Shively Labs®
a division of Howell Laboratories, Inc.
P. O. Box 389, 188 Harrison Rd.
Bridgton, Maine 04009 USA
(207) 647-3327
888-SHIVELY
Fax: (207) 647-8273
E-mail: sales@shively.com
Web site: www.shively.com

S.O. 29134

Report of Test 6016-1-2-DA

for

INTER MIRIFICA, INC.

WSQM 90.9 MHz Noblesville, IN

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a 6016-1-2-DA to meet the needs of WSQM and to comply with the requirements of the FCC construction permit, file number BNPED-20071022BHU. 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 BNPED-20071022BHU indicates that the Horizontal radiation component shall not exceed 1.30 kW at any azimuth and is restricted to the following values at the azimuths specified:

010 to 040 Degrees T: 0.104 Kw

190 Degrees T: 0.113 Kw

210 Degrees T: 0.113 Kw

From Figure 1A, the maximum radiation of the Horizontal component occurs at 114 Degrees T to 116 Degrees T and 294 Degrees T to 296 Degrees T. At the restricted azimuth of 010 to 040 Degrees T the Vertical component is 15.92 dB down from the maximum of 1.30 kW, or 0.033 kW and the restricted azimuth of 190 Degrees T the horizontal component is 14.89 dB down from the maximum of 1.30 kW, or 0.042 kW and the restricted azimuth of 210 Degrees T the Vertical component is 15.92 dB down from the maximum of 1.30 kW, or 0.033 kW.

The R.M.S. of the Horizontal component is 0.567. The total Horizontal power gain is 2.209. The R.M.S. of the Vertical component is 0.559. The total Vertical power gain is 1.869. See Figure 4 for calculations. The R.M.S. of the FCC composite pattern is 0.662. The R.M.S. of the measured composite pattern is 0.593. Eighty-five percent (85%) of the original authorized FCC composite pattern is 0.563. Therefore this pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One bay of the 6016-1-2-DA was mounted on a tower of precise scale to the tower at the WSQM site. The spacing of the antenna to the tower was varied to achieve the Horizontal and Vertical patterns shown in Figure 1A. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BNPED-20071022BHU, a single level of the 6016-1-2-DA 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 9^{th} and 10^{th} 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

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 409.05 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 1A.

Respectfully submitted by:

Robert A. Surette
Director of Sales Engineering
S/O 29134
July 12, 2011

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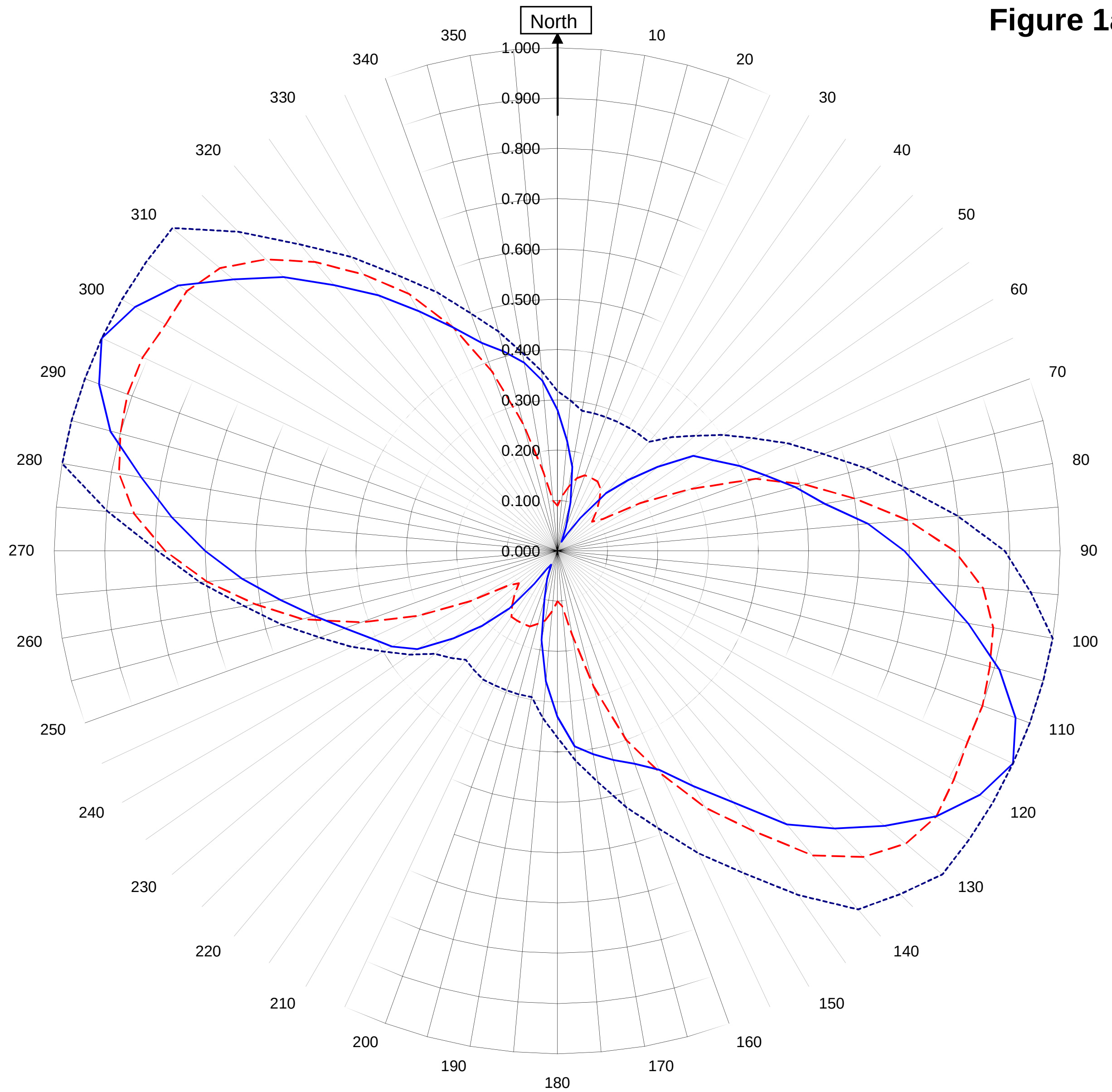
Figure 1a



WSQM Noblesville, IN

29134

July 12, 2011

Horizontal RMS	0.567
Vertical RMS	0.559
H/V Composite RMS	0.593
...............FCC Composite RMS	0.662

Frequency	90.9 / 409.05 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6016-1-2-DA
Pattern Type	Directional Azimuth

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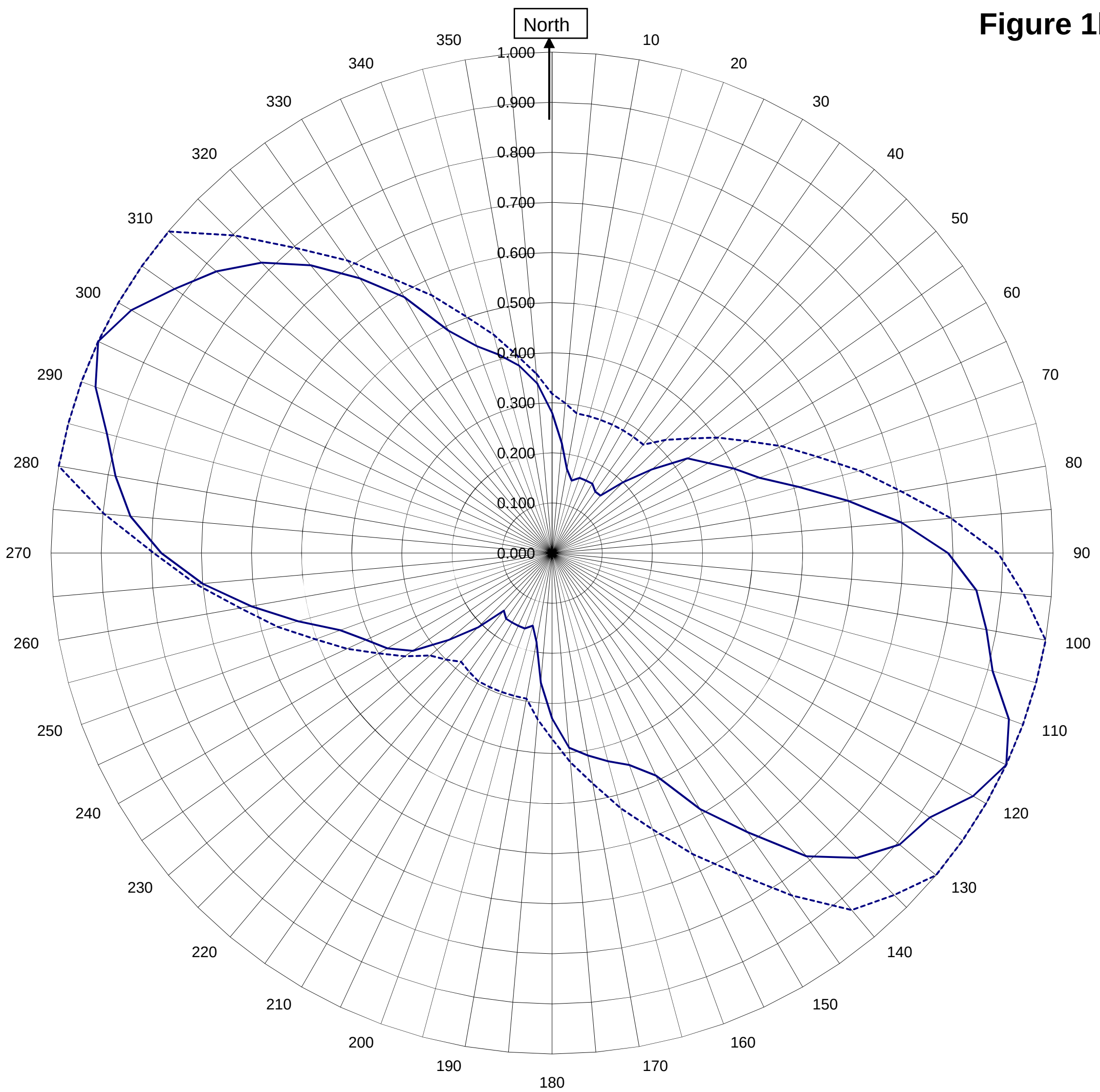
Figure 1b



WSQM Noblesville, IN

29134

July 12, 2011

__________H/VComposite RMS	0.593
……………FCC Composite RMS	0.662

Frequency	90.9 / 409.05 mHz
Plot	Relative Field
Scale	4.5 : 1
	See Figure 2 for Mechanical Details

Antenna Model	6016-1-2-DA
Pattern Type	Directional H/V Composite

Figure 1c

Tabulation of Horizontal Azimuth Pattern
WSQM Noblesville, IN

Azimuth	Rel Field	Azimuth	Rel Field
0	0.280	180	0.330
10	0.170	190	0.180
20	0.050	200	0.060
30	0.040	210	0.040
40	0.150	220	0.150
45	0.200	225	0.210
50	0.260	230	0.270
60	0.360	240	0.380
70	0.440	250	0.450
80	0.540	260	0.560
90	0.690	270	0.700
100	0.830	280	0.840
110	0.970	290	0.970
120	0.970	300	0.970
130	0.850	310	0.840
135	0.780	315	0.770
140	0.710	320	0.690
150	0.540	330	0.550
160	0.450	340	0.440
170	0.410	350	0.380

Figure 1d

Tabulation of Vertical Azimuth Pattern
WSQM Noblesville, IN

Azimuth	Rel Field	Azimuth	Rel Field
0	0.090	180	0.100
10	0.130	190	0.140
20	0.160	200	0.160
30	0.160	210	0.160
40	0.130	220	0.140
45	0.110	225	0.120
50	0.090	230	0.100
60	0.190	240	0.200
70	0.420	250	0.415
80	0.600	260	0.610
90	0.790	270	0.780
100	0.880	280	0.885
110	0.900	290	0.910
120	0.910	300	0.900
130	0.905	310	0.875
135	0.860	315	0.820
140	0.790	320	0.750
150	0.590	330	0.590
160	0.400	340	0.380
170	0.170	350	0.160

Figure 1e

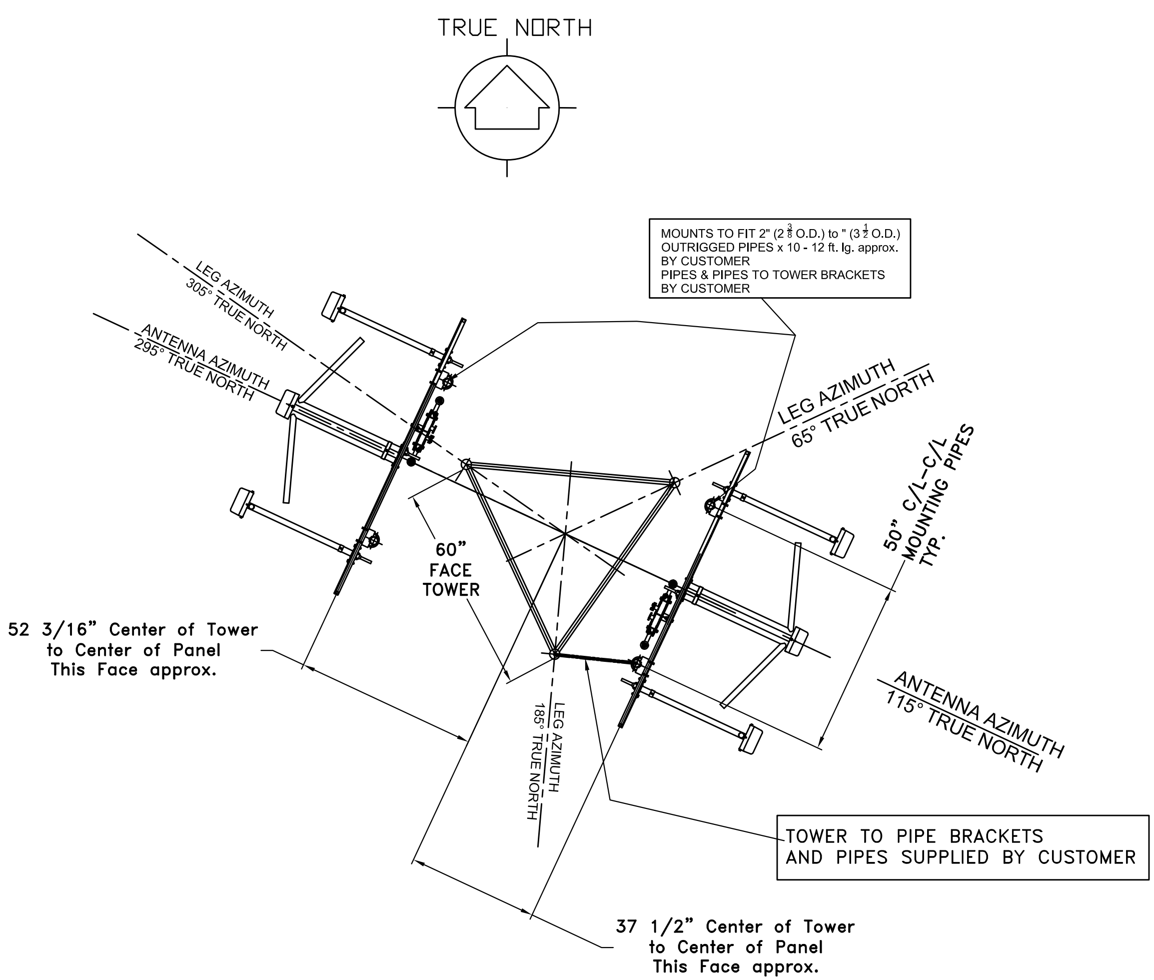
Tabulation of Composite Azimuth Pattern
WSQM Noblesville, IN

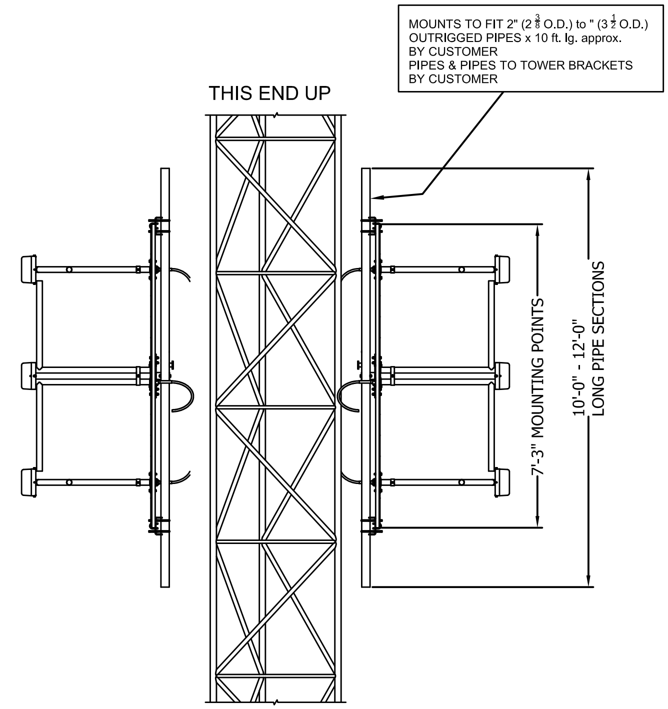
Azimuth	Rel Field	Azimuth	Rel Field
0	0.280	180	0.330
10	0.170	190	0.180
20	0.160	200	0.160
30	0.160	210	0.160
40	0.150	220	0.150
45	0.200	225	0.210
50	0.260	230	0.270
60	0.360	240	0.380
70	0.440	250	0.450
80	0.600	260	0.610
90	0.790	270	0.780
100	0.880	280	0.885
110	0.970	290	0.970
120	0.970	300	0.970
130	0.905	310	0.875
135	0.860	315	0.820
140	0.790	320	0.750
150	0.590	330	0.590
160	0.450	340	0.440
170	0.410	350	0.380

Figure 1f

Tabulation of FCC Directional Composite
WSQM Noblesville, IN

Azimuth	Rel Field	Azimuth	Rel Field
0	0.318	180	0.371
10	0.283	190	0.295
20	0.283	200	0.295
30	0.283	210	0.295
40	0.283	220	0.283
50	0.356	230	0.318
60	0.448	240	0.400
70	0.563	250	0.503
80	0.708	260	0.632
90	0.890	270	0.795
100	1.000	280	1.000
110	1.000	290	1.000
120	1.000	300	1.000
130	1.000	310	0.999
140	0.930	320	0.795
150	0.739	330	0.632
160	0.587	340	0.503
170	0.467	350	0.400





SHIVELY LABS
A DIVISION OF HOWELL LABORATORIES INC.,BRIDGTON, MAINE

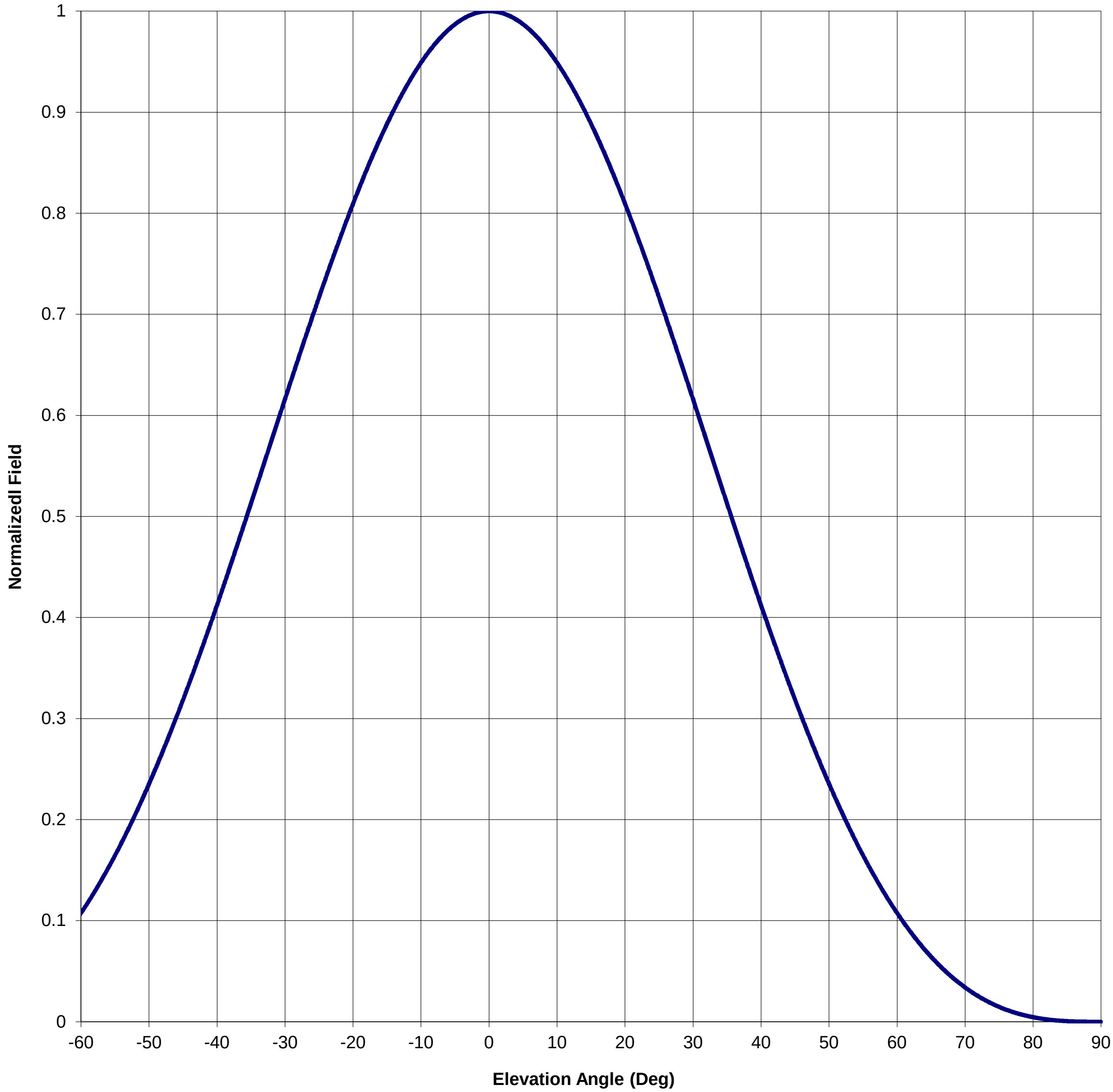
SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY: / APPROVED BY:
29134	90.9 Mhz	N.T.S.	DAB / RAS

TITLE: MODEL–6016–1/2–DIRECTIONAL ANTENNA

DATE: 7/6/11

FIGURE 2

Antenna Mfg.:	**Shively Labs**			**Date:**	**7/12/2011**
Antenna Type:	**6016-1-2-DA**				
Station:	**WSQM**	**Beam Tilt**	**0**		
Frequency:	**90.9**	**Gain (Max)**	**2.209**	**3.442**	**dB**
Channel #:	**215**	**Gain (Horizon)**	**2.209**	**3.442**	**dB**
Figure:	**Figure 3**				



Antenna Mfg.:	Shively Labs			Date:	7/12/2011
Antenna Type:	6016-1-2-DA				
Station:	WSQM	Beam Tilt	0		
Frequency:	90.9	Gain (Max)	2.209	3.442	dB
Channel #:	215	Gain (Horizon)	2.209	3.442	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	0.337	0	1.000	46	0.301
-89	0.000	-43	0.355	1	0.999	47	0.284
-88	0.000	-42	0.374	2	0.998	48	0.267
-87	0.000	-41	0.393	3	0.995	49	0.251
-86	0.000	-40	0.412	4	0.992	50	0.235
-85	0.001	-39	0.432	5	0.987	51	0.220
-84	0.001	-38	0.452	6	0.981	52	0.205
-83	0.002	-37	0.472	7	0.975	53	0.191
-82	0.002	-36	0.492	8	0.967	54	0.178
-81	0.003	-35	0.513	9	0.959	55	0.165
-80	0.005	-34	0.533	10	0.949	56	0.152
-79	0.006	-33	0.554	11	0.939	57	0.140
-78	0.008	-32	0.575	12	0.927	58	0.129
-77	0.010	-31	0.595	13	0.915	59	0.118
-76	0.012	-30	0.616	14	0.902	60	0.108
-75	0.015	-29	0.637	15	0.888	61	0.098
-74	0.018	-28	0.657	16	0.874	62	0.089
-73	0.021	-27	0.677	17	0.859	63	0.080
-72	0.025	-26	0.697	18	0.843	64	0.072
-71	0.029	-25	0.717	19	0.826	65	0.064
-70	0.034	-24	0.736	20	0.809	66	0.057
-69	0.039	-23	0.755	21	0.792	67	0.051
-68	0.045	-22	0.774	22	0.774	68	0.045
-67	0.051	-21	0.792	23	0.755	69	0.039
-66	0.057	-20	0.809	24	0.736	70	0.034
-65	0.064	-19	0.826	25	0.717	71	0.029
-64	0.072	-18	0.843	26	0.697	72	0.025
-63	0.080	-17	0.859	27	0.677	73	0.021
-62	0.089	-16	0.874	28	0.657	74	0.018
-61	0.098	-15	0.888	29	0.637	75	0.015
-60	0.108	-14	0.902	30	0.616	76	0.012
-59	0.118	-13	0.915	31	0.595	77	0.010
-58	0.129	-12	0.927	32	0.575	78	0.008
-57	0.140	-11	0.939	33	0.554	79	0.006
-56	0.152	-10	0.949	34	0.533	80	0.005
-55	0.165	-9	0.959	35	0.513	81	0.003
-54	0.178	-8	0.967	36	0.492	82	0.002
-53	0.191	-7	0.975	37	0.472	83	0.002
-52	0.205	-6	0.981	38	0.452	84	0.001
-51	0.220	-5	0.987	39	0.432	85	0.001
-50	0.235	-4	0.992	40	0.412	86	0.000
-49	0.251	-3	0.995	41	0.393	87	0.000
-48	0.267	-2	0.998	42	0.374	88	0.000
-47	0.284	-1	0.999	43	0.355	89	0.000
-46	0.301	0	1.000	44	0.337	90	0.000
-45	0.319			45	0.319		

S.O. 29134 Figure 4

VALIDATION OF TOTAL POWER GAIN CALCULATION

WSQM Noblesville, IN

6016-1-2-DA

Elevation Gain of Antenna 0.7

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

H RMS 0.567 V RMS 0.559 H/V Ratio 1.014

Elevation Gain of Horizontal Component 0.710

Elevation Gain of Vertical Component 0.690

Horizontal Azimuth Gain equals $1/(RMS)^2$. 3.111

Vertical Azimuth Gain equals $1/(RMS/Max\ Vert)^2$. 2.709
Max. Vertical 0.92

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

Total Horizontal Power Gain = **2.209**

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

Total Vertical Power Gain = **1.869**

==

ERP divided by Horizontal Power Gain equals Antenna Input Power

1.3 kW ERP Divided by H Gain 2.209 equals 0.59 kW H Antenna Input Power

Antenna Input Power times Vertical Power Gain equals Vertical ERP

0.59 kW Times V Gain 1.869 equals 1.10 kW V ERP

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

(0.92)^2 Times 1.30 Equals 1.10 kW Vertical ERP

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