

S.O. 35841
Report of Test 6815-5-SS(.944)-DA
for
LIGHT OF LIFE MINISTRIES, INC.
WRNM 91.7 MHz ELLSWORTH. ME.

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6815-5-SS(.944)-DA to meet the needs of WRNM and to comply with the requirements of the FCC construction permit, file number BPED-20171207ACH. 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-20171207ACH indicates that the Horizontal radiation component shall not exceed 12.5 kW at any azimuth and is restricted to the following values at the azimuths specified:

0 Degrees True: 0.461 kilowatts

80 Degrees True: 7.880 kilowatts

From Figure 1A, the maximum radiation of the Horizontal component occurs at 153 Degrees True to 217 Degrees True. At the restricted azimuth of 0 Degrees True the Horizontal component is 14.66 dB down from the maximum of 12.5 kW, or 0.428 kW and at the restricted azimuth of 80 Degrees True the horizontal component is 3.74 dB down from the maximum of 12.5 kW, or 5.281 kW.

The R.M.S. of the Horizontal component is 0.707. The total Horizontal power gain is 5.927. The R.M.S. of the Vertical component is 0.662. The total Vertical power gain is 5.751. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.816. The R.M.S. of the measured composite pattern is 0.708. Eighty-five percent (85%) of the original authorized FCC composite pattern is .6936. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6815-5-SS(.944)-DA was mounted on a tower of precise scale to the Rohn-45 tower at the WRNM site. The spacing of the antenna to the tower was varied to achieve the vertical pattern shown in Figure 1A. Horizontal parasitic elements were placed $\frac{1}{4}$ wave length above and below the bay. The horizontal parasitic elements, length and angle were 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-20171207ACH, a single level of the 6815-5-SS(.944)-DA was set up on the Shively Labs scale model antenna pattern measuring range. A scale of 4.5:1 was used.

EQUIPMENT:

The 4.5:1 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 4395-A Network Analyzer

PC Based Controller

Computer Conversions Digital Positioner 0 to 359 degrees

Output Standard Printer or 'pdf'

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

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 412.65 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:



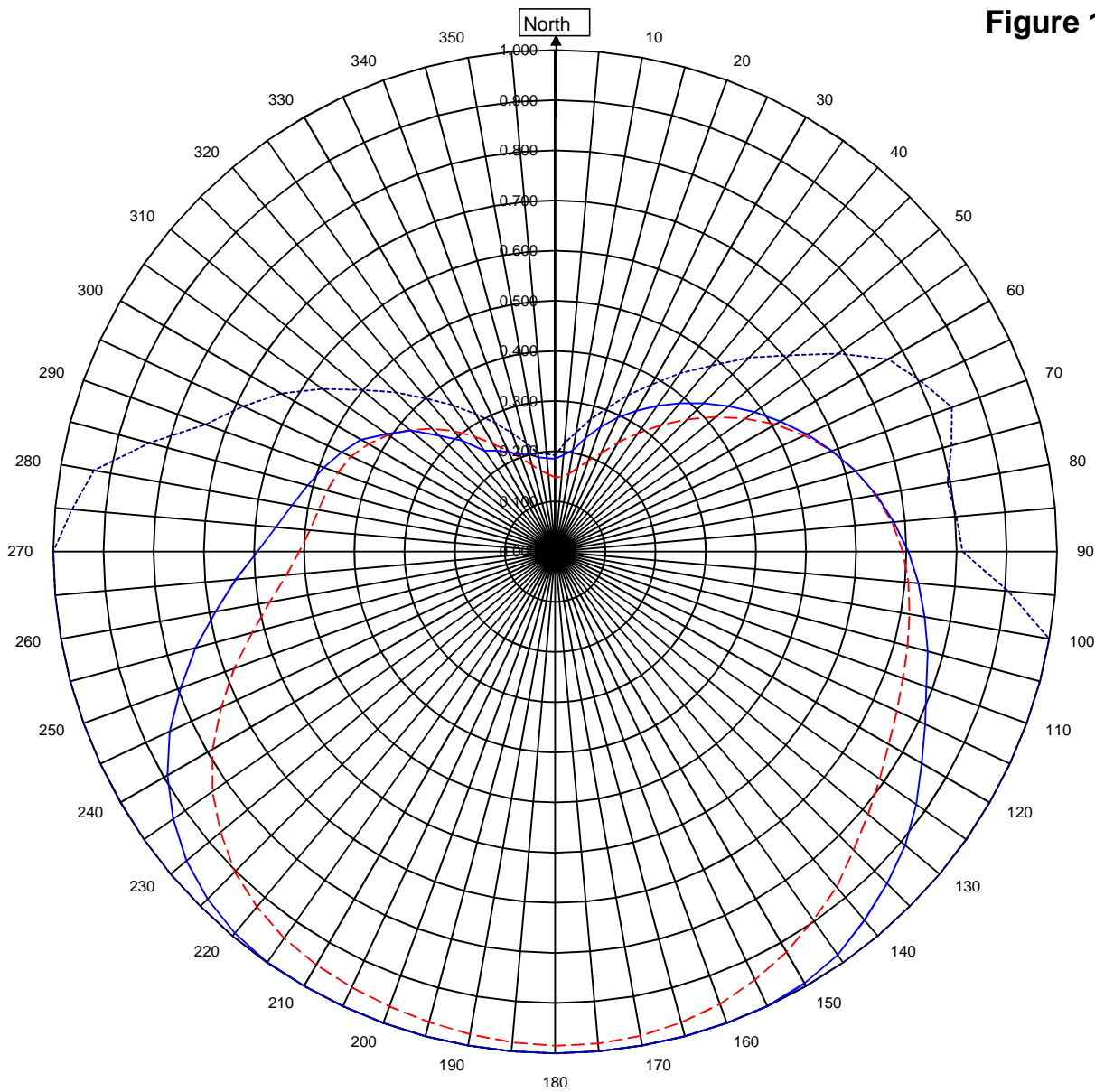
Angela Gillespie
Vice President, Shively Labs

S/O 35841
September 14, 2018

Shively Labs

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

Figure 1A



WRNM ELLSWORTH, ME.
35841
September 14, 2018

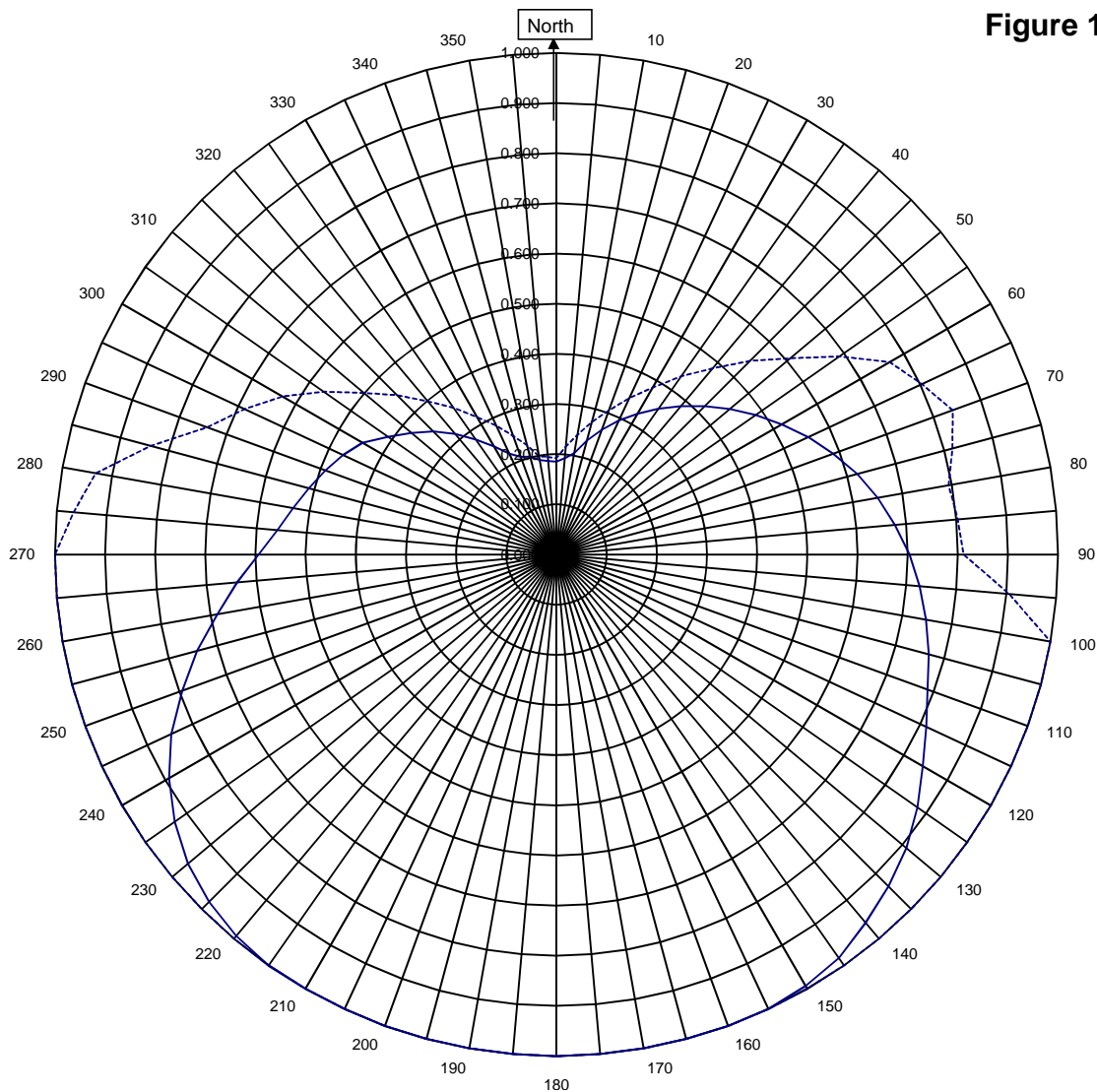
Horizontal RMS	0.707	Frequency	91.7 / 412.65 mHz
Vertical RMS	0.662	Plot	Relative Field
H/V Composite RMS	0.708	Scale	4.5 : 1
FCC Composite RMS	0.816	See Figure 2 for Mechanical Details	

Antenna Model	6815-5-SS(.944)-DA
Pattern Type	Directional Azimuth

Shively Labs

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

Figure 1B



WRNM ELLLSWORTH, ME.

35841
September 14, 2018

—————H/V Composite RMS	0.708
.....FCC Composite RMS	0.816

Frequency	91.7 / 412.65 mHz
Plot	Relative Field
Scale	4.5 : 1
See Figure 2 for Mechanical Details	

Antenna Model	6815-5-SS(.944)-DA
Pattern Type	Directional H/V Composite

Figure 1C

Tabulation of Horizontal Azimuth Pattern
WRNM ELLLSWORTH, ME.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.185	180	1.000
10	0.205	190	1.000
20	0.265	200	1.000
30	0.324	210	1.000
40	0.386	220	0.993
45	0.418	225	0.979
50	0.451	230	0.959
60	0.519	240	0.892
70	0.587	250	0.794
80	0.650	260	0.687
90	0.704	270	0.594
100	0.748	280	0.533
110	0.787	290	0.491
120	0.844	300	0.446
130	0.911	310	0.375
135	0.936	315	0.327
140	0.959	320	0.289
150	0.994	330	0.233
160	1.000	340	0.207
170	1.000	350	0.191

Figure 1D

Tabulation of Vertical Azimuth Pattern
WRNM ELLLSWORTH, ME.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.148	180	0.985
10	0.158	190	0.977
20	0.193	200	0.965
30	0.252	210	0.952
40	0.329	220	0.924
45	0.373	225	0.903
50	0.418	230	0.870
60	0.507	240	0.788
70	0.587	250	0.681
80	0.649	260	0.577
90	0.693	270	0.510
100	0.717	280	0.479
110	0.738	290	0.460
120	0.768	300	0.429
130	0.814	310	0.377
135	0.841	315	0.347
140	0.873	320	0.314
150	0.922	330	0.249
160	0.960	340	0.199
170	0.980	350	0.164

Figure 1E

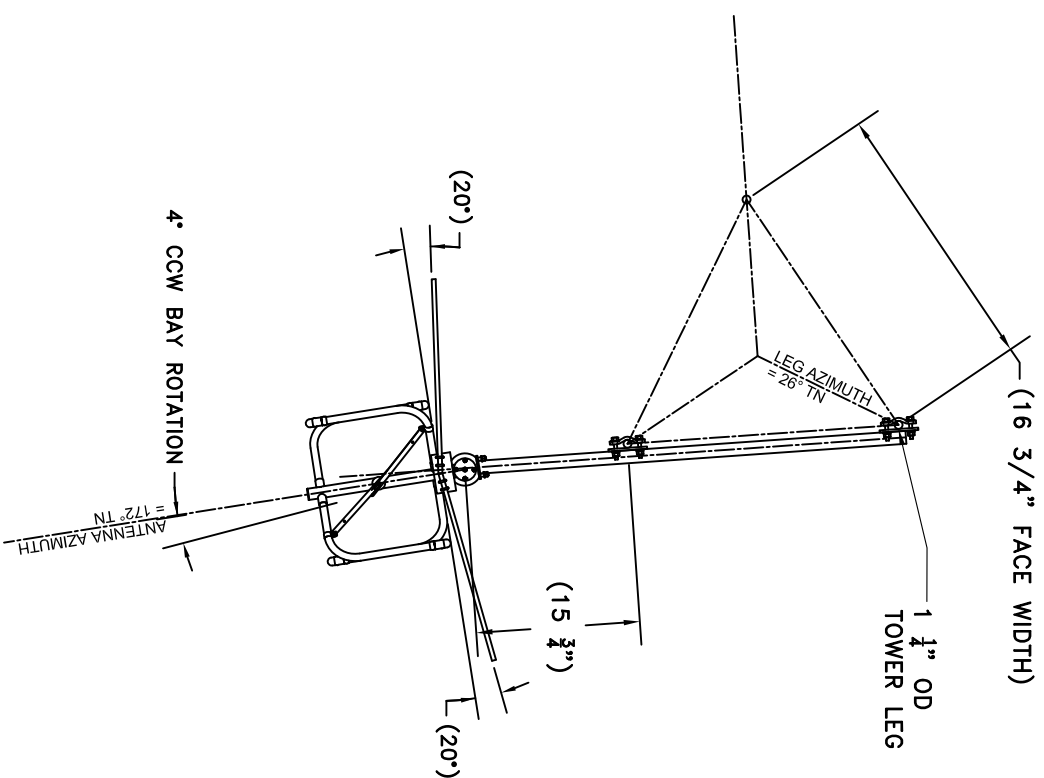
Tabulation of Composite Azimuth Pattern
WRNM ELLLSWORTH, ME.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.185	180	1.000
10	0.205	190	1.000
20	0.265	200	1.000
30	0.324	210	1.000
40	0.386	220	0.993
45	0.418	225	0.979
50	0.451	230	0.959
60	0.519	240	0.892
70	0.587	250	0.794
80	0.650	260	0.687
90	0.704	270	0.594
100	0.748	280	0.533
110	0.787	290	0.491
120	0.844	300	0.446
130	0.911	310	0.377
135	0.936	315	0.347
140	0.959	320	0.314
150	0.994	330	0.249
160	1.000	340	0.207
170	1.000	350	0.191

Figure 1F

Tabulation of FCC Directional Composite
WRNM ELLLSWORTH, ME.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.192	180	1.000
10	0.242	190	1.000
20	0.305	200	1.000
30	0.384	210	1.000
40	0.484	220	1.000
50	0.609	230	1.000
60	0.767	240	1.000
70	0.841	250	1.000
80	0.794	260	1.000
90	0.812	270	1.000
100	1.000	280	0.933
110	1.000	290	0.741
120	1.000	300	0.630
130	1.000	310	0.501
140	1.000	320	0.398
150	1.000	330	0.316
160	1.000	340	0.251
170	1.000	350	0.199



TOP VIEW
TOWER MAKE: ROHN 45

SHIVELY LABS			
A DIVISION OF HOWELL LABORATORIES INC., BRISTOL, MAINE			
SHIP ORDER:	FREQUENCY:	SCALE:	DRUM BY:
355841	91.7	N.T.S.	ASP
TITLE:		APPROVED BY:	
MODEL-6815-5-.944-DIRECTIONAL ANTENNA		DAB	
DATE:			
12-7-18		FIGURE 2	

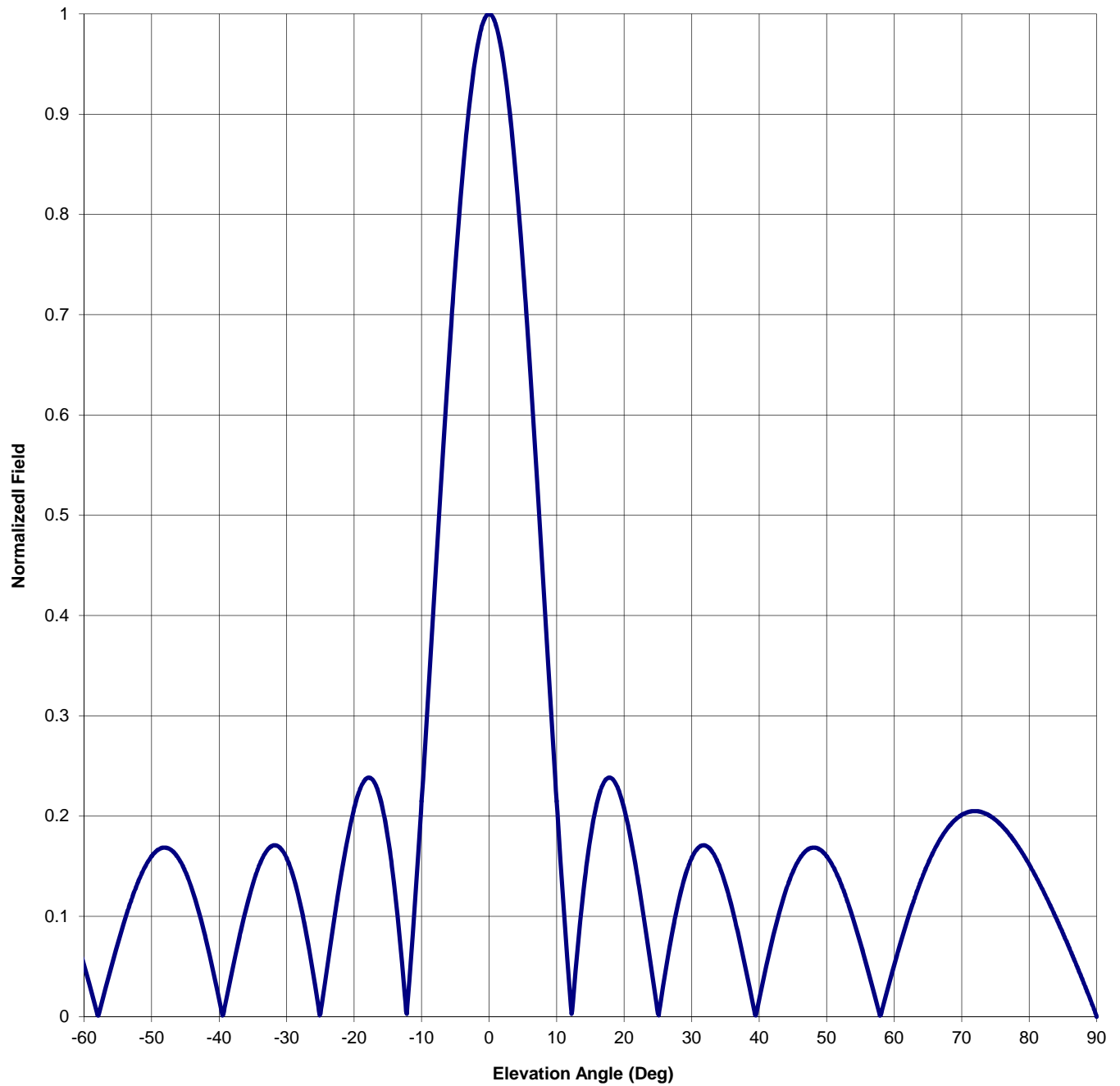
Antenna Mfg.: Shively Labs
Antenna Type: 6815-5-SS(.944)-DA

Date: 9/14/2018

Station: WRNM
Frequency: 91.7
Channel #: 219

Beam Tilt	0	
Gain (Max)	5.927	7.728 dB
Gain (Horizon)	5.927	7.728 dB

Figure: Figure 3



Antenna Mfg.: Shively Labs
Antenna Type: 6815-5-SS(.944)-DA

Date: 9/14/2018

Station: WRNM

Beam Tilt 0

Frequency: 91.7

Gain (Max) 5.927 7.728 dB

Channel #: 219

Gain (Horizon) 5.927 7.728 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	0.127	0	1.000	46	0.158
-89	0.018	-43	0.105	1	0.989	47	0.166
-88	0.035	-42	0.078	2	0.957	48	0.169
-87	0.052	-41	0.049	3	0.905	49	0.167
-86	0.068	-40	0.017	4	0.835	50	0.160
-85	0.083	-39	0.015	5	0.750	51	0.149
-84	0.098	-38	0.048	6	0.652	52	0.134
-83	0.113	-37	0.079	7	0.546	53	0.117
-82	0.126	-36	0.108	8	0.435	54	0.096
-81	0.140	-35	0.132	9	0.324	55	0.073
-80	0.152	-34	0.152	10	0.215	56	0.049
-79	0.163	-33	0.165	11	0.113	57	0.024
-78	0.173	-32	0.171	12	0.020	58	0.002
-77	0.182	-31	0.169	13	0.061	59	0.027
-76	0.190	-30	0.158	14	0.127	60	0.051
-75	0.196	-29	0.140	15	0.179	61	0.075
-74	0.201	-28	0.113	16	0.214	62	0.097
-73	0.204	-27	0.080	17	0.234	63	0.118
-72	0.205	-26	0.040	18	0.238	64	0.136
-71	0.204	-25	0.003	19	0.229	65	0.153
-70	0.201	-24	0.049	20	0.208	66	0.167
-69	0.196	-23	0.095	21	0.177	67	0.179
-68	0.189	-22	0.138	22	0.138	68	0.189
-67	0.179	-21	0.177	23	0.095	69	0.196
-66	0.167	-20	0.208	24	0.049	70	0.201
-65	0.153	-19	0.229	25	0.003	71	0.204
-64	0.136	-18	0.238	26	0.040	72	0.205
-63	0.118	-17	0.234	27	0.080	73	0.204
-62	0.097	-16	0.214	28	0.113	74	0.201
-61	0.075	-15	0.179	29	0.140	75	0.196
-60	0.051	-14	0.127	30	0.158	76	0.190
-59	0.027	-13	0.061	31	0.169	77	0.182
-58	0.002	-12	0.020	32	0.171	78	0.173
-57	0.024	-11	0.113	33	0.165	79	0.163
-56	0.049	-10	0.215	34	0.152	80	0.152
-55	0.073	-9	0.324	35	0.132	81	0.140
-54	0.096	-8	0.435	36	0.108	82	0.126
-53	0.117	-7	0.546	37	0.079	83	0.113
-52	0.134	-6	0.652	38	0.048	84	0.098
-51	0.149	-5	0.750	39	0.015	85	0.083
-50	0.160	-4	0.835	40	0.017	86	0.068
-49	0.167	-3	0.905	41	0.049	87	0.052
-48	0.169	-2	0.957	42	0.078	88	0.035
-47	0.166	-1	0.989	43	0.105	89	0.018
-46	0.158	0	1.000	44	0.127	90	0.000
-45	0.145			45	0.145		

VALIDATION OF TOTAL POWER GAIN CALCULATION

WRNM ELLSWORTH, ME.

MODEL 6815-5-SS(.944)-DA

Elevation Gain of Antenna

2.775

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

H RMS	0.707169	V RMS	0.662044	H/V Ratio	1.068
-------	----------	-------	----------	-----------	-------

Elevation Gain of Horizontal Component	2.964
----------------------------------------	-------

Elevation Gain of Vertical Component	2.598
--------------------------------------	-------

Horizontal Azimuth Gain equals $1/(\text{RMS})^2$.	2.000
-----------------------------------------------------	-------

Vertical Azimuth Gain equals $1/(\text{RMS}/\text{Max Vert})^2$.	2.214
-------------------------------------------------------------------	-------

Max. Vertical	0.985
---------------	-------

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

Total Horizontal Power Gain = 5.927

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

Total Vertical Power Gain = 5.751

ERP divided by Horizontal Power Gain equals Antenna Input Power

12.5	kW ERP	Divided by H Gain	5.927	equals	2.109	kW H Antenna Input Power
------	--------	-------------------	-------	--------	-------	--------------------------

Antenna Input Power times Vertical Power Gain equals Vertical ERP

2.109	kW	Times V Gain	5.751	equals	12.128	kW V ERP
-------	----	--------------	-------	--------	--------	----------

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

$(0.985)^2$	Times	12.50	Equals	12.128	kW Vertical ERP
-------------	-------	-------	--------	--------	-----------------

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