

S.O. 33872

Report of Test: Scala CL-FM-2 (VRM/50 & HRM/50)-DA

for

WASATCH PUBLIC MEDIA

KCPW-FM 88.3 MHz SALT LAKE CITY, UT.

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a Scala CL-FM-2 (VRM/50 & HRM/50)-DA to meet the needs of KCPW-FM and to comply with the requirements of the FCC construction permit, file number BMPED-20160330ATI. This test characterizes only the radiation characteristics of the antenna when mounted on the tower as described. It does not represent or imply any guarantee of specific coverage which can be influenced by factors beyond the scope of this test.

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-20160330ATI indicates that the Horizontal radiation component shall not exceed .45 kW at any azimuth and is restricted to the following values at the azimuths specified:

215 – 305 Degrees True: 0.028 kilowatts

From Figure 1A, the maximum radiation of the Horizontal component occurs at 73 Degrees True to 77 Degrees True. At the restricted azimuth of 215 to 305 Degrees True the Horizontal component is 17.92 dB down from the maximum of 0.45 kW, or 0.007

The R.M.S. of the Horizontal component is 0.433. The total Horizontal power gain is 2.801. The R.M.S. of the Vertical component is 0.453. The total Vertical power gain is 2.641. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.514. The R.M.S. of the measured composite pattern is 0.461. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.437. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One level of the Scala CL-FM (VRM/50 & HRM/50)-DA was mounted on a tower of precise scale to the Ronh-55 tower at the KCPW site. Both Scala CL-FM's were positioned on the tower, at the same azimuth, with the CL-FM HRM one wave-length above the CL-FM VRM. A two way equal power split was used, having equal phase and amplitude to each CL-FM. The spacing of the antenna to the tower was varied to achieve the horizontal and vertical pattern shown in Figure 1A. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BMPED-20160330ATI, a single level of the Scala CL-FM (VRM/50 & HRM/50)-DA was set up on the Shively Labs scale model antenna pattern measuring range. A scale of 4.5:1 was used.

EQUIPMENT:

The 4.5:1 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 4395-A Network Analyzer

PC Based Controller

Output Standard Printer or 'pdf'

All testing is carried out in strict accordance with approved procedures under our ISO9001:2008.

TEST PROCEDURES:

The receiving antenna system is mounted so that the horizontal and vertical azimuth patterns are measured independently. The network analyzer was set to 397.35 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:

A handwritten signature in blue ink, appearing to read 'Martyn Gregory', with a stylized, flowing script.

Martyn Gregory

Vice President, Shively Labs

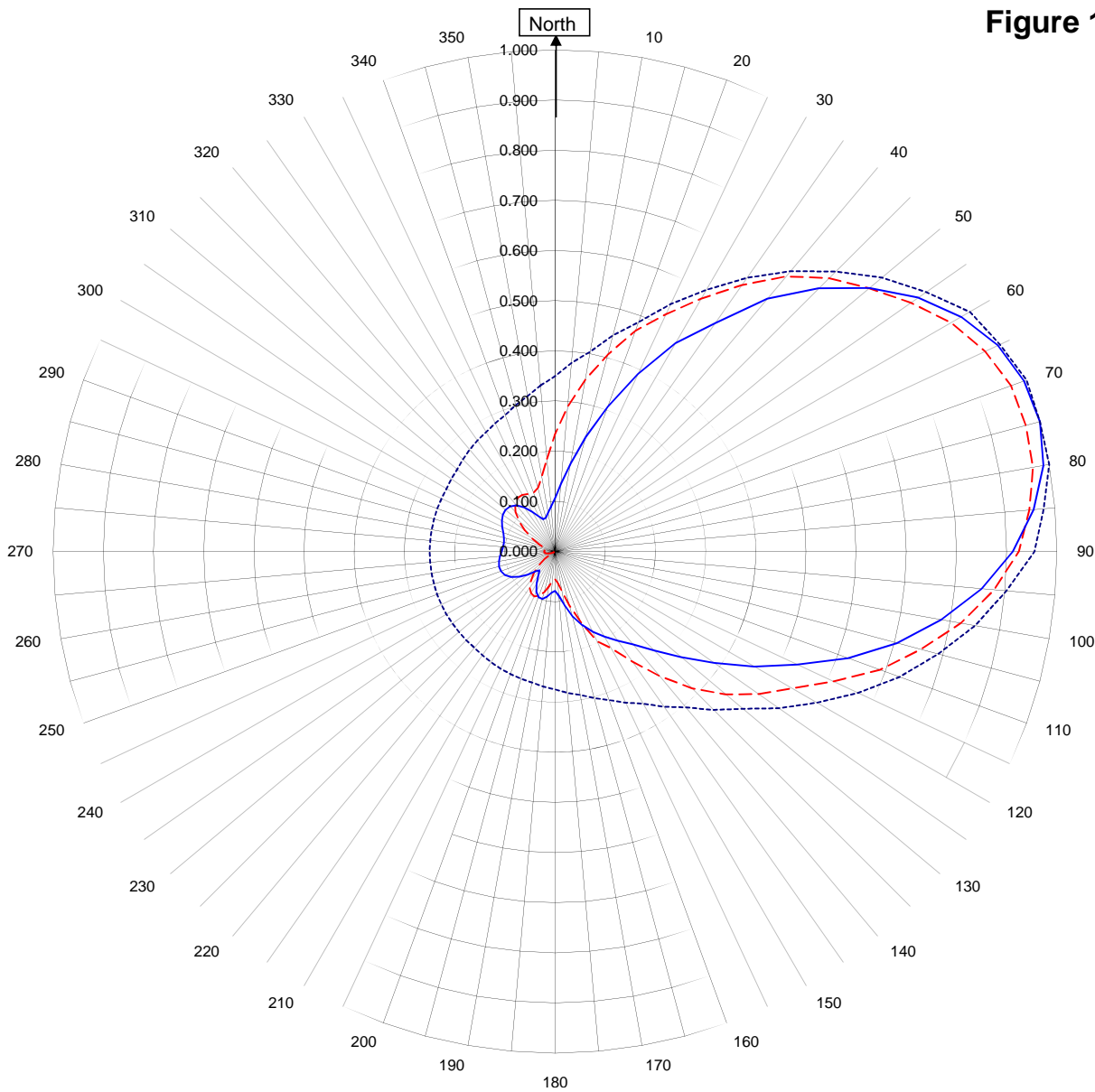
S/O 33872

Date August 16, 2016

Shively Labs

Shively Labs, a division of Howell Laboratories, Inc. Bridgton, ME (207)647-3327

Figure 1A



KCPW SALT LAKE CITY, UT.
33872
August 16, 2016

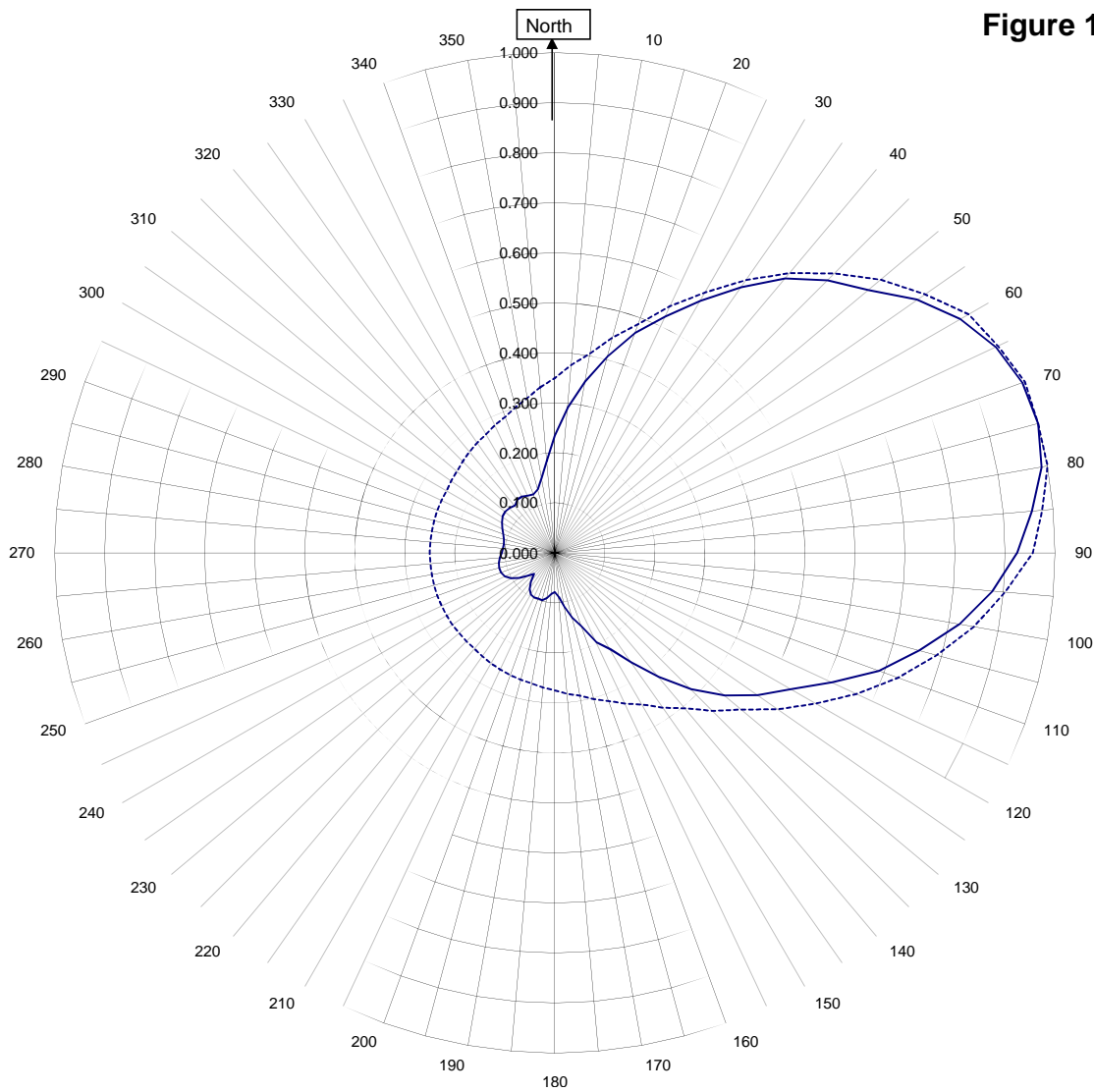
Horizontal RMS	0.433	Frequency	88.3 / 397.35 MHz
Vertical RMS	0.453	Plot	Relative Field
H/V Composite RMS	0.461	Scale	4.5 : 1
FCC Composite RMS	0.514	See Figure 2 for Mechanical Details	

Antenna Model	Scala CL-FM (VRM-50 & HRM-50)
Pattern Type	Directional Azimuth

Shively Labs

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Figure 1B



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33872
August 16, 2016

—————H/V Composite RMS	0.461
.....FCC Composite RMS	0.514

Frequency	88.3 / 397.35 mHz
Plot	Relative Field
Scale	4.5 : 1
See Figure 2 for Mechanical Details	

Antenna Model	Scala CL-FM (VRM-50 & HRM-50)
Pattern Type	Directional H/V Composite

Tabulation of Horizontal Azimuth Pattern

KCPW SALT LAKE CITY, UT.

		Azimuth	Rel Field	Azimuth	Rel Field
		0	0.107	180	0.078
		10	0.179	190	0.091
		20	0.307	200	0.097
		30	0.480	210	0.074
		40	0.658	220	0.049
		45	0.742	225	0.055
		50	0.818	230	0.071
		60	0.935	240	0.101
		70	0.995	250	0.115
		80	0.988	260	0.114
Additional		90	0.912	270	0.107
azimuths		100	0.781	280	0.104
65	0.973	110	0.621	290	0.110
85	0.957	120	0.459	300	0.122
		130	0.327	310	0.129
		135	0.279	315	0.127
		140	0.241	320	0.120
		150	0.195	330	0.092
		160	0.156	340	0.069
		170	0.109	350	0.079

Figure 1D

Tabulation of Vertical Azimuth Pattern
KCPW SALT LAKE CITY, UT.

		Azimuth	Rel Field	Azimuth	Rel Field
		0	0.235	180	0.055
		10	0.348	190	0.070
		20	0.469	200	0.093
		30	0.582	210	0.096
		40	0.716	220	0.075
		45	0.771	225	0.059
		50	0.817	230	0.042
		60	0.912	240	0.012
		70	0.967	250	0.009
		80	0.967	260	0.019
		90	0.924	270	0.022
		100	0.821	280	0.020
		110	0.689	290	0.024
		120	0.545	300	0.053
		130	0.443	310	0.093
		135	0.385	315	0.112
		140	0.323	320	0.124
		150	0.222	330	0.131
		160	0.150	340	0.125
		170	0.082	350	0.152

Additional			
azimuths:			
65	0.945		
85	0.948		

Figure 1E

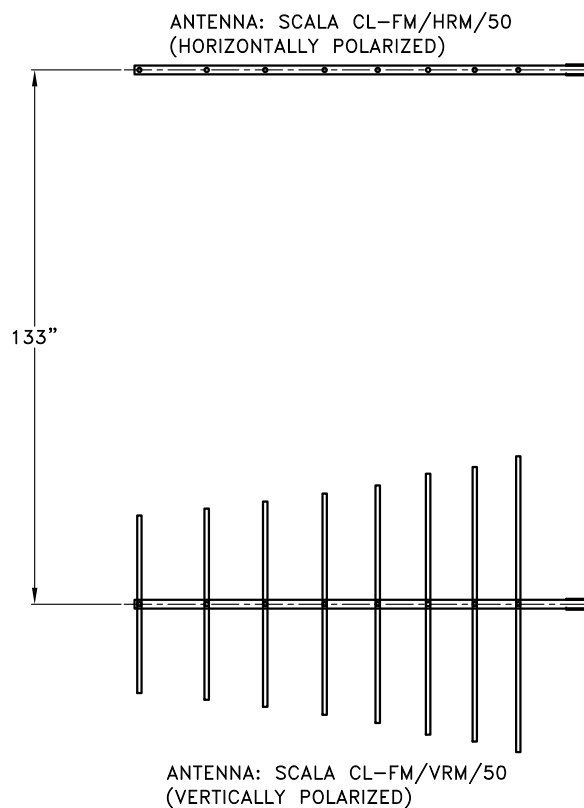
Tabulation of Composite Azimuth Pattern
KCPW SALT LAKE CITY, UT.

		Azimuth	Rel Field	Azimuth	Rel Field
		0	0.235	180	0.078
		10	0.348	190	0.091
		20	0.469	200	0.097
		30	0.582	210	0.096
		40	0.716	220	0.075
		45	0.771	225	0.059
		50	0.818	230	0.071
		60	0.935	240	0.101
		70	0.995	250	0.115
		80	0.988	260	0.114
		90	0.924	270	0.107
Additional		100	0.821	280	0.104
azimuths:		110	0.689	290	0.110
65	0.973	120	0.545	300	0.122
85	0.957	130	0.443	310	0.129
		135	0.385	315	0.127
		140	0.323	320	0.124
		150	0.222	330	0.131
		160	0.156	340	0.125
		170	0.109	350	0.152

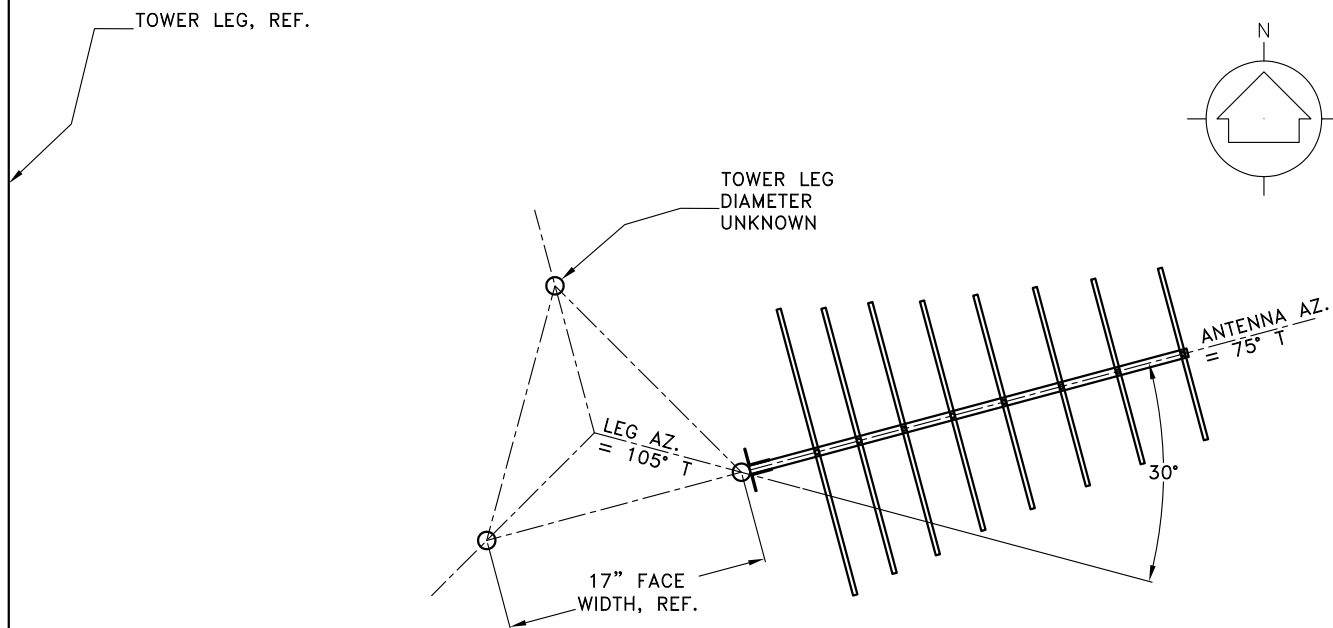
Figure 1F

Tabulation of FCC Directional Composite
KCPW SALT LAKE CITY, UT.

		Azimuth	Rel Field	Azimuth	Rel Field
		0	0.350	180	0.275
		10	0.405	190	0.265
		20	0.487	200	0.260
		30	0.602	210	0.255
		40	0.730	220	0.250
		50	0.850	230	0.250
		60	0.955	240	0.250
		70	1.000	250	0.250
		80	1.000	260	0.250
Additional		90	0.955	270	0.250
azimuths:		100	0.850	280	0.250
65	1.000	110	0.730	290	0.250
85	1.000	120	0.602	300	0.250
		130	0.487	310	0.255
		140	0.405	320	0.265
		150	0.350	330	0.275
		160	0.315	340	0.290
		170	0.290	350	0.315



ELEVATION VIEW



TOP VIEW

TOWER MAKE:
ROHN 55

SHIVELY LABS A DIVISION OF HOWELL LABORATORIES INC., BRIDGTON, MAINE			
SHOP ORDER: 33872-1	FREQUENCY: 88.3 MHz	SCALE: N.T.S.	DRAWN BY: ASP
APPROVED BY:			
TITLE: SCALA LOG PERIODIC ANTENNA SYSTEM			
DATE: 8-16-16	FIGURE 2		

Antenna Mfg.: Shively Labs
Antenna Type: Scala CLFM (V&H RM)

Date: 8/17/2016

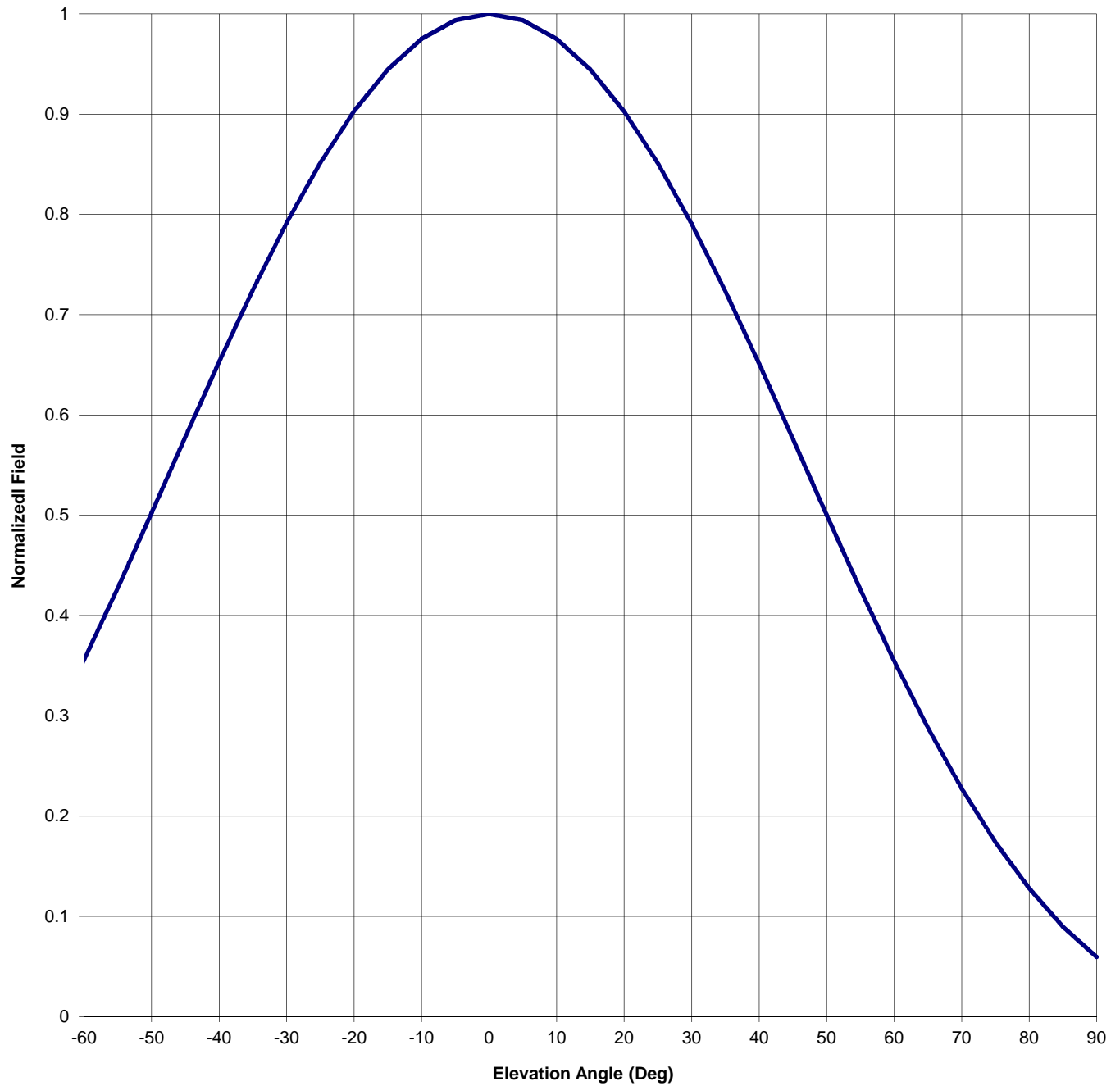
Station: KCPW-FM

Frequency: 88.3

Channel #: 202

Figure: Figure 3

Beam Tilt	0	
Gain (Max)	2.801	4.473 dB
Gain (Horizon)	2.801	4.473 dB



Antenna Mfg.: Shively Labs
 Antenna Type: Scala CLFM (V&H RM)

Date: 8/17/2016

Station: KCPW-FM

Beam Tilt 0

Frequency: 88.3

Gain (Max) 2.801

4.473 dB

Channel #: 202

Gain (Horizon) 2.801

4.473 dB

Figure: 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	0.059	-44	0.593	0	1.000	46	0.561
-89	0.066	-43	0.608	1	0.999	47	0.546
-88	0.072	-42	0.623	2	0.997	48	0.531
-87	0.078	-41	0.638	3	0.996	49	0.515
-86	0.084	-40	0.653	4	0.995	50	0.500
-85	0.090	-39	0.667	5	0.994	51	0.485
-84	0.097	-38	0.682	6	0.990	52	0.471
-83	0.105	-37	0.696	7	0.986	53	0.456
-82	0.113	-36	0.710	8	0.983	54	0.441
-81	0.120	-35	0.725	9	0.979	55	0.426
-80	0.128	-34	0.738	10	0.975	56	0.412
-79	0.137	-33	0.752	11	0.969	57	0.397
-78	0.146	-32	0.765	12	0.963	58	0.383
-77	0.156	-31	0.778	13	0.957	59	0.369
-76	0.165	-30	0.792	14	0.951	60	0.355
-75	0.174	-29	0.804	15	0.944	61	0.341
-74	0.185	-28	0.816	16	0.936	62	0.328
-73	0.196	-27	0.828	17	0.928	63	0.315
-72	0.206	-26	0.840	18	0.919	64	0.301
-71	0.217	-25	0.852	19	0.911	65	0.288
-70	0.228	-24	0.862	20	0.903	66	0.276
-69	0.240	-23	0.872	21	0.892	67	0.264
-68	0.252	-22	0.883	22	0.882	68	0.252
-67	0.265	-21	0.893	23	0.872	69	0.240
-66	0.277	-20	0.903	24	0.861	70	0.228
-65	0.289	-19	0.911	25	0.851	71	0.217
-64	0.302	-18	0.920	26	0.839	72	0.206
-63	0.316	-17	0.928	27	0.827	73	0.195
-62	0.329	-16	0.936	28	0.815	74	0.185
-61	0.343	-15	0.945	29	0.803	75	0.174
-60	0.356	-14	0.951	30	0.791	76	0.165
-59	0.370	-13	0.957	31	0.777	77	0.156
-58	0.385	-12	0.963	32	0.764	78	0.146
-57	0.399	-11	0.969	33	0.750	79	0.137
-56	0.413	-10	0.975	34	0.737	80	0.128
-55	0.428	-9	0.979	35	0.723	81	0.120
-54	0.443	-8	0.983	36	0.709	82	0.113
-53	0.458	-7	0.986	37	0.694	83	0.105
-52	0.473	-6	0.990	38	0.680	84	0.097
-51	0.487	-5	0.994	39	0.666	85	0.090
-50	0.502	-4	0.995	40	0.651	86	0.084
-49	0.518	-3	0.996	41	0.636	87	0.078
-48	0.533	-2	0.998	42	0.621	88	0.072
-47	0.548	-1	0.999	43	0.606	89	0.066
-46	0.563	0	1.000	44	0.591	90	0.059
-45	0.578			45	0.576		

VALIDATION OF TOTAL POWER GAIN CALCULATION

KCPW SALT LAKE CITY, UT.

MODEL Scala CL-FM (VRM-50 & HRM-50)

Elevation Gain of Antenna

0.55

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

H RMS 0.433036

V RMS 0.453476

H/V Ratio

0.955

Elevation Gain of Horizontal Component

0.525

Elevation Gain of Vertical Component

0.576

Horizontal Azimuth Gain equals $1/(\text{RMS})^2$.

5.333

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

4.575

Max. Vertical 0.97

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

Total Horizontal Power Gain =

2.801

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

Total Vertical Power Gain =

2.635

ERP divided by Horizontal Power Gain equals Antenna Input Power

0.45 kW ERP Divided by H Gain 2.801 equals 0.161 kW H Antenna Input Power

0.45 Kw ERP Divided by V Gain 2.635 equals 0.171 kW V Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

0.161 kW Times V Gain 2.635 equals 0.423 kW V ERP

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

(0.97)² Times 0.45 Equals 0.423 kW Vertical ERP

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