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S.O. 23526

Report of Test 6810-4R-SS-V/H-PN-DA

for

NEW HAMPSHIRE PUBLIC RADIO, INC.

WEVS 88.3 MHz NASHUA, NH

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6810-4R-SS-V/H-PN-DA to meet the needs of WEVS and to comply with the requirements of the FCC construction permit, file number BMPED-20050222ABT.

RESULTS:

The measured azimuth pattern for the 6810-4R-SS-V/H-PN-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 BMPED-20050222ABT indicates that the Vertical radiation component shall not exceed 5.0 kW at any azimuth and is restricted to the following values at the azimuths specified:

150 Degrees T: 0.509 kW

From Figure 1, the maximum radiation of the Vertical component occurs at 312 Degrees T to 034 Degrees T. At the restricted azimuth of 150 Degrees T the Vertical component is 12.579 dB down from the maximum of 5.0 kW, or 0.276 kW.

The R.M.S. of the Horizontal component is 0.608. The total Horizontal power gain is 1.664. The R.M.S. of the Vertical component is 0.704. The total Vertical power gain is 2.381. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.745. The R.M.S. of the measured composite pattern is 0.705. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.633. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6810-4R-SS-V/H-PN-DA was mounted on a tower of exact scale to a Pirod-24 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 BMPED-20050222ABT, a single level of the 6810-4R-SS-V/H-PN-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.

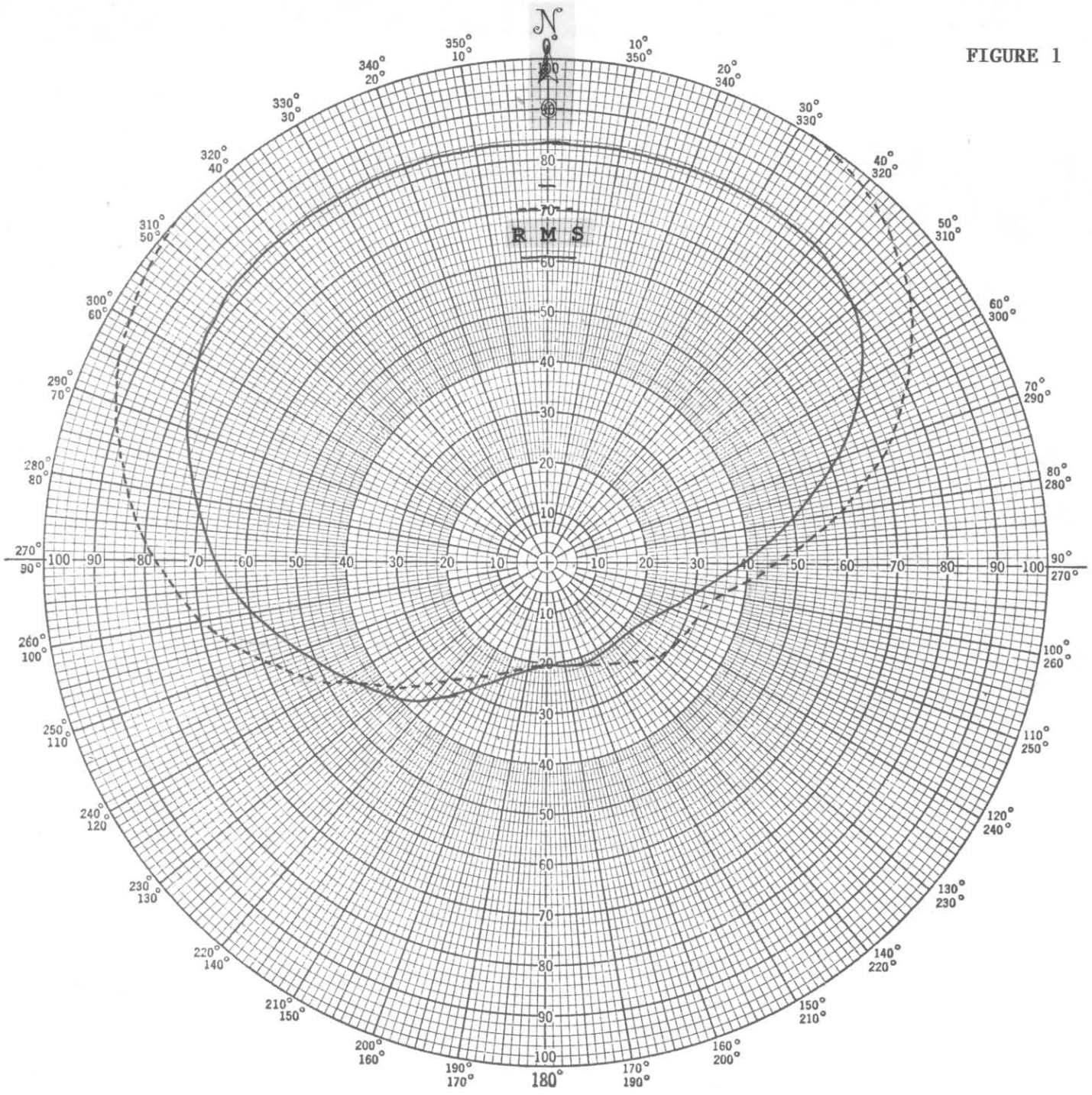
TEST PROCEDURES:

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 397.35 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 23526
July 6, 2005

FIGURE 1



Shively Labs

PROJECT NAME WEVS NASHUA, NH

PROJECT NUMBER 23526 DATE 6/29/05

MODEL (X) FULL SCALE ( ) FREQUENCY 397.35/88.3 MHz

POLARIZATION HORIZ (——); VERT (----)

CURVE PLOTTED IN: VOLTAGE (X) POWER( ) DB( )

OBSERVER RAS

ANTENNA TYPE 6810-4R-SS-V/H-PN-DA

PATTERN TYPE DIRECTIONAL AZIMUTH

REMARKS: SEE FIGURE 2 FOR MECHANICAL DETAILS

Figure 1A

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TABULATION OF HORIZONTAL POLARIZATION
WEVS NASHUA, NH

DEGREE	RELATIVE FIELD	DEGREE	RELATIVE FIELD
0	0.836	180	0.209
10	0.836	190	0.221
20	0.836	200	0.251
30	0.836	210	0.301
40	0.836	220	0.363
45	0.827	225	0.395
50	0.802	230	0.418
60	0.728	240	0.464
70	0.627	250	0.531
80	0.506	260	0.593
90	0.397	270	0.661
100	0.317	280	0.710
110	0.264	290	0.766
120	0.234	300	0.802
130	0.218	310	0.832
135	0.218	315	0.836
140	0.218	320	0.836
150	0.218	330	0.836
160	0.218	340	0.836
170	0.213	350	0.836

Figure 1B

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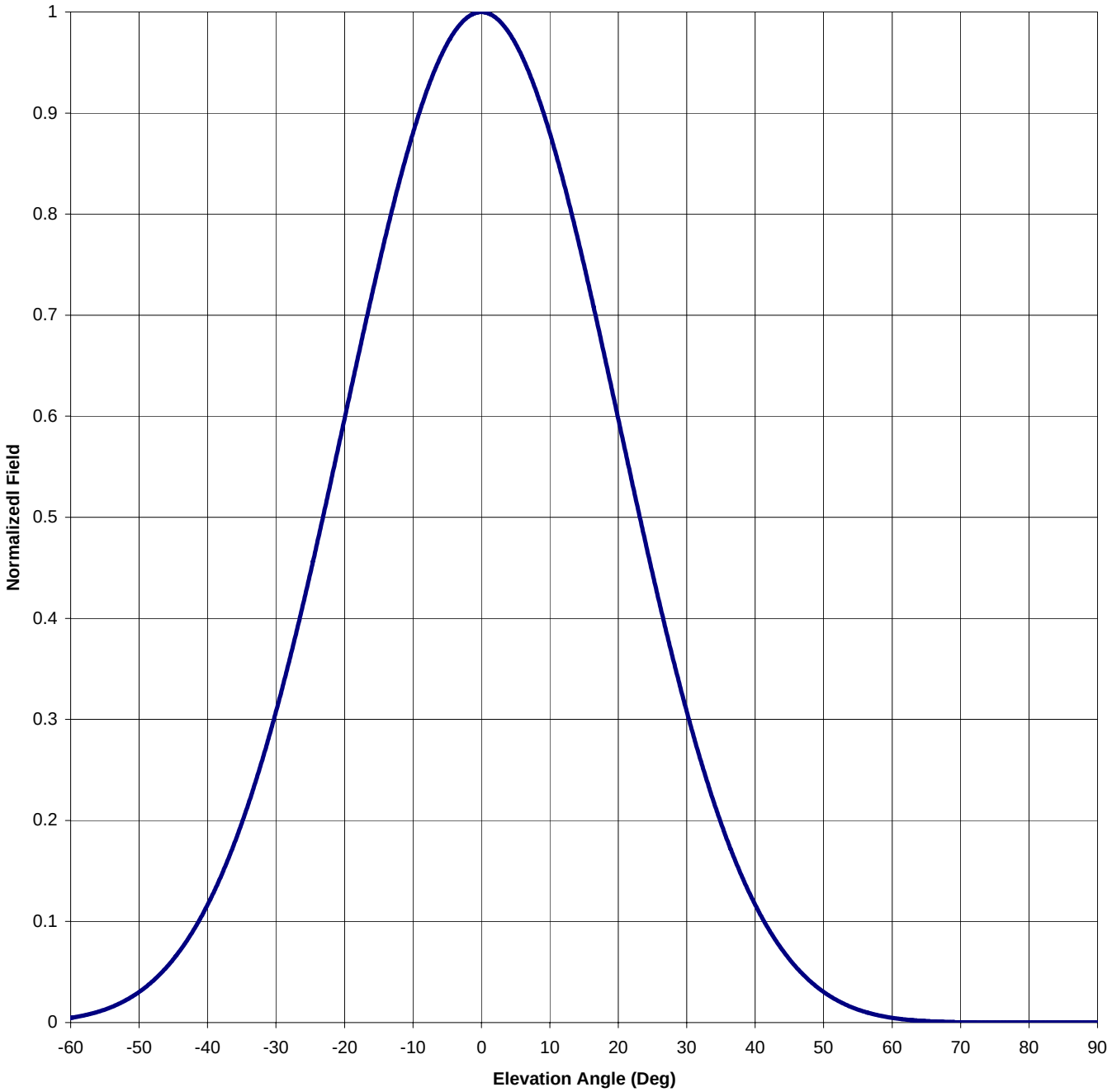
TABULATION OF VERTICAL POLARIZATION
WEVS NASHUA, NH

DEGREE	RELATIVE FIELD	DEGREE	RELATIVE FIELD
0	1.000	180	0.210
10	1.000	190	0.215
20	1.000	200	0.235
30	1.000	210	0.265
40	0.975	220	0.320
45	0.955	225	0.360
50	0.925	230	0.400
60	0.840	240	0.485
70	0.730	250	0.595
80	0.595	260	0.700
90	0.460	270	0.780
100	0.355	280	0.850
110	0.315	290	0.915
120	0.305	300	0.960
130	0.290	310	0.990
135	0.280	315	1.000
140	0.260	320	1.000
150	0.235	330	1.000
160	0.220	340	1.000
170	0.215	350	1.000

Antenna Mfg.:	**Shively Labs**			**Date:**	**5/6/2005**
Antenna Type:	**6810-4R-SS-V/H-PN-DA**				
Station:	**WEVS**	**Beam Tilt**	**0**		
Frequency:	**88.3**	**Gain (Max)**	**2.381**	**3.768**	**dB**
Channel #:	**202**	**Gain (Horizon)**	**2.381**	**3.768**	**dB**
Figure:	**1**				



Antenna Mfg.: Shively Labs **Date:** 5/6/2005

Antenna Type: 6810-4R-SS-V/H-PN-DA

Station: WEVS **Beam Tilt** 0

Frequency: 88.3 **Gain (Max)** 2.381 3.768 dB

Channel #: 202 **Gain (Horizon)** 2.381 3.768 dB

Figure: 1

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	0.072	0	1.000	46	0.055
-89	0.000	-43	0.081	1	0.999	47	0.047
-88	0.000	-42	0.092	2	0.995	48	0.041
-87	0.000	-41	0.104	3	0.989	49	0.035
-86	0.000	-40	0.117	4	0.980	50	0.030
-85	0.000	-39	0.130	5	0.969	51	0.026
-84	0.000	-38	0.145	6	0.955	52	0.022
-83	0.000	-37	0.162	7	0.939	53	0.018
-82	0.000	-36	0.179	8	0.922	54	0.015
-81	0.000	-35	0.197	9	0.902	55	0.013
-80	0.000	-34	0.217	10	0.880	56	0.011
-79	0.000	-33	0.238	11	0.857	57	0.009
-78	0.000	-32	0.260	12	0.832	58	0.007
-77	0.000	-31	0.283	13	0.805	59	0.006
-76	0.000	-30	0.308	14	0.778	60	0.005
-75	0.000	-29	0.333	15	0.749	61	0.004
-74	0.000	-28	0.360	16	0.720	62	0.003
-73	0.000	-27	0.387	17	0.690	63	0.002
-72	0.000	-26	0.415	18	0.659	64	0.002
-71	0.000	-25	0.444	19	0.628	65	0.001
-70	0.000	-24	0.474	20	0.597	66	0.001
-69	0.000	-23	0.504	21	0.566	67	0.001
-68	0.001	-22	0.535	22	0.535	68	0.001
-67	0.001	-21	0.566	23	0.504	69	0.000
-66	0.001	-20	0.597	24	0.474	70	0.000
-65	0.001	-19	0.628	25	0.444	71	0.000
-64	0.002	-18	0.659	26	0.415	72	0.000
-63	0.002	-17	0.690	27	0.387	73	0.000
-62	0.003	-16	0.720	28	0.360	74	0.000
-61	0.004	-15	0.749	29	0.333	75	0.000
-60	0.005	-14	0.778	30	0.308	76	0.000
-59	0.006	-13	0.805	31	0.283	77	0.000
-58	0.007	-12	0.832	32	0.260	78	0.000
-57	0.009	-11	0.857	33	0.238	79	0.000
-56	0.011	-10	0.880	34	0.217	80	0.000
-55	0.013	-9	0.902	35	0.197	81	0.000
-54	0.015	-8	0.922	36	0.179	82	0.000
-53	0.018	-7	0.939	37	0.162	83	0.000
-52	0.022	-6	0.955	38	0.145	84	0.000
-51	0.026	-5	0.969	39	0.130	85	0.000
-50	0.030	-4	0.980	40	0.117	86	0.000
-49	0.035	-3	0.989	41	0.104	87	0.000
-48	0.041	-2	0.995	42	0.092	88	0.000
-47	0.047	-1	0.999	43	0.081	89	0.000
-46	0.055	0	1.000	44	0.072	90	0.000
-45	0.063			45	0.063		

FIGURE 4

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VALIDATION OF GAIN CALCULATION

WEVS NASHUA, NH

MODEL 6810-4R-SS-V/H-PN-DA

Elevation Gain of 6810-4R-SS-V/H-PN-DA equals 1.019

The RMS values are calculated utilizing the data of a planimeter.

Horizontal RMS divided by Vertical RMS equals
$0.608 \div 0.704 = 0.8636$

Elevation Gain of Horizontal Component equals
$1.019 \times 0.8636 = 0.880$

Elevation Gain of Vertical Component equals
$1.019 \times 1.158 = 1.180$

Vertical Azimuth Gain equals $1/(\text{RMS})^2$
$1/(0.704)^2 = 2.018$

Horizontal Azimuth Gain equals $1/(\text{RMS} \div \text{Max Vert})^2$
$1/(0.608 \div 0.836)^2 = 1.891$

*** Total Horizontal Gain is Elevation Gain times Azimuth Gain**
$0.880 \times 1.891 = 1.664$

*** Total Vertical Gain is Elevation Gain times Azimuth Gain**
$1.180 \times 2.018 = 2.381$

ERP divided by Horizontal Gain equals Antenna Input Power
$5.0 \text{ kW} \div 2.381 = 2.10 \text{ kW}$

Antenna Input Power times Vertical Gain equals Vertical ERP
$2.10 \text{ kW} \times 1.664 = 3.494 \text{ kW}$

Maximum Value of the Vertical Component squared times the Maximum ERP equals the Vertical ERP
$(0.836)^2 \times 5.0 \text{ kW} = 3.494 \text{ kW}$

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