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S.O. 31037

Report of Test 6810-2R-DA

for

Mars Hill Broadcasting Co., Inc.

WMHU 91.1 MHz Cold Brood, NY

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-2R-DA to meet the needs of WMHU and to comply with the requirements of the FCC construction permit, file number BPED-20130513ADO. 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-20130513ADO indicates that the Horizontal radiation component shall not exceed 0.38 kW at any azimuth and is restricted to the following values at the azimuths specified:

250 - 260 Degrees True: 0.012 kilowatt (12watts)

From Figure 1A, the maximum radiation of the Horizontal component occurs at 35 Degrees True to 95 Degrees True. At the restricted azimuth of 250 – 260 Degrees True the Horizontal component is 15.62 dB down from the maximum of 0.38 kW, or 0.010 kW (10 watts).

The R.M.S. of the Horizontal component is 0.738. The total Horizontal power gain is 1.866. The R.M.S. of the Vertical component is 0.719. The total Vertical power gain is 1.825. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.811. The R.M.S. of the measured composite pattern is 0.740. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.689. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6810-2R-DA was mounted on a pole of precise scale to the 4" Pole at the WMHU 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-20130513ADO, a single level of the 6810-2R-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 409.95 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 31037
August 27, 2013

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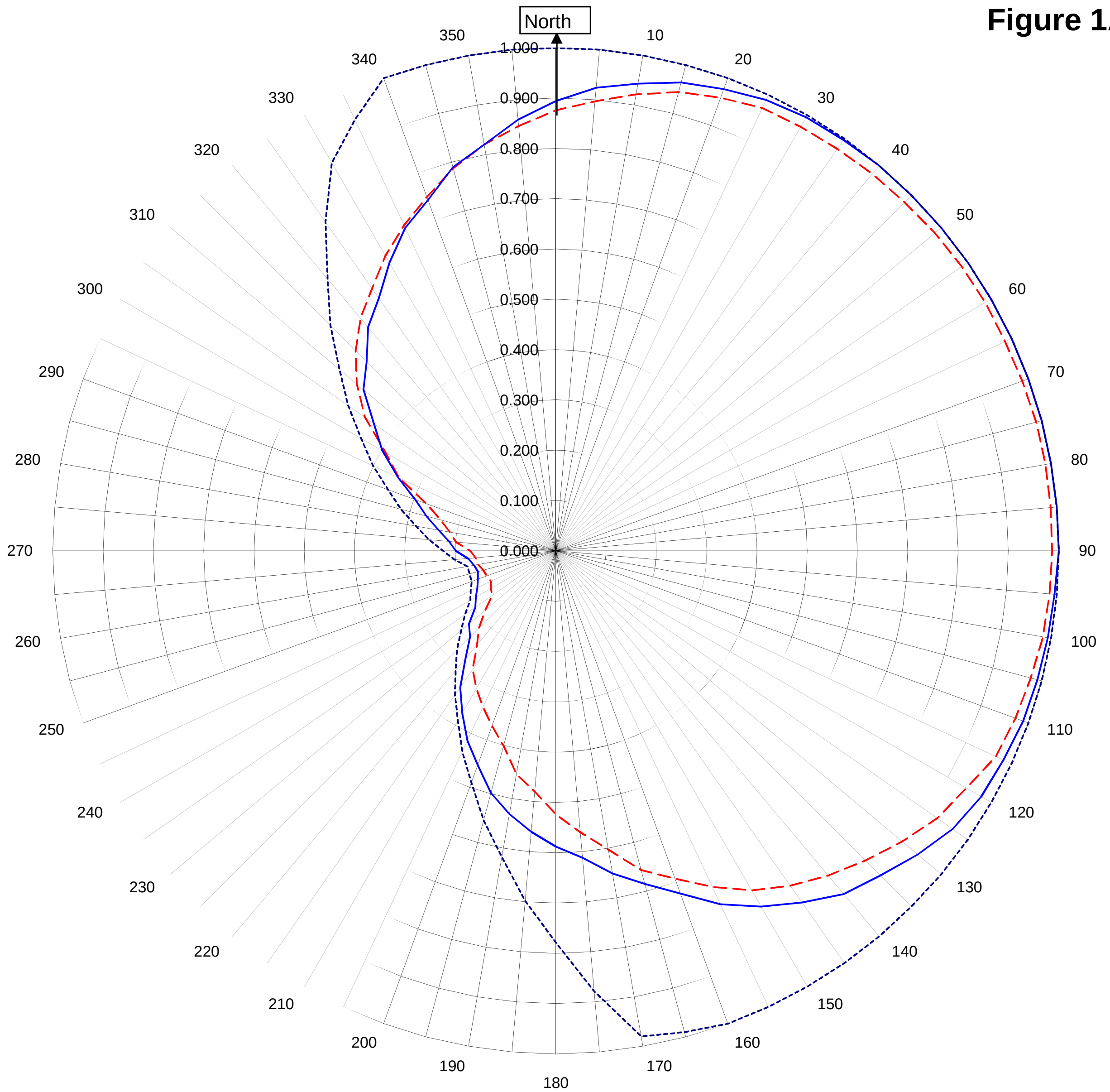
Figure 1A



WMHU COLD BROOK, NY.

31037

August 28, 2013

Horizontal RMS	0.738
Vertical RMS	0.719
H/V Composite RMS	0.740
……………FCC Composite RMS	0.811

Frequency	91.1 / 409.95 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6810-2R-DA
Pattern Type	Directional Azimuth

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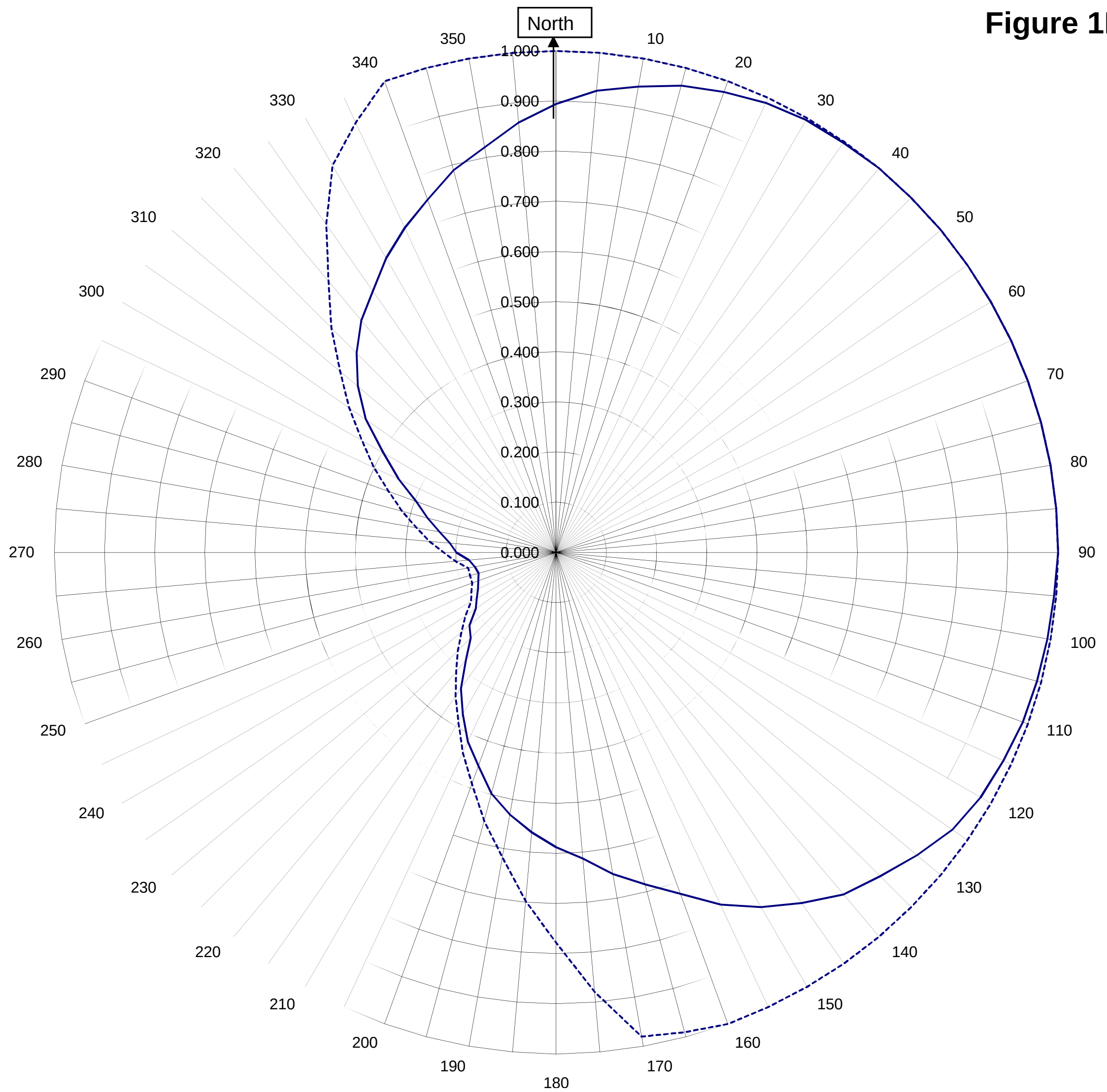
Figure 1B



WMHU COLD BROOK, NY.

31037

August 28, 2013

__________H/VComposite RMS	0.740
……………FCC Composite RMS	0.811

Frequency	91.1 / 409.95 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6810-2R-DA
Pattern Type	Directional H/V Composite

Figure 1C

Tabulation of Horizontal Azimuth Pattern
WMHU COLD BROOK, NY.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.894	180	0.587
10	0.943	190	0.531
20	0.977	200	0.454
30	0.996	210	0.372
40	1.000	220	0.280
45	1.000	225	0.241
50	1.000	230	0.226
60	1.000	240	0.183
70	1.000	250	0.165
80	1.000	260	0.165
90	1.000	270	0.199
100	0.994	280	0.237
110	0.989	290	0.297
120	0.976	300	0.399
130	0.939	310	0.500
135	0.913	315	0.532
140	0.890	320	0.581
150	0.816	330	0.662
160	0.725	340	0.743
170	0.651	350	0.820

Figure 1D

Tabulation of Vertical Azimuth Pattern
WMHU COLD BROOK, NY.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.876	180	0.524
10	0.922	190	0.450
20	0.959	200	0.370
30	0.974	210	0.316
40	0.979	220	0.244
45	0.980	225	0.216
50	0.984	230	0.184
60	0.987	240	0.149
70	0.987	250	0.146
80	0.989	260	0.157
90	0.987	270	0.170
100	0.984	280	0.213
110	0.973	290	0.274
120	0.943	300	0.392
130	0.899	310	0.517
135	0.870	315	0.563
140	0.843	320	0.604
150	0.779	330	0.678
160	0.694	340	0.749
170	0.603	350	0.821

Figure 1E

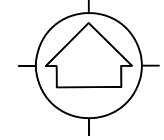
Tabulation of Composite Azimuth Pattern
WMHU COLD BROOK, NY.

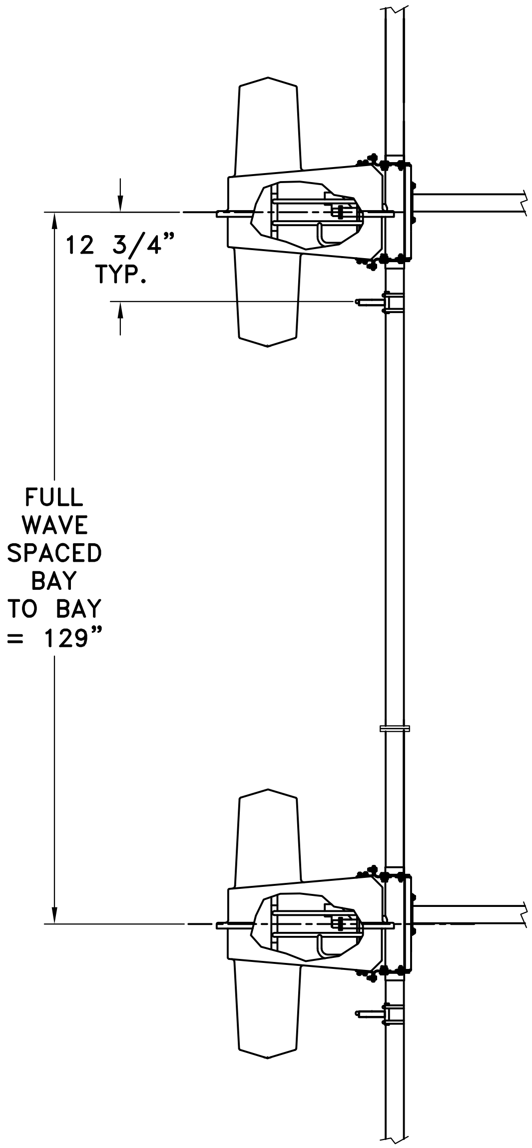
Azimuth	Rel Field	Azimuth	Rel Field
0	0.894	180	0.587
10	0.943	190	0.531
20	0.977	200	0.454
30	0.996	210	0.372
40	1.000	220	0.280
45	1.000	225	0.241
50	1.000	230	0.226
60	1.000	240	0.183
70	1.000	250	0.165
80	1.000	260	0.165
90	1.000	270	0.199
100	0.994	280	0.237
110	0.989	290	0.297
120	0.976	300	0.399
130	0.939	310	0.517
135	0.913	315	0.563
140	0.890	320	0.604
150	0.816	330	0.678
160	0.725	340	0.749
170	0.651	350	0.821

Figure 1F

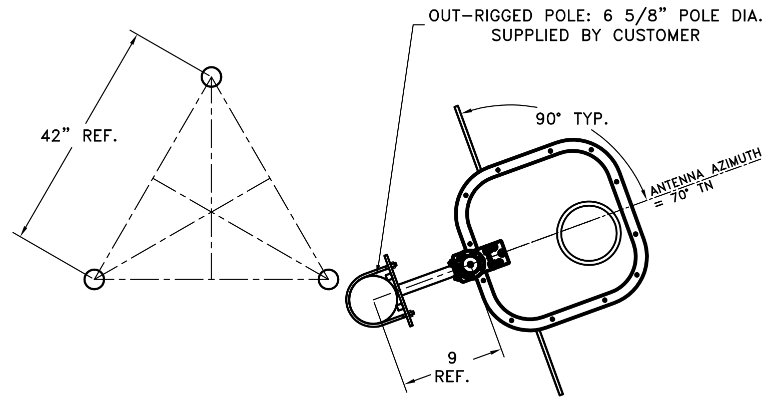
Tabulation of FCC Directional Composite
WMHU COLD BROOK, NY.

Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	0.778
10	1.000	190	0.618
20	1.000	200	0.491
30	1.000	210	0.390
40	1.000	220	0.310
50	1.000	230	0.246
60	1.000	240	0.196
70	1.000	250	0.178
80	1.000	260	0.178
90	1.000	270	0.224
100	1.000	280	0.282
110	1.000	290	0.355
120	1.000	300	0.447
130	1.000	310	0.562
140	1.000	320	0.706
150	1.000	330	0.891
160	1.000	340	1.000
170	0.980	350	1.000





SIDE VIEW



TOP VIEW

POLE MAKE: TOP MOUNTED POLE

ANTENNA HEADING 70° TRUE NORTH

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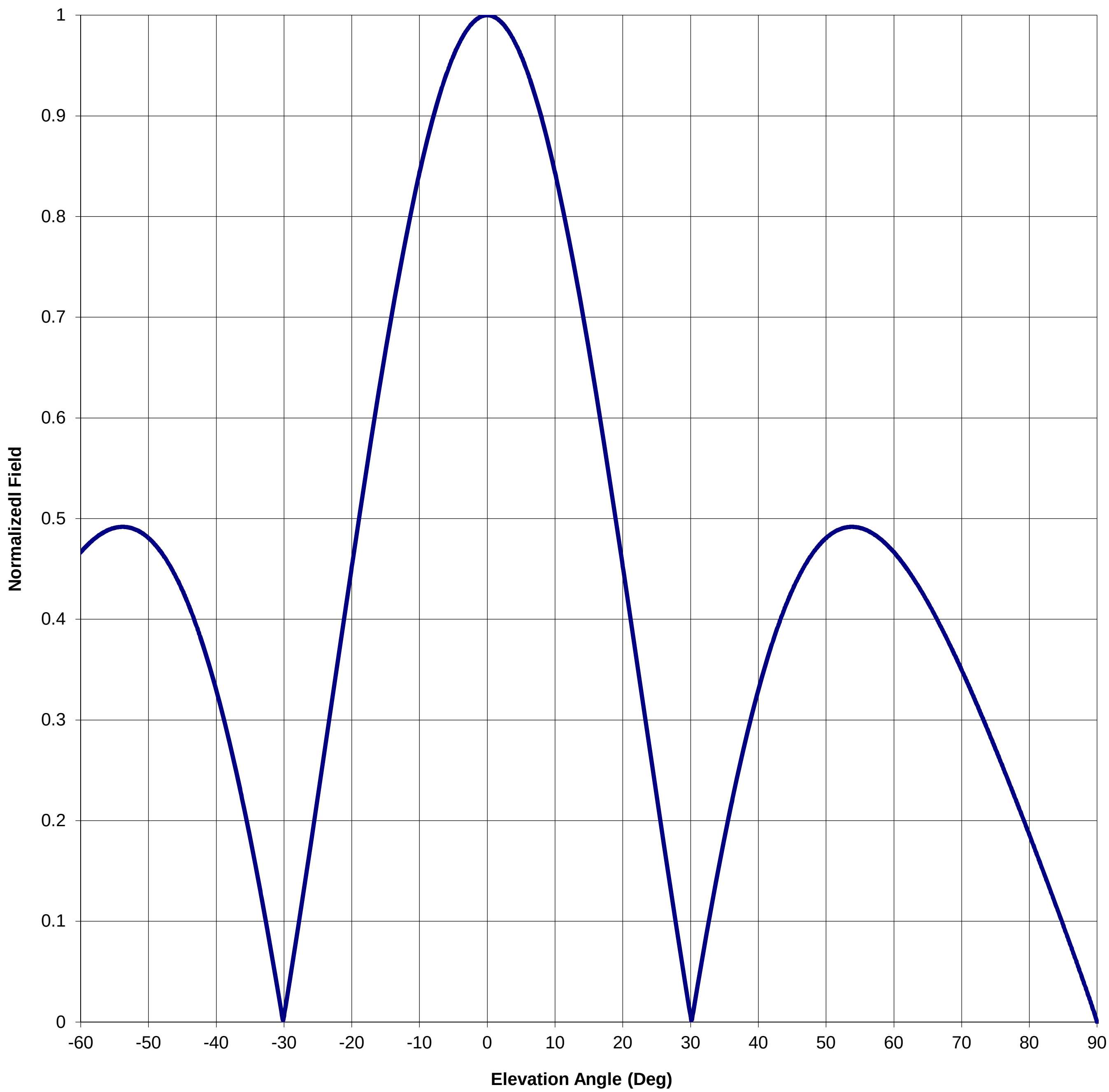
SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY: / APPROVED BY:
31037	91.1	N.T.S.	ASP / DAB

TITLE: MODEL-6810-2R-DIRECTIONAL ANTENNA

DATE: 8-20-13

FIGURE 2

Antenna Mfg.:	Shively Labs			Date:	8/27/2013
Antenna Type:	6810-2R-DA				
Station:	WMHU	Beam Tilt	0		
Frequency:	91.1	Gain (Max)	1.866	2.710	dB
Channel #:	216	Gain (Horizon)	1.866	2.710	dB
Figure:	Figure 3				



Antenna Mfg.: **Shively Labs** | **Date:** **8/27/2013**

Antenna Type: **6810-2R-DA**

Station: **WMHU** | **Beam Tilt** **0**

Frequency: **91.1** | **Gain (Max)** **1.866** **2.710 dB**

Channel #: **216** | **Gain (Horizon)** **1.866** **2.710 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	0.413	0	1.000	46	0.443
-89	0.021	-43	0.395	1	0.998	47	0.455
-88	0.040	-42	0.375	2	0.993	48	0.465
-87	0.059	-41	0.353	3	0.985	49	0.474
-86	0.078	-40	0.330	4	0.974	50	0.481
-85	0.096	-39	0.304	5	0.960	51	0.486
-84	0.114	-38	0.277	6	0.942	52	0.489
-83	0.132	-37	0.247	7	0.922	53	0.491
-82	0.150	-36	0.216	8	0.898	54	0.492
-81	0.168	-35	0.183	9	0.872	55	0.491
-80	0.186	-34	0.148	10	0.844	56	0.488
-79	0.203	-33	0.112	11	0.813	57	0.485
-78	0.221	-32	0.074	12	0.779	58	0.480
-77	0.238	-31	0.035	13	0.744	59	0.474
-76	0.255	-30	0.006	14	0.706	60	0.467
-75	0.271	-29	0.048	15	0.667	61	0.459
-74	0.288	-28	0.091	16	0.627	62	0.449
-73	0.304	-27	0.134	17	0.585	63	0.439
-72	0.319	-26	0.179	18	0.541	64	0.429
-71	0.335	-25	0.224	19	0.497	65	0.417
-70	0.350	-24	0.270	20	0.452	66	0.405
-69	0.364	-23	0.315	21	0.407	67	0.392
-68	0.378	-22	0.361	22	0.361	68	0.378
-67	0.392	-21	0.407	23	0.315	69	0.364
-66	0.405	-20	0.452	24	0.270	70	0.350
-65	0.417	-19	0.497	25	0.224	71	0.335
-64	0.429	-18	0.541	26	0.179	72	0.319
-63	0.439	-17	0.585	27	0.134	73	0.304
-62	0.449	-16	0.627	28	0.091	74	0.288
-61	0.459	-15	0.667	29	0.048	75	0.271
-60	0.467	-14	0.706	30	0.006	76	0.255
-59	0.474	-13	0.744	31	0.035	77	0.238
-58	0.480	-12	0.779	32	0.074	78	0.221
-57	0.485	-11	0.813	33	0.112	79	0.203
-56	0.488	-10	0.844	34	0.148	80	0.186
-55	0.491	-9	0.872	35	0.183	81	0.168
-54	0.492	-8	0.898	36	0.216	82	0.150
-53	0.491	-7	0.922	37	0.247	83	0.132
-52	0.489	-6	0.942	38	0.277	84	0.114
-51	0.486	-5	0.960	39	0.304	85	0.096
-50	0.481	-4	0.974	40	0.330	86	0.078
-49	0.474	-3	0.985	41	0.353	87	0.059
-48	0.465	-2	0.993	42	0.375	88	0.040
-47	0.455	-1	0.998	43	0.395	89	0.021
-46	0.443	0	1.000	44	0.413	90	0.000
-45	0.429			45	0.429		

S.O. 31037 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WMHU COLD BROOK, NY.

MODEL 6810-2R-DA

Elevation Gain of Antenna 0.99

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

H RMS	0.738191	V RMS	0.718634	H/V Ratio	1.027

Elevation Gain of Horizontal Component 1.017

Elevation Gain of Vertical Component 0.964

Horizontal Azimuth Gain equals $1/(RMS)^2$. 1.835

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 1.894

Max. Vertical 0.989

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

Total Horizontal Power Gain = **1.866**

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

Total Vertical Power Gain = **1.825**

==

ERP divided by Horizontal Power Gain equals Antenna Input Power

0.38	kW ERP	Divided by H Gain	1.866	equals	0.204	kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

0.204	kW	Times V Gain	1.825	equals	0.372	kW V ERP

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

(0.989)^2 Times 0.38 Equals 0.372 kW Vertical ERP

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