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S.O. 36344

Report of Test 6810-2R-EF-DA-88.10

for

American Family Association

WWGV-FM 88.1 MHz   Grove City, OH

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-2R-EF-DA-88.10 to meet the needs of WWGV-FM and to comply with the requirements of the FCC construction permit, file number BPED-20160915AAW. 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-20160915AAW indicates that the Horizontal radiation component shall not exceed 14 kW at any azimuth and is restricted to the following value(s) at the azimuth(s) specified:

270 Degrees True: 3.3 kilowatts
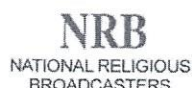
From Figure 1A, the maximum radiation of the Horizontal component occurs at 100 Degrees True. At the restricted azimuth of 270 Degrees True, the Horizontal component is 10.99 dB down from 14 kW at 1.11 kW, which is below the restricted value of 3.3 kW.

The R.M.S. of the Horizontal component is 0.723. The total Horizontal power gain is 2.242. The R.M.S. of the Vertical component is 0.611. The total Vertical power gain is 1.977. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.900. The R.M.S. of the measured composite pattern is 0.771. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.765. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6810-2R-EF-DA-88.10 was mounted on a tower of precise scale to the Pirod PN111574 tower at the WWGV-FM 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-20160915AAW, a single level of the 6810-2R-EF-DA-88.10 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
>
> 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 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:

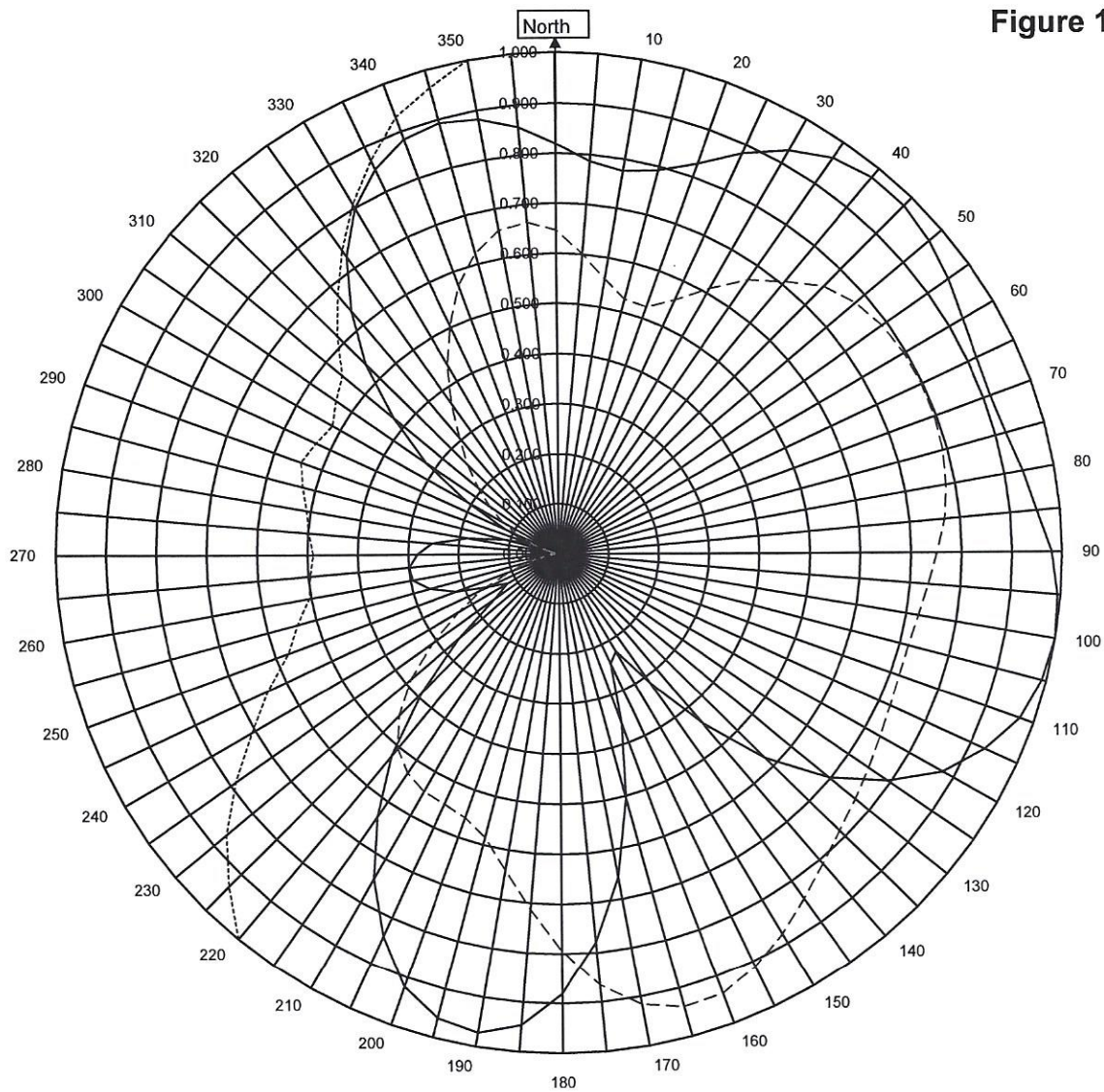Angela Gillespie
Vice President, Shively Labs

S/O 36344
Date 10 May 2019

Shively Labs

Figure 1A

WWGV   **Grove City, OH**

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———— Horizontal RMS	0.723	
– – – – – Vertical RMS	0.611	
H/V Composite RMS	0.771	
·············FCC Composite RMS	0.900	

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

Antenna Model	6810-2R-EF-DA-88.10
Pattern Type	Directional Azimuth

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Figure 1B
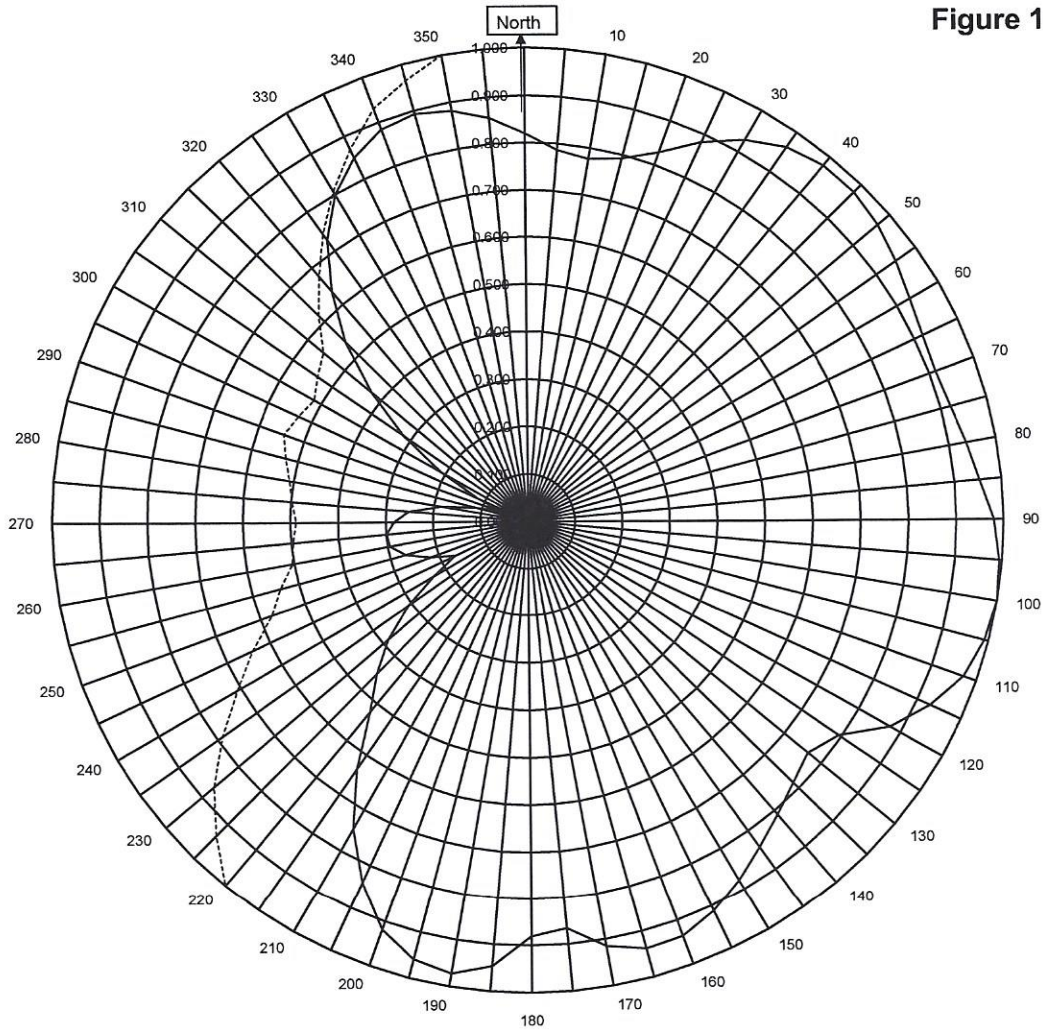
WWGV   **Grove City, OH**

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May 2019

_____ H/VComposite RMS	0.771	
............FCC Composite RMS	0.900	

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

Antenna Model	6810-2R-EF-DA-88.10
Pattern Type	Directional H/V Composite

Tabulation of Horizontal Azimuth Pattern
WWGV Grove City, OH

Azimuth	Rel Field	Azimuth	Rel Field
0	0.820	180	0.882
10	0.776	190	0.972
20	0.829	200	0.919
30	0.928	210	0.747
40	0.978	220	0.522
45	0.978	225	0.389
50	0.967	230	0.262
60	0.931	240	0.117
70	0.914	250	0.218
80	0.937	260	0.295
90	0.979	270	0.282
100	1.000	280	0.183
110	0.972	290	0.060
120	0.875	300	0.211
130	0.697	310	0.426
135	0.576	315	0.539
140	0.442	320	0.635
150	0.225	330	0.799
160	0.361	340	0.883
170	0.656	350	0.882

Tabulation of Vertical Azimuth Pattern
WWGV Grove City, OH

Azimuth	Rel Field	Azimuth	Rel Field
0	0.646	180	0.794
10	0.557	190	0.641
20	0.524	200	0.558
30	0.611	210	0.544
40	0.707	220	0.504
45	0.752	225	0.454
50	0.775	230	0.387
60	0.796	240	0.230
70	0.796	250	0.105
80	0.781	260	0.018
90	0.751	270	0.016
100	0.725	280	0.001
110	0.718	290	0.055
120	0.733	300	0.127
130	0.764	310	0.208
135	0.784	315	0.256
140	0.811	320	0.305
150	0.879	330	0.438
160	0.937	340	0.571
170	0.915	350	0.656

Tabulation of Composite Azimuth Pattern
WWGV Grove City, OH

Azimuth	Rel Field	Azimuth	Rel Field
0	0.820	180	0.882
10	0.776	190	0.972
20	0.829	200	0.919
30	0.928	210	0.747
40	0.978	220	0.522
45	0.978	225	0.454
50	0.967	230	0.387
60	0.931	240	0.230
70	0.914	250	0.218
80	0.937	260	0.295
90	0.979	270	0.282
100	1.000	280	0.183
110	0.972	290	0.060
120	0.875	300	0.211
130	0.764	310	0.426
135	0.784	315	0.539
140	0.811	320	0.635
150	0.879	330	0.799
160	0.937	340	0.883
170	0.915	350	0.882

Tabulation of FCC Directional Composite
WWGV Grove City, OH

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	1.000
50	1.000	230	0.868
60	1.000	240	0.708
70	1.000	250	0.574
80	1.000	260	0.504
90	1.000	270	0.488
100	1.000	280	0.508
110	1.000	290	0.544
120	1.000	300	0.517
130	1.000	310	0.558
140	1.000	320	0.677
150	1.000	330	0.808
160	1.000	340	0.930
170	1.000	350	1.000

SIDE VIEW

FULL WAVE SPACED BAY TO BAY = 133 1/2"

26 1/4" TYP.
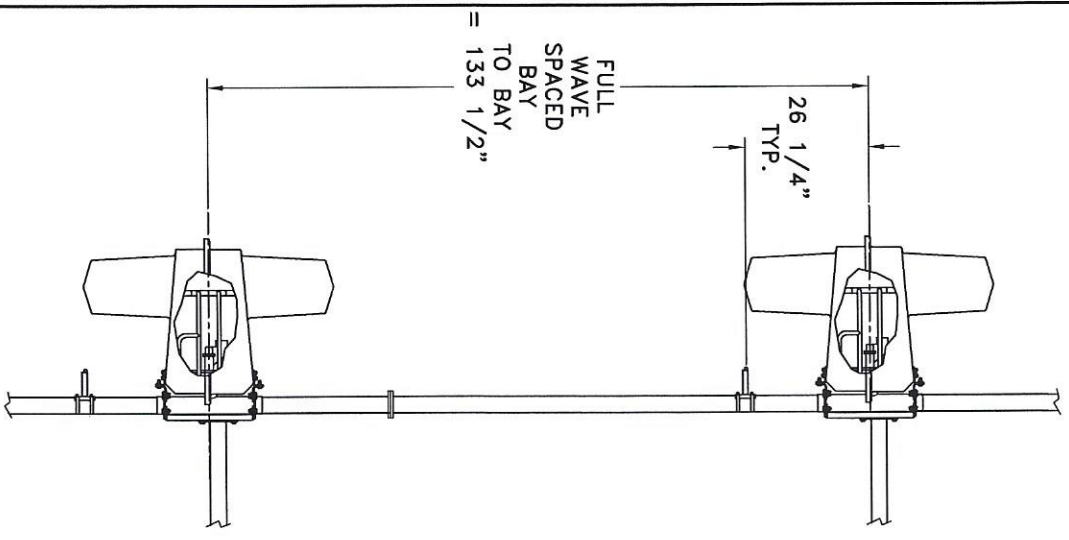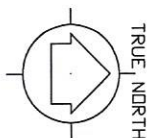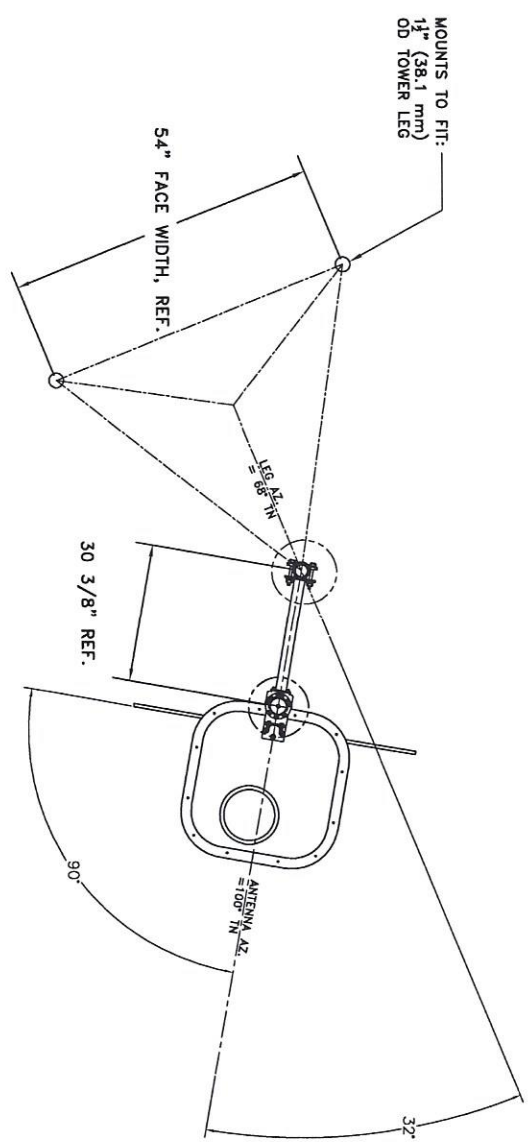
TOP VIEW

TOWER MAKE: 54" FACE
STRAIGHT SECTION
PIROD SELF SUPPORTING

MOUNTS TO FIT:
1½" (38.1 mm)
OD TOWER LEG

54" FACE WIDTH, REF.

LEG AZ = 68° TN

30 3/8" REF.

ANTENNA AZ = 100° TN

90

32°

ANTENNA HEADING 100° TRUE NORTH

TRUE NORTH

SHIVELY LABS			
A DIVISION OF HOWELL LABORATORIES INC.,BRIDGTON, MAINE			
SHOP ORDER: 36344	FREQUENCY: 88.1	SCALE: N.T.S.	DRAWN BY: JHFF APPROVED BY: ASP
TITLE: MODEL-6810-2R-DIRECTIONAL ANTENNA			
DATE: 5-7-19	FIGURE 2		

Antenna Mfg.: **Shively Labs**
Antenna Type: **6810-2R-EF-DA-88.10**
Station: **WWGV**
Frequency: **88.1**
Channel #: **201**
Figure: **Figure 3**

Date: **5/6/2019**

Beam Tilt	**0**	
Gain (Max)	**2.242**	**3.506 dB**
Gain (Horizon)	**2.242**	**3.506 dB**
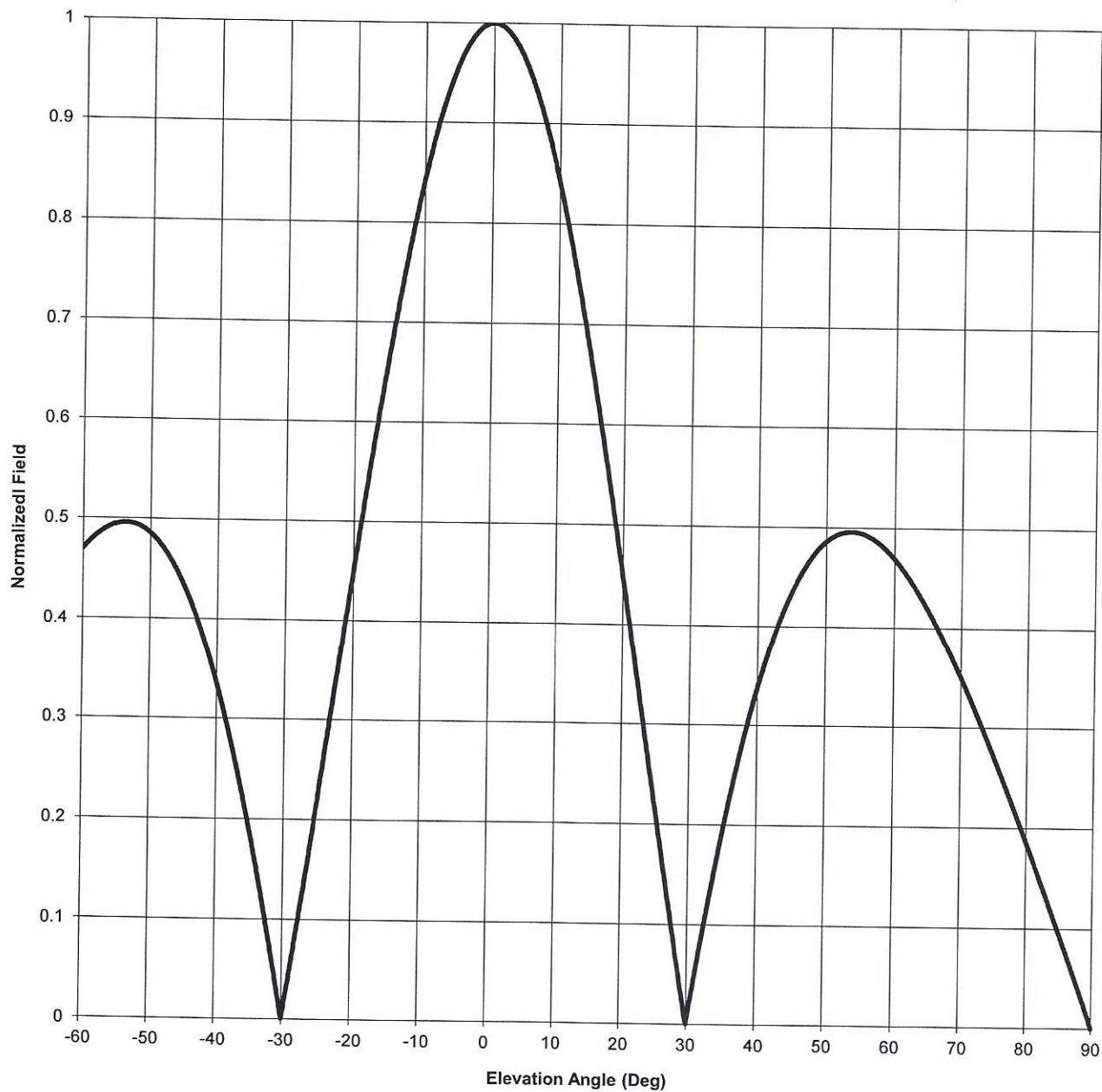
Antenna Mfg.: Shively Labs
Antenna Type: 6810-2R-EF-DA-88.10
Station: WWGV
Frequency: 88.1
Channel #: 201
Figure: Figure 3

Date: 5/6/2019

Beam Tilt	**0**
Gain (Max)	**2.242** **3.506 dB**
Gain (Horizon)	**2.242** **3.506 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	0.419	0	1.000	46	0.448
-89	0.021	-43	0.401	1	0.998	47	0.460
-88	0.040	-42	0.381	2	0.993	48	0.471
-87	0.059	-41	0.360	3	0.985	49	0.479
-86	0.078	-40	0.336	4	0.974	50	0.486
-85	0.096	-39	0.311	5	0.959	51	0.490
-84	0.114	-38	0.283	6	0.942	52	0.494
-83	0.133	-37	0.254	7	0.921	53	0.496
-82	0.151	-36	0.222	8	0.897	54	0.496
-81	0.168	-35	0.189	9	0.871	55	0.495
-80	0.186	-34	0.155	10	0.842	56	0.492
-79	0.204	-33	0.118	11	0.811	57	0.488
-78	0.221	-32	0.080	12	0.777	58	0.483
-77	0.238	-31	0.041	13	0.742	59	0.477
-76	0.255	-30	0.000	14	0.704	60	0.469
-75	0.272	-29	0.042	15	0.665	61	0.461
-74	0.288	-28	0.085	16	0.624	62	0.452
-73	0.304	-27	0.129	17	0.581	63	0.441
-72	0.320	-26	0.173	18	0.538	64	0.430
-71	0.336	-25	0.219	19	0.494	65	0.419
-70	0.351	-24	0.265	20	0.448	66	0.406
-69	0.365	-23	0.311	21	0.403	67	0.393
-68	0.380	-22	0.357	22	0.357	68	0.380
-67	0.393	-21	0.403	23	0.311	69	0.365
-66	0.406	-20	0.448	24	0.265	70	0.351
-65	0.419	-19	0.494	25	0.219	71	0.336
-64	0.430	-18	0.538	26	0.173	72	0.320
-63	0.441	-17	0.581	27	0.129	73	0.304
-62	0.452	-16	0.624	28	0.085	74	0.288
-61	0.461	-15	0.665	29	0.042	75	0.272
-60	0.469	-14	0.704	30	0.000	76	0.255
-59	0.477	-13	0.742	31	0.041	77	0.238
-58	0.483	-12	0.777	32	0.080	78	0.221
-57	0.488	-11	0.811	33	0.118	79	0.204
-56	0.492	-10	0.842	34	0.155	80	0.186
-55	0.495	-9	0.871	35	0.189	81	0.168
-54	0.496	-8	0.897	36	0.222	82	0.151
-53	0.496	-7	0.921	37	0.254	83	0.133
-52	0.494	-6	0.942	38	0.283	84	0.114
-51	0.490	-5	0.959	39	0.311	85	0.096
-50	0.486	-4	0.974	40	0.336	86	0.078
-49	0.479	-3	0.985	41	0.360	87	0.059
-48	0.471	-2	0.993	42	0.381	88	0.040
-47	0.460	-1	0.998	43	0.401	89	0.021
-46	0.448	0	1.000	44	0.419	90	0.000
-45	0.435			45	0.435		

S.O. 36344   Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WWGV   Grove City, OH

MODEL   6810-2R-EF-DA-88.10

Elevation Gain of Antenna   0.99

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

H RMS   0.722565   V RMS   0.611198   H/V Ratio   1.182

Elevation Gain of Horizontal Component   1.170

Elevation Gain of Vertical Component   0.837

Horizontal Azimuth Gain equals $1/(RMS)^2$.   1.915

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$.   2.360
Max. Vertical   0.939

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

Total Horizontal Power Gain =   2.242

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

Total Vertical Power Gain =   **1.977**

===

ERP divided by Horizontal Power Gain equals Antenna Input Power

14   kW ERP   Divided by H Gain   2.242   equals   6.245   kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

6.245   kW   Times V Gain   1.977   equals   12.344   kW V ERP

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

$(0.939)^2$ Times   14.00   Equals   12.344   kW Vertical ERP

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