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S.O. 25950

Report of Test Scala 2-CA5-FM-VRM (Slant)

for

NEW JERSEY PUBLIC BROADCASTING AUTHORITY

990730ME 89.3 MHz NETCONG, NJ

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a Scala 2-CA5-FM-VRM (Slant) to meet the needs of 990730ME and to comply with the requirements of the FCC construction permit, file number BPED-19990730ME.

RESULTS:

The measured azimuth pattern for the Scala 2-CA5-FM-VRM (Slant) is shown in Figure 1. Figure 1A shows the Tabulation of the Vertical Polarization. The horizontal component of this antenna was developed by constructing the dipole 2.3° off of vertical. The horizontal azimuth pattern of this antenna is omni-directional and therefore is not shown. Figure 1B shows the Tabulation of the FCC Composite Pattern. The calculated elevation pattern of the antenna is shown in Figure 3. Construction permit file number BPED-19990730ME indicates that the Vertical radiation component shall not exceed 0.60 kW at any azimuth and is restricted to the following values at the azimuths specified:

000 - 010 Degrees T: 0.074 kW
030 – 060 Degrees T: 0.121 kW
130 Degrees T: 0.162 kW
240 Degrees T: 0.228 kW

From Figure 1, the maximum radiation of the Vertical component occurs at 278 Degrees T to 284 Degrees T. At the restricted azimuth of 000 - 010 Degrees T the Vertical component is 12.765 dB down from the maximum of 0.60 kW, or 0.032 kW. At the restricted azimuth of 030 - 060 Degrees T the Vertical component is 15.650 dB down from the maximum of

0.60 kW, or 0.016 kW. At the restricted azimuth of 130 Degrees T the Vertical component is 6.196 dB down from the maximum of 0.60 kW, or 0.144 kW. At the restricted azimuth of 240 Degrees T the Vertical component is 4.293 dB down from the maximum of 0.60 kW, or 0.223 kW. The R.M.S. of the Vertical component is 0.628. The total Vertical power gain is 3.190. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.731. The R.M.S. of the measured composite pattern is 0.629. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.621. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

The Scala 2-CA5-FM/VRM (Slant) was mounted on a tower of precise scale to the Rohn SSV tower at the site. The spacing of the antenna to the tower was varied 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-19990730ME, a single level of the Scala 2-CA5-FM/VRM (Slant) 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 and 10th Editions 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 401.85 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
Director of Sales Engineering
S/O 25950
August 23, 2007

Shively Labs

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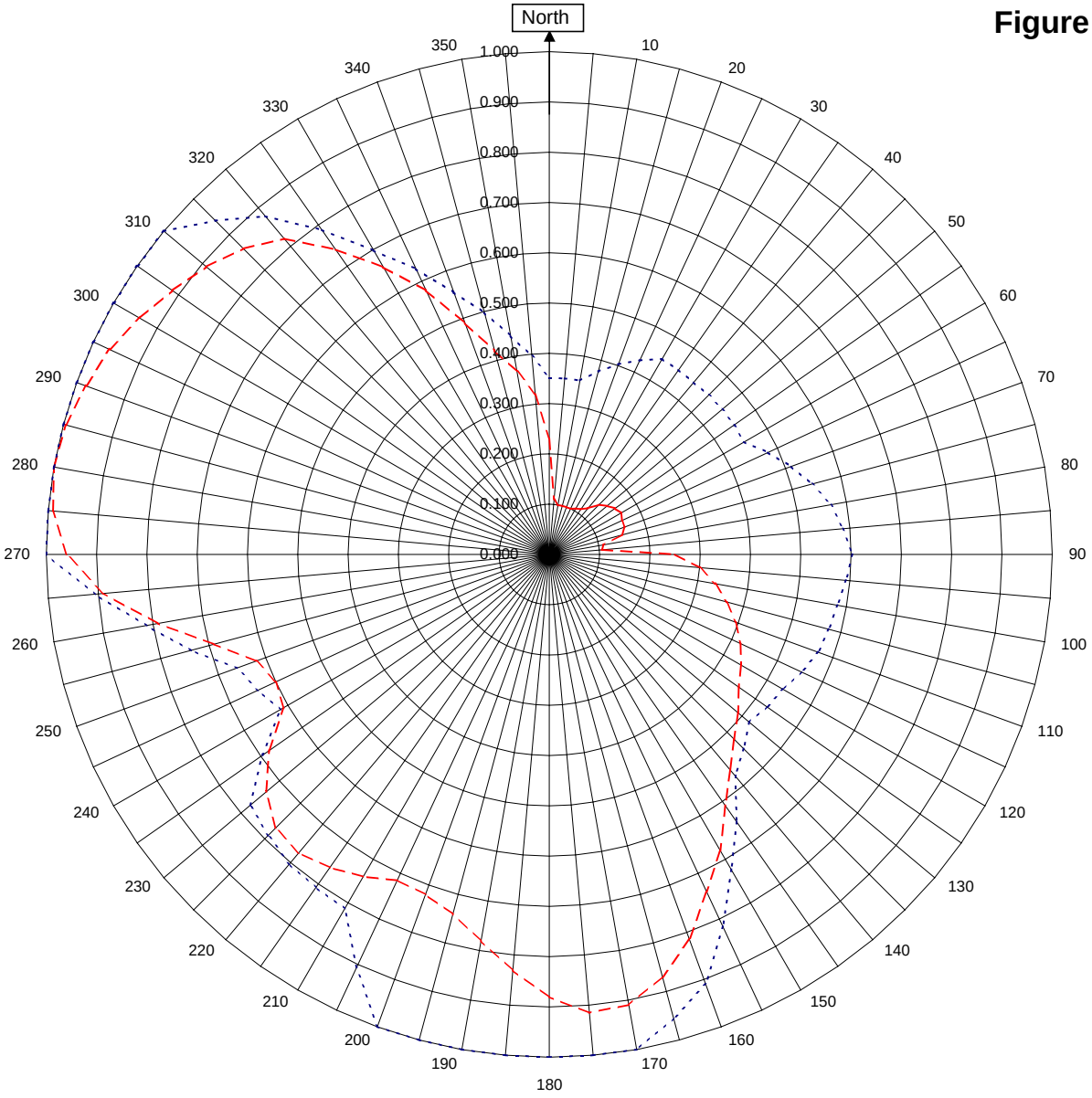
Figure 1



990730ME Netcong, NJ

25950

August 23, 2007

_____Horizontal RMS	0.000
_ _ _ _ _ _ _ _ _ Vertical RMS	0.628
H/V Composite RMS	0.629
.....FCC Composite RMS	0.731

Frequency	89.3 / 401.85 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	Scala 2-CA5-FM/VRM Slant
Pattern Type	Directional Azimuth

Figure 1a

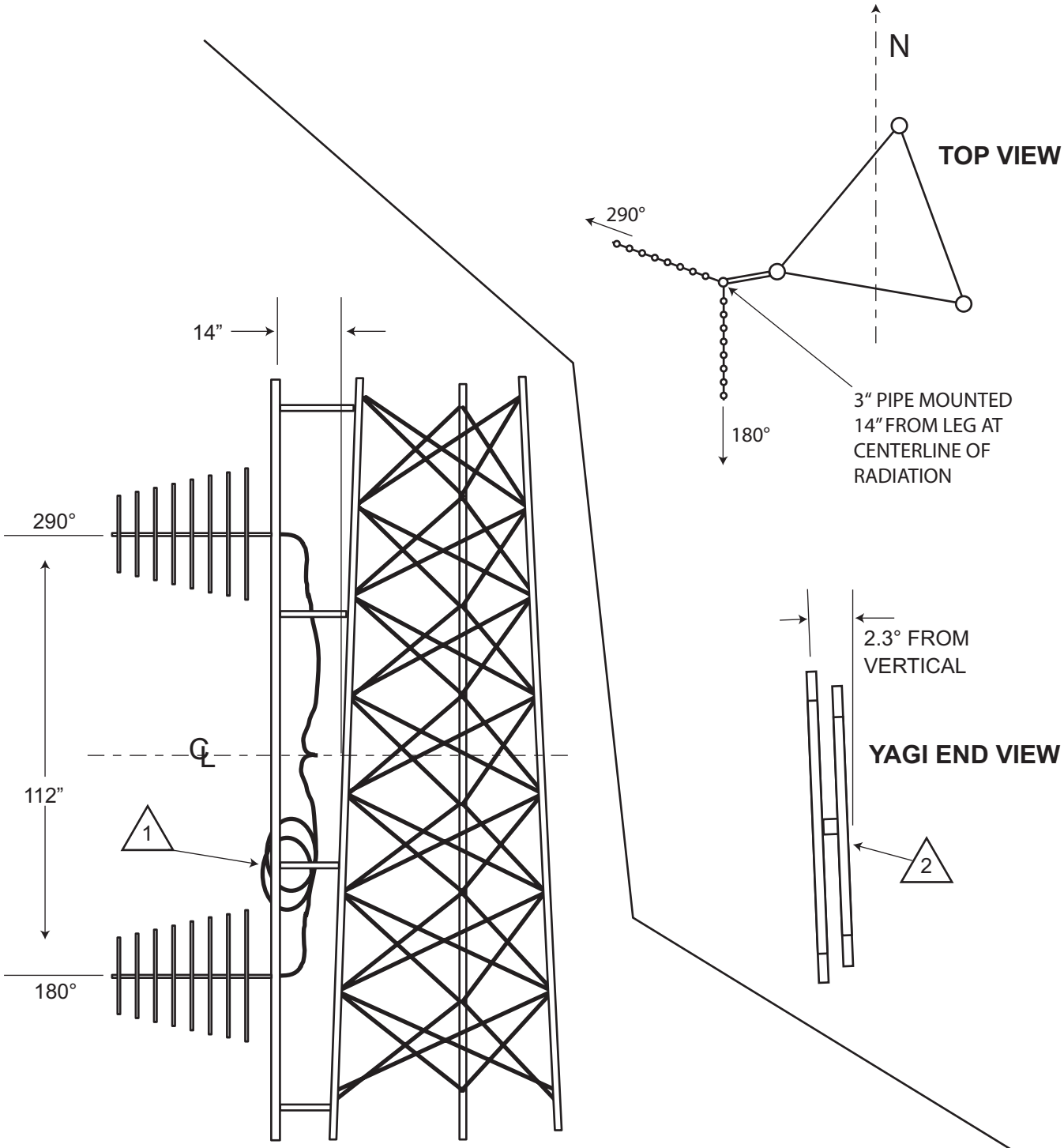
Tabulation of Vertical Azimuth Pattern
990730ME Netcong, NJ

Azimuth	Rel Field	Azimuth	Rel Field
0	0.230	180	0.880
10	0.100	190	0.780
20	0.100	200	0.720
30	0.105	210	0.740
40	0.120	220	0.775
45	0.140	225	0.770
50	0.150	230	0.735
60	0.165	240	0.610
70	0.160	250	0.620
80	0.110	260	0.790
90	0.250	270	0.960
100	0.335	280	1.000
110	0.395	290	0.980
120	0.440	300	0.940
130	0.490	310	0.890
135	0.520	315	0.860
140	0.560	320	0.820
150	0.680	330	0.660
160	0.815	340	0.490
170	0.910	350	0.370

Figure 1b

Tabulation of FCC Directional Composite
990730ME Netcong, NJ

Azimuth	Rel Field	Azimuth	Rel Field
0	0.351	180	1.000
10	0.351	190	1.000
20	0.403	200	1.000
30	0.449	210	0.813
40	0.447	220	0.804
50	0.449	230	0.776
60	0.447	240	0.617
70	0.512	250	0.661
80	0.569	260	0.813
90	0.603	270	1.000
100	0.582	280	1.000
110	0.569	290	1.000
120	0.537	300	1.000
130	0.519	310	1.000
140	0.575	320	0.878
150	0.724	330	0.698
160	0.910	340	0.555
170	1.000	350	0.442



NOTES:
1. THE CABLE TO THE 180° YAGI MUST BE 115 ELECTRICAL DEGREES LONGER THAN THE CABLE TO THE 290° YAGI.
2. BOTH YAGIS ARE ROTATED 2.3 DEGREES FROM THE VERTICAL, IN THE SAME DIRECTION.

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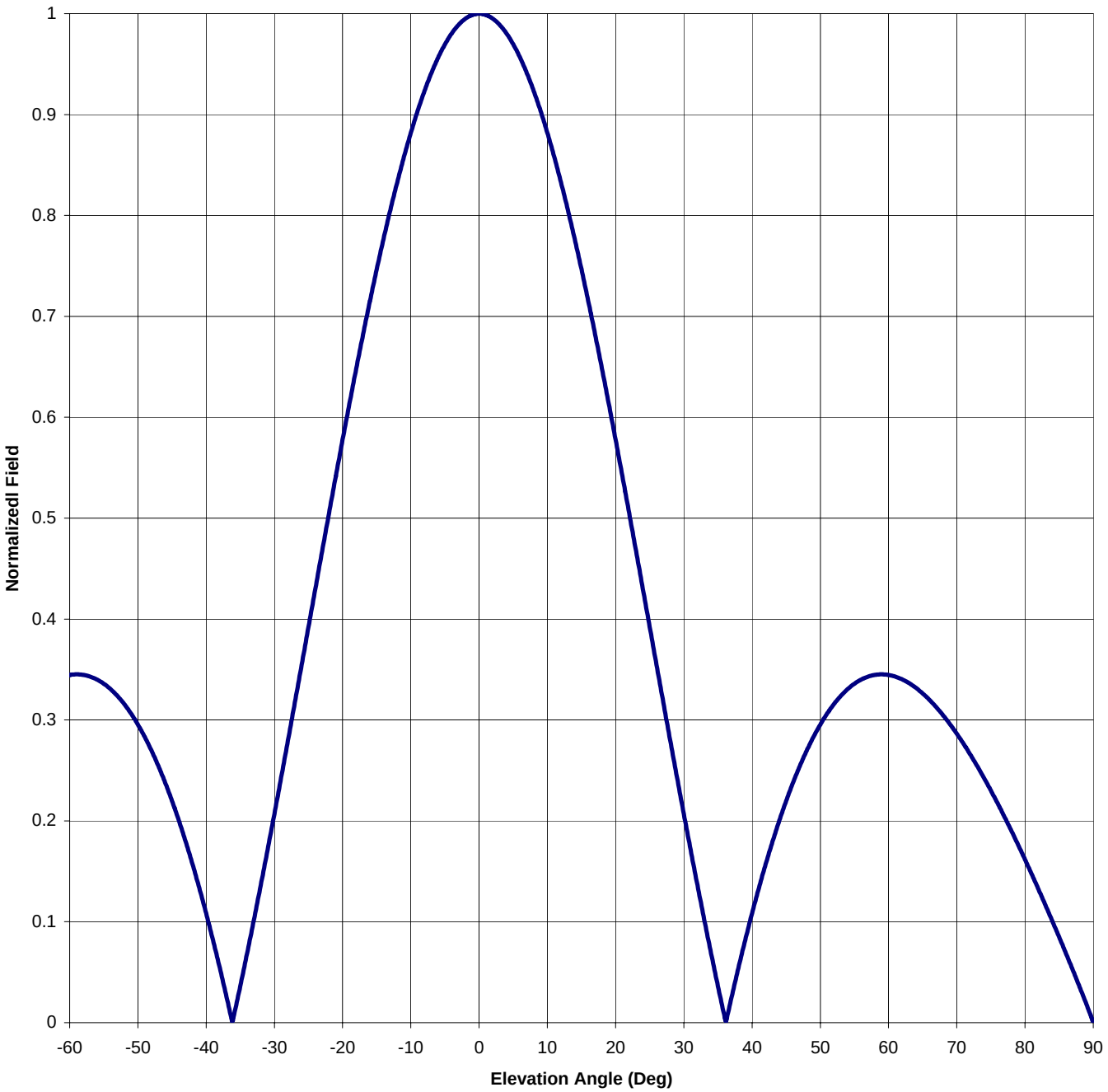
Figure 2
990730ME

SIZE	CODE IDENT NO.	DRAWING NO.	REV
C	22501	AGF070823-001	—

SCALE		SHEET
NONE	51598	1 of 1

Antenna Mfg.:	**Shively Labs**				**Date: 8/23/2007**
Antenna Type:	**Scala 2-CA5-FM-VRM Slant**				
Station:	**990730ME**	**Beam Tilt**	**0**		
Frequency:	**89.3**	**Gain (Max)**	**3.190**	**5.037 dB**	
Channel #:	**207**	**Gain (Horizon)**	**3.190**	**5.037 dB**	
Figure:	**3 Vertical**				



Antenna Mfg.: Shively Labs **Date:** 8/23/2007

Antenna Type: Scala 2-CA5-FM-VRM Slant

Station: 990730ME **Beam Tilt** 0

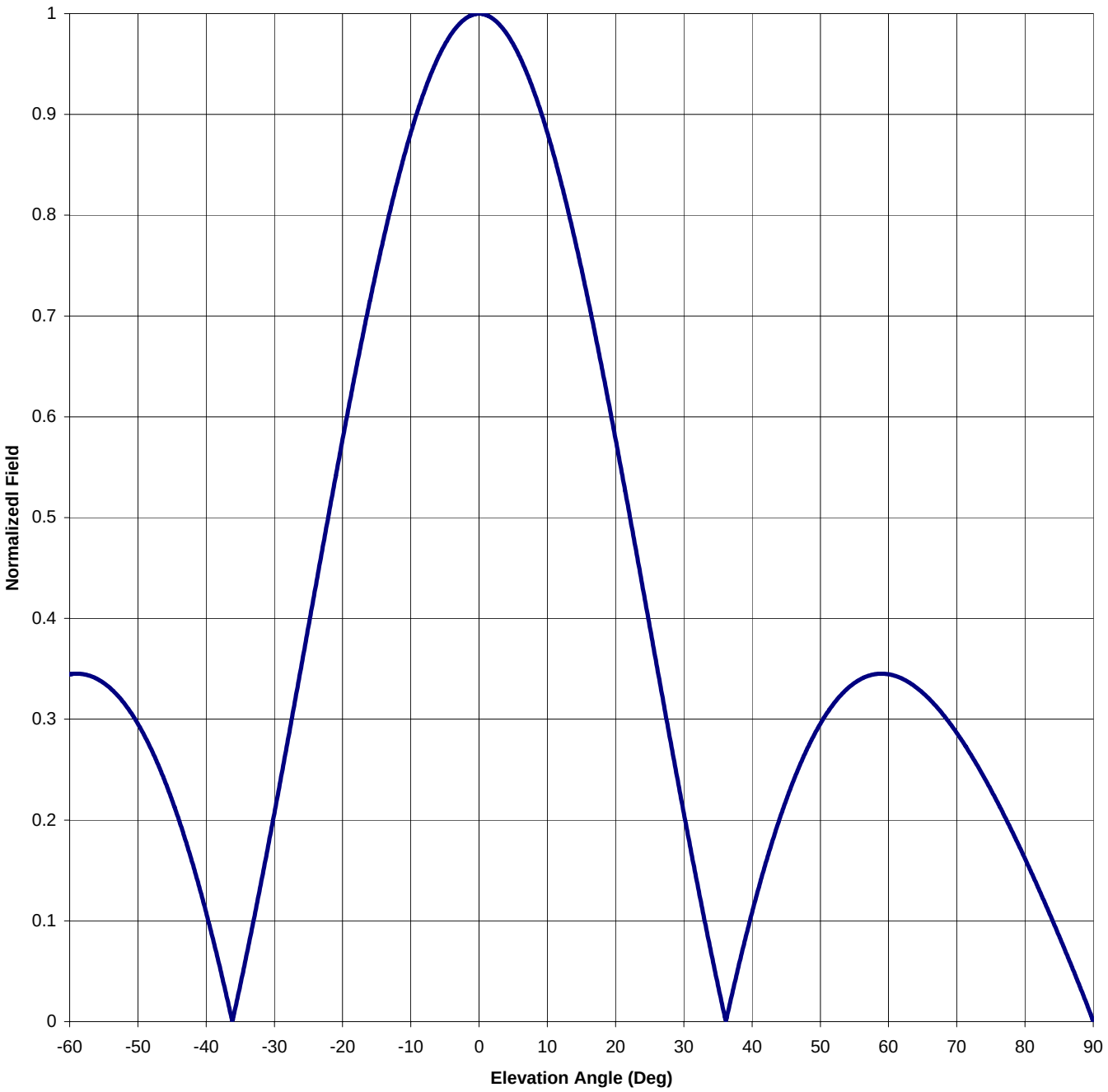
Frequency: 89.3 **Gain (Max)** 3.190 5.037 dB

Channel #: 207 **Gain (Horizon)** 3.190 5.037 dB

Figure: 3 Vertical

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	0.200	0	1.000	46	0.238
-89	0.018	-43	0.179	1	0.999	47	0.254
-88	0.035	-42	0.157	2	0.995	48	0.270
-87	0.052	-41	0.133	3	0.989	49	0.283
-86	0.069	-40	0.108	4	0.981	50	0.295
-85	0.085	-39	0.082	5	0.970	51	0.306
-84	0.101	-38	0.054	6	0.956	52	0.316
-83	0.116	-37	0.025	7	0.941	53	0.324
-82	0.132	-36	0.005	8	0.923	54	0.331
-81	0.147	-35	0.036	9	0.904	55	0.336
-80	0.162	-34	0.069	10	0.882	56	0.340
-79	0.176	-33	0.102	11	0.858	57	0.343
-78	0.190	-32	0.136	12	0.833	58	0.345
-77	0.204	-31	0.171	13	0.806	59	0.345
-76	0.217	-30	0.207	14	0.777	60	0.345
-75	0.230	-29	0.243	15	0.747	61	0.343
-74	0.242	-28	0.280	16	0.715	62	0.340
-73	0.254	-27	0.317	17	0.682	63	0.337
-72	0.266	-26	0.355	18	0.648	64	0.332
-71	0.276	-25	0.392	19	0.613	65	0.326
-70	0.286	-24	0.430	20	0.578	66	0.320
-69	0.296	-23	0.467	21	0.541	67	0.313
-68	0.305	-22	0.505	22	0.505	68	0.305
-67	0.313	-21	0.541	23	0.467	69	0.296
-66	0.320	-20	0.578	24	0.430	70	0.286
-65	0.326	-19	0.613	25	0.392	71	0.276
-64	0.332	-18	0.648	26	0.355	72	0.266
-63	0.337	-17	0.682	27	0.317	73	0.254
-62	0.340	-16	0.715	28	0.280	74	0.242
-61	0.343	-15	0.747	29	0.243	75	0.230
-60	0.345	-14	0.777	30	0.207	76	0.217
-59	0.345	-13	0.806	31	0.171	77	0.204
-58	0.345	-12	0.833	32	0.136	78	0.190
-57	0.343	-11	0.858	33	0.102	79	0.176
-56	0.340	-10	0.882	34	0.069	80	0.162
-55	0.336	-9	0.904	35	0.036	81	0.147
-54	0.331	-8	0.923	36	0.005	82	0.132
-53	0.324	-7	0.941	37	0.025	83	0.116
-52	0.316	-6	0.956	38	0.054	84	0.101
-51	0.306	-5	0.970	39	0.082	85	0.085
-50	0.295	-4	0.981	40	0.108	86	0.069
-49	0.283	-3	0.989	41	0.133	87	0.052
-48	0.270	-2	0.995	42	0.157	88	0.035
-47	0.254	-1	0.999	43	0.179	89	0.018
-46	0.238	0	1.000	44	0.200	90	0.000
-45	0.220			45	0.220		

Antenna Mfg.:	**Shively Labs**			**Date:**	**8/23/2007**
Antenna Type:	**Scala 2-CA5-FM-VRM Slant**				
Station:	**990730ME**	**Beam Tilt**	**0**		
Frequency:	**89.3**	**Gain (Max)**	**0.0053**	**-22.739**	**dB**
Channel #:	**207**	**Gain (Horizon)**	**0.0053**	**-22.739**	**dB**
Figure:	**3 Horizontal**				



Antenna Mfg.: Shively Labs **Date:** 8/23/2007

Antenna Type: Scala 2-CA5-FM-VRM Slant

Station: 990730ME **Beam Tilt** 0

Frequency: 89.3 **Gain (Max)** 0.0053 -22.739 dB

Channel #: 207 **Gain (Horizon)** 0.0053 -22.739 dB

Figure: 3 Horizontal

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	0.200	0	1.000	46	0.238
-89	0.018	-43	0.179	1	0.999	47	0.254
-88	0.035	-42	0.157	2	0.995	48	0.270
-87	0.052	-41	0.133	3	0.989	49	0.283
-86	0.069	-40	0.108	4	0.981	50	0.295
-85	0.085	-39	0.082	5	0.970	51	0.306
-84	0.101	-38	0.054	6	0.956	52	0.316
-83	0.116	-37	0.025	7	0.941	53	0.324
-82	0.132	-36	0.005	8	0.923	54	0.331
-81	0.147	-35	0.036	9	0.904	55	0.336
-80	0.162	-34	0.069	10	0.882	56	0.340
-79	0.176	-33	0.102	11	0.858	57	0.343
-78	0.190	-32	0.136	12	0.833	58	0.345
-77	0.204	-31	0.171	13	0.806	59	0.345
-76	0.217	-30	0.207	14	0.777	60	0.345
-75	0.230	-29	0.243	15	0.747	61	0.343
-74	0.242	-28	0.280	16	0.715	62	0.340
-73	0.254	-27	0.317	17	0.682	63	0.337
-72	0.266	-26	0.355	18	0.648	64	0.332
-71	0.276	-25	0.392	19	0.613	65	0.326
-70	0.286	-24	0.430	20	0.578	66	0.320
-69	0.296	-23	0.467	21	0.541	67	0.313
-68	0.305	-22	0.505	22	0.505	68	0.305
-67	0.313	-21	0.541	23	0.467	69	0.296
-66	0.320	-20	0.578	24	0.430	70	0.286
-65	0.326	-19	0.613	25	0.392	71	0.276
-64	0.332	-18	0.648	26	0.355	72	0.266
-63	0.337	-17	0.682	27	0.317	73	0.254
-62	0.340	-16	0.715	28	0.280	74	0.242
-61	0.343	-15	0.747	29	0.243	75	0.230
-60	0.345	-14	0.777	30	0.207	76	0.217
-59	0.345	-13	0.806	31	0.171	77	0.204
-58	0.345	-12	0.833	32	0.136	78	0.190
-57	0.343	-11	0.858	33	0.102	79	0.176
-56	0.340	-10	0.882	34	0.069	80	0.162
-55	0.336	-9	0.904	35	0.036	81	0.147
-54	0.331	-8	0.923	36	0.005	82	0.132
-53	0.324	-7	0.941	37	0.025	83	0.116
-52	0.316	-6	0.956	38	0.054	84	0.101
-51	0.306	-5	0.970	39	0.082	85	0.085
-50	0.295	-4	0.981	40	0.108	86	0.069
-49	0.283	-3	0.989	41	0.133	87	0.052
-48	0.270	-2	0.995	42	0.157	88	0.035
-47	0.254	-1	0.999	43	0.179	89	0.018
-46	0.238	0	1.000	44	0.200	90	0.000
-45	0.220			45	0.220		

FIGURE 4

S.O. 25950

VALIDATION OF GAIN CALCULATION

990730ME 89.3 MHz NETCONG, NJ

MODEL Scala CA5-FM-VRM (Slant)

Elevation Gain of Scala CA5-FM-VRM (Slant) equals 1.258/0.0053

Elevation Gain of Vertical Component equals 1.258

Vertical Azimuth Gain equals $1/(RMS)^2$
$1/(0.628)^2 = 2.536$

*** Total Horizontal Gain is 0.0053**

*** Total Vertical Gain is Elevation Gain times Azimuth Gain**
1.258 x 2.536 = 3.190

ERP divided by Vertical Gain equals Antenna Input Power
0.60 kW ÷ 3.19 = 0.188 watts

Antenna Input Power times Vertical Gain equals ERP
0.188 watts x 3.19 = 0.60 kW

Antenna Input Power times Horizontal Gain equals Vertical ERP
0.188 watts x 0.0053 = 0.001