION) TO
12' FACE WIDTH (TAPERED SECTION) IN
APPERATURE OF ANTENNA

| SHIVELY LABS | | | |
|---------------------------------------------------------|--------------------------|----------|-----------|
| A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE | | | |
| SHOP ORDER: | FREQUENCY: | SCALE: | DRAWN BY: |
| 32097 | 91.5 MHz HONOLULU, HI | N. T. S. | ASP |
| TITLE: | | | |
| MODEL-6014-14/1-(BROADBAND) DIRECTIONAL ANTENNA | | | |
| DATE: | APPROVED BY: | | |
| 10-24-14 | FIGURE 2 | | |

Antenna Mfg.: Shively Labs
Antenna Type: 6014-14/1-DA

Date: 2/16/2022

Station: KUMU

Beam Tilt 0

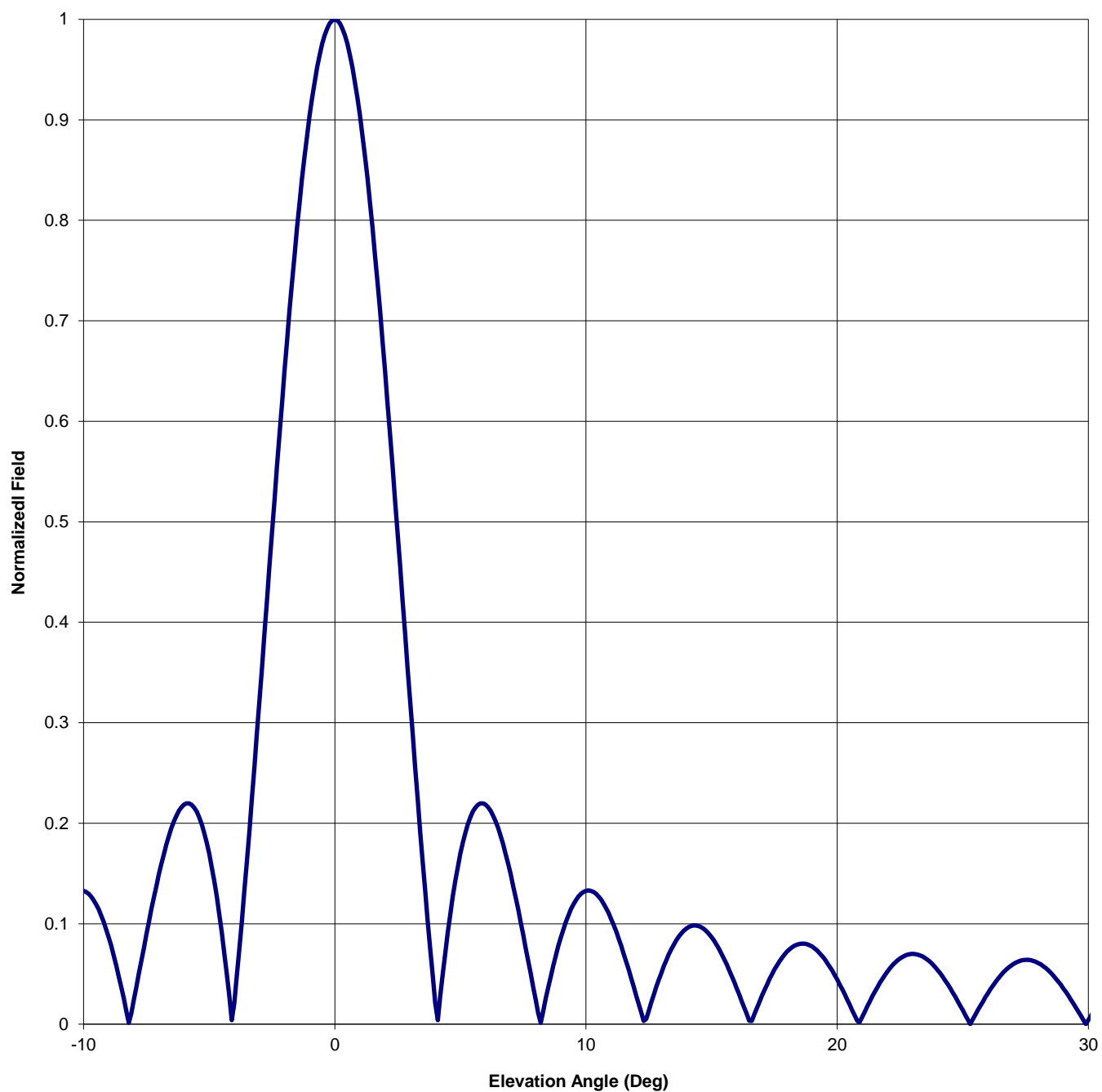
Frequency: 94.7

Gain (Max) 32.103 15.065 dB

Channel #: 234

Gain (Horizon) 32.103 15.065 dB

Figure: Figure 3



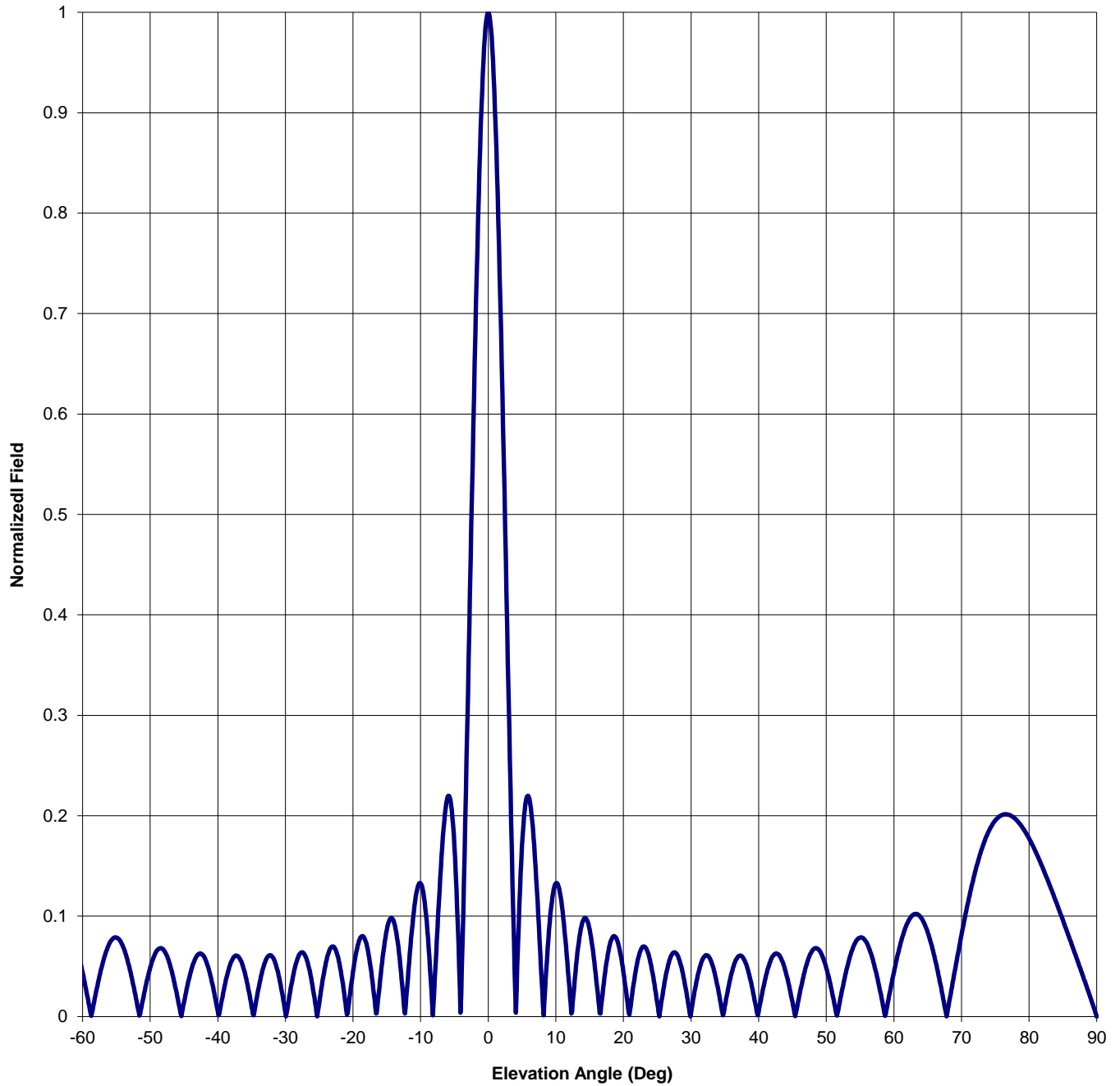
Antenna Mfg.: Shively Labs
Antenna Type: 6014-14/1-DA

Date: 2/16/2022

Station: KUMU
Frequency: 94.7
Channel #: 234

| | | |
|----------------|--------|-----------|
| Beam Tilt | 0 | |
| Gain (Max) | 32.103 | 15.065 dB |
| Gain (Horizon) | 32.103 | 15.065 dB |

Figure: Figure 3



Antenna Mfg.: Shively Labs
Antenna Type: 6014-14/1-DA

Date: 2/16/2022

Station: KUMU

Beam Tilt 0

Frequency: 94.7

Gain (Max) 32.103

15.065 dB

Channel #: 234

Gain (Horizon) 32.103

15.065 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 | 0.045 | 0 | 1.000 | 46 | 0.020 |
| -89 | 0.020 | -43 | 0.061 | 1 | 0.904 | 47 | 0.050 |
| -88 | 0.040 | -42 | 0.059 | 2 | 0.650 | 48 | 0.066 |
| -87 | 0.059 | -41 | 0.038 | 3 | 0.322 | 49 | 0.066 |
| -86 | 0.078 | -40 | 0.005 | 4 | 0.021 | 50 | 0.049 |
| -85 | 0.096 | -39 | 0.030 | 5 | 0.170 | 51 | 0.020 |
| -84 | 0.114 | -38 | 0.055 | 6 | 0.219 | 52 | 0.015 |
| -83 | 0.132 | -37 | 0.060 | 7 | 0.149 | 53 | 0.047 |
| -82 | 0.148 | -36 | 0.043 | 8 | 0.024 | 54 | 0.069 |
| -81 | 0.164 | -35 | 0.010 | 9 | 0.086 | 55 | 0.079 |
| -80 | 0.177 | -34 | 0.027 | 10 | 0.133 | 56 | 0.073 |
| -79 | 0.189 | -33 | 0.055 | 11 | 0.105 | 57 | 0.054 |
| -78 | 0.197 | -32 | 0.060 | 12 | 0.029 | 58 | 0.025 |
| -77 | 0.201 | -31 | 0.041 | 13 | 0.051 | 59 | 0.010 |
| -76 | 0.201 | -30 | 0.004 | 14 | 0.095 | 60 | 0.044 |
| -75 | 0.195 | -29 | 0.036 | 15 | 0.087 | 61 | 0.073 |
| -74 | 0.184 | -28 | 0.061 | 16 | 0.036 | 62 | 0.093 |
| -73 | 0.167 | -27 | 0.060 | 17 | 0.028 | 63 | 0.102 |
| -72 | 0.144 | -26 | 0.031 | 18 | 0.072 | 64 | 0.099 |
| -71 | 0.115 | -25 | 0.014 | 19 | 0.077 | 65 | 0.084 |
| -70 | 0.081 | -24 | 0.054 | 20 | 0.044 | 66 | 0.060 |
| -69 | 0.045 | -23 | 0.070 | 21 | 0.007 | 67 | 0.028 |
| -68 | 0.007 | -22 | 0.052 | 22 | 0.052 | 68 | 0.007 |
| -67 | 0.028 | -21 | 0.007 | 23 | 0.070 | 69 | 0.045 |
| -66 | 0.060 | -20 | 0.044 | 24 | 0.054 | 70 | 0.081 |
| -65 | 0.084 | -19 | 0.077 | 25 | 0.014 | 71 | 0.115 |
| -64 | 0.099 | -18 | 0.072 | 26 | 0.031 | 72 | 0.144 |
| -63 | 0.102 | -17 | 0.028 | 27 | 0.060 | 73 | 0.167 |
| -62 | 0.093 | -16 | 0.036 | 28 | 0.061 | 74 | 0.184 |
| -61 | 0.073 | -15 | 0.087 | 29 | 0.036 | 75 | 0.195 |
| -60 | 0.044 | -14 | 0.095 | 30 | 0.004 | 76 | 0.201 |
| -59 | 0.010 | -13 | 0.051 | 31 | 0.041 | 77 | 0.201 |
| -58 | 0.025 | -12 | 0.029 | 32 | 0.060 | 78 | 0.197 |
| -57 | 0.054 | -11 | 0.105 | 33 | 0.055 | 79 | 0.189 |
| -56 | 0.073 | -10 | 0.133 | 34 | 0.027 | 80 | 0.177 |
| -55 | 0.079 | -9 | 0.086 | 35 | 0.010 | 81 | 0.164 |
| -54 | 0.069 | -8 | 0.024 | 36 | 0.043 | 82 | 0.148 |
| -53 | 0.047 | -7 | 0.149 | 37 | 0.060 | 83 | 0.132 |
| -52 | 0.015 | -6 | 0.219 | 38 | 0.055 | 84 | 0.114 |
| -51 | 0.020 | -5 | 0.170 | 39 | 0.030 | 85 | 0.096 |
| -50 | 0.049 | -4 | 0.021 | 40 | 0.005 | 86 | 0.078 |
| -49 | 0.066 | -3 | 0.322 | 41 | 0.038 | 87 | 0.059 |
| -48 | 0.066 | -2 | 0.650 | 42 | 0.059 | 88 | 0.040 |
| -47 | 0.050 | -1 | 0.904 | 43 | 0.061 | 89 | 0.020 |
| -46 | 0.020 | 0 | 1.000 | 44 | 0.045 | 90 | 0.000 |
| -45 | 0.014 | | | 45 | 0.014 | | |