Shively Labs
a division of Howell Laboratories,Inc.

P. O. Box 389 Harrison Rd.,
Bridgton, Maine 04009 USA

- An Employee-Owned Company -

(207) 647-3327
888-SHIVELY
Fax: (207) 647-8273
E-mail: sales@shively.com
Web site: www.shively.com

S.O. 26024

Report of Test 6810-1R-DA

for

WASHINGTON STATE UNIVERSITY

KMWS 89.7 MHz MOUNT VERNON, WA

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-1R-DA to meet the needs of KMWS and to comply with the requirements of the FCC construction permit, file number BPED-20020408ABO.

RESULTS:

The measured azimuth pattern for the 6810-1R-DA is shown in Figure 1. Figure 1A shows the Tabulation of the Horizontal Polarization. Figure 1B shows the Tabulation of the Vertical Polarization. Figure 1C shows the Tabulation of the FCC Composite Pattern. The calculated elevation pattern of the antenna is shown in Figure 3. Construction permit file number BPED-20020408ABO indicates that the Horizontal radiation component shall not exceed 1.5 kW at any azimuth and is restricted to the following values at the azimuths specified:

290-320 Degrees T: 0.05 kW

From Figure 1, the maximum radiation of the Horizontal component occurs at 103 Degrees T to 137 Degrees T. At the restricted azimuth of 290-320 Degrees T the Horizontal component is 16.19 dB down from the maximum of 1.5 kW, or 0.04 kW.

The R.M.S. of the Horizontal component is 0.694. The total Horizontal power gain is 0.948. The R.M.S. of the Vertical component is 0.690. The total Vertical power gain is 0.929. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.767. The R.M.S. of the measured composite pattern is 0.720. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.652. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

The 6810-1R-DA was mounted on a tower of exact scale to the Pi-Rod tower at the KMWS site. The spacing of the antenna to the tower was varied to achieve the vertical pattern shown in Figure 1. A horizontal parasitic element was placed directly under the bay. The position of this horizontal parasitic element was changed until the horizontal pattern shown in Figure 1 was achieved. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BPED-20020408ABO, a single level of the 6810-1R-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 403.65 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 1.

Respectfully submitted by:

Robert A. Surette
Director of Sales Engineering
S/O 26024
September 14, 2007

Shively Labs

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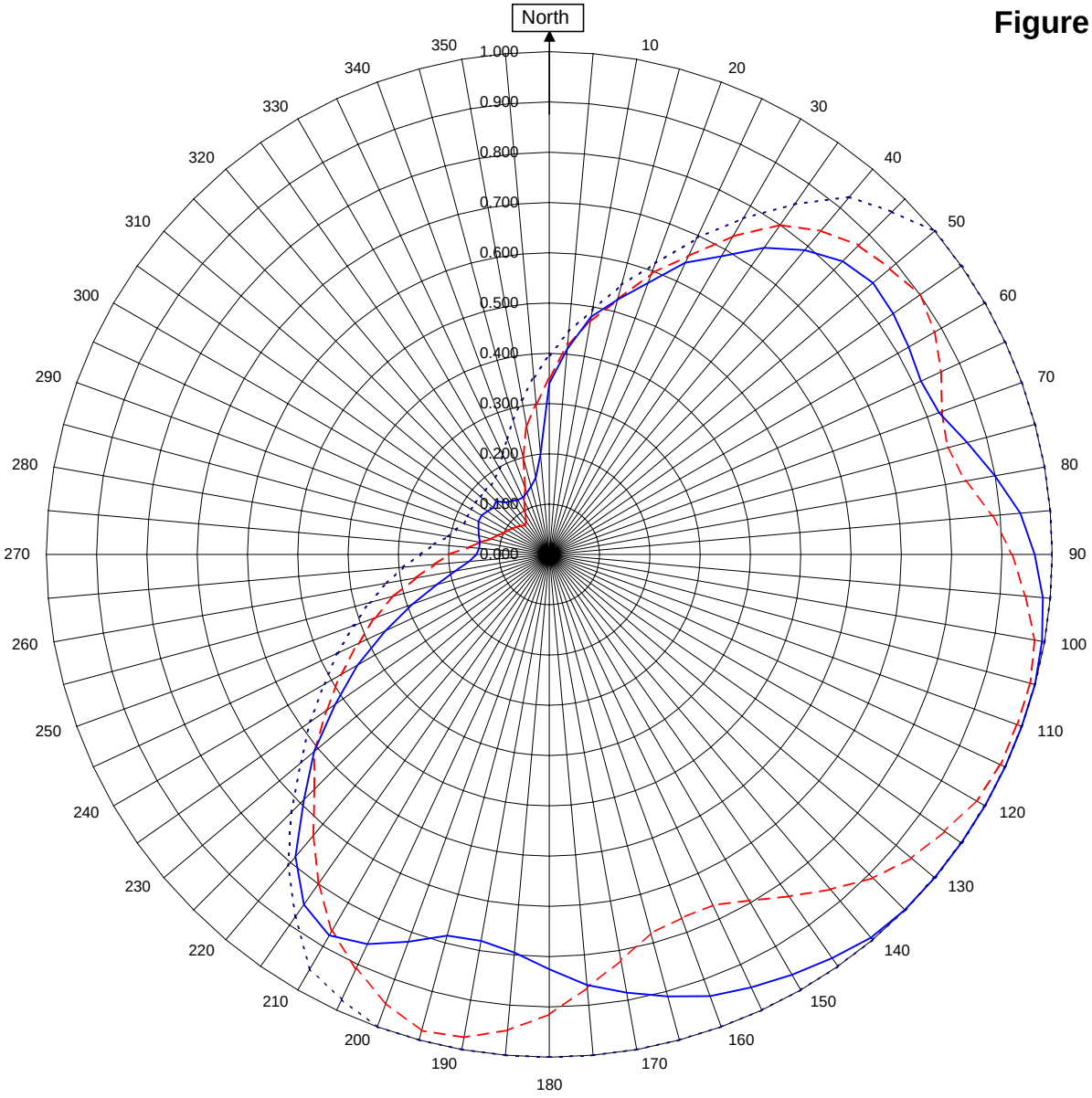
Figure 1



KMWS Mt. Vernon, WA

26024

September 14, 2007

Horizontal RMS	0.694
Vertical RMS	0.690
H/V Composite RMS	0.720
FCC Composite RMS	0.767

Frequency	89.7 / 403.65 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6810-1R-DA
Pattern Type	Directional Azimuth

Figure 1a

Tabulation of Horizontal Azimuth Pattern
KMWS Mt. Vernon, WA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.340	180	0.825
10	0.480	190	0.780
20	0.575	200	0.820
30	0.685	210	0.875
40	0.790	220	0.785
45	0.825	225	0.690
50	0.840	230	0.610
60	0.825	240	0.440
70	0.825	250	0.290
80	0.900	260	0.190
90	0.965	270	0.145
100	0.995	280	0.140
110	1.000	290	0.150
120	1.000	300	0.155
130	1.000	310	0.145
135	1.000	315	0.150
140	0.995	320	0.135
150	0.965	330	0.125
160	0.935	340	0.130
170	0.885	350	0.155

Figure 1b

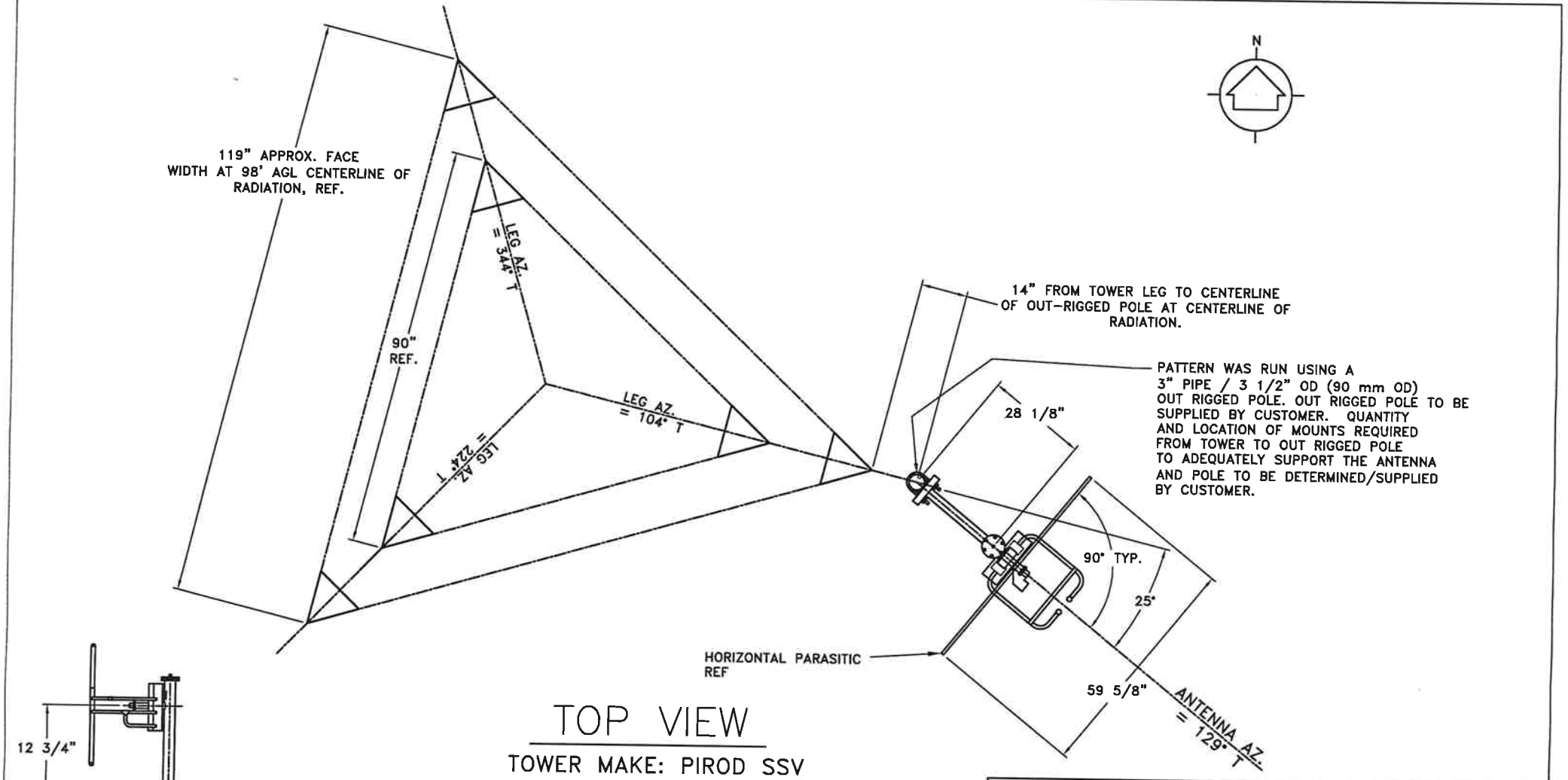
Tabulation of Vertical Azimuth Pattern
KMWS Mt. Vernon, WA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.350	180	0.915
10	0.470	190	0.975
20	0.595	200	0.950
30	0.730	210	0.865
40	0.840	220	0.730
45	0.870	225	0.660
50	0.885	230	0.610
60	0.885	240	0.480
70	0.830	250	0.370
80	0.840	260	0.270
90	0.920	270	0.200
100	0.980	280	0.140
110	0.990	290	0.110
120	0.980	300	0.095
130	0.940	310	0.085
135	0.910	315	0.080
140	0.870	320	0.075
150	0.795	330	0.095
160	0.770	340	0.140
170	0.820	350	0.260

Figure 1c

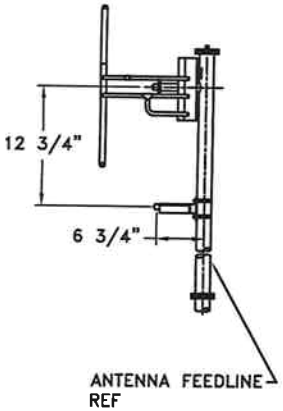
Tabulation of FCC Directional Composite
KMWS Mt. Vernon, WA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.396	180	1.000
10	0.494	190	1.000
20	0.616	200	1.000
30	0.772	210	0.952
40	0.928	220	0.808
50	1.000	230	0.644
60	1.000	240	0.516
70	1.000	250	0.414
80	1.000	260	0.328
90	1.000	270	0.256
100	1.000	280	0.204
110	1.000	290	0.180
120	1.000	300	0.180
130	1.000	310	0.180
140	1.000	320	0.180
150	1.000	330	0.196
160	1.000	340	0.244
170	1.000	350	0.312



TOP VIEW

TOWER MAKE: PIROD SSV

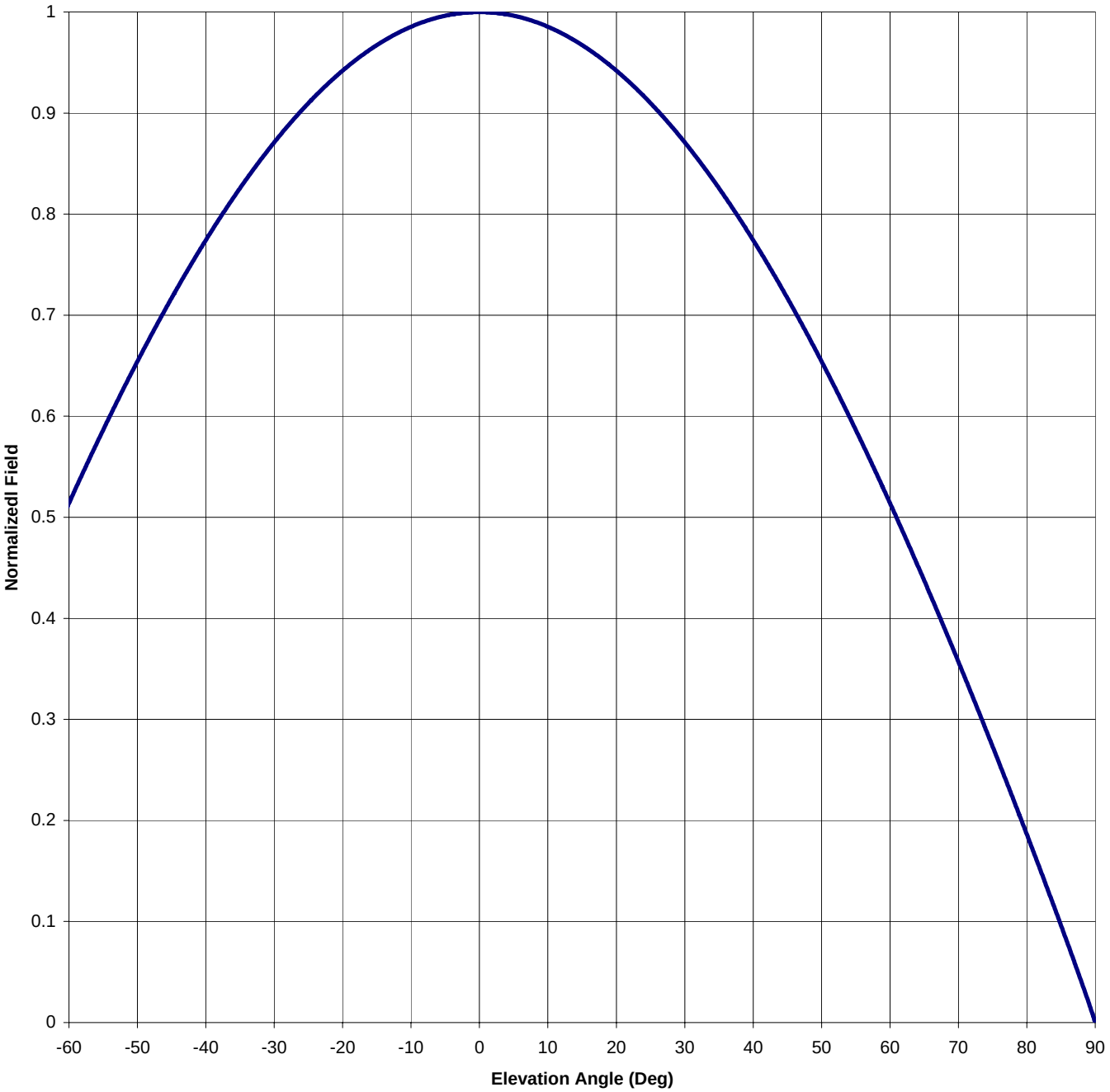


SIDE VIEW

ANTENNA HEADING: 129° TRUE NORTH

SHIVELY LABS A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE			
SHOP ORDER: 26024	FREQUENCY: 89.7 MHz.	SCALE: N.T.S.	DRAWN BY: ASP APPROVED BY:
MODEL: 6810-1R-DIRECTIONAL ANTENNA			
DATE: 9/14/07	FIGURE 2		

Antenna Mfg.:	**Shively Labs**			**Date:**	**9/14/2007**
Antenna Type:	**6810-1R-DA**				
Station:	**KMWS**	**Beam Tilt**	**0**		
Frequency:	**89.7**	**Gain (Max)**	**0.948**	**-0.232**	**dB**
Channel #:	**209**	**Gain (Horizon)**	**0.948**	**-0.232**	**dB**
Figure:	**3**				



Antenna Mfg.: Shively Labs **Date:** 9/14/2007

Antenna Type: 6810-1R-DA

Station: KMWS **Beam Tilt** 0

Frequency: 89.7 **Gain (Max)** 0.948 -0.232 dB

Channel #: 209 **Gain (Horizon)** 0.948 -0.232 dB

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. 26024 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

KMWS Mount Vernon, WA

6810-1R-DA

Elevation Gain of Antenna 0.454

The RMS values are calculated utilizing the data of a planimeter

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

H RMS 0.694 V RMS 0.69 H/V Ratio 1.006

Elevation Gain of Horizontal Component 0.457

Elevation Gain of Vertical Component 0.451

Horizontal Azimuth Gain equals 1/(RMS)SQ. 2.076

Vertical Azimuth Gain equals 1/(RMS/Max Vert)SQ. 2.059
Max. Vertical 0.99

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

Total Horizontal Power Gain = **0.948**

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

Total Vertical Power Gain = **0.929**

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ERP divided by Horizontal Power Gain equals Antenna Input Power

1.5 KW ERP Equals 1.582 KW Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

1.582 KW Times 0.929 KW Equals 1.470 KW ERP

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

0.99 Equals 1.470 KW Vertical ERP

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