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S.O. 28378

Report of Test 6810BB-6R-SS(0.88)-DA

for

NORTHWEST COMMUNITY COLLEGE, STATE OF WYOMING

KNWT 89.1 MHz Cody, WY

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810BB-6R-SS(0.88)-DA to meet the needs of KNWT and to comply with the requirements of the FCC construction permit, file number BNPED-20071017AKH.

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 BNPED-20071017AKH indicates that the Horizontal radiation component shall not exceed 18.5 kW at any azimuth and is restricted to the following values at the azimuths specified:

220 – 240 Degrees T: 0.740 kW

From Figure 1A, the maximum radiation of the Horizontal component occurs at 344 Degrees T to 131 Degrees T. At the restricted azimuth of 220 - 240 Degrees T the Horizontal component is 14.42 dB down from the maximum of 18.5 kW, or 0.668 kW.

The R.M.S. of the Horizontal component is 0.788. The total Horizontal power gain is 5.558. The R.M.S. of the Vertical component is 0.738. The total Vertical power gain is 5.447. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.822. The R.M.S. of the measured composite pattern is 0.788. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.699. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6810BB-6R-SS(0.88)-DA was mounted on a tower of precise scale to the Rohn 65G tower at the KNWT site. The spacing of the antenna to the tower was varied 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 BNPED-20071017AKH, a single level of the 6810BB-6R-SS(0.88)-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 and 10th 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 400.95 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 28378
August 23, 2010

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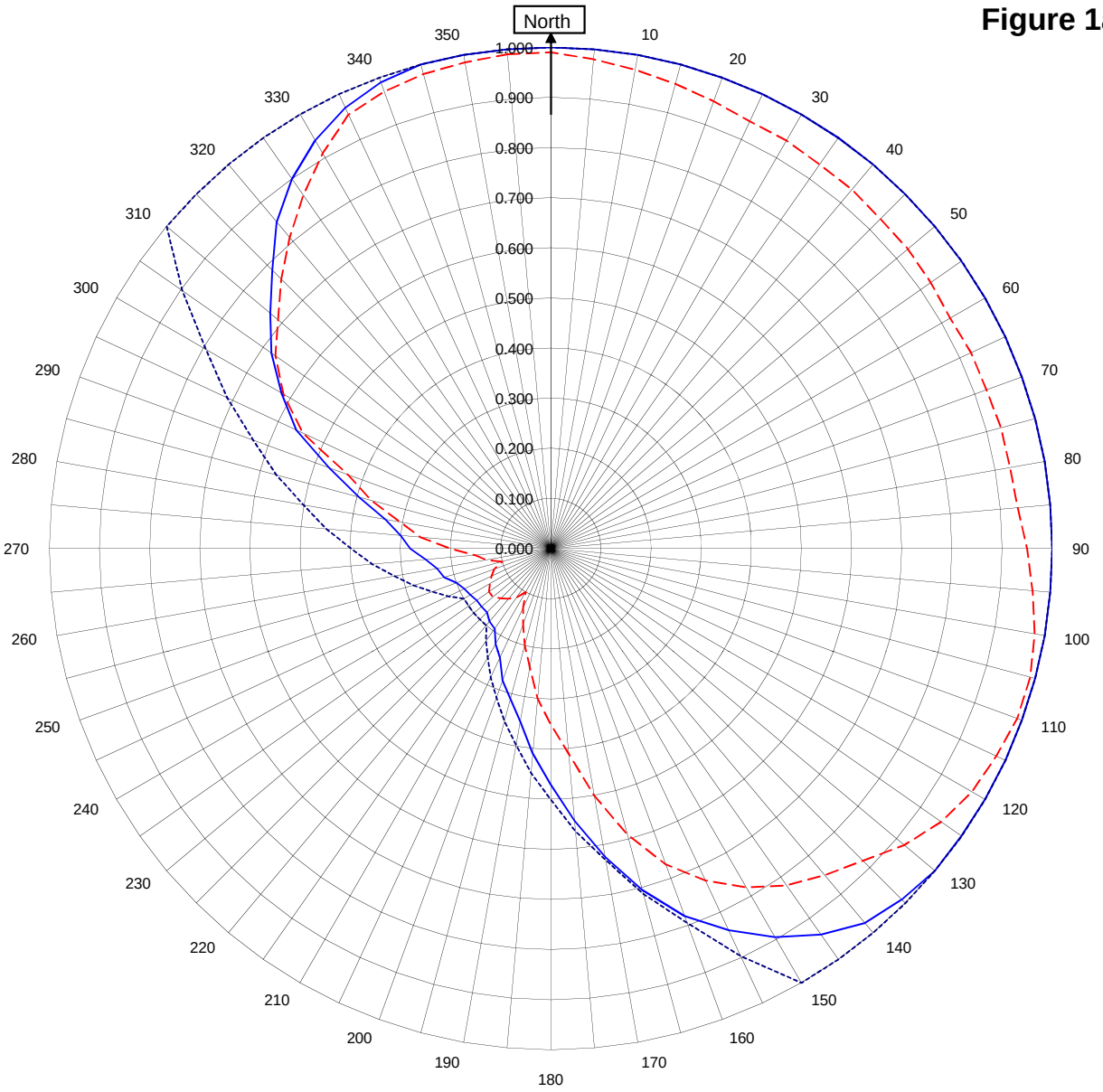
Figure 1a



KNWT Cody , WY

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August 23, 2010

Horizontal RMS	0.788
Vertical RMS	0.738
H/V Composite RMS	0.788
FCC Composite RMS	0.822

Frequency	89.1 / 400.95 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6810-6R-SS(0.88)-DA
Pattern Type	Directional Azimuth

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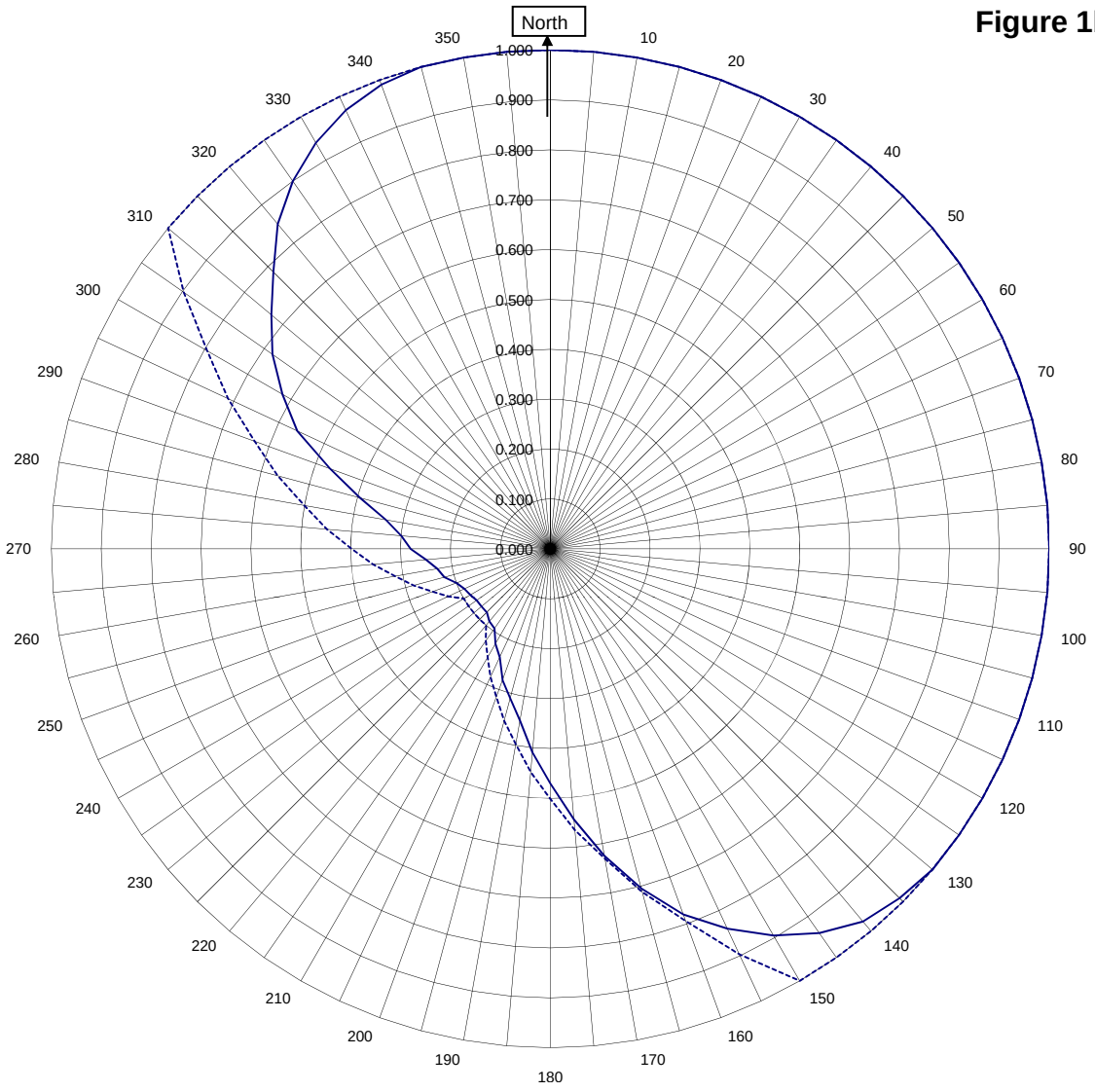
Figure 1b



KNWT Cody , WY

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August 23, 2010

_____H/VComposite RMS	0.788
……..FCC Composite RMS	0.822

Frequency	89.1 / 400.95 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6810-6R-SS(0.88)-DA
Pattern Type	Directional H/V Composite

Figure 1c

Tabulation of Horizontal Azimuth Pattern
KNWT Cody , WY

Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	0.470
10	1.000	190	0.350
20	1.000	200	0.280
30	1.000	210	0.220
40	1.000	220	0.190
45	1.000	225	0.180
50	1.000	230	0.180
60	1.000	240	0.185
70	1.000	250	0.200
80	1.000	260	0.230
90	1.000	270	0.280
100	1.000	280	0.335
110	1.000	290	0.470
120	1.000	300	0.620
130	1.000	310	0.730
135	0.990	315	0.785
140	0.975	320	0.850
150	0.895	330	0.940
160	0.780	340	0.990
170	0.625	350	1.000

Figure 1d

Tabulation of Vertical Azimuth Pattern
KNWT Cody , WY

Azimuth	Rel Field	Azimuth	Rel Field
0	0.990	180	0.350
10	0.970	190	0.240
20	0.950	200	0.160
30	0.940	210	0.100
40	0.935	220	0.130
45	0.930	225	0.140
50	0.930	230	0.150
60	0.920	240	0.140
70	0.925	250	0.120
80	0.930	260	0.130
90	0.950	270	0.200
100	0.980	280	0.305
110	0.990	290	0.430
120	0.970	300	0.615
130	0.920	310	0.710
135	0.880	315	0.760
140	0.850	320	0.810
150	0.780	330	0.910
160	0.670	340	0.970
170	0.500	350	0.985

Figure 1e

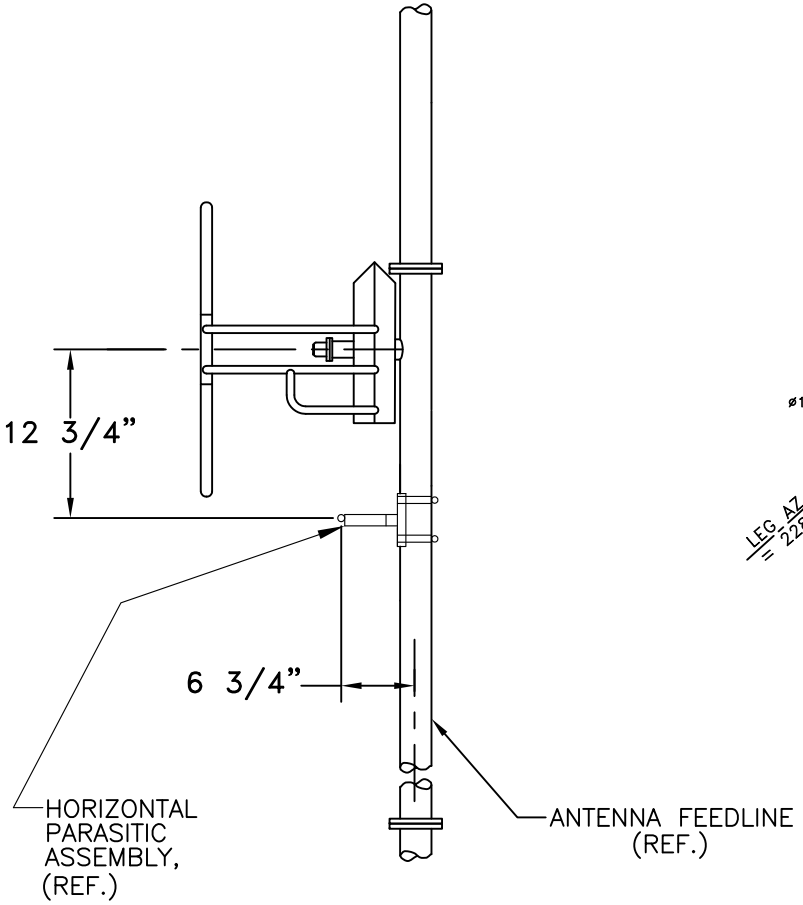
Tabulation of Composite Azimuth Pattern
KNWT Cody , WY

Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	0.470
10	1.000	190	0.350
20	1.000	200	0.280
30	1.000	210	0.220
40	1.000	220	0.190
45	1.000	225	0.180
50	1.000	230	0.180
60	1.000	240	0.185
70	1.000	250	0.200
80	1.000	260	0.230
90	1.000	270	0.280
100	1.000	280	0.335
110	1.000	290	0.470
120	1.000	300	0.620
130	1.000	310	0.730
135	0.990	315	0.785
140	0.975	320	0.850
150	0.895	330	0.940
160	0.780	340	0.990
170	0.625	350	1.000

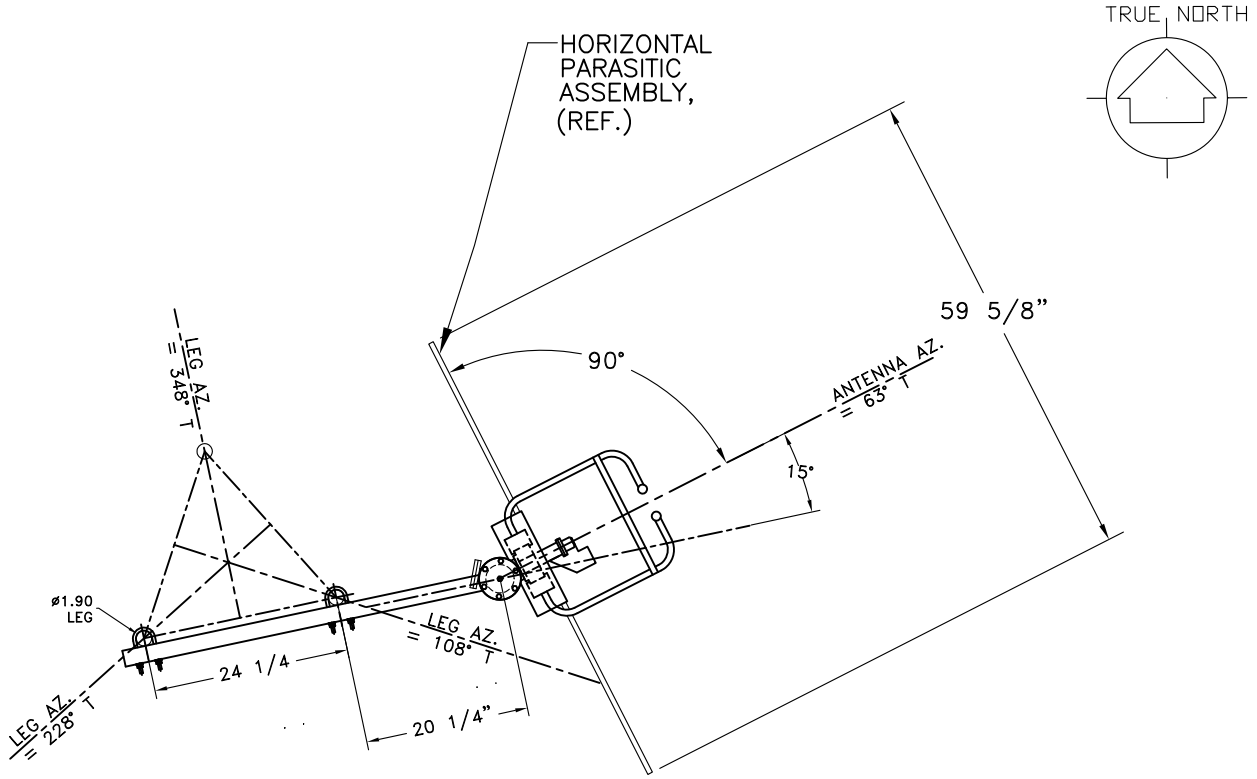
Figure 1f

Tabulation of FCC Directional Composite
KNWT Cody , WY

Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	0.501
10	1.000	190	0.398
20	1.000	200	0.316
30	1.000	210	0.251
40	1.000	220	0.200
50	1.000	230	0.200
60	1.000	240	0.200
70	1.000	250	0.251
80	1.000	260	0.316
90	1.000	270	0.398
100	1.000	280	0.501
110	1.000	290	0.631
120	1.000	300	0.794
130	1.000	310	1.000
140	1.000	320	1.000
150	1.000	330	1.000
160	0.794	340	1.000
170	0.631	350	1.000



SIDE VIEW



TOP VIEW

TOWER MAKE: ROHN 65

ANTENNA HEADING 63° TRUE NORTH

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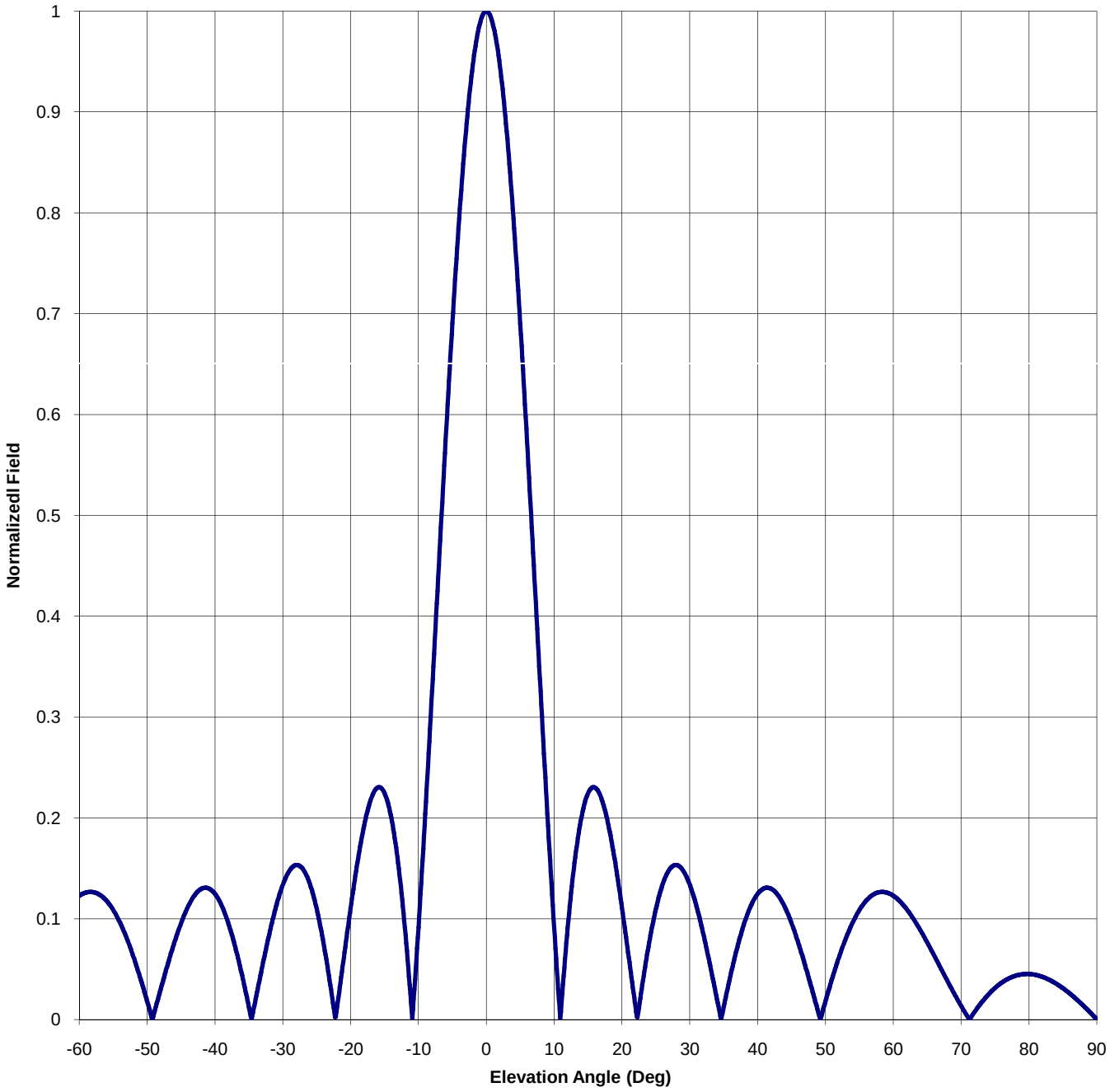
SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY:
28378	89.1	N.T.S.	ASP
			APPROVED BY: DAB

TITLE: MODEL-6810BB-6R-.88SS-DIRECTIONAL ANTENNA

DATE: 8/19/10

FIGURE 2

Antenna Mfg.:	**Shively Labs**			**Date:**	**8/23/2010**
Antenna Type:	**6810-6R-SS(0.88)-DA**				
Station:	**KNWT**	**Beam Tilt**	**0**		
Frequency:	**89.1**	**Gain (Max)**	**5.558**	**7.449**	**dB**
Channel #:	**206**	**Gain (Horizon)**	**5.558**	**7.449**	**dB**
Figure:	**Figure 3**				



Antenna Mfg.: Shively Labs **Date:** 8/23/2010

Antenna Type: 6810-6R-SS(0.88)-DA

Station: KNWT **Beam Tilt** 0

Frequency: 89.1 **Gain (Max)** 5.558 7.449 dB

Channel #: 206 **Gain (Horizon)** 5.558 7.449 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	0.112	0	1.000	46	0.076
-89	0.007	-43	0.123	1	0.986	47	0.054
-88	0.014	-42	0.130	2	0.946	48	0.030
-87	0.020	-41	0.130	3	0.881	49	0.006
-86	0.026	-40	0.125	4	0.794	50	0.018
-85	0.031	-39	0.113	5	0.690	51	0.041
-84	0.036	-38	0.095	6	0.574	52	0.062
-83	0.039	-37	0.072	7	0.450	53	0.081
-82	0.042	-36	0.044	8	0.325	54	0.096
-81	0.044	-35	0.013	9	0.204	55	0.109
-80	0.045	-34	0.020	10	0.092	56	0.118
-79	0.045	-33	0.053	11	0.008	57	0.124
-78	0.043	-32	0.085	12	0.091	58	0.126
-77	0.041	-31	0.112	13	0.155	59	0.126
-76	0.037	-30	0.134	14	0.200	60	0.123
-75	0.031	-29	0.148	15	0.225	61	0.117
-74	0.025	-28	0.153	16	0.230	62	0.109
-73	0.017	-27	0.149	17	0.219	63	0.099
-72	0.008	-26	0.134	18	0.193	64	0.088
-71	0.002	-25	0.110	19	0.156	65	0.076
-70	0.013	-24	0.076	20	0.111	66	0.064
-69	0.025	-23	0.035	21	0.062	67	0.051
-68	0.038	-22	0.012	22	0.012	68	0.038
-67	0.051	-21	0.062	23	0.035	69	0.025
-66	0.064	-20	0.111	24	0.076	70	0.013
-65	0.076	-19	0.156	25	0.110	71	0.002
-64	0.088	-18	0.193	26	0.134	72	0.008
-63	0.099	-17	0.219	27	0.149	73	0.017
-62	0.109	-16	0.230	28	0.153	74	0.025
-61	0.117	-15	0.225	29	0.148	75	0.031
-60	0.123	-14	0.200	30	0.134	76	0.037
-59	0.126	-13	0.155	31	0.112	77	0.041
-58	0.126	-12	0.091	32	0.085	78	0.043
-57	0.124	-11	0.008	33	0.053	79	0.045
-56	0.118	-10	0.092	34	0.020	80	0.045
-55	0.109	-9	0.204	35	0.013	81	0.044
-54	0.096	-8	0.325	36	0.044	82	0.042
-53	0.081	-7	0.450	37	0.072	83	0.039
-52	0.062	-6	0.574	38	0.095	84	0.036
-51	0.041	-5	0.690	39	0.113	85	0.031
-50	0.018	-4	0.794	40	0.125	86	0.026
-49	0.006	-3	0.881	41	0.130	87	0.020
-48	0.030	-2	0.946	42	0.130	88	0.014
-47	0.054	-1	0.986	43	0.123	89	0.007
-46	0.076	0	1.000	44	0.112	90	0.000
-45	0.095			45	0.095		

S.O. 28378 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

KNWT 89.1 MHz Cody, WY

Model 6810-6R-SS(0.88)-DA

Elevation Gain of Antenna 3.232

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

H RMS	0.788	V RMS	0.738	H/V Ratio	1.068

Elevation Gain of Horizontal Component 3.451

Elevation Gain of Vertical Component 3.027

Horizontal Azimuth Gain equals $1/(RMS)^2$. 1.610

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 1.800

Max. Vertical 0.99

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

Total Horizontal Power Gain = **5.558**

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

Total Vertical Power Gain = **5.447**

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ERP divided by Horizontal Power Gain equals Antenna Input Power

18.5	kW ERP	Divided by H Gain	5.558	equals	3.33	kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

3.33	kW	Times V Gain	5.447	equals	18.13	kW V ERP

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

(0.99)^2	Times	18.50	Equals	18.13	kW Vertical ERP

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