Shively Labs®
a division of Howell Laboratories, Inc.
P. O. Box 389, 188 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. 29986

Report of Test 6810-3-(0.9)SS-DA

for

The Regents of the University of California

KZCS 88.1 MHz Santa Cruz, CA

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-3-(0.9)SS-DA to meet the needs of KZCS and to comply with the requirements of the FCC construction permit, file number BPED-20120224ABJ. This test characterizes only the radiation characteristics of the antenna when mounted on the tower as described. It does not represent or imply any guarantee of specific coverage which can be influenced by factors beyond the scope of this test.

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 BPED-20120224ABJ indicates that the Horizontal radiation component shall not exceed 20.0 kW at any azimuth and is restricted to the following values at the azimuths specified:

280 Degrees T: 5.2 kW

From Figure 1A, the maximum radiation of the Horizontal component occurs at 137 Degrees T to 147 Degrees T. At the restricted azimuth of 280 Degrees T the Horizontal component is 8.922 dB down from the maximum of 20.0 kW, or 2.563 kW.

The R.M.S. of the Horizontal component is 0.773. The total Horizontal power gain is 2.946. The R.M.S. of the Vertical component is 0.695. The total Vertical power gain is 2.488. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.857. The R.M.S. of the measured composite pattern is 0.783. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.728. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6810-3-(0.9)SS-DA was mounted on a tower of precise scale to the Rohn 4N/5N tower at the KZCS 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 BPED-20120224ABJ, a single level of the 6810-3-(0.9)SS-DA was set up on the Shively Labs 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

All testing is carried out in strict accordance with approved procedures under our ISO9001:2008.

TEST PROCEDURES:

The receiving antenna system is mounted so that the horizontal and vertical azimuth patterns are measured independently. The network analyzer was set to 396.45 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.

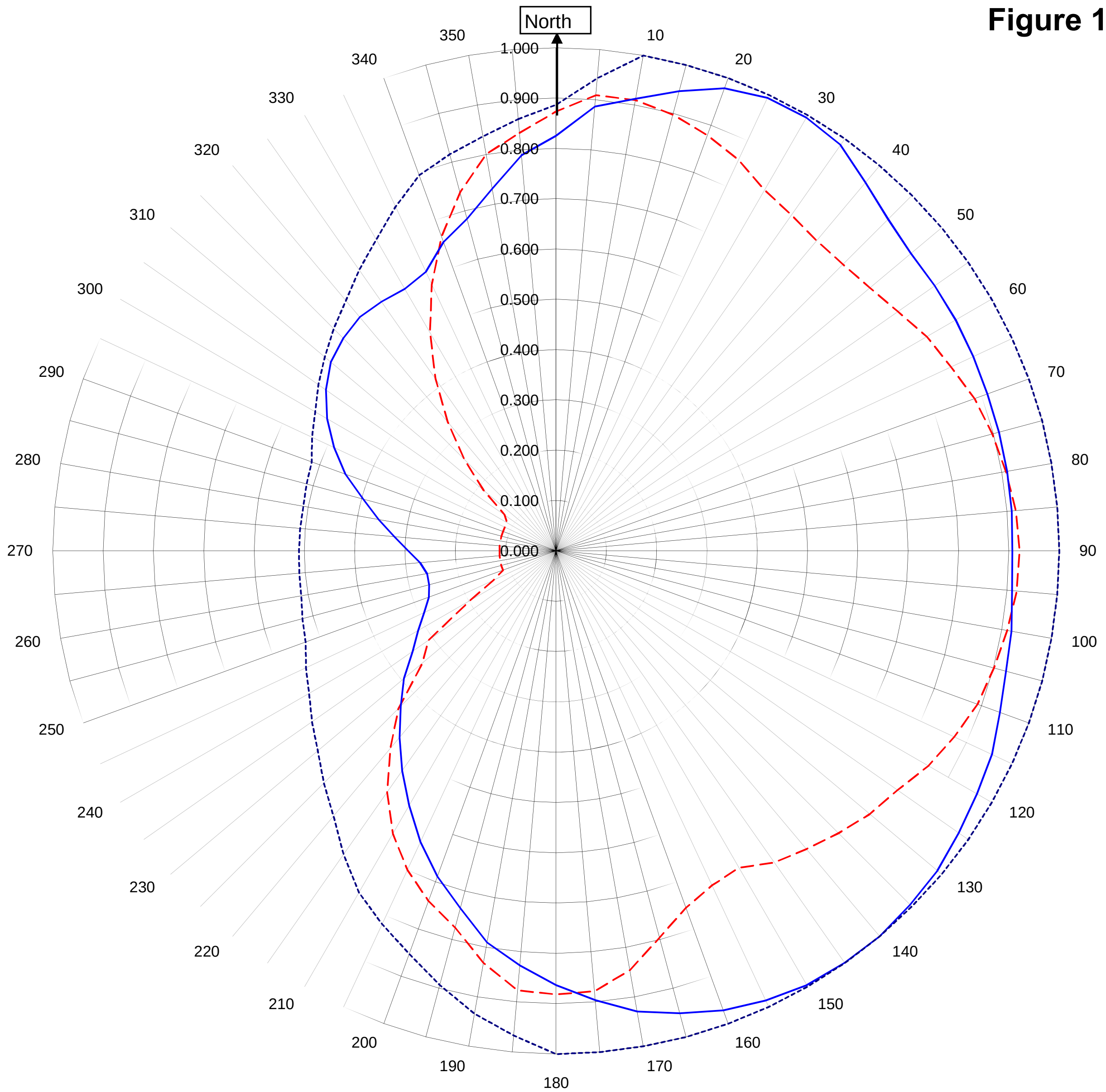
Respectfully submitted by:

Robert A. Surette
Director of Sales Engineering
S/O 29986
July 16, 2012

Shively Labs

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

Figure 1A



KZSC SANTA CRUZ, CA.

29986

July 16, 2012

Horizontal RMS	0.773
Vertical RMS	0.695
H/V Composite RMS	0.783
...............FCC Composite RMS	0.857

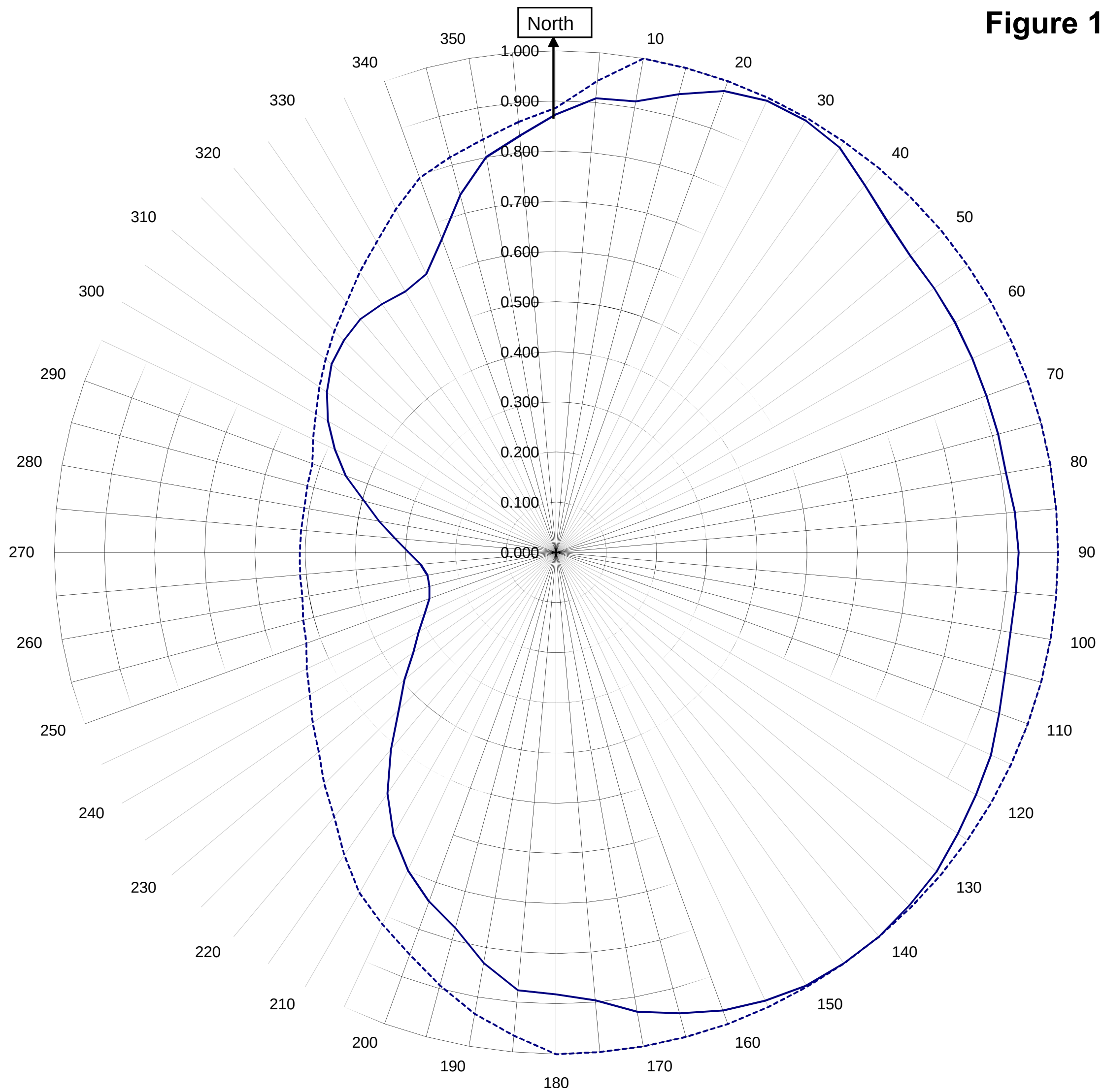
Frequency	88.1 / 396.45 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6810-3-(0.9)SS-DA
Pattern Type	Directional Azimuth

Shively Labs

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

Figure 1B



KZSC SANTA CRUZ, CA.

29986
July 16, 2012

__________H/VComposite RMS	0.783
……………FCC Composite RMS	0.857

Frequency	88.1 / 396.45 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6810-3-(0.9)SS-DA
Pattern Type	Directional H/V Composite

Figure 1C

Tabulation of Horizontal Azimuth Pattern
KZSC SANTA CRUZ, CA.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.825	180	0.863
10	0.913	190	0.790
20	0.979	200	0.689
30	0.995	210	0.584
40	0.957	220	0.484
45	0.933	225	0.437
50	0.921	230	0.395
60	0.918	240	0.317
70	0.912	250	0.269
80	0.910	260	0.260
90	0.907	270	0.294
100	0.919	280	0.358
110	0.939	290	0.446
120	0.966	300	0.526
130	0.989	310	0.585
135	0.995	315	0.598
140	1.000	320	0.607
150	0.997	330	0.601
160	0.972	340	0.654
170	0.930	350	0.731

Figure 1D

Tabulation of Vertical Azimuth Pattern
KZSC SANTA CRUZ, CA.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.874	180	0.881
10	0.910	190	0.832
20	0.879	200	0.740
30	0.829	210	0.649
40	0.805	220	0.513
45	0.806	225	0.443
50	0.814	230	0.346
60	0.851	240	0.199
70	0.885	250	0.113
80	0.908	260	0.113
90	0.921	270	0.113
100	0.911	280	0.113
110	0.891	290	0.113
120	0.855	300	0.113
130	0.814	310	0.188
135	0.794	315	0.258
140	0.774	320	0.335
150	0.727	330	0.501
160	0.755	340	0.665
170	0.846	350	0.801

Figure 1E

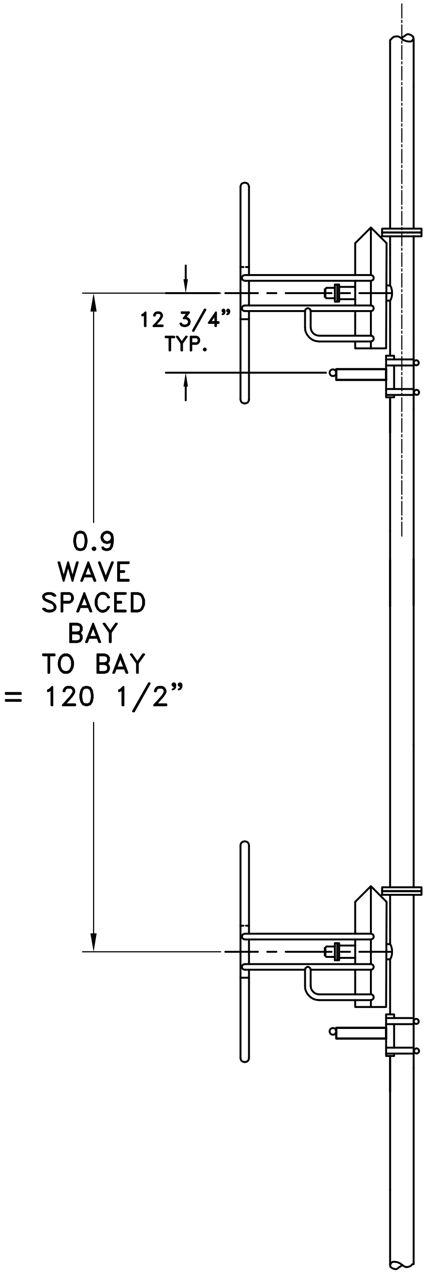
Tabulation of Composite Azimuth Pattern
KZSC SANTA CRUZ, CA.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.874	180	0.881
10	0.913	190	0.832
20	0.979	200	0.740
30	0.995	210	0.649
40	0.957	220	0.513
45	0.933	225	0.443
50	0.921	230	0.395
60	0.918	240	0.317
70	0.912	250	0.269
80	0.910	260	0.260
90	0.921	270	0.294
100	0.919	280	0.358
110	0.939	290	0.446
120	0.966	300	0.526
130	0.989	310	0.585
135	0.995	315	0.598
140	1.000	320	0.607
150	0.997	330	0.601
160	0.972	340	0.665
170	0.930	350	0.801

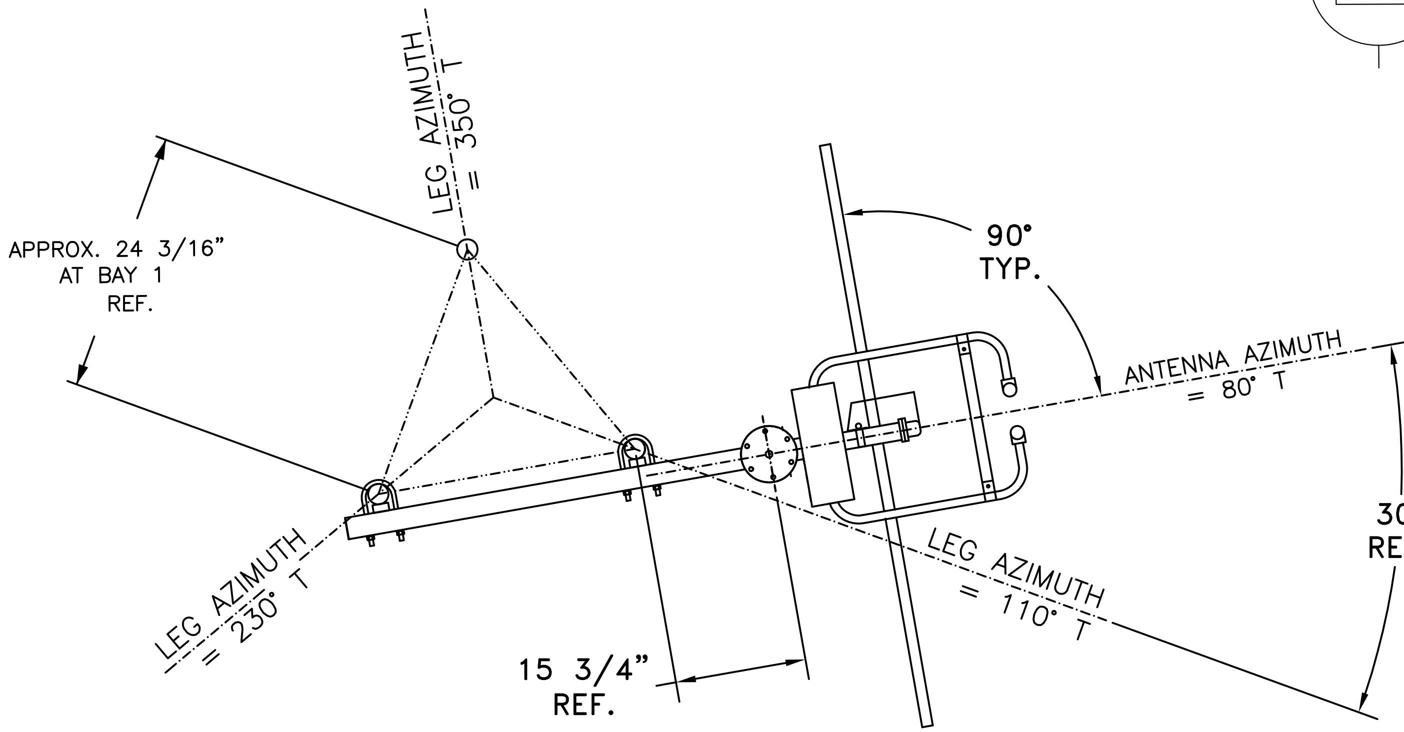
Figure 1F

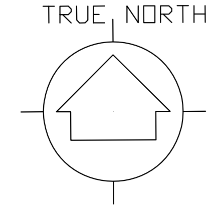
Tabulation of FCC Directional Composite
KZSC SANTA CRUZ, CA.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.887	180	1.000
10	1.000	190	0.934
20	1.000	200	0.853
30	1.000	210	0.784
40	1.000	220	0.688
50	1.000	230	0.618
60	1.000	240	0.567
70	1.000	250	0.530
80	1.000	260	0.514
90	1.000	270	0.511
100	1.000	280	0.510
110	1.000	290	0.517
120	1.000	300	0.553
130	1.000	310	0.600
140	1.000	320	0.650
150	1.000	330	0.715
160	1.000	340	0.795
170	1.000	350	0.837



SIDE VIEW





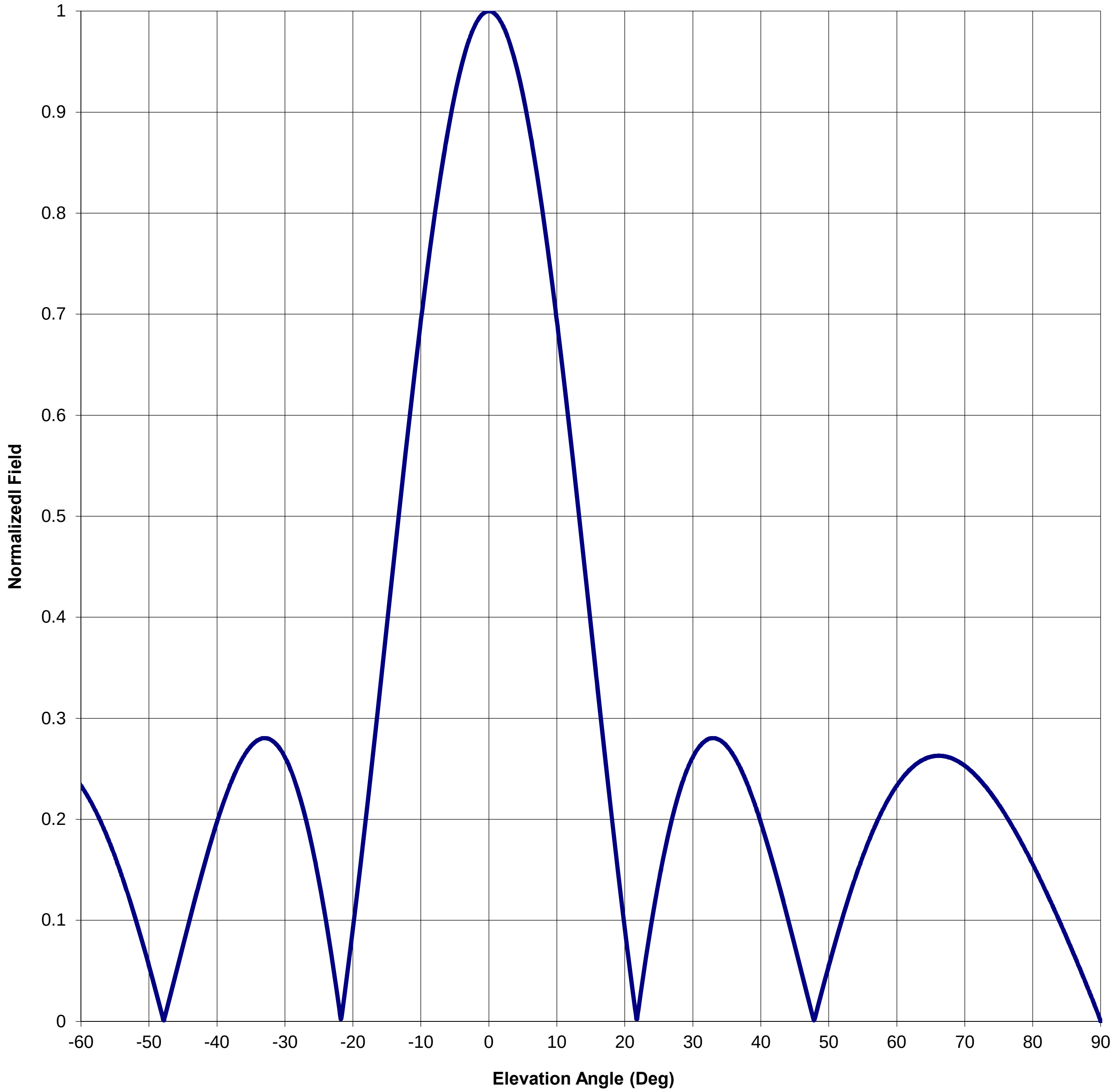
TOP VIEW

TOWER: ROHN 4N/5N
TAPERED SECTIONS

ANTENNA HEADING 80° TRUE NORTH

SHIVELY LABS A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE			
SHOP ORDER: 29986	FREQUENCY: 88.1	SCALE: N.T.S.	DRAWN BY: ASP APPROVED BY: DAB
TITLE: MODEL–6810–3–.9SS–DIRECTIONAL ANTENNA			
DATE: 7/16/12	FIGURE 2		

Antenna Mfg.:	Shively Labs				Date: 7/16/2012
Antenna Type:	6810-3-(0.9)SS-DA				
Station:	KZCS	Beam Tilt	0		
Frequency:	88.1	Gain (Max)	2.946	4.692 dB	
Channel #:	201	Gain (Horizon)	2.946	4.692 dB	
Figure:	Figure 3				



Antenna Mfg.: Shively Labs | **Date:** 7/16/2012
Antenna Type: 6810-3-(0.9)SS-DA
Station: KZCS | **Beam Tilt** 0
Frequency: 88.1 | **Gain (Max)** 2.946 | 4.692 dB
Channel #: 201 | **Gain (Horizon)** 2.946 | 4.692 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	0.101	0	1.000	46	0.048
-89	0.018	-43	0.127	1	0.997	47	0.022
-88	0.035	-42	0.151	2	0.986	48	0.004
-87	0.051	-41	0.175	3	0.970	49	0.030
-86	0.067	-40	0.197	4	0.947	50	0.055
-85	0.083	-39	0.217	5	0.917	51	0.079
-84	0.098	-38	0.235	6	0.882	52	0.102
-83	0.113	-37	0.251	7	0.842	53	0.124
-82	0.128	-36	0.263	8	0.797	54	0.144
-81	0.142	-35	0.272	9	0.747	55	0.163
-80	0.156	-34	0.278	10	0.694	56	0.180
-79	0.169	-33	0.280	11	0.637	57	0.196
-78	0.181	-32	0.278	12	0.578	58	0.210
-77	0.193	-31	0.272	13	0.517	59	0.223
-76	0.204	-30	0.262	14	0.455	60	0.233
-75	0.215	-29	0.246	15	0.392	61	0.242
-74	0.224	-28	0.227	16	0.329	62	0.250
-73	0.233	-27	0.202	17	0.267	63	0.255
-72	0.241	-26	0.173	18	0.207	64	0.259
-71	0.247	-25	0.139	19	0.148	65	0.262
-70	0.253	-24	0.101	20	0.092	66	0.263
-69	0.257	-23	0.059	21	0.038	67	0.262
-68	0.261	-22	0.012	22	0.012	68	0.261
-67	0.262	-21	0.038	23	0.059	69	0.257
-66	0.263	-20	0.092	24	0.101	70	0.253
-65	0.262	-19	0.148	25	0.139	71	0.247
-64	0.259	-18	0.207	26	0.173	72	0.241
-63	0.255	-17	0.267	27	0.202	73	0.233
-62	0.250	-16	0.329	28	0.227	74	0.224
-61	0.242	-15	0.392	29	0.246	75	0.215
-60	0.233	-14	0.455	30	0.262	76	0.204
-59	0.223	-13	0.517	31	0.272	77	0.193
-58	0.210	-12	0.578	32	0.278	78	0.181
-57	0.196	-11	0.637	33	0.280	79	0.169
-56	0.180	-10	0.694	34	0.278	80	0.156
-55	0.163	-9	0.747	35	0.272	81	0.142
-54	0.144	-8	0.797	36	0.263	82	0.128
-53	0.124	-7	0.842	37	0.251	83	0.113
-52	0.102	-6	0.882	38	0.235	84	0.098
-51	0.079	-5	0.917	39	0.217	85	0.083
-50	0.055	-4	0.947	40	0.197	86	0.067
-49	0.030	-3	0.970	41	0.175	87	0.051
-48	0.004	-2	0.986	42	0.151	88	0.035
-47	0.022	-1	0.997	43	0.127	89	0.018
-46	0.048	0	1.000	44	0.101	90	0.000
-45	0.075			45	0.075		

S.O. 29986 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

KZSC SANTA CRUZ, CA.

MODEL 6810-3-(0.9)SS-DA

Elevation Gain of Antenna 1.584

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

H RMS	0.773252	V RMS	0.695428	H/V Ratio	1.112

Elevation Gain of Horizontal Component	1.761
Elevation Gain of Vertical Component	1.425
Horizontal Azimuth Gain equals $1/(RMS)^2$.	1.672
Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$.	1.746

Max. Vertical 0.919

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

Total Horizontal Power Gain = **2.946**

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

Total Vertical Power Gain = **2.488**

==

ERP divided by Horizontal Power Gain equals Antenna Input Power

20.0 kW ERP Divided by H Gain 2.946 equals 6.790 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

6.790 kW Times V Gain 2.488 equals 16.891 kW V ERP

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

(0.919)^2 Times 20.00 Equals 16.891 kW Vertical ERP

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