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S.O. 32974

Report of Test 6815-4-CF-SS(0.5)-DA

for

Louisiana State University

KLSU 91.1 MHz Baton Rouge, LA.

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6815-4-CF-SS(0.5)-DA to meet the needs of KLSU and to comply with the requirements of the FCC construction permit, file number BMPED-20141202AAN. 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-20141202AAN indicates that the Horizontal radiation component shall not exceed 23.0 kW at any azimuth and is restricted to the following values at the azimuths specified:

160 - 170 Degrees True: 0.920 kilowatts

200 - 210 Degrees True: 1.900 kilowatts

From Figure 1A, the maximum radiation of the Horizontal component occurs at 30 Degrees True to 35 Degrees True. At the restricted azimuth of 160 Degrees True to 170 Degrees True the Vertical component is 16.193 dB down from the maximum of 23 kW, or 0.553 kW and at the restricted azimuth of 200 Degrees True to 210 Degrees True the Horizontal component is 17.458 dB down from the maximum of 23 kW, or 0.413 kW.

The R.M.S. of the Horizontal component is 0.612. The total Horizontal power gain is 3.651. The R.M.S. of the Vertical component is 0.587. The total Vertical power gain is 3.274. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.648. The R.M.S. of the measured composite pattern is 0.614. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0551. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6815-4-CF-SS(0.5)-DA was mounted on a tower of precise scale to the Rohn-45 tower at the KLSU site. The spacing of the antenna to the tower was varied to achieve the vertical pattern shown in Figure 1A. Horizontal parasitic elements were placed ¼ of a wave length above and below the bays. The length of these horizontal parasitic elements were changed until the horizontal pattern shown in Figure 1A was achieved. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BMPED-20141202AAN, a single level of the 6815-4-CF-SS(0.5)-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

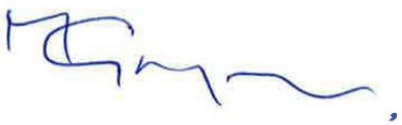
Output Standard Printer or 'pdf'

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 409.95 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:



Martyn Gregory

Vice President, Shively Labs
S/O 32974
Date October 29, 2015, 2015

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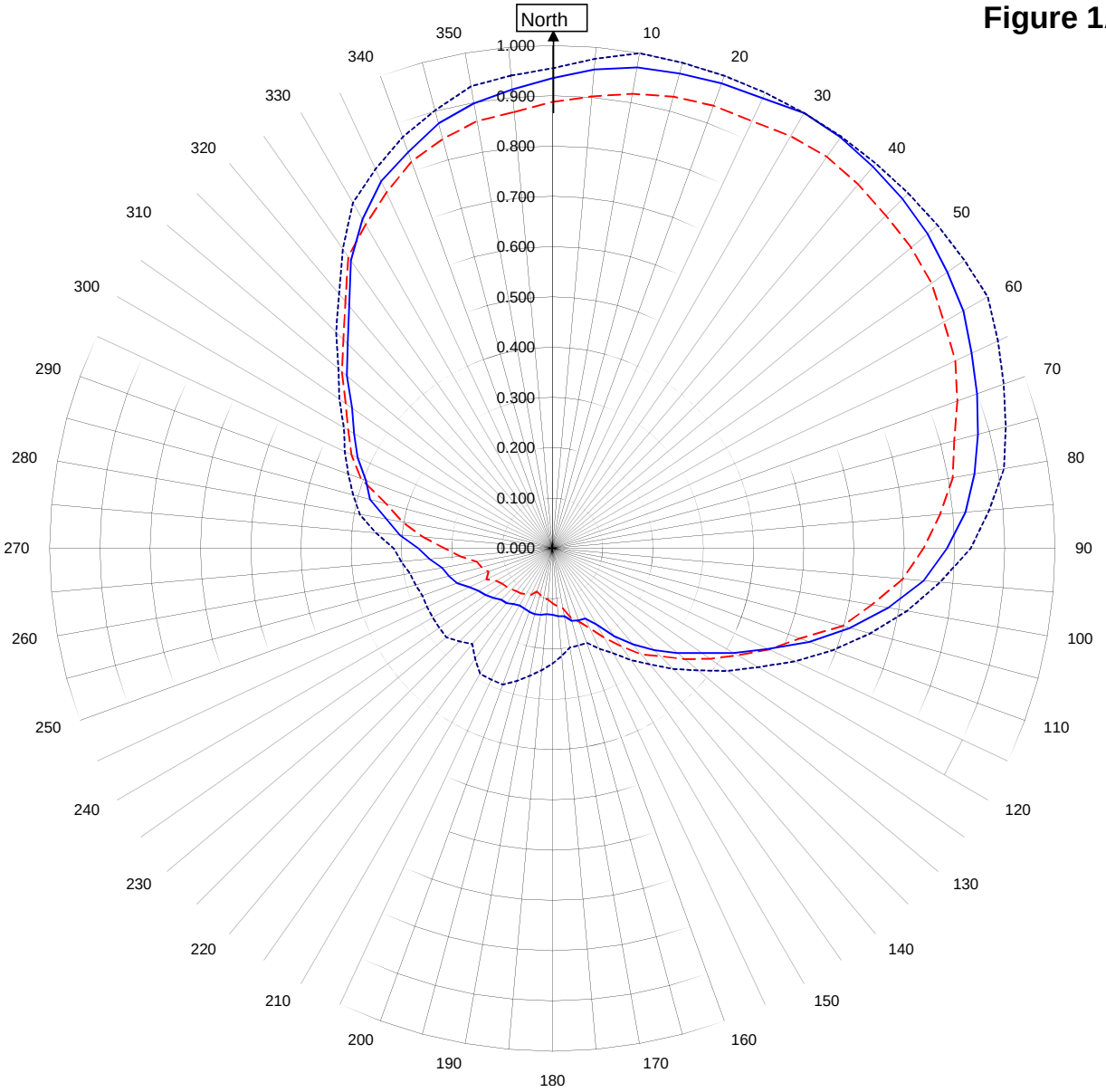
Figure 1A



KLSU BATON ROUGE, LA.

32974

October 15, 2015

Horizontal RMS	0.612
Vertical RMS	0.587
H/V Composite RMS	0.614
FCC Composite RMS	0.648

Frequency	91.1 / 409.95 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6815-4-CF-SS(0.5)-DA
Pattern Type	Directional Azimuth

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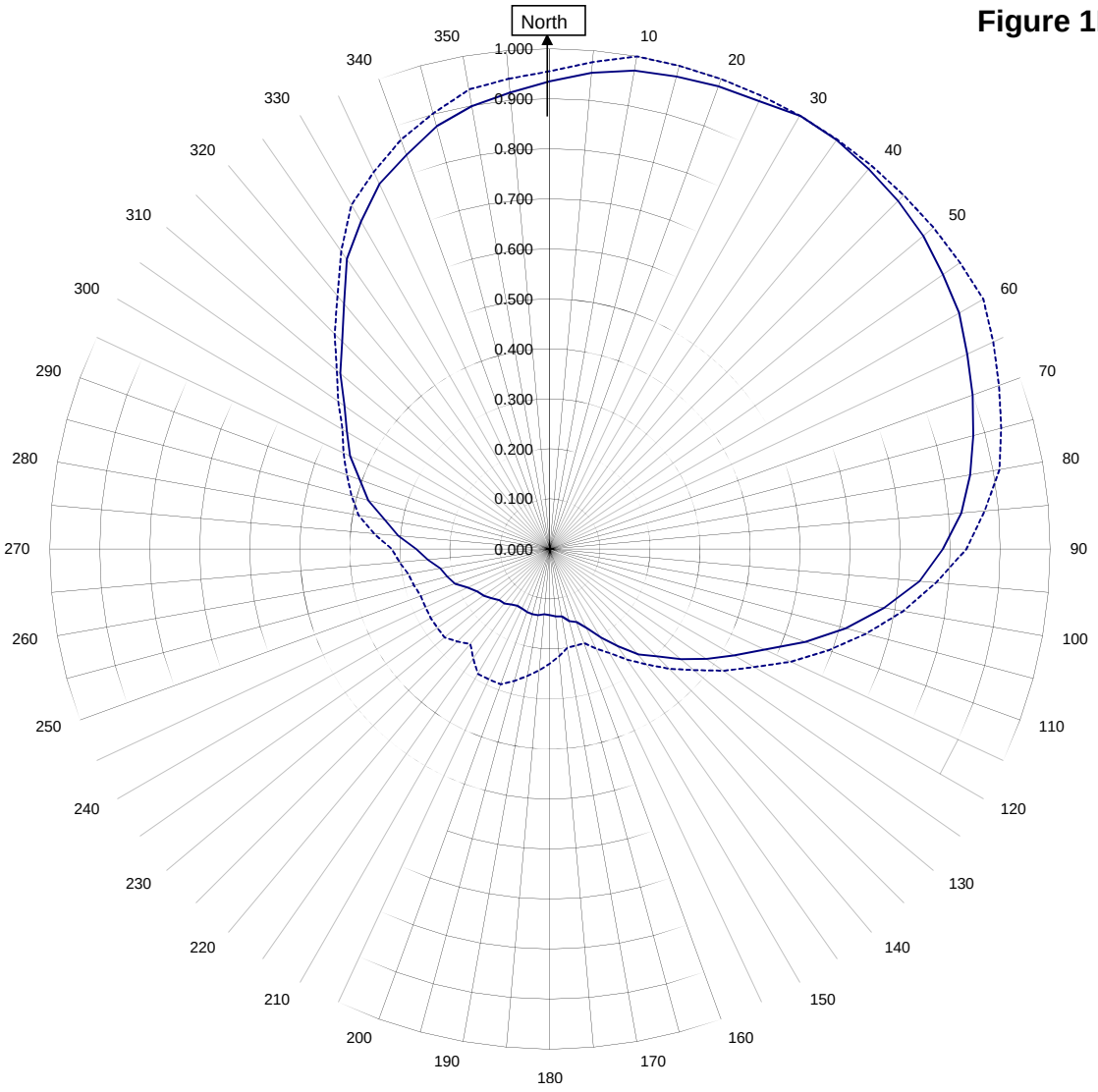
Figure 1B



KLSU BATON ROUGE, LA.

32974

October 15, 2015

_____H/VComposite RMS	0.614
……FCC Composite RMS	0.648

Frequency	91.1 / 409.95 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6815-4-CF-SS(0.5)-DA
Pattern Type	Directional H/V Composite

Figure 1C

Tabulation of Horizontal Azimuth Pattern
KLSU BATON ROUGE, LA.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.935	180	0.132
10	0.971	190	0.134
20	0.984	200	0.134
30	1.000	210	0.131
40	0.991	220	0.142
45	0.984	225	0.144
50	0.974	230	0.153
60	0.944	240	0.169
70	0.899	250	0.202
80	0.852	260	0.223
90	0.785	270	0.267
100	0.678	280	0.335
110	0.543	290	0.395
120	0.416	300	0.456
130	0.323	310	0.534
135	0.286	315	0.576
140	0.249	320	0.629
150	0.175	330	0.756
160	0.152	340	0.839
170	0.137	350	0.899

Figure 1D

Tabulation of Vertical Azimuth Pattern
KLSU BATON ROUGE, LA.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.888	180	0.109
10	0.918	190	0.101
20	0.937	200	0.091
30	0.947	210	0.105
40	0.945	220	0.111
45	0.937	225	0.115
50	0.931	230	0.119
60	0.900	240	0.129
70	0.857	250	0.135
80	0.808	260	0.153
90	0.738	270	0.214
100	0.645	280	0.303
110	0.523	290	0.405
120	0.425	300	0.469
130	0.342	310	0.547
135	0.303	315	0.588
140	0.275	320	0.641
150	0.205	330	0.744
160	0.155	340	0.819
170	0.121	350	0.863

Figure 1E

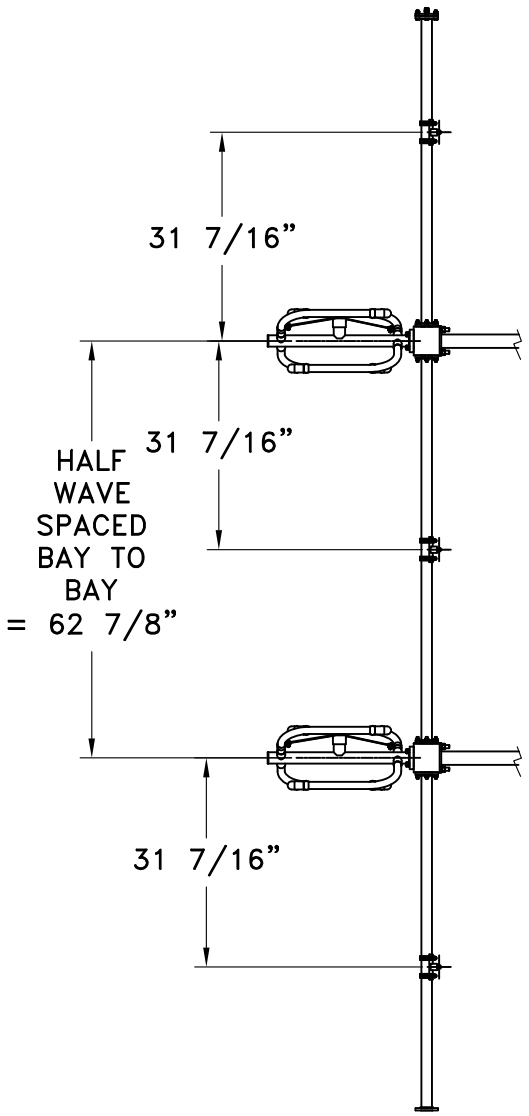
Tabulation of Composite Azimuth Pattern
KLSU BATON ROUGE, LA.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.935	180	0.132
10	0.971	190	0.134
20	0.984	200	0.134
30	1.000	210	0.131
40	0.991	220	0.142
45	0.984	225	0.144
50	0.974	230	0.153
60	0.944	240	0.169
70	0.899	250	0.202
80	0.852	260	0.223
90	0.785	270	0.267
100	0.678	280	0.335
110	0.543	290	0.405
120	0.425	300	0.469
130	0.342	310	0.547
135	0.303	315	0.588
140	0.275	320	0.641
150	0.205	330	0.756
160	0.155	340	0.839
170	0.137	350	0.899

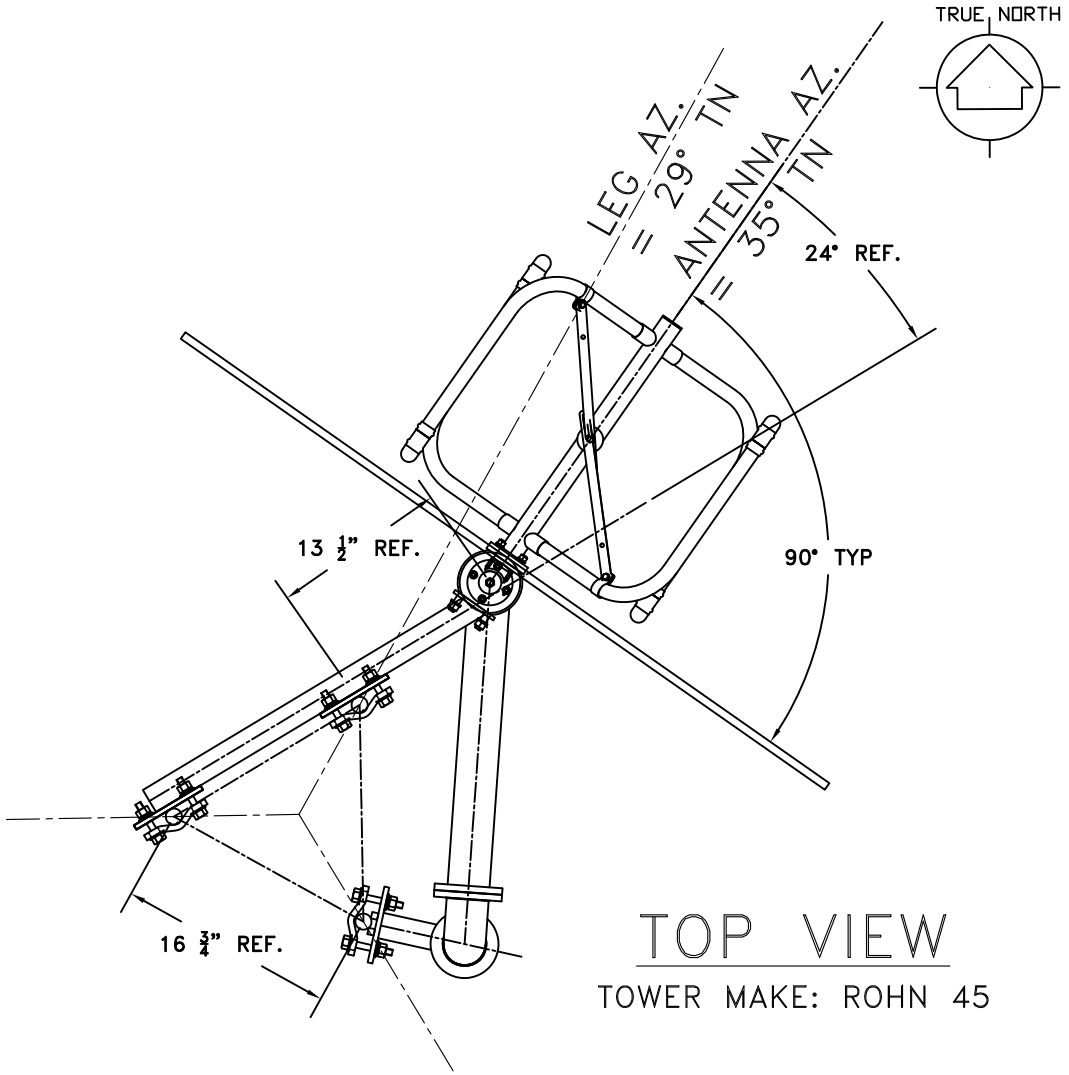
Figure 1F

Tabulation of FCC Directional Composite
KLSU BATON ROUGE, LA.

Azimuth	Rel Field	Azimuth	Rel Field
0	0.955	180	0.229
10	1.000	190	0.257
20	1.000	200	0.288
30	1.000	210	0.288
40	1.000	220	0.248
50	1.000	230	0.275
60	1.000	240	0.275
70	0.955	250	0.275
80	0.912	260	0.288
90	0.832	270	0.316
100	0.716	280	0.389
110	0.592	290	0.432
120	0.472	300	0.479
130	0.377	310	0.556
140	0.301	320	0.661
150	0.240	330	0.794
160	0.200	340	0.871
170	0.200	350	0.933



SIDE VIEW



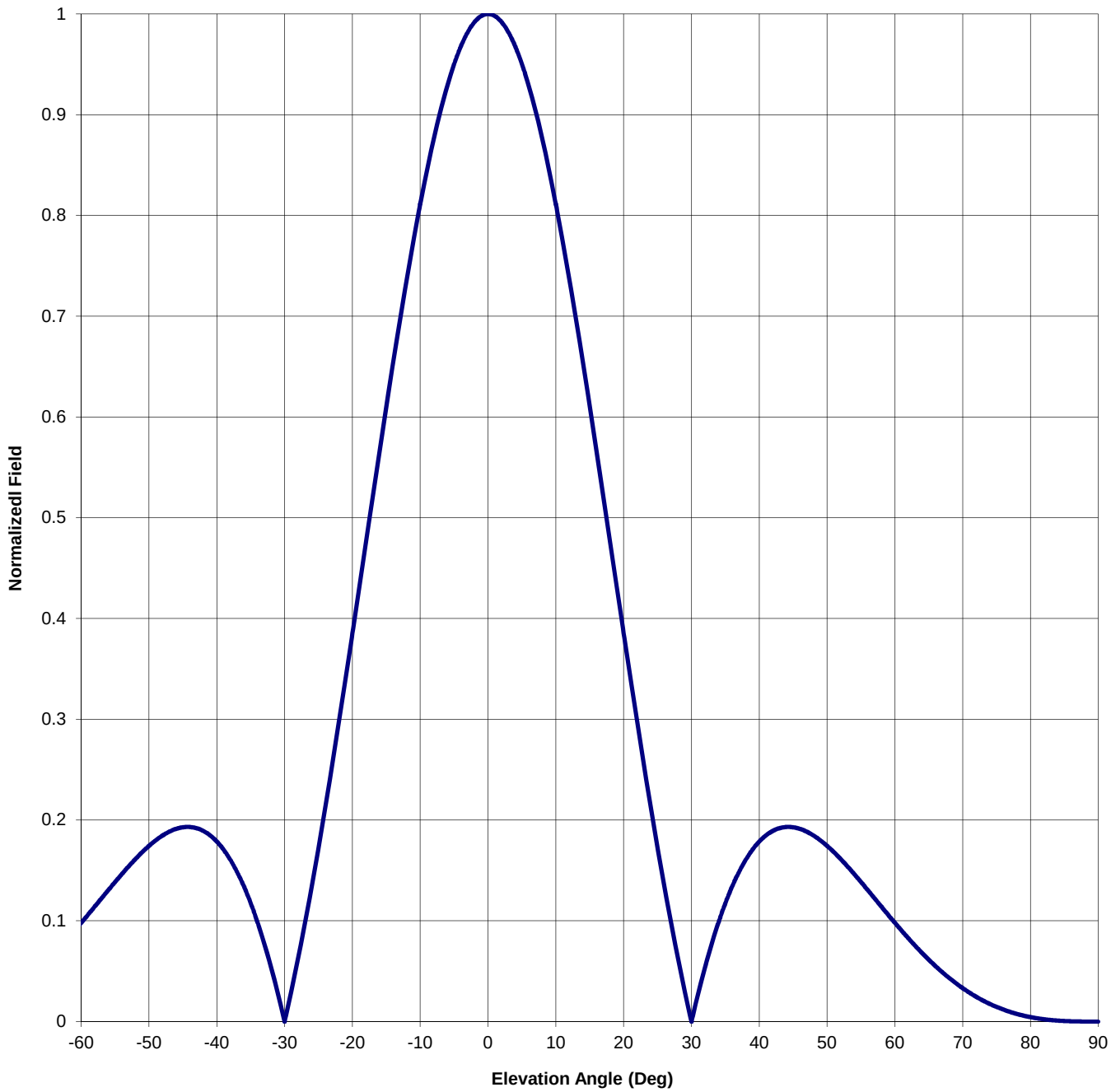
TOP VIEW

TOWER MAKE: ROHN 45

ANTENNA HEADING 35° TRUE NORTH

SHIVELY LABS A DIVISION OF HOWELL LABORATORIES INC.,BRIDGTON, MAINE			
SHOP ORDER: 32974	FREQUENCY: 91.1	SCALE: N.T.S.	DRAWN BY: ASP APPROVED BY: DAB
TITLE: MODEL-6815-4-SS-DIRECTIONAL ANTENNA			
DATE: 10-29-15	FIGURE 2		

Antenna Mfg.:	**Shively Labs**				**Date: 10/15/2015**
Antenna Type:	**6815-4-CF-SS(0.5)-DA**				
Station:	**KLSU**	**Beam Tilt**	**0**		
Frequency:	**91.1**	**Gain (Max)**	**3.651**	**5.624 dB**	
Channel #:	**216**	**Gain (Horizon)**	**3.651**	**5.624 dB**	
Figure:	**Figure 3**				



Antenna Mfg.: Shively Labs **Date:** 10/15/2015

Antenna Type: 6815-4-CF-SS(0.5)-DA

Station: KLSU **Beam Tilt** 0

Frequency: 91.1 **Gain (Max)** 3.651 5.624 dB

Channel #: 216 **Gain (Horizon)** 3.651 5.624 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	0.000	-44	0.193	0	1.000	46	0.191
-89	0.000	-43	0.192	1	0.998	47	0.188
-88	0.000	-42	0.189	2	0.992	48	0.185
-87	0.000	-41	0.185	3	0.982	49	0.180
-86	0.000	-40	0.179	4	0.968	50	0.174
-85	0.001	-39	0.171	5	0.950	51	0.168
-84	0.001	-38	0.161	6	0.929	52	0.161
-83	0.002	-37	0.148	7	0.904	53	0.154
-82	0.002	-36	0.134	8	0.876	54	0.146
-81	0.003	-35	0.117	9	0.845	55	0.139
-80	0.004	-34	0.099	10	0.811	56	0.130
-79	0.006	-33	0.077	11	0.775	57	0.122
-78	0.008	-32	0.054	12	0.736	58	0.114
-77	0.010	-31	0.028	13	0.696	59	0.106
-76	0.012	-30	0.000	14	0.654	60	0.098
-75	0.015	-29	0.030	15	0.611	61	0.090
-74	0.018	-28	0.063	16	0.566	62	0.083
-73	0.021	-27	0.098	17	0.521	63	0.075
-72	0.025	-26	0.134	18	0.476	64	0.068
-71	0.029	-25	0.173	19	0.431	65	0.061
-70	0.033	-24	0.213	20	0.385	66	0.055
-69	0.038	-23	0.254	21	0.341	67	0.049
-68	0.043	-22	0.297	22	0.297	68	0.043
-67	0.049	-21	0.341	23	0.254	69	0.038
-66	0.055	-20	0.385	24	0.213	70	0.033
-65	0.061	-19	0.431	25	0.173	71	0.029
-64	0.068	-18	0.476	26	0.134	72	0.025
-63	0.075	-17	0.521	27	0.098	73	0.021
-62	0.083	-16	0.566	28	0.063	74	0.018
-61	0.090	-15	0.611	29	0.030	75	0.015
-60	0.098	-14	0.654	30	0.000	76	0.012
-59	0.106	-13	0.696	31	0.028	77	0.010
-58	0.114	-12	0.736	32	0.054	78	0.008
-57	0.122	-11	0.775	33	0.077	79	0.006
-56	0.130	-10	0.811	34	0.099	80	0.004
-55	0.139	-9	0.845	35	0.117	81	0.003
-54	0.146	-8	0.876	36	0.134	82	0.002
-53	0.154	-7	0.904	37	0.148	83	0.002
-52	0.161	-6	0.929	38	0.161	84	0.001
-51	0.168	-5	0.950	39	0.171	85	0.001
-50	0.174	-4	0.968	40	0.179	86	0.000
-49	0.180	-3	0.982	41	0.185	87	0.000
-48	0.185	-2	0.992	42	0.189	88	0.000
-47	0.188	-1	0.998	43	0.192	89	0.000
-46	0.191	0	1.000	44	0.193	90	0.000
-45	0.193			45	0.193		

S.O. 32974 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

KLSU BATON ROUGE, LA.

MODEL 6815-4-CF-SS(0.5)-DA

Elevation Gain of Antenna 1.31

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

H RMS 0.611808 V RMS 0.586501 H/V Ratio 1.043

Elevation Gain of Horizontal Component 1.367

Elevation Gain of Vertical Component 1.256

Horizontal Azimuth Gain equals $1/(RMS)^2$. 2.672

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 2.607

Max. Vertical 0.947

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

Total Horizontal Power Gain = **3.651**

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

Total Vertical Power Gain = **3.274**

==========

ERP divided by Horizontal Power Gain equals Antenna Input Power

23 kW ERP Divided by H Gain 3.651 equals 6.300 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

6.300 kW Times V Gain 3.274 equals 20.627 kW V ERP

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

(0.947)^2 Times 23.00 Equals 20.627 kW Vertical ERP

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