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S.O. 37971

Report of Test 6810-2R-EF-DA

for

FAMILY STATIONS, INC.

WCOA 88.5 MHz JOHNSTOWN, PA

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-2R-EF-DA to meet the needs of WCOA and to comply with the requirements of the FCC construction permit, file number 0000145264. 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 0000145264 indicates that the Horizontal radiation component shall not exceed 10 kW at any azimuth and is restricted to the following values at the azimuths specified:

230 Degrees True: 2.116 kilowatts

From Figure 1A, the maximum radiation of the Horizontal component occurs at 150 Degrees True to 155 Degrees True. At the restricted azimuth of 230 Degrees True the Horizontal component is 11.340 dB down from the maximum of 10 kW, or 0.514 kW.

The R.M.S. of the Horizontal component is 0.747. The total Horizontal power gain is 1.826. The R.M.S. of the Vertical component is 0.726. The total Vertical power gain is 1.811. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.914. The R.M.S. of the measured composite pattern is 0.779. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.777. 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 was mounted on a tower of precise scale to the Pi-Rod 45" tower at the WCOA 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 0000145264, a single level of the 6810-2R-EF-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 parabolic dish 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 Hypercell Superflex and Cellflex lCF cabling respectively.

The control building is equipped with:

Hewlett Packard Model 4395-A Network Analyzer

PC Based Controller

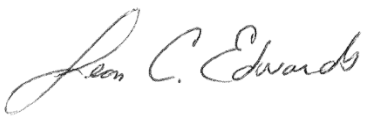
Output Standard Printer or 'pdf'

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 398.25 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:



Sean C. Edwards
Director RF Engineering, Shively Labs

S/O 37971
Date 7/8/2022

Shively Labs

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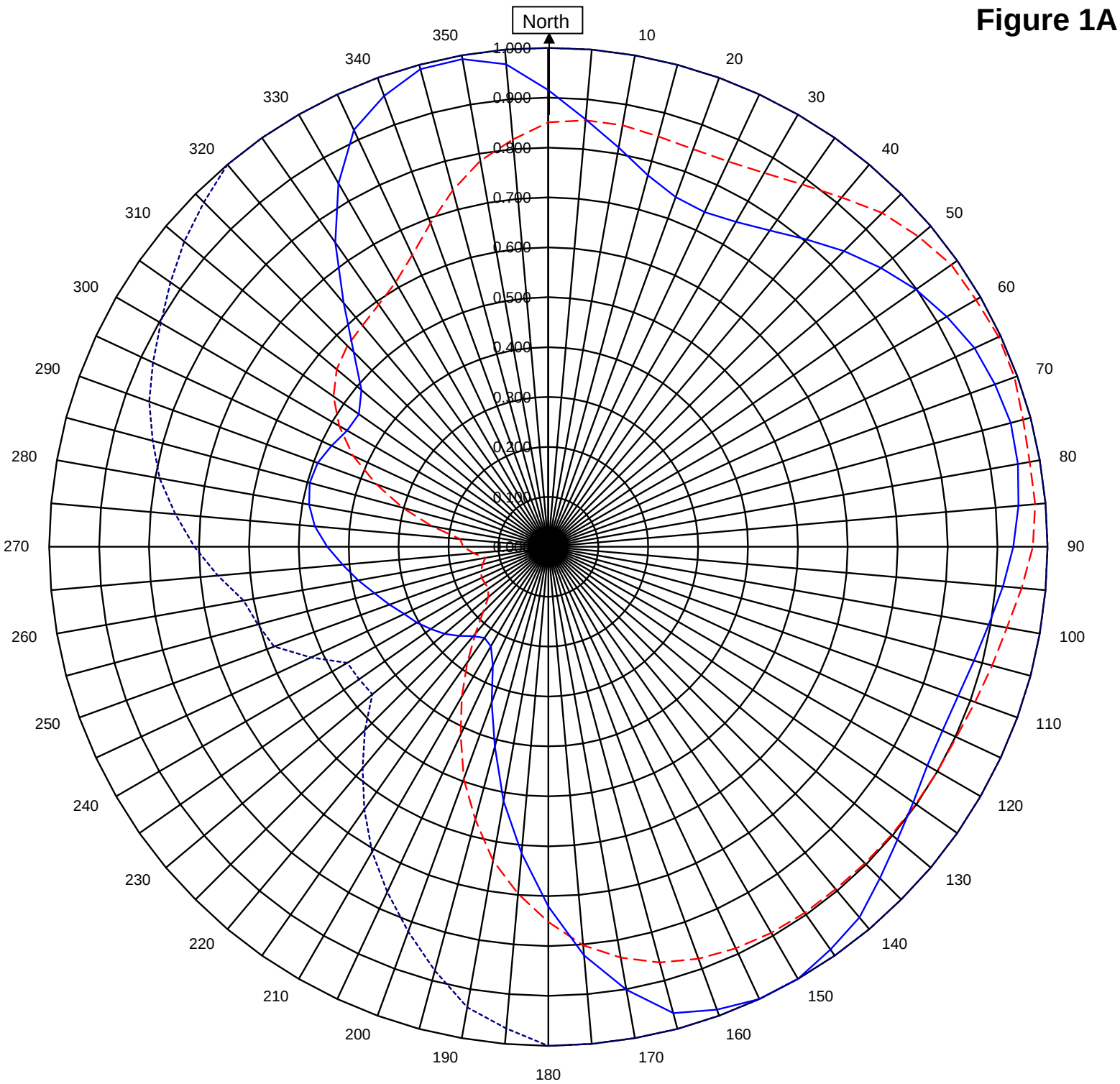
Figure 1A



WCOA JOHNSTOWN, PA

37971

July 8, 2022

Horizontal RMS	0.747
Vertical RMS	0.726
H/V Composite RMS	0.779
FCC Composite RMS	0.914

Frequency	88.5 / 398.25 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

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

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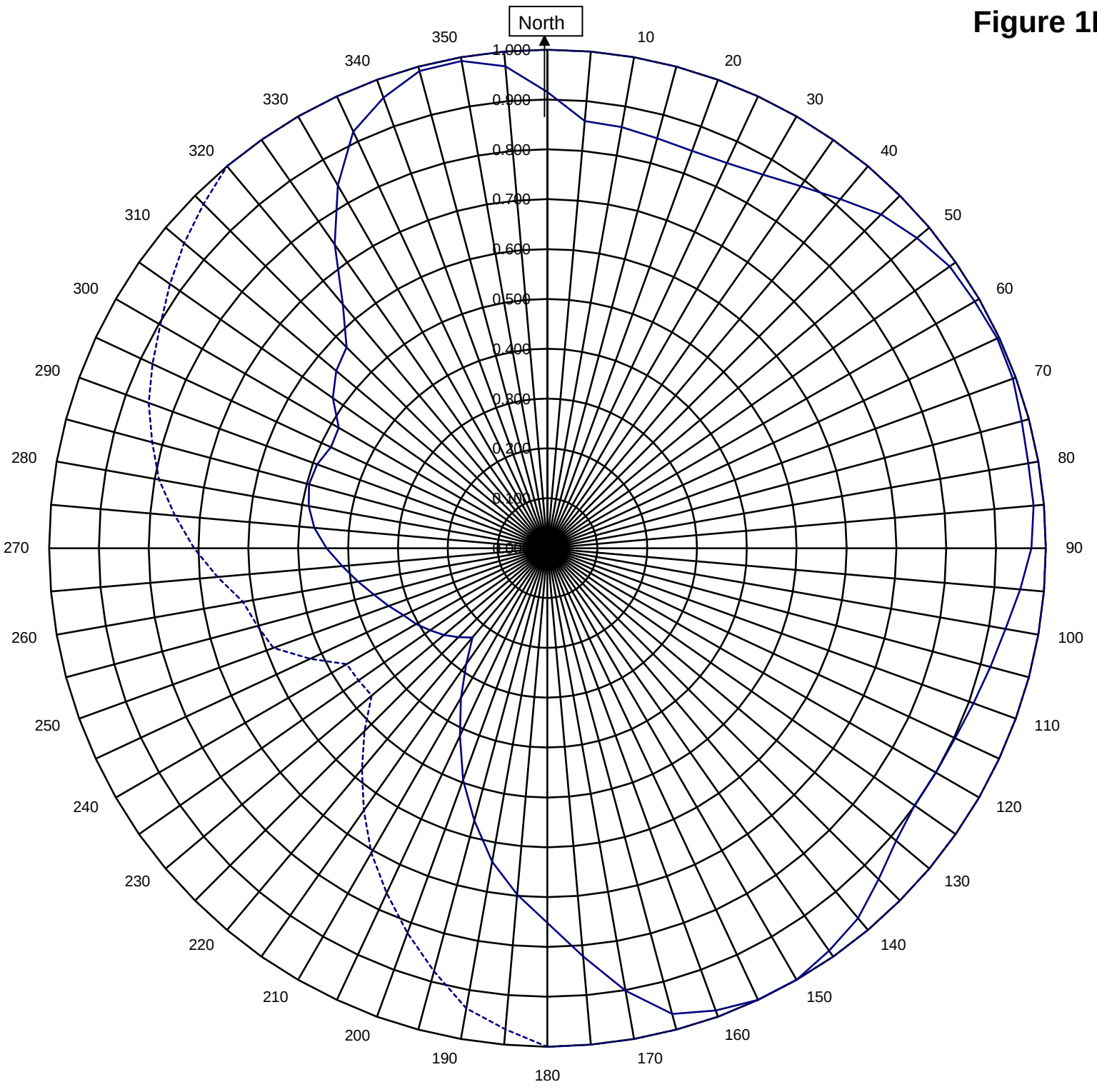
Figure 1B



WCOA JOHNSTOWN, PA

37971

July 8, 2022

_____H/VComposite RMS	0.779
……..FCC Composite RMS	0.914

Frequency	88.5 / 398.25 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

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

Figure 1C

Tabulation of Horizontal Azimuth Pattern
WCOA JOHNSTOWN, PA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.915	180	0.721
10	0.812	190	0.517
20	0.746	200	0.332
30	0.752	210	0.230
40	0.804	220	0.234
45	0.838	225	0.253
50	0.870	230	0.271
60	0.922	240	0.304
70	0.952	250	0.339
80	0.955	260	0.386
90	0.932	270	0.443
100	0.896	280	0.487
110	0.874	290	0.492
120	0.877	300	0.466
130	0.913	310	0.489
135	0.939	315	0.552
140	0.969	320	0.639
150	1.000	330	0.841
160	0.987	340	0.962
170	0.901	350	0.993

Figure 1D

Tabulation of Vertical Azimuth Pattern
WCOA JOHNSTOWN, PA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.850	180	0.752
10	0.857	190	0.639
20	0.848	200	0.495
30	0.865	210	0.347
40	0.914	220	0.228
45	0.946	225	0.185
50	0.968	230	0.157
60	0.990	240	0.147
70	0.994	250	0.144
80	0.980	260	0.128
90	0.971	270	0.171
100	0.933	280	0.236
110	0.910	290	0.367
120	0.900	300	0.483
130	0.898	310	0.553
135	0.897	315	0.570
140	0.896	320	0.579
150	0.893	330	0.612
160	0.879	340	0.690
170	0.836	350	0.785

Figure 1E

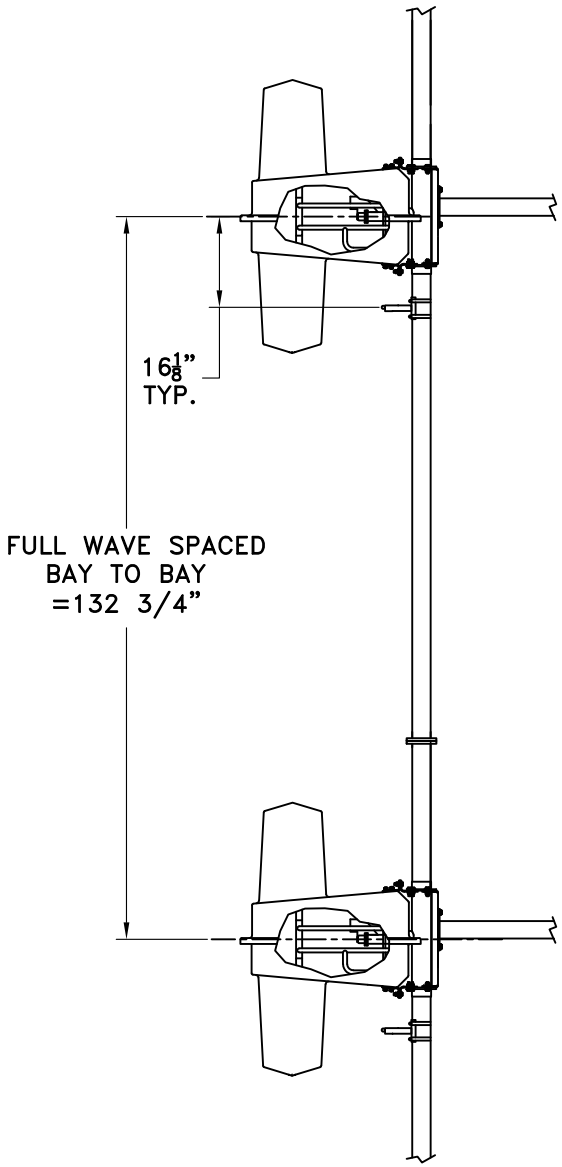
Tabulation of Composite Azimuth Pattern
WCOA JOHNSTOWN, PA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.915	180	0.752
10	0.857	190	0.639
20	0.848	200	0.495
30	0.865	210	0.347
40	0.914	220	0.234
45	0.946	225	0.253
50	0.968	230	0.271
60	0.990	240	0.304
70	0.994	250	0.339
80	0.980	260	0.386
90	0.971	270	0.443
100	0.933	280	0.487
110	0.910	290	0.492
120	0.900	300	0.483
130	0.913	310	0.553
135	0.939	315	0.570
140	0.969	320	0.639
150	1.000	330	0.841
160	0.987	340	0.962
170	0.901	350	0.993

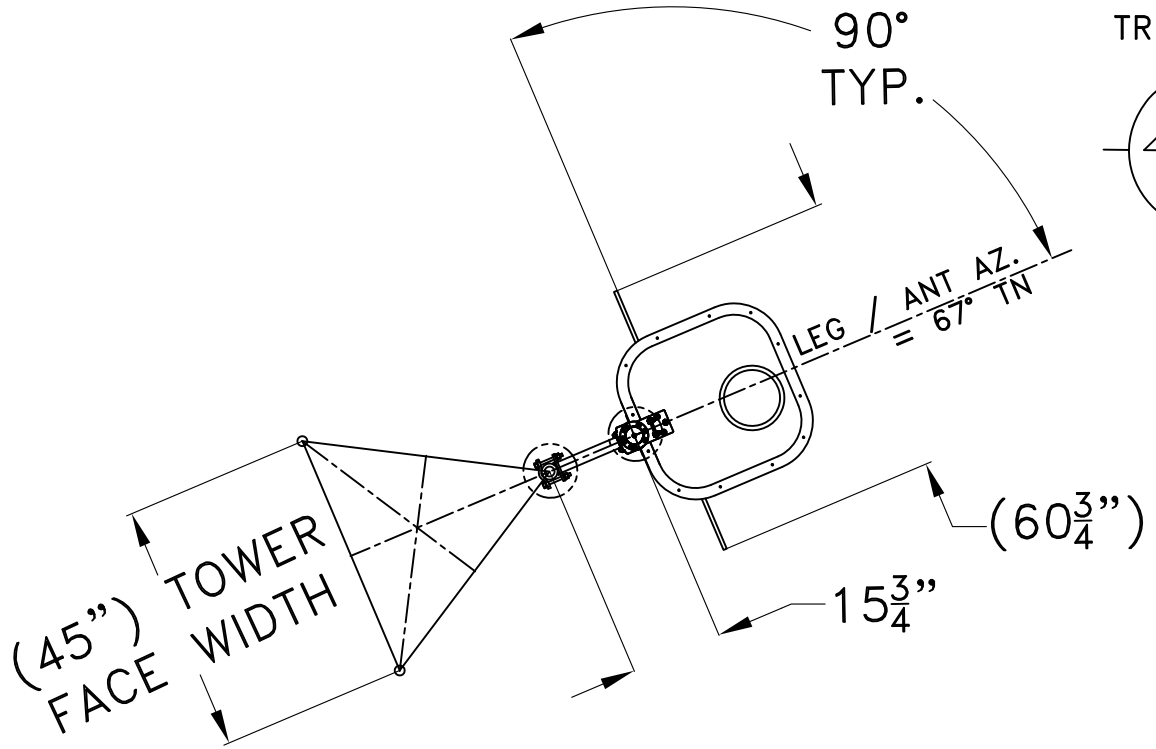
Figure 1F

Tabulation of FCC Directional Composite
WCOA JOHNSTOWN, PA

Azimuth	Rel Field	Azimuth	Rel Field
0	1.000	180	1.000
10	1.000	190	0.937
20	1.000	200	0.821
30	1.000	210	0.706
40	1.000	220	0.579
50	1.000	230	0.460
60	1.000	240	0.465
70	1.000	250	0.585
80	1.000	260	0.620
90	1.000	270	0.709
100	1.000	280	0.791
110	1.000	290	0.851
120	1.000	300	0.897
130	1.000	310	0.952
140	1.000	320	1.000
150	1.000	330	1.000
160	1.000	340	1.000
170	1.000	350	1.000

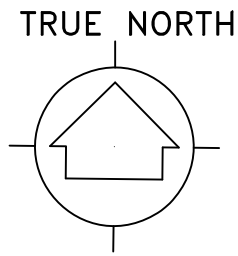


SIDE VIEW



TOP VIEW

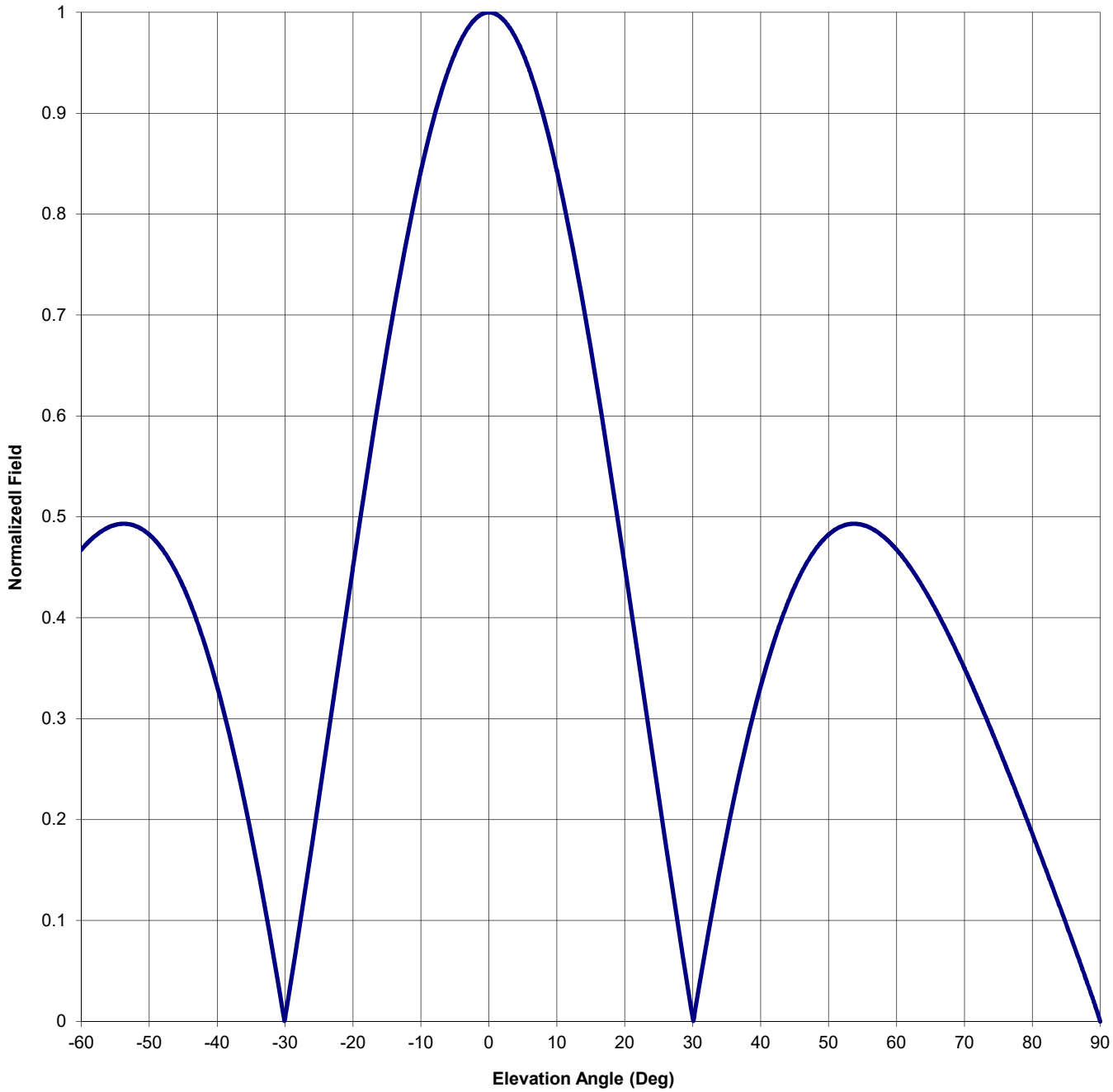
TOWER: PiROD 48M



ANTENNA HEADING 67° TRUE NORTH

SHIVELY LABS A DIVISION OF HOWELL LABORATORIES INC.,BRIDGTON, MAINE			
SHOP ORDER: 37971	FREQUENCY: 88.5	SCALE: N.T.S.	DRAWN BY: JHFF APPROVED BY: ASP
TITLE: MODEL-6810-2R-HP-DIRECTIONAL ANTENNA			
DATE: 8-4-21	FIGURE 2		

Antenna Mfg.:	**Shively Labs**			**Date: 7/8/2022**
Antenna Type:	**6810-2R-EF-DA**			
Station:	**WCOA**	**Beam Tilt**	**0**	
Frequency:	**88.5**	**Gain (Max)**	**1.826**	**2.614 dB**
Channel #:	**203**	**Gain (Horizon)**	**1.826**	**2.614 dB**
Figure:	**Figure 3**			



Antenna Mfg.: Shively Labs **Date:** 7/8/2022

Antenna Type: 6810-2R-EF-DA

Station: WCOA **Beam Tilt** 0

Frequency: 88.5 **Gain (Max)** 1.826 2.614 dB

Channel #: 203 **Gain (Horizon)** 1.826 2.614 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	0.415	0	1.000	46	0.445
-89	0.021	-43	0.397	1	0.998	47	0.457
-88	0.040	-42	0.377	2	0.993	48	0.467
-87	0.059	-41	0.356	3	0.985	49	0.476
-86	0.078	-40	0.332	4	0.974	50	0.482
-85	0.096	-39	0.306	5	0.959	51	0.488
-84	0.114	-38	0.279	6	0.942	52	0.491
-83	0.133	-37	0.249	7	0.921	53	0.493
-82	0.150	-36	0.218	8	0.898	54	0.493
-81	0.168	-35	0.185	9	0.872	55	0.492
-80	0.186	-34	0.150	10	0.843	56	0.490
-79	0.203	-33	0.114	11	0.812	57	0.486
-78	0.221	-32	0.076	12	0.779	58	0.481
-77	0.238	-31	0.037	13	0.743	59	0.475
-76	0.255	-30	0.004	14	0.706	60	0.468
-75	0.271	-29	0.046	15	0.666	61	0.459
-74	0.288	-28	0.089	16	0.626	62	0.450
-73	0.304	-27	0.132	17	0.583	63	0.440
-72	0.320	-26	0.177	18	0.540	64	0.429
-71	0.335	-25	0.222	19	0.496	65	0.418
-70	0.350	-24	0.268	20	0.451	66	0.405
-69	0.365	-23	0.314	21	0.406	67	0.392
-68	0.379	-22	0.360	22	0.360	68	0.379
-67	0.392	-21	0.406	23	0.314	69	0.365
-66	0.405	-20	0.451	24	0.268	70	0.350
-65	0.418	-19	0.496	25	0.222	71	0.335
-64	0.429	-18	0.540	26	0.177	72	0.320
-63	0.440	-17	0.583	27	0.132	73	0.304
-62	0.450	-16	0.626	28	0.089	74	0.288
-61	0.459	-15	0.666	29	0.046	75	0.271
-60	0.468	-14	0.706	30	0.004	76	0.255
-59	0.475	-13	0.743	31	0.037	77	0.238
-58	0.481	-12	0.779	32	0.076	78	0.221
-57	0.486	-11	0.812	33	0.114	79	0.203
-56	0.490	-10	0.843	34	0.150	80	0.186
-55	0.492	-9	0.872	35	0.185	81	0.168
-54	0.493	-8	0.898	36	0.218	82	0.150
-53	0.493	-7	0.921	37	0.249	83	0.133
-52	0.491	-6	0.942	38	0.279	84	0.114
-51	0.488	-5	0.959	39	0.306	85	0.096
-50	0.482	-4	0.974	40	0.332	86	0.078
-49	0.476	-3	0.985	41	0.356	87	0.059
-48	0.467	-2	0.993	42	0.377	88	0.040
-47	0.457	-1	0.998	43	0.397	89	0.021
-46	0.445	0	1.000	44	0.415	90	0.000
-45	0.431			45	0.431		

S.O. 37971 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WCOA	JOHNSTOWN, PA
MODEL	6810-2R-EF-DA

Elevation Gain of Antenna 0.99

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

H RMS 0.746592 V RMS 0.726287 H/V Ratio 1.028

Elevation Gain of Horizontal Component 1.018

Elevation Gain of Vertical Component 0.963

Horizontal Azimuth Gain equals $1/(RMS)^2$. 1.794

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 1.881

Max. Vertical 0.996

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

Total Horizontal Power Gain = **1.826**

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

Total Vertical Power Gain = **1.811**

==========

ERP divided by Horizontal Power Gain equals Antenna Input Power

10 kW ERP Divided by H Gain 1.826 equals 5.477 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

5.477 kW Times V Gain 1.811 equals 9.920 kW V ERP

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

(0.996)^2 Times 10.00 Equals 9.920 kW Vertical ERP

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