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S.O. 20,723

Report of Test 6014-6/2-DA

for

PACIFIC LUTHERAN UNIVERSITY, INC.

KPLU-FM TACOMA, WA

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6014-6/2-DA to meet the needs of KPLU-FM and to comply with the requirements of the FCC construction permit, file number BPED-19991014ABD.

RESULTS:

The measured azimuth pattern for the 6014-6/2-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-19991014ABD indicates that the Horizontal radiation component shall not exceed 50 kW at any azimuth and is restricted to the following values at the azimuths specified:

90 to 110 Degrees T: 2.0 kW

From Figure 1, the maximum radiation of the Horizontal component occurs at 208 Degrees T to 231 Degrees T and at 333 Degrees T to 351 Degrees T. At the restricted azimuth of 90 to 110 Degrees T the Vertical component is 14.199 dB down from the maximum of 50 kW, or 1.9 kW.

The R.M.S. of the Horizontal component is 0.720. The total Horizontal power gain is 6.389. The R.M.S. of the Vertical component is 0.700. The total Vertical power gain is 6.261. See Figure Four for calculations. The R.M.S. of the FCC composite pattern is 0.760. Therefore this Pattern complies with the FCC requirement of 73.316(c)(9).

METHOD OF DIRECTIONALIZATION:

The 6014-6/2-DA was mounted on a tower of exact scale to a Valmont-Microflect 300 ft. self-supporting tower. The spacing of the antenna to the tower was varied to achieve the vertical pattern shown in Figure 1. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BPED-19991014ABD, a single level of the 6014-6/2-DA was set up on the Howell Laboratories scale model antenna pattern measuring range. A scale of 4.5:1 was used.

SUPERVISION:

The tests were carried out under the direction of Robert A. Surette, Manager of RF Engineering. 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 both full size and scale model pattern measurements since 1974 as an RF Engineer with Shively Labs and with Dielectric Communications (a unit of General Signal). He is currently an Associate Member of the Association of Federal Communications Consulting Engineers and a Member of IEEE.

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 8505 Network Analyzer
PC Based Controller
Hewlett Packard 7550A Graphics Plotter

The test equipment is calibrated to MIL-STD-45662.

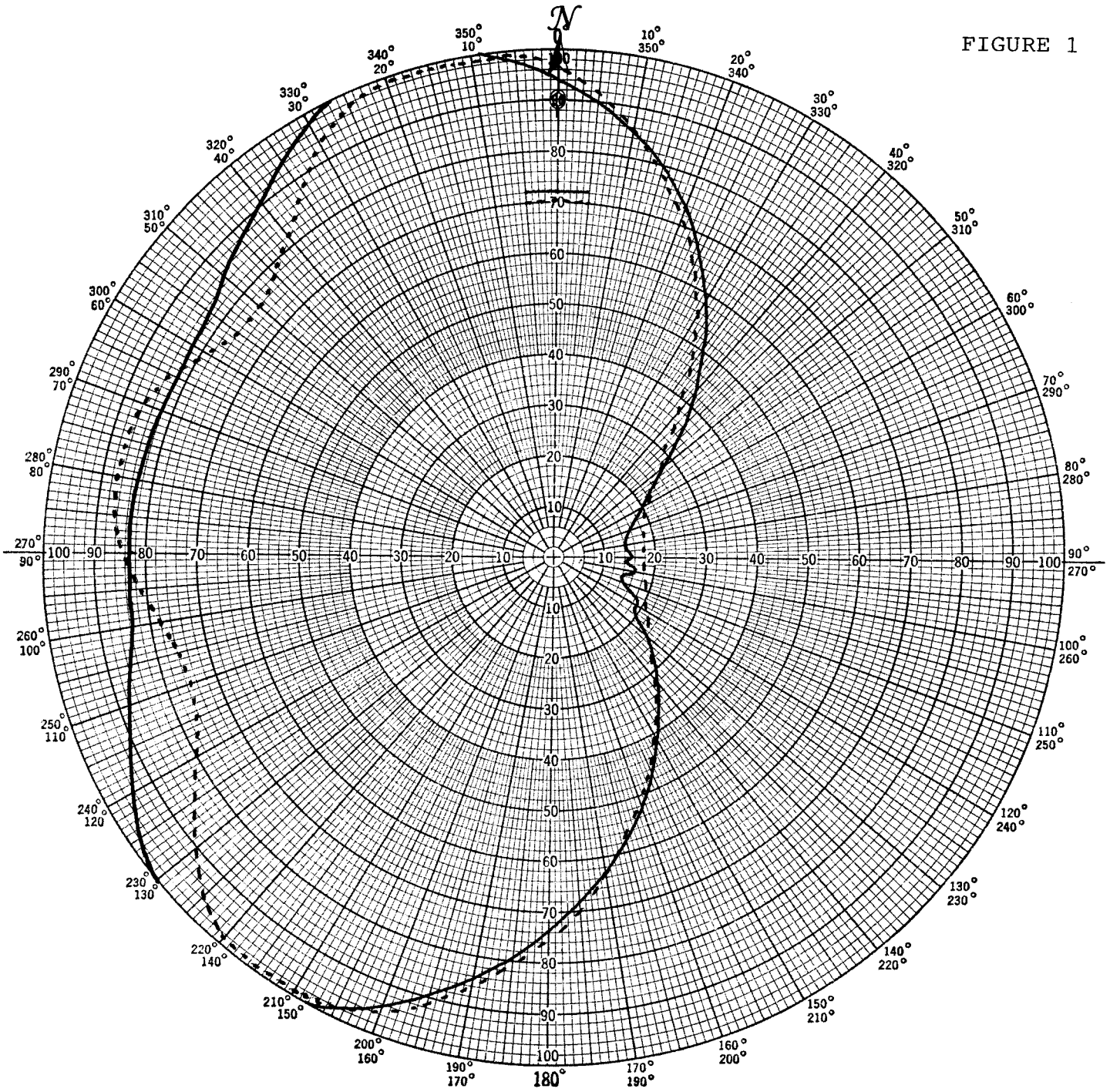
TEST PROCEDURES:

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 398.25 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 20,723
July 13, 2000

FIGURE 1



Shively Labs

PROJECT NAME KPLU-FM TACOMA, WA

PROJECT NUMBER 20,723 DATE 7/13/00

MODEL (X) FULL SCALE ( ) FREQUENCY 398.25/88.5 MHz

POLARIZATION HORIZ (———); VERT (----)

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

OBSERVER RAS

ANTENNA TYPE 6014-6/2-DA

PATTERN TYPE DIRECTIONAL AZIMUTH

REMARKS: SEE FIGURE 2 FOR MECHANICAL DETAILS

Figure 1A

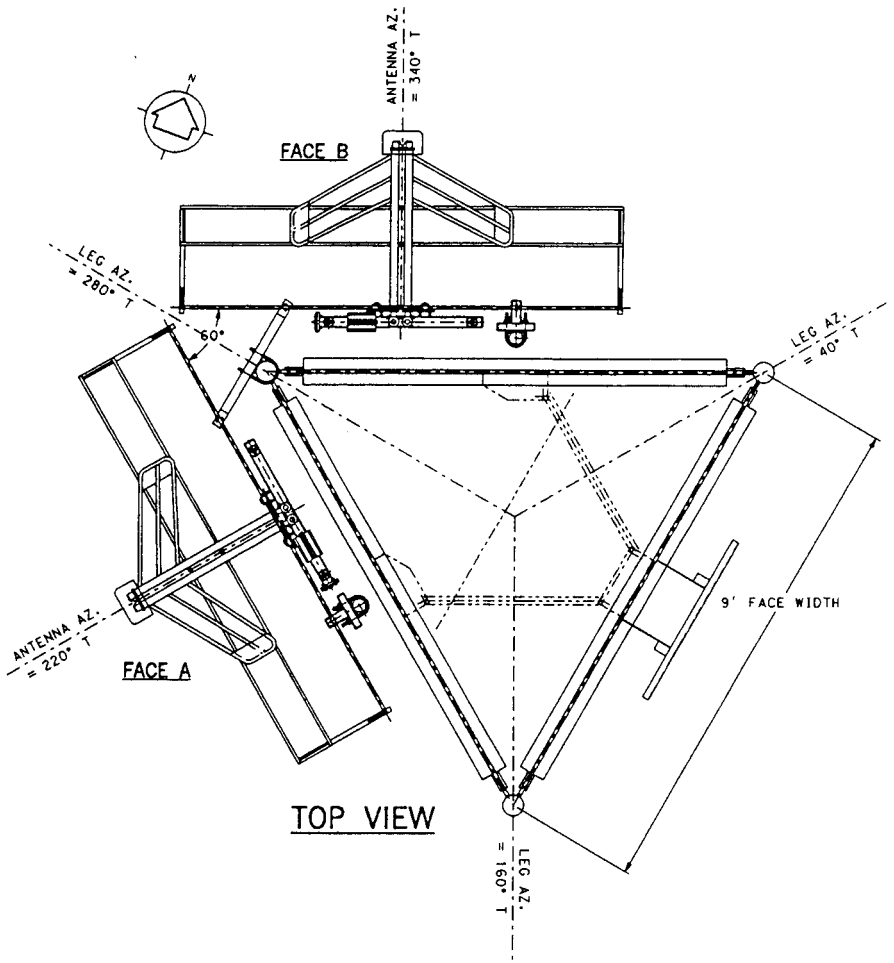
S/O 20,723
TABULATION OF HORIZONTAL POLARIZATION
KPLU-FM TACOMA, WA

DEGREE	RELATIVE FIELD	DEGREE	RELATIVE FIELD
0	0.940	180	0.735
10	0.855	190	0.845
20	0.740	200	0.945
30	0.590	210	1.000
40	0.430	220	1.000
45	0.360	225	1.000
50	0.290	230	1.000
60	0.200	240	0.945
70	0.155	250	0.880
80	0.145	260	0.835
90	0.155	270	0.830
100	0.160	280	0.830
110	0.150	290	0.820
120	0.190	300	0.820
130	0.240	310	0.855
135	0.290	315	0.880
140	0.330	320	0.905
150	0.420	330	0.980
160	0.530	340	1.000
170	0.630	350	1.000

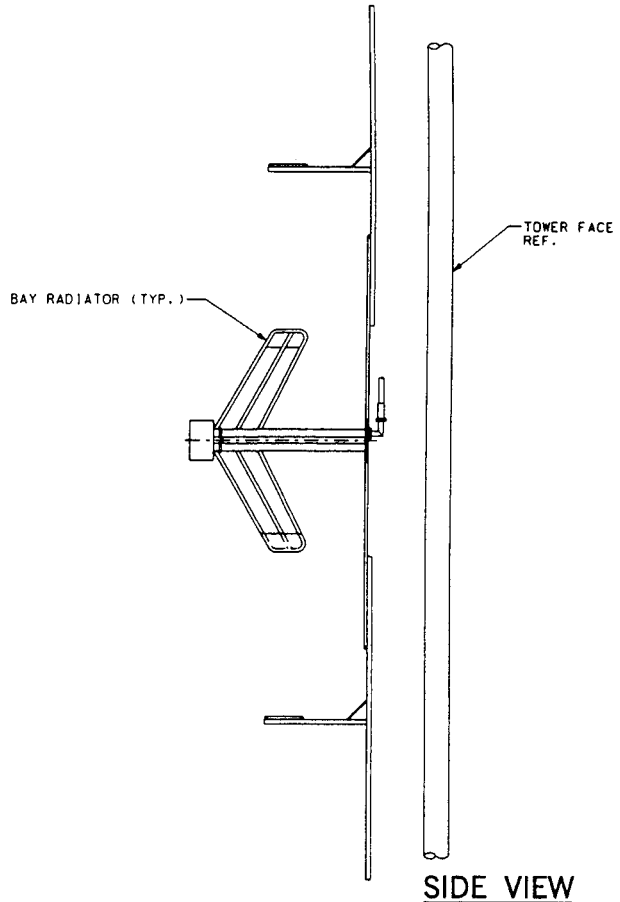
Figure 1B

S/O 20,723
TABULATION OF VERTICAL POLARIZATION
KPLU-FM TACOMA, WA

DEGREE	RELATIVE FIELD	DEGREE	RELATIVE FIELD
0	0.965	180	0.755
10	0.855	190	0.860
20	0.710	200	0.955
30	0.560	210	0.990
40	0.370	220	0.985
45	0.300	225	0.955
50	0.275	230	0.905
60	0.210	240	0.800
70	0.190	250	0.755
80	0.180	260	0.780
90	0.180	270	0.845
100	0.180	280	0.870
110	0.195	290	0.860
120	0.210	300	0.790
130	0.245	310	0.760
135	0.280	315	0.780
140	0.320	320	0.820
150	0.410	330	0.935
160	0.515	340	0.990
170	0.635	350	0.990



TOP VIEW



SIDE VIEW

TOWER BY: VALMONT-MICROFLECT
MODEL: 300 FT. SELF-SUPPORTING

SHIVELY LABS

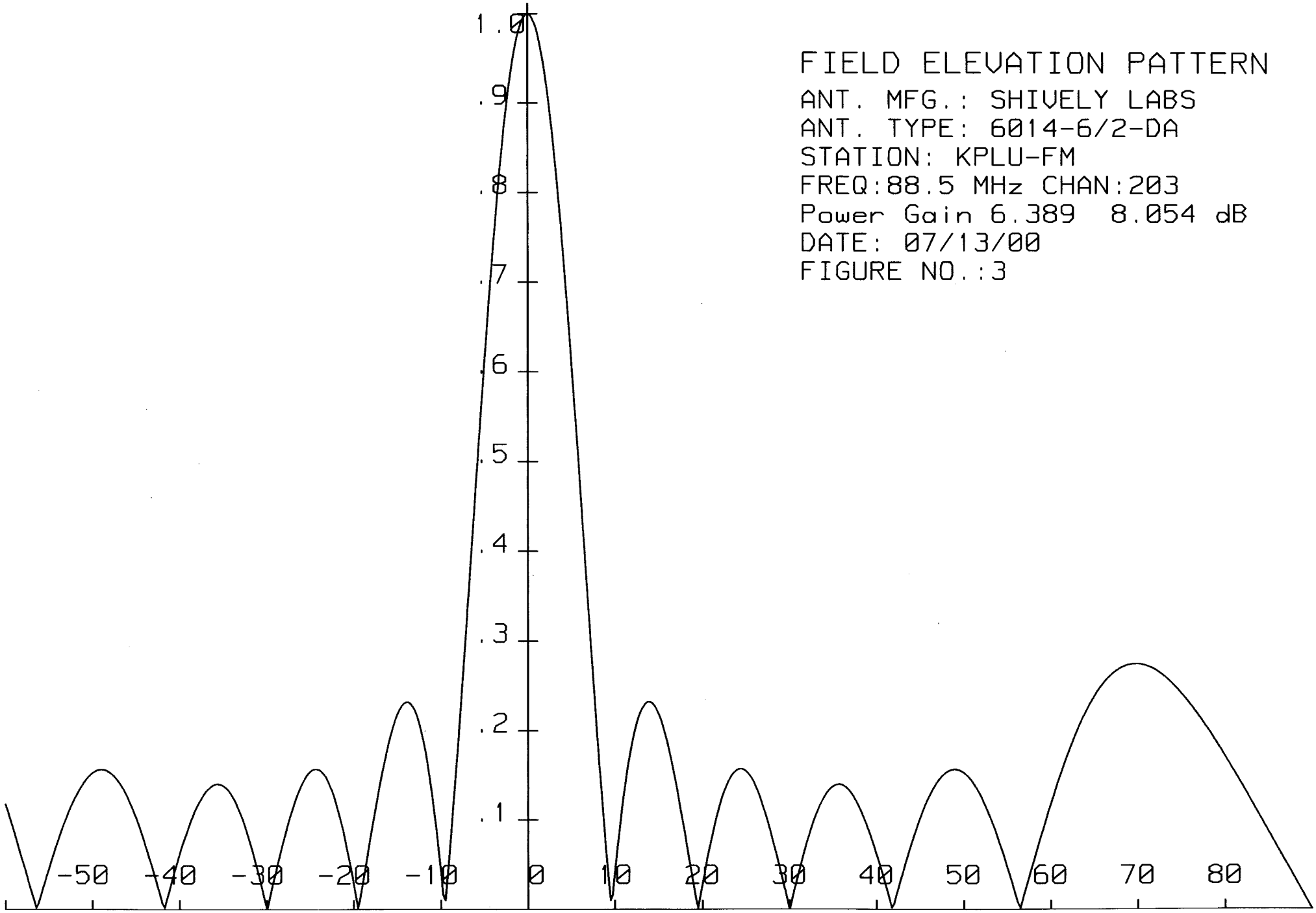
A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE

SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY:
20723A	88 - 108 MHz	N.T.S.	ASP
			APPROVED BY:

TITLE: MODEL-6014-6/2-DIRECTIONAL ANTENNA

DATE: 9-29-99

FIGURE 2



FIELD ELEVATION PATTERN
ANT. MFG.: SHIVELY LABS
ANT. TYPE: 6014-6/2-DA
STATION: KPLU-FM
FREQ:88.5 MHz CHAN:203
Power Gain 6.389 8.054 dB
DATE: 07/13/00
FIGURE NO.:3

FIGURE 4

S.O. 20,723

VALIDATION OF GAIN CALCULATION

KPLU-FM Tacoma, WA

MODEL 6014-6/2-DA

Elevation Gain of 6014-6/2-DA equals 3.22

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

Horizontal RMS divided by Vertical RMS equals
$0.720 \div 0.700 = 1.0286$

Elevation Gain of Horizontal Component equals
$3.22 \times 1.0286 = 3.3120$

Elevation Gain of Vertical Component equals
$3.22 \times 1/1.0286 = 3.1304$

Horizontal Azimuth Gain equals $1/(\text{RMS})^2$
$1/(0.720)^2 = 1.929$

Vertical Azimuth Gain equals $1/(\text{RMS} \div \text{Max Vert})^2$
$1/(0.700 \div 0.990)^2 = 2.000$

*** Total Horizontal Gain is Elevation Gain times Azimuth Gain**
$3.3120 \times 1.929 = 6.389$

*** Total Vertical Gain is Elevation Gain times Azimuth Gain**
$3.1304 \times 2.000 = 6.261$

ERP divided by Horizontal Gain equals Antenna Input Power
$50 \text{ kW} \div 6.389 = 7.826 \text{ kW}$

Antenna Input Power times Vertical Gain equals Vertical ERP
$7.826 \text{ kW} \times 6.261 = 48.999 \text{ kW}$

Maximum Value of the Vertical Component squared times the Maximum ERP equals the Vertical ERP
$(0.990)^2 \times 50 \text{ kW} = 49.005 \text{ kW}$

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

COUGAR MOUNTAIN
SYSTEM LOSSES
S/O 20,723

FREQ.	COMBINER INSERTION LOSS	POWER SPLITTER LOSS	TRANSMISSION LINE LOSS	TOTAL SYSTEM LOSS
88.5	-.283	-.038	-.302	-.623
97.3	-.341	-.038	-.316	-.695
98.1	-.414	-.038	-.319	-.771
99.9	-.307	-.038	-.322	-.667
100.7	-.429	-.038	-.323	-.790
103.7	-.431	-.038	-.328	-.797
107.7	-.390	-.038	-.335	-.763

2/24/00