ShivelyLabs
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S.O. 27520

Report of Test CA5-FM/CP/RM Yagi

for

Educational Public Radio, Inc

KLSI 89.3 MHz Moss Beach, CA

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a CA5-FM/CP/RM to meet the needs of KLSI and to comply with the requirements of the FCC construction permit, file number BMPED-20080618APB.

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 BMPED-20080618APB indicates that the Horizontal radiation component shall not exceed 0.043 kW at any azimuth and is restricted to the following values at the azimuths specified:

73 - 93 Degrees T: 0.00135 kW

From Figure 1A, the maximum radiation of the Horizontal component occurs at 264 Degrees T to 276 Degrees T. At the restricted azimuth of 73 - 93 Degrees T the Horizontal component is 15.24 dB down from the maximum of 0.043 kW, or 0.00129 kW.

The R.M.S. of the Horizontal component is 0.433. The total Horizontal power gain is 2.715. The R.M.S. of the Vertical component is 0.433. The total Vertical power gain is 2.450. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.523. The R.M.S. of the measured composite pattern is 0.455. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.445. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the CA5-FM/CP/RM was mounted on a pole of precise scale to the 2 3/8 inch OD pole attached to a wooden telephone pole at the KLSI site. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BMPED-20080618APB, a single level of the CA5-FM/CP/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 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 1A.

Respectfully submitted by:

Robert A. Surette
Director of Sales Engineering
S/O 27520
Date: May 14, 2009

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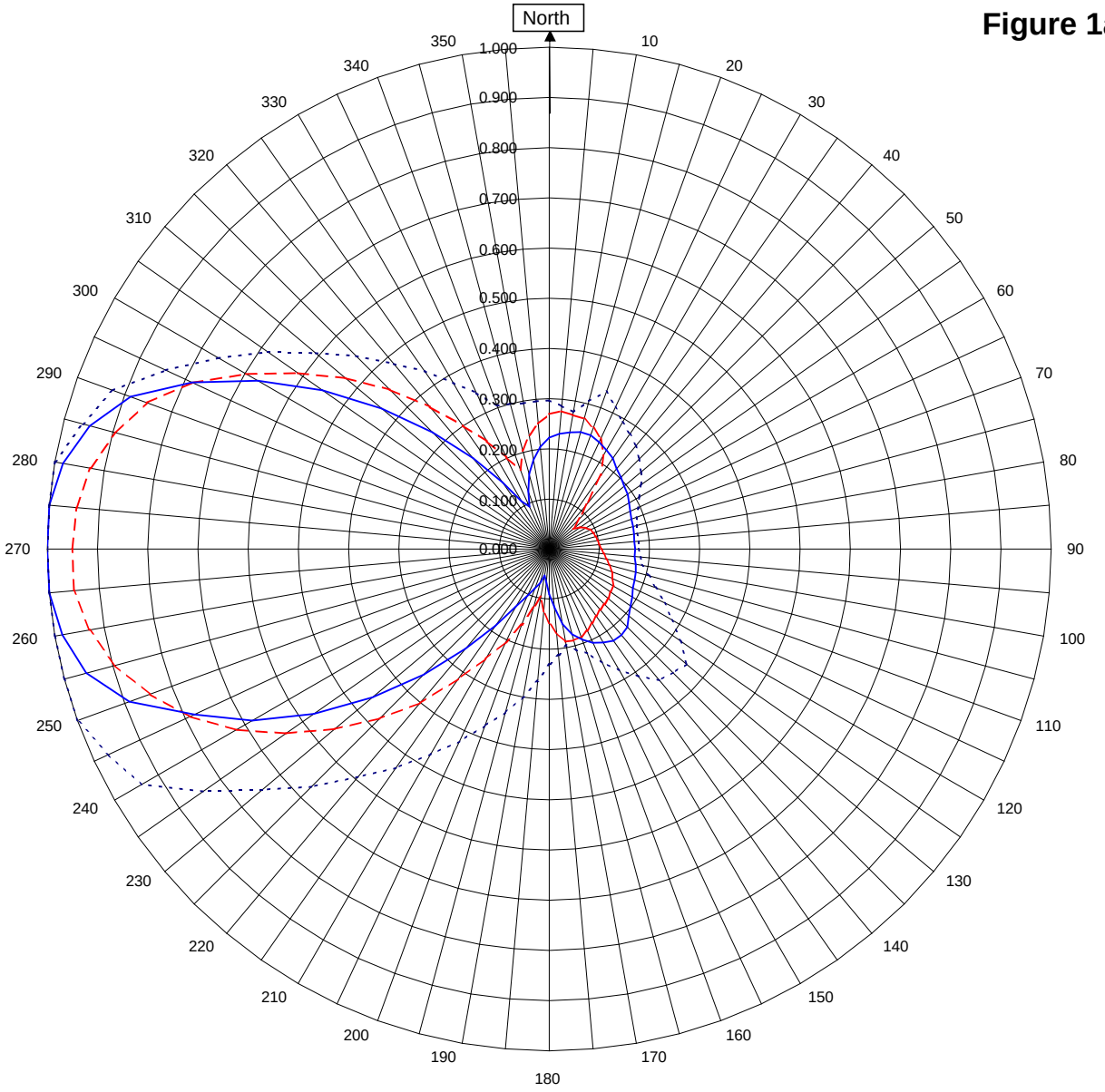
Figure 1a



KLSI Moss Beach, CA

27520

May 12, 2009

Horizontal RMS	0.433
Vertical RMS	0.433
H/V Composite RMS	0.455
FCC Composite RMS	0.523

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

Antenna Model	CA5-FM/CP/RM
Pattern Type	Directional Azimuth

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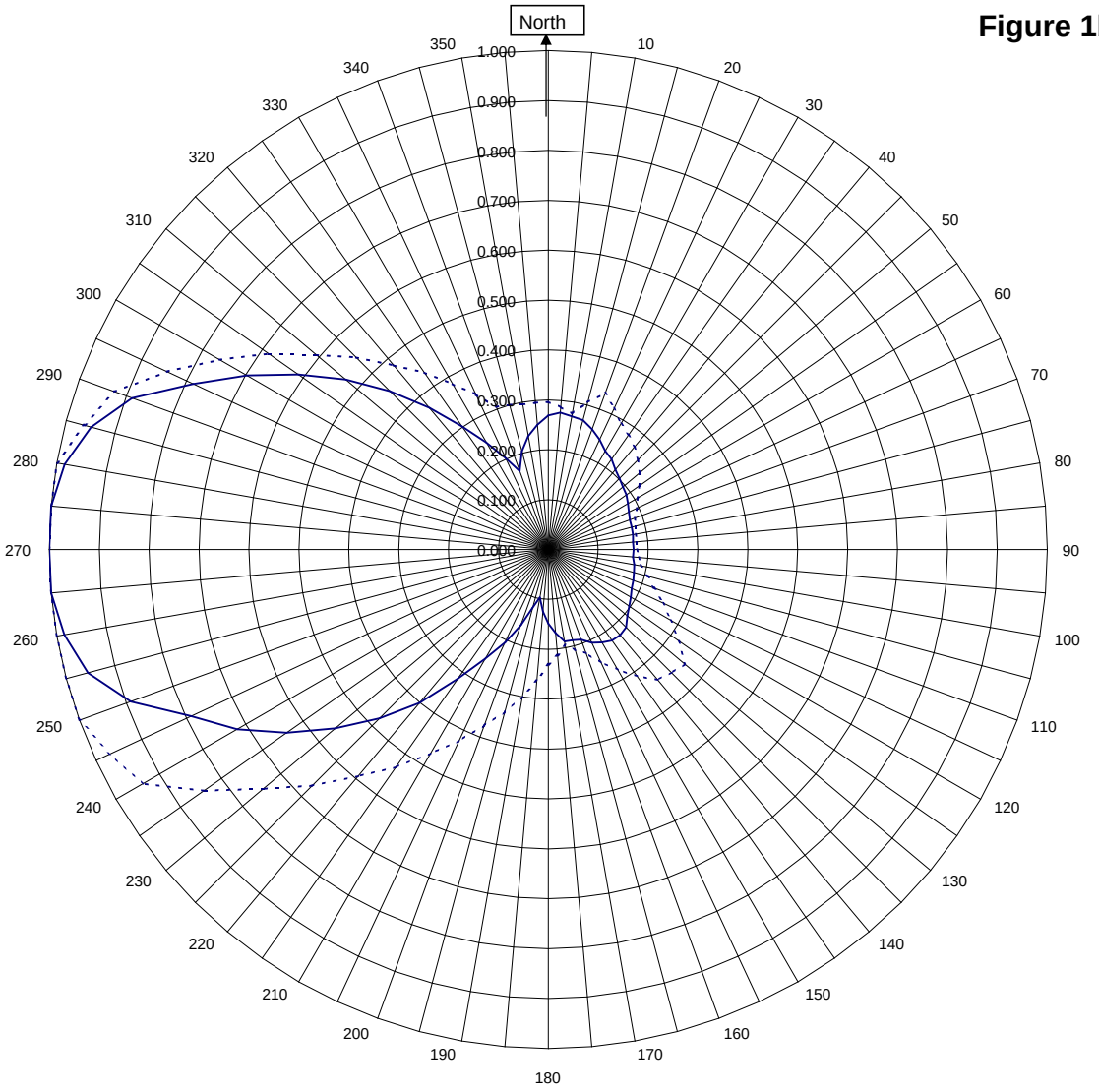
Figure 1b



KLSI Moss Beach, CA

27520

May 12, 2009

_____H/VComposite RMS	0.455
……FCC Composite RMS	0.523

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

Antenna Model	CA5-FM/CP/RM
Pattern Type	Directional H/V Composite

Figure 1c

Tabulation of Horizontal Azimuth Pattern
KLSI Moss Beach, CA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.222	180	0.090
10	0.236	190	0.053
20	0.241	200	0.084
30	0.228	210	0.132
40	0.209	220	0.259
45	0.202	225	0.354
50	0.195	230	0.460
60	0.184	240	0.683
70	0.174	250	0.890
80	0.172	260	0.985
90	0.171	270	1.000
100	0.175	280	0.984
110	0.181	290	0.888
120	0.191	300	0.670
130	0.207	310	0.435
135	0.220	315	0.329
140	0.224	320	0.236
150	0.215	330	0.110
160	0.192	340	0.122
170	0.152	350	0.181

Figure 1d

Tabulation of Vertical Azimuth Pattern
KLSI Moss Beach, CA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.269	180	0.148
10	0.271	190	0.097
20	0.257	200	0.161
30	0.216	210	0.253
40	0.116	220	0.401
45	0.085	225	0.478
50	0.062	230	0.558
60	0.084	240	0.720
70	0.094	250	0.846
80	0.098	260	0.930
90	0.104	270	0.950
100	0.116	280	0.928
110	0.133	290	0.853
120	0.148	300	0.697
130	0.154	310	0.530
135	0.155	315	0.449
140	0.158	320	0.370
150	0.171	330	0.248
160	0.186	340	0.167
170	0.187	350	0.231

Figure 1e

Tabulation of Composite Azimuth Pattern
KLSI Moss Beach, CA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.269	180	0.148
10	0.271	190	0.097
20	0.257	200	0.161
30	0.228	210	0.253
40	0.209	220	0.401
45	0.202	225	0.478
50	0.195	230	0.558
60	0.184	240	0.720
70	0.174	250	0.890
80	0.172	260	0.985
90	0.171	270	1.000
100	0.175	280	0.984
110	0.181	290	0.888
120	0.191	300	0.697
130	0.207	310	0.530
135	0.220	315	0.449
140	0.224	320	0.370
150	0.215	330	0.248
160	0.192	340	0.167
170	0.187	350	0.231

Figure 1f

Tabulation of FCC Directional Composite
KLSI Moss Beach, CA

Azimuth	Rel Field	Azimuth	Rel Field
0	0.296	180	0.230
10	0.277	190	0.299
20	0.334	200	0.375
30	0.291	210	0.472
40	0.269	220	0.593
50	0.239	230	0.746
60	0.207	240	0.938
70	0.185	250	1.000
80	0.178	260	1.000
90	0.178	270	1.000
100	0.187	280	1.000
110	0.225	290	0.925
120	0.283	300	0.761
130	0.357	310	0.607
140	0.341	320	0.482
150	0.278	330	0.383
160	0.221	340	0.304
170	0.195	350	0.295

REV NO	REVISON	DATE	APP'D

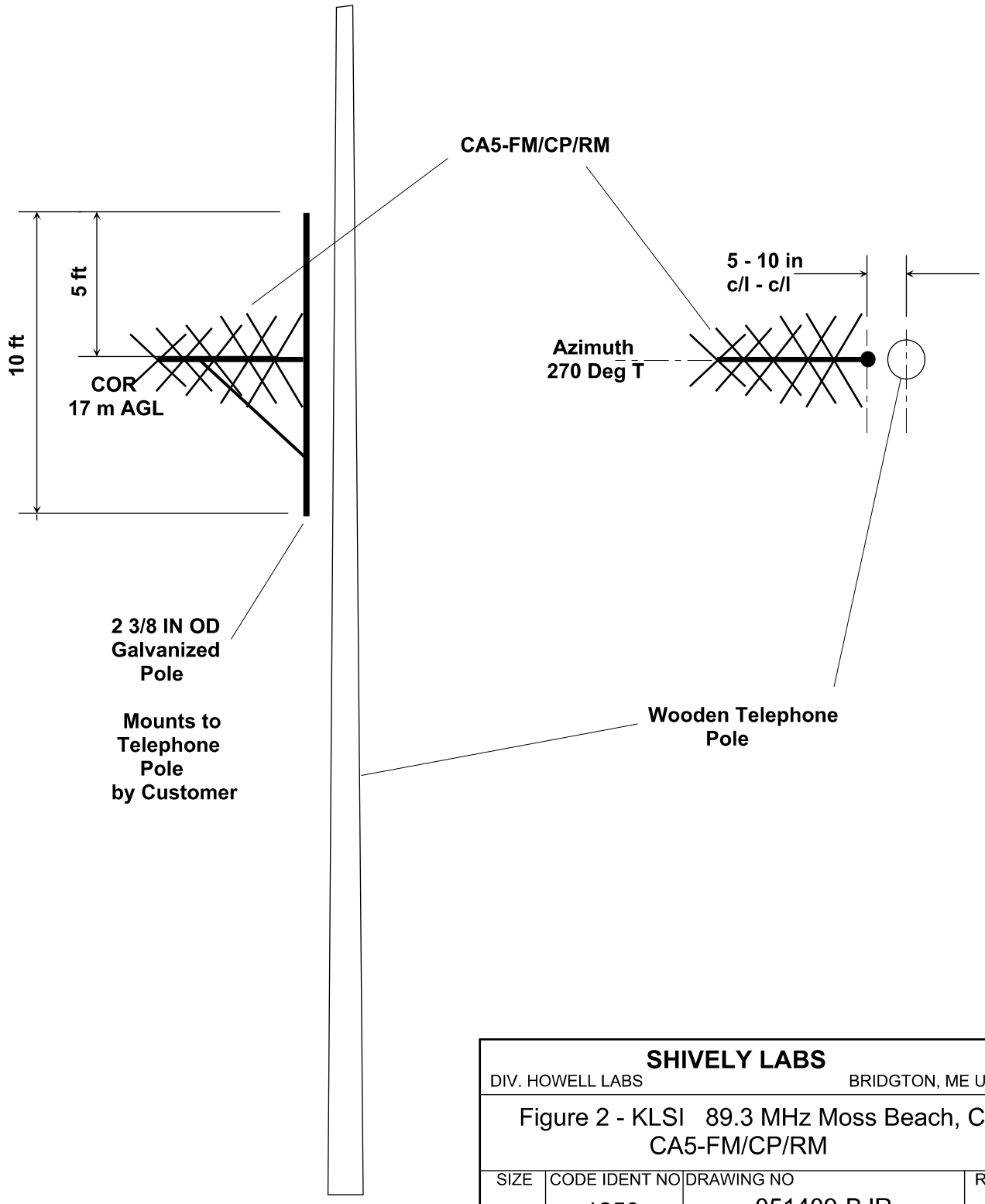


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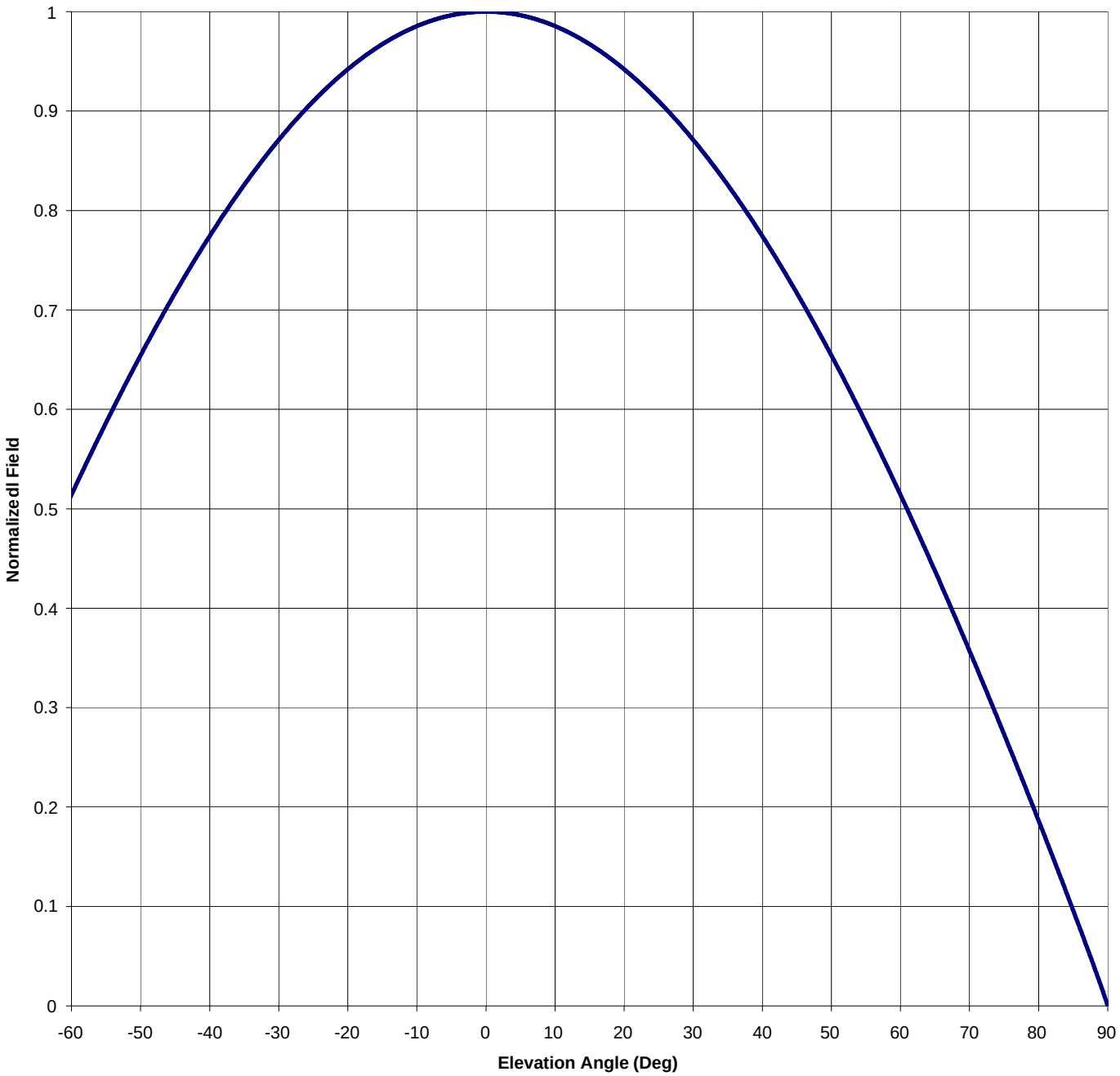
Figure 2 - KLSI 89.3 MHz Moss Beach, CA
CA5-FM/CP/RM

SIZE	CODE IDENT NO	DRAWING NO	REV
A	1250	051409-BJR	---

SCALE		SHEET
NONE	SO 27520	1 of 1

Antenna Mfg.:	**Shively Labs**			**Date: 5/14/2009**
Antenna Type:	**CA5-FM/CP/RM**			
Station:	**KLSI**	**Beam Til**	**0**	
Frequency:	**89.3**	**Gain (Max)**	**2.715**	**4.337 dB**
Channel #:	**207**	**Gain (Horizon)**	**2.715**	**4.337 dB**
Figure:	**3**			



Antenna Mfg.: Shively Labs **Date:** 5/14/2009

Antenna Type: CA5-FM/CP/RM

Station: KLSI **Beam Tilt** 0

Frequency: 89.3 **Gain (Max)** 2.715 4.337 dB

Channel #: 207 **Gain (Horizon)** 2.715 4.337 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		

S.O. 27520 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

KLSI Moss Beach, CA

CA5-FM/CP/RM

Elevation Gain of Antenna 0.509

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

H RMS	0.433	V RMS	0.433	H/V Ratio	1.000

Elevation Gain of Horizontal Component 0.509

Elevation Gain of Vertical Component 0.509

Horizontal Azimuth Gain equals $1/(RMS)^2$. 5.334

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 4.814

Max. Vertical 0.950

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

Total Horizontal Power Gain = **2.715**

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

Total Vertical Power Gain = **2.450**

==========

ERP divided by Horizontal Power Gain equals Antenna Input Power

0.043	kW ERP	Divided by H Gain	2.715	equals	0.02	kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

0.02	kW	Times V Gain	2.450	equals	0.04	kW V ERP

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

(0.95)^2	Times	0.04	Equals	0.04	kW Vertical ERP

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