

## **S.O. 27470**

### **Report of Test 6810-5R-DA**

**for**

**WHITE PARK BROADCASTING, INC.**

**KRAN 103.3 MHz Warren AFB, WY**

### **OBJECTIVE:**

The objective of this test was to demonstrate the directional characteristics of a 6810-5R-DA to meet the needs of KRAN and to comply with the requirements of the FCC construction permit, file number BMPH-20090309ABS.

### **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

Figure 5 - Amended Composite Azimuth Pattern

Figure 5A-Tabulation of the Amended Composite Azimuth Pattern

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

Construction permit file number BMPH-20090309ABS indicates that the Horizontal radiation component shall not exceed 37.0 kW at any azimuth and is restricted to the following values at the azimuths specified:

170 Degrees T: 15.0 kW

From Figure 1A, the maximum radiation of the Horizontal component occurs at 55 Degrees T, 224 Degrees T to 230 Degrees T and 285 Degrees T to 295 Degrees T. At the restricted azimuth of 170 Degrees T the Vertical component is 4.1 dB down from the maximum of 37.0 kW, or 14.6 kW.

The R.M.S. of the Horizontal component is 0.745. The total Horizontal power gain is 5.192. The R.M.S. of the Vertical component is 0.698. The total Vertical power gain is 4.726. See Figure 4 for calculations.

**AMENDED FCC COMPOSITE PATTERN:**

The R.M.S. of the measured composite pattern is 0.965. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.820. Therefore the measured pattern does not comply with the FCC requirement of 73.316(c)(ix)(A). In accordance with 73.1690(c)(2)(ii) an amended composite pattern with an R.M.S. value of 0.944 is attached as Figure 5. Figure 5A shows the tabulations of the amended composite pattern. This new composite pattern allows the above measured pattern to comply with the FCC requirement of 73.316(c)(ix)(A).

**METHOD OF DIRECTIONALIZATION:**

One bay of the 6810-5R-DA was mounted on a tower of precise scale to the Sabre tower at the KRAN site. The spacing of the antenna to the tower was varied and a vertical parasitic element was attached to the interbay feedline to achieve the vertical pattern shown in Figure 1A. 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 1A was achieved. See Figure 2 for mechanical details.

**METHOD OF MEASUREMENT:**

As allowed by the construction permit, file number BMPH-20090309ABS, a single level of the 6810-5R-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 9<sup>th</sup> and 10<sup>th</sup> Editions 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 464.85 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:

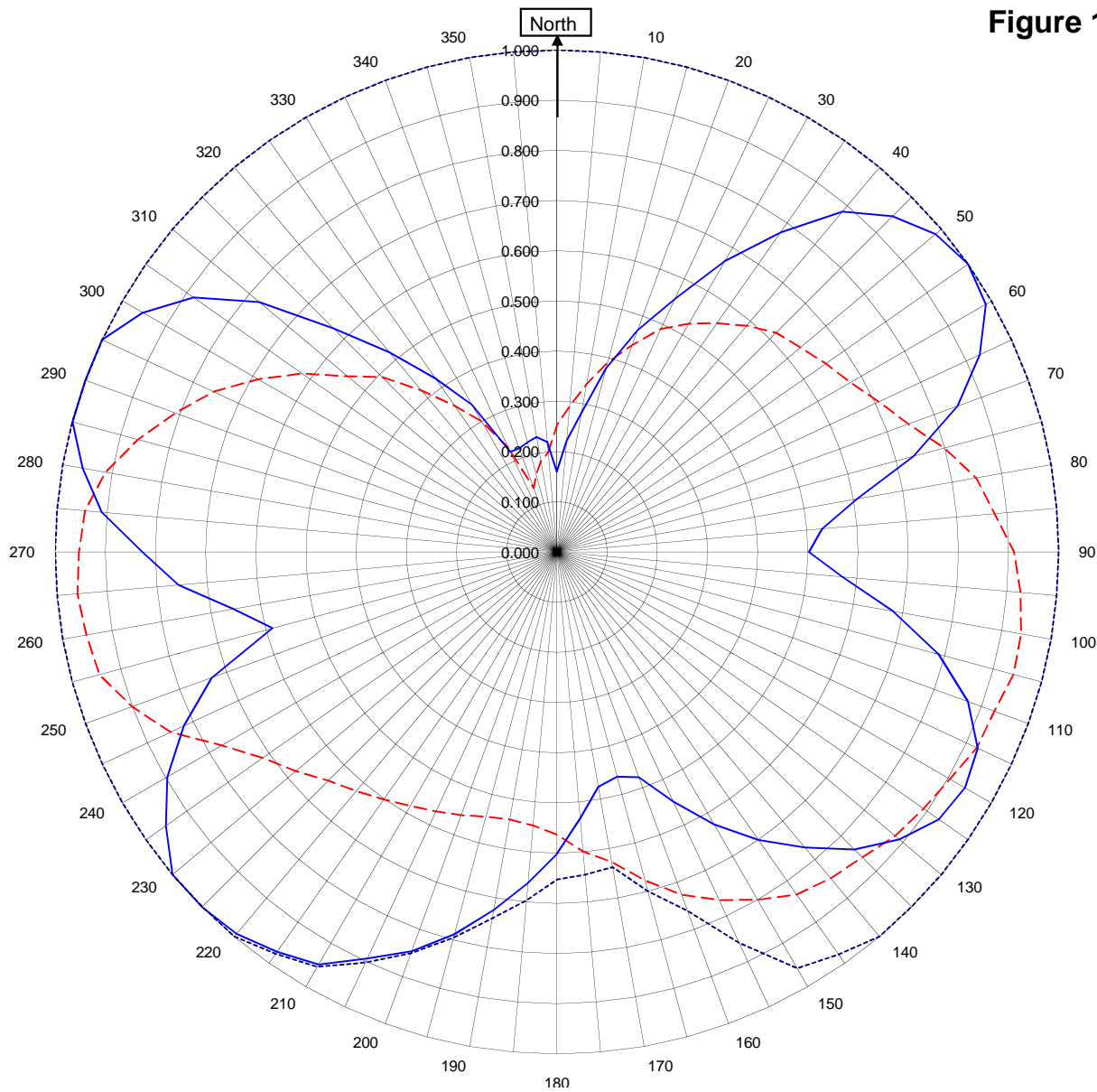


Robert A. Surette  
Director of Sales Engineering  
S/O 27470  
May 18, 2009

# Shively Labs

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

Figure 1a



## KRAN Warren AFB, WY

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May 18, 2009

Horizontal RMS	0.745
Vertical RMS	0.698
H/V Composite RMS	0.805
FCC Composite RMS	0.965

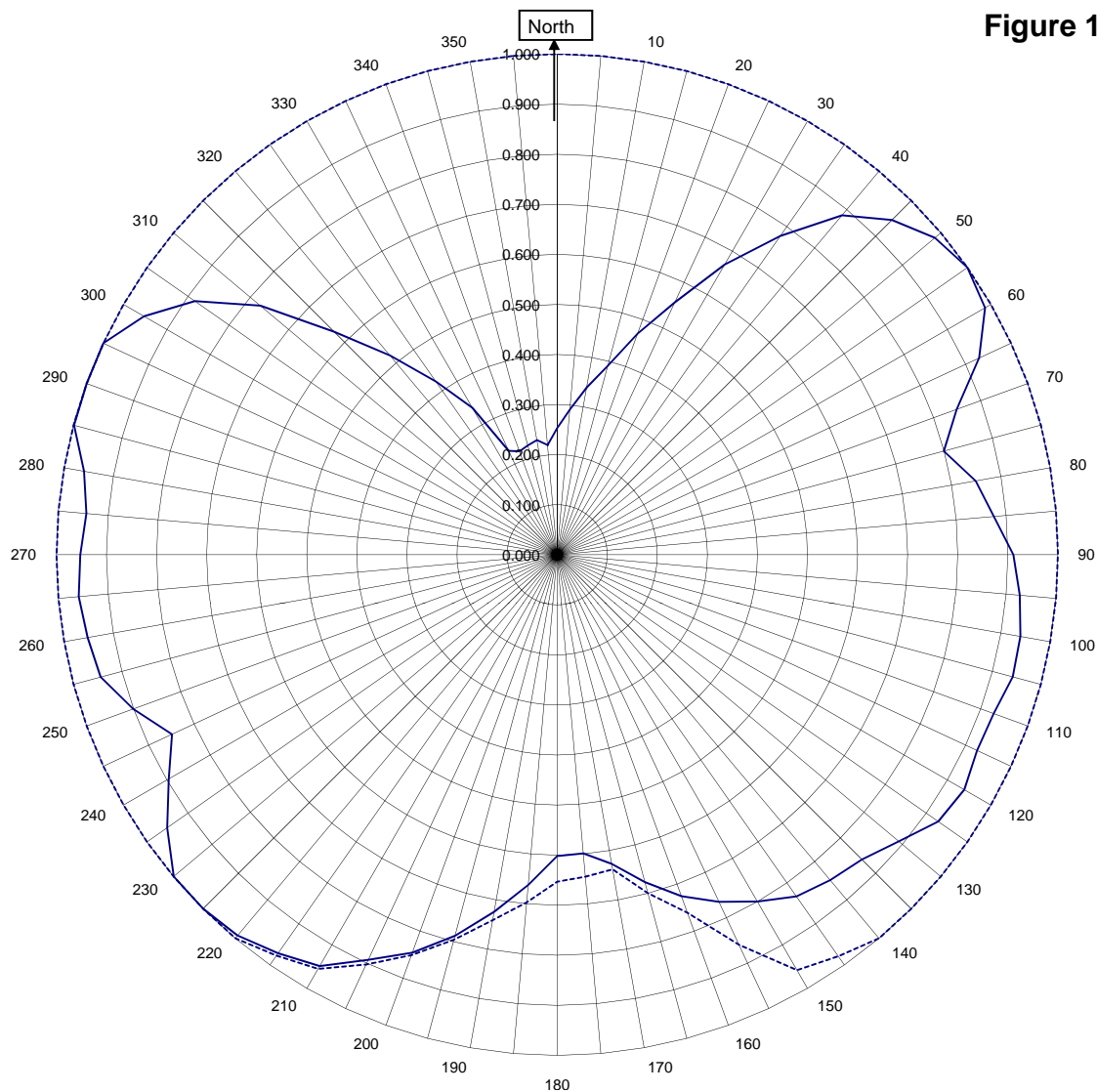
Frequency	103.3 / 464.85 mHz
Plot	Relative Field
Scale	4.5 : 1
See Figure 2 for Mechanical Details	

Antenna Model	6810-5R-EF-DA Patt 07-A
Pattern Type	Directional Azimuth

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Figure 1b



KRAN Warren AFB, WY

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May 18, 2009

—————H/V Composite RMS	0.805
.....FCC Composite RMS	0.965

Frequency	103.3 / 464.85 mHz
Plot	Relative Field
Scale	4.5 : 1
See Figure 2 for Mechanical Details	

Antenna Model	6810-5R-EF-DA Patt 07-A
Pattern Type	Directional H/V Composite

Figure 1c

Tabulation of Horizontal Azimuth Pattern  
KRAN Warren AFB, WY

Azimuth	Rel Field	Azimuth	Rel Field
0	0.160	180	0.602
10	0.282	190	0.724
20	0.470	200	0.846
30	0.669	210	0.949
40	0.885	220	0.993
45	0.946	225	1.000
50	0.985	230	1.000
60	0.987	240	0.896
70	0.849	250	0.732
80	0.606	260	0.654
90	0.502	270	0.826
100	0.680	280	0.960
110	0.871	290	1.000
120	0.939	300	0.953
130	0.891	310	0.774
135	0.838	315	0.630
140	0.768	320	0.519
150	0.626	330	0.339
160	0.477	340	0.220
170	0.475	350	0.233

Figure 1d

Tabulation of Vertical Azimuth Pattern  
KRAN Warren AFB, WY

Azimuth	Rel Field	Azimuth	Rel Field
0	0.253	180	0.563
10	0.339	190	0.541
20	0.438	200	0.558
30	0.525	210	0.584
40	0.588	220	0.622
45	0.618	225	0.644
50	0.633	230	0.679
60	0.676	240	0.771
70	0.746	250	0.901
80	0.849	260	0.952
90	0.911	270	0.953
100	0.939	280	0.914
110	0.928	290	0.809
120	0.904	300	0.688
130	0.880	310	0.544
135	0.861	315	0.493
140	0.848	320	0.420
150	0.800	330	0.301
160	0.726	340	0.136
170	0.627	350	0.183

Figure 1e

Tabulation of Composite Azimuth Pattern  
KRAN Warren AFB, WY

Azimuth	Rel Field	Azimuth	Rel Field
0	0.253	180	0.602
10	0.339	190	0.724
20	0.470	200	0.846
30	0.669	210	0.949
40	0.885	220	0.993
45	0.946	225	1.000
50	0.985	230	1.000
60	0.987	240	0.896
70	0.849	250	0.901
80	0.849	260	0.952
90	0.911	270	0.953
100	0.939	280	0.960
110	0.928	290	1.000
120	0.939	300	0.953
130	0.891	310	0.774
135	0.861	315	0.630
140	0.848	320	0.519
150	0.800	330	0.339
160	0.726	340	0.220
170	0.627	350	0.233

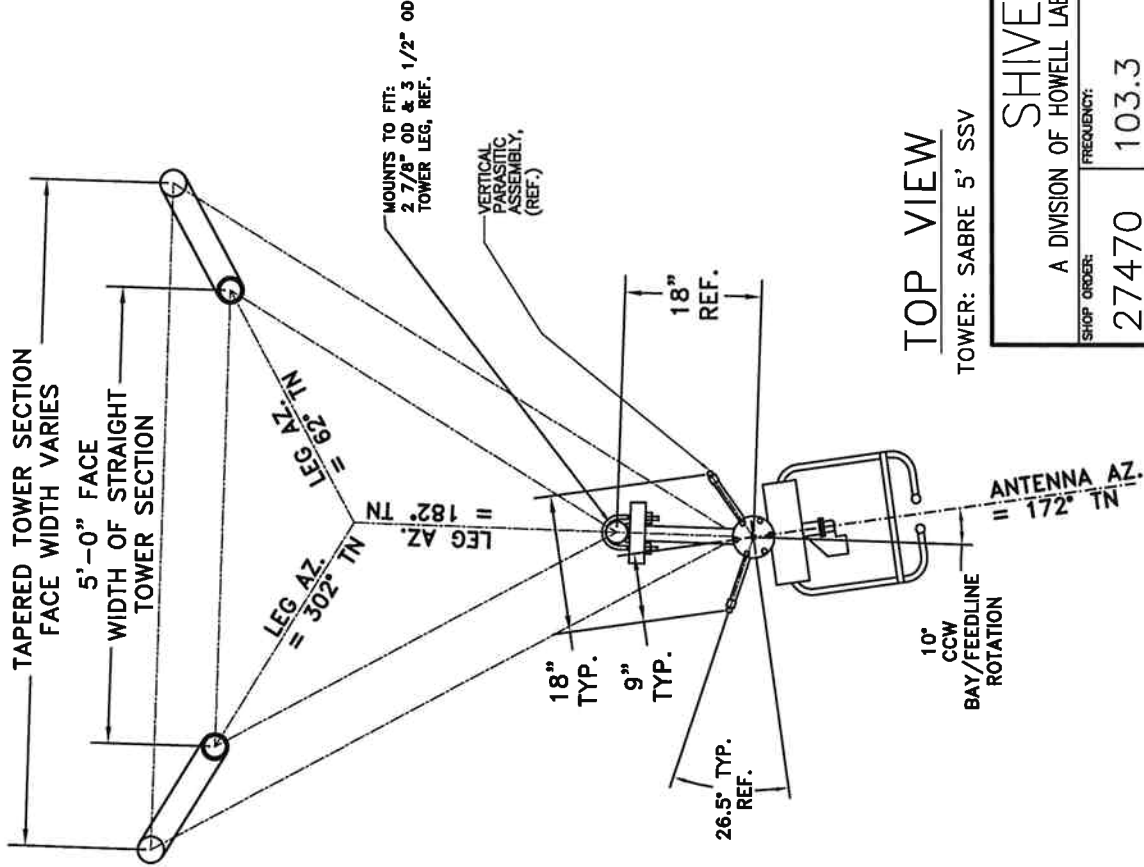
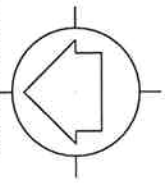


Figure 1f

Tabulation of FCC Directional Composite  
KРАН Warren AFB, WY

Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	0.653
10	1.000	190	0.741
20	1.000	200	0.851
30	1.000	210	0.955
40	1.000	220	1.000
50	1.000	230	1.000
60	1.000	240	1.000
70	1.000	250	1.000
80	1.000	260	1.000
90	1.000	270	1.000
100	1.000	280	1.000
110	1.000	290	1.000
120	1.000	300	1.000
130	1.000	310	1.000
140	1.000	320	1.000
150	0.958	330	1.000
160	0.761	340	1.000
170	0.638	350	1.000

TRUE NORTH



# TOP VIEW

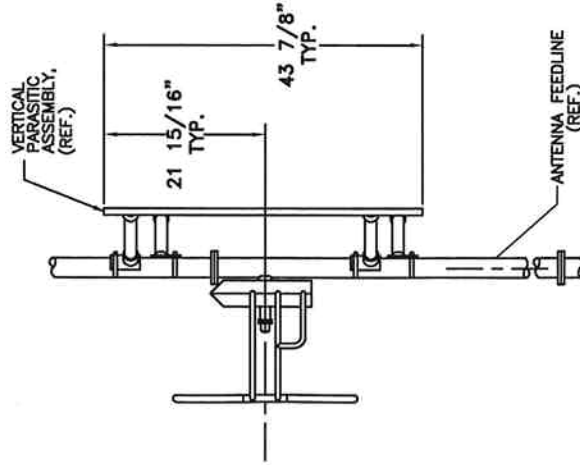
TOWER: SABRE 5' SSV

SHIVELY LABS A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE		SCALE: N.T.S.	DRAWN BY: ASP
SHOP ORDER: 27470	FREQUENCY: 103.3	APPROVED BY: DAB	
TITLE: MODEL-6810-5R-DIRECTIONAL ANTENNA			
DATE: 5/18/09			

MODEL-6810-5R-DIRECTIONAL ANTENNA

FIGURE 2

ANTENNA HEADING 172° TRUE NORTH



# SIDE VIEW

Antenna Mfg.: Shively Labs  
Antenna Type: 6810-5R-DA

Date: 5/18/2009

Station: KRAN

Frequency: 103.3

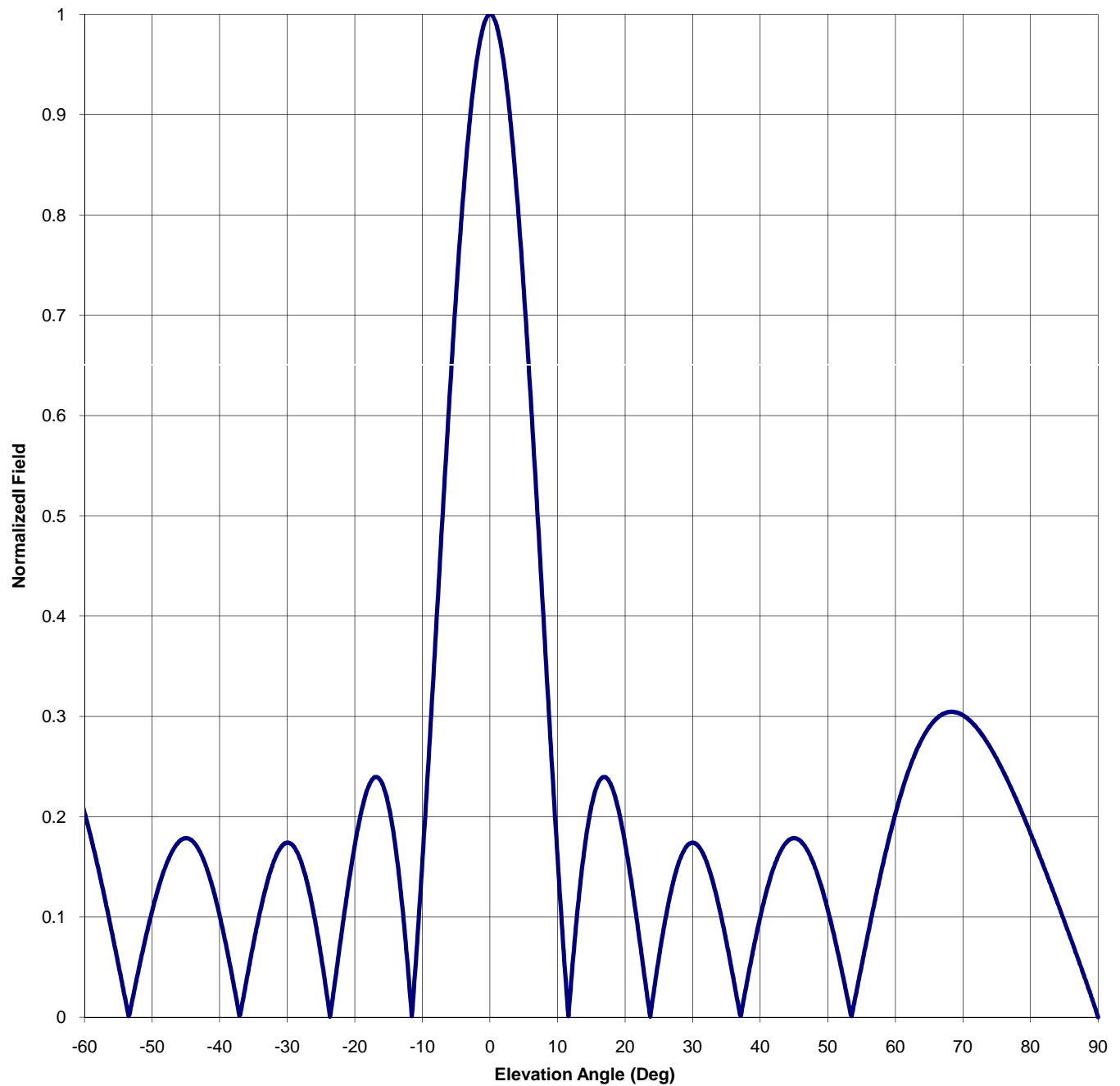
Channel #: 277

Figure: 3

Beam Tilt 0

Gain (Max) 5.192 7.153 dB

Gain (Horizon) 5.192 7.153 dB



Antenna Mfg.: Shively Labs

Antenna Type: 6810-5R-DA

Station: KRAN

Frequency: 103.3

Channel #: 277

Figure: 3

Date: 5/18/2009

Beam Tilt 0

Gain (Max) 5.192

Gain (Horizon) 5.192

7.153 dB

7.153 dB

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	0.175	0	1.000	46	0.175
-89	0.021	-43	0.166	1	0.988	47	0.166
-88	0.040	-42	0.150	2	0.952	48	0.151
-87	0.059	-41	0.128	3	0.895	49	0.131
-86	0.077	-40	0.100	4	0.818	50	0.107
-85	0.096	-39	0.069	5	0.724	51	0.079
-84	0.114	-38	0.034	6	0.618	52	0.048
-83	0.132	-37	0.002	7	0.504	53	0.016
-82	0.149	-36	0.039	8	0.386	54	0.018
-81	0.167	-35	0.074	9	0.269	55	0.052
-80	0.183	-34	0.107	10	0.158	56	0.085
-79	0.200	-33	0.134	11	0.055	57	0.117
-78	0.215	-32	0.156	12	0.035	58	0.148
-77	0.230	-31	0.169	13	0.111	59	0.177
-76	0.245	-30	0.174	14	0.169	60	0.203
-75	0.258	-29	0.170	15	0.210	61	0.226
-74	0.269	-28	0.156	16	0.233	62	0.247
-73	0.280	-27	0.132	17	0.239	63	0.264
-72	0.289	-26	0.100	18	0.230	64	0.278
-71	0.296	-25	0.060	19	0.207	65	0.289
-70	0.301	-24	0.015	20	0.173	66	0.297
-69	0.304	-23	0.034	21	0.131	67	0.302
-68	0.304	-22	0.083	22	0.083	68	0.304
-67	0.302	-21	0.131	23	0.034	69	0.304
-66	0.297	-20	0.173	24	0.015	70	0.301
-65	0.289	-19	0.207	25	0.060	71	0.296
-64	0.278	-18	0.230	26	0.100	72	0.289
-63	0.264	-17	0.239	27	0.132	73	0.280
-62	0.247	-16	0.233	28	0.156	74	0.269
-61	0.226	-15	0.210	29	0.170	75	0.258
-60	0.203	-14	0.169	30	0.174	76	0.245
-59	0.177	-13	0.111	31	0.169	77	0.230
-58	0.148	-12	0.035	32	0.156	78	0.215
-57	0.117	-11	0.055	33	0.134	79	0.200
-56	0.085	-10	0.158	34	0.107	80	0.183
-55	0.052	-9	0.269	35	0.074	81	0.167
-54	0.018	-8	0.386	36	0.039	82	0.149
-53	0.016	-7	0.504	37	0.002	83	0.132
-52	0.048	-6	0.618	38	0.034	84	0.114
-51	0.079	-5	0.724	39	0.069	85	0.096
-50	0.107	-4	0.818	40	0.100	86	0.077
-49	0.131	-3	0.895	41	0.128	87	0.059
-48	0.151	-2	0.952	42	0.150	88	0.040
-47	0.166	-1	0.988	43	0.166	89	0.021
-46	0.175	0	1.000	44	0.175	90	0.000
-45	0.179			45	0.179		

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Figure 4

# VALIDATION OF TOTAL POWER GAIN CALCULATION

KRAN Warren AFB, WY

Model 6810-5R-EF-DA

Elevation Gain of Antenna 2.700

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

H RMS	0.745	V RMS	0.698	H/V Ratio	1.067
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Elevation Gain of Horizontal Component	2.882
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Elevation Gain of Vertical Component	2.530
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Horizontal Azimuth Gain equals $1/(\text{RMS})^2$ .	1.802
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Vertical Azimuth Gain equals $1/(\text{RMS}/\text{Max Vert})^2$ .	1.868
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Max. Vertical 0.954

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

Total Horizontal Power Gain = 5.192

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

Total Vertical Power Gain = 4.726

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ERP divided by Horizontal Power Gain equals Antenna Input Power

37	kW ERP	Divided by H Gain	5.192	equals	7.13	kW H Antenna Input Power
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Antenna Input Power times Vertical Power Gain equals Vertical ERP

7.13	kW	Times V Gain	4.726	equals	33.67	kW V ERP
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Maximum Value of the Vertical Component squared times the Maximum ERP equals the Vertical ERP

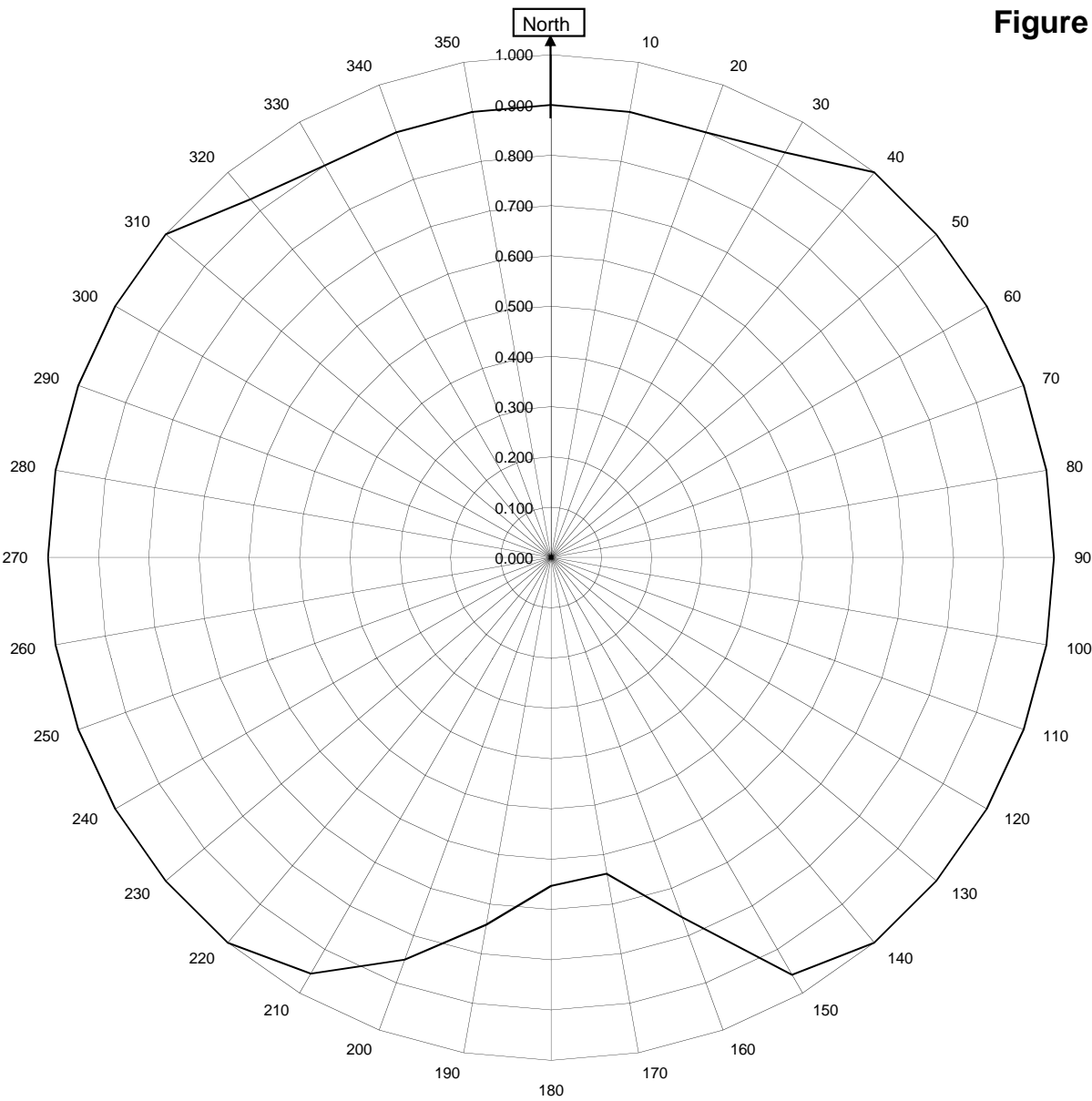
$(0.954)^2$	Times	37.00	Equals	33.67	kW Vertical ERP
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NOTE: Calculating the ERP of the Vertical Component by two methods validates the total power gain calculations

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Figure 5



## KRAN Warren AFB, WY

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May 18, 2009

Amended Composite RMS	0.944
85% Amended Composite RMS	0.803

Frequency	103.3 / 464.85 mHz
Plot	Relative Field

Antenna Model	6810-5R-EF-DA Patt 07-A
Pattern Type	Amended FCC Composite

Figure 5a

Tabulation of Amended Composite Pattern  
KRAN Warren AFB, WY

Azimuth	Rel Field	Azimuth	Rel Field
0	0.900	180	0.653
10	0.900	190	0.741
20	0.900	200	0.851
30	0.930	210	0.955
40	1.000	220	1.000
50	1.000	230	1.000
60	1.000	240	1.000
70	1.000	250	1.000
80	1.000	260	1.000
90	1.000	270	1.000
100	1.000	280	1.000
110	1.000	290	1.000
120	1.000	300	1.000
130	1.000	310	1.000
140	1.000	320	0.930
150	0.958	330	0.900
160	0.761	340	0.900
170	0.638	350	0.900