Shively Labs
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S.O. 27344

Report of Test Scala CA5-FM/RM

for

WASU-FM

WASU-FM 90.5 MHz Boone, NC

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a Scala CA5-FM/RM to meet the needs of WASU-FM and to comply with the requirements of the FCC construction permit, file number BPED-20080722AAP.

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 BPED-20080722AAP indicates that the Horizontal radiation component shall not exceed 0.14 kW at any azimuth and is restricted to the following values at the azimuths specified:

260 Degrees T: 0.0049 kW
290 Degrees T: 0.005 kW
320 – 330 Degrees T: 0.0044 kW

EXHIBIT B
APPLICATION FOR STATION LICENSE
WASU-FM
WASU-FM RADIO STATION
CH 213A - 90.5 MHZ - 0.14 KW (DA)
BOONE, NORTH CAROLINA
July 2011

From Figure 1A, the maximum radiation of the Horizontal component occurs at 084 Degrees T to 086 Degrees T. At the restricted azimuth of 260 Degrees T the Horizontal component is 17.72 dB down from the maximum of 0.14 kW, or .0024 kW. At the restricted azimuth of 290 Degrees T the Horizontal component is 17.72 dB down from the maximum of 0.14 kW, or .002 kW. At the restricted azimuth of 320 – 330 Degrees T the Horizontal component is 15.92 dB down from the maximum of 0.14 kW, or .0036 kW.

The R.M.S. of the Horizontal component is 0.403. The total Horizontal power gain is 3.165. The R.M.S. of the Vertical component is 0.399. The total Vertical power gain is 2.685. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.484. The R.M.S. of the measured composite pattern is 0.424. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.411. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

The Scala CA5-FM/RM was mounted on a pipe of precise scale to the 3-inch metal pipe mounted above a wooden pole at the WASU-FM site. The spacing of the antenna to the pipe was varied to achieve the vertical and horizontal patterns shown in Figure 1A. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BPED-20080722AAP, a single level of the Scala CA5-FM/RM 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 407.25 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:

Robert A. Surette
Director of Sales Engineering
S/O 27344
March 13, 2009

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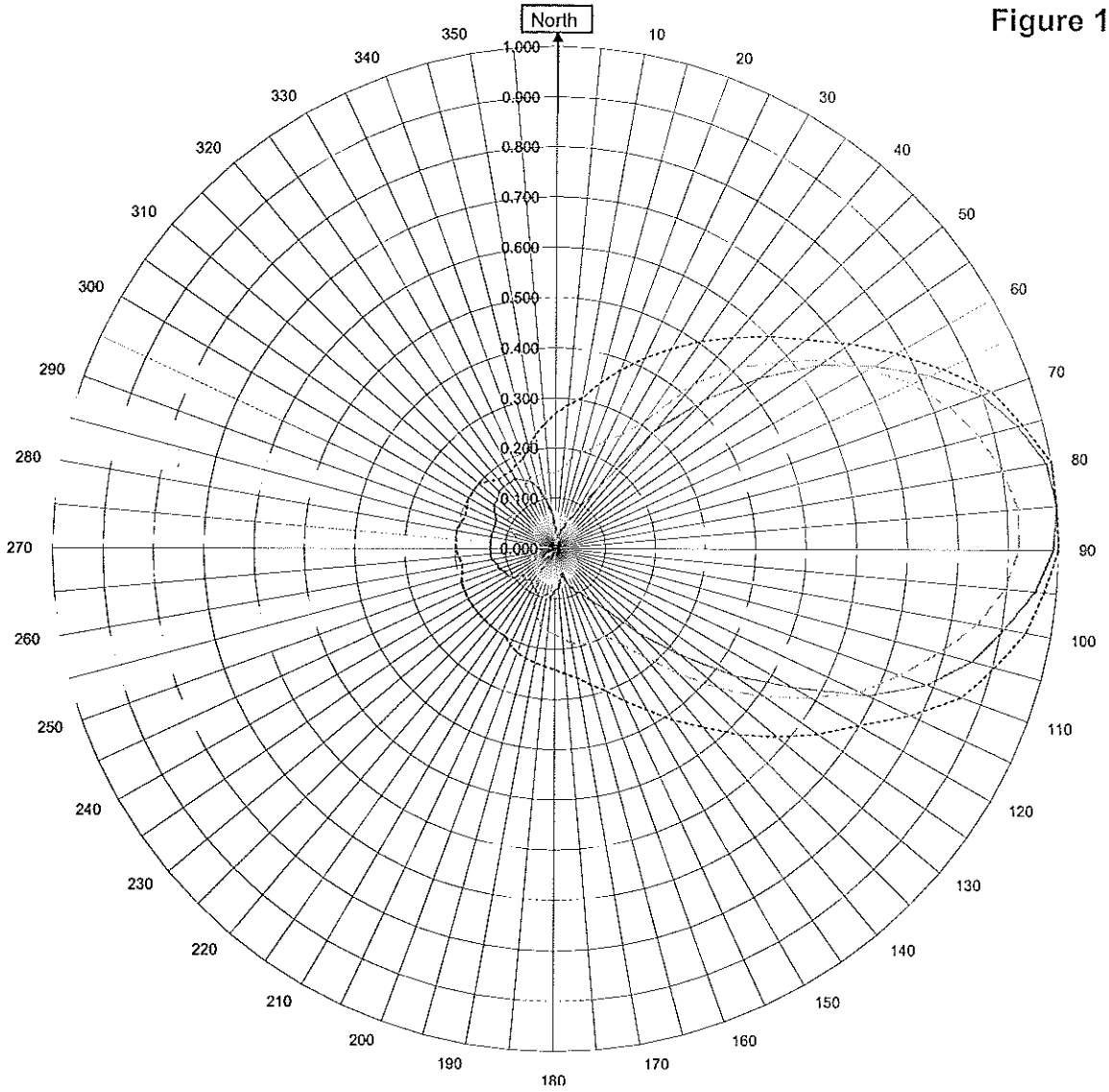
Figure 1a



WASU Boone, NC

27344

March 13, 2009

Horizontal RMS	0.403
Vertical RMS	0.399
H/V Composite RMS	0.424
FCC Composite RMS	0.484

Frequency	90.5 / 407.25 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	Scala CA5-FM/RM Patt 5
Pattern Type	Directional Azimuth

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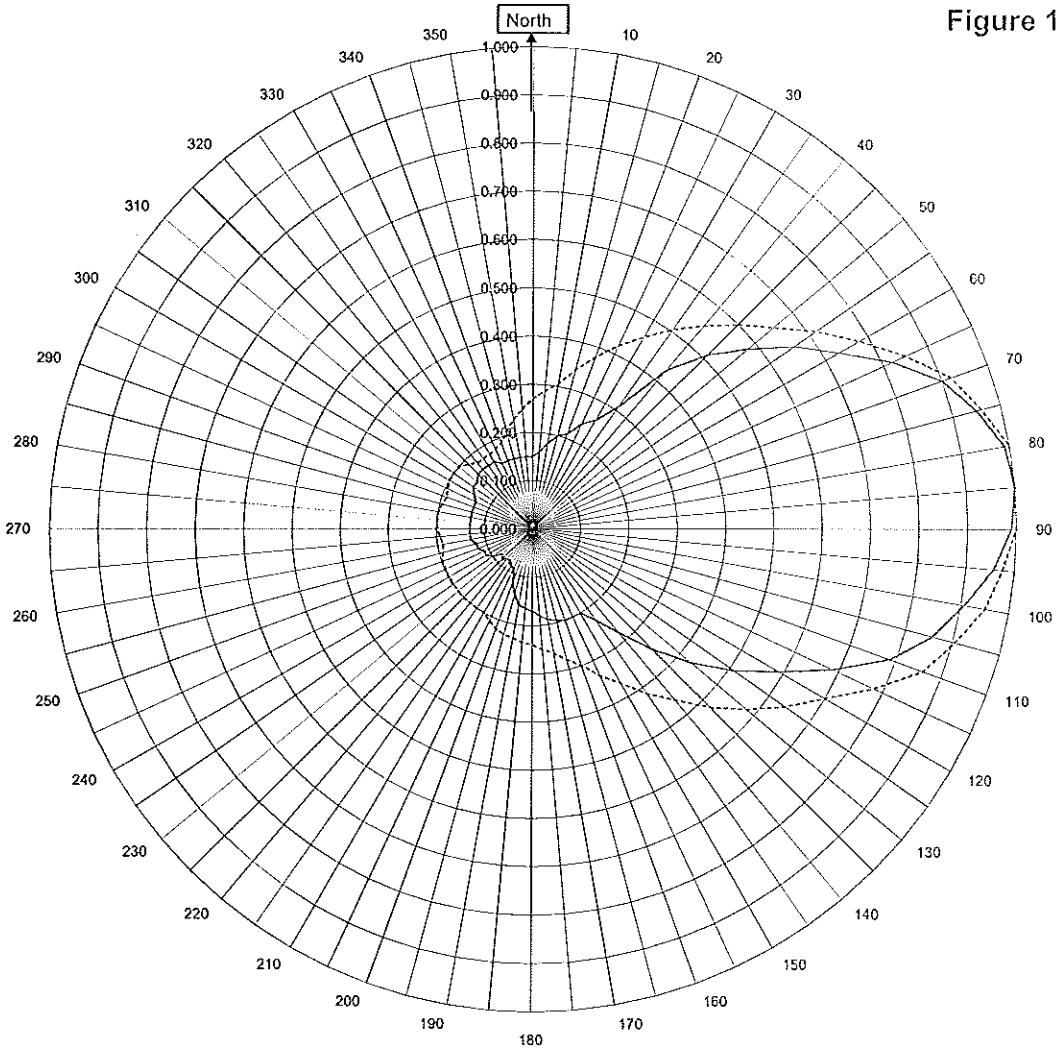
Figure 1b



WASU Boone, NC

27344

March 13, 2009

_____H/VComposite RMS	0.424
.....FCC Composite RMS	0.484

Frequency	90.5 / 407.25 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	Scala CA5-FM/RM Patt 5
Pattern Type	Directional H/V Composite

Figure 1c

Tabulation of Horizontal Azimuth Pattern
WASU Boone, NC

Azimuth	Rel Field	Azimuth	Rel Field
0	0.040	180	0.080
10	0.010	190	0.090
20	0.040	200	0.100
30	0.090	210	0.090
40	0.310	220	0.080
45	0.420	225	0.090
50	0.530	230	0.080
60	0.731	240	0.110
70	0.900	250	0.120
80	0.990	260	0.130
90	0.990	270	0.130
100	0.907	280	0.130
110	0.787	290	0.130
120	0.547	300	0.140
130	0.327	310	0.150
135	0.237	315	0.160
140	0.157	320	0.160
150	0.102	330	0.160
160	0.077	340	0.140
170	0.060	350	0.090
85	1.000		

Figure 1d

Tabulation of Vertical Azimuth Pattern
WASU Boone, NC

Azimuth	Rel Field	Azimuth	Rel Field
0	0.150	180	0.170
10	0.180	190	0.160
20	0.210	200	0.120
30	0.260	210	0.070
40	0.430	220	0.020
45	0.510	225	0.010
50	0.580	230	0.020
60	0.720	240	0.040
70	0.830	250	0.050
80	0.901	260	0.060
90	0.921	270	0.060
100	0.852	280	0.080
110	0.730	290	0.090
120	0.590	300	0.110
130	0.430	310	0.110
135	0.350	315	0.110
140	0.280	320	0.120
150	0.200	330	0.130
160	0.200	340	0.150
170	0.190	350	0.150

Figure 1e

Tabulation of Composite Azimuth Pattern
WASU Boone, NC

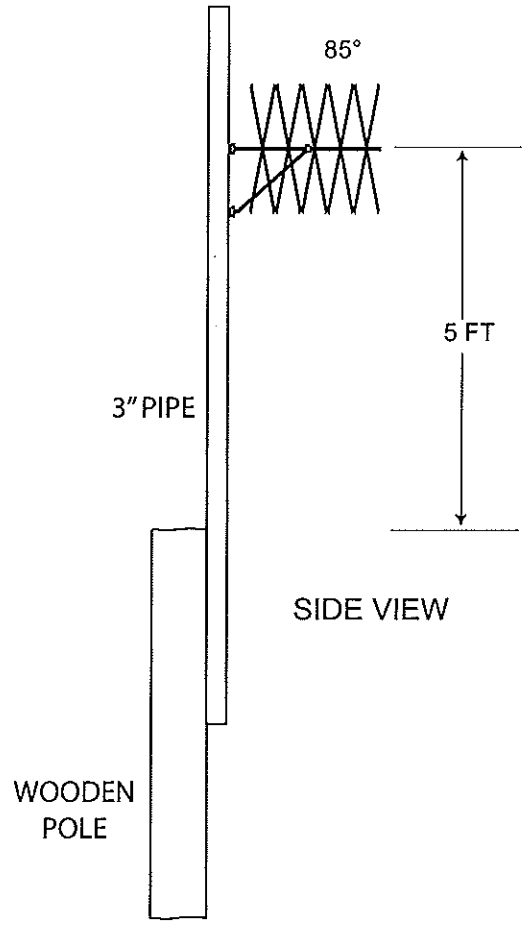
Azimuth	Rel Field	Azimuth	Rel Field
0	0.150	180	0.170
10	0.180	190	0.160
20	0.210	200	0.120
30	0.260	210	0.090
40	0.430	220	0.080
45	0.510	225	0.090
50	0.580	230	0.080
60	0.731	240	0.110
70	0.900	250	0.120
80	0.990	260	0.130
90	0.990	270	0.130
100	0.907	280	0.130
110	0.787	290	0.130
120	0.590	300	0.140
130	0.430	310	0.150
135	0.350	315	0.160
140	0.280	320	0.160
150	0.200	330	0.160
160	0.200	340	0.150
170	0.190	350	0.150

Figure 1f

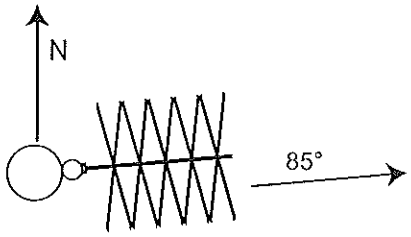
Tabulation of FCC Directional Composite
WASU Boone, NC

Azimuth	Rel Field	Azimuth	Rel Field
0	0.270	180	0.240
10	0.305	190	0.230
20	0.380	200	0.220
30	0.460	210	0.200
40	0.550	220	0.200
50	0.650	230	0.200
60	0.780	240	0.200
70	0.920	250	0.198
80	1.000	260	0.188
90	1.000	270	0.198
100	0.950	280	0.200
110	0.860	290	0.190
120	0.700	300	0.200
130	0.580	310	0.200
140	0.462	320	0.178
150	0.369	330	0.178
160	0.300	340	0.190
170	0.260	350	0.230

REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED



SIDE VIEW



TOP VIEW

PART NO.

DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED.
TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONAL: ± 1/32
ANGLES: ± 1/2
2 PL DECIMAL: ± .02
3 PL DECIMAL: ± .005
SURFACE FINISH 63
FILLETS .015 MAX

ANGLE PROJECTION

MATERIAL

	APPROVED BY	DATE
MFG. APPROVAL		
ENG. APPROVAL		
CHECKED		
DRAWN BY	AGF	03/06/09

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

FIGURE 2
YAGI, SCALA CA5-FM/RM
WASU-FM, 90.5 MHz

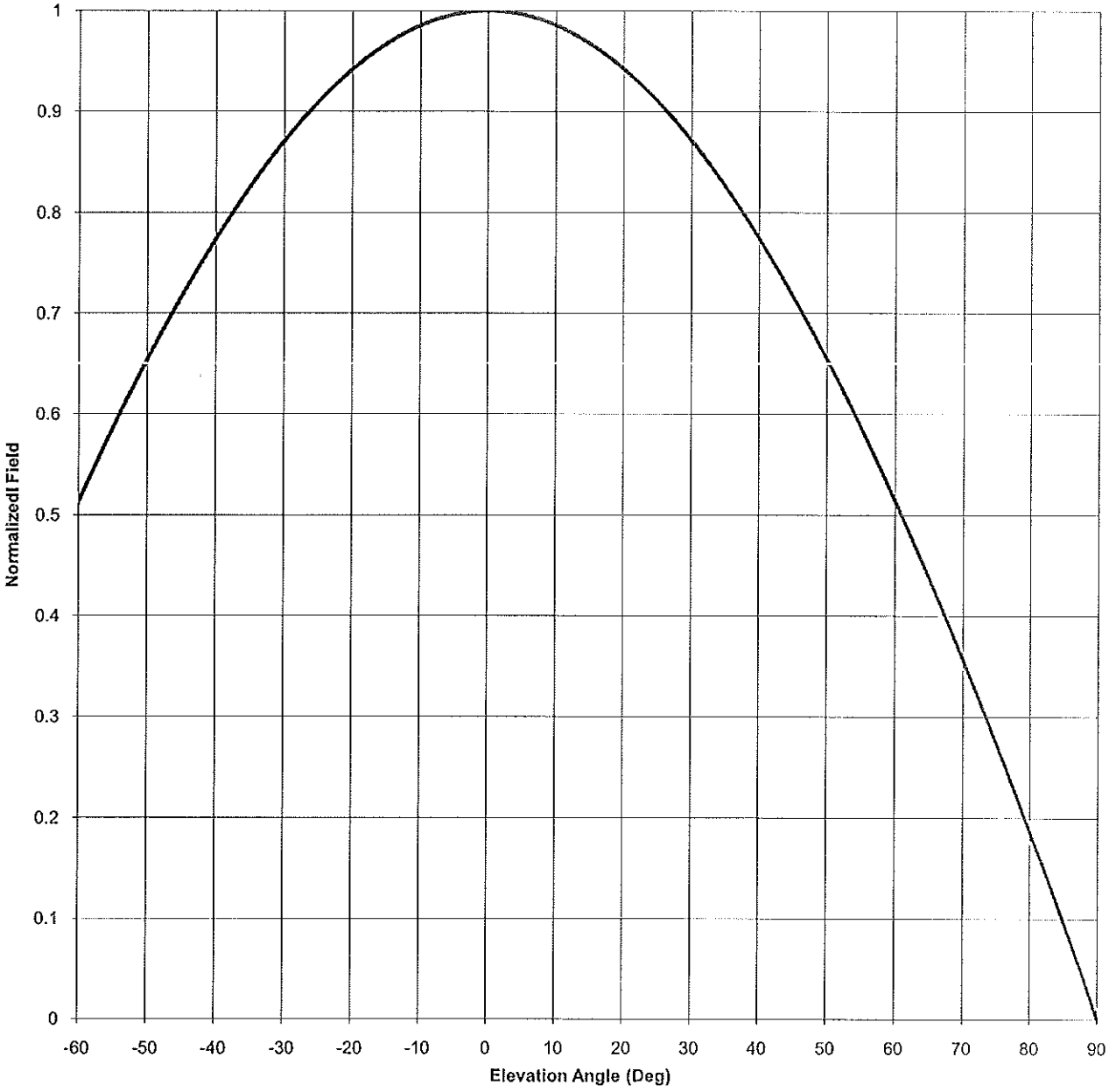
SIZE	CAGE CODE	DWG NO	REV
B	26750	AGF090306-001	--

SCALE		SHEET
NONE	27344	1 OF 1

Antenna Mfg.: Shively Labs
Antenna Type: Scala CA5-FM/RM
Station: WASU-FM
Frequency: 90.5
Channel #: 202
Figure: 3

Date: 3/13/2009

Beam Tilt	0	
Gain (Max)	3.165	5.004 dB
Gain (Horizon)	3.165	5.004 dB



Antenna Mfg.: Shively Labs
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Frequency: 90.5
Channel #: 202
Figure: 3

Beam Tilt 0
Gain (Max) 3.165 5.004 dB
Gain (Horizon) 3.165 5.004 dB

Date: 3/13/2009

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	0.729	0	1.000	46	0.705
-89	0.021	-43	0.741	1	1.000	47	0.693
-88	0.040	-42	0.752	2	0.999	48	0.680
-87	0.059	-41	0.763	3	0.999	49	0.667
-86	0.078	-40	0.774	4	0.998	50	0.654
-85	0.096	-39	0.785	5	0.996	51	0.641
-84	0.114	-38	0.796	6	0.995	52	0.628
-83	0.133	-37	0.806	7	0.993	53	0.614
-82	0.151	-36	0.816	8	0.991	54	0.600
-81	0.168	-35	0.826	9	0.988	55	0.586
-80	0.186	-34	0.835	10	0.985	56	0.572
-79	0.204	-33	0.845	11	0.982	57	0.558
-78	0.221	-32	0.854	12	0.979	58	0.544
-77	0.239	-31	0.862	13	0.975	59	0.529
-76	0.256	-30	0.871	14	0.971	60	0.514
-75	0.273	-29	0.879	15	0.967	61	0.499
-74	0.290	-28	0.887	16	0.963	62	0.484
-73	0.307	-27	0.895	17	0.958	63	0.469
-72	0.324	-26	0.903	18	0.953	64	0.453
-71	0.341	-25	0.910	19	0.948	65	0.437
-70	0.357	-24	0.917	20	0.942	66	0.422
-69	0.373	-23	0.924	21	0.936	67	0.406
-68	0.390	-22	0.930	22	0.930	68	0.390
-67	0.406	-21	0.936	23	0.924	69	0.373
-66	0.422	-20	0.942	24	0.917	70	0.357
-65	0.437	-19	0.948	25	0.910	71	0.341
-64	0.453	-18	0.953	26	0.903	72	0.324
-63	0.469	-17	0.958	27	0.895	73	0.307
-62	0.484	-16	0.963	28	0.887	74	0.290
-61	0.499	-15	0.967	29	0.879	75	0.273
-60	0.514	-14	0.971	30	0.871	76	0.256
-59	0.529	-13	0.975	31	0.862	77	0.239
-58	0.544	-12	0.979	32	0.854	78	0.221
-57	0.558	-11	0.982	33	0.845	79	0.204
-56	0.572	-10	0.985	34	0.835	80	0.186
-55	0.586	-9	0.988	35	0.826	81	0.168
-54	0.600	-8	0.991	36	0.816	82	0.151
-53	0.614	-7	0.993	37	0.806	83	0.133
-52	0.628	-6	0.995	38	0.796	84	0.114
-51	0.641	-5	0.996	39	0.785	85	0.096
-50	0.654	-4	0.998	40	0.774	86	0.078
-49	0.667	-3	0.999	41	0.763	87	0.059
-48	0.680	-2	0.999	42	0.752	88	0.040
-47	0.693	-1	1.000	43	0.741	89	0.021
-46	0.705	0	1.000	44	0.729	90	0.000
-45	0.717			45	0.717		

S.O. 27344 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WASU-FM 90.5 MHz Boone, NC

Scala CA5-FM/RM

Elevation Gain of Antenna 0.509

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

H RMS	0.403	V RMS	0.399	H/V Ratio	1.010

Elevation Gain of Horizontal Component 0.514

Elevation Gain of Vertical Component 0.504

Horizontal Azimuth Gain equals $1/(RMS)^2$. 6.157

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 5.328
Max. Vertical 0.921

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

Total Horizontal Power Gain = **3.165**

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

Total Vertical Power Gain = **2.685**

==========

ERP divided by Horizontal Power Gain equals Antenna Input Power

0.14	kW ERP	Divided by H Gain	3.165	equals	0.04	kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

0.044	kW	Times V Gain	2.685	equals	0.119	kW V ERP

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

(0.921)^2	Times	0.14	Equals	0.119	kW Vertical ERP

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