APPLICATION FOR LICENSE INFORMATION
RADIO STATION KLMS
LINCOLN, NEBRASKA

December 19, 2014

1480 KHZ   1 KW – D   0.75 KW - N   DA-2

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Executive Summary - KLMS

This engineering exhibit supports an application for License (requesting modification of the station license to specify new antenna monitor operating parameters) for the directional antenna system of radio station KLMS in Lincoln. Nebraska. KLMS operates fulltime on 1480 kilohertz with 1.0 kilowatt in the daytime and 0.75 kilowatt at night, employing different directional antenna patterns during daytime and nighttime hours.

The authorized KLMS directional antenna theoretical parameters and array geometry remain unchanged. The antenna monitor operating parameters specified herein were derived through Method of Moments modeling. In all other respects, the KLMS antenna system remains unchanged.

The antenna system measurements presented herein were made by the undersigned, Mr. Lloyd Collins and Mr. Robert Cook. The computer modeling was the responsibility of the undersigned.

Information is provided herein demonstrating that the directional antenna parameters have been determined in accordance with the requirements of section 73.151(c) of the FCC Rules. The antenna system has been adjusted to produce antenna monitor parameters within +/- 5 percent in ratio and +/- 3 degrees in phase of the modeled values, as required by the Rules. Information regarding direct measurement of power is also included herein.

Ronald D. Rackley, P.E.
December 19, 2014

Analysis of Tower Impedance Measurements to Verify Method of Moments Model – KLMS

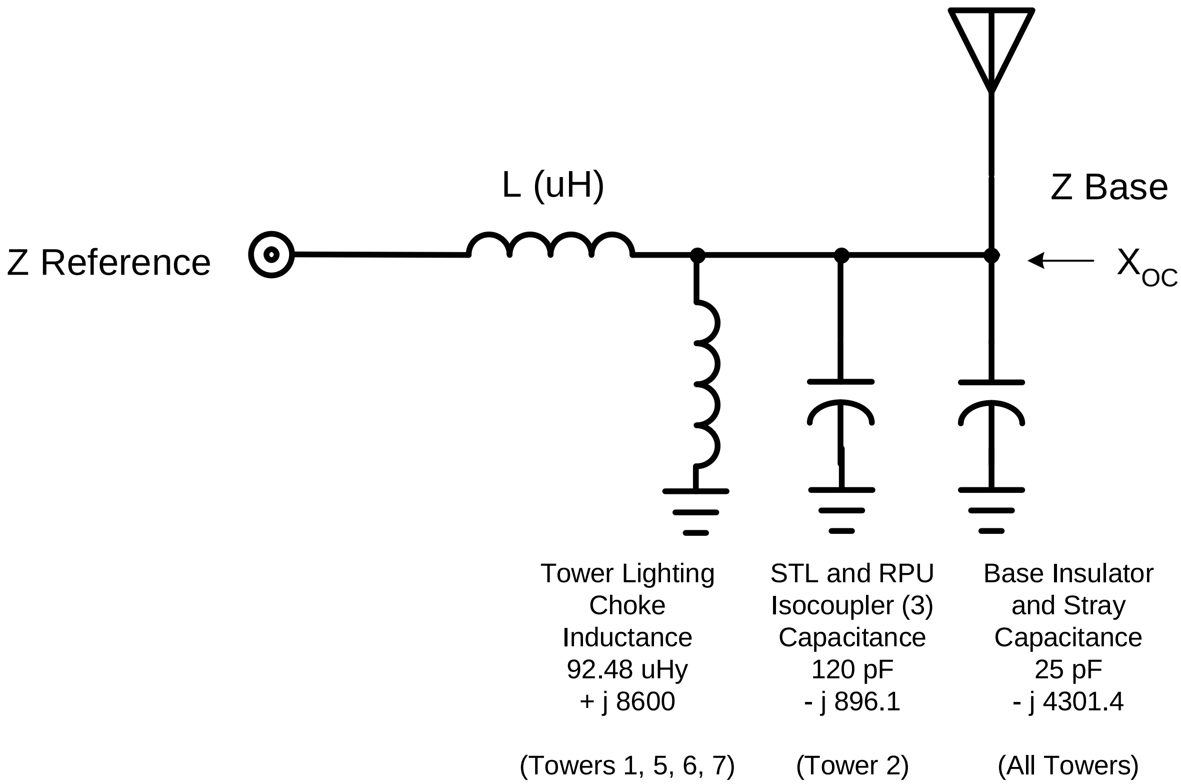
Tower base impedance measurements were made at the outputs of the antenna tuning units ("ATUs") using an Advantest R3754B network analyzer and a Tunwall Radio directional coupler in a calibrated measurement system. The towers were all open circuited at their ATU outputs for the measurements.

The reference point at each tower is adjacent to the sampling transformer of the antenna monitor system at the output of the ATU enclosure. The current passes directly from that point over conductors through the enclosure insulator and on to the tower above the base insulator. There are no adjustable shunt components following the sampling transformers. An assumed value for the base insulator capacitance and base region stray capacitance across the ATU output was employed in the base circuit calculations for each tower, with additional capacitive reactance across the base of tower 2 to account for the three RPU and STL isocouplers that are there. Identical lighting chokes are employed at the towers having lights and the reactance of one was measured for use in the calculations for them. Using the assumed base shunt capacitances and measured lighting choke reactance, satisfactory analysis was possible with all other assumptions well within the range limitations of the FCC Rules. Circuit calculations were performed to relate the method of moments modeled impedances of the tower feedpoints to the ATU output measurement (reference) points as shown on the following pages. The Xoc shown for each tower, which was calculated for the assumed base conditions, was used in the method of moments model as a load at ground level for the open circuited case.

In addition to the page showing the schematic of the assumed circuit and tabulation of calculated values, pages showing the results of calculations using the WCAP network analysis program from Westberg Consulting are provided. WCAP performs such calculations using nodal analysis, as do other modern circuit analysis programs such as the commonly available ones based on SPICE software.

In each of the WCAP tabulations, node 2 represents the ATU output reference point and node 3 represents the tower feedpoint. Node 0 represents ground potential. The numerals in the file names shown on the tabulations correspond to the tower numbers. It should be noted that the calculated reference point impedances appear under the "TO NODE IMPEDANCE" columns of the WCAP tabulations, following the phantom 1.0 ohm resistors (R 1 - 2) that were included in series with the drive current sources (I 0 -1)) to provide calculation points for the impedances. The tower base impedances from the method of moments model are represented by complex loads from node 3 to ground (R 3 - 0). The shunt capacitances shown for the towers on the schematic were used for the calculations, although they only appear to the nearest 0.0001 microfarad on the WCAP printout due to rounding. As verification, the reactances of the shunt capacitances appear correctly in the WCAP printout.

The modeled and measured base impedances at the ATU outputs with the other towers open circuited at their outputs agree within +/- 2 ohms and +/- 4 percent for resistance and reactance, as required by the FCC Rules.



TOWER	L (uH)	X_L	X_{OC}	Z Base (Modeled)	Z Reference (Modeled)	Z Reference (Measured)
1	4.205	+ j 39.1	- j 8605.6	80.66 +j 131.86	83.2 +j 172.2	82.7 +j 172.2
2	4.499	+ j 41.8	- j 741.6	92.58 +j 152.22	143.0 +j 210.9	140.9 +j 210.9
3	5.355	+ j 49.8	- j 4301.4	74.90 +j 120.10	79.2 +j 171.9	77.2 +j 171.9
4	5.237	+ j 48.7	- j 4301.4	81.06 +j 126.55	86.0 +j 177.4	85.4 +j 177.4
5	4.431	+ j 41.2	- j 8605.6	80.38 +j 130.50	82.9 +j 172.9	81.3 +j 172.9
6	4.828	+ j 44.9	- j 8605.6	86.86 +j 130.38	89.5 +j 176.4	88.8 +j 176.4
7	4.000	+ j 37.2	- j 8605.6	80.30 +j 127.56	82.7 +j 165.9	81.5 +j 165.9
8	3.990	+ j 37.1	- j 4301.4	91.83 +j 137.69	98.0 +j 177.2	96.5 +j 177.2

ANALYSIS OF TOWER IMPEDANCE MEASUREMENTS TO VERIFY METHOD OF MOMENTS MODEL

RADIO STATION KLMS
LINCOLN, NEBRASKA
1480 KHZ 1 KW - D 0.75 KW - N DA-2

du Treil, Lundin & Rackley, Inc. Sarasota, Florida

Tower 1 Individually Driven Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


FILE NAME = KLMS1OC.TXT

I     1.0000    0    1     .0000     .0000     .0000
R     1.0000    1    2     .0000     .0000     .0000
L     4.2050    2    3     .0000     .0000     .0000
L   924.8000    3    0     .0000     .0000     .0000
C      .0000    3    0     .0000     .0000     .0000
R    80.6560    3    0  131.8600     .0000     .0000
EX     .0000    0    0     .0000     .0000     .0000


FREQ = 1.480

  NODE       VOLT MAG     VOLT PHASE
   1        191.6942        63.9518
   2        191.2572        64.2210
   3        156.9699        58.0014
                           BRANCH VOLTAGE      BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                           MAG       PHASE       MAG       PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
R    1-  2     1.000      1.00       .000      1.00       .000      84.18     172.22     83.18    172.22
L    2-  3     4.205     39.10     90.000      1.00       .000      83.18     172.22     83.18    133.12
L    3-  0   924.800    156.97     58.001       .02    -31.999        .00    8599.82       .00       .00
C    3-  0      .000    156.97     58.001       .04    148.001        .00   -4301.49       .00       .00
R    3-  0    80.656    156.97     58.001      1.02      -.545      80.66     131.86       .00       .00
```

Tower 2 Individually Driven Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


FILE NAME = KLMS2OC.TXT

I     1.0000    0    1     .0000     .0000     .0000
R     1.0000    1    2     .0000     .0000     .0000
L     4.4990    2    3     .0000     .0000     .0000
C      .0001    3    0     .0000     .0000     .0000
R    92.5790    3    0  152.2200     .0000     .0000
EX     .0000    0    0     .0000     .0000     .0000


FREQ = 1.480

  NODE       VOLT MAG     VOLT PHASE
   1        255.3967        55.6674
   2        254.8341        55.8530
   3        221.4586        49.7659
                           BRANCH VOLTAGE      BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                           MAG       PHASE       MAG       PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
R    1-  2     1.000      1.00       .000      1.00       .000     144.04     210.90    143.04    210.90
L    2-  3     4.499     41.84     90.000      1.00       .000     143.04     210.90    143.04    169.06
C    3-  0      .000    221.46     49.766       .30    139.766        .00    -741.64       .00       .00
R    3-  0    92.579    221.46     49.766      1.24     -8.926      92.58     152.22       .00       .00
```

Tower 3 Individually Driven Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


FILE NAME = KLMS3OC.TXT

I     1.0000    0    1     .0000     .0000     .0000
R     1.0000    1    2     .0000     .0000     .0000
L     5.3550    2    3     .0000     .0000     .0000
C      .0000    3    0     .0000     .0000     .0000
R    74.9020    3    0  120.1000     .0000     .0000
EX     .0000    0    0     .0000     .0000     .0000


FREQ = 1.480

  NODE       VOLT MAG     VOLT PHASE
   1       189.7300        64.9808
   2       189.3093        65.2550
   3       145.5848        57.0235
                            BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                            MAG       PHASE       MAG       PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
R    1-  2      1.000      1.00       .000       1.00       .000      80.24    171.93      79.24    171.93
L    2-  3      5.355     49.80     90.000       1.00       .000      79.24    171.93      79.24    122.13
C    3-  0       .000    145.58     57.023        .03    147.023        .00  -4301.49        .00       .00
R    3-  0     74.902    145.58     57.023       1.03     -1.026      74.90    120.10        .00       .00
```

Tower 4 Individually Driven Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


FILE NAME = KLMS4OC.TXT

I     1.0000    0    1     .0000     .0000     .0000
R     1.0000    1    2     .0000     .0000     .0000
L     5.2370    2    3     .0000     .0000     .0000
C      .0000    3    0     .0000     .0000     .0000
R    81.0570    3    0  126.5500     .0000     .0000
EX     .0000    0    0     .0000     .0000     .0000


FREQ = 1.480

  NODE       VOLT MAG     VOLT PHASE
   1       197.6044        63.8745
   2       197.1661        64.1354
   3       154.8097        56.2476
                            BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                            MAG       PHASE       MAG       PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
R    1-  2      1.000      1.00       .000       1.00       .000      87.01    177.42      86.01    177.42
L    2-  3      5.237     48.70     90.000       1.00       .000      86.01    177.42      86.01    128.72
C    3-  0       .000    154.81     56.248        .04    146.248        .00  -4301.49        .00       .00
R    3-  0     81.057    154.81     56.248       1.03     -1.112      81.06    126.55        .00       .00
```

Tower 5 Individually Driven Base Circuit Analysis

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = KLMS5OC.TXT

I	1.0000	0	1	.0000	.0000	.0000
R	1.0000	1	2	.0000	.0000	.0000
L	4.4310	2	3	.0000	.0000	.0000
L	924.8000	3	0	.0000	.0000	.0000
C	.0000	3	0	.0000	.0000	.0000
R	80.3820	3	0	130.5000	.0000	.0000
EX	.0000	0	0	.0000	.0000	.0000

FREQ = 1.480

NODE	VOLT MAG	VOLT PHASE
1	192.1926	64.1269
2	191.7584	64.3957
3	155.6223	57.8255

				BRANCH VOLTAGE		BRANCH CURRENT		FROM NODE IMPEDANCE		TO NODE IMPEDANCE	
				MAG	PHASE	MAG	PHASE	RESISTANCE	REACTANCE	RESISTANCE	REACTANCE
R	1-	2	1.000	1.00	.000	1.00	.000	83.87	172.93	82.87	172.93
L	2-	3	4.431	41.20	90.000	1.00	.000	82.87	172.93	82.87	131.72
L	3-	0	924.800	155.62	57.825	.02	-32.175	.00	8599.82	.00	.00
C	3-	0	.000	155.62	57.825	.04	147.825	.00	-4301.49	.00	.00
R	3-	0	80.382	155.62	57.825	1.02	-.543	80.38	130.50	.00	.00

Tower 6 Individually Driven Base Circuit Analysis

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = KLMS6OC.TXT

I	1.0000	0	1	.0000	.0000	.0000
R	1.0000	1	2	.0000	.0000	.0000
L	4.8280	2	3	.0000	.0000	.0000
L	924.8000	3	0	.0000	.0000	.0000
C	.0000	3	0	.0000	.0000	.0000
R	86.8580	3	0	130.3800	.0000	.0000
EX	.0000	0	0	.0000	.0000	.0000

FREQ = 1.480

NODE	VOLT MAG	VOLT PHASE
1	198.2475	62.8250
2	197.7927	63.0827
3	159.0645	55.7416

				BRANCH VOLTAGE		BRANCH CURRENT		FROM NODE IMPEDANCE		TO NODE IMPEDANCE	
				MAG	PHASE	MAG	PHASE	RESISTANCE	REACTANCE	RESISTANCE	REACTANCE
R	1-	2	1.000	1.00	.000	1.00	.000	90.54	176.36	89.54	176.36
L	2-	3	4.828	44.90	90.000	1.00	.000	89.54	176.36	89.54	131.47
L	3-	0	924.800	159.06	55.742	.02	-34.258	.00	8599.82	.00	.00
C	3-	0	.000	159.06	55.742	.04	145.742	.00	-4301.49	.00	.00
R	3-	0	86.858	159.06	55.742	1.02	-.587	86.86	130.38	.00	.00

Tower 7 Individually Driven Base Circuit Analysis

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = KLMS7OC.TXT

I	1.0000	0	1	.0000	.0000	.0000
R	1.0000	1	2	.0000	.0000	.0000
L	4.0000	2	3	.0000	.0000	.0000
L	924.8000	3	0	.0000	.0000	.0000
C	.0000	3	0	.0000	.0000	.0000
R	80.2980	3	0	127.5600	.0000	.0000
EX	.0000	0	0	.0000	.0000	.0000

FREQ = 1.480

NODE	VOLT MAG	VOLT PHASE
1	185.8227	63.2201
2	185.3743	63.4961
3	152.9902	57.2673

				BRANCH VOLTAGE		BRANCH CURRENT		FROM NODE IMPEDANCE		TO NODE IMPEDANCE	
				MAG	PHASE	MAG	PHASE	RESISTANCE	REACTANCE	RESISTANCE	REACTANCE
R	1-	2	1.000	1.00	.000	1.00	.000	83.72	165.89	82.72	165.89
L	2-	3	4.000	37.20	90.000	1.00	.000	82.72	165.89	82.72	128.70
L	3-	0	924.800	152.99	57.267	.02	-32.733	.00	8599.82	.00	.00
C	3-	0	.000	152.99	57.267	.04	147.267	.00	-4301.49	.00	.00
R	3-	0	80.298	152.99	57.267	1.01	-.543	80.30	127.56	.00	.00

Tower 8 Individually Driven Base Circuit Analysis

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = KLMS8OC.TXT

I	1.0000	0	1	.0000	.0000	.0000
R	1.0000	1	2	.0000	.0000	.0000
L	3.9900	2	3	.0000	.0000	.0000
C	.0000	3	0	.0000	.0000	.0000
R	91.8320	3	0	137.6900	.0000	.0000
EX	.0000	0	0	.0000	.0000	.0000

FREQ = 1.480

NODE	VOLT MAG	VOLT PHASE
1	202.9475	60.8167
2	202.4618	61.0638
3	170.9356	55.0354

				BRANCH VOLTAGE		BRANCH CURRENT		FROM NODE IMPEDANCE		TO NODE IMPEDANCE	
				MAG	PHASE	MAG	PHASE	RESISTANCE	REACTANCE	RESISTANCE	REACTANCE
R	1-	2	1.000	1.00	.000	1.00	.000	98.96	177.19	97.96	177.19
L	2-	3	3.990	37.10	90.000	1.00	.000	97.96	177.19	97.96	140.08
C	3-	0	.000	170.94	55.035	.04	145.035	.00	-4301.49	.00	.00
R	3-	0	91.832	170.94	55.035	1.03	-1.263	91.83	137.69	.00	.00

Derivation of Operating Parameters for Daytime Directional Antenna - KLMS

The method of moments model of the array, following verification with the measured individual open circuited base impedances, was utilized for directional antenna calculations. Calculations were made to determine the complex voltage values for sources located at the base insulator level under each tower of the array to produce current moment sums for the towers that, when normalized, equated to the theoretical field parameters of the authorized directional antenna pattern with towers 6, 7 and 8 detuned. With these voltage sources, the tower currents were calculated. The currents at the ATU unit outputs, where the antenna monitor samples are taken, were calculated from the method of moments tower currents for directional antenna operation using WCAP circuit modeling with the assumptions that were derived from the single tower measurements on the array and the method of moments calculated tower operating impedances. For detuning, inductors within the ATUs of towers 6, 7 and 8 were adjusted to the opposite reactances of those of their calculated operating impedances. In each of the following WCAP tabulations, node 2 represents the reference point and node 3 represents the tower feedpoint. Node 0 represents ground potential. The tower operating impedances are represented by complex loads from node 3 to ground (R 3 - 0). It should be noted that the calculated reference point current magnitudes and phases appear in the first and fourth columns following the drive current sources (I 0 -1)). As the current transformers and sampling lines are identical, the antenna monitor ratios and phases corresponding to the theoretical parameters were calculated directly from the modeled reference point currents.

Tower	Modeled Current Pulse	Modeled Current Magnitude @ Toroid (amperes)	Modeled Current Phase @ Toroid (degrees)	Modeled Antenna Monitor Ratio	Modeled Antenna Monitor Phase (degrees)
1	1	0.1745	+ 36.8	0.075	+ 160.9
2	16	0.8795	+ 146.2	0.378	- 89.7
3	31	2.3280	- 124.1	1.000	0.0
4	46	1.8349	- 13.1	0.788	+ 111.0
5	61	0.6633	+ 94.1	0.285	- 141.8
6	76	--	--	Detuned	--
7	91	--	--	Detuned	--
8	106	--	--	Detuned	--

Tower 1 Day DA Base Circuit Analysis

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = KLMS1DAD.TXT

I	17.4500	0	1	36.8300	.0000	.0000
R	1.0000	1	2	.0000	.0000	.0000
L	4.2050	2	3	.0000	.0000	.0000
L	924.8000	3	0	.0000	.0000	.0000
C	.0000	3	0	.0000	.0000	.0000
R	862.1600	3	0	1078.8000	.0000	.0000
EX	.0000	0	0	.0000	.0000	.0000

FREQ = 1.480

NODE	VOLT MAG	VOLT PHASE
1	27870.4900	82.6341
2	27858.3300	82.6598
3	27373.0300	81.6646

				BRANCH VOLTAGE		BRANCH CURRENT		FROM NODE IMPEDANCE		TO NODE IMPEDANCE	
				MAG	PHASE	MAG	PHASE	RESISTANCE	REACTANCE	RESISTANCE	REACTANCE
R	1-	2	1.000	17.45	36.832	17.45	36.832	1113.41	1145.04	1112.41	1145.04
L	2-	3	4.205	682.34	126.830	17.45	36.830	1112.40	1145.10	1112.40	1106.00
L	3-	0	924.800	27373.03	81.665	3.18	-8.335	.00	8599.82	.00	.00
C	3-	0	.000	27373.03	81.665	6.36	171.665	.00	-4301.49	.00	.00
R	3-	0	862.160	27373.03	81.665	19.82	30.296	862.16	1078.80	.00	.00

Tower 2 Day DA Base Circuit Analysis

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = KLMS2DAD.TXT

I	87.9520	0	1	146.2000	.0000	.0000
R	1.0000	1	2	.0000	.0000	.0000
L	4.4990	2	3	.0000	.0000	.0000
C	.0001	3	0	.0000	.0000	.0000
R	164.2100	3	0	290.3800	.0000	.0000
EX	.0000	0	0	.0000	.0000	.0000

FREQ = 1.480

NODE	VOLT MAG	VOLT PHASE
1	47849.5200	-170.0014
2	47786.0800	-169.9284
3	45313.6500	-173.2844

				BRANCH VOLTAGE		BRANCH CURRENT		FROM NODE IMPEDANCE		TO NODE IMPEDANCE	
				MAG	PHASE	MAG	PHASE	RESISTANCE	REACTANCE	RESISTANCE	REACTANCE
R	1-	2	1.000	87.95	146.199	87.95	146.199	392.68	376.55	391.68	376.55
L	2-	3	4.499	3679.62	-123.800	87.95	146.200	391.68	376.54	391.68	334.71
C	3-	0	.000	45313.65	-173.284	61.10	-83.284	.00	-741.64	.00	.00
R	3-	0	164.210	45313.65	-173.284	135.83	126.204	164.21	290.38	.00	.00

Currents are multiplied X 100 for improved resolution.

Tower 3 Day DA Base Circuit Analysis

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = KLMS3DAD.TXT

I	232.8000	0	1	235.8900	.0000	.0000	
R	1.0000	1	2	.0000	.0000	.0000	
L	5.3550	2	3	.0000	.0000	.0000	
C	.0000	3	0	.0000	.0000	.0000	
R	79.0820	3	0	155.0200	.0000	.0000	
EX	.0000	0	0	.0000	.0000	.0000	

FREQ = 1.480

NODE	VOLT MAG	VOLT PHASE
1	52617.7500	-56.4948
2	52529.5300	-56.2600
3	42020.3300	-62.2306

			BRANCH VOLTAGE		BRANCH CURRENT		FROM NODE IMPEDANCE		TO NODE IMPEDANCE	
			MAG	PHASE	MAG	PHASE	RESISTANCE	REACTANCE	RESISTANCE	REACTANCE
R	1- 2	1.000	232.80	-124.110	232.80	-124.110	86.07	208.99	85.07	208.99
L	2- 3	5.355	11592.68	-34.110	232.80	-124.110	85.07	208.99	85.07	159.19
C	3- 0	.000	42020.33	-62.231	9.77	27.769	.00	-4301.49	.00	.00
R	3- 0	79.082	42020.33	-62.231	241.46	-125.203	79.08	155.02	.00	.00

Tower 4 Day DA Base Circuit Analysis

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = KLMS4DAD.TXT

I	183.4900	0	1	346.9300	.0000	.0000	
R	1.0000	1	2	.0000	.0000	.0000	
L	5.2370	2	3	.0000	.0000	.0000	
C	.0000	3	0	.0000	.0000	.0000	
R	53.4250	3	0	122.6100	.0000	.0000	
EX	.0000	0	0	.0000	.0000	.0000	

FREQ = 1.480

NODE	VOLT MAG	VOLT PHASE
1	33662.9000	58.6326
2	33605.7500	58.9296
3	25258.6500	52.6533

			BRANCH VOLTAGE		BRANCH CURRENT		FROM NODE IMPEDANCE		TO NODE IMPEDANCE	
			MAG	PHASE	MAG	PHASE	RESISTANCE	REACTANCE	RESISTANCE	REACTANCE
R	1- 2	1.000	183.49	-13.070	183.49	-13.070	57.60	174.18	56.60	174.18
L	2- 3	5.237	8935.86	76.930	183.49	-13.070	56.60	174.18	56.60	125.48
C	3- 0	.000	25258.65	52.653	5.87	142.653	.00	-4301.49	.00	.00
R	3- 0	53.425	25258.65	52.653	188.86	-13.802	53.43	122.61	.00	.00

Currents are multiplied X 100 for improved resolution.

Tower 5 Day DA Base Circuit Analysis

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = KLMS5DAD.TXT

I	66.3318	0	1	94.0700	.0000	.0000
R	1.0000	1	2	.0000	.0000	.0000
L	4.4310	2	3	.0000	.0000	.0000
L	924.8000	3	0	.0000	.0000	.0000
C	.0000	3	0	.0000	.0000	.0000
R	24.6010	3	0	92.0180	.0000	.0000
EX	.0000	0	0	.0000	.0000	.0000

FREQ = 1.480

NODE	VOLT MAG	VOLT PHASE
1	9065.3380	173.0451
2	9052.8870	173.4572
3	6386.3490	168.9365

			BRANCH VOLTAGE		BRANCH CURRENT		FROM NODE IMPEDANCE		TO NODE IMPEDANCE	
			MAG	PHASE	MAG	PHASE	RESISTANCE	REACTANCE	RESISTANCE	REACTANCE
R	1- 2	1.000	66.33	94.070	66.33	94.070	26.14	134.14	25.14	134.14
L	2- 3	4.431	2733.16	-175.930	66.33	94.070	25.14	134.14	25.14	92.94
L	3- 0	924.800	6386.35	168.936	.74	78.936	.00	8599.82	.00	.00
C	3- 0	.000	6386.35	168.936	1.48	-101.064	.00	-4301.49	.00	.00
R	3- 0	24.601	6386.35	168.936	67.05	93.904	24.60	92.02	.00	.00

Tower 6 Day DA Base Circuit Analysis

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = KLMS6DAD.TXT

I	1.7150	0	1	86.3000	.0000	.0000
R	1.0000	1	2	.0000	.0000	.0000
L	4.8280	2	3	.0000	.0000	.0000
L	924.8000	3	0	.0000	.0000	.0000
C	.0000	3	0	.0000	.0000	.0000
R	-10.4900	3	0	-446.1500	.0000	.0000
EX	.0000	0	0	.0000	.0000	.0000

FREQ = 1.480

NODE	VOLT MAG	VOLT PHASE
1	650.6204	-4.9810
2	650.6611	-5.1320
3	727.6364	-4.9805

			BRANCH VOLTAGE		BRANCH CURRENT		FROM NODE IMPEDANCE		TO NODE IMPEDANCE	
			MAG	PHASE	MAG	PHASE	RESISTANCE	REACTANCE	RESISTANCE	REACTANCE
R	1- 2	1.000	1.71	86.301	1.71	86.301	-8.48	-379.28	-9.48	-379.28
L	2- 3	4.828	77.00	176.300	1.72	86.300	-9.48	-379.28	-9.48	-424.17
L	3- 0	924.800	727.64	-4.981	.08	-94.980	.00	8599.82	.00	.00
C	3- 0	.000	727.64	-4.981	.17	85.019	.00	-4301.49	.00	.00
R	3- 0	-10.490	727.64	-4.981	1.63	86.366	-10.49	-446.15	.00	.00

Currents are multiplied X 100 for improved resolution.

Tower 7 Day DA Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


FILE NAME = KLMS7DAD.TXT

I    13.3724    0    1  165.8000     .0000     .0000
R     1.0000    1    2     .0000     .0000     .0000
L     4.0000    2    3     .0000     .0000     .0000
L   924.8000    3    0     .0000     .0000     .0000
C      .0000    3    0     .0000     .0000     .0000
R     8.7324    3    0 -415.5100     .0000     .0000
EX     .0000    0    0     .0000     .0000     .0000


FREQ = 1.480

  NODE       VOLT MAG      VOLT PHASE
   1       4804.6370        77.2268
   2       4804.3230        77.0674
   3       5301.6200        76.9485
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG       PHASE        MAG     PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
R    1-  2     1.000     13.37   165.800     13.37   165.800      8.94   -359.18      7.94   -359.18
L    2-  3     4.000    497.41  -104.200     13.37   165.800      7.95   -359.18      7.95   -396.38
L    3-  0   924.800   5301.62    76.949       .62   -13.051       .00   8599.82       .00       .00
C    3-  0      .000   5301.62    76.949      1.23   166.949       .00  -4301.49       .00       .00
R    3-  0     8.732   5301.62    76.949     12.76   165.745      8.73   -415.51       .00       .00
```

Tower 8 Day DA Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


FILE NAME = KLMS8DAD.TXT

I    26.2834    0    1  196.3000     .0000     .0000
R     1.0000    1    2     .0000     .0000     .0000
L     3.9900    2    3     .0000     .0000     .0000
C      .0000    3    0     .0000     .0000     .0000
R     5.0193    3    0 -415.8400     .0000     .0000
EX     .0000    0    0     .0000     .0000     .0000


FREQ = 1.480

  NODE       VOLT MAG      VOLT PHASE
   1       8992.1520       107.1664
   2       8991.7940       106.9990
   3       9966.9340       106.9306
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG       PHASE        MAG     PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
R    1-  2     1.000     26.28  -163.700     26.28  -163.700      5.17   -342.08      4.17   -342.08
L    2-  3     3.990    975.21   -73.700     26.28  -163.700      4.17   -342.08      4.17   -379.19
C    3-  0      .000   9966.93   106.931      2.32  -163.069       .00  -4301.49       .00       .00
R    3-  0     5.019   9966.93   106.931     23.97  -163.761      5.02   -415.84       .00       .00
```

Currents are multiplied X 100 for improved resolution.

Derivation of Operating Parameters for Nighttime Directional Antenna - KLMS

The method of moments model of the array, following verification with the measured individual open circuited base impedances, was utilized for directional antenna calculations. Calculations were made to determine the complex voltage values for sources located at the base insulator level under each tower of the array to produce current moment sums for the towers that, when normalized, equated to the theoretical field parameters of the authorized directional antenna pattern with towers 1, 2, 3 and 4 detuned. With these voltage sources, the tower currents were calculated. The currents at the ATU unit outputs, where the antenna monitor samples are taken, were calculated from the method of moments tower currents for directional antenna operation using WCAP circuit modeling with the assumptions that were derived from the single tower measurements on the array and the method of moments calculated tower operating impedances. For detuning, inductors within the ATUs of towers 1, 2, 3 and 4 were adjusted to the opposite reactances of those of their calculated operating impedances. In each of the following WCAP tabulations, node 2 represents the reference point and node 3 represents the tower feedpoint. Node 0 represents ground potential. The tower operating impedances are represented by complex loads from node 3 to ground (R 3 - 0). It should be noted that the calculated reference point current magnitudes and phases appear in the first and fourth columns following the drive current sources (I 0 -1)). As the current transformers and sampling lines are identical, the antenna monitor ratios and phases corresponding to the theoretical parameters were calculated directly from the modeled reference point currents.

Tower	Modeled Current Pulse	Modeled Current Magnitude @ Toroid (amperes)	Modeled Current Phase @ Toroid (degrees)	Modeled Antenna Monitor Ratio	Modeled Antenna Monitor Phase (degrees)
1	1	--	--	Detuned	--
2	16	--	--	Detuned	--
3	31	--	--	Detuned	--
4	46	--	--	Detuned	--
5	61	1.4407	+ 9.7	1.000	0.0
6	76	1.5171	+ 131.8	1.053	+ 122.1
7	91	2.0049	- 106.5	1.392	- 116.2
8	106	1.6362	+133.7	1.136	+ 124.0

Tower 1 Night DA Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


FILE NAME = KLMS1DAN.TXT

I    30.4730    0    1  130.1000     .0000     .0000
R     1.0000    1    2     .0000     .0000     .0000
L     4.2050    2    3     .0000     .0000     .0000
L   924.8000    3    0     .0000     .0000     .0000
C      .0000    3    0     .0000     .0000     .0000
R     7.0440    3    0 -416.6200     .0000     .0000
EX     .0000    0    0     .0000     .0000     .0000


FREQ = 1.480

  NODE       VOLT MAG     VOLT PHASE
   1     10920.3500        41.2846
   2     10919.7600        41.1247
   3     12111.1700        41.0239
                         BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                           MAG       PHASE       MAG     PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
R    1-  2      1.000      30.47   130.099     30.47   130.099       7.41   -358.29       6.41   -358.29
L    2-  3      4.205    1191.58  -139.900     30.47   130.100       6.41   -358.28       6.41   -397.39
L    3-  0    924.800   12111.17    41.024      1.41   -48.976        .00   8599.82        .00       .00
C    3-  0       .000   12111.17    41.024      2.82   131.024        .00  -4301.49        .00       .00
R    3-  0      7.044   12111.17    41.024     29.07   130.055       7.04   -416.62        .00       .00
```

Tower 2 Night DA Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


FILE NAME = KLMS2DAN.TXT

I    36.4000    0    1  171.2000     .0000     .0000
R     1.0000    1    2     .0000     .0000     .0000
L     4.4990    2    3     .0000     .0000     .0000
C      .0001    3    0     .0000     .0000     .0000
R     2.0601    3    0 -409.1300     .0000     .0000
EX     .0000    0    0     .0000     .0000     .0000


FREQ = 1.480

  NODE       VOLT MAG     VOLT PHASE
   1      8075.1640        81.6793
   2      8074.9410        81.4210
   3      9597.7880        81.3859
                         BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                           MAG       PHASE       MAG     PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
R    1-  2      1.000      36.40   171.200     36.40   171.200       1.86   -221.84        .86   -221.84
L    2-  3      4.499    1522.86   -98.800     36.40   171.200        .86   -221.84        .86   -263.67
C    3-  0       .000    9597.79    81.386     12.94   171.386        .00   -741.64        .00       .00
R    3-  0      2.060    9597.79    81.386     23.46   171.097       2.06   -409.13        .00       .00
```

Currents are multiplied X 100 for improved resolution.

Tower 3 Night DA Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM

 FILE NAME = KLMS3DAN.TXT

 I    15.3880    0    1   81.2000     .0000     .0000
 R     1.0000    1    2     .0000     .0000     .0000
 L     5.3550    2    3     .0000     .0000     .0000
 C      .0000    3    0     .0000     .0000     .0000
 R     9.9466    3    0 -425.0000     .0000     .0000
 EX     .0000    0    0     .0000     .0000     .0000

 FREQ = 1.480

   NODE      VOLT MAG     VOLT PHASE
    1      5187.7820       -7.2298
    2      5187.3830       -7.3997
    3      5953.4560       -7.5799
                            BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                             MAG      PHASE       MAG     PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
 R    1-  2      1.000      15.39    81.201     15.39    81.201       9.24   -337.01       8.24   -337.01
 L    2-  3      5.355     766.27   171.200     15.39    81.200       8.24   -337.01       8.24   -386.80
 C    3-  0       .000    5953.46    -7.580      1.38    82.420        .00  -4301.49        .00        .00
 R    3-  0      9.947    5953.46    -7.580     14.00    81.079       9.95   -425.00        .00        .00
```

Tower 4 Night DA Base Circuit Analysis

```
 WESTBERG CIRCUIT ANALYSIS PROGRAM

 FILE NAME = KLMS4DAN.TXT

 I    38.1930    0    1   77.6000     .0000     .0000
 R     1.0000    1    2     .0000     .0000     .0000
 L     5.2370    2    3     .0000     .0000     .0000
 C      .0000    3    0     .0000     .0000     .0000
 R     4.6875    3    0 -421.7000     .0000     .0000
 EX     .0000    0    0     .0000     .0000     .0000

 FREQ = 1.480

   NODE      VOLT MAG     VOLT PHASE
    1     12809.5200      -11.5650
    2     12809.0200      -11.7358
    3     14668.8900      -11.8200
                            BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                             MAG      PHASE       MAG     PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
 R    1-  2      1.000      38.19    77.599     38.19    77.599       4.89   -335.35       3.89   -335.35
 L    2-  3      5.237    1859.98   167.600     38.19    77.600       3.89   -335.35       3.89   -384.05
 C    3-  0       .000   14668.89   -11.820      3.41    78.180        .00  -4301.49        .00        .00
 R    3-  0      4.688   14668.89   -11.820     34.78    77.543       4.69   -421.70        .00        .00
```

Currents are multiplied X 100 for improved resolution.

Tower 5 Night DA Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


FILE NAME = KLMS5DAN.TXT

I   144.0690    0    1    9.7300     .0000     .0000
R     1.0000    1    2     .0000     .0000     .0000
L     4.4310    2    3     .0000     .0000     .0000
L   924.8000    3    0     .0000     .0000     .0000
C      .0000    3    0     .0000     .0000     .0000
R    93.1010    3    0  157.3400     .0000     .0000
EX     .0000    0    0     .0000     .0000     .0000

FREQ = 1.480

  NODE       VOLT MAG     VOLT PHASE
   1     32114.1000        73.7664
   2     32051.2900        73.9979
   3     26827.7800        68.4851
                           BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                           MAG      PHASE      MAG     PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
R    1-  2      1.000    144.07     9.730    144.07     9.730     97.59    200.41     96.59    200.41
L    2-  3      4.431   5936.27    99.730    144.07     9.730     96.59    200.41     96.59    159.21
L    3-  0    924.800  26827.78    68.485      3.12   -21.515       .00   8599.82       .00       .00
C    3-  0       .000  26827.78    68.485      6.24   158.485       .00  -4301.49       .00       .00
R    3-  0     93.101  26827.78    68.485    146.74     9.099     93.10    157.34       .00       .00
```

Tower 6 Night DA Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


FILE NAME = KLMS6DAN.TXT

I   151.7060    0    1  131.8000     .0000     .0000
R     1.0000    1    2     .0000     .0000     .0000
L     4.8280    2    3     .0000     .0000     .0000
L   924.8000    3    0     .0000     .0000     .0000
C      .0000    3    0     .0000     .0000     .0000
R    15.9550    3    0  135.0600     .0000     .0000
EX     .0000    0    0     .0000     .0000     .0000

FREQ = 1.480

  NODE       VOLT MAG     VOLT PHASE
   1     27749.2200      -143.6799
   2     27735.1400      -143.3680
   3     20960.8000      -145.0452
                           BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                           MAG      PHASE      MAG     PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
R    1-  2      1.000    151.71   131.800    151.71   131.800     17.47    182.08     16.47    182.08
L    2-  3      4.828   6811.01  -138.200    151.71   131.800     16.47    182.08     16.47    137.18
L    3-  0    924.800  20960.80  -145.045      2.44   124.955       .00   8599.82       .00       .00
C    3-  0       .000  20960.80  -145.045      4.87   -55.045       .00  -4301.49       .00       .00
R    3-  0     15.955  20960.80  -145.045    154.12   131.692     15.95    135.06       .00       .00
```

Currents are multiplied X 100 for improved resolution.

Tower 7 Night DA Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


FILE NAME = KLMS7DAN.TXT

I   200.4910    0    1  253.5000     .0000     .0000
R     1.0000    1    2     .0000     .0000     .0000
L     4.0000    2    3     .0000     .0000     .0000
L   924.8000    3    0     .0000     .0000     .0000
C      .0000    3    0     .0000     .0000     .0000
R    30.6950    3    0  115.5800     .0000     .0000
EX     .0000    0    0     .0000     .0000     .0000


FREQ = 1.480

  NODE      VOLT MAG     VOLT PHASE
   1     31603.4400       -28.4119
   2     31562.6700       -28.0557
   3     24302.2400       -31.5801
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                            MAG      PHASE       MAG     PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
R    1-  2      1.000    200.49  -106.500    200.49  -106.500      32.54    154.24      31.54    154.24
L    2-  3      4.000   7457.55   -16.500    200.49  -106.500      31.54    154.24      31.54    117.04
L    3-  0    924.800  24302.24   -31.580      2.83  -121.580        .00   8599.82        .00       .00
C    3-  0       .000  24302.24   -31.580      5.65    58.420        .00  -4301.49        .00       .00
R    3-  0     30.695  24302.24   -31.580    203.22  -106.707      30.70    115.58        .00       .00
```

Tower 8 Night DA Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


FILE NAME = KLMS8DAN.TXT

I   163.6200    0    1  133.7000     .0000     .0000
R     1.0000    1    2     .0000     .0000     .0000
L     3.9900    2    3     .0000     .0000     .0000
C      .0000    3    0     .0000     .0000     .0000
R   130.1800    3    0  202.1500     .0000     .0000
EX     .0000    0    0     .0000     .0000     .0000


FREQ = 1.480

  NODE      VOLT MAG     VOLT PHASE
   1     46468.3500      -166.8116
   2     46385.4800      -166.6375
   3     41260.0300      -170.8995
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                            MAG      PHASE       MAG     PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
R    1-  2      1.000    163.62   133.700    163.62   133.700     144.19    244.67     143.19    244.67
L    2-  3      3.990   6070.87  -136.300    163.62   133.700     143.19    244.67     143.19    207.57
C    3-  0       .000  41260.03  -170.900      9.59   -80.900        .00  -4301.49        .00       .00
R    3-  0    130.180  41260.03  -170.900    171.60   131.881     130.18    202.15        .00       .00
```

Currents are multiplied X 100 for improved resolution.

Method of Moments Model Details for Towers Driven Individually – KLMS

The array of towers was modeled using Expert MININEC Broadcast Professional Version 14.5. The tower geometry was specified using the geographic coordinate system. Each tower was modeled using a wire having 15 segments. The towers are all physically 102.9 degrees in electrical height and their segment length is 6.86 electrical degrees.

The individual tower model characteristics were adjusted to provide a match of their modeled impedances - when presented to a circuit model which included branches representing the shunt capacitances, lighting chokes and feedline hookup inductances - with the base impedances that were measured at the output jacks of the tuning units while the other towers of the array were open circuited. The method of moments model assumed loads at ground level having the reactances that were calculated for them using the base circuit models for the open circuited towers of the array.

Each tower's modeled height relative to its physical height falls within the required range of 75 to 125 percent.

TOWER	Physical Height (degrees)	Modeled Height (degrees)	Modeled Percent of Height
1	102.9	108.9	105.8
2	102.9	111.8	108.6
3	102.9	107.7	104.7
4	102.9	108.3	105.2
5	102.9	108.9	105.8
6	102.9	108.9	105.8
7	102.9	109.5	106.4
8	102.9	109.5	106.4

All of the towers are identical, being triangular in cross section with a face width of 18 inches. They were modeled with the radius of a circle having a circumference equal to the sum of the widths of the tower sides.

The following pages show the details of the method of moments models for the individually driven towers. The numerals in the file names shown on the tabulations correspond to the tower numbers.

Tower 1 Driven Individually

CC:\MBPRO14.5\KLMS1OC 12-05-2014   13:23:45

IMPEDANCE

normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 1, sector 1							
1.48	80.656	131.86	154.57	58.5	6.3876	-2.7421	-3.2961

GEOMETRY

Wire coordinates in degrees; other dimensions in meters

Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.218	15
		0	0	108.9		
2	none	100.	89.	0	.218	15
		100.	89.	111.8		
3	none	200.	89.	0	.218	15
		200.	89.	107.7		
4	none	300.	89.	0	.218	15
		300.	89.	108.3		
5	none	400.	89.	0	.218	15
		400.	89.	108.9		
6	none	446.8	99.4	0	.218	15
		446.8	99.4	108.9		
7	none	266.1	148.8	0	.218	15
		266.1	148.8	109.5		
8	none	176.4	146.6	0	.218	15
		176.4	146.6	109.5		

Number of wires = 8

current nodes = 120

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	3	7.18	2	7.45333
radius	1	.218	1	.218

ELECTRICAL DESCRIPTION

Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	segment length (wavelengths) maximum
1	1.48	0	1	.0199444	.0207037

Sources

source	node	sector	magnitude	phase	type
1	1	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	16	0	-741.6	0	0	0
2	31	0	-4,301.4	0	0	0
3	46	0	-4,301.4	0	0	0
4	61	0	-8,605.6	0	0	0
5	76	0	-8,605.6	0	0	0
6	91	0	-8,605.6	0	0	0
7	106	0	-4,301.4	0	0	0

Tower 2 Driven Individually

C:\MBPRO14.5\KLMS2OC 12-05-2014 13:28:50

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 16, sector 1							
1.48	92.579	152.22	178.16	58.7	7.2598	-2.4082	-3.7095

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.218	15
		0	0	108.9		
2	none	100.	89.	0	.218	15
		100.	89.	111.8		
3	none	200.	89.	0	.218	15
		200.	89.	107.7		
4	none	300.	89.	0	.218	15
		300.	89.	108.3		
5	none	400.	89.	0	.218	15
		400.	89.	108.9		
6	none	446.8	99.4	0	.218	15
		446.8	99.4	108.9		
7	none	266.1	148.8	0	.218	15
		266.1	148.8	109.5		
8	none	176.4	146.6	0	.218	15
		176.4	146.6	109.5		

Number of wires = 8
current nodes = 120

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	3	7.18	2	7.45333
radius	1	.218	1	.218

ELECTRICAL DESCRIPTION

Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	1.48	0	1	.0199444	.0207037

Sources

source	node	sector	magnitude	phase	type
1	16	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	0	-8,605.6	0	0	0
2	31	0	-4,301.4	0	0	0
3	46	0	-4,301.4	0	0	0
4	61	0	-8,605.6	0	0	0
5	76	0	-8,605.6	0	0	0
6	91	0	-8,605.6	0	0	0
7	106	0	-4,301.4	0	0	0

Tower 3 Driven Individually

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IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 31, sector 1							
1.48	74.902	120.1	141.54	58.	5.8458	-3.0012	-3.0194

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.218	15
		0	0	108.9		
2	none	100.	89.	0	.218	15
		100.	89.	111.8		
3	none	200.	89.	0	.218	15
		200.	89.	107.7		
4	none	300.	89.	0	.218	15
		300.	89.	108.3		
5	none	400.	89.	0	.218	15
		400.	89.	108.9		
6	none	446.8	99.4	0	.218	15
		446.8	99.4	108.9		
7	none	266.1	148.8	0	.218	15
		266.1	148.8	109.5		
8	none	176.4	146.6	0	.218	15
		176.4	146.6	109.5		

Number of wires = 8
current nodes = 120

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	3	7.18	2	7.45333
radius	1	.218	1	.218

ELECTRICAL DESCRIPTION

Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	1.48	0	1	.0199444	.0207037

Sources

source	node	sector	magnitude	phase	type
1	31	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	0	-8,605.6	0	0	0
2	16	0	-741.6	0	0	0
3	46	0	-4,301.4	0	0	0
4	61	0	-8,605.6	0	0	0
5	76	0	-8,605.6	0	0	0
6	91	0	-8,605.6	0	0	0
7	106	0	-4,301.4	0	0	0

Tower 4 Driven Individually

```
C:\MBPRO14.5\KLMS4OC  12-05-2014   13:35:54

IMPEDANCE
   normalization = 50.
freq     resist   react    imped    phase    VSWR    S11      S12
(MHz)    (ohms)   (ohms)   (ohms)   (deg)            dB       dB
source =  1; node 46, sector 1
1.48     81.057   126.55   150.29   57.4     6.0238  -2.9108  -3.1121

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire  caps Distance     Angle        Z            radius      segs
 1    none 0            0            0            .218         15
           0            0            108.9
 2    none 100.         89.          0            .218         15
           100.         89.          111.8
 3    none 200.         89.          0            .218         15
           200.         89.          107.7
 4    none 300.         89.          0            .218         15
           300.         89.          108.3
 5    none 400.         89.          0            .218         15
           400.         89.          108.9
 6    none 446.8        99.4         0            .218         15
           446.8        99.4         108.9
 7    none 266.1        148.8        0            .218         15
           266.1        148.8        109.5
 8    none 176.4        146.6        0            .218         15
           176.4        146.6        109.5

Number of wires         =  8
          current nodes  =  120

                        minimum                   maximum
Individual wires      wire    value             wire  value
segment length         3      7.18               2    7.45333
radius                 1      .218               1    .218
```

ELECTRICAL DESCRIPTION

Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	1.48	0	1	.0199444	.0207037

Sources

source	node	sector	magnitude	phase	type
1	46	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	0	-8,605.6	0	0	0
2	16	0	-741.6	0	0	0
3	31	0	-4,301.4	0	0	0
4	61	0	-8,605.6	0	0	0
5	76	0	-8,605.6	0	0	0
6	91	0	-8,605.6	0	0	0
7	106	0	-4,301.4	0	0	0

Tower 5 Driven Individually

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IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 61, sector 1							
1.48	80.382	130.5	153.27	58.4	6.3085	-2.7771	-3.2567

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.218	15
		0	0	108.9		
2	none	100.	89.	0	.218	15
		100.	89.	111.8		
3	none	200.	89.	0	.218	15
		200.	89.	107.7		
4	none	300.	89.	0	.218	15
		300.	89.	108.3		
5	none	400.	89.	0	.218	15
		400.	89.	108.9		
6	none	446.8	99.4	0	.218	15
		446.8	99.4	108.9		
7	none	266.1	148.8	0	.218	15
		266.1	148.8	109.5		
8	none	176.4	146.6	0	.218	15
		176.4	146.6	109.5		

Number of wires = 8
current nodes = 120

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	3	7.18	2	7.45333
radius	1	.218	1	.218

ELECTRICAL DESCRIPTION

Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	1.48	0	1	.0199444	.0207037

Sources

source	node	sector	magnitude	phase	type
1	61	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	0	-8,605.6	0	0	0
2	16	0	-741.6	0	0	0
3	31	0	-4,301.4	0	0	0
4	46	0	-4,301.4	0	0	0
5	76	0	-8,605.6	0	0	0
6	91	0	-8,605.6	0	0	0
7	106	0	-4,301.4	0	0	0

Tower 6 Driven Individually

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IMPEDANCE

normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 76, sector 1							
1.48	86.858	130.38	156.66	56.3	6.0619	-2.8921	-3.1318

GEOMETRY

Wire coordinates in degrees; other dimensions in meters

Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.218	15
		0	0	108.9		
2	none	100.	89.	0	.218	15
		100.	89.	111.8		
3	none	200.	89.	0	.218	15
		200.	89.	107.7		
4	none	300.	89.	0	.218	15
		300.	89.	108.3		
5	none	400.	89.	0	.218	15
		400.	89.	108.9		
6	none	446.8	99.4	0	.218	15
		446.8	99.4	108.9		
7	none	266.1	148.8	0	.218	15
		266.1	148.8	109.5		
8	none	176.4	146.6	0	.218	15
		176.4	146.6	109.5		

Number of wires = 8

current nodes = 120

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	3	7.18	2	7.45333
radius	1	.218	1	.218

ELECTRICAL DESCRIPTION

Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	1.48	0	1	.0199444	.0207037

Sources

source	node	sector	magnitude	phase	type
1	76	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	0	-8,605.6	0	0	0
2	16	0	-741.6	0	0	0
3	31	0	-4,301.4	0	0	0
4	46	0	-4,301.4	0	0	0
5	61	0	-8,605.6	0	0	0
6	91	0	-8,605.6	0	0	0
7	106	0	-4,301.4	0	0	0

Tower 7 Driven Individually

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IMPEDANCE

normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 91, sector 1							
1.48	80.298	127.56	150.73	57.8	6.1179	-2.8652	-3.1604

GEOMETRY

Wire coordinates in degrees; other dimensions in meters

Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.218	15
		0	0	108.9		
2	none	100.	89.	0	.218	15
		100.	89.	111.8		
3	none	200.	89.	0	.218	15
		200.	89.	107.7		
4	none	300.	89.	0	.218	15
		300.	89.	108.3		
5	none	400.	89.	0	.218	15
		400.	89.	108.9		
6	none	446.8	99.4	0	.218	15
		446.8	99.4	108.9		
7	none	266.1	148.8	0	.218	15
		266.1	148.8	109.5		
8	none	176.4	146.6	0	.218	15
		176.4	146.6	109.5		

Number of wires = 8

current nodes = 120

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	3	7.18	2	7.45333
radius	1	.218	1	.218

ELECTRICAL DESCRIPTION

Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	1.48	0	1	.0199444	.0207037

Sources

source	node	sector	magnitude	phase	type
1	91	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	0	-8,605.6	0	0	0
2	16	0	-741.6	0	0	0
3	31	0	-4,301.4	0	0	0
4	46	0	-4,301.4	0	0	0
5	61	0	-8,605.6	0	0	0
6	76	0	-8,605.6	0	0	0
7	106	0	-4,301.4	0	0	0

Tower 8 Driven Individually

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IMPEDANCE

normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 106, sector 1							
1.48	91.832	137.69	165.5	56.3	6.3525	-2.7576	-3.2787

GEOMETRY

Wire coordinates in degrees; other dimensions in meters

Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.218	15
		0	0	108.9		
2	none	100.	89.	0	.218	15
		100.	89.	111.8		
3	none	200.	89.	0	.218	15
		200.	89.	107.7		
4	none	300.	89.	0	.218	15
		300.	89.	108.3		
5	none	400.	89.	0	.218	15
		400.	89.	108.9		
6	none	446.8	99.4	0	.218	15
		446.8	99.4	108.9		
7	none	266.1	148.8	0	.218	15
		266.1	148.8	109.5		
8	none	176.4	146.6	0	.218	15
		176.4	146.6	109.5		

Number of wires = 8

current nodes = 120

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	3	7.18	2	7.45333
radius	1	.218	1	.218

ELECTRICAL DESCRIPTION

Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	1.48	0	1	.0199444	.0207037

Sources

source	node	sector	magnitude	phase	type
1	106	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	0	-8,605.6	0	0	0
2	16	0	-741.6	0	0	0
3	31	0	-4,301.4	0	0	0
4	46	0	-4,301.4	0	0	0
5	61	0	-8,605.6	0	0	0
6	76	0	-8,605.6	0	0	0
7	91	0	-8,605.6	0	0	0

Method of Moments Model Details for Daytime Directional Antenna - KLMS

The array of towers was modeled using Expert MININEC Broadcast Professional Version 14.5 with the characteristics that were verified by the individual tower impedance measurements. Calculations were made to determine the complex voltage values for sources located at the base insulator level under each tower of the array to produce current moment sums for the towers that, when normalized, equated to the theoretical field parameters of the authorized directional antenna pattern. The following pages contain details of the method of moments model of the directional antenna pattern.

Tower	Wires	Base Node
1	1	1
2	2	16
3	3	31
4	4	46
5	5	61
6	6	76
7	7	91
8	8	106

It should be noted that voltages and currents shown on the tabulations that are not specified as “rms” values are the corresponding peak values.

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MEDIUM WAVE ARRAY SYNTHESIS FROM FIELD RATIOS

Frequency = 1.48 MHz

tower	field ratio magnitude	phase (deg)
1	1.	0
2	2.98	113.
3	4.03	227.
4	2.98	340.5
5	1.	91.
6	0	0
7	0	0
8	0	0

VOLTAGES AND CURRENTS - rms

source node	voltage magnitude	phase (deg)	current magnitude	phase (deg)
1	273.732	81.7	.198219	30.3
16	453.137	186.8	1.35833	126.2
31	420.212	297.8	2.41462	234.8
46	252.596	52.6	1.8887	346.2
61	63.8635	169.	.670482	93.9
76	7.27627	355.1	.0163044	86.4
91	53.0131	76.9	.127559	165.7
106	99.6638	106.9	.239652	196.2

Sum of square of source currents = 23.6109
Total power = 1,000. watts

NOTE: The array synthesis calculations (above) were performed to solve for the base voltage drives required to produce the specified field parameters, including the detuned condition for towers 6, 7 and 8 which are unused in the daytime. The detuning reactances at the tower bases are equal in magnitude and opposite in sign to the reactive components of the operating impedances that were determined using the voltage sources from the array synthesis calculations.

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.218	15
		0	0	108.9		
2	none	100.	89.	0	.218	15
		100.	89.	111.8		
3	none	200.	89.	0	.218	15
		200.	89.	107.7		
4	none	300.	89.	0	.218	15
		300.	89.	108.3		
5	none	400.	89.	0	.218	15
		400.	89.	108.9		
6	none	446.8	99.4	0	.218	15
		446.8	99.4	108.9		
7	none	266.1	148.8	0	.218	15
		266.1	148.8	109.5		
8	none	176.4	146.6	0	.218	15
		176.4	146.6	109.5		

Number of wires = 8
current nodes = 120

Individual wires	minimum wire	minimum value	maximum wire	maximum value
segment length	3	7.18	2	7.45333
radius	1	.218	1	.218

ELECTRICAL DESCRIPTION

Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	1.48	0	1	.0199444	.0207037

Sources

source	node	sector	magnitude	phase	type
1	1	1	387.116	81.7	voltage
2	16	1	640.832	186.8	voltage
3	31	1	594.269	297.8	voltage
4	46	1	357.224	52.6	voltage
5	61	1	90.3166	169.	voltage
6	76	1	10.2902	355.1	voltage
7	91	1	74.9718	76.9	voltage
8	106	1	140.946	106.9	voltage

IMPEDANCE

normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 1, sector 1							
1.48	862.16	1,078.8	1,381.	51.4	44.274	-.39244	-10.635
source = 2; node 16, sector 1							
1.48	164.21	290.38	333.6	60.5	13.786	-1.2623	-5.982
source = 3; node 31, sector 1							
1.48	79.082	155.02	174.03	63.	8.1692	-2.1372	-4.1042
source = 4; node 46, sector 1							
1.48	53.425	122.61	133.74	66.5	7.4985	-2.3306	-3.8165
source = 5; node 61, sector 1							
1.48	24.601	92.018	95.25	75.	9.3008	-1.875	-4.5516
source = 6; node 76, sector 1							
1.48	-10.49	-446.15	446.28	268.7	****	****	****
source = 7; node 91, sector 1							
1.48	8.7324	-415.51	415.6	271.2	401.31	-4.3E-02	-20.036
source = 8; node 106, sector 1							
1.48	5.0193	-415.84	415.87	270.7	699.1	-2.5E-02	-22.437

CURRENT rms
Frequency = 1.48 MHz
Input power = 1,000. watts
Efficiency = 100. %
coordinates in degrees

current no.	X	Y	Z	mag (amps)	phase (deg)	real (amps)	imaginary (amps)
GND	0	0	0	.198219	30.3	.171126	.100034
2	0	0	7.26	.383369	10.4	.377093	.0690821
3	0	0	14.52	.505024	5.5	.502712	.0482696
4	0	0	21.78	.597926	2.9	.59715	.0304594
5	0	0	29.04	.666095	1.3	.665928	.0149349
6	0	0	36.3	.711124	.1	.711123	1.51E-03
7	0	0	43.56	.733773	359.2	.733708	-9.8E-03
8	0	0	50.82	.734588	358.5	.734344	-.0189242
9	0	0	58.08	.714098	357.9	.713633	-.0257762
10	0	0	65.34	.672943	357.4	.672262	-.0302586
11	0	0	72.6	.611844	357.	.610992	-.0322868
12	0	0	79.86	.531578	356.6	.530627	-.0317842
13	0	0	87.12	.432814	356.2	.431863	-.0286701
14	0	0	94.38	.315712	355.9	.314886	-.022822
15	0	0	101.64	.178731	355.5	.178184	-.0139633
END	0	0	108.9	0	0	0	0
GND	1.74524	-99.9848	0	1.35833	126.3	-.803195	1.09542
17	1.74524	-99.9848	7.45333	1.66616	120.3	-.840106	1.43886
18	1.74524	-99.9848	14.9067	1.84705	117.5	-.852417	1.63859
19	1.74524	-99.9848	22.36	1.96966	115.6	-.850048	1.77679
20	1.74524	-99.9848	29.8133	2.04129	114.1	-.834393	1.86296
21	1.74524	-99.9848	37.2667	2.06488	113.	-.806285	1.90096
22	1.74524	-99.9848	44.72	2.04218	112.	-.76644	1.8929
23	1.74524	-99.9848	52.1733	1.97474	111.2	-.715613	1.84052
24	1.74524	-99.9848	59.6267	1.86434	110.6	-.654643	1.74563
25	1.74524	-99.9848	67.08	1.71298	109.9	-.584433	1.6102
26	1.74524	-99.9848	74.5333	1.52296	109.4	-.505947	1.43647
27	1.74524	-99.9848	81.9867	1.29668	108.9	-.420153	1.22672
28	1.74524	-99.9848	89.44	1.03629	108.4	-.327916	.98304
29	1.74524	-99.9848	96.8933	.742777	108.	-.229735	.706356
30	1.74524	-99.9848	104.347	.41331	107.6	-.12499	.393957
END	1.74524	-99.9848	111.8	0	0	0	0
GND	3.49047	-199.97	0	2.41462	234.8	-1.39199	-1.973
32	3.49047	-199.97	7.18	2.68921	231.7	-1.66639	-2.11068
33	3.49047	-199.97	14.36	2.83131	230.	-1.81824	-2.17033
34	3.49047	-199.97	21.54	2.90767	228.8	-1.91521	-2.18782
35	3.49047	-199.97	28.72	2.92602	227.8	-1.96525	-2.1678
36	3.49047	-199.97	35.9	2.88991	227.	-1.97184	-2.11268
37	3.49047	-199.97	43.08	2.80175	226.3	-1.93701	-2.0243
38	3.49047	-199.97	50.26	2.66384	225.6	-1.86253	-1.90448
39	3.49047	-199.97	57.44	2.47864	225.1	-1.75017	-1.75516
40	3.49047	-199.97	64.62	2.24888	224.6	-1.60186	-1.57846
41	3.49047	-199.97	71.8	1.97752	224.1	-1.41969	-1.37662
42	3.49047	-199.97	78.98	1.66753	223.7	-1.20577	-1.15186
43	3.49047	-199.97	86.16	1.32144	223.3	-.961884	-.906086
44	3.49047	-199.97	93.34	.940249	222.9	-.68868	-.640147
45	3.49047	-199.97	100.52	.520084	222.5	-.383208	-.351624
END	3.49047	-199.97	107.7	0	0	0	0
GND	5.23571	-299.954	0	1.88869	346.2	1.83395	-.451431
47	5.23571	-299.954	7.22	2.05602	344.	1.97666	-.565711
48	5.23571	-299.954	14.44	2.13647	342.8	2.04123	-.630794
49	5.23571	-299.954	21.66	2.17185	341.9	2.06444	-.674566
50	5.23571	-299.954	28.88	2.16727	341.1	2.05102	-.700268
51	5.23571	-299.954	36.1	2.12518	340.5	2.00334	-.709235
52	5.23571	-299.954	43.32	2.0474	339.9	1.92321	-.702227
53	5.23571	-299.954	50.54	1.93567	339.4	1.81236	-.679842

54	5.23571	-299.954	57.76	1.79189	339.	1.67267	-.642686
55	5.23571	-299.954	64.98	1.61813	338.6	1.50618	-.59142
56	5.23571	-299.954	72.2	1.41663	338.2	1.31505	-.52676
57	5.23571	-299.954	79.42	1.1896	337.8	1.10143	-.44943
58	5.23571	-299.954	86.64	.938956	337.5	.867181	-.36005
59	5.23571	-299.954	93.86	.665514	337.1	.613128	-.258809
60	5.23571	-299.954	101.08	.366683	336.8	.336991	-.144546
END	5.23571	-299.954	108.3	0	0	0	0
GND	6.98095	-399.939	0	.670482	93.9	-.0458921	.668909
62	6.98095	-399.939	7.26	.714016	92.9	-.0362442	.713096
63	6.98095	-399.939	14.52	.73238	92.3	-.0295404	.731784
64	6.98095	-399.939	21.78	.736871	91.8	-.0235793	.736494
65	6.98095	-399.939	29.04	.728949	91.4	-.0181436	.728723
66	6.98095	-399.939	36.3	.709393	91.1	-.0131846	.70927
67	6.98095	-399.939	43.56	.67882	90.7	-8.72E-03	.678764
68	6.98095	-399.939	50.82	.637833	90.4	-4.78E-03	.637815
69	6.98095	-399.939	58.08	.5871	90.1	-1.43E-03	.587098
70	6.98095	-399.939	65.34	.527347	89.9	1.28E-03	.527346
71	6.98095	-399.939	72.6	.459346	89.6	3.28E-03	.459334
72	6.98095	-399.939	79.86	.383863	89.3	4.51E-03	.383836
73	6.98095	-399.939	87.12	.301563	89.1	4.92E-03	.301523
74	6.98095	-399.939	94.38	.212754	88.8	4.43E-03	.212708
75	6.98095	-399.939	101.64	.116671	88.5	2.97E-03	.116634
END	6.98095	-399.939	108.9	0	0	0	0
GND	-72.9741	-440.8	0	.0163044	86.4	1.02E-03	.0162723
77	-72.9741	-440.8	7.26	.0106796	87.1	5.49E-04	.0106655
78	-72.9741	-440.8	14.52	7.03E-03	87.8	2.65E-04	7.02E-03
79	-72.9741	-440.8	21.78	4.03E-03	89.2	5.74E-05	4.03E-03
80	-72.9741	-440.8	29.04	1.54E-03	93.4	-9.03E-05	1.54E-03
81	-72.9741	-440.8	36.3	5.33E-04	249.6	-1.86E-04	-4.99E-04
82	-72.9741	-440.8	43.56	2.12E-03	263.6	-2.37E-04	-2.11E-03
83	-72.9741	-440.8	50.82	3.31E-03	265.7	-2.49E-04	-3.3E-03
84	-72.9741	-440.8	58.08	4.1E-03	266.8	-2.3E-04	-4.09E-03
85	-72.9741	-440.8	65.34	4.5E-03	267.6	-1.89E-04	-4.5E-03
86	-72.9741	-440.8	72.6	4.55E-03	268.3	-1.35E-04	-4.55E-03
87	-72.9741	-440.8	79.86	4.26E-03	269.	-7.73E-05	-4.26E-03
88	-72.9741	-440.8	87.12	3.67E-03	269.6	-2.5E-05	-3.67E-03
89	-72.9741	-440.8	94.38	2.79E-03	270.3	1.25E-05	-2.79E-03
90	-72.9741	-440.8	101.64	1.63E-03	270.9	2.59E-05	-1.63E-03
END	-72.9741	-440.8	108.9	0	0	0	0
GND	-227.613	-137.847	0	.127559	165.7	-.123595	.0315505
92	-227.613	-137.847	7.3	.0862241	165.2	-.0833452	.0220945
93	-227.613	-137.847	14.6	.0588751	164.6	-.0567517	.0156692
94	-227.613	-137.847	21.9	.0359152	163.7	-.0344631	.0101092
95	-227.613	-137.847	29.2	.0163269	161.4	-.0154762	5.2E-03
96	-227.613	-137.847	36.5	1.05E-03	59.2	5.35E-04	8.99E-04
97	-227.613	-137.847	43.8	.0139473	348.5	.0136659	-2.79E-03
98	-227.613	-137.847	51.1	.0246328	346.3	.0239347	-5.82E-03
99	-227.613	-137.847	58.4	.0323802	345.4	.0313346	-8.16E-03
100	-227.613	-137.847	65.7	.0371628	344.8	.0358589	-9.76E-03
101	-227.613	-137.847	73.	.0389681	344.3	.0375089	-.0105639
102	-227.613	-137.847	80.3	.0377921	343.8	.0362949	-.0105319
103	-227.613	-137.847	87.6	.0336265	343.4	.0322236	-9.61E-03
104	-227.613	-137.847	94.9	.0264185	343.	.0252607	-7.74E-03
105	-227.613	-137.847	102.2	.015951	342.6	.0152171	-4.78E-03
END	-227.613	-137.847	109.5	0	0	0	0
GND	-147.267	-97.1048	0	.239653	196.2	-.23009	-.0670214
107	-147.267	-97.1048	7.3	.161927	195.9	-.155705	-.0444569
108	-147.267	-97.1048	14.6	.11049	195.6	-.106426	-.0296918
109	-147.267	-97.1048	21.9	.0673035	195.	-.0649986	-.0174623
110	-147.267	-97.1048	29.2	.0304501	193.7	-.0295887	-7.19E-03
111	-147.267	-97.1048	36.5	1.37E-03	73.9	3.8E-04	1.32E-03
112	-147.267	-97.1048	43.8	.0263513	18.	.0250583	8.15E-03

113	-147.267	-97.1048	51.1	.0464069	16.7	.0444469	.0133446
114	-147.267	-97.1048	58.4	.0609034	16.1	.0585037	.0169274
115	-147.267	-97.1048	65.7	.0698052	15.7	.0671868	.0189393
116	-147.267	-97.1048	73.	.0731009	15.4	.0704716	.019429
117	-147.267	-97.1048	80.3	.0707994	15.1	.0683514	.0184564
118	-147.267	-97.1048	87.6	.0629052	14.8	.0608136	.0160865
119	-147.267	-97.1048	94.9	.0493451	14.5	.0477689	.0123724
120	-147.267	-97.1048	102.2	.0297438	14.2	.0288333	7.3E-03
END	-147.267	-97.1048	109.5	0	0	0	0

Method of Moments Model Details for Nighttime Directional Antenna - KLMS

The array of towers was modeled using Expert MININEC Broadcast Professional Version 14.5 with the characteristics that were verified by the individual tower impedance measurements. Calculations were made to determine the complex voltage values for sources located at the base insulator level under each tower of the array to produce current moment sums for the towers that, when normalized, equated to the theoretical field parameters of the authorized directional antenna pattern. The following pages contain details of the method of moments model of the directional antenna pattern.

Tower	Wires	Base Node
1	1	1
2	2	16
3	3	31
4	4	46
5	5	61
6	6	76
7	7	91
8	8	106

It should be noted that voltages and currents shown on the tabulations that are not specified as “rms” values are the corresponding peak values.

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MEDIUM WAVE ARRAY SYNTHESIS FROM FIELD RATIOS

Frequency = 1.48 MHz

tower	field ratio magnitude	phase (deg)
1	0	0
2	0	0
3	0	0
4	0	0
5	1.	0
6	1.	130.
7	1.28	-110.
8	1.28	120.

VOLTAGES AND CURRENTS - rms

source node	voltage magnitude	phase (deg)	current magnitude	phase (deg)
1	121.109	41.1	.290653	130.1
16	95.9733	81.3	.234577	171.1
31	59.5343	352.4	.140044	81.1
46	146.685	348.1	.347819	77.5
61	268.291	68.5	1.46749	9.1
76	209.606	215.	1.54118	131.7
91	243.013	328.5	2.03218	253.3
106	412.612	189.1	1.71608	131.9

Sum of square of source currents = 23.767
Total power = 750. watts

NOTE: The array synthesis calculations (above) were performed to solve for the base voltage drives required to produce the specified field parameters, including the detuned condition for towers 1, 2, 3 and 4 which are unused at night. The detuning reactances at the tower bases are equal in magnitude and opposite in sign to the reactive components of the operating impedances that were determined using the voltage sources from the array synthesis calculations.

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.218	15
		0	0	108.9		
2	none	100.	89.	0	.218	15
		100.	89.	111.8		
3	none	200.	89.	0	.218	15
		200.	89.	107.7		
4	none	300.	89.	0	.218	15
		300.	89.	108.3		
5	none	400.	89.	0	.218	15
		400.	89.	108.9		
6	none	446.8	99.4	0	.218	15
		446.8	99.4	108.9		
7	none	266.1	148.8	0	.218	15
		266.1	148.8	109.5		
8	none	176.4	146.6	0	.218	15
		176.4	146.6	109.5		

Number of wires = 8
current nodes = 120

Individual wires	minimum wire	minimum value	maximum wire	maximum value
segment length	3	7.18	2	7.45333
radius	1	.218	1	.218

ELECTRICAL DESCRIPTION

Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	1.48	0	1	.0199444	.0207037

Sources

source	node	sector	magnitude	phase	type
1	1	1	171.274	41.1	voltage
2	16	1	135.727	81.3	voltage
3	31	1	84.1942	352.4	voltage
4	46	1	207.444	348.1	voltage
5	61	1	379.421	68.5	voltage
6	76	1	296.428	215.	voltage
7	91	1	343.673	328.5	voltage
8	106	1	583.521	189.1	voltage

IMPEDANCE

normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 1, sector 1							
1.48	7.0441	-416.62	416.68	271.	500.04	-3.5E-02	-20.987
source = 2; node 16, sector 1							
1.48	2.0601	-409.13	409.13	270.3	1,649.3	-1.1E-02	-26.158
source = 3; node 31, sector 1							
1.48	9.9466	-425.	425.12	271.3	368.42	-4.7E-02	-19.666
source = 4; node 46, sector 1							
1.48	4.6875	-421.7	421.73	270.6	769.5	-2.3E-02	-22.853
source = 5; node 61, sector 1							
1.48	93.101	157.34	182.82	59.4	7.5855	-2.3035	-3.8549
source = 6; node 76, sector 1							
1.48	15.955	135.06	136.	83.3	26.282	-.66128	-8.5004
source = 7; node 91, sector 1							
1.48	30.695	115.58	119.58	75.1	10.854	-1.605	-5.1009
source = 8; node 106, sector 1							
1.48	130.18	202.15	240.44	57.2	9.1564	-1.9048	-4.497

CURRENT rms
Frequency = 1.48 MHz
Input power = 750. watts
Efficiency = 100. %
coordinates in degrees

current no.	X	Y	Z	mag (amps)	phase (deg)	real (amps)	imaginary (amps)
GND	0	0	0	.290655	130.1	-.18718	.22236
2	0	0	7.26	.196527	129.7	-.125444	.151283
3	0	0	14.52	.134258	129.2	-.0848351	.104059
4	0	0	21.78	.0819518	128.4	-.0509512	.0641878
5	0	0	29.04	.0372883	126.6	-.0222358	.029933
6	0	0	36.3	1.99E-03	22.8	1.83E-03	7.69E-04
7	0	0	43.56	.0317356	312.5	.021421	-.0234155
8	0	0	50.82	.0561445	310.7	.0365911	-.0425829
9	0	0	58.08	.0738418	309.9	.0473665	-.0566482
10	0	0	65.34	.0847658	309.4	.0537782	-.0655221
11	0	0	72.6	.0888866	308.9	.0558763	-.069128
12	0	0	79.86	.0861972	308.6	.0537301	-.067402
13	0	0	87.12	.0766833	308.2	.0474105	-.0602707
14	0	0	94.38	.0602327	307.8	.0369359	-.0475785
15	0	0	101.64	.0363604	307.4	.0221082	-.028867
END	0	0	108.9	0	0	0	0
GND	1.74524	-99.9848	0	.234577	171.1	-.231724	.0364765
17	1.74524	-99.9848	7.45333	.158713	170.9	-.156727	.0250322
18	1.74524	-99.9848	14.9067	.108305	170.8	-.106903	.0173702
19	1.74524	-99.9848	22.36	.0659323	170.5	-.0650302	.010869
20	1.74524	-99.9848	29.8133	.0297462	169.8	-.029279	5.25E-03
21	1.74524	-99.9848	37.2667	1.02E-03	25.3	9.19E-04	4.34E-04
22	1.74524	-99.9848	44.72	.0259628	352.	.0257121	-3.6E-03
23	1.74524	-99.9848	52.1733	.0456217	351.4	.0451062	-6.84E-03
24	1.74524	-99.9848	59.6267	.0597938	351.1	.0590715	-9.27E-03
25	1.74524	-99.9848	67.08	.0684524	350.9	.067586	-.0108564
26	1.74524	-99.9848	74.5333	.0715966	350.7	.0706533	-.0115838
27	1.74524	-99.9848	81.9867	.0692496	350.5	.0683016	-.011419
28	1.74524	-99.9848	89.44	.0614356	350.3	.0605616	-.0103255
29	1.74524	-99.9848	96.8933	.0481081	350.1	.047396	-8.25E-03
30	1.74524	-99.9848	104.347	.0289321	349.9	.0284854	-5.06E-03
END	1.74524	-99.9848	111.8	0	0	0	0
GND	3.49047	-199.97	0	.140043	81.1	.02166	.138358
32	3.49047	-199.97	7.18	.094155	80.5	.0155321	.092865
33	3.49047	-199.97	14.36	.0639746	79.8	.0112931	.06297
34	3.49047	-199.97	21.54	.0387456	78.8	7.54E-03	.0380044
35	3.49047	-199.97	28.72	.01732	76.1	4.15E-03	.0168148
36	3.49047	-199.97	35.9	1.48E-03	318.3	1.11E-03	-9.86E-04
37	3.49047	-199.97	43.08	.0156043	264.2	-1.58E-03	-.0155245
38	3.49047	-199.97	50.26	.0271141	261.8	-3.85E-03	-.0268394
39	3.49047	-199.97	57.44	.0353972	260.8	-5.67E-03	-.0349409
40	3.49047	-199.97	64.62	.0404439	260.1	-6.97E-03	-.039839
41	3.49047	-199.97	71.8	.0422612	259.5	-7.71E-03	-.0415529
42	3.49047	-199.97	78.98	.040865	259.	-7.82E-03	-.0401102
43	3.49047	-199.97	86.16	.0362657	258.5	-7.25E-03	-.0355345
44	3.49047	-199.97	93.34	.0284256	258.	-5.92E-03	-.0278033
45	3.49047	-199.97	100.52	.0171298	257.5	-3.71E-03	-.0167235
END	3.49047	-199.97	107.7	0	0	0	0
GND	5.23571	-299.954	0	.347817	77.5	.0754624	.339532
47	5.23571	-299.954	7.22	.234277	77.2	.0519534	.228444
48	5.23571	-299.954	14.44	.159414	76.9	.0362075	.155247
49	5.23571	-299.954	21.66	.0967094	76.4	.0227782	.0939886
50	5.23571	-299.954	28.88	.0433309	75.1	.0111102	.0418824
51	5.23571	-299.954	36.1	2.25E-03	297.9	1.05E-03	-1.98E-03
52	5.23571	-299.954	43.32	.0386079	258.9	-7.4E-03	-.0378912
53	5.23571	-299.954	50.54	.0674136	257.8	-.0142179	-.0658972

54	5.23571	-299.954	57.76	.0881456	257.3	-.0193279	-.0860005
55	5.23571	-299.954	64.98	.100784	257.	-.022672	-.0982009
56	5.23571	-299.954	72.2	.105342	256.7	-.0241908	-.102526
57	5.23571	-299.954	79.42	.10186	256.5	-.0238264	-.0990338
58	5.23571	-299.954	86.64	.0903713	256.2	-.0215139	-.0877732
59	5.23571	-299.954	93.86	.0707994	256.	-.0171514	-.0686906
60	5.23571	-299.954	101.08	.0426312	255.7	-.0105157	-.0413139
END	5.23571	-299.954	108.3	0	0	0	0
GND	6.98095	-399.939	0	1.46749	9.1	1.44913	.231392
62	6.98095	-399.939	7.26	1.63905	5.4	1.63171	.154948
63	6.98095	-399.939	14.52	1.72913	3.5	1.72596	.104677
64	6.98095	-399.939	21.78	1.7786	2.	1.7775	.0627476
65	6.98095	-399.939	29.04	1.79209	.9	1.79189	.0272366
66	6.98095	-399.939	36.3	1.77171	359.9	1.77171	-2.5E-03
67	6.98095	-399.939	43.56	1.71893	359.1	1.71872	-.0266667
68	6.98095	-399.939	50.82	1.63514	358.4	1.63451	-.0453443
69	6.98095	-399.939	58.08	1.5219	357.8	1.52077	-.0585686
70	6.98095	-399.939	65.34	1.38094	357.2	1.37935	-.0663893
71	6.98095	-399.939	72.6	1.21418	356.7	1.21222	-.0688834
72	6.98095	-399.939	79.86	1.02354	356.3	1.02139	-.066154
73	6.98095	-399.939	87.12	.81069	355.9	.808591	-.0583066
74	6.98095	-399.939	94.38	.576403	355.5	.574614	-.0453795
75	6.98095	-399.939	101.64	.318472	355.1	.317314	-.0271405
END	6.98095	-399.939	108.9	0	0	0	0
GND	-72.9741	-440.8	0	1.54118	131.7	-1.02548	1.1505
77	-72.9741	-440.8	7.26	1.69187	131.1	-1.11161	1.27544
78	-72.9741	-440.8	14.52	1.76553	130.7	-1.15171	1.33816
79	-72.9741	-440.8	21.78	1.80023	130.4	-1.1678	1.37006
80	-72.9741	-440.8	29.04	1.80065	130.2	-1.16266	1.37498
81	-72.9741	-440.8	36.3	1.76907	130.	-1.13767	1.35474
82	-72.9741	-440.8	43.56	1.70708	129.8	-1.09386	1.31057
83	-72.9741	-440.8	50.82	1.61617	129.7	-1.03221	1.2436
84	-72.9741	-440.8	58.08	1.49795	129.5	-.953802	1.15504
85	-72.9741	-440.8	65.34	1.35417	129.4	-.859778	1.04621
86	-72.9741	-440.8	72.6	1.18669	129.3	-.751379	.918511
87	-72.9741	-440.8	79.86	.997403	129.2	-.629859	.773363
88	-72.9741	-440.8	87.12	.787897	129.	-.496279	.611956
89	-72.9741	-440.8	94.38	.55886	128.9	-.351125	.434782
90	-72.9741	-440.8	101.64	.308112	128.8	-.193095	.240098
END	-72.9741	-440.8	108.9	0	0	0	0
GND	-227.613	-137.847	0	2.03217	253.3	-.582979	-1.94676
92	-227.613	-137.847	7.3	2.20154	252.1	-.677251	-2.09478
93	-227.613	-137.847	14.6	2.28076	251.4	-.728278	-2.16136
94	-227.613	-137.847	21.9	2.31269	250.8	-.759263	-2.1845
95	-227.613	-137.847	29.2	2.30269	250.4	-.772974	-2.16908
96	-227.613	-137.847	36.5	2.25345	250.	-.770633	-2.11758
97	-227.613	-137.847	43.8	2.16691	249.7	-.752998	-2.03187
98	-227.613	-137.847	51.1	2.04502	249.4	-.720726	-1.91381
99	-227.613	-137.847	58.4	1.88984	249.1	-.674511	-1.76537
100	-227.613	-137.847	65.7	1.70367	248.8	-.615107	-1.58876
101	-227.613	-137.847	73.	1.48896	248.6	-.543325	-1.38629
102	-227.613	-137.847	80.3	1.24815	248.4	-.459993	-1.1603
103	-227.613	-137.847	87.6	.9834	248.2	-.365822	-.912825
104	-227.613	-137.847	94.9	.695679	248.	-.261103	-.644821
105	-227.613	-137.847	102.2	.382464	247.8	-.14479	-.353997
END	-227.613	-137.847	109.5	0	0	0	0
GND	-147.267	-97.1048	0	1.71607	131.9	-1.14568	1.27763
107	-147.267	-97.1048	7.3	1.97987	126.9	-1.18934	1.58283
108	-147.267	-97.1048	14.6	2.12733	124.4	-1.20138	1.75563
109	-147.267	-97.1048	21.9	2.21886	122.6	-1.19393	1.87026
110	-147.267	-97.1048	29.2	2.26094	121.1	-1.16873	1.93543
111	-147.267	-97.1048	36.5	2.25634	120.	-1.12687	1.95479
112	-147.267	-97.1048	43.8	2.20685	119.	-1.06932	1.93048

113	-147.267	-97.1048	51.1	2.11416	118.1	-.997056	1.86428
114	-147.267	-97.1048	58.4	1.98014	117.4	-.911206	1.75802
115	-147.267	-97.1048	65.7	1.80694	116.7	-.812968	1.61373
116	-147.267	-97.1048	73.	1.59696	116.1	-.703595	1.43361
117	-147.267	-97.1048	80.3	1.35263	115.6	-.584332	1.2199
118	-147.267	-97.1048	87.6	1.0761	115.1	-.456265	.974584
119	-147.267	-97.1048	94.9	.768287	114.6	-.31995	.698496
120	-147.267	-97.1048	102.2	.42615	114.2	-.174361	.388847
END	-147.267	-97.1048	109.5	0	0	0	0

Sampling System Measurements – KLMS

Impedance measurements were made of the antenna monitor sampling system using an Advantest R3754B network analyzer and a Tunwall Radio directional coupler in a calibrated measurement system. The measurements were made looking into the antenna monitor ends of the sampling lines for two conditions – with them open circuited at their tower ends and with them connected to the sampling devices at the tower bases.

The following table shows two adjacent frequencies where resonance – zero reactance corresponding with low resistance – was found. As the length of a distortionless transmission line is 180 electrical degrees at the difference frequency between adjacent frequencies of resonance, and frequencies of resonance occur at odd multiples of 90 degrees electrical length, the sampling line length at the resonant frequency below carrier frequency was found to be 630 electrical degrees and the length at the resonant frequency above carrier frequency was found to be 810 electrical degrees. As the resonant frequencies below carrier frequency are the closest to carrier frequency, in terms of their ratios to carrier frequency, the electrical lengths at carrier frequency appearing in the table below were calculated by ratioing them to carrier frequency.

Tower	Sampling Line Open-Circuited Resonance Below 1480 kHz (kHz)	Sampling Line Open-Circuited Resonance Above 1480 kHz (kHz)	Sampling Line Calculated Electrical Length at 1480 kHz (degrees)	1480 KHz Measured Impedance with Toroid Connected (Ohms)
1	1403.1	1807.6	664.5	47.9 – j 1.1
2	1403.5	1807.6	664.3	48.2 – j 1.4
3	1403.1	1807.6	664.5	47.9 – j 1.1
4	1402.8	1807.2	664.7	48.8 – j 1.7
5	1403.3	1807.4	664.4	47.9 – j 1.3
6	1403.6	1807.8	664.3	49.2 – j 1.8
7	1402.6	1806.3	664.8	47.4 – j 0.4
8	1402.8	1807.5	664.7	48.3 – j 1.4

The sampling line lengths meet the requirement that they be equal in length within 1 electrical degree.

The characteristic impedance was calculated using the following formula, where $R_1 + j X_1$ and $R_2 + j X_2$ are the measured impedances at the +45 and –45 degree offset frequencies, respectively:

$$Zo = ((R_1^2 + X_1^2)^{1/2} \bullet (R_2^2 + X_2^2)^{1/2})^{1/2}$$

Tower	-45 Degree Offset Frequency (kHz)	-45 Degree Measured Impedance (Ohms)	+45 Degree Offset Frequency (kHz)	+45 Degree Measured Impedance (Ohms)	Calculated Characteristic Impedance (Ohms)
1	1302.88	18.46 –j 45.02	1503.32	21.71 +j 44.49	49.1
2	1303.25	18.37 –j 45.03	1503.75	21.98 +j 44.81	49.3
3	1302.88	18.16 –j 44.69	1503.32	21.47 +j 44.34	48.7
4	1302.60	18.56 –j 45.32	1503.00	21.94 +j 44.99	49.5
5	1303.06	18.24 –j 44.71	1503.54	21.69 +j 44.34	48.8
6	1303.34	18.80 –j 45.92	1503.86	22.32 +j 45.53	50.1
7	1302.41	18.23 –j 44.62	1502.79	21.08 +j 43.85	48.4
8	1302.60	18.62 –j 45.46	1503.00	21.67+j 44.73	49.4

The sampling line measured characteristic impedances meet the requirement that they be equal within 2 ohms.

The toroidal transformers were calibrated by measuring their outputs with a common reference signal using an Advantest R3754B network analyzer in a calibrated measurement system. They were placed side-by-side with a conductor carrying the reference signal passing through them and their outputs were fed into the A and B receiver inputs of the analyzer which was configured to measure the relative ratios and phases of their output voltages. The following results were found for carrier frequency, 1480 kilohertz:

Tower	Toroid Ratio	Toroid Phase (Degrees)
1	Reference	Reference
2	1.000	- 0.04
3	1.000	- 0.08
4	0.999	-0.05
5	0.999	-0.05
6	1.002	-0.21
7	1.002	-0.15
8	1.001	+0.04

Delta type TCT-3 toroidal transformers are rated for absolute magnitude accuracy of +/- 2% and absolute phase accuracy of +/- 3 degrees. As the maximum measured transformer-to-transformer variations were no more than 0.2 percent and 0.25 degree, they provide far more accurate relative indications than could be the case within their rated accuracies.

Reference Field Strength Measurements – KLMS

Reference field strength measurements were made at three locations each along the 2.5, 32, 59.5, 118.5, 146 and 175.5 degree radials specified for monitoring by the station license for the daytime pattern and the 35, 96.5, 163, 209.5 and 323 degree radials specified for monitoring by the station license for the nighttime pattern. Additionally, measurements were made on major lobe radials at 269 degrees true for the daytime pattern and at 353 degrees true for the nighttime pattern. The measured field strengths, descriptions and GPS coordinates for the reference measurement points are shown on the following pages.

Reference Field Strength Measurements

KLMS DA-D

Radial (Deg.)	Point	Dist. (Km)	Field (mV/m)	Coordinates (NAD 27)		Description
				N	W	
2.5	1	3.49	1.43	40-49-40.0	96-34-49.5	N side road near mailbox 10200
	2	5.11	5.51	40-50-32.4	96-34-46.6	N side road between two tree groups
	3	6.73	3.82	40-51-24.7	96-34-43.2	S side road, opposite W end of trees to N
32	1	4.09	2.76	40-49-39.5	96-33-23.1	N side road at mailbox 12201
	2	6.74	3.35	40-50-52.3	96-32-23.2	W side road, N of subdivision entry
	3	7.86	3.46	40-51-23.1	96-31-57.8	S side road, E of culvert
59.5	1	2.30	5.61	40-48-24.7	96-33-31.3	E side road, N of farm drive on W
	2	3.67	0.78	40-48-47.3	96-32-40.7	Driveway to 12900
	3	6.00	2.21	40-49-25.7	96-31-14.7	W side road N of 1000 drive on W
118.5	1	2.85	7.33	40-47-02.8	96-33-08.8	N side road W of HV power line
	2	4.59	4.48	40-46-36.1	96-32-03.3	W side road at fence corner
	3	5.90	1.03	40-46-15.9	96-31-14.0	E side road at N edge of tree line
146	1	5.54	6.17	40-45-18.3	96-32-43.6	S side road opposite W end fence on N
	2	6.51	2.76	40-44-52.3	96-32-20.2	S side road at no litter sign
	3	7.48	7.96	40-44-26.1	96-31-57.3	S side road W of tree stand

Reference Field Strength Measurements

KLMS DA-D Continued

175.5	1	4.59	2.59	40-45-18.8	96-34-40.8	N side road at nursery sign
	2	6.22	5.61	40-44-26.1	96-34-35.3	S side road E of driveway 10405
	3	7.83	5.79	40-43-34.1	96-34-29.6	S side road opposite driveways 10700 and 10720
269	1	2.73	212.8	40-47-45.4	96-36-52.6	Trendwood Park sign on S 77th
	2	3.86	143.4	40-47-44.9	96-37-41.3	NE corner, Sumner & Brighton
	3	4.60	134.5	40-47-44.5	96-38-13.0	NE corner, Sumner & Crestline

Reference Field Strength Measurements

KLMS DA-N

Radial (Deg.)	Point	Dist. (Km)	Field (mV/m)	Coordinates (NAD 27)		Description
				N	W	
35	1	4.23	7.43	40-49-39.3	96-33-12.5	E driveway at 12300 Holdrege
	2	6.19	5.13	40-50-31.3	96-32-23.9	NW corner, 134 & Adams
	3	8.14	7.70	40-51-23.1	96-31-35.9	Top of hill at field entrance, S side of road
96.5	1	3.61	3.77	40-47-33.7	96-32-22.6	E side road at telco pedestal
	2	5.22	2.40	40-47-27.9	96-31-13.9	E side road at field entrance with water pipe
	3	6.83	2.07	40-47-21.9	96-30-05.8	W side road at field entrance N of farm
163	1	3.10	8.89	40-46-10.9	96-34-17.4	N side road at field entrance by tree line
	2	4.80	3.88	40-45-18.3	96-33-55.9	S side road by gas marker post
	3	6.48	1.27	40-44-26.3	96-33-35.0	S side road opposite driveway to shop
209.5	1	3.39	2.64	40-46-11.5	96-36-07.4	N side by telco pad SE of building
	2	4.06	2.04	40-45-52.7	96-36-21.7	Stop sign, SW corner 84 & Mandarin
	3	5.24	1.79	40-45-19.3	96-36-46.3	N side road at Burrington Park sign
323	1	3.19	23.6	40-49-09.6	96-36-18.2	Mailbox 630 Sunny Slope Road
	2	4.40	16.0	40-49-40.9	96-36-49.4	Sidewalk in front of Church S entrance
	3	5.27	17.4	40-50-03.5	96-37-11.7	NW corner Ammon and Garland

Reference Field Strength Measurements

KLMS DA-N Continued

Radial (Deg.)	Point	Dist. (Km)	Field (mV/m)	Coordinates (NAD 27)		Description
				N	W	
353	1	3.53	151.2	40-49-40.4	96-35-14.4	N side road opposite shop building
	2	5.16	89.4	40-50-33.0	96-35-22.9	N side road opposite flood plane sign
	3	6.80	69.3	40-51-25.5	96-35-31.6	S side road at field entrance

All of the field strength observations were made on December 16 and 17, 2014 by Mr. Robert Cook. The measurements were made with Potomac Instruments FIM-4100 field strength meter serial number 161. Prior to the measurements, a calibration check was made by comparison with Potomac Instruments FIM-41, serial number 1506, which was most recently calibrated in a standard field by its manufacturer on May 19, 2014 and the indications of both were found to be in agreement.

Direct Measurement of Power - KLMS

Common point impedance measurements were made using a Delta Electronics OIB-1 Operating Impedance Bridge. The bridge was placed in the circuit adjacent to the common point current meter that is used to determine operating power. The common point impedance was adjusted to 50.0 + j 0.0 ohms for both directional patterns.

Section 73.51(b)(1) of the FCC Rules specifies that the authorized antenna input power of a directional antenna for up to five kilowatts nominal power shall be increased by 8 percent above the nominal power. For the daytime 1,000 watt pattern, the common point current was calculated for 1,080 watts antenna input power. For the nighttime 750 watt pattern, the common point current was calculated for 810 watts antenna input power.

Antenna Monitor and Sampling System - KLMS

The base current sampling devices are Delta Electronics Type TCT-3 shielded toroidal transformers located at the ATU output reference points. The TCT-3 transformers have a sensitivity of 1.0 volt per ampere of RF current. The toroids are connected through equal length foam heliax sampling lines to the antenna monitor. The outdoor portions of the sampling lines are buried underground and are exposed to identical environmental conditions.

The antenna monitor is a Potomac Instruments model AM-1901. It was purchased new and installed before the system was adjusted to the modeled antenna parameters. It has a new calibration performed by its manufacturer.

RFR Protection – KLMS

No changes have been made to the KLMS antenna system other than adjustment to the computer modeled antenna monitor parameters shown herein. The RF networks inside their enclosures, the towers and the ground system remain unchanged. Fences to restrict access to areas near the towers remain in place. The measures to restrict human exposure to radio frequency fields previously provided to the FCC remain in force at the KLMS transmitter site.

Derivation of Inverted Nighttime Directional Antenna Parameters KLMS

The KLMS nighttime directional antenna pattern, which remains unchanged, was adjusted to field parameters based upon ratio inversion of an embedded tower pair. By mathematical analysis, the parameters of the four towers were found to be from multiplication of two tower pairs that define null locations of the resulting pattern shape. As the array employs equal height towers positioned symmetrically with the geometry of a parallelogram, the embedded design pairs can be inverted (having their field ratios changed to their inverse values) in any combination to achieve different base impedance, power division and pattern bandwidth characteristics.[1] The parameters were adjusted to one of the four possible sets of theoretical field parameters that produce the same pattern shape.

To demonstrate the equivalence of the pattern shape for the field parameters to which the directional antenna system was adjusted - as shown in the analysis contained herein - to the pattern shape calculated for the theoretical parameters shown on the station license, tabulations for both appear on the following pages. For sake of comparison, the patterns corresponding to both sets of parameters were calculated using the present-day standard one-ohm loss assumption. It can be seen that the patterns are identical within the range allowed by rounding of the normalized field ratios and phases, with no difference in standard field approaching two percent at any azimuth. As the accuracy required by 47 CFR 73.1215 for the indicating instruments used to determine the power of broadcast stations is two percent of their full scale value, there is no significant difference between the inverted nighttime directional antenna pattern of this adjustment and the licensed pattern.

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[1] Rackley, Ronald D. *AM Antenna Systems*, chapter 4.3 of NAB Engineering Handbook, 10th ed., ed. Edmund Williams, National Association of Broadcasters (Washington, 2007), pp.721-722.

CALCULATION USING LICENSED PARAMETERS

AM BROADCAST STATION KLMS
LINCOLN, NEBRASKA

1480 KHZ   1.0 KW-D   0.75 KW–N   DA-2

NIGHTTIME STANDARD RADIATION PATTERN DATA
(Radiation Values at One Kilometer)

TOWER Number	Field Ratio	Phase (deg)	Spacing (deg)	Bearing (deg)	Height (deg)
5	1.280	0.0	340.0	63.0	102.9
6	1.280	+130.0	351.7	77.8	102.9
7	1.000	-110.0	90.0	153.0	102.9
8	1.000	+120.0	0.0	0.0	102.9

Input Power (kW)	Loop Loss (ohms)	Theoretical RMS (mV/m)	Theoretical RSS (mV/m)	Q Factor (mV/m)	Standard RMS (mV/m)
0.75	1.00	277.4	333.9	10.0	291.5

Azimuth (deg)	Field (mV/m)	Azimuth (deg)	Field (mV/m)	Azimuth (deg)	Field (mV/m)	Azimuth (deg)	Field (mV/m)
0	603.	90	12.7	180	134.	270	424.
5	538.	95	10.8	185	138.	275	479.
10	452.	100	12.5	190	126.	280	529.
15	355.	105	27.8	195	102.	285	567.
20	257.	110	55.3	200	69.2	290	588.
25	166.	115	90.9	205	33.2	295	584.
30	94.2	120	130.	210	12.0	300	550.
35	62.3	125	167.	215	42.4	305	483.
40	79.0	130	195.	220	73.5	310	384.
45	103.	135	211.	225	101.	315	257.
50	118.	140	209.	230	126.	320	122.
55	122.	145	188.	235	150.	325	108.
60	115.	150	151.	240	175.	330	248.
65	100.0	155	101.	245	203.	335	390.
70	80.1	160	47.9	250	235.	340	508.
75	58.1	165	36.1	255	274.	345	592.
80	37.0	170	77.3	260	319.	350	635.
85	20.7	175	113.	265	370.	355	638.

CALCULATION USING INVERTED PARAMETERS

AM BROADCAST STATION KLMS
LINCOLN, NEBRASKA

1480 kHz   1.0 KW-D   0.75 KW-N   DA-2

NIGHTTIME STANDARD RADIATION PATTERN DATA
(Radiation Values at One Kilometer)

TOWER Number	Field Ratio	Phase (deg)	Spacing (deg)	Bearing (deg)	Height (deg)
5	1.000	0.0	340.0	63.0	102.9
6	1.000	+130.0	351.7	77.8	102.9
7	1.280	-110.0	90.0	153.0	102.9
8	1.280	+120.0	0.0	0.0	102.9

Input Power (kW)	Loop Loss (ohms)	Theoretical RMS (mV/m)	Theoretical RSS (mV/m)	Q Factor (mV/m)	Standard RMS (mV/m)
0.75	1.00	277.4	333.9	10.0	291.5

Azimuth (deg)	Field (mV/m)	Azimuth (deg)	Field (mV/m)	Azimuth (deg)	Field (mV/m)	Azimuth (deg)	Field (mV/m)
0	603.	90	12.5	180	134.	270	424.
5	538.	95	10.7	185	138.	275	479.
10	452.	100	12.6	190	126.	280	529.
15	355.	105	27.9	195	102.	285	567.
20	257.	110	55.5	200	69.3	290	588.
25	166.	115	91.0	205	33.3	295	584.
30	94.5	120	130.	210	12.0	300	550.
35	62.7	125	167.	215	42.3	305	483.
40	79.2	130	195.	220	73.4	310	384.
45	104.	135	211.	225	101.	315	257.
50	118.	140	209.	230	126.	320	122.
55	122.	145	188.	235	150.	325	108.
60	115.	150	151.	240	175.	330	248.
65	100.	155	101.	245	203.	335	390.
70	80.1	160	48.5	250	235.	340	508.
75	58.0	165	36.8	255	274.	345	592.
80	37.0	170	77.6	260	319.	350	635.
85	20.6	175	113.	265	370.	355	638.

Antenna Monitor Parameters and Antenna System Description Information KLMS

Section III, question 8, of FCC Form 302 does not have sufficient space for providing the antenna monitor indications for the eight KLMS towers. Likewise, question 9 does not have sufficient space for the requested information for all eight towers. The information is provided in the following tabulations:

FCC Form 302 Section III Question 8 Day DA Information			
Antenna indications for directional operation			
Towers	Antenna monitor phase reading(s) in degrees	Antenna monitor sample current ratio(s)	Antenna Base Currents
1	+ 160.9	0.075	N/A
2	-89.7	0.378	N/A
3	0.0	1.000	N/A
4	+111.0	0.788	N/A
5	-141.8	0.285	N/A
6	--	--	N/A
7	--	--	N/A
8	--	--	N/A

FCC Form 302 Section III Question 8 Night DA Information			
Antenna indications for directional operation			
Towers	Antenna monitor phase reading(s) in degrees	Antenna monitor sample current ratio(s)	Antenna Base Currents
1	--	--	N/A
2	--	--	N/A
3	--	--	N/A
4	--	--	N/A
5	0.0	1.000	N/A
6	+122.1	1.053	N/A
7	-116.2	1.392	N/A
8	+124.0	1.136	N/A

FCC Form 302 Section III Question 9 Tower Information				
Description of antenna system				
Type Radiator	Overall height in meters of radiator above base insulator, or above base, if grounded.	Overall height in meters above ground (without obstruction lighting)	Overall height in meters above ground (include obstruction lighting)	If antenna is either top loaded or sectionalized, describe fully in an Exhibit.
Tower 1 uniform cross section, guyed, series fed	57.9	59.2	60.3	N/A
Tower 2 uniform cross section, guyed, series fed	57.9	58.9	60.1	N/A
Tower 3 uniform cross section, guyed, series fed	57.9	59.3	59.3	N/A
Tower 4 uniform cross section, guyed, series fed	57.9	59.2	59.9	N/A
Tower 5 uniform cross section, guyed, series fed	57.9	58.9	59.6	N/A
Tower 6 uniform cross section, guyed, series fed	57.9	59.3	59.9	N/A
Tower 7 uniform cross section, guyed, series fed	57.9	58.7	59.6	N/A
Tower 8 uniform cross section, guyed, series fed	57.9	58.8	59.7	N/A

Tower Numbering - KLMS

There is confusion with regard to the numbering scheme for the towers of the KLMS directional antenna system in the FCC records. The standard patterns in the FCC's engineering database show theoretical parameters specified with the towers numbered from 1 to 5 for the daytime directional antenna pattern and from 1 to 4 for the nighttime directional antenna pattern – with the nighttime tower 1, 2, 3 and 4 designations referring to towers 8, 5, 6 and 7 of the array, respectively. All references to tower numbering at the site – including the antenna monitor and the nomenclature of the phasing and coupling equipment – follow the eight-tower array scheme. Towers 6 through 8 are not used in the daytime and towers 1 through 4 are not used at night.

To eliminate this confusion, it is requested that the new license have the numbering scheme that is in use at the site, with operating parameters specified for towers 1, 2, 3, 4 and 5 in the daytime and 5, 6 7 and 8 at night. All tower numbering herein adheres to that scheme. The antenna monitor parameters provided herein and on the associated FCC Form 302 technical section correspond to the towers numbered accordingly.

KLMS Tower Numbering		
Number at Transmitter Site*	Number in Daytime FCC Standard Pattern Database	Number in Nighttime FCC Standard Pattern Database
1	1	
2	2	
3	3	
4	4	
5	5	2
6		3
7		4
8		1

* It is requested that the numbering on the station license be made to agree with the numbering of the towers at the transmitter site.

SECTION III - LICENSE APPLICATION ENGINEERING DATA

Name of Applicant
Digity 3E License, L.L.C.

PURPOSE OF AUTHORIZATION APPLIED FOR: (check one)

☑ Station License ☐ Direct Measurement of Power

1. Facilities authorized in construction permit

Call Sign	File No. of Construction Permit (if applicable)	Frequency (kHz)	Hours of Operation	Power in kilowatts Night	Power in kilowatts Day
KLMS	N/A	1480	UNLIIMITED	0.75	1.0

2. Station location

State	City or Town
Nebraska	Lincoln

3. Transmitter location

State	County	City or Town	Street address (or other identification)
NE	Lancaster	Lincoln	10101 East A Street

4. Main studio location

State	County	City or Town	Street address (or other identification)
NE	Lancaster	Lincoln	3800 Cornhusker Highway

5. Remote control point location (specify only if authorized directional antenna)

State	County	City or Town	Street address (or other identification)
NE	Lancaster	Lincoln	3800 Cornhusker Highway

6. Has type-approved stereo generating equipment been installed? ☐ Yes ☑ No

7. Does the sampling system meet the requirements of 47 C.F.R. Section 73.68? ☑ Yes ☐ No

☐ Not Applicable

Attach as an Exhibit a detailed description of the sampling system as installed.

Exhibit No.
TECH EXHIBIT

8. Operating constants:

RF common point or antenna current (in amperes) without modulation for night system	RF common point or antenna current (in amperes) without modulation for day system
4.02	4.65

Measured antenna or common point resistance (in ohms) at operating frequency Night	Day	Measured antenna or common point reactance (in ohms) at operating frequency Night	Day
50.0	50.0	0.0	0.0

Antenna indications for directional operation

Towers	Antenna monitor Phase reading(s) in degrees Night	Antenna monitor Phase reading(s) in degrees Day	Antenna monitor sample current ratio(s) Night	Antenna monitor sample current ratio(s) Day	Antenna base currents Night	Antenna base currents Day
SEE	SEE	SEE	SEE	SEE	SEE	SEE
TECHNICAL	TECHNICAL	TECHNICAL	TECHNICAL	TECHNICAL	TECHNICAL	TECHNICAL
EXHIBIT	EXHIBIT	EXHIBIT	EXHIBIT	EXHIBIT	EXHIBIT	EXHIBIT
ITEM 13	ITEM 13	ITEM 13	ITEM 13	ITEM 13	ITEM 13	ITEM 13
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Manufacturer and type of antenna monitor: Potomac Instruments AM-1901

9. Description of antenna system ((f directional antenna is used, the information requested below should be given for each element of the array. Use separate sheets if necessary.)

Type Radiator	Overall height in meters of radiator above base insulator, or above base, if grounded.	Overall height in meters above ground (without obstruction lighting)	Overall height in meters above ground (include obstruction lighting)	If antenna is either top loaded or sectionalized, describe fully in an Exhibit.
SEE	TECHNICAL	EXHIBIT	ITEM 13	Exhibit No.

Excitation ☑ Series ☐ Shunt

Geographic coordinates to nearest second. For directional antenna give coordinates of center of array. For single vertical radiator give tower location.

North Latitude 40 ° 47 ' 47 "	West Longitude 96 ° 34 ' 56 "

If not fully described above, attach as an Exhibit further details and dimensions including any other antenna mounted on tower and associated isolation circuits.

Exhibit No. N/A

Also, if necessary for a complete description, attach as an Exhibit a sketch of the details and dimensions of ground system.

Exhibit No. N/A

10. In what respect, if any, does the apparatus constructed differ from that described in the application for construction permit or in the permit?

None

11. Give reasons for the change in antenna or common point resistance.

There is no change in antenna resistance; only the antenna monitor parameters have changed.

I certify that I represent the applicant in the capacity indicated below and that I have examined the foregoing statement of technical information and that it is true to the best of my knowledge and belief.

Name (Please Print or Type)	Signature (
Ronald D. Rackley, P.E.	
Address (include ZIP Code) du Treil, Lundin & Rackley, Inc. 201 Fletcher Avenue Sarasota, FL 34237	Date December 19, 2014 Telephone No. (Include Area Code) 941-329-6000

☐ Technical Director

☑ Registered Professional Engineer

☐ Chief Operator

☐ Technical Consultant

☐ Other (specify)