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S.O. 23421

Report of Test 6810-3R-SS-DA

for

BONNEVILLE HOLDING COMPANY

WGMS-FM 103.5 MHz WASHINGTON, DC

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-3R-SS-DA to meet the needs of WGMS-FM and to comply with the requirements of the FCC construction permit, file number BMXPH-20041129AAZ.

RESULTS:

The measured azimuth pattern for the 6810-3R-SS-DA is shown in Figure 1. Figure 1A shows the Tabulation of the Horizontal Polarization. Figure 1B shows the Tabulation of the Vertical Polarization. The calculated elevation pattern of the antenna is shown in Figure 3. Construction permit file number BMXPH-20041129AAZ indicates that the Horizontal radiation component shall not exceed 15 kW at any azimuth and is restricted to the following values at the azimuths specified:

10-30 Degrees T: 0.730 kW

From Figure 1, the maximum radiation of the Horizontal component occurs at 221 Degrees T to 247 Degrees T. At the restricted azimuth of 10 Degrees T the Horizontal component is 19.58 dB down from the maximum of 15 kW, or 0.165 kW. At the restricted azimuth of 30 Degrees T the Horizontal component is 18.79 dB down from the maximum of 15 kW, or 0.198 kW.

The R.M.S. of the Horizontal component is 0.691. The total Horizontal power gain is 2.163. The R.M.S. of the Vertical component is 0.681. The total Vertical power gain is 2.120. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.797. The R.M.S. of the measured composite pattern is 0.721. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.677. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6810-3R-SS-DA was mounted on a tower of exact scale to an SST 48″ face tower. The spacing of the antenna to the tower was varied to achieve the vertical pattern shown in Figure 1. 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 1 was achieved. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BMXPH-20041129AAZ, a single level of the 6810-3R-SS-DA was set up on the Howell Laboratories 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 Edition 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

The test equipment is calibrated to ANSI/NCSL Z540-1-1994.

TEST PROCEDURES:

The corner reflector is mounted so that the horizontal and vertical azimuth patterns are measured independently by rotating the corner reflector by 90 degrees. The network analyzer was set to 465.75 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 1.

Respectfully submitted by:

Robert A. Surette
Manager of RF Engineering
S/O 23421
September 1, 2005

Shively Labs

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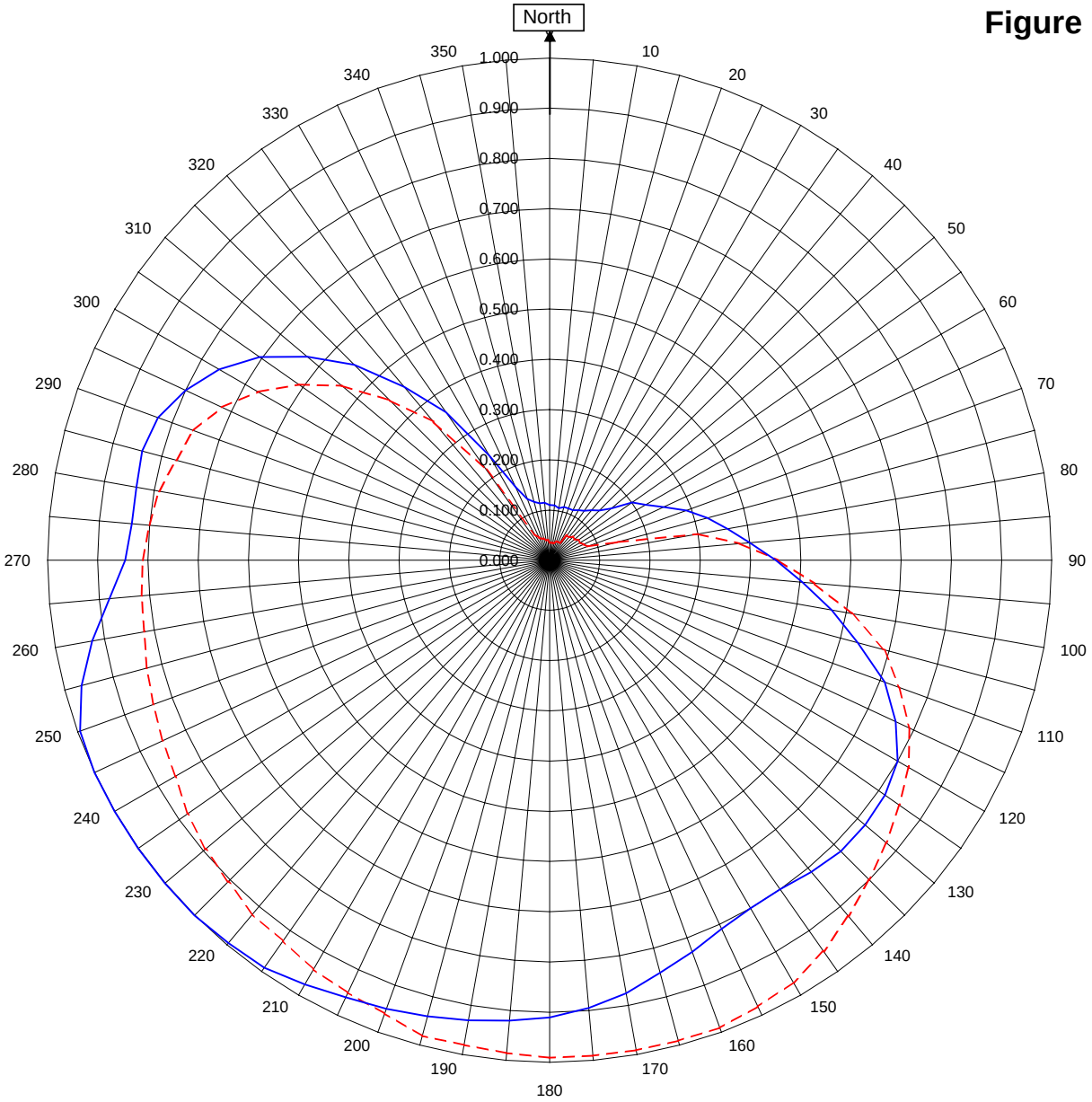
Figure 1



WGMS-FM Washington, DC

23421

August 31, 2005

Horizontal RMS	0.691
Vertical RMS	0.681
H/V Composite RMS	0.721

Frequency	103.5 / 465.75 mHz
Plot	Relative Field
Scale	4.5 : 1

Antenna Model	6810-3R-SS-DA
Pattern Type	Directional Azimuth

See Figure 2 for Mechanical Details

Figure 1a

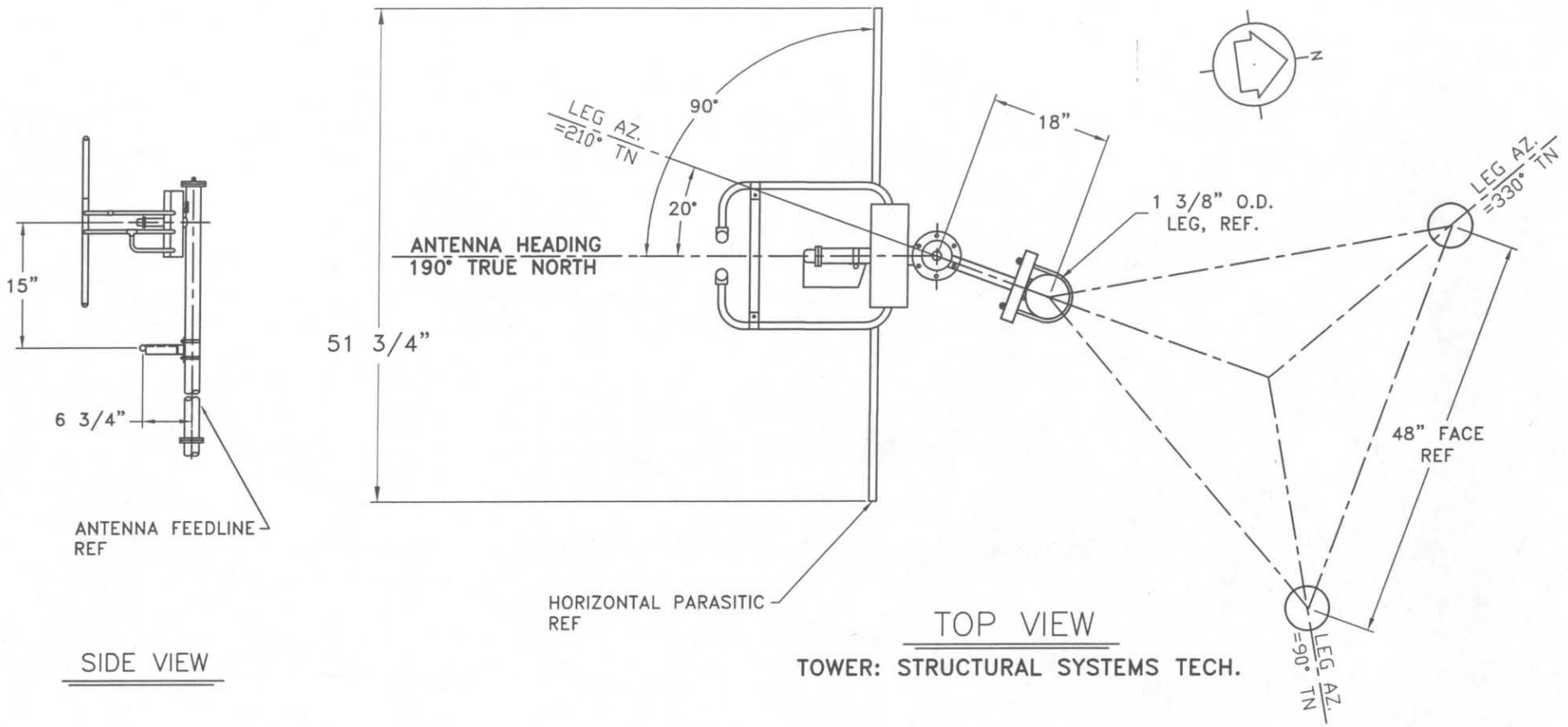
Tabulation of Horizontal Azimuth Pattern
WGMS-FM Washington, DC

Azimuth	Rel Field	Azimuth	Rel Field
0	0.110	180	0.910
10	0.105	190	0.930
20	0.110	200	0.950
30	0.115	210	0.975
40	0.130	220	0.995
45	0.140	225	1.000
50	0.160	230	1.000
60	0.220	240	1.000
70	0.290	250	0.995
80	0.360	260	0.925
90	0.450	270	0.845
100	0.570	280	0.835
110	0.710	290	0.830
120	0.800	300	0.760
130	0.820	310	0.630
135	0.820	315	0.550
140	0.810	320	0.450
150	0.800	330	0.240
160	0.830	340	0.130
170	0.875	350	0.115

Figure 1b

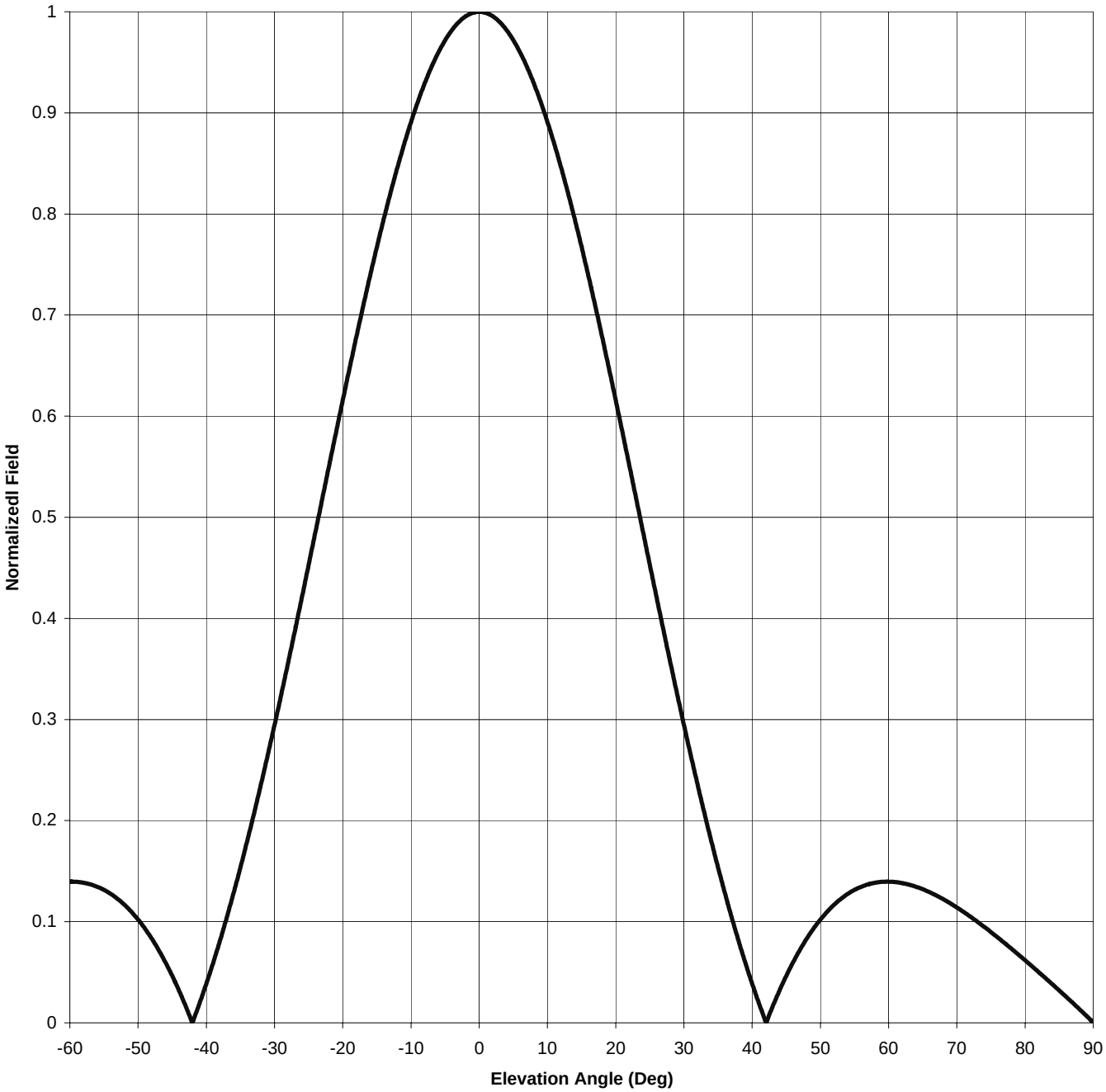
Tabulation of Vertical Azimuth Pattern
WGMS-FM Washington, DC

Azimuth	Rel Field	Azimuth	Rel Field
0	0.035	180	0.990
10	0.035	190	0.980
20	0.040	200	0.960
30	0.040	210	0.940
40	0.060	220	0.920
45	0.065	225	0.905
50	0.065	230	0.895
60	0.070	240	0.860
70	0.080	250	0.840
80	0.300	260	0.820
90	0.455	270	0.810
100	0.610	280	0.790
110	0.740	290	0.755
120	0.825	300	0.670
130	0.875	310	0.540
135	0.900	315	0.450
140	0.925	320	0.360
150	0.970	330	0.060
160	0.990	340	0.045
170	0.990	350	0.040



SHIVELY LABS A DIVISION OF HOWELL LABORATORIES INC.,BRIDGTON, MAINE			
SHOP ORDER: 23421	FREQUENCY: 103.5 MHz.	SCALE: N.T.S.	DRAWN BY: AMG APPROVED BY:
MODEL: 6810-3R-SS-DIRECTIONAL ANTENNA			
DATE: 4/26/04	FIGURE 2		

Antenna Mfg.:	**Shively Labs**			**Date: 9/1/2005**
Antenna Type:	**6810-3R-SS-DA**			
Station:	**WGMS**	**Beam Tilt**	**0**	
Frequency:	**103.5**	**Gain (Max)**	**2.163**	**3.344 dB**
Channel #:	**278**	**Gain (Horizon)**	**2.163**	**3.344 dB**
Figure:	**3**			



Antenna Mfg.: Shively Labs **Date:** 9/1/2005

Antenna Type: 6810-3R-SS-DA

Station: WGMS **Beam Tilt** 0

Frequency: 103.5 **Gain (Max)** 2.163 3.344 dB

Channel #: 278 **Gain (Horizon)** 2.163 3.344 dB

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	0.032	0	1.000	46	0.060
-89	0.007	-43	0.016	1	0.999	47	0.072
-88	0.013	-42	0.001	2	0.995	48	0.083
-87	0.020	-41	0.019	3	0.990	49	0.093
-86	0.026	-40	0.039	4	0.982	50	0.102
-85	0.032	-39	0.059	5	0.972	51	0.110
-84	0.038	-38	0.081	6	0.960	52	0.117
-83	0.044	-37	0.104	7	0.945	53	0.123
-82	0.050	-36	0.128	8	0.929	54	0.127
-81	0.056	-35	0.154	9	0.911	55	0.131
-80	0.062	-34	0.180	10	0.891	56	0.135
-79	0.068	-33	0.207	11	0.869	57	0.137
-78	0.073	-32	0.236	12	0.846	58	0.139
-77	0.079	-31	0.265	13	0.821	59	0.139
-76	0.084	-30	0.295	14	0.795	60	0.140
-75	0.090	-29	0.325	15	0.767	61	0.139
-74	0.095	-28	0.357	16	0.739	62	0.138
-73	0.100	-27	0.388	17	0.709	63	0.137
-72	0.105	-26	0.420	18	0.679	64	0.135
-71	0.110	-25	0.453	19	0.648	65	0.132
-70	0.114	-24	0.486	20	0.616	66	0.129
-69	0.118	-23	0.518	21	0.584	67	0.126
-68	0.122	-22	0.551	22	0.551	68	0.122
-67	0.126	-21	0.584	23	0.518	69	0.118
-66	0.129	-20	0.616	24	0.486	70	0.114
-65	0.132	-19	0.648	25	0.453	71	0.110
-64	0.135	-18	0.679	26	0.420	72	0.105
-63	0.137	-17	0.709	27	0.388	73	0.100
-62	0.138	-16	0.739	28	0.357	74	0.095
-61	0.139	-15	0.767	29	0.325	75	0.090
-60	0.140	-14	0.795	30	0.295	76	0.084
-59	0.139	-13	0.821	31	0.265	77	0.079
-58	0.139	-12	0.846	32	0.236	78	0.073
-57	0.137	-11	0.869	33	0.207	79	0.068
-56	0.135	-10	0.891	34	0.180	80	0.062
-55	0.131	-9	0.911	35	0.154	81	0.056
-54	0.127	-8	0.929	36	0.128	82	0.050
-53	0.123	-7	0.945	37	0.104	83	0.044
-52	0.117	-6	0.960	38	0.081	84	0.038
-51	0.110	-5	0.972	39	0.059	85	0.032
-50	0.102	-4	0.982	40	0.039	86	0.026
-49	0.093	-3	0.990	41	0.019	87	0.020
-48	0.083	-2	0.995	42	0.001	88	0.013
-47	0.072	-1	0.999	43	0.016	89	0.007
-46	0.060	0	1.000	44	0.032	90	0.000
-45	0.047			45	0.047		

S.O. 23421 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WGMS Washington, D.C.

MODEL 6810-3R-SS-DA

Elevation Gain of Antenna 1.018

The RMS values are calculated utilizing the data of a planimeter

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

H RMS 0.691 V RMS 0.681 H/V Ratio 1.015

Elevation Gain of Horizontal Component 1.033

Elevation Gain of Vertical Component 1.003

Horizontal Azimuth Gain equals 1/(RMS)SQ. 2.094

Vertical Azimuth Gain equals 1/(RMS/Max Vert)SQ. 2.113
Max. Vertical 0.99

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

Total Horizontal Power Gain = **2.163**

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

Total Vertical Power Gain = **2.120**

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ERP divided by Horizontal Power Gain equals Antenna Input Power

15 KW ERP Equals 6.934 KW Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

6.934 KW Times 2.120 KW Equals 14.702 KW ERP

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

0.99 Equals 14.702 KW Vertical ERP

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