Shively Labs
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S.O. 30258

Report of Test 6810-2R-SS(0.5)-DA

for

Codcomm, Inc.

WFRQ 93.5 MHz Harwich Port, MA

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-2R-SS(0.5)-DA to meet the needs of WFRQ and to comply with the requirements of the FCC construction permit, file number BPH-20120716ADH. 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 BPH-20120716ADH indicates that the Horizontal radiation component shall not exceed 6.0 kW at any azimuth and is restricted to the following values at the azimuths specified:

250 degrees True 1.406 kilowatts

280-290 degrees True (clockwise): 1.199 kilowatts

EXHIBIT D

From Figure 1A, the maximum radiation of the Horizontal component occurs at 074 Degrees T to 137 Degrees T. At the restricted azimuth of 250 Degrees T the Horizontal component is 6.52 dB down from the maximum of 6.0 kW, or 1.337 kW and at the restricted azimuth of 280-290 degrees True (clockwise) the horizontal component is 7.29 dB down from the maximum of 6.0 kW, or 1.12 kW.

The R.M.S. of the Horizontal component is 0.789. The total Horizontal power gain is 1.187. The R.M.S. of the Vertical component is 0.748. The total Vertical power gain is 1.037. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.894 The R.M.S. of the measured composite pattern is 0.794. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.760. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6810-2R-SS(0.5)-DA was mounted on a pole of precise scale to the 8 5/8" diameter pole at the WFRQ 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 BPH-20120716ADH a single level of the 6810-2R-SS(0.5)-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 420.75 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 30258
October 31, 2012

Shively Labs

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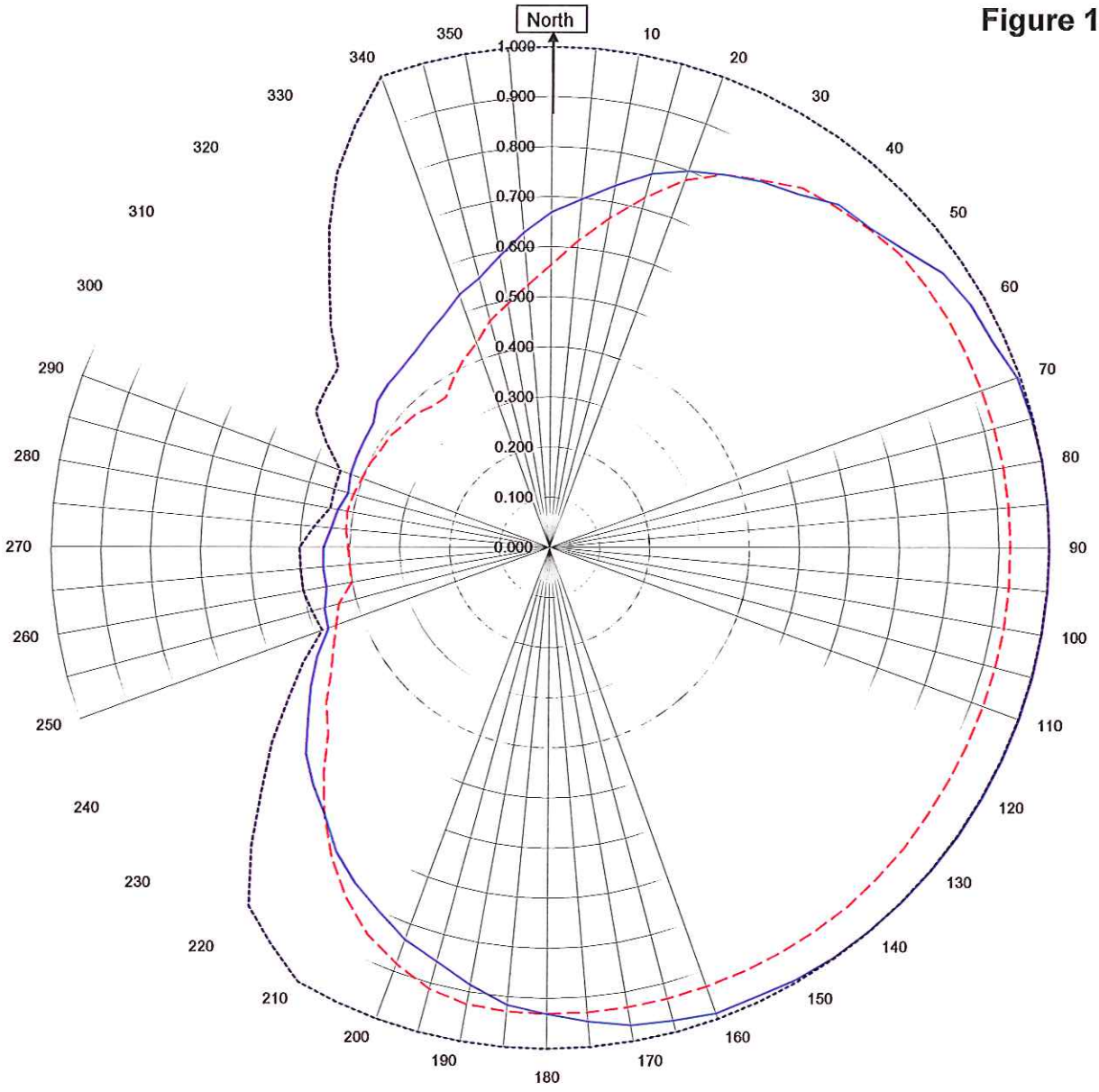
Figure 1A



WFRQ HARWICH PORT, MA.

30258

October 31, 2012

Horizontal RMS	0.789
Vertical RMS	0.748
H/V Composite RMS	0.794
FCC Composite RMS	0.894

Frequency	93.5 / 420.75 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6810-2R-SS(0.5)-DA
Pattern Type	Directional Azimuth

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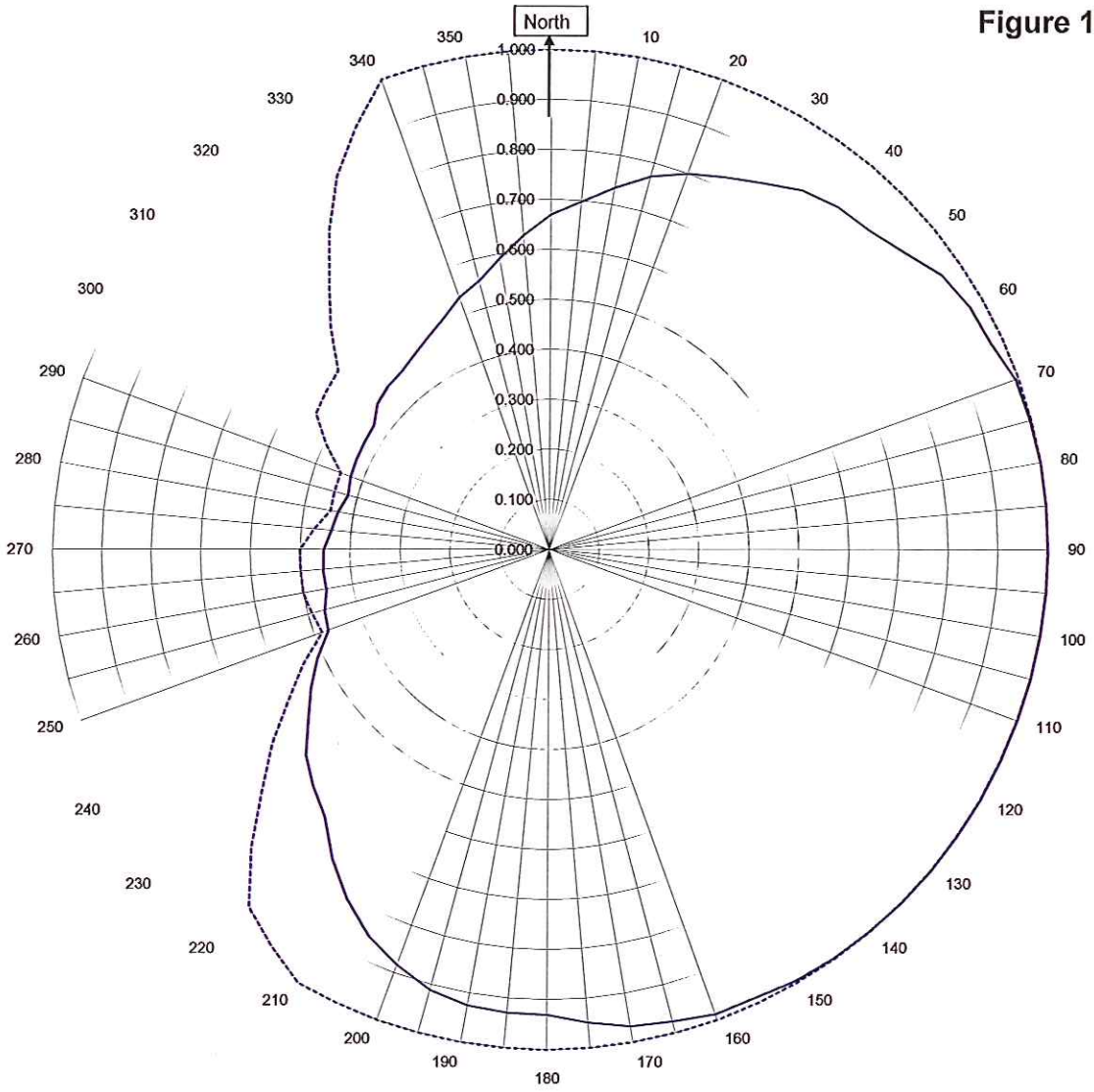
Figure 1B



WFRQ HARWICH PORT, M/

30258

October 31, 2012

_____H/VComposite RMS	0.794
.....FCC Composite RMS	0.894

Frequency	93.5 / 420.75 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6810-2R-SS(0.5)-DA
Pattern Type	Directional H/V Composite

Figure 1C

Tabulation of Horizontal Azimuth Pattern
WFRQ HARWICH PORT, MA.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.670	180	0.930
10	0.735	190	0.886
20	0.800	200	0.833
30	0.844	210	0.772
40	0.894	220	0.696
45	0.903	225	0.668
50	0.925	230	0.636
60	0.970	240	0.552
70	0.994	250	0.472
80	1.000	260	0.454
90	1.000	270	0.454
100	1.000	280	0.432
110	1.000	290	0.426
120	1.000	300	0.430
130	1.000	310	0.454
135	1.000	315	0.462
140	0.998	320	0.466
150	0.995	330	0.492
160	0.988	340	0.537
170	0.967	350	0.592

Figure 1D

Tabulation of Vertical Azimuth Pattern
WFRQ HARWICH PORT, MA.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.564	180	0.930
10	0.666	190	0.925
20	0.779	200	0.884
30	0.846	210	0.806
40	0.888	220	0.697
45	0.900	225	0.635
50	0.911	230	0.575
60	0.917	240	0.504
70	0.919	250	0.454
80	0.922	260	0.402
90	0.922	270	0.404
100	0.924	280	0.412
110	0.925	290	0.400
120	0.926	300	0.390
130	0.931	310	0.381
135	0.933	315	0.378
140	0.935	320	0.367
150	0.933	330	0.388
160	0.932	340	0.434
170	0.931	350	0.494

Figure 1E

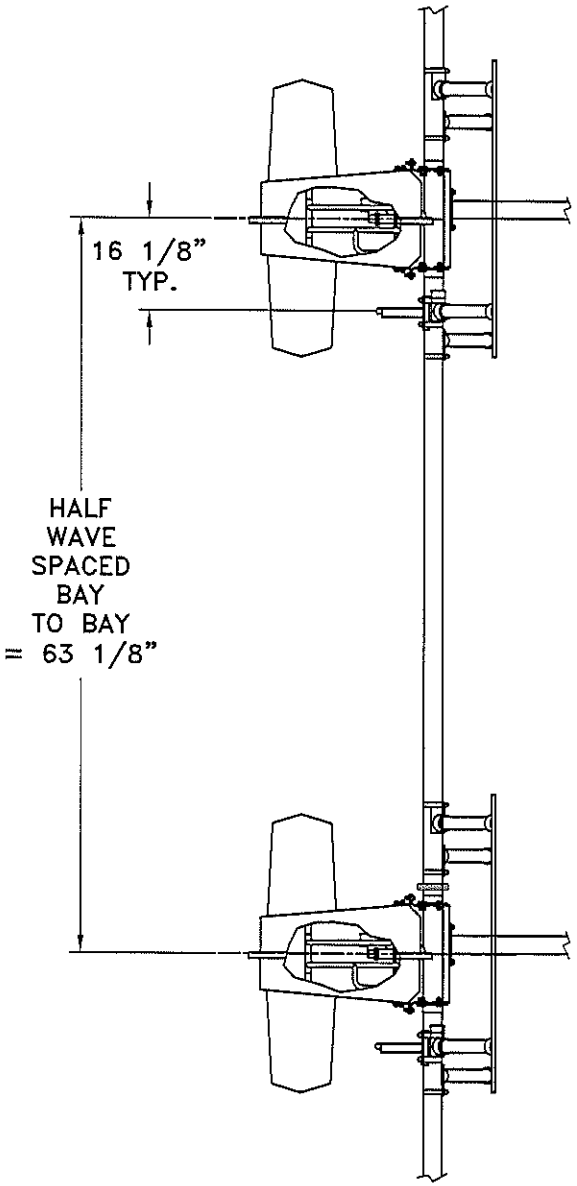
Tabulation of Composite Azimuth Pattern
WFRQ HARWICH PORT, MA.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.670	180	0.930
10	0.735	190	0.925
20	0.800	200	0.884
30	0.846	210	0.806
40	0.894	220	0.697
45	0.903	225	0.668
50	0.925	230	0.636
60	0.970	240	0.552
70	0.994	250	0.472
80	1.000	260	0.454
90	1.000	270	0.454
100	1.000	280	0.432
110	1.000	290	0.426
120	1.000	300	0.430
130	1.000	310	0.454
135	1.000	315	0.462
140	0.998	320	0.466
150	0.995	330	0.492
160	0.988	340	0.537
170	0.967	350	0.592

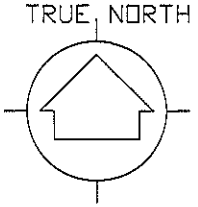
Figure 1F

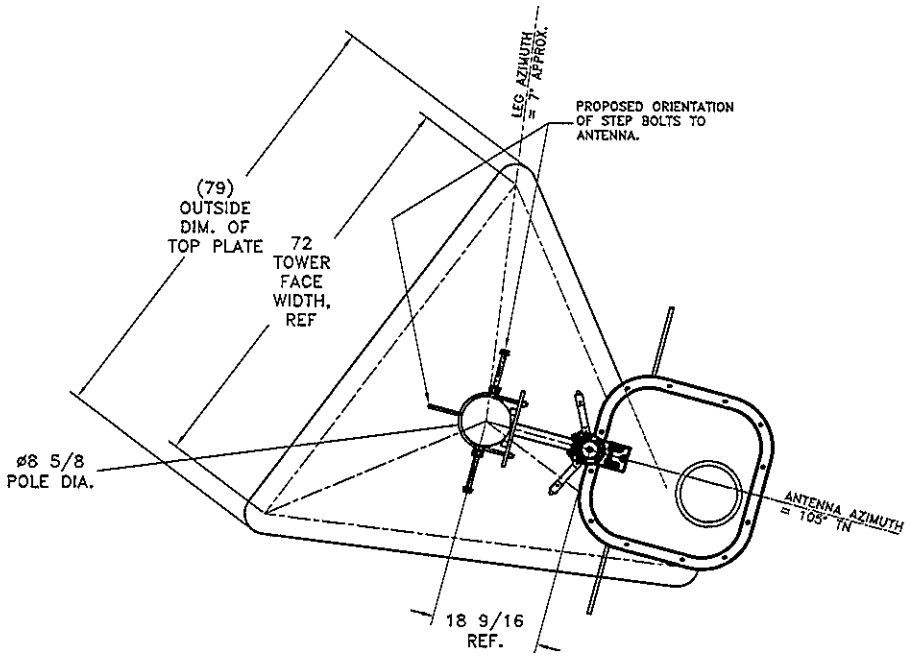
Tabulation of FCC Directional Composite
WFRQ HARWICH PORT, MA.

Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	1.000
10	1.000	190	1.000
20	1.000	200	1.000
30	1.000	210	1.000
40	1.000	220	0.933
50	1.000	230	0.750
60	1.000	240	0.603
70	1.000	250	0.484
80	1.000	260	0.501
90	1.000	270	0.501
100	1.000	280	0.447
110	1.000	290	0.447
120	1.000	300	0.543
130	1.000	310	0.556
140	1.000	320	0.692
150	1.000	330	0.861
160	1.000	340	1.000
170	1.000	350	1.000



SIDE VIEW





TOP VIEW

POLE MAKE: FDH ENGINEERING

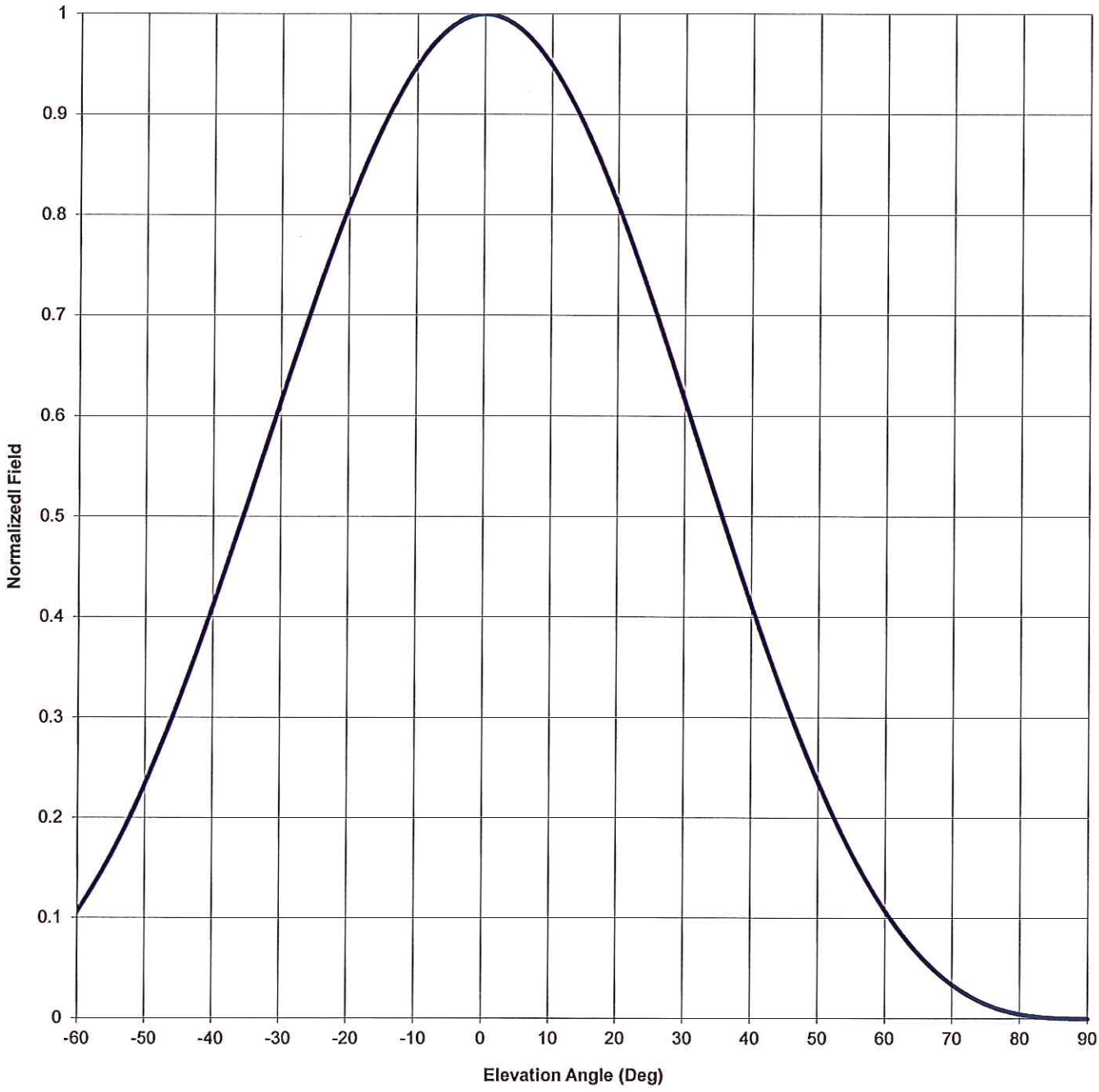
ANTENNA HEADING 105° TRUE NORTH

SHIVELY LABS A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE			
SHOP ORDER: 30258	FREQUENCY: 93.5	SCALE: N.T.S.	DRAWN BY: ASP APPROVED BY: DAB
TITLE: MODEL-6810-2R-SS-DIRECTIONAL ANTENNA			
DATE: 10-3-12	FIGURE 2		

Antenna Mfg.: Shively Labs
Antenna Type: 6810-2R-SS(0.5)-DA
Station: WFRQ
Frequency: 93.5
Channel #: 228
Figure: Figure 3

Date: 10/31/2012

Beam Tilt	0	
Gain (Max)	1.187	0.744 dB
Gain (Horizon)	1.187	0.744 dB



Antenna Mfg.: Shively Labs
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Station: WFRQ
Frequency: 93.5
Channel #: 228
Figure: Figure 3

Date: 10/31/2012

Beam Tilt	**0**	
Gain (Max)	**1.187**	**0.744 dB**
Gain (Horizon)	**1.187**	**0.744 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	0.336	0	1.000	46	0.301
-89	0.000	-43	0.355	1	0.999	47	0.284
-88	0.000	-42	0.373	2	0.998	48	0.267
-87	0.000	-41	0.392	3	0.995	49	0.251
-86	0.000	-40	0.412	4	0.992	50	0.235
-85	0.001	-39	0.432	5	0.987	51	0.220
-84	0.001	-38	0.452	6	0.981	52	0.205
-83	0.002	-37	0.472	7	0.975	53	0.191
-82	0.002	-36	0.492	8	0.967	54	0.177
-81	0.003	-35	0.513	9	0.958	55	0.164
-80	0.004	-34	0.533	10	0.949	56	0.152
-79	0.006	-33	0.554	11	0.939	57	0.140
-78	0.008	-32	0.575	12	0.927	58	0.128
-77	0.010	-31	0.595	13	0.915	59	0.118
-76	0.012	-30	0.616	14	0.902	60	0.107
-75	0.015	-29	0.636	15	0.888	61	0.098
-74	0.018	-28	0.657	16	0.874	62	0.088
-73	0.021	-27	0.677	17	0.859	63	0.080
-72	0.025	-26	0.697	18	0.843	64	0.072
-71	0.029	-25	0.717	19	0.826	65	0.064
-70	0.034	-24	0.736	20	0.809	66	0.057
-69	0.039	-23	0.755	21	0.792	67	0.050
-68	0.044	-22	0.774	22	0.774	68	0.044
-67	0.050	-21	0.792	23	0.755	69	0.039
-66	0.057	-20	0.809	24	0.736	70	0.034
-65	0.064	-19	0.826	25	0.717	71	0.029
-64	0.072	-18	0.843	26	0.697	72	0.025
-63	0.080	-17	0.859	27	0.677	73	0.021
-62	0.088	-16	0.874	28	0.657	74	0.018
-61	0.098	-15	0.888	29	0.636	75	0.015
-60	0.107	-14	0.902	30	0.616	76	0.012
-59	0.118	-13	0.915	31	0.595	77	0.010
-58	0.128	-12	0.927	32	0.575	78	0.008
-57	0.140	-11	0.939	33	0.554	79	0.006
-56	0.152	-10	0.949	34	0.533	80	0.004
-55	0.164	-9	0.958	35	0.513	81	0.003
-54	0.177	-8	0.967	36	0.492	82	0.002
-53	0.191	-7	0.975	37	0.472	83	0.002
-52	0.205	-6	0.981	38	0.452	84	0.001
-51	0.220	-5	0.987	39	0.432	85	0.001
-50	0.235	-4	0.992	40	0.412	86	0.000
-49	0.251	-3	0.995	41	0.392	87	0.000
-48	0.267	-2	0.998	42	0.373	88	0.000
-47	0.284	-1	0.999	43	0.355	89	0.000
-46	0.301	0	1.000	44	0.336	90	0.000
-45	0.318			45	0.318		

S.O. 30258 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WFRQ HARWICH PORT, MA.

MODEL 6810-2R-SS(0.5)-DA

Elevation Gain of Antenna 0.7

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

H RMS 0.789083 V RMS 0.747572 H/V Ratio 1.056

Elevation Gain of Horizontal Component 0.739

Elevation Gain of Vertical Component 0.663

Horizontal Azimuth Gain equals $1/(RMS)^2$. 1.606

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 1.564

Max. Vertical 0.935

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

Total Horizontal Power Gain = **1.187**

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

Total Vertical Power Gain = **1.037**

==========

ERP divided by Horizontal Power Gain equals Antenna Input Power

6.0 kW ERP Divided by H Gain 1.187 equals 5.056 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

5.056 kW Times V Gain 1.037 equals 5.245 kW V ERP

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

(0.935)^2 Times 6.00 Equals 5.245 kW Vertical ERP

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