Shively Labs
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S.O. 24458

Report of Test 2 x YA7-FM Scala Yagis

for

CSN INTERNATIONAL

KYWH 88.9 MHz LOCKWOOD, MT

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of 2 x YA7-FM Scala Yagis to meet the needs of KYWH and to comply with the requirements of the FCC construction permit, file number BMPED-20051123AKX.

RESULTS:

The measured azimuth pattern for the 2 x YA7-FM Scala Yagis 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 BMPED-20051123AKX indicates that the Vertical radiation component shall not exceed 1.90 kW at any azimuth and is restricted to the following values at the azimuths specified:

170 Degrees T: 0.081 kW
180 - 10 Degrees T: 0.081 kW

From Figure 1, the maximum radiation of the Vertical component occurs at 090 Degrees T. At the restricted azimuth of 170 Degrees T the Vertical component is 20.0 dB down from the maximum of 1.90 kW, or 0.019 kW. At the restricted azimuth of 180 - 10 Degrees T the Vertical component is 20.0 dB down from the maximum of 1.90 kW, or 0.019 kW.

The R.M.S. of the Vertical component is 0.356. The total Vertical power gain is 8.174. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.417. The R.M.S. of the measured composite pattern is 0.356. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.354. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

The 2 x YA7-FM Scala Yagis were mounted on a tower of exact scale to a Magnum-24 tower at the KYWH site. The spacing of the antennas 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 BMPED-20051123AKX, a single level of the 2 x YA7-FM Scala Yagis 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 400.05 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 24458
December 27, 2005

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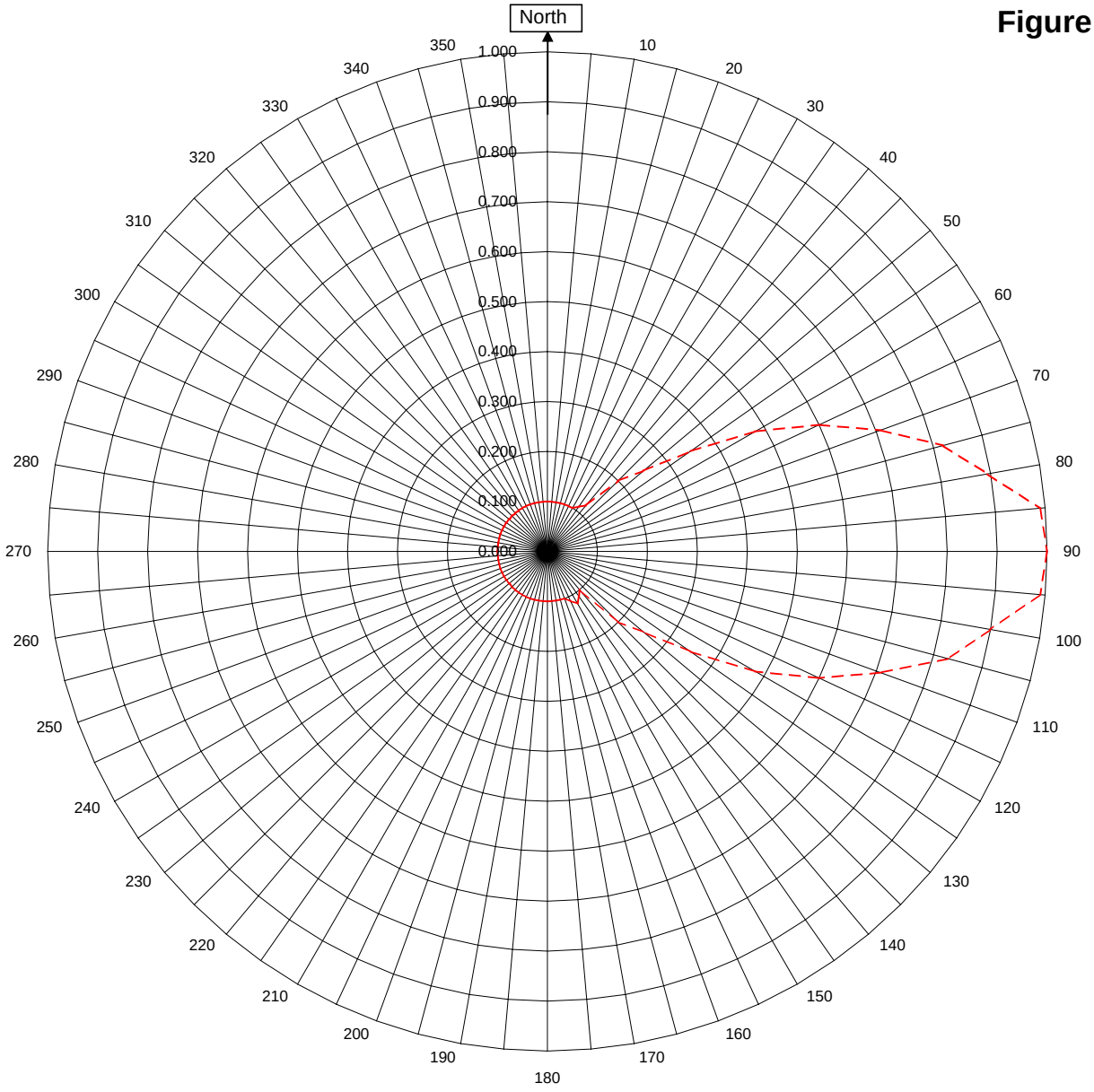
Figure 1



KYWH
Lockwood, MT

24458

December 28, 2005

Horizontal RMS	0.000
Vertical RMS	0.356
H/V Composite RMS	0.356

Frequency	88.9 / 400.05 mHz
Plot	Relative Field
Scale	4.5 : 1

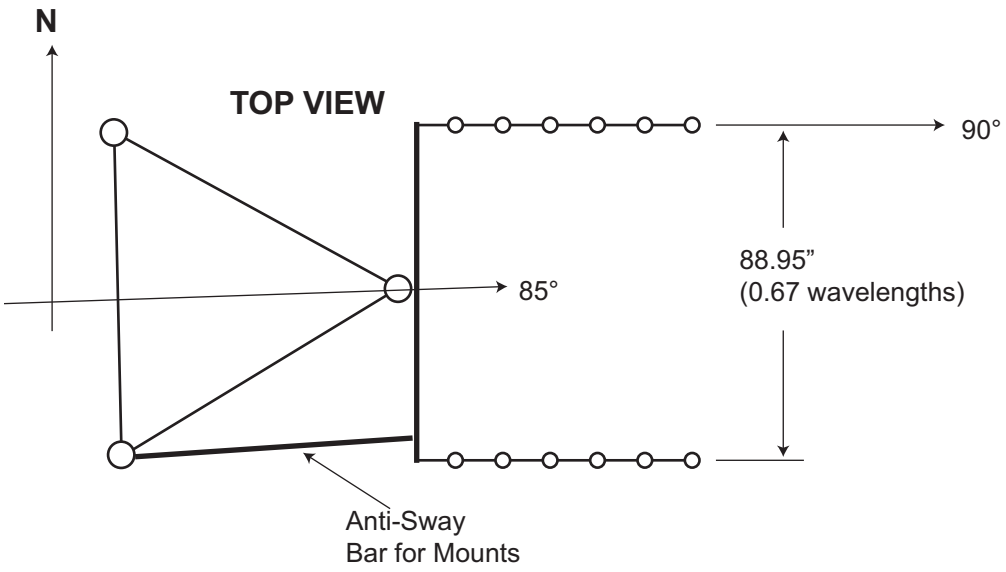
Antenna Model	2 x YA7-FM Scala Yagis
Pattern Type	Directional Azimuth

See Figure 2 for Mechanical Details

Figure 1a

Tabulation of Vertical Azimuth Pattern
KYWH Lockwood, MT

Azimuth	Rel Field	Azimuth	Rel Field
0	0.100	180	0.100
10	0.100	190	0.100
20	0.100	200	0.100
30	0.100	210	0.100
40	0.120	220	0.100
45	0.200	225	0.100
50	0.250	230	0.100
60	0.480	240	0.100
70	0.710	250	0.100
80	0.895	260	0.100
90	1.000	270	0.100
100	0.900	280	0.100
110	0.710	290	0.100
120	0.480	300	0.100
130	0.250	310	0.100
135	0.200	315	0.100
140	0.100	320	0.100
150	0.120	330	0.100
160	0.100	340	0.100
170	0.100	350	0.100



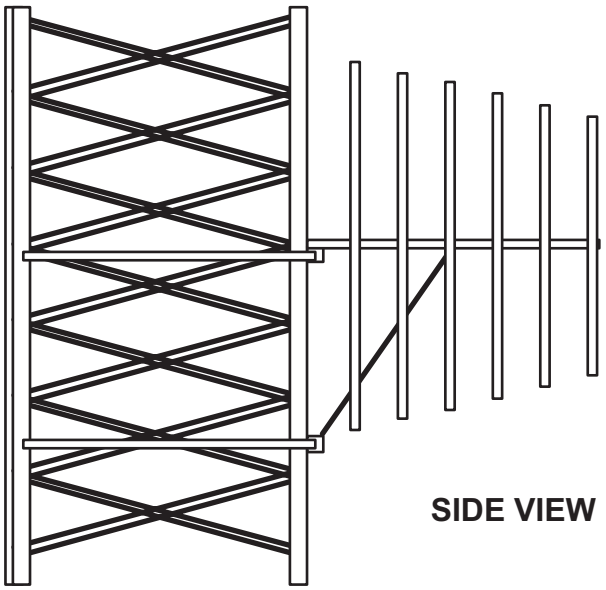


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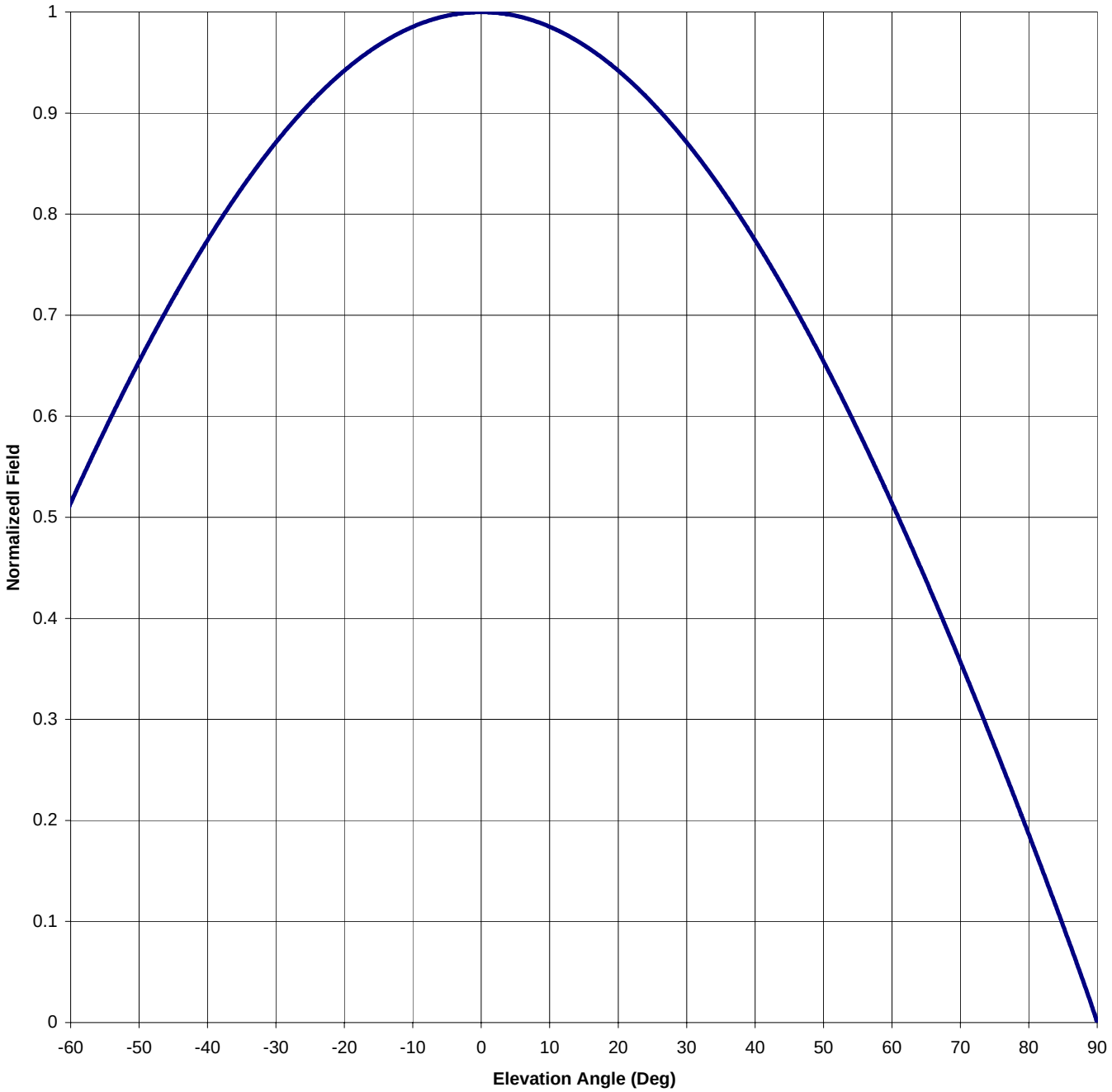
Figure 2

SIZE	CODE IDENT NO.	DRAWING NO.	REV
C	22501	AGF051228-001	
SCALE NONE	S/O 24458	SHEET 1 of 1	

Antenna Mfg.:	**Shively Labs**			**Date: 1/16/2006**
Antenna Type:	**2 x YA7-FM Scala Yagis**			
Station:	**KYWH**	**Beam Tilt**	**0**	
Frequency:	**88.9**	**Gain (Max)**	**8.174**	**9.124 dB**
Channel #:	**205**	**Gain (Horizon)**	**8.174**	**9.124 dB**
Figure:	**3**			



Antenna Mfg.: Shively Labs **Date:** 1/16/2006

Antenna Type: 2 x YA7-FM Scala Yagis

Station: KYWH **Beam Tilt** 0

Frequency: 88.9 **Gain (Max)** 8.174 9.124 dB

Channel #: 205 **Gain (Horizon)** 8.174 9.124 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	0.729	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		

FIGURE 4

S.O. 24458

VALIDATION OF GAIN CALCULATION

KYWH 88.9 MHz LOCKWOOD, MT

2 x YA7-FM Scala Yagis

Elevation Gain of **2 x YA7-FM Scala Yagis** equals 1.036

Vertical Azimuth Gain equals $1/(RMS)^2$
$1/(0.356)^2 = 7.89$

*** Total Vertical Gain is Elevation Gain times Azimuth Gain**
1.036 x 7.89 = 8.174

ERP divided by Vertical Gain equals Antenna Input Power
1.90 kW ÷ 8.174 = 0.232 kW