Shively Labs
a division of Howell Laboratories,Inc.

- An Employee-Owned Company -

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

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

S.O. 27124

Report of Test 6810-6-DA

for

AMERICAN FAMILY ASSOCIATION

WAQL 90.5 MHz McComb, MS

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-6-DA to meet the needs of WAQL and to comply with the requirements of the FCC construction permit, file number BMPED-20080828AAG.

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 BMPED-20080828AAG indicates that the Horizontal radiation component shall not exceed 30 kW at any azimuth and is restricted to the following values at the azimuths specified:

030 Degrees T: 10.5 kW

From Figure 1A, the maximum radiation of the Horizontal component occurs at 314 Degrees T to 320 Degrees T. At the restricted azimuth of 030 Degrees T the Horizontal component is 6.34 dB down from the maximum of 30 kW, or 7.0 kW.

The R.M.S. of the Horizontal component is 0.786. The total Horizontal power gain is 5.639. The R.M.S. of the Vertical component is 0.740. The total Vertical power gain is 5.416. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.951. The R.M.S. of the measured composite pattern is 0.813. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.808. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6810-6-DA was mounted on a tower of precise scale to the Allied-24 tower at the WAQL site. The spacing of the antenna to the tower was varied and vertical parasitic elements were 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 BMPED-20080828AAG, a single level of the 6810-6-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 407.25 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 1A.

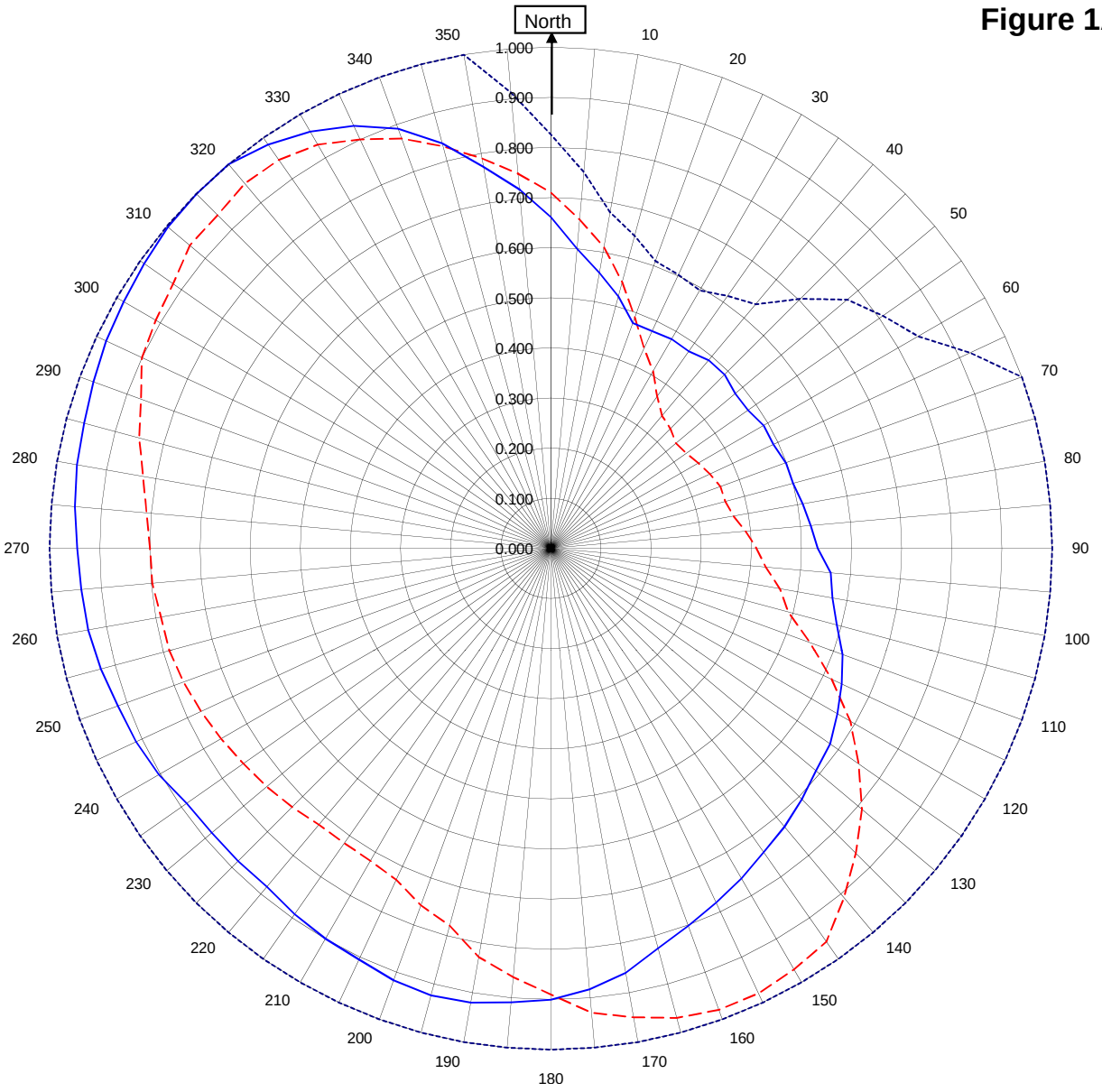
Respectfully submitted by:

Robert A. Surette
Director of Sales Engineering
S/O 27124
April 22, 2009

Shively Labs

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

Figure 1A



WAQL McComb, MS

27124

April 22, 2009

Horizontal RMS	0.786
Vertical RMS	0.740
H/V Composite RMS	0.813
FCC Composite RMS	0.951

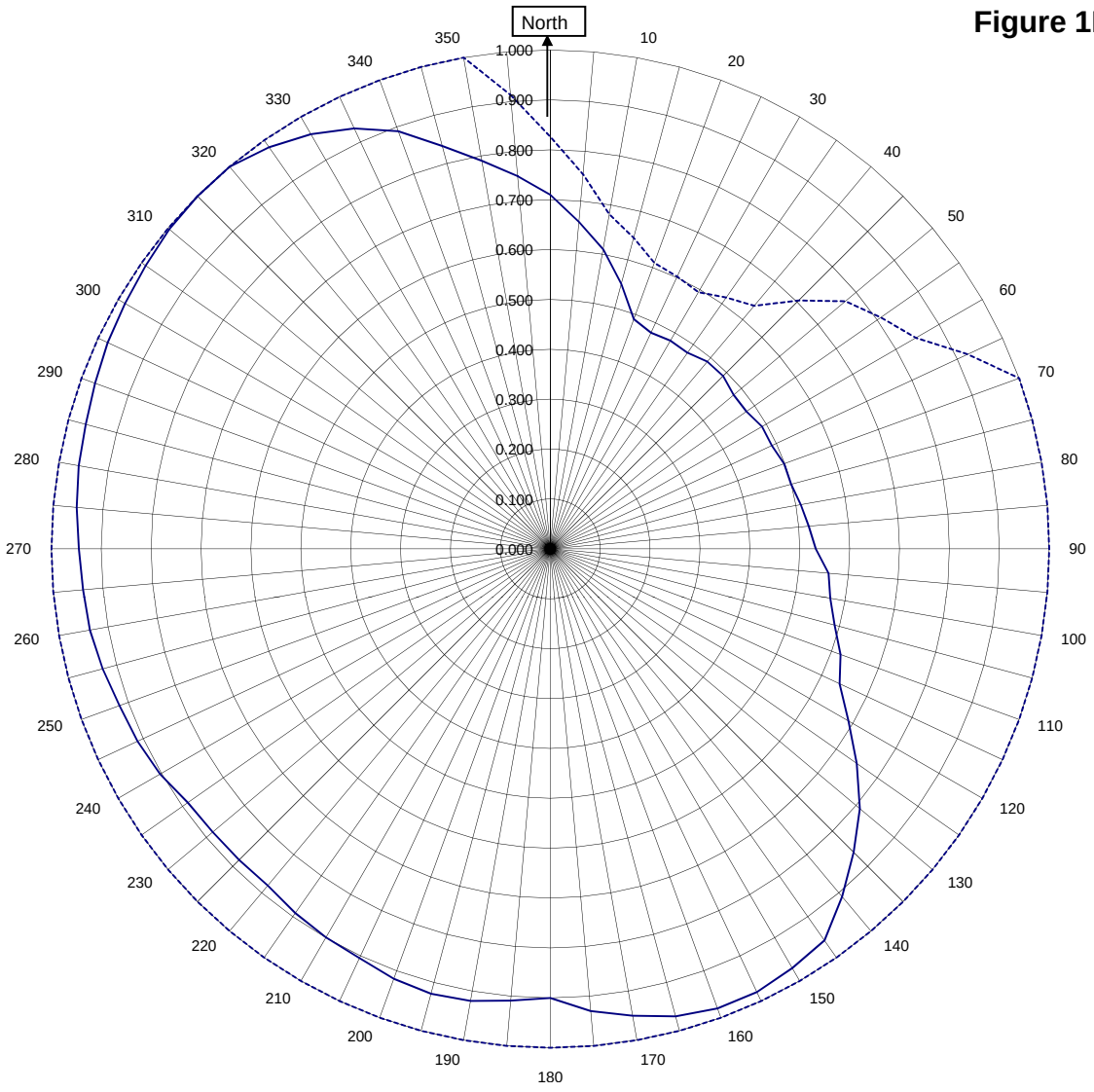
Frequency	90.5 / 407.25 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6810-6-DA Patt Sh-06-B
Pattern Type	Directional Azimuth

Shively Labs

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

Figure 1B



WAQL McComb, MS

27124

April 22, 2009

_____H/VComposite RMS	0.813
……..FCC Composite RMS	0.951

Frequency	90.5 / 407.25 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6810-6-DA Patt Sh-06-B
Pattern Type	Directional H/V Composite

Figure 1C

Tabulation of Horizontal Azimuth Pattern
WAQL McComb, MS

Azimuth	Rel Field	Azimuth	Rel Field
0	0.661	180	0.900
10	0.558	190	0.920
20	0.478	200	0.917
30	0.482	210	0.899
40	0.490	220	0.881
45	0.490	225	0.882
50	0.480	230	0.883
60	0.490	240	0.903
70	0.499	250	0.919
80	0.510	260	0.937
90	0.532	270	0.945
100	0.570	280	0.960
110	0.619	290	0.971
120	0.660	300	0.984
130	0.690	310	0.997
135	0.708	315	1.000
140	0.725	320	1.000
150	0.760	330	0.960
160	0.801	340	0.891
170	0.860	350	0.773

Figure 1D

Tabulation of Vertical Azimuth Pattern
WAQL McComb, MS

Azimuth	Rel Field	Azimuth	Rel Field
0	0.710	180	0.890
10	0.610	190	0.828
20	0.490	200	0.758
30	0.408	210	0.720
40	0.345	220	0.720
45	0.337	225	0.730
50	0.326	230	0.740
60	0.340	240	0.760
70	0.360	250	0.780
80	0.370	260	0.790
90	0.410	270	0.800
100	0.464	280	0.826
110	0.550	290	0.870
120	0.690	300	0.910
130	0.810	310	0.940
135	0.860	315	0.940
140	0.910	320	0.950
150	0.970	330	0.930
160	0.980	340	0.870
170	0.950	350	0.790

Figure 1E

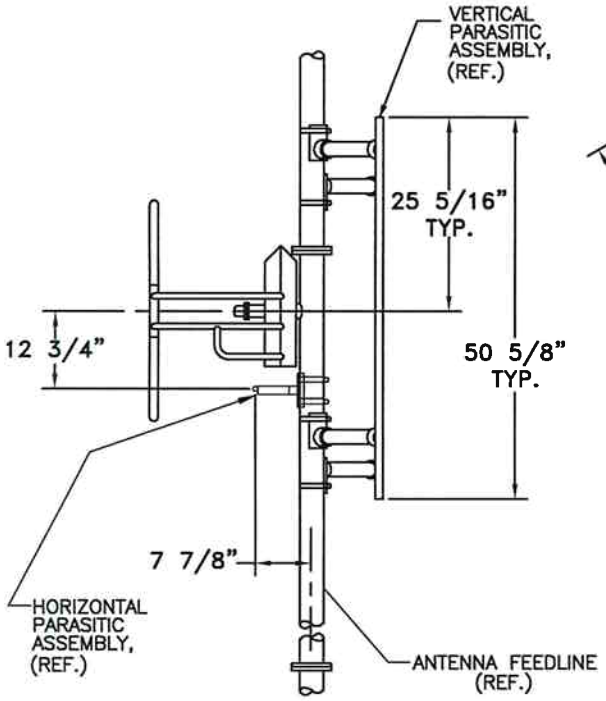
Tabulation of Composite Azimuth Pattern
WAQL McComb, MS

Azimuth	Rel Field	Azimuth	Rel Field
0	0.710	180	0.900
10	0.610	190	0.920
20	0.490	200	0.917
30	0.482	210	0.899
40	0.490	220	0.881
45	0.490	225	0.882
50	0.480	230	0.883
60	0.490	240	0.903
70	0.499	250	0.919
80	0.510	260	0.937
90	0.532	270	0.945
100	0.570	280	0.960
110	0.619	290	0.971
120	0.690	300	0.984
130	0.810	310	0.997
135	0.860	315	1.000
140	0.910	320	1.000
150	0.970	330	0.960
160	0.980	340	0.891
170	0.950	350	0.790

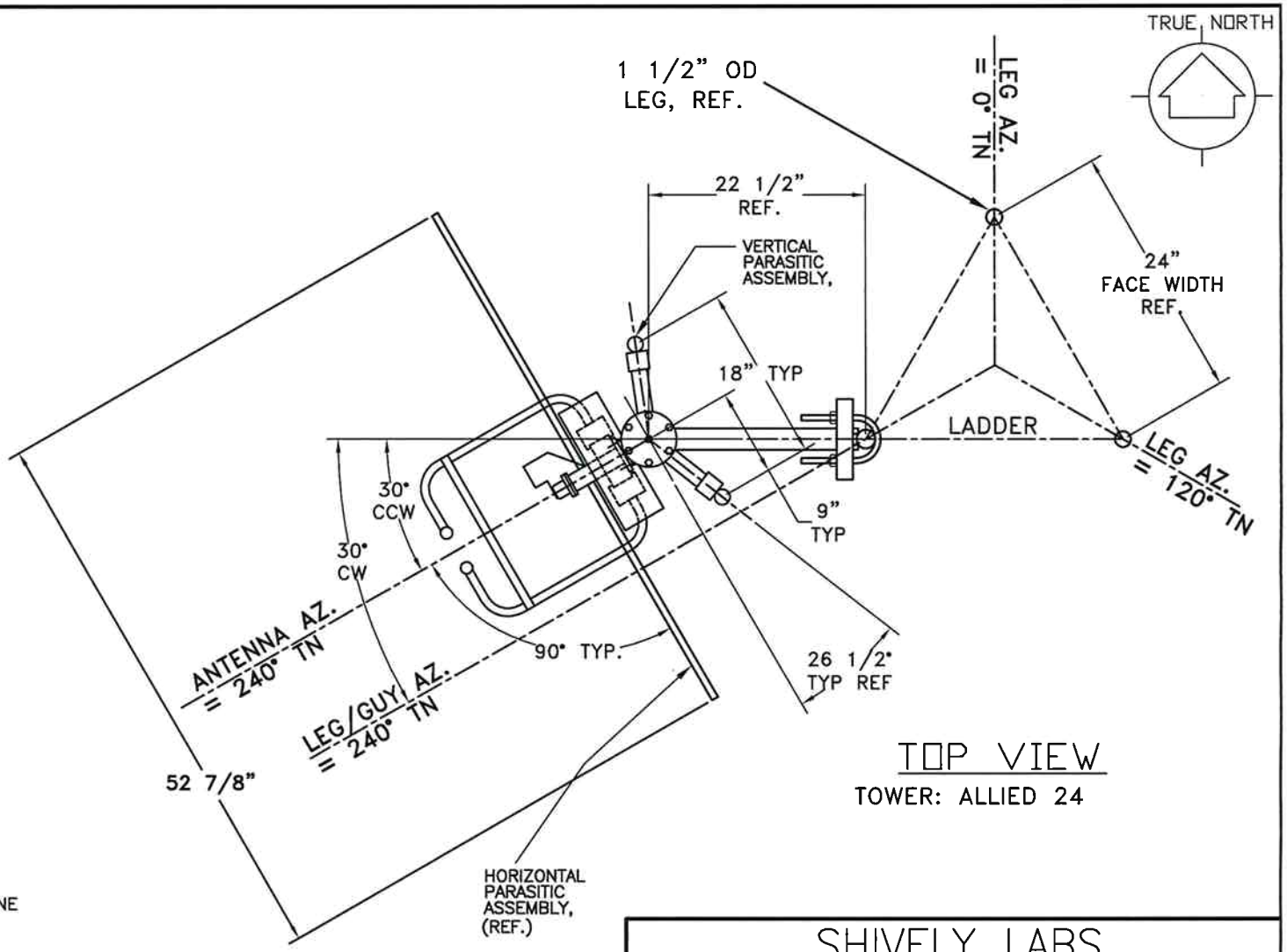
Figure 1F

Tabulation of FCC Directional Composite
WAQL McComb, MS

Azimuth	Rel Field	Azimuth	Rel Field
0	0.826	180	1.000
10	0.681	190	1.000
20	0.610	200	1.000
30	0.594	210	1.000
40	0.636	220	1.000
50	0.772	230	1.000
60	0.846	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	1.000	330	1.000
160	1.000	340	1.000
170	1.000	350	1.000



SIDE VIEW



TOP VIEW

TOWER: ALLIED 24

ANTENNA HEADING 240° TRUE NORTH

SHIVELY LABS

A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE

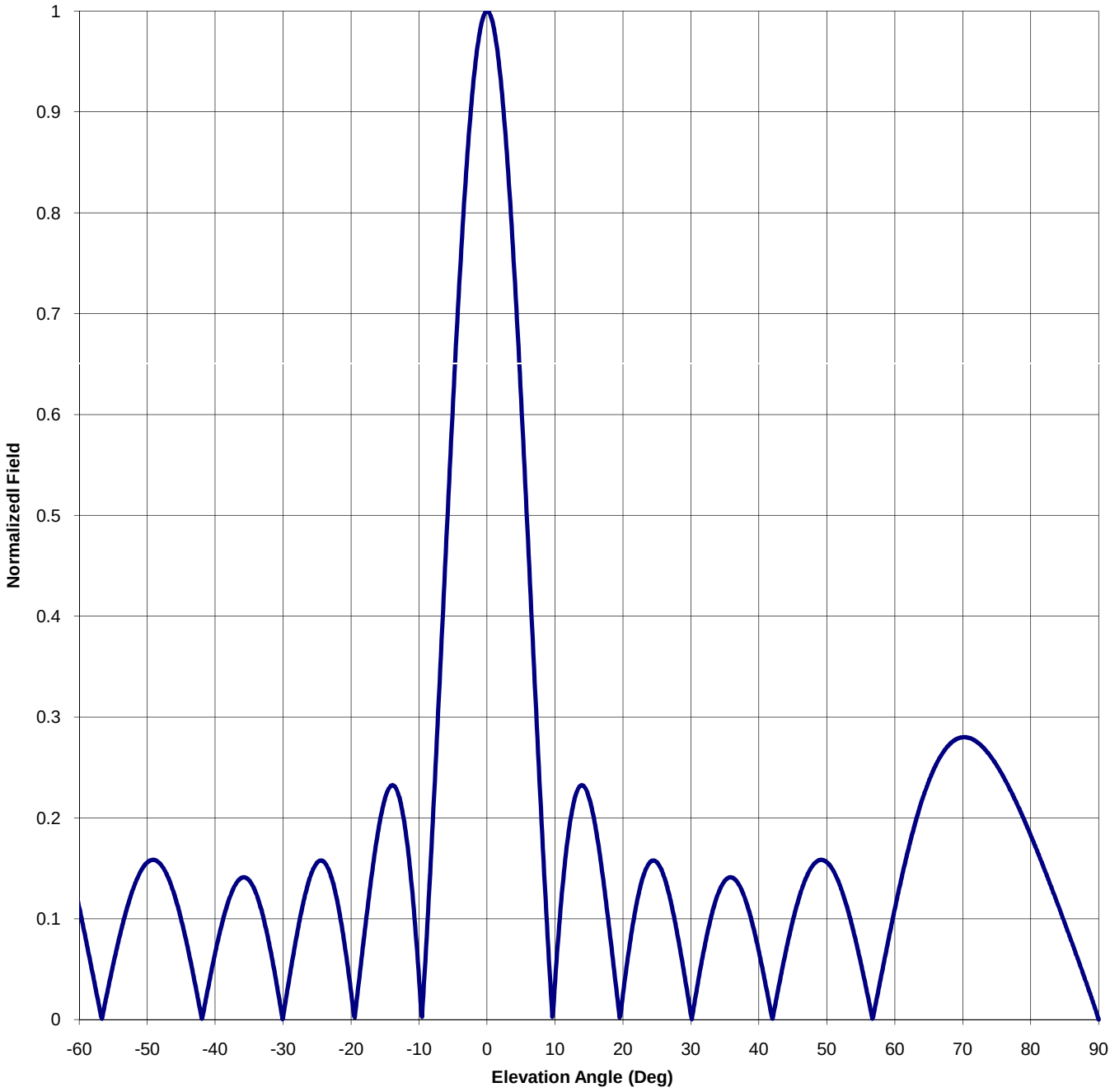
SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY:
27124A	90.5	N.T.S.	ASP
			APPROVED BY: DAB

TITLE: MODEL-6810-6-DIRECTIONAL ANTENNA

DATE: 4/21/09

FIGURE 2

Antenna Mfg.:	**Shively Labs**			**Date: 4/22/2009**
Antenna Type:	**6810-6-DA**			
Station:	**WAQL**	**Beam Tilt**	**0**	
Frequency:	**90.5**	**Gain (Max)**	**5.639**	**7.512 dB**
Channel #:	**202**	**Gain (Horizon)**	**5.639**	**7.512 dB**
Figure:	**3**			



Antenna Mfg.: Shively Labs
Antenna Type: 6810-6-DA
Station: WAQL
Frequency: 90.5
Channel #: 202
Figure: 3

Beam Tilt 0
Gain (Max) 5.639
Gain (Horizon) 5.639

Date: 4/22/2009
7.512 dB
7.512 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	0.069	0	1.000	46	0.123
-89	0.021	-43	0.036	1	0.983	47	0.142
-88	0.040	-42	0.001	2	0.931	48	0.153
-87	0.059	-41	0.034	3	0.849	49	0.158
-86	0.077	-40	0.067	4	0.741	50	0.156
-85	0.096	-39	0.096	5	0.615	51	0.147
-84	0.114	-38	0.119	6	0.476	52	0.132
-83	0.132	-37	0.134	7	0.334	53	0.111
-82	0.149	-36	0.141	8	0.197	54	0.085
-81	0.166	-35	0.138	9	0.070	55	0.056
-80	0.183	-34	0.125	10	0.038	56	0.024
-79	0.198	-33	0.103	11	0.125	57	0.009
-78	0.214	-32	0.072	12	0.186	58	0.043
-77	0.228	-31	0.036	13	0.222	59	0.077
-76	0.240	-30	0.004	14	0.232	60	0.110
-75	0.252	-29	0.046	15	0.220	61	0.141
-74	0.262	-28	0.084	16	0.189	62	0.169
-73	0.270	-27	0.118	17	0.143	63	0.195
-72	0.276	-26	0.142	18	0.089	64	0.217
-71	0.279	-25	0.156	19	0.031	65	0.236
-70	0.280	-24	0.156	20	0.026	66	0.252
-69	0.278	-23	0.143	21	0.075	67	0.264
-68	0.273	-22	0.115	22	0.115	68	0.273
-67	0.264	-21	0.075	23	0.143	69	0.278
-66	0.252	-20	0.026	24	0.156	70	0.280
-65	0.236	-19	0.031	25	0.156	71	0.279
-64	0.217	-18	0.089	26	0.142	72	0.276
-63	0.195	-17	0.143	27	0.118	73	0.270
-62	0.169	-16	0.189	28	0.084	74	0.262
-61	0.141	-15	0.220	29	0.046	75	0.252
-60	0.110	-14	0.232	30	0.004	76	0.240
-59	0.077	-13	0.222	31	0.036	77	0.228
-58	0.043	-12	0.186	32	0.072	78	0.214
-57	0.009	-11	0.125	33	0.103	79	0.198
-56	0.024	-10	0.038	34	0.125	80	0.183
-55	0.056	-9	0.070	35	0.138	81	0.166
-54	0.085	-8	0.197	36	0.141	82	0.149
-53	0.111	-7	0.334	37	0.134	83	0.132
-52	0.132	-6	0.476	38	0.119	84	0.114
-51	0.147	-5	0.615	39	0.096	85	0.096
-50	0.156	-4	0.741	40	0.067	86	0.077
-49	0.158	-3	0.849	41	0.034	87	0.059
-48	0.153	-2	0.931	42	0.001	88	0.040
-47	0.142	-1	0.983	43	0.036	89	0.021
-46	0.123	0	1.000	44	0.069	90	0.000
-45	0.098			45	0.098		

S.O. 27124 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WAQL 90.5 MHz McComb, MS

MODEL 6810-6-DA

Elevation Gain of Antenna 3.28

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

H RMS	0.786	V RMS	0.74	H/V Ratio	1.062

Elevation Gain of Horizontal Component 3.484

Elevation Gain of Vertical Component 3.088

Horizontal Azimuth Gain equals $1/(RMS)^2$. 1.619

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 1.754

Max. Vertical 0.98

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

Total Horizontal Power Gain = **5.639**

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

Total Vertical Power Gain = **5.416**

==========

ERP divided by Horizontal Power Gain equals Antenna Input Power

30	kW ERP	Divided by H Gain	5.639	equals	5.32	kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

5.320	kW	Times V Gain	5.416	equals	28.812	kW V ERP

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

(0.98)^2	Times	30.00	Equals	28.812	kW Vertical ERP

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