Shively Labs
a division of Howell Laboratories,Inc.

- An Employee-Owned Company -

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S.O. 24026

Report of Test 6513-4-SS-DA

for

UNIVERSITY OF MASSACHUSETTS

WNEF 91.7 MHz NEWBURYPORT, MA

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6513-4-SS-DA to meet the needs of WNEF and to comply with the requirements of the FCC construction permit, file number BPED-20041124AGW.

RESULTS:

The measured azimuth pattern for the 6513-4-SS-DA is shown in Figure 1. Figure 1A shows the Tabulation of the Vertical Polarization. The calculated elevation pattern of the antenna is shown in Figure 3. Construction permit file number BPED-20041124AGW indicates that the Vertical radiation component shall not exceed 1.00 kW at any azimuth and is restricted to the following values at the azimuths specified:

180 Degrees T: 0.071 kW
350 Degrees T: 0.376 kW

From Figure 1, the maximum radiation of the Vertical component occurs at 269 Degrees T to 281 Degrees T. At the restricted azimuth of 180 Degrees T the Vertical component is 15.139 dB down from the maximum of 1.00 kW, or 0.031 kW. At the restricted azimuth of 350 Degrees T the Vertical component is 4.51 dB down from the maximum of 1.00 kW, or 0.354 kW.

The R.M.S. of the Vertical component is 0.715. The total Vertical power gain is 5.152. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.8398. The R.M.S. of the measured composite pattern is 0.715. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.7138. Therefore this Pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6513-4-SS-DA was mounted on a pole of exact scale to the pole attached to the self-supported tower at the WNEF tower site. The spacing of the antenna to the mounting pole was varied and vertical parasitic elements were used to achieve the vertical pattern shown in Figure 1. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BPED-20041124AGW, a single level of the 6513-4-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.

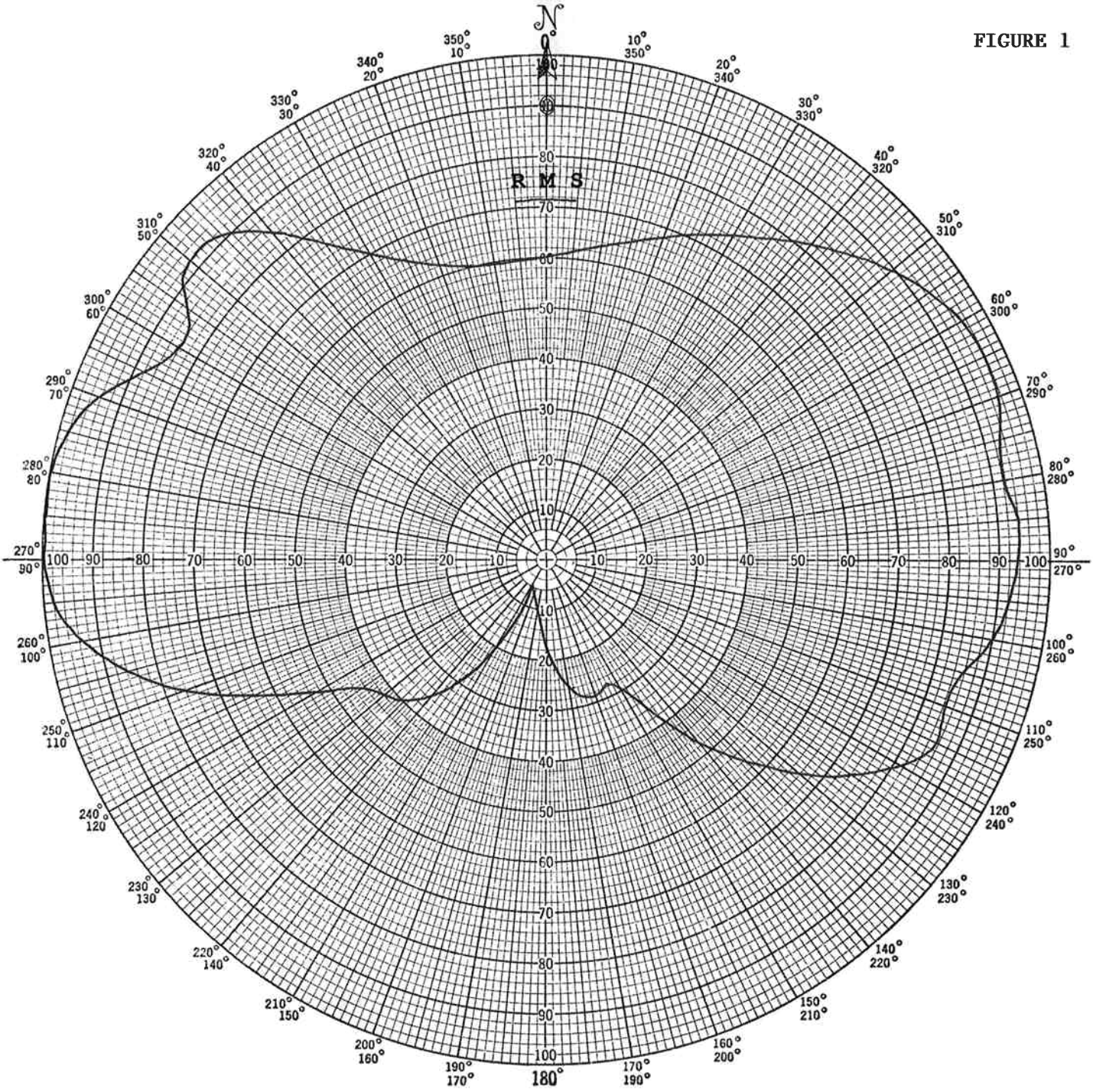
TEST PROCEDURES:

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 412.65 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 24026
November 11, 2005

FIGURE 1



Shively Labs

PROJECT NAME WNEF NEWBURYPORT, MA

PROJECT NUMBER 24026 DATE 6/10/05

MODEL (X) FULL SCALE ( ) FREQUENCY 412.65/91.7 MHz

POLARIZATION VERTICAL

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

OBSERVER RAS

ANTENNA TYPE 6513-4-SS-DA

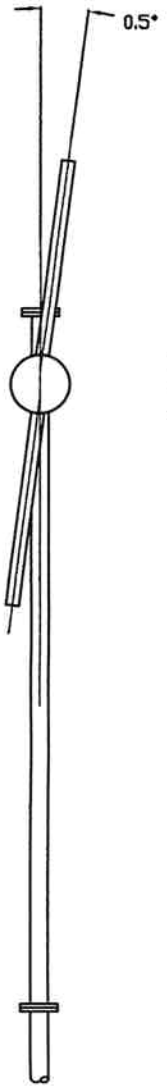
PATTERN TYPE DIRECTIONAL AZIMUTH

REMARKS: SEE FIGURE 2 FOR MECHANICAL DETAILS

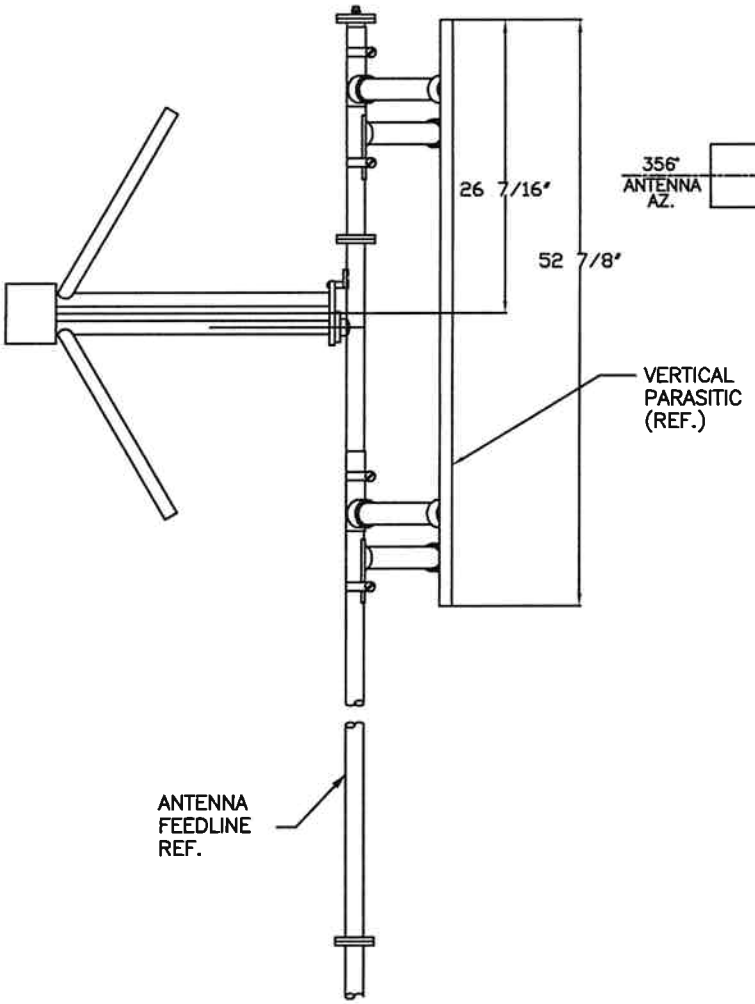
Figure 1A

S/O 24026
TABULATION OF VERTICAL POLARIZATION
WNEF NEWBURYPORT, MA

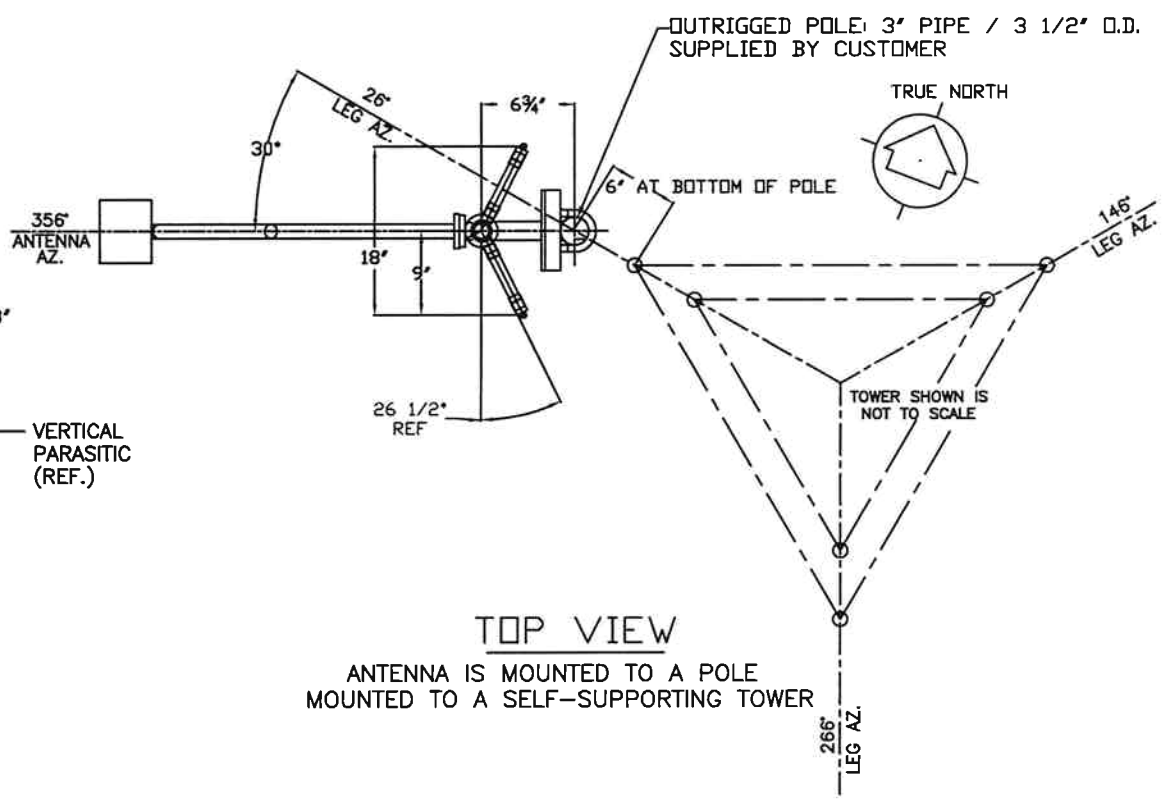
DEGREE	RELATIVE FIELD	DEGREE	RELATIVE FIELD
0	0.600	180	0.175
10	0.635	190	0.100
20	0.685	200	0.070
30	0.745	210	0.200
40	0.820	220	0.355
45	0.855	225	0.400
50	0.895	230	0.420
60	0.955	240	0.525
70	0.955	250	0.760
80	0.920	260	0.935
90	0.935	270	1.000
100	0.900	280	1.000
110	0.845	290	0.945
120	0.815	300	0.840
130	0.660	310	0.920
135	0.565	315	0.910
140	0.475	320	0.845
150	0.295	330	0.700
160	0.285	340	0.625
170	0.260	350	0.595



FRONT VIEW



SIDE VIEW



TOP VIEW

ANTENNA IS MOUNTED TO A POLE MOUNTED TO A SELF-SUPPORTING TOWER

ANTENNA HEADING: 356° TRUE NORTH

SHIVELY LABS

A DIVISION OF HOWELL LABORATORIES INC.,BRIDGTON, MAINE, USA

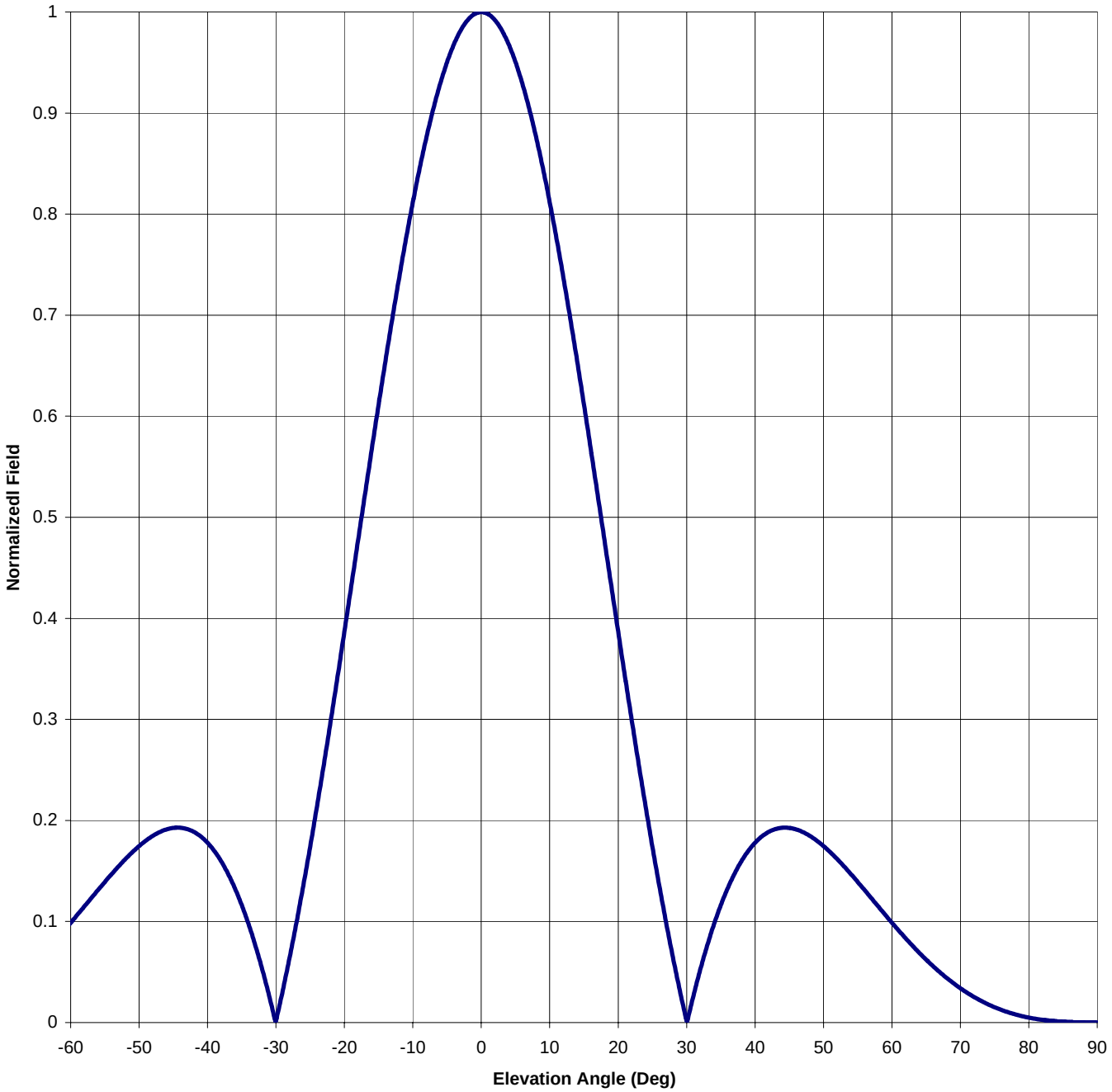
SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY:
24026	91.7 MHz.	N.T.S.	LRA
			APPROVED BY: ASP

TITLE: MODEL 6513-4-1/2SS-DIRECTIONAL ANTENNA FM STATION

DATE: 11/2/05

FIGURE 2

Antenna Mfg.:	**Shively Labs**			**Date:**	**5/6/2005**
Antenna Type:	**6513-4-SS-DA**				
Station:	**WNEF**	**Beam Tilt**	**0**		
Frequency:	**91.7**	**Gain (Max)**	**2.575**	**4.109**	**dB**
Channel #:	**219**	**Gain (Horizon)**	**2.575**	**4.109**	**dB**
Figure:	**1**				



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

Antenna Type: 6513-4-SS-DA

Station: WNEF **Beam Tilt** 0

Frequency: 91.7 **Gain (Max)** 2.575 4.109 dB

Channel #: 219 **Gain (Horizon)** 2.575 4.109 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	0.193	0	1.000	46	0.191
-89	0.000	-43	0.192	1	0.998	47	0.188
-88	0.000	-42	0.189	2	0.992	48	0.185
-87	0.000	-41	0.184	3	0.982	49	0.180
-86	0.000	-40	0.178	4	0.968	50	0.175
-85	0.001	-39	0.170	5	0.950	51	0.168
-84	0.001	-38	0.160	6	0.929	52	0.162
-83	0.002	-37	0.147	7	0.904	53	0.155
-82	0.003	-36	0.133	8	0.876	54	0.147
-81	0.004	-35	0.116	9	0.846	55	0.139
-80	0.005	-34	0.097	10	0.812	56	0.131
-79	0.006	-33	0.076	11	0.776	57	0.123
-78	0.008	-32	0.052	12	0.737	58	0.115
-77	0.010	-31	0.027	13	0.697	59	0.107
-76	0.013	-30	0.002	14	0.655	60	0.099
-75	0.015	-29	0.032	15	0.612	61	0.091
-74	0.018	-28	0.065	16	0.567	62	0.083
-73	0.022	-27	0.099	17	0.522	63	0.076
-72	0.025	-26	0.136	18	0.477	64	0.069
-71	0.029	-25	0.174	19	0.432	65	0.062
-70	0.034	-24	0.214	20	0.387	66	0.056
-69	0.039	-23	0.256	21	0.342	67	0.050
-68	0.044	-22	0.298	22	0.298	68	0.044
-67	0.050	-21	0.342	23	0.256	69	0.039
-66	0.056	-20	0.387	24	0.214	70	0.034
-65	0.062	-19	0.432	25	0.174	71	0.029
-64	0.069	-18	0.477	26	0.136	72	0.025
-63	0.076	-17	0.522	27	0.099	73	0.022
-62	0.083	-16	0.567	28	0.065	74	0.018
-61	0.091	-15	0.612	29	0.032	75	0.015
-60	0.099	-14	0.655	30	0.002	76	0.013
-59	0.107	-13	0.697	31	0.027	77	0.010
-58	0.115	-12	0.737	32	0.052	78	0.008
-57	0.123	-11	0.776	33	0.076	79	0.006
-56	0.131	-10	0.812	34	0.097	80	0.005
-55	0.139	-9	0.846	35	0.116	81	0.004
-54	0.147	-8	0.876	36	0.133	82	0.003
-53	0.155	-7	0.904	37	0.147	83	0.002
-52	0.162	-6	0.929	38	0.160	84	0.001
-51	0.168	-5	0.950	39	0.170	85	0.001
-50	0.175	-4	0.968	40	0.178	86	0.000
-49	0.180	-3	0.982	41	0.184	87	0.000
-48	0.185	-2	0.992	42	0.189	88	0.000
-47	0.188	-1	0.998	43	0.192	89	0.000
-46	0.191	0	1.000	44	0.193	90	0.000
-45	0.193			45	0.193		

FIGURE 4

S.O. 24026

VALIDATION OF GAIN CALCULATION

WNEF NEWBURYPORT, MA

MODEL 6513-4-SS-DA

Elevation Gain of 6513-4-SS-DA equals 2.634

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

Vertical Azimuth Gain equals $1/(RMS)^2$
$1/(0.715)^2 = 1.956$

*** Total Vertical Gain is Elevation Gain times Azimuth Gain**
2.634 x 1.956 = 5.152

ERP divided by Vertical Gain equals Antenna Input Power
1.0 kW ÷ 5.152 = 0.194 kW

The 0.001 kW of Horizontal polarization is achieved by rotation the bays of the antenna by an angle of 0.5 degrees