Shively Labs
a division of Howell Laboratories,Inc.

- An Employee-Owned Company -

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S.O. 22113

Report of Test 6014-2/2-(0.75)-DA

for

SEATTLE PUBLIC SCHOOLS

KNHC Seattle, WA

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6014-2/2-(0.75)-DA to meet the needs of KNHC and to comply with the requirements of the FCC construction permit, file number BPED-20000918AGG.

RESULTS:

The measured azimuth pattern for the 6014-2/2-(0.75)-DA is shown in Figure 1. Figure 1A shows the Tabulation of the Horizontal Polarization. Figure 1B shows the Tabulation of the Vertical Polarization. The calculated elevation pattern of the antenna is shown in Figure 3. Construction permit file number BPED-20000918AGG indicates that the Horizontal radiation component shall not exceed 8.5 kW at any azimuth and is restricted to the following values at the azimuths specified:

190-200 Degrees T: 0.43 kW

From Figure 1, the maximum radiation of the Horizontal component occurs at 43 Degrees T to 52 Degrees T. At the restricted azimuth of 190-200 Degrees T the Vertical component is 17.72 dB down from the maximum of 8.5 kW, or 0.14 kW. The R.M.S. of the Horizontal component is 0.640. The total Horizontal power gain is 2.534. The R.M.S. of the Vertical component is 0.580. The total Vertical power gain is 2.435. See Figure Four for calculations.

AMENDED FCC COMPOSITE PATTERN:

The R.M.S. of the measured composite pattern is 0.660. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.730. Therefore the measured pattern does not comply with the FCC requirement of 73.316(c)(ix)(A). In accordance with 73.1690(2)(ii) an amended composite pattern is attached as Figure 5 that will allow the above measured pattern to comply with the FCC requirement of 73.316(c)(ix)(A). Figure 5A shows the tabulations of the amended composite Figure 5. Eighty-five percent (85%) of the amended FCC composite pattern is 0.660. Therefore the RMS of the measured pattern will comply with the requirement of 73.316(c)(ix)(A).

METHOD OF DIRECTIONALIZATION:

The 6014-2/2-(0.75)-DA was mounted on outrigged poles of exact scale mounted off a Valmont Microflect tapered tower section. The spacing of the antenna to the tower was varied to achieve the horizontal and vertical patterns shown in Figure 1. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BPED-20000918AGG, a single level of the 6014-2/2-(0.75)-DA was set up on the Howell Laboratories scale model antenna pattern measuring range. A scale of 4.5:1 was used.

SUPERVISION:

Mr. Surette was graduated from Lowell Technological Institute, Lowell, Massachusetts in 1973 with the degree of Bachelor of Science in Electrical Engineering. He has been directly involved with design and development of broadcast antennas, filter systems and RF transmission components since 1974, as an RF Engineer for six years with the original Shively Labs in Raymond, ME and for a short period of time with Dielectric Communications. He is currently an Associate Member of the AFCCE and a Senior Member of IEEE. He has authored a chapter on filters and combining systems for the latest edition of the CRC Electronics Handbook and for the 9th Edition of the NAB Handbook.

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.

The control building is equipped with:

Hewlett Packard Model 8753 Network Analyzer
PC Based Controller
Hewlett Packard 7550A Graphics Plotter

The test equipment is calibrated to ANSI/NCSL Z540-1-1994.

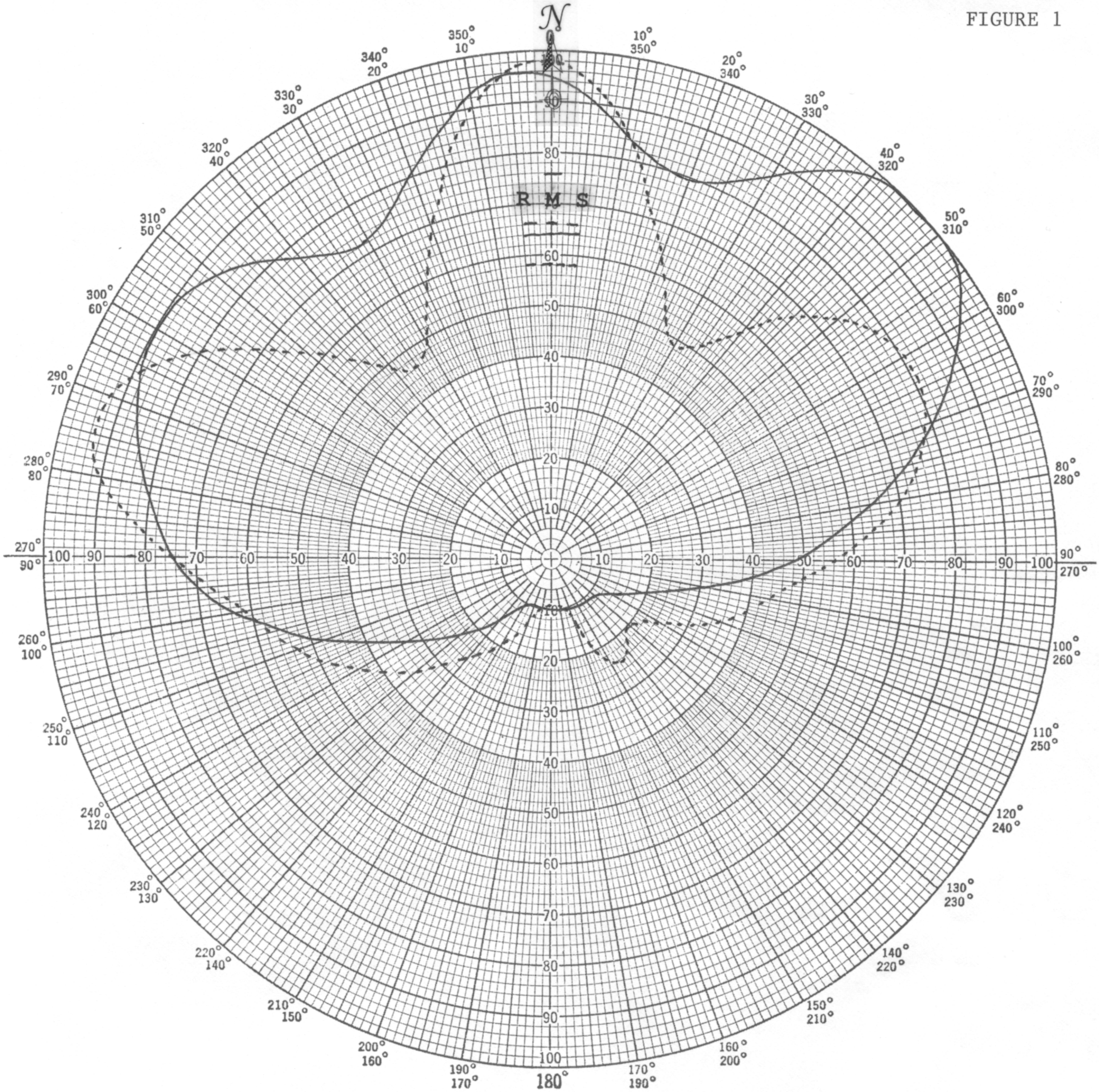
TEST PROCEDURES:

The corner reflector is mounted so that the horizontal and vertical azimuth patterns are measured independently by rotating the corner reflector by 90 degrees. The network analyzer was set to 402.75 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 1.

Respectfully submitted by:

Robert A. Surette
Manager of RF Engineering
S/O 22113
March 13, 2002

FIGURE 1



Shively Labs

PROJECT NAME KNHC SEATTLE, WA

PROJECT NUMBER 22113 DATE 12/20/01

MODEL (X) FULL SCALE ( ) FREQUENCY 402.75/89.5 MHz

POLARIZATION HORIZ (——); VERT (----)

CURVE PLOTTED IN: VOLTAGE (X) POWER( ) DB( )

OBSERVER RAS

ANTENNA TYPE 6014-2/2-(0.75)-DA

PATTERN TYPE DIRECTIONAL AZIMUTH

REMARKS: SEE FIGURE 2 FOR MECHANICAL DETAILS

Figure 1A

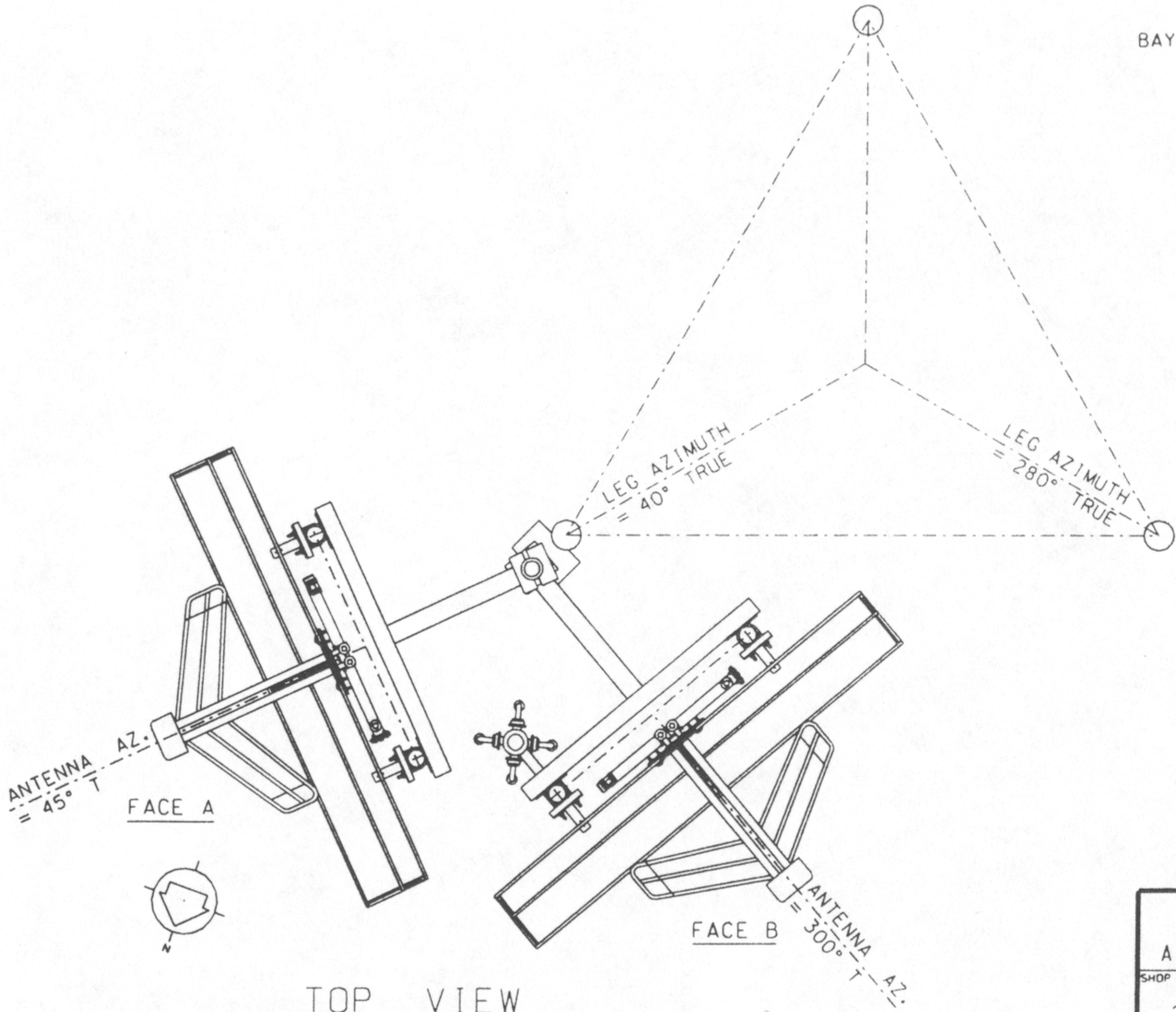
S/O 22113
TABULATION OF HORIZONTAL POLARIZATION
KNHC Seattle, WA

DEGREE	RELATIVE FIELD	DEGREE	RELATIVE FIELD
0	0.950	180	0.100
10	0.850	190	0.100
20	0.795	200	0.100
30	0.870	210	0.100
40	0.990	220	0.160
45	1.000	225	0.200
50	1.000	230	0.235
60	0.935	240	0.330
70	0.810	250	0.480
80	0.650	260	0.640
90	0.490	270	0.745
100	0.320	280	0.810
110	0.200	290	0.870
120	0.140	300	0.900
130	0.115	310	0.860
135	0.110	315	0.820
140	0.110	320	0.770
150	0.105	330	0.725
160	0.105	340	0.810
170	0.100	350	0.930

Figure 1B

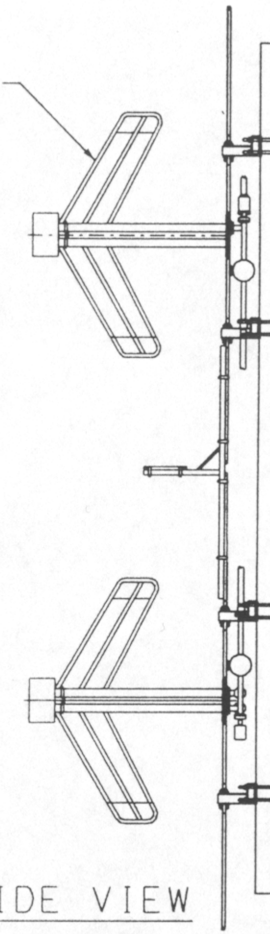
S/O 22113
TABULATION OF VERTICAL POLARIZATION
KNHC Seattle, WA

DEGREE	RELATIVE FIELD	DEGREE	RELATIVE FIELD
0	0.980	180	0.095
10	0.860	190	0.100
20	0.640	200	0.130
30	0.480	210	0.200
40	0.590	220	0.260
45	0.680	225	0.300
50	0.740	230	0.350
60	0.805	240	0.435
70	0.790	250	0.530
80	0.710	260	0.615
90	0.560	270	0.745
100	0.440	280	0.905
110	0.360	290	0.925
120	0.250	300	0.805
130	0.205	310	0.630
135	0.210	315	0.550
140	0.240	320	0.490
150	0.230	330	0.490
160	0.110	340	0.700
170	0.095	350	0.900



TOP VIEW

OUTRIGGED POLES (BY CUSTOMER)
MOUNTED OFF A VALMONT MICROFLECT
TAPERED TOWER SECTION



SIDE VIEW

SHIVELY LABS

A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE

SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY: APL / APPROVED BY:
22113A	89.5 MHz	N.T.S.	

TITLE: MODEL-6014-2/2-.75SS-DIRECTIONAL ANTENNA

DATE: 01-21-02

FIGURE 2

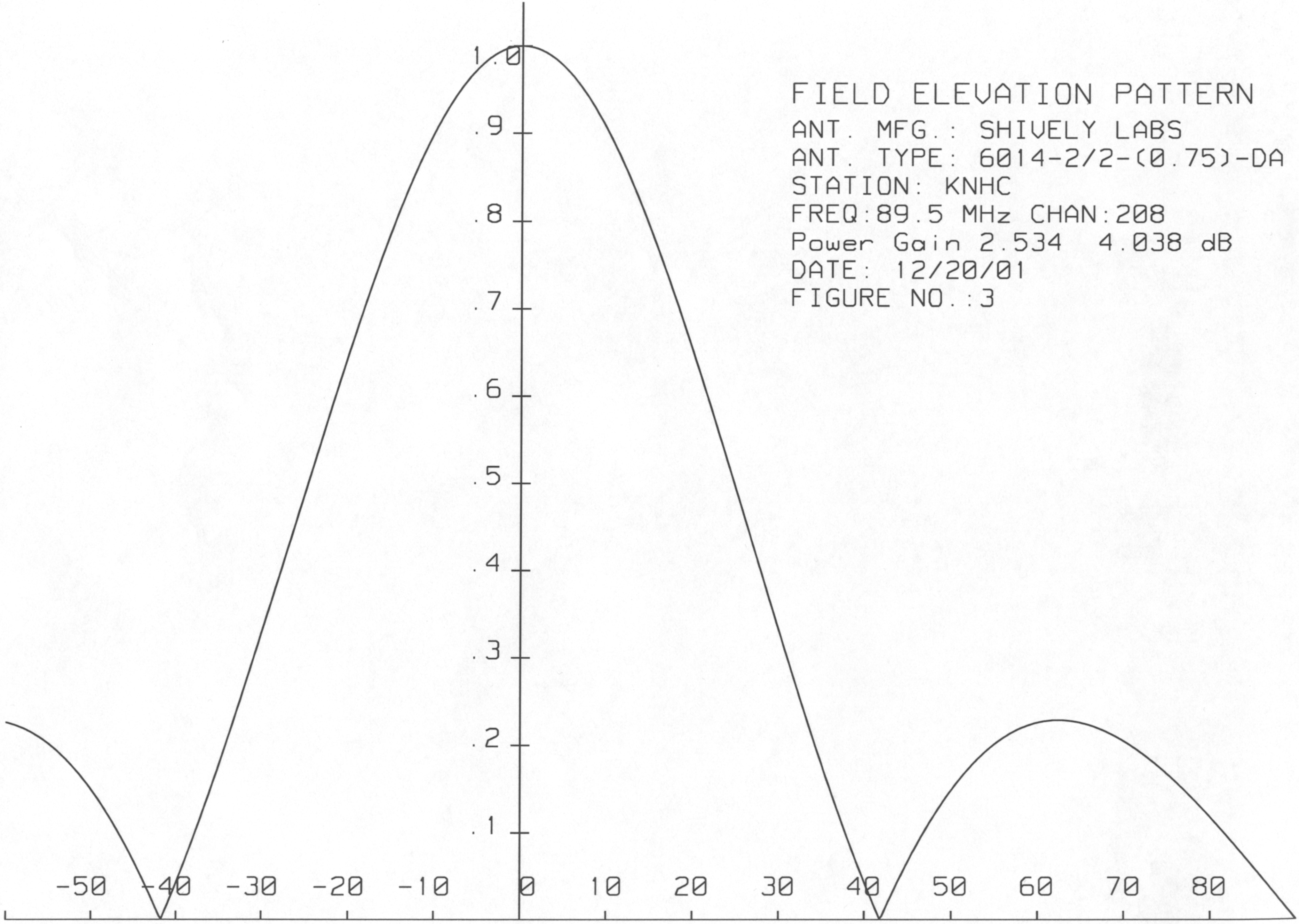

FIELD ELEVATION PATTERN
ANT. MFG.: SHIVELY LABS
ANT. TYPE: 6014-2/2-(0.75)-DA
STATION: KNHC
FREQ:89.5 MHz CHAN:208
Power Gain 2.534 4.038 dB
DATE: 12/20/01
FIGURE NO.:3
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80

FIGURE 4

S.O. 22113

VALIDATION OF GAIN CALCULATION

KNHC SEATTLE, WA

MODEL 6014-2/2-(0.75)-DA

Elevation Gain of 6014-2/2-(0.75)-DA equals 0.941

The RMS values are calculated utilizing the data of a planimeter.

Horizontal RMS divided by Vertical RMS equals
$0.640 \div 0.580 = 1.103$

Elevation Gain of Horizontal Component equals
$0.941 \times 1.103 = 1.038$

Elevation Gain of Vertical Component equals
$0.941 \times 0.906 = 0.853$

Horizontal Azimuth Gain equals $1/(RMS)^2$
$1/(0.640)^2 = 2.441$

Vertical Azimuth Gain equals $1/(RMS \div Max\ Vert)^2$
$1/(0.58 \div 0.98)^2 = 2.855$

* **Total Horizontal Gain is Elevation Gain times Azimuth Gain**
  $1.038 \times 2.441 = 2.534$

* **Total Vertical Gain is Elevation Gain times Azimuth Gain**
  $0.853 \times 2.855 = 2.435$

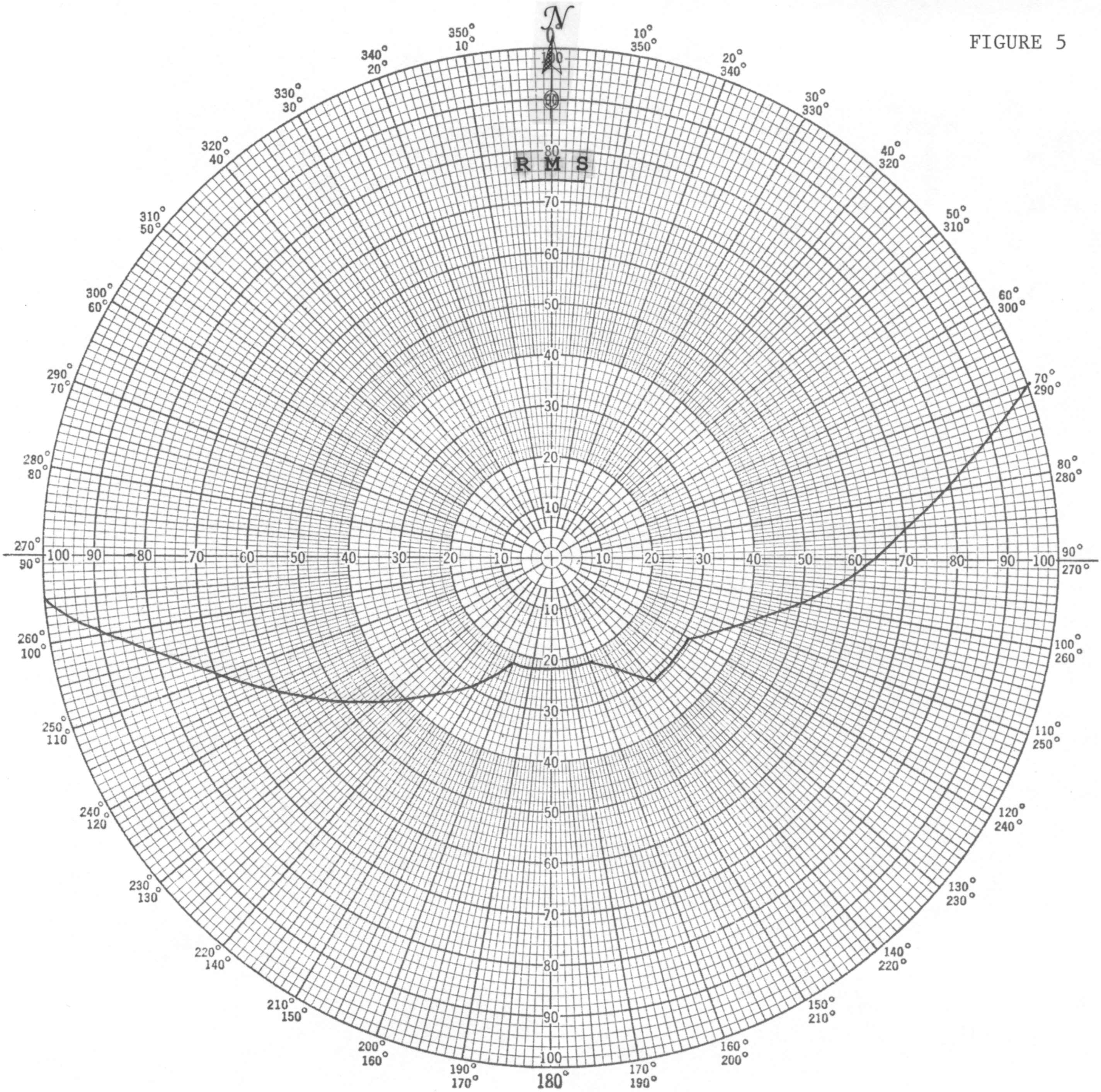
ERP divided by Horizontal Gain equals Antenna Input Power
$8.5\ kW \div 2.534 = 3.354\ kW$

Antenna Input Power times Vertical Gain equals Vertical ERP
$3.354\ kW \times 2.435 = 8.168\ kW$

Maximum Value of the Vertical Component squared times the Maximum ERP equals the Vertical ERP
$(0.980)^2 \times 8.5\ kW = 8.163\ kW$

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

FIGURE 5



Shively Labs

PROJECT NAME KNHC SEATTLE, WA

PROJECT NUMBER 22113 DATE 3/11/02

MODEL (X) FULL SCALE ( ) FREQUENCY 402.75/89.5 MHz

POLARIZATION COMPOSITE

CURVE PLOTTED IN: VOLTAGE (X) POWER( ) DB( )

OBSERVER RAS

ANTENNA TYPE 6014-2/2-(0.75)-DA

PATTERN TYPE DIRECTIONAL AZIMUTH

REMARKS:

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Figure 5A

S/O 22113
TABULATION OF COMPOSITE PATTERN
KNHC SEATTLE, WA

DEGREE	RELATIVE FIELD	DEGREE	RELATIVE FIELD
0	1.000	180	0.224
10	1.000	190	0.224
20	1.000	200	0.224
30	1.000	210	0.282
40	1.000	220	0.355
45	1.000	225	0.395
50	1.000	230	0.447
60	1.000	240	0.562
70	1.000	250	0.708
80	0.794	260	0.891
90	0.631	270	1.000
100	0.501	280	1.000
110	0.398	290	1.000
120	0.316	300	1.000
130	0.316	310	1.000
135	0.316	315	1.000
140	0.316	320	1.000
150	0.251	330	1.000
160	0.224	340	1.000
170	0.224	350	1.000