SELLMEYER ENGINEERING
BROADCAST & COMMUNICATION CONSULTING ENGINEERS
2 Pecan Grove Circle, Lucas, Texas 75002
MEMBER AFCCE

EXHIBIT E-1

ENGINEERING STATEMENT RE:
APPLICATION FOR STATION LICENSE
METHOD OF MOMENTS PROOF OF PERFORMANCE
TOWNSQUARE MEDIA SHREVEPORT LICENSE, LLC
RADIO STATION KWKH
1130 KHZ, 50.0 KW, DA-N UNL
SHREVEPORT, LOUISIANA

FACILITY ID: 60266

DECEMBER, 2013

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EXHIBIT E-1

ENGINEERING STATEMENT RE: APPLICATION FOR STATION LICENSE TOWNSQUARE MEDIA SHREPORT LICENSE, LLC RADIO STATION KWKH 1130 KHZ, 50.0 KW, DA-N UNL SHREVEPORT, LOUISIANA

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SECTION III - LICENSE APPLICATION ENGINEERING DATA

Name of Applicant
TOWNSQUARE MEDIA SHREVEPORT LICENSE, LLC

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	Day
KWKH	N/A	1130	UNL	50	50

2. Station location

State	City or Town
LOUISIANA	SHREVEPORT

3. Transmitter location

State	County	City or Town	Street address (or other identification)
LA	Caddo Parish	Belcher	10406 North Highway 169

4. Main studio location

State	County	City or Town	Street address (or other identification)
LA	Caddo Parish	Shreveport	6341 Westport Drive

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

State	County	City or Town	Street address (or other identification)
LA	Caddo Parish	Shreveport	6341 Westport Drive

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. E-1

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
32.4	24.6

Measured antenna or common point resistance (in ohms) at operating frequency		Measured antenna or common point reactance (in ohms) at operating frequency	
Night	Day	Night	Day
50.0	82.5	-j1.4	-j193

Antenna indications for directional operation

Towers	Antenna monitor Phase reading(s) in degrees		Antenna monitor sample current ratio(s)		Antenna base currents	
	Night	Day	Night	Day	Night	Day
1 (NE)	108.1	N/A	0.362	N/A	N/A	N/A
2 (C)	0.0	N/A	1.000	N/A	N/A	24.6
3 (SW)	-110.0	N/A	0.864	N/A	N/A	N/A

Manufacturer and type of antenna monitor: Potomac Instruments 1904-3

SECTION III - Page 2

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 E-1, SECTION-5	SEE E-1, SECTION-5	SEE E-1, SECTION-5	Exhibit No. N/A

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	32 °	42 '	18 "	West Longitude	93 °	52 '	55 "

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. E-1

Also, if necessary for a complete description, attach as an Exhibit a sketch of the details and dimensions of ground system. Exhibit No. E-1

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.

Compete refurbishment of Directive Array

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 (check appropriate box below)
J, S, Sellmeyer, PE	J. S. Sellmeyer
Address (include ZIP Code) Sellmeyer Engineering 2 Pecan Grove Circle Lucas, TX 75002	Date December 26, 2013
	Telephone No. (Include Area Code) 972-542-2056

☐ Technical Director

☐ Chief Operator

☐ Other (specify)

☑ Registered Professional Engineer

☐ Technical Consultant

SELLMEYER ENGINEERING
BROADCAST & COMMUNICATION CONSULTING ENGINEERS
2 Pecan Grove Circle, Lucas, Texas 75002
MEMBER AFCCE

EXHIBIT E-1

ENGINEERING STATEMENT RE: LICENSE APPLICATION FOR RADIO STATION KWKH 1130 KHZ, 50.0 KW DA-N-UNL SHREVEPORT, LOUISIANA FACILITY ID: 60266 METHOD OF MOMENTS DA PROOF OF PERFORMANCE

INTRODUCTION

The instant application is being filed to relicense the existing KWKH Directive Arrays under the Method of Moments modeling Rules of Section 73.151(c) of the Rules.

Townsquare Media Shreveport License, LLC, license of Radio Station KWKH has recently completed a major refurbishment of the Transmitter Plant and the associated Directional Array. This project included replacement of the Antenna Monitoring System, including a new Antenna Monitor and installation of Kintronic Laboratories model VSU-1-HV Voltage Sampling Units at each tower base. The sample lines are carried by a messenger cable supported below the 350 ohm open wire transmission line originating behind the transmitter building and extending toward the center tower of the directional array. From this location, a set of poles carries the lines to the northeast tower (1) and toward the southwest tower (3).

The control and power lines are buried along the east side of the three antenna coupling buildings, with a drop at each tower. From the southwest tower, the cables are routed directly to the northwest corner of the transmitter building where the power vault is located.

The open wire transmission lines were refurbished as necessary, particularly with respect to proper grounding of the four outer conductors.\

Each of the antenna coupling networks and the Nighttime Phasing Equipment was refurbished where necessary, along with the ground system in the immediate vicinity of the tower base compounds.

New Voltage Sampling Units were installed on each of the three base piers and connected to the tower base steel via short lengths of thick wall copper tubing. The ground terminals of the VSU's are connected to the lightning protection strap at the tower bases which are directly connected to the ground system below grade level.

The sampling lines are Andrew LDF-4-50A jacketed Heliax cable of equal length with the cable run in rigid aluminum conduit down the nearest transmission line support pole to a sweeping elbow at grade level where it is extended to the tower base pier and a second sweeping elbow at the tower base pier. The conduit is bonded to the ground system at the support pole and the tower base with a short length of number 4 solid copper wire secured to a brass clamp around the conduit. The Sample Lines were verified to be of equal lengths within the limits specified in the Rules.

Four copper straps are used for lightning protection of the base pier concrete. These straps are connected to the copper buss where the ground radials terminate at the tower bases. The radials and the base ground straps are connected to the antenna coupling equipment with an additional four inch copper strap which is run into each coupler building.

SUMMARY

The instant Engineering Statement and associated exhibits support an application for station license on FCC Form 302-AM for the newly refurbished transmission facilities for station KWKH, Shreveport, Louisiana. The nighttime array uses all three of the towers. The daytime non-directional antenna is the center tower with the outer pair of towers shorted to ground inside the associated coupler building. The inductance of the series tower feeder pipe is sufficient to detune the end towers at the 1130 KHZ channel. Provisions are made to manually reconfigure the southwest tower for emergency use as a non directional antenna.

The AM technical Rules permitting method of moments modeling of eligible directional arrays have been employed for the directive array adjustments as the refurbished KWKH array fully complies with the newly enacted Rules.

Information is provided herein demonstrating that the directional antenna parameters for the nighttime pattern authorized by the FCC have been determined in accordance with the requirements of 47 CFR Section 73.151(c). The Antenna Monitoring System has been designed and constructed in accordance with Section 73.68 of the Rules. The 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 new Rules.

The following exhibits describe in full the steps taken to verify the Method of Moments model and to determine the operating parameters of each array.

SELLMEYER ENGINEERING
BROADCAST & COMMUNICATION CONSULTING ENGINEERS
2 Pecan Grove Circle, Lucas, Texas 75002
MEMBER AFCCE

CERTIFICATION OF ENGINEER

I hereby state that:

I am President of Sellmeyer Engineering

The Firm of Sellmeyer Engineering has been retained by Townsquare Media, Shreveport Licensee, LLC to prepare this Engineering Exhibit

I am a graduate of Arizona State University with the degree of Bachelor of Science in Engineering

I am a Registered Professional Engineer in the States of Ohio and Texas

My qualifications as an Engineer are a matter of record with the Federal Communications Commission

This Engineering Exhibit was prepared by me personally or under my direct supervision, and

All facts stated herein are true and correct to the best of my knowledge and belief.

J. S. Sellmeyer P. E.

December 23, 2013

Sellmeyer Engineering
2 Pecan Grove Circle
Lucas, Texas 75002
972-542-2056
jack@sellmeyereng.com
Texas Firm Number: F-004814

SELLMEYER ENGINEERING
BROADCAST & COMMUNICATIONS CONSULTING ENGINEERS
2 Pecan Grove Circle
Lucas, Texas, 75002
MEMBER AFCCE

RADIO STATION KWKH
1130 KHZ, 50 KW, DA-N UNL
SHREVEPORT, LOUISIANA

SECTION-1

Analysis of Measured Tower Impedance Data
For Verification of Method of Moments Model for Towers Driven Separately

The KWKH Nighttime Directive Array employs four of the three KWKH towers. The Daytime Non-directional antenna is the center tower (2).

The electrical height of each of the northeast (1) and center (2) towers is 198.0 degrees at the 1130 kHz channel. The electrical height of the southwest tower (3) is 184.0 degrees. The towers are identical in cross section with the exception of Tower-3 which has an RCA type BF-14 FM antenna mounted at the top of the lattice tower. The antenna is no longer used and the associated transmission line has been removed from the tower. The FM antenna is modeled as a cylinder throughout its length.

Tower 3 has installed at the top of the skeletal tower, a Mark Products Grid antenna for the STL System. The antenna is fed by a 7/8 inch Heliax cable which is bonded to the tower structure and isolated at the base by a Kintronic Labs Isocoupler.

Base Voltage Sampling by means of Kintronic Labs model VSU-1-HV Voltage Sampling Units ("VSU's") employed at the tower bases for the Antenna Monitoring System.

The KWKH array was modeled using ACSModel, (Mininec 3.1 Core). One wire was used to represent each tower. The top and bottom wire end points were specified in meters in the Cartesian coordinate system, as converted from the theoretical directional antenna specifications taking into account the carrier frequency wavelength. Towers 1 and 2 were modeled using 40 wire segments. The skeletal Tower 3 was modeled with 35 wire segments. The RCA BF-14B FM Antenna atop the skeletal tower was modeled using 5 wire segments to accurately define the cylindrical FM antenna atop the skeletal tower. As towers 1 and 2 are physically 198.0° in electrical height, each segment represents 4.95 electrical degrees. For tower-3 each segment represents 4.60 electrical degrees.

The individual tower's physical characteristics were adjusted to provide a match of the modeled and measured impedances, with the assumed stray

capacitances, and RF feed line hookup inductances that were measured at the output RF test jack in the VSU while all of the other towers were short circuited across their bases. The method of moments model assumed loads at ground level having zero reactances while short circuited. The modeled reactances of the WCAP network analyses were used to match the modeled base impedances to the measured values on an individual bases leaving all others grounded. The individual tower models, thus generated, were used to determine the antenna monitor parameters from the MOM Directive Array modeled parameters.

Each tower's modeled height, relative to its physical height, falls within the range of 75 to 125 percent of the physical height and each tower's modeled equivalent radius falls within the required range of 80 percent to 150 percent of the radius of a circle having a circumference equal to the sum of the widths of the tower faces. The array consists of three uniform cross section towers having a face width of 48 inches, with the exception of Tower 3 which is described above.

TABLE OF MODELED TOWER HEIGHTS

TOWER	Electrical Height (Degrees)	Physical Height (meters)	Modeled Height (meters)	Modeled Percent of Height	Modeled Radius (meters)	Percent Equivalent Radius
1	198.0	145.9204	153.946	105.50	0.6050	103.393
2	198.0	145.9204	152.049	104.20	0.5821	100.00
3A	-----	119.1462	127.2794	106.83	0.5384	92.490
3B	184.0	135.6028	143.7359	106.00	0.2478	100.000

Tower base impedance measurements were measured by a Hewlett Packard 8753C network analyzer connected to an RF Power Amplifier, a resistive attenuator and a directional coupler in a calibrated measurement system.

The reference point at each tower is the output Jack of the Voltage Sampling Unit which is located on the base pier of the tower. This unit is connected directly to the tower feed point with a short length of copper tubing. The base voltage magnitude and phase at this point is measured by the VSU and transmitted to the Antenna Monitor through the sample line.

All of the stray inductive and capacitive reactances have been incorporated in the Base Region Models used in the calibration process. Circuit calculations were performed to relate the method of moments modeled impedances to the VSU measurement (reference) points as shown on the following pages.

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 for each tower. 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 ACU reference point "the Output Jack" and Node-3 represents the tower feed point. Node 0 represents ground potential. The tower operating impedances and base Voltages (the "Modeled Base ....") are represented by complex loads from Node-3 to ground (Zi_{-0}). It should be noted that the VSU voltage and phase at Node-2 is the modeled voltage and phase from the WCAP model for each of the four elements. The Node-2 voltage and Phase are an exact translation of the Node-3 (base) values from the tower base to the output terminal of the associated VSU.

The calculated VSU output impedances appear after the "TO IMPEDANCE" columns of the WCAP Tabulations, following the phantom 1 ohm resistor (R 1-2) that is placed in series with the current source to provide calculation points for the impedances. The tower feed point impedances from the method of moments model are represented by complex loads from Node-3 to ground (R 3-0). The modeled and measured base impedances at the VSU output jacks with all the other towers short circuited across their base insulators agree within +/- 2 ohms and +/- 4 percent for resistance and reactance, as required by the Rules.

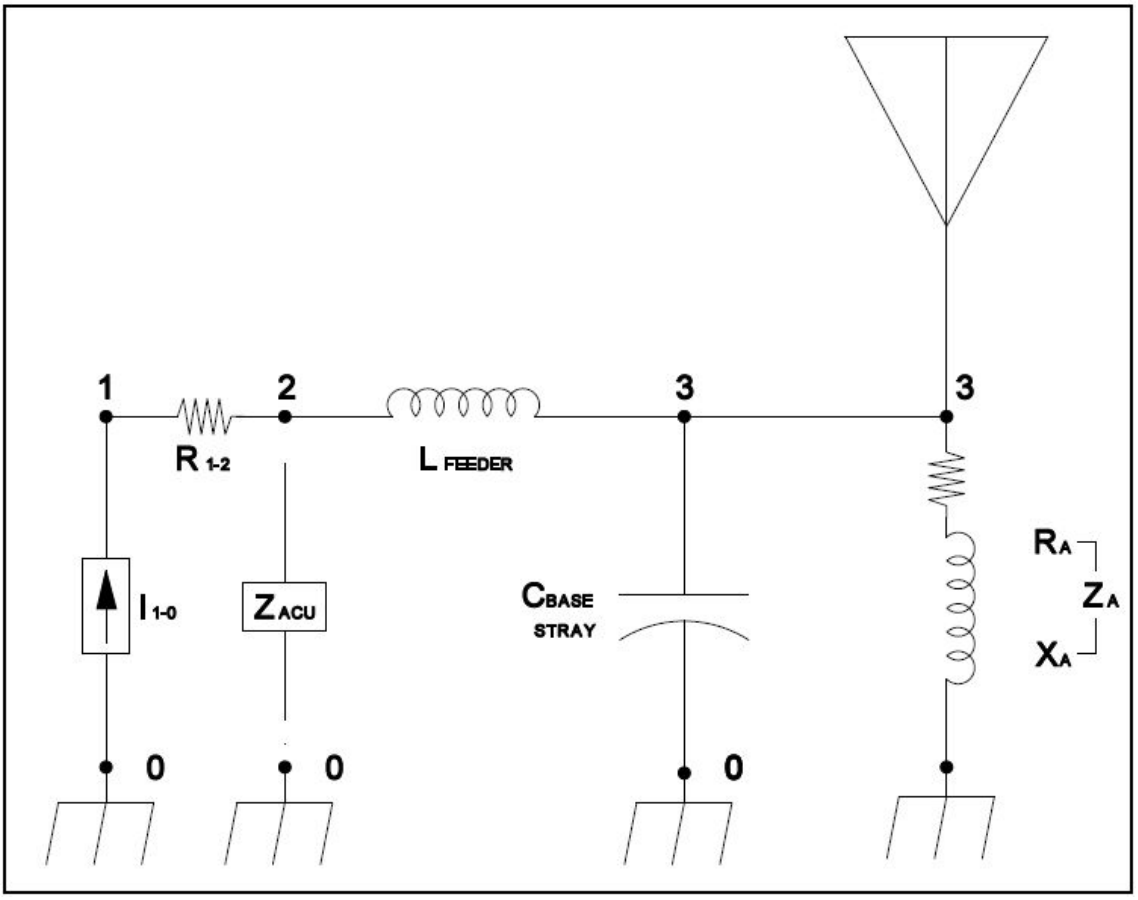
KWKH NON-DIRECTIONAL BASE REGION MODEL TABULATION

TWR	BASE SHUNT C (pF)	FEEDER INDUCTANCE (uHy)	BASE IMPEDANCE FROM MOM MODEL (OHMS)	BASE IMPEDANCE @ VSU FROM WCAP MODEL (OHMS)	MEASURED BASE IMPEDANCE Zb @ VSU (OHMS)
1	45	2.95	83.94-j240.62	72.34-j204.30	70.1-j208.0
2	30	2.86	98.33-j249.24	88.63-j218.13	88.0-j220.4
3	95	2.96	184.66-j347.91	110.47-262.90	109.9-j267.8
NOTES: BASES SHORTED AT EACH TOWER; Zb MEASURED AT VSU OUPTPUT JACK					

BASE SHUNT CAPACITANCES

TWR	VSU	AUSTIN TRANSFORMER	BASE INSULATOR	ISOCOUPLER	TOTAL BASE SHUNT	SHUNT REACTANCE
1	33 pF	15 pF	30 pF	--	45 pF	-j3,130
2	33 pF	--	30 pF	--	30 pF	-j4,695
3	33 pF	15 pF	30 pF	70 pF	115 pF	-j1,225

BASE REGION MODEL



The base insulator & other stray capacitances are lumped at Node-0-3

WCAP CIRCUIT ANALYSIS FILES APPEAR ON THE FOLLOWING PAGES

WCAP - KWKH-TWR-1 BASE REGION MODEL

WCAP OUTPUT AT FREQUENCY: 1.130 MHz

NODE VOLTAGES

Node: 1 217.0632 ∡ -70.2532° V
Node: 2 216.7274 ∡ -70.5020° V
Node: 3 236.5746 ∡ -72.1953° V

	WCAP PART		BRANCH VOLTAGE	BRANCH CURRENT
R	1→2	1.00000000	1.00 ∡ 0.000° V	1.00 ∡ 0.000° A
L	2→3	2.95000000	20.94 ∡ 90.000° V	1.00 ∡ 0.000° A
R	3→0	83.94000000	236.57 ∡ -72.195° V	0.93 ∡ -1.427° A
C	3→0	0.00004500	236.57 ∡ -72.195° V	0.08 ∡ 17.805° A

	WCAP PART		FROM IMPEDANCE	TO IMPEDANCE
R	1→2	1.00000000	73.34 - j 204.299	**72.34 - j 204.299[2]**
L	2→3	2.95000000	72.34 - j 204.299	72.34 - j 225.244
R	3→0	83.94000000	83.94 - j 240.620	0.00 + j 0.000
C	3→0	0.00004500	0.00 - j 3129.891	0.00 + j 0.000

WCAP INPUT DATA:

	1.1300		0.00000000	0	
I	1.00000000	0	1	0.00000000	**1: Modeled Base Impedance**
R	1.00000000	1	2	0.00000000	**2: Modeled VSU Impedance**
L	2.95000000	2	3	0.00000000	
R	**83.94000000**	3	0	**-240.62000000[1]**	
C	0.00004500	3	0		

WCAP – KWKH TWR-2 BASE REGION MODEL

WCAP OUTPUT AT FREQUENCY: 1.130 MHz

NODE VOLTAGES

Node: 1 235.8289 ∡ -67.6622° V
Node: 2 235.4507 ∡ -67.8872° V
Node: 3 254.3780 ∡ -69.6092° V

	WCAP PART		BRANCH VOLTAGE	BRANCH CURRENT
R	1→2	1.00000000	1.00 ∡ 0.000° V	1.00 ∡ 0.000° A
L	2→3	2.86000000	20.31 ∡ 90.000° V	1.00 ∡ 0.000° A
R	3→0	98.33000000	254.38 ∡ -69.609° V	0.95 ∡ -1.139° A
C	3→0	0.00003000	254.38 ∡ -69.609° V	0.05 ∡ 20.391° A

	WCAP PART		FROM IMPEDANCE	TO IMPEDANCE
R	1→2	1.00000000	89.63 - j 218.132	**88.63 - j 218.132[2]**
L	2→3	2.86000000	88.63 - j 218.132	88.63 - j 238.438
R	3→0	98.33000000	98.33 - j 249.240	0.00 + j 0.000
C	3→0	0.00003000	0.00 - j 4694.836	0.00 + j 0.000

WCAP INPUT DATA:

	1.1300		0.00000000	0	
I	1.00000000	0	1	0.00000000	**1: Modeled Base Impedance**
R	1.00000000	1	2	0.00000000	**2: Modeled VSU Impedance**
L	2.86000000	2	3	0.00000000	
R	**98.33000000**	3	0	**-249.24000000[1]**	
C	0.00003000	3	0		

WCAP - KWKH-TWR-3 BASE REGION MODEL

WCAP OUTPUT AT FREQUENCY: 1.130 MHz

NODE VOLTAGES

Node: 1 285.5551 ∠ -67.0227° V
Node: 2 285.1663 ∠ -67.2076° V
Node: 3 304.6500 ∠ -68.7390° V

	WCAP PART		BRANCH VOLTAGE	BRANCH CURRENT
R	1→2	1.00000000	1.00 ∠ 0.000° V	1.00 ∠ 0.000° A
L	2→3	2.96000000	21.02 ∠ 90.000° V	1.00 ∠ 0.000° A
R	3→0	184.66000000	304.65 ∠ -68.739° V	0.77 ∠ -6.697° A
C	3→0	0.00011500	304.65 ∠ -68.739° V	0.25 ∠ 21.261° A

	WCAP PART		FROM IMPEDANCE	TO IMPEDANCE
R	1→2	1.00000000	111.47 - j 262.899	**110.47 - j 262.899**[2]
L	2→3	2.96000000	110.47 - j 262.899	110.47 - j 283.915
R	3→0	184.66000000	**184.66 - j 347.910**[1]	0.00 + j 0.000
C	3→0	0.00011500	0.00 - j 1224.740	0.00 + j 0.000

WCAP INPUT DATA:

1.1300 0.00000000 0

I	1.00000000	0	1	0.00000000
R	1.00000000	1	2	0.00000000
L	2.96000000	2	3	0.00000000
R	**184.66000000**	**3**	**0**	**-347.91000000**[1]
C	0.00011500	3	0	

1: Modeled Base Impedance
2: Modeled VSU Impedance

****
ACSModel
(MININEC 3.1 Core)
09-11-2013 13:54:56
****

KWKH
TWR-1 CALIBRATION MODEL, (NORTH)

Frequency = 1.130 MHz Wavelength = 265.30974 Meters
No. of Wires: 10

Wire No. 1	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
0	0	0		-1	
0	0	1.980979	0.2286	0	1

Wire No. 2	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
0	0	1.980979		1	
0	0	3.962696	0.4054	0	1

Wire No. 3	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
0	0	3.962696		2	
0	0	153.946	0.605	0	38

Wire No. 4	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-77.01152	-35.91106	0		-4	
-77.01152	-35.91106	1.980979	0.2286	0	1

Wire No. 5	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-77.01152	-35.91106	1.980979		4	
-77.01152	-35.91106	3.962696	0.4054	0	1

Wire No. 6	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-77.01152	-35.91106	3.962696		5	
-77.01152	-35.91106	152.049	0.5821	0	38

Wire No. 7	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-154.023	-71.82213	0		-7	
-154.023	-71.82213	1.980979	0.2286	0	1

Wire No. 8	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-154.023	-71.82213	1.980979		7	
-154.023	-71.82213	3.962696	0.4054	0	1

Wire No. 9	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-154.023	-71.82213	3.962696		8	
-154.023	-71.82213	127.2794	0.5384	0	33

Wire No. 10	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-154.023	-71.82213	127.2794		9	
-154.023	-71.82213	143.7389	0.2478	0	5

****** ANTENNA GEOMETRY ******

Wire No. 1 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
0	0	0	0.2286	-1	0	1

Wire No. 2 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
0	0	1.980979	0.4054	1	0	2

Wire No. 3 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
0	0	3.962696	0.605	2	3	3
0	0	7.909624	0.605	3	3	4
0	0	11.85655	0.605	3	3	5
0	0	15.80348	0.605	3	3	6
0	0	19.75041	0.605	3	3	7
0	0	23.69734	0.605	3	3	8
0	0	27.64427	0.605	3	3	9
0	0	31.59119	0.605	3	3	10
0	0	35.53812	0.605	3	3	11
0	0	39.48505	0.605	3	3	12
0	0	43.43198	0.605	3	3	13
0	0	47.37891	0.605	3	3	14
0	0	51.32584	0.605	3	3	15
0	0	55.27277	0.605	3	3	16
0	0	59.21969	0.605	3	3	17
0	0	63.16662	0.605	3	3	18
0	0	67.11355	0.605	3	3	19
0	0	71.06048	0.605	3	3	20
0	0	75.0074	0.605	3	3	21
0	0	78.95433	0.605	3	3	22
0	0	82.90126	0.605	3	3	23
0	0	86.84819	0.605	3	3	24
0	0	90.79511	0.605	3	3	25
0	0	94.74204	0.605	3	3	26
0	0	98.68897	0.605	3	3	27
0	0	102.6359	0.605	3	3	28
0	0	106.5828	0.605	3	3	29
0	0	110.5298	0.605	3	3	30
0	0	114.4767	0.605	3	3	31
0	0	118.4236	0.605	3	3	32
0	0	122.3705	0.605	3	3	33
0	0	126.3175	0.605	3	3	34
0	0	130.2644	0.605	3	3	35
0	0	134.2113	0.605	3	3	36
0	0	138.1583	0.605	3	3	37
0	0	142.1052	0.605	3	3	38
0	0	146.0521	0.605	3	3	39
0	0	149.999	0.605	3	0	40

Wire No. 4 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-77.01152	-35.91106	0	0.2286	-4	0	41

Wire No. 5 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-77.01152	-35.91106	1.980979	0.4054	4	0	42

Wire No. 6	Coordinates			Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-77.01152	-35.91106	3.962696	0.5821	5	6	43
-77.01152	-35.91106	7.859704	0.5821	6	6	44
-77.01152	-35.91106	11.75671	0.5821	6	6	45
-77.01152	-35.91106	15.65372	0.5821	6	6	46
-77.01152	-35.91106	19.55073	0.5821	6	6	47
-77.01152	-35.91106	23.44774	0.5821	6	6	48
-77.01152	-35.91106	27.34475	0.5821	6	6	49
-77.01152	-35.91106	31.24175	0.5821	6	6	50
-77.01152	-35.91106	35.13876	0.5821	6	6	51
-77.01152	-35.91106	39.03577	0.5821	6	6	52
-77.01152	-35.91106	42.93278	0.5821	6	6	53
-77.01152	-35.91106	46.82979	0.5821	6	6	54
-77.01152	-35.91106	50.7268	0.5821	6	6	55
-77.01152	-35.91106	54.62381	0.5821	6	6	56
-77.01152	-35.91106	58.52081	0.5821	6	6	57
-77.01152	-35.91106	62.41782	0.5821	6	6	58
-77.01152	-35.91106	66.31483	0.5821	6	6	59
-77.01152	-35.91106	70.21184	0.5821	6	6	60
-77.01152	-35.91106	74.10884	0.5821	6	6	61
-77.01152	-35.91106	78.00585	0.5821	6	6	62
-77.01152	-35.91106	81.90285	0.5821	6	6	63
-77.01152	-35.91106	85.79987	0.5821	6	6	64
-77.01152	-35.91106	89.69688	0.5821	6	6	65
-77.01152	-35.91106	93.59389	0.5821	6	6	66
-77.01152	-35.91106	97.4909	0.5821	6	6	67
-77.01152	-35.91106	101.3879	0.5821	6	6	68
-77.01152	-35.91106	105.2849	0.5821	6	6	69
-77.01152	-35.91106	109.1819	0.5821	6	6	70
-77.01152	-35.91106	113.0789	0.5821	6	6	71
-77.01152	-35.91106	116.9759	0.5821	6	6	72
-77.01152	-35.91106	120.8729	0.5821	6	6	73
-77.01152	-35.91106	124.77	0.5821	6	6	74
-77.01152	-35.91106	128.667	0.5821	6	6	75
-77.01152	-35.91106	132.564	0.5821	6	6	76
-77.01152	-35.91106	136.461	0.5821	6	6	77
-77.01152	-35.91106	140.358	0.5821	6	6	78
-77.01152	-35.91106	144.255	0.5821	6	6	79
-77.01152	-35.91106	148.152	0.5821	6	0	80

Wire No. 7	Coordinates			Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-154.023	-71.82213	0	0.2286	-7	0	81

Wire No. 8	Coordinates			Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-154.023	-71.82213	1.980979	0.4054	7	0	82

Wire No. 9 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-154.023	-71.82213	3.962696	0.5384	8	9	83
-154.023	-71.82213	7.699565	0.5384	9	9	84
-154.023	-71.82213	11.43644	0.5384	9	9	85
-154.023	-71.82213	15.17331	0.5384	9	9	86
-154.023	-71.82213	18.91018	0.5384	9	9	87
-154.023	-71.82213	22.64705	0.5384	9	9	88
-154.023	-71.82213	26.38391	0.5384	9	9	89
-154.023	-71.82213	30.12078	0.5384	9	9	90
-154.023	-71.82213	33.85765	0.5384	9	9	91
-154.023	-71.82213	37.59452	0.5384	9	9	92
-154.023	-71.82213	41.33139	0.5384	9	9	93
-154.023	-71.82213	45.06826	0.5384	9	9	94
-154.023	-71.82213	48.80513	0.5384	9	9	95
-154.023	-71.82213	52.542	0.5384	9	9	96
-154.023	-71.82213	56.27887	0.5384	9	9	97
-154.023	-71.82213	60.01574	0.5384	9	9	98
-154.023	-71.82213	63.75261	0.5384	9	9	99
-154.023	-71.82213	67.48949	0.5384	9	9	100
-154.023	-71.82213	71.22635	0.5384	9	9	101
-154.023	-71.82213	74.96322	0.5384	9	9	102
-154.023	-71.82213	78.70009	0.5384	9	9	103
-154.023	-71.82213	82.43696	0.5384	9	9	104
-154.023	-71.82213	86.17383	0.5384	9	9	105
-154.023	-71.82213	89.9107	0.5384	9	9	106
-154.023	-71.82213	93.64757	0.5384	9	9	107
-154.023	-71.82213	97.38444	0.5384	9	9	108
-154.023	-71.82213	101.1213	0.5384	9	9	109
-154.023	-71.82213	104.8582	0.5384	9	9	110
-154.023	-71.82213	108.595	0.5384	9	9	111
-154.023	-71.82213	112.3319	0.5384	9	9	112
-154.023	-71.82213	116.0688	0.5384	9	9	113
-154.023	-71.82213	119.8057	0.5384	9	9	114
-154.023	-71.82213	123.5425	0.5384	9	0	115

Wire No. 10 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-154.023	-71.82213	127.2794	0.2478	9	10	116
-154.023	-71.82213	130.5713	0.2478	10	10	117
-154.023	-71.82213	133.8632	0.2478	10	10	118
-154.023	-71.82213	137.1551	0.2478	10	10	119
-154.023	-71.82213	140.447	0.2478	10	0	120

Sources: 1
Pulse No., Voltage Magnitude, Phase (Degrees): 1, 1000.0, 0.0

Number of Loads: 2
Pulse No., Resistance, Reactance: 41 , 0 , 0
Pulse No., Resistance, Reactance: 81 , 0 , 0

********** **SOURCE DATA** **********
Pulse 1 Voltage = (1000.0, 0.0j)
Current = (1.2926, 3.705j)
Impedance = (**83.943, -240.618j**) **MODELED IMPEDANCE, TWR-1**
Power = 646.28 Watts

********** **CURRENT DATA** **********

Wire No. 1 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
1	1.2926	3.705	3.924	70.7679
J	1.2918	3.3124	3.5553	68.695

Wire No. 2 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	1.2918	3.3124	3.5553	68.695
J	1.289	3.0071	3.2717	66.7967

Wire No. 3 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	1.289	3.0071	3.2717	66.7967
4	1.2776	2.3943	2.7138	61.9156
5	1.2615	1.8725	2.2578	56.0316
6	1.2405	1.3771	1.8534	47.9866
7	1.2146	0.897	1.5099	36.4464
8	1.1839	0.4281	1.2589	19.8806
9	1.1487	-0.0304	1.1491	-1.5147
10	1.1093	-0.4778	1.2078	-23.3016
11	1.0659	-0.9125	1.4031	-40.5661
12	1.0189	-1.3325	1.6775	-52.5961
13	0.9688	-1.7356	1.9876	-60.8307
14	0.9158	-2.1192	2.3086	-66.6296
15	0.8604	-2.4809	2.6259	-70.8739
16	0.803	-2.8184	2.9305	-74.0964
17	0.7442	-3.1291	3.2164	-76.6221
18	0.6843	-3.4111	3.479	-78.6557
19	0.6239	-3.6621	3.7149	-80.3308
20	0.5635	-3.8804	3.9211	-81.7374
21	0.5035	-4.0643	4.0953	-82.9383
22	0.4443	-4.2124	4.2357	-83.9783
23	0.3866	-4.3236	4.3408	-84.8905
24	0.3307	-4.397	4.4094	-85.6994
25	0.277	-4.432	4.4406	-86.4239
26	0.226	-4.4283	4.4341	-87.0785
27	0.1781	-4.3858	4.3894	-87.6747
28	0.1336	-4.3048	4.3069	-88.2218
29	0.093	-4.1858	4.1869	-88.7273
30	0.0565	-4.0295	4.0299	-89.1973
31	0.0243	-3.837	3.837	-89.6368
32	-0.0032	-3.6093	3.6093	-90.0501
33	-0.0258	-3.3479	3.348	-90.4409
34	-0.0433	-3.0543	3.0546	-90.8124
35	-0.0556	-2.7298	2.7304	-91.1672
36	-0.0625	-2.3758	2.3766	-91.508
37	-0.0639	-1.9932	1.9942	-91.8369
38	-0.0596	-1.5818	1.5829	-92.1567
39	-0.0491	-1.1385	1.1395	-92.4702
40	-0.032	-0.657	0.6578	-92.7883
E	0.0	0.0	0.0	0.0

Wire No. 4 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
41	0.5507	-0.4833	0.7326	-41.2701
J	0.5503	-0.4828	0.7321	-41.2623

Wire No. 5 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	0.5503	-0.4828	0.7321	-41.2623
J	0.5493	-0.4814	0.7304	-41.2322

Wire No. 6 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	0.5493	-0.4814	0.7304	-41.2322
44	0.5451	-0.475	0.723	-41.0693
45	0.5392	-0.4654	0.7123	-40.7966
46	0.5316	-0.4526	0.6982	-40.4093
47	0.5223	-0.4367	0.6808	-39.9013
48	0.5112	-0.4179	0.6603	-39.2645
49	0.4986	-0.3964	0.637	-38.4885
50	0.4843	-0.3725	0.611	-37.5601
51	0.4687	-0.3463	0.5827	-36.4628
52	0.4517	-0.3183	0.5526	-35.1763
53	0.4334	-0.2888	0.5208	-33.6751
54	0.4141	-0.2581	0.488	-31.9282
55	0.3939	-0.2265	0.4543	-29.8972
56	0.3728	-0.1944	0.4204	-27.5354
57	0.3511	-0.1621	0.3867	-24.7861
58	0.3289	-0.1301	0.3537	-21.5817
59	0.3063	-0.0986	0.3218	-17.8439
60	0.2835	-0.068	0.2916	-13.486
61	0.2607	-0.0386	0.2635	-8.4203
62	0.238	-0.0107	0.2383	-2.5738
63	0.2156	0.0154	0.2162	4.0867
64	0.1936	0.0395	0.1976	11.519
65	0.1722	0.0612	0.1828	19.5731
66	0.1516	0.0805	0.1716	27.9843
67	0.1317	0.0971	0.1637	36.4106
68	0.1129	0.111	0.1583	44.5099
69	0.0951	0.1218	0.1546	52.0171
70	0.0786	0.1297	0.1516	58.7821
71	0.0634	0.1344	0.1486	64.7625
72	0.0495	0.136	0.1448	69.9915
73	0.0372	0.1345	0.1396	74.5427
74	0.0264	0.1299	0.1325	78.5043
75	0.0172	0.1221	0.1233	81.9638
76	0.0097	0.1113	0.1117	85.0009
77	0.0039	0.0974	0.0974	87.6854
78	-0.0001	0.0803	0.0803	90.0776
79	-0.0023	0.0599	0.0599	92.2318
80	-0.0026	0.0358	0.0358	94.2379
E	0.0	0.0	0.0	0.0

Wire No. 7 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
81	-0.2483	-0.2343	0.3414	-136.6598
J	-0.2481	-0.2342	0.3412	-136.6576

Wire No. 8 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	-0.2481	-0.2342	0.3412	-136.6576
J	-0.2475	-0.2337	0.3404	-136.6488

Wire No. 9 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	-0.2475	-0.2337	0.3404	-136.6488
84	-0.2452	-0.2318	0.3375	-136.6068
85	-0.2419	-0.2292	0.3333	-136.5371
86	-0.2374	-0.2258	0.3277	-136.4385
87	-0.2319	-0.2216	0.3208	-136.3093
88	-0.2254	-0.2166	0.3126	-136.1473
89	-0.2179	-0.2108	0.3032	-135.9496
90	-0.2095	-0.2043	0.2926	-135.7126
91	-0.2002	-0.1972	0.281	-135.432
92	-0.1902	-0.1895	0.2685	-135.1021
93	-0.1795	-0.1812	0.255	-134.7161
94	-0.1681	-0.1725	0.2409	-134.2653
95	-0.1563	-0.1634	0.2261	-133.7391
96	-0.1441	-0.1539	0.2109	-133.1238
97	-0.1316	-0.1442	0.1952	-132.4023
98	-0.119	-0.1342	0.1794	-131.5522
99	-0.1062	-0.1242	0.1634	-130.5446
100	-0.0935	-0.1141	0.1475	-129.341
101	-0.0809	-0.104	0.1318	-127.8896
102	-0.0686	-0.0941	0.1164	-126.1194
103	-0.0567	-0.0843	0.1016	-123.9307
104	-0.0452	-0.0748	0.0874	-121.1813
105	-0.0344	-0.0655	0.074	-117.6635
106	-0.0242	-0.0567	0.0616	-113.0711
107	-0.0147	-0.0483	0.0505	-106.9537
108	-0.0062	-0.0404	0.0409	-98.683
109	0.0014	-0.0331	0.0331	-87.5305
110	0.008	-0.0263	0.0275	-73.1226
111	0.0134	-0.0202	0.0243	-56.399
112	0.0177	-0.0148	0.0231	-39.8857
113	0.0207	-0.0101	0.0231	-25.9258
114	0.0224	-0.0061	0.0232	-15.1761
115	0.0227	-0.0028	0.0229	-7.1197
J	0.0214	-0.0003	0.0214	-0.746

Wire No. 10 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	0.0214	-0.0003	0.0214	-0.746
117	0.0197	0.0008	0.0197	2.273
118	0.0169	0.0014	0.0169	4.9031
119	0.013	0.0016	0.0131	7.0777
120	0.0078	0.0012	0.0079	8.9064
E	0.0	0.0	0.0	0.0

****
ACSModel
(MININEC 3.1 Core)
09-11-2013 14:03:56
****

KWKH
TWR-2 CALIBRATION MODEL (CENTER)

Frequency = 1.130 MHz Wavelength = 265.30974 Meters

No. of Wires: 10

Wire No. 1	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
0	0	0		-1	
0	0	1.980979	0.2286	0	1

Wire No. 2	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
0	0	1.980979		1	
0	0	3.962696	0.4054	0	1

Wire No. 3	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
0	0	3.962696		2	
0	0	153.946	0.605	0	38

Wire No. 4	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-77.01152	-35.91106	0		-4	
-77.01152	-35.91106	1.980979	0.2286	0	1

Wire No. 5	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-77.01152	-35.91106	1.980979		4	
-77.01152	-35.91106	3.962696	0.4054	0	1

Wire No. 6	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-77.01152	-35.91106	3.962696		5	
-77.01152	-35.91106	152.049	0.5821	0	38

Wire No. 7	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-154.023	-71.82213	0		-7	
-154.023	-71.82213	1.980979	0.2286	0	1

Wire No. 8	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-154.023	-71.82213	1.980979		7	
-154.023	-71.82213	3.962696	0.4054	0	1

Wire No. 9	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-154.023	-71.82213	3.962696		8	
-154.023	-71.82213	127.2794	0.5384	0	33

Wire No. 10	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-154.023	-71.82213	127.2794		9	
-154.023	-71.82213	143.7389	0.2478	0	5

****** ANTENNA GEOMETRY ******

Wire No. 1 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
0	0	0	0.2286	-1	0	1

Wire No. 2 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
0	0	1.980979	0.4054	1	0	2

Wire No. 3 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
0	0	3.962696	0.605	2	3	3
0	0	7.909624	0.605	3	3	4
0	0	11.85655	0.605	3	3	5
0	0	15.80348	0.605	3	3	6
0	0	19.75041	0.605	3	3	7
0	0	23.69734	0.605	3	3	8
0	0	27.64427	0.605	3	3	9
0	0	31.59119	0.605	3	3	10
0	0	35.53812	0.605	3	3	11
0	0	39.48505	0.605	3	3	12
0	0	43.43198	0.605	3	3	13
0	0	47.37891	0.605	3	3	14
0	0	51.32584	0.605	3	3	15
0	0	55.27277	0.605	3	3	16
0	0	59.21969	0.605	3	3	17
0	0	63.16662	0.605	3	3	18
0	0	67.11355	0.605	3	3	19
0	0	71.06048	0.605	3	3	20
0	0	75.0074	0.605	3	3	21
0	0	78.95433	0.605	3	3	22
0	0	82.90126	0.605	3	3	23
0	0	86.84819	0.605	3	3	24
0	0	90.79511	0.605	3	3	25
0	0	94.74204	0.605	3	3	26
0	0	98.68897	0.605	3	3	27
0	0	102.6359	0.605	3	3	28
0	0	106.5828	0.605	3	3	29
0	0	110.5298	0.605	3	3	30
0	0	114.4767	0.605	3	3	31
0	0	118.4236	0.605	3	3	32
0	0	122.3705	0.605	3	3	33
0	0	126.3175	0.605	3	3	34
0	0	130.2644	0.605	3	3	35
0	0	134.2113	0.605	3	3	36
0	0	138.1583	0.605	3	3	37
0	0	142.1052	0.605	3	3	38
0	0	146.0521	0.605	3	3	39
0	0	149.999	0.605	3	0	40

Wire No. 4 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-77.01152	-35.91106	0	0.2286	-4	0	41

Wire No. 5 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-77.01152	-35.91106	1.980979	0.4054	4	0	42

Wire No. 6	Coordinates			Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-77.01152	-35.91106	3.962696	0.5821	5	6	43
-77.01152	-35.91106	7.859704	0.5821	6	6	44
-77.01152	-35.91106	11.75671	0.5821	6	6	45
-77.01152	-35.91106	15.65372	0.5821	6	6	46
-77.01152	-35.91106	19.55073	0.5821	6	6	47
-77.01152	-35.91106	23.44774	0.5821	6	6	48
-77.01152	-35.91106	27.34475	0.5821	6	6	49
-77.01152	-35.91106	31.24175	0.5821	6	6	50
-77.01152	-35.91106	35.13876	0.5821	6	6	51
-77.01152	-35.91106	39.03577	0.5821	6	6	52
-77.01152	-35.91106	42.93278	0.5821	6	6	53
-77.01152	-35.91106	46.82979	0.5821	6	6	54
-77.01152	-35.91106	50.7268	0.5821	6	6	55
-77.01152	-35.91106	54.62381	0.5821	6	6	56
-77.01152	-35.91106	58.52081	0.5821	6	6	57
-77.01152	-35.91106	62.41782	0.5821	6	6	58
-77.01152	-35.91106	66.31483	0.5821	6	6	59
-77.01152	-35.91106	70.21184	0.5821	6	6	60
-77.01152	-35.91106	74.10884	0.5821	6	6	61
-77.01152	-35.91106	78.00585	0.5821	6	6	62
-77.01152	-35.91106	81.90285	0.5821	6	6	63
-77.01152	-35.91106	85.79987	0.5821	6	6	64
-77.01152	-35.91106	89.69688	0.5821	6	6	65
-77.01152	-35.91106	93.59389	0.5821	6	6	66
-77.01152	-35.91106	97.4909	0.5821	6	6	67
-77.01152	-35.91106	101.3879	0.5821	6	6	68
-77.01152	-35.91106	105.2849	0.5821	6	6	69
-77.01152	-35.91106	109.1819	0.5821	6	6	70
-77.01152	-35.91106	113.0789	0.5821	6	6	71
-77.01152	-35.91106	116.9759	0.5821	6	6	72
-77.01152	-35.91106	120.8729	0.5821	6	6	73
-77.01152	-35.91106	124.77	0.5821	6	6	74
-77.01152	-35.91106	128.667	0.5821	6	6	75
-77.01152	-35.91106	132.564	0.5821	6	6	76
-77.01152	-35.91106	136.461	0.5821	6	6	77
-77.01152	-35.91106	140.358	0.5821	6	6	78
-77.01152	-35.91106	144.255	0.5821	6	6	79
-77.01152	-35.91106	148.152	0.5821	6	0	80

Wire No. 7	Coordinates			Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-154.023	-71.82213	0	0.2286	-7	0	81

Wire No. 8	Coordinates			Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-154.023	-71.82213	1.980979	0.4054	7	0	82

Wire No. 9 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-154.023	-71.82213	3.962696	0.5384	8	9	83
-154.023	-71.82213	7.699565	0.5384	9	9	84
-154.023	-71.82213	11.43644	0.5384	9	9	85
-154.023	-71.82213	15.17331	0.5384	9	9	86
-154.023	-71.82213	18.91018	0.5384	9	9	87
-154.023	-71.82213	22.64705	0.5384	9	9	88
-154.023	-71.82213	26.38391	0.5384	9	9	89
-154.023	-71.82213	30.12078	0.5384	9	9	90
-154.023	-71.82213	33.85765	0.5384	9	9	91
-154.023	-71.82213	37.59452	0.5384	9	9	92
-154.023	-71.82213	41.33139	0.5384	9	9	93
-154.023	-71.82213	45.06826	0.5384	9	9	94
-154.023	-71.82213	48.80513	0.5384	9	9	95
-154.023	-71.82213	52.542	0.5384	9	9	96
-154.023	-71.82213	56.27887	0.5384	9	9	97
-154.023	-71.82213	60.01574	0.5384	9	9	98
-154.023	-71.82213	63.75261	0.5384	9	9	99
-154.023	-71.82213	67.48949	0.5384	9	9	100
-154.023	-71.82213	71.22635	0.5384	9	9	101
-154.023	-71.82213	74.96322	0.5384	9	9	102
-154.023	-71.82213	78.70009	0.5384	9	9	103
-154.023	-71.82213	82.43696	0.5384	9	9	104
-154.023	-71.82213	86.17383	0.5384	9	9	105
-154.023	-71.82213	89.9107	0.5384	9	9	106
-154.023	-71.82213	93.64757	0.5384	9	9	107
-154.023	-71.82213	97.38444	0.5384	9	9	108
-154.023	-71.82213	101.1213	0.5384	9	9	109
-154.023	-71.82213	104.8582	0.5384	9	9	110
-154.023	-71.82213	108.595	0.5384	9	9	111
-154.023	-71.82213	112.3319	0.5384	9	9	112
-154.023	-71.82213	116.0688	0.5384	9	9	113
-154.023	-71.82213	119.8057	0.5384	9	9	114
-154.023	-71.82213	123.5425	0.5384	9	0	115

Wire No. 10 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-154.023	-71.82213	127.2794	0.2478	9	10	116
-154.023	-71.82213	130.5713	0.2478	10	10	117
-154.023	-71.82213	133.8632	0.2478	10	10	118
-154.023	-71.82213	137.1551	0.2478	10	10	119
-154.023	-71.82213	140.447	0.2478	10	0	120

Sources: 1
Pulse No., Voltage Magnitude, Phase (Degrees): 41, 1000.0, 0.0

Number of Loads: 2
Pulse No., Resistance, Reactance: 1 , 0 , 0
Pulse No., Resistance, Reactance: 81 , 0 , 0

******************** SOURCE DATA ********************
Pulse 41 Voltage = (1000.0, 0.0j)
Current = (1.3698, 3.4718j)
Impedance = (98.334, -249.239j) MODELED IMPEDANCE, TWR-2
Power = 684.88 Watts

********** **CURRENT DATA** **********

Wire No. 1 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
1	0.5506	-0.4832	0.7326	-41.2699
J	0.5503	-0.4828	0.7321	-41.2617

Wire No. 2 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	0.5503	-0.4828	0.7321	-41.2617
J	0.5493	-0.4814	0.7304	-41.2304

Wire No. 3 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	0.5493	-0.4814	0.7304	-41.2304
4	0.5452	-0.4748	0.7229	-41.0522
5	0.5396	-0.465	0.7123	-40.7531
6	0.5323	-0.4519	0.6982	-40.3278
7	0.5234	-0.4356	0.681	-39.7697
8	0.5129	-0.4164	0.6606	-39.0701
9	0.5009	-0.3944	0.6375	-38.2177
10	0.4874	-0.3699	0.6118	-37.1986
11	0.4725	-0.3432	0.584	-35.9954
12	0.4563	-0.3146	0.5543	-34.5869
13	0.439	-0.2845	0.5232	-32.9472
14	0.4207	-0.2532	0.491	-31.045
15	0.4014	-0.2211	0.4582	-28.8425
16	0.3813	-0.1884	0.4253	-26.2954
17	0.3606	-0.1557	0.3927	-23.3515
18	0.3393	-0.1232	0.361	-19.9521
19	0.3177	-0.0913	0.3305	-16.0336
20	0.2958	-0.0604	0.3019	-11.5327
21	0.2739	-0.0307	0.2756	-6.3961
22	0.2519	-0.0026	0.252	-0.5954
23	0.2302	0.0236	0.2314	5.8519
24	0.2088	0.0477	0.2142	12.8617
25	0.1879	0.0694	0.2003	20.2725
26	0.1676	0.0886	0.1895	27.856
27	0.148	0.105	0.1814	35.3538
28	0.1292	0.1185	0.1753	42.527
29	0.1114	0.129	0.1704	49.1976
30	0.0946	0.1365	0.166	55.2651
31	0.079	0.1407	0.1614	60.6992
32	0.0646	0.1418	0.1559	65.5203
33	0.0515	0.1398	0.149	69.7785
34	0.0398	0.1346	0.1403	73.5366
35	0.0295	0.1262	0.1296	76.8596
36	0.0206	0.1147	0.1166	79.8092
37	0.0133	0.1002	0.101	82.4412
38	0.0075	0.0825	0.0828	84.8059
39	0.0033	0.0614	0.0615	86.95
40	0.0007	0.0367	0.0367	88.9598
E	0.0	0.0	0.0	0.0

Wire No. 4 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
41	1.3698	3.4718	3.7322	68.4689
J	1.369	3.0792	3.3698	66.0307

Wire No. 5 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	1.369	3.0792	3.3698	66.0307
J	1.3662	2.7729	3.0912	63.7711

Wire No. 6 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	1.3662	2.7729	3.0912	63.7711
44	1.3552	2.1813	2.568	58.148
45	1.3398	1.6766	2.1462	51.3711
46	1.3197	1.1992	1.7832	42.2601
47	1.2949	0.7382	1.4906	29.6872
48	1.2656	0.2898	1.2984	12.8954
49	1.232	-0.1472	1.2408	-6.8137
50	1.1943	-0.5721	1.3243	-25.5967
51	1.1527	-0.9836	1.5154	-40.4739
52	1.1077	-1.3799	1.7695	-51.2453
53	1.0595	-1.759	2.0534	-58.9385
54	1.0084	-2.1186	2.3463	-64.5461
55	0.9549	-2.4565	2.6356	-68.7575
56	0.8994	-2.7707	2.913	-72.0162
57	0.8422	-3.059	3.1728	-74.6063
58	0.7838	-3.3194	3.4107	-76.7135
59	0.7247	-3.5502	3.6234	-78.4627
60	0.6652	-3.7497	3.8082	-79.9401
61	0.6058	-3.9165	3.9631	-81.2069
62	0.547	-4.0494	4.0861	-82.3075
63	0.489	-4.1474	4.1761	-83.2749
64	0.4325	-4.2097	4.2319	-84.134
65	0.3778	-4.236	4.2528	-84.904
66	0.3252	-4.226	4.2385	-85.5999
67	0.2751	-4.1796	4.1887	-86.2338
68	0.228	-4.0973	4.1036	-86.8152
69	0.1841	-3.9794	3.9837	-87.3519
70	0.1436	-3.8268	3.8295	-87.8504
71	0.107	-3.6405	3.642	-88.316
72	0.0745	-3.4215	3.4223	-88.7532
73	0.0462	-3.1711	3.1715	-89.166
74	0.0223	-2.8908	2.8909	-89.5575
75	0.0031	-2.5819	2.5819	-89.9309
76	-0.0113	-2.2456	2.2457	-90.2887
77	-0.0208	-1.8828	1.8829	-90.6334
78	-0.0252	-1.4931	1.4933	-90.9676
79	-0.0243	-1.0737	1.0739	-91.2945
80	-0.0175	-0.6184	0.6187	-91.6251
E	0.0	0.0	0.0	0.0

Wire No. 7 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
81	0.5466	-0.4082	0.6822	-36.7515
J	0.5463	-0.4079	0.6818	-36.744

Wire No. 8 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	0.5463	-0.4079	0.6818	-36.744
J	0.5453	-0.4067	0.6802	-36.7141

Wire No. 9 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	0.5453	-0.4067	0.6802	-36.7141
84	0.5416	-0.4018	0.6744	-36.5718
85	0.5365	-0.3946	0.666	-36.3367
86	0.5298	-0.385	0.655	-36.0064
87	0.5216	-0.3731	0.6413	-35.5776
88	0.5119	-0.359	0.6252	-35.0463
89	0.5007	-0.3429	0.6069	-34.4073
90	0.4881	-0.325	0.5864	-33.6542
91	0.4742	-0.3054	0.564	-32.7794
92	0.4591	-0.2844	0.54	-31.7738
93	0.4428	-0.2622	0.5146	-30.6263
94	0.4256	-0.239	0.4881	-29.3243
95	0.4073	-0.2152	0.4607	-27.8527
96	0.3883	-0.191	0.4328	-26.1938
97	0.3686	-0.1667	0.4045	-24.3275
98	0.3483	-0.1424	0.3763	-22.2303
99	0.3276	-0.1184	0.3484	-19.876
100	0.3066	-0.0951	0.321	-17.2351
101	0.2853	-0.0726	0.2944	-14.2758
102	0.264	-0.0512	0.2689	-10.9648
103	0.2428	-0.031	0.2448	-7.2694
104	0.2218	-0.0122	0.2221	-3.1611
105	0.201	0.0048	0.2011	1.3801
106	0.1807	0.0201	0.1819	6.3589
107	0.161	0.0335	0.1645	11.7575
108	0.142	0.0448	0.1489	17.5298
109	0.1237	0.054	0.1349	23.5976
110	0.1062	0.061	0.1225	29.8547
111	0.0898	0.0657	0.1112	36.1772
112	0.0744	0.068	0.1008	42.4405
113	0.0601	0.068	0.0907	48.539
114	0.047	0.0656	0.0807	54.405
115	0.035	0.0608	0.0701	60.0318
J	0.0238	0.0529	0.058	65.7259

Wire No. 10 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	0.0238	0.0529	0.058	65.7259
117	0.0179	0.0466	0.0499	68.9896
118	0.0123	0.0384	0.0403	72.2387
119	0.0075	0.0284	0.0294	75.2886
120	0.0035	0.0165	0.0169	78.1776
E	0.0	0.0	0.0	0.0

****
ACSModel
(MININEC 3.1 Core)
09-11-2013 13:08:52
****

KWKH
TWR-3 CALIBRATION MODEL (SOUTH)

Frequency = 1.130 MHz Wavelength = 265.30974 Meters

No. of Wires: 10

Wire No. 1	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
0	0	0		-1	
0	0	1.980979	0.2286	0	1

Wire No. 2	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
0	0	1.980979		1	
0	0	3.962696	0.4054	0	1

Wire No. 3	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
0	0	3.962696		2	
0	0	153.946	0.605	0	38

Wire No. 4	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-77.01152	-35.91106	0		-4	
-77.01152	-35.91106	1.980979	0.2286	0	1

Wire No. 5	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-77.01152	-35.91106	1.980979		4	
-77.01152	-35.91106	3.962696	0.4054	0	1

Wire No. 6	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-77.01152	-35.91106	3.962696		5	
-77.01152	-35.91106	152.049	0.5821	0	38

Wire No. 7	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-154.023	-71.82213	0		-7	
-154.023	-71.82213	1.980979	0.2286	0	1

Wire No. 8	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-154.023	-71.82213	1.980979		7	
-154.023	-71.82213	3.962696	0.4054	0	1

Wire No. 9	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-154.023	-71.82213	3.962696		8	
-154.023	-71.82213	127.2794	0.5384	0	33

Wire No. 10	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-154.023	-71.82213	127.2794		9	
-154.023	-71.82213	143.7389	0.2478	0	5

****** ANTENNA GEOMETRY ******

Wire No. 1 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
0	0	0	0.2286	-1	0	1

Wire No. 2 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
0	0	1.980979	0.4054	1	0	2

Wire No. 3 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
0	0	3.962696	0.605	2	3	3
0	0	7.909624	0.605	3	3	4
0	0	11.85655	0.605	3	3	5
0	0	15.80348	0.605	3	3	6
0	0	19.75041	0.605	3	3	7
0	0	23.69734	0.605	3	3	8
0	0	27.64427	0.605	3	3	9
0	0	31.59119	0.605	3	3	10
0	0	35.53812	0.605	3	3	11
0	0	39.48505	0.605	3	3	12
0	0	43.43198	0.605	3	3	13
0	0	47.37891	0.605	3	3	14
0	0	51.32584	0.605	3	3	15
0	0	55.27277	0.605	3	3	16
0	0	59.21969	0.605	3	3	17
0	0	63.16662	0.605	3	3	18
0	0	67.11355	0.605	3	3	19
0	0	71.06048	0.605	3	3	20
0	0	75.0074	0.605	3	3	21
0	0	78.95433	0.605	3	3	22
0	0	82.90126	0.605	3	3	23
0	0	86.84819	0.605	3	3	24
0	0	90.79511	0.605	3	3	25
0	0	94.74204	0.605	3	3	26
0	0	98.68897	0.605	3	3	27
0	0	102.6359	0.605	3	3	28
0	0	106.5828	0.605	3	3	29
0	0	110.5298	0.605	3	3	30
0	0	114.4767	0.605	3	3	31
0	0	118.4236	0.605	3	3	32
0	0	122.3705	0.605	3	3	33
0	0	126.3175	0.605	3	3	34
0	0	130.2644	0.605	3	3	35
0	0	134.2113	0.605	3	3	36
0	0	138.1583	0.605	3	3	37
0	0	142.1052	0.605	3	3	38
0	0	146.0521	0.605	3	3	39
0	0	149.999	0.605	3	0	40

Wire No. 4 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-77.01152	-35.91106	0	0.2286	-4	0	41

Wire No. 5 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-77.01152	-35.91106	1.980979	0.4054	4	0	42

Wire No. 6	Coordinates			Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-77.01152	-35.91106	3.962696	0.5821	5	6	43
-77.01152	-35.91106	7.859704	0.5821	6	6	44
-77.01152	-35.91106	11.75671	0.5821	6	6	45
-77.01152	-35.91106	15.65372	0.5821	6	6	46
-77.01152	-35.91106	19.55073	0.5821	6	6	47
-77.01152	-35.91106	23.44774	0.5821	6	6	48
-77.01152	-35.91106	27.34475	0.5821	6	6	49
-77.01152	-35.91106	31.24175	0.5821	6	6	50
-77.01152	-35.91106	35.13876	0.5821	6	6	51
-77.01152	-35.91106	39.03577	0.5821	6	6	52
-77.01152	-35.91106	42.93278	0.5821	6	6	53
-77.01152	-35.91106	46.82979	0.5821	6	6	54
-77.01152	-35.91106	50.7268	0.5821	6	6	55
-77.01152	-35.91106	54.62381	0.5821	6	6	56
-77.01152	-35.91106	58.52081	0.5821	6	6	57
-77.01152	-35.91106	62.41782	0.5821	6	6	58
-77.01152	-35.91106	66.31483	0.5821	6	6	59
-77.01152	-35.91106	70.21184	0.5821	6	6	60
-77.01152	-35.91106	74.10884	0.5821	6	6	61
-77.01152	-35.91106	78.00585	0.5821	6	6	62
-77.01152	-35.91106	81.90285	0.5821	6	6	63
-77.01152	-35.91106	85.79987	0.5821	6	6	64
-77.01152	-35.91106	89.69688	0.5821	6	6	65
-77.01152	-35.91106	93.59389	0.5821	6	6	66
-77.01152	-35.91106	97.4909	0.5821	6	6	67
-77.01152	-35.91106	101.3879	0.5821	6	6	68
-77.01152	-35.91106	105.2849	0.5821	6	6	69
-77.01152	-35.91106	109.1819	0.5821	6	6	70
-77.01152	-35.91106	113.0789	0.5821	6	6	71
-77.01152	-35.91106	116.9759	0.5821	6	6	72
-77.01152	-35.91106	120.8729	0.5821	6	6	73
-77.01152	-35.91106	124.77	0.5821	6	6	74
-77.01152	-35.91106	128.667	0.5821	6	6	75
-77.01152	-35.91106	132.564	0.5821	6	6	76
-77.01152	-35.91106	136.461	0.5821	6	6	77
-77.01152	-35.91106	140.358	0.5821	6	6	78
-77.01152	-35.91106	144.255	0.5821	6	6	79
-77.01152	-35.91106	148.152	0.5821	6	0	80

Wire No. 7	Coordinates			Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-154.023	-71.82213	0	0.2286	-7	0	81

Wire No. 8	Coordinates			Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-154.023	-71.82213	1.980979	0.4054	7	0	82

Wire No. 9 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-154.023	-71.82213	3.962696	0.5384	8	9	83
-154.023	-71.82213	7.699565	0.5384	9	9	84
-154.023	-71.82213	11.43644	0.5384	9	9	85
-154.023	-71.82213	15.17331	0.5384	9	9	86
-154.023	-71.82213	18.91018	0.5384	9	9	87
-154.023	-71.82213	22.64705	0.5384	9	9	88
-154.023	-71.82213	26.38391	0.5384	9	9	89
-154.023	-71.82213	30.12078	0.5384	9	9	90
-154.023	-71.82213	33.85765	0.5384	9	9	91
-154.023	-71.82213	37.59452	0.5384	9	9	92
-154.023	-71.82213	41.33139	0.5384	9	9	93
-154.023	-71.82213	45.06826	0.5384	9	9	94
-154.023	-71.82213	48.80513	0.5384	9	9	95
-154.023	-71.82213	52.542	0.5384	9	9	96
-154.023	-71.82213	56.27887	0.5384	9	9	97
-154.023	-71.82213	60.01574	0.5384	9	9	98
-154.023	-71.82213	63.75261	0.5384	9	9	99
-154.023	-71.82213	67.48949	0.5384	9	9	100
-154.023	-71.82213	71.22635	0.5384	9	9	101
-154.023	-71.82213	74.96322	0.5384	9	9	102
-154.023	-71.82213	78.70009	0.5384	9	9	103
-154.023	-71.82213	82.43696	0.5384	9	9	104
-154.023	-71.82213	86.17383	0.5384	9	9	105
-154.023	-71.82213	89.9107	0.5384	9	9	106
-154.023	-71.82213	93.64757	0.5384	9	9	107
-154.023	-71.82213	97.38444	0.5384	9	9	108
-154.023	-71.82213	101.1213	0.5384	9	9	109
-154.023	-71.82213	104.8582	0.5384	9	9	110
-154.023	-71.82213	108.595	0.5384	9	9	111
-154.023	-71.82213	112.3319	0.5384	9	9	112
-154.023	-71.82213	116.0688	0.5384	9	9	113
-154.023	-71.82213	119.8057	0.5384	9	9	114
-154.023	-71.82213	123.5425	0.5384	9	0	115

Wire No. 10 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-154.023	-71.82213	127.2794	0.2478	9	10	116
-154.023	-71.82213	130.5713	0.2478	10	10	117
-154.023	-71.82213	133.8632	0.2478	10	10	118
-154.023	-71.82213	137.1551	0.2478	10	10	119
-154.023	-71.82213	140.447	0.2478	10	0	120

Sources: 1
Pulse No., Voltage Magnitude, Phase (Degrees): 81, 1000.0, 0.0

Number of Loads: 2
Pulse No., Resistance, Reactance: 1 , 0 , 0
Pulse No., Resistance, Reactance: 41 , 0 , 0

********************** SOURCE DATA **********************
Pulse 81 Voltage = (1000.0, 0.0j)
Current = (1.1903, 2.2425j)
Impedance = (184.663, -347.907j) MODELED IMPEDANCE, TWR-3
Power = 595.15 Watts

********** **CURRENT DATA** **********

Wire No. 1 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
1	-0.2483	-0.2343	0.3414	-136.6582
J	-0.2481	-0.2342	0.3412	-136.6531

Wire No. 2 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	-0.2481	-0.2342	0.3412	-136.6531
J	-0.2475	-0.2338	0.3404	-136.6335

Wire No. 3 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	-0.2475	-0.2338	0.3404	-136.6335
4	-0.2448	-0.2321	0.3374	-136.5214
5	-0.2409	-0.23	0.3331	-136.3333
6	-0.2358	-0.2272	0.3275	-136.0657
7	-0.2295	-0.2238	0.3205	-135.7143
8	-0.2219	-0.2198	0.3124	-135.2736
9	-0.2133	-0.2153	0.303	-134.7364
10	-0.2036	-0.2101	0.2926	-134.0938
11	-0.193	-0.2045	0.2812	-133.3349
12	-0.1815	-0.1984	0.2689	-132.4464
13	-0.1692	-0.1918	0.2558	-131.412
14	-0.1563	-0.1849	0.2421	-130.212
15	-0.1429	-0.1776	0.228	-128.8224
16	-0.1291	-0.17	0.2134	-127.2146
17	-0.115	-0.1621	0.1988	-125.3538
18	-0.1008	-0.154	0.1841	-123.1982
19	-0.0866	-0.1458	0.1695	-120.6986
20	-0.0724	-0.1374	0.1553	-117.7971
21	-0.0586	-0.129	0.1417	-114.4282
22	-0.0451	-0.1205	0.1287	-110.521
23	-0.0322	-0.1121	0.1166	-106.0049
24	-0.0198	-0.1037	0.1056	-100.8218
25	-0.0083	-0.0955	0.0958	-94.9437
26	0.0024	-0.0874	0.0874	-88.3979
27	0.0122	-0.0795	0.0804	-81.2906
28	0.0208	-0.0718	0.0747	-73.8164
29	0.0283	-0.0643	0.0703	-66.2391
30	0.0346	-0.0572	0.0668	-58.8433
31	0.0395	-0.0503	0.064	-51.8762
32	0.0431	-0.0438	0.0615	-45.5062
33	0.0452	-0.0377	0.0588	-39.814
34	0.0458	-0.0319	0.0558	-34.8072
35	0.0449	-0.0264	0.0521	-30.4459
36	0.0425	-0.0213	0.0475	-26.6658
37	0.0384	-0.0166	0.0418	-23.3937
38	0.0326	-0.0122	0.0348	-20.5565
39	0.025	-0.0082	0.0263	-18.084
40	0.0154	-0.0044	0.016	-15.8668
E	0.0	0.0	0.0	0.0

Wire No. 4 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
41	0.5466	-0.4082	0.6822	-36.7506
J	0.5463	-0.4079	0.6818	-36.7433

Wire No. 5 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	0.5463	-0.4079	0.6818	-36.7433
J	0.5454	-0.4067	0.6803	-36.7146

Wire No. 6 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	0.5454	-0.4067	0.6803	-36.7146
44	0.5418	-0.4018	0.6745	-36.5598
45	0.5369	-0.3944	0.6662	-36.3018
46	0.5307	-0.3847	0.6554	-35.9379
47	0.523	-0.3726	0.6422	-35.4648
48	0.514	-0.3583	0.6266	-34.8785
49	0.5037	-0.342	0.6088	-34.174
50	0.4921	-0.3238	0.589	-33.3452
51	0.4793	-0.304	0.5675	-32.385
52	0.4653	-0.2828	0.5445	-31.2849
53	0.4504	-0.2604	0.5202	-30.0352
54	0.4344	-0.2371	0.4949	-28.6247
55	0.4176	-0.2132	0.4689	-27.0407
56	0.4001	-0.1888	0.4424	-25.2689
57	0.3818	-0.1644	0.4157	-23.2938
58	0.3631	-0.1401	0.3892	-21.0984
59	0.3438	-0.1161	0.3629	-18.6649
60	0.3243	-0.0928	0.3373	-15.9751
61	0.3044	-0.0703	0.3125	-13.0117
62	0.2845	-0.0489	0.2887	-9.7596
63	0.2645	-0.0288	0.2661	-6.2076
64	0.2447	-0.01	0.2449	-2.3514
65	0.225	0.0071	0.2251	1.804
66	0.2056	0.0225	0.2068	6.2413
67	0.1866	0.036	0.1901	10.9287
68	0.1681	0.0476	0.1747	15.819
69	0.1502	0.0572	0.1607	20.851
70	0.1329	0.0647	0.1478	25.953
71	0.1164	0.07	0.1358	31.0486
72	0.1006	0.0733	0.1245	36.0633
73	0.0857	0.0743	0.1135	40.9309
74	0.0718	0.0733	0.1025	45.5985
75	0.0587	0.0701	0.0914	50.0282
76	0.0467	0.0648	0.0799	54.1981
77	0.0357	0.0574	0.0676	58.1005
78	0.0257	0.0478	0.0543	61.7412
79	0.0167	0.036	0.0397	65.1403
80	0.0086	0.0217	0.0233	68.3951
E	0.0	0.0	0.0	0.0

Wire No. 7 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
81	1.1903	2.2425	2.5389	62.0415
J	1.1896	1.8506	2.2	57.2661

Wire No. 8 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	1.1896	1.8506	2.2	57.2661
J	1.1873	1.5451	1.9486	52.4591

Wire No. 9 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	1.1873	1.5451	1.9486	52.4591
84	1.1792	1.0113	1.5534	40.6181
85	1.1677	0.5606	1.2953	25.6466
86	1.1527	0.1432	1.1616	7.0831
87	1.1342	-0.251	1.1617	-12.4767
88	1.1124	-0.6261	1.2765	-29.3732
89	1.0873	-0.9836	1.4661	-42.1335
90	1.059	-1.3234	1.695	-51.3329
91	1.0279	-1.6451	1.9398	-58.0028
92	0.994	-1.9476	2.1866	-62.9621
93	0.9576	-2.2297	2.4267	-66.7587
94	0.9189	-2.4903	2.6544	-69.7462
95	0.8782	-2.7279	2.8657	-72.1551
96	0.8357	-2.9414	3.0578	-74.139
97	0.7917	-3.1296	3.2282	-75.8028
98	0.7466	-3.2915	3.3751	-77.2204
99	0.7005	-3.4261	3.497	-78.4449
100	0.6537	-3.5327	3.5926	-79.5156
101	0.6067	-3.6106	3.6612	-80.4618
102	0.5596	-3.6595	3.702	-81.3059
103	0.5127	-3.679	3.7145	-82.0656
104	0.4664	-3.669	3.6985	-82.7547
105	0.421	-3.6296	3.654	-83.3843
106	0.3766	-3.5612	3.581	-83.9633
107	0.3336	-3.464	3.48	-84.4992
108	0.2922	-3.3388	3.3515	-84.9982
109	0.2527	-3.1861	3.1961	-85.4656
110	0.2152	-3.007	3.0147	-85.9059
111	0.1801	-2.8022	2.808	-86.3232
112	0.1474	-2.5728	2.5771	-86.7215
113	0.1173	-2.3196	2.3226	-87.1045
114	0.09	-2.0429	2.0449	-87.477
115	0.0655	-1.7424	1.7436	-87.8457
J	0.043	-1.3989	1.3996	-88.2385

Wire No. 10 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	0.043	-1.3989	1.3996	-88.2385
117	0.0313	-1.1775	1.1779	-88.4767
118	0.0206	-0.9272	0.9275	-88.7259
119	0.0118	-0.6581	0.6583	-88.9731
120	0.005	-0.3664	0.3664	-89.2217
E	0.0	0.0	0.0	0.0

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SECTION-2
DETERMINATION OF OPERATING PARAMETERS
FOR KWKH DIRECTIONAL ANTENNA SYSTEM

The calibrated Method of Moments model used for the individual KWKH towers was run with towers 1 – 3 driven to obtain the proper operating parameters for the nighttime directional antenna. All towers were modeled at the same heights and equivalent radii as the non-directional models. The complex voltages required at the sources located at ground level at the base of each tower to produce the current moment sums, which, when normalized, are equal to the theoretical field parameters calculated by the DA Model. The tower drive voltages and phases were calculated from these base voltages.

The voltages which are sampled by the antenna monitor system at the Voltage Sampling Units ("VSU's") were calculated from the Method of Moments directional antenna model. The sampling lines are electrically identical in composition and length within the tolerances permitted by the Rules. Therefore, the antenna monitor parameters required to produce the theoretical parameters can be calculated from the modeled base voltages and phases which correspond to the location of the VSU's at the bases of the three towers. Method of Moments model and circuit calculation details are included in this report. Section-3 contains the calibration details of the sample system.

TABLE OF MODELED PARAMETERS AT TOWER BASES

TWR	MODEL CURRENT PULSE	MODEL VOLTAGE MAGNITUDE (VOLTS)	MODEL VOLTAGE PHASE (DEGREES)	MODEL DRIVE IMPEDANCE (OHMS)	MODEL DRIVE POWER (WATTS)
1	1	2964.4	176.7°	62.3-j346.5	2208.7
2	41	6972.9	76.7°	86.6-j261.9	27,685.2
3	81	5027.3	-29.5°	117.5-j245.0	20,109.1

METHOD OF MOMENTS MODELS FOR KWKH DIRECTIVE ARRAY

The Ratio and Phase parameters were derived from the same set of Base Region Circuit Models used in the Non-Directional Model Calibration with the exception that the modeled input data was taken from the Directional Antenna Model. The input voltage magnitudes and phases appearing at Node-1 for each of the three towers of the array were matched in voltage Magnitude and Phase to the Base Driving voltages of the Mininec DA Model by adjustment of the magnitude and phase of the voltage source for each WCAP tower model. The resulting Magnitude and Phase of the Node-2 voltages are the exact operating parameters for each tower. When normalized to Tower-2, they represent the operating parameters for the array.

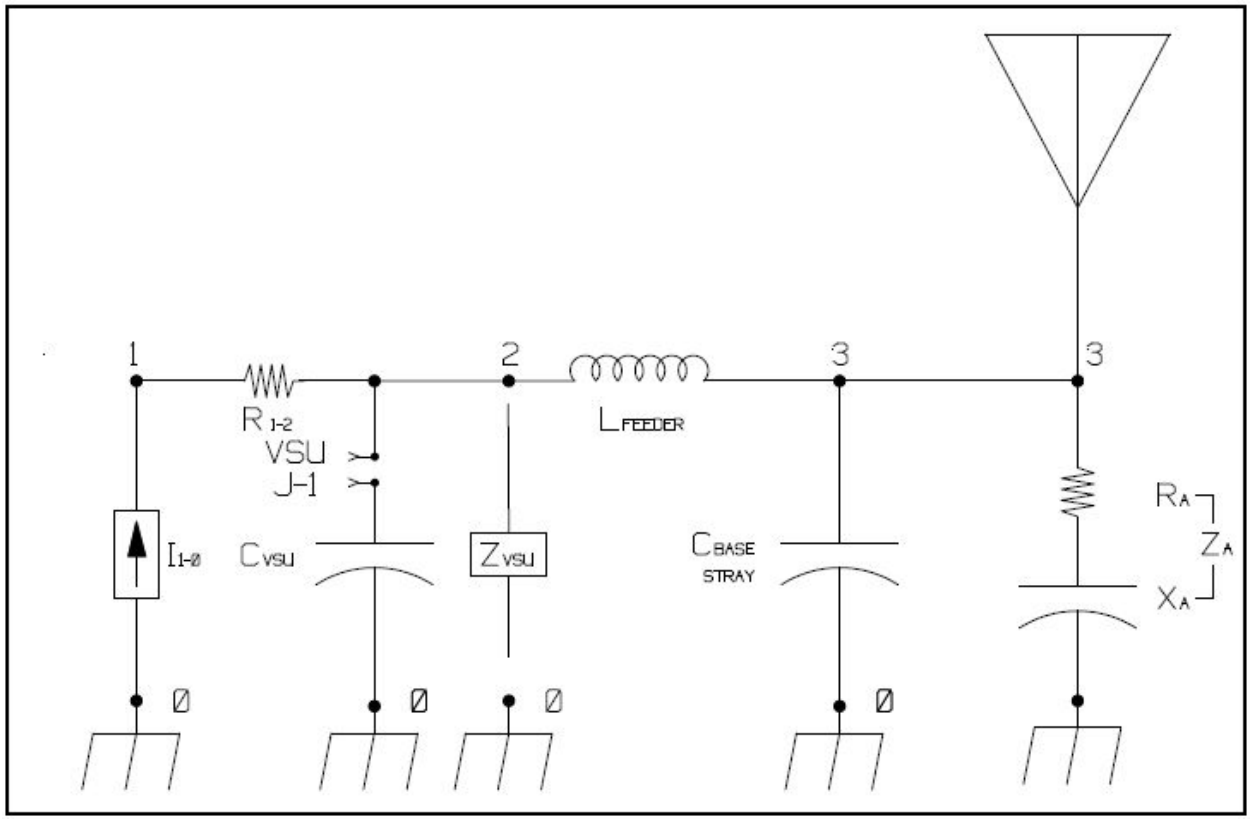
TABLE OF MODELED PARAMETERS AT VSU'S

TWR	MODEL CURRENT PULSE	VOLTAGE MAGNITUDE AT VSU (VOLTS)	VOLTAGE PHASE AT VSU (DEGREES)	DRIVE IMPEDANCE AT VSU (OHMS)	NORMALIZED RATIO/PHASE
1	1	195.92	-12.47	50.48-j291.92	0.362/108.1
2	41	542.02	-120.60	77.67-j229.11	1.000/00.0
3	81	468.06	+129.44	81.11-j189.63	0.864/-110.0

The KWKH Directive array is adjusted to within +/-5 percent and +/-3 degrees of the calibrated Antenna Monitor Parameters listed on page 3 of Section-3.

The individual WCAP circuit files appear on the following pages.

SCHEMATIC OF BASE REGION MODEL



The base insulator, Austin Xfmr & Isocoupler capacitances are lumped at Node-3
For VSU Output Terminal Inpedance Measurement purposes, the Shunt Capacitance of the VSU is not Included,

KWKH DIRECTIONAL BASE REGION MODEL TABULATION

TWR	BASE SHUNT C (pF)	FEEDER INDUCTANCE (uHy)	BASE IMPEDANCE FROM MOM MODEL (OHMS)	MODELED IMPEDANCE @ VSU FROM WCAP MODEL (OHMS)
1	45	2.95	62.30-j346.49	50.48-j291.92
2	30	2.86	86.63-j261.86	77.67-j229.11
3	115	2.96	117.53-j245.04	81.10-j189.65

WCAP - KWKH-TWR-1 DA-N

WCAP OUTPUT AT FREQUENCY: 1.130 MHz

NODE VOLTAGES

Node: 1 2772.7310 ∠ 177.5358° V
Node: 2 2771.1218 ∠ 177.3454° V
Node: 3 2964.3596 ∠ 176.7001° V

	WCAP PART		BRANCH VOLTAGE	BRANCH CURRENT
R	1→2	1.00000000	9.35 ∠ -102.466° V	9.35 ∠ -102.466° A
L	2→3	2.95000000	**195.92 ∠ -12.466° V[2]**	9.35 ∠ -102.466° A
R	3→0	62.30000000	**2964.36 ∠ 176.700° V[1]**	8.42 ∠ -103.493° A
C	3→0	0.00004500	2964.36 ∠ 176.700° V	0.95 ∠ -93.300° A

	WCAP PART		FROM IMPEDANCE	TO IMPEDANCE
R	1→2	1.00000000	51.48 - j 291.923	**50.48 - j 291.923**
L	2→3	2.95000000	50.48 - j 291.923	50.48 - j 312.868
R	3→0	62.30000000	**62.30 - j 346.500**	0.00 + j 0.000
C	3→0	0.00004500	0.00 - j 3129.891	0.00 + j 0.000

WCAP INPUT DATA:

	1.1300	0.00000000	0	
I	9.35380000	0	1	257.53400000
R	1.00000000	1	2	0.00000000
L	2.95000000	2	3	0.00000000
R	62.30000000	3	0	-346.50000000
C	0.00004500	3	0	

1: Modeled Base Voltage/Phase, Impedance
2: Modeled VSU Voltage/Phase, Impedance

WCAP - KWKH-TWR-2 DA-N

WCAP OUTPUT AT FREQUENCY: 1.130 MHz

NODE VOLTAGES

Node: 1 6466.0184 ∠ 78.3541° V
Node: 2 6457.3995 ∠ 78.1301° V
Node: 3 6972.8949 ∠ 76.7001° V

	WCAP PART		BRANCH VOLTAGE	BRANCH CURRENT
R	1→2	1.00000000	26.69 ∠ 149.404° V	26.69 ∠ 149.404° A
L	2→3	2.86000000	**542.02 ∠ -120.596° V[2]**	26.69 ∠ 149.404° A
R	3→0	86.60000000	**6972.89 ∠ 76.700° V[1]**	25.28 ∠ 148.403° A
C	3→0	0.00003000	6972.89 ∠ 76.700° V	1.49 ∠ 166.700° A

	WCAP PART		FROM IMPEDANCE	TO IMPEDANCE
R	1→2	1.00000000	78.67 - j 229.113	**77.67 - j 229.113**
L	2→3	2.86000000	77.67 - j 229.113	77.67 - j 249.419
R	3→0	86.60000000	**86.60 - j 261.900**	0.00 + j 0.000
C	3→0	0.00003000	0.00 - j 4694.836	0.00 + j 0.000

WCAP INPUT DATA:

	1.1300	0.00000000	0	
I	26.69240000	0	1	149.40400000
R	1.00000000	1	2	0.00000000
L	2.86000000	2	3	0.00000000
R	86.60000000	3	0	-261.90000000
C	0.00003000	3	0	

1: Modeled Base Voltage/Phase, Impedance
2: Modeled VSU Voltage/Phase, Impedance

WCAP - KWKH-3T6-4B2
WCAP OUTPUT AT FREQUENCY: 1.130 MHz

NODE VOLTAGES
Node: 1 4602.6550 ∠ -27.1554° V
Node: 2 4593.8536 ∠ -27.4103° V
Node: 3 5027.5975 ∠ -29.5078° V

	WCAP PART		BRANCH VOLTAGE	BRANCH CURRENT
R	1→2	1.00000000	22.27 ∠ 39.440° V	22.27 ∠ 39.440° A
L	2→3	2.96000000	**468.06 ∠ 129.440° V**[2]	22.27 ∠ 39.440° A
R	3→0	117.53000000	**5027.60 ∠ -29.508° V**[1]	18.50 ∠ 34.868° A
C	3→0	0.00011500	5027.60 ∠ -29.508° V	4.11 ∠ 60.492° A

	WCAP PART		FROM IMPEDANCE	TO IMPEDANCE
R	1→2	1.00000000	82.09 - j 189.655	**81.09 - j 189.655**[2]
L	2→3	2.96000000	81.09 - j 189.655	81.09 - j 210.671
R	3→0	117.53000000	**117.53 - j 245.040**[1]	0.00 + j 0.000
C	3→0	0.00011500	0.00 - j 1224.740	0.00 + j 0.000

WCAP INPUT DATA:

	1.1300	0.00000000	0	
I	22.27176000	0	1	39.44000000
R	1.00000000	1	2	0.00000000
L	2.96000000	2	3	0.00000000
R	**117.53000000**	**3**	**0**	**-245.04000000**[1]
C	0.00011500	3	0	

1: Modeled Base Voltage/Phase. Impedance
2: **Modeled Base Voltage/Phase. Impedance**

****
ACSModel
(MININEC 3.1 Core)
09-11-2013 16:44:52
****

KWKH
DA PARAMETER DERIVATION
Frequency = 1.130 MHz Wavelength = 265.30974 Meters
No. of Wires: 10

Wire No. 1 Coordinates				End	No. of
X	Y	Z	Radius	Connection	Segments
0	0	0		-1	
0	0	1.980979	0.2286	0	1

Wire No. 2 Coordinates				End	No. of
X	Y	Z	Radius	Connection	Segments
0	0	1.980979		1	
0	0	3.962696	0.4054	0	1

Wire No. 3 Coordinates				End	No. of
X	Y	Z	Radius	Connection	Segments
0	0	3.962696		2	
0	0	153.946	0.605	0	38

Wire No. 4 Coordinates				End	No. of
X	Y	Z	Radius	Connection	Segments
-77.01152	-35.91106	0		-4	
-77.01152	-35.91106	1.980979	0.2286	0	1

Wire No. 5 Coordinates				End	No. of
X	Y	Z	Radius	Connection	Segments
-77.01152	-35.91106	1.980979		4	
-77.01152	-35.91106	3.962696	0.4054	0	1

Wire No. 6 Coordinates				End	No. of
X	Y	Z	Radius	Connection	Segments
-77.01152	-35.91106	3.962696		5	
-77.01152	-35.91106	152.049	0.5821	0	38

Wire No. 7 Coordinates				End	No. of
X	Y	Z	Radius	Connection	Segments
-154.023	-71.82213	0		-7	
-154.023	-71.82213	1.980979	0.2286	0	1

Wire No. 8 Coordinates				End	No. of
X	Y	Z	Radius	Connection	Segments
-154.023	-71.82213	1.980979		7	
-154.023	-71.82213	3.962696	0.4054	0	1

Wire No. 9 Coordinates				End	No. of
X	Y	Z	Radius	Connection	Segments
-154.023	-71.82213	3.962696		8	
-154.023	-71.82213	127.2794	0.5384	0	33

Wire No. 10 Coordinates				End	No. of
X	Y	Z	Radius	Connection	Segments
-154.023	-71.82213	127.2794		9	
-154.023	-71.82213	143.7389	0.2478	0	5

****** ANTENNA GEOMETRY ******

Wire No. 1 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
0	0	0	0.2286	-1	0	1

Wire No. 2 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
0	0	1.980979	0.4054	1	0	2

Wire No. 3 Coordinates				Connection		Pulse

X	Y	Z	Radius	End1	End2	No.
0	0	3.962696	0.605	2	3	3
0	0	7.909624	0.605	3	3	4
0	0	11.85655	0.605	3	3	5
0	0	15.80348	0.605	3	3	6
0	0	19.75041	0.605	3	3	7
0	0	23.69734	0.605	3	3	8
0	0	27.64427	0.605	3	3	9
0	0	31.59119	0.605	3	3	10
0	0	35.53812	0.605	3	3	11
0	0	39.48505	0.605	3	3	12
0	0	43.43198	0.605	3	3	13
0	0	47.37891	0.605	3	3	14
0	0	51.32584	0.605	3	3	15
0	0	55.27277	0.605	3	3	16
0	0	59.21969	0.605	3	3	17
0	0	63.16662	0.605	3	3	18
0	0	67.11355	0.605	3	3	19
0	0	71.06048	0.605	3	3	20
0	0	75.0074	0.605	3	3	21
0	0	78.95433	0.605	3	3	22
0	0	82.90126	0.605	3	3	23
0	0	86.84819	0.605	3	3	24
0	0	90.79511	0.605	3	3	25
0	0	94.74204	0.605	3	3	26
0	0	98.68897	0.605	3	3	27
0	0	102.6359	0.605	3	3	28
0	0	106.5828	0.605	3	3	29
0	0	110.5298	0.605	3	3	30
0	0	114.4767	0.605	3	3	31
0	0	118.4236	0.605	3	3	32
0	0	122.3705	0.605	3	3	33
0	0	126.3175	0.605	3	3	34
0	0	130.2644	0.605	3	3	35
0	0	134.2113	0.605	3	3	36
0	0	138.1583	0.605	3	3	37
0	0	142.1052	0.605	3	3	38
0	0	146.0521	0.605	3	3	39
0	0	149.999	0.605	3	0	40

Wire No. 4 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-77.01152	-35.91106	0	0.2286	-4	0	41

Wire No. 5 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-77.01152	-35.91106	1.980979	0.4054	4	0	42

Wire No. 6 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-77.01152	-35.91106	3.962696	0.5821	5	6	43
-77.01152	-35.91106	7.859704	0.5821	6	6	44
-77.01152	-35.91106	11.75671	0.5821	6	6	45
-77.01152	-35.91106	15.65372	0.5821	6	6	46
-77.01152	-35.91106	19.55073	0.5821	6	6	47
-77.01152	-35.91106	23.44774	0.5821	6	6	48
-77.01152	-35.91106	27.34475	0.5821	6	6	49
-77.01152	-35.91106	31.24175	0.5821	6	6	50
-77.01152	-35.91106	35.13876	0.5821	6	6	51
-77.01152	-35.91106	39.03577	0.5821	6	6	52
-77.01152	-35.91106	42.93278	0.5821	6	6	53
-77.01152	-35.91106	46.82979	0.5821	6	6	54
-77.01152	-35.91106	50.7268	0.5821	6	6	55
-77.01152	-35.91106	54.62381	0.5821	6	6	56
-77.01152	-35.91106	58.52081	0.5821	6	6	57
-77.01152	-35.91106	62.41782	0.5821	6	6	58
-77.01152	-35.91106	66.31483	0.5821	6	6	59
-77.01152	-35.91106	70.21184	0.5821	6	6	60
-77.01152	-35.91106	74.10884	0.5821	6	6	61
-77.01152	-35.91106	78.00585	0.5821	6	6	62
-77.01152	-35.91106	81.90285	0.5821	6	6	63
-77.01152	-35.91106	85.79987	0.5821	6	6	64
-77.01152	-35.91106	89.69688	0.5821	6	6	65
-77.01152	-35.91106	93.59389	0.5821	6	6	66
-77.01152	-35.91106	97.4909	0.5821	6	6	67
-77.01152	-35.91106	101.3879	0.5821	6	6	68
-77.01152	-35.91106	105.2849	0.5821	6	6	69
-77.01152	-35.91106	109.1819	0.5821	6	6	70
-77.01152	-35.91106	113.0789	0.5821	6	6	71
-77.01152	-35.91106	116.9759	0.5821	6	6	72
-77.01152	-35.91106	120.8729	0.5821	6	6	73
-77.01152	-35.91106	124.77	0.5821	6	6	74
-77.01152	-35.91106	128.667	0.5821	6	6	75
-77.01152	-35.91106	132.564	0.5821	6	6	76
-77.01152	-35.91106	136.461	0.5821	6	6	77
-77.01152	-35.91106	140.358	0.5821	6	6	78
-77.01152	-35.91106	144.255	0.5821	6	6	79
-77.01152	-35.91106	148.152	0.5821	6	0	80

Wire No. 7 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-154.023	-71.82213	0	0.2286	-7	0	81

Wire No. 8 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-154.023	-71.82213	1.980979	0.4054	7	0	82

Wire No. 9 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-154.023	-71.82213	3.962696	0.5384	8	9	83
-154.023	-71.82213	7.699565	0.5384	9	9	84
-154.023	-71.82213	11.43644	0.5384	9	9	85
-154.023	-71.82213	15.17331	0.5384	9	9	86
-154.023	-71.82213	18.91018	0.5384	9	9	87
-154.023	-71.82213	22.64705	0.5384	9	9	88
-154.023	-71.82213	26.38391	0.5384	9	9	89
-154.023	-71.82213	30.12078	0.5384	9	9	90
-154.023	-71.82213	33.85765	0.5384	9	9	91
-154.023	-71.82213	37.59452	0.5384	9	9	92
-154.023	-71.82213	41.33139	0.5384	9	9	93
-154.023	-71.82213	45.06826	0.5384	9	9	94
-154.023	-71.82213	48.80513	0.5384	9	9	95
-154.023	-71.82213	52.542	0.5384	9	9	96
-154.023	-71.82213	56.27887	0.5384	9	9	97
-154.023	-71.82213	60.01574	0.5384	9	9	98
-154.023	-71.82213	63.75261	0.5384	9	9	99
-154.023	-71.82213	67.48949	0.5384	9	9	100
-154.023	-71.82213	71.22635	0.5384	9	9	101
-154.023	-71.82213	74.96322	0.5384	9	9	102
-154.023	-71.82213	78.70009	0.5384	9	9	103
-154.023	-71.82213	82.43696	0.5384	9	9	104
-154.023	-71.82213	86.17383	0.5384	9	9	105
-154.023	-71.82213	89.9107	0.5384	9	9	106
-154.023	-71.82213	93.64757	0.5384	9	9	107
-154.023	-71.82213	97.38444	0.5384	9	9	108
-154.023	-71.82213	101.1213	0.5384	9	9	109
-154.023	-71.82213	104.8582	0.5384	9	9	110
-154.023	-71.82213	108.595	0.5384	9	9	111
-154.023	-71.82213	112.3319	0.5384	9	9	112
-154.023	-71.82213	116.0688	0.5384	9	9	113
-154.023	-71.82213	119.8057	0.5384	9	9	114
-154.023	-71.82213	123.5425	0.5384	9	0	115

Wire No. 10 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-154.023	-71.82213	127.2794	0.2478	9	10	116
-154.023	-71.82213	130.5713	0.2478	10	10	117
-154.023	-71.82213	133.8632	0.2478	10	10	118
-154.023	-71.82213	137.1551	0.2478	10	10	119
-154.023	-71.82213	140.447	0.2478	10	0	120

Sources: 3

Pulse No., Voltage Magnitude, Phase (Degrees): 1, 2964.4, 176.7 TWR-1 MAG/PH

Pulse No., Voltage Magnitude, Phase (Degrees): 41, 6972.9, 76.7 TWR-2 MAG/PH

Pulse No., Voltage Magnitude, Phase (Degrees): 81, 5027.3, -29.5 TWR-3 MAG/PH

Number of Loads: 0

```
********************    SOURCE DATA     ********************
Pulse  1      Voltage = (-2959.4085, 171.3416j)
Current = (-1.9667, -8.1875j)
Impedance = (62.301, -346.488j)
Power = 2208.69 Watts

Pulse  41     Voltage = (1598.3389, 6787.2544j)
Current = (-21.5427, 13.2302j)
Impedance = (86.625, -261.861j)
Power = 27682.23 Watts

Pulse  81     Voltage = (4373.6019, -2478.9459j)
Current = (15.1844, 10.5659j)
Impedance = (117.527, -245.036j)
Power = 20109.08 Watts

Total Power = 49999.999 Watts
```

********** **CURRENT DATA** **********

Wire No. 1 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
1	-1.9667	-8.1875	8.4204	-103.5068
J	-1.8992	-7.0269	7.279	-105.1245

Wire No. 2 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	-1.8992	-7.0269	7.279	-105.1245
J	-1.8465	-6.1283	6.4004	-106.7683

Wire No. 3 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	-1.8465	-6.1283	6.4004	-106.7683
4	-1.7434	-4.3337	4.6713	-111.9139
5	-1.6598	-2.815	3.2679	-120.525
6	-1.5839	-1.3812	2.1016	-138.91
7	-1.5133	-0.0002	1.5133	-179.9907
8	-1.4467	1.3403	1.9722	137.1865
9	-1.3834	2.6431	2.9832	117.6274
10	-1.3227	3.9062	4.1241	108.7073
11	-1.2643	5.1252	5.2789	103.8569
12	-1.2076	6.2945	6.4093	100.8602
13	-1.1523	7.4076	7.4967	98.842
14	-1.0981	8.4578	8.5287	97.3972
15	-1.0445	9.438	9.4956	96.315
16	-0.9913	10.3417	10.3891	95.4752
17	-0.9382	11.1625	11.2019	94.8043
18	-0.885	11.8944	11.9272	94.2552
19	-0.8315	12.5318	12.5594	93.7963
20	-0.7777	13.07	13.0932	93.4053
21	-0.7235	13.5049	13.5242	93.0665
22	-0.6689	13.8328	13.849	92.7682
23	-0.6139	14.0512	14.0646	92.5017
24	-0.5588	14.1582	14.1693	92.2604
25	-0.5039	14.1528	14.1617	92.0389
26	-0.4492	14.0346	14.0418	91.8333
27	-0.3953	13.8044	13.81	91.6403
28	-0.3425	13.4635	13.4678	91.4574
29	-0.2913	13.014	13.0173	91.2823
30	-0.2421	12.4591	12.4614	91.1134
31	-0.1955	11.8022	11.8038	90.9492
32	-0.1521	11.0475	11.0485	90.7887
33	-0.1123	10.1996	10.2002	90.6308
34	-0.0768	9.2634	9.2637	90.4748
35	-0.046	8.2438	8.2439	90.3199
36	-0.0206	7.1451	7.1451	90.1655
37	-0.0011	5.9703	5.9703	90.011
38	0.0119	4.7193	4.7193	89.8558
39	0.0178	3.3835	3.3836	89.6988
40	0.0158	1.9448	1.9449	89.5348
E	0.0	0.0	0.0	0.0

Wire No. 4 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
41	-21.5427	13.2302	25.2809	148.4442
J	-18.8786	12.5981	22.6961	146.284

Wire No. 5 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	-18.8786	12.5981	22.6961	146.284
J	-16.803	12.0927	20.702	144.2584

Wire No. 6 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	-16.803	12.0927	20.702	144.2584
44	-12.7969	11.0833	16.9293	139.1045

45	-9.3839	10.1872	13.8505	132.6495
46	-6.1582	9.3066	11.1596	123.4926
47	-3.0478	8.425	8.9593	109.8883
48	-0.0253	7.5366	7.5366	90.192
49	2.9159	6.6411	7.2531	66.2952
50	5.7719	5.7408	8.1408	44.8454
51	8.5335	4.8395	9.8103	29.5585
52	11.1884	3.9419	11.8625	19.4082
53	13.7228	3.0531	14.0583	12.5433
54	16.1218	2.1789	16.2683	7.6971
55	18.3706	1.325	18.4183	4.1254
56	20.4545	0.4972	20.4605	1.3926
57	22.3594	-0.2986	22.3614	-0.765
58	24.0722	-1.0567	24.0954	-2.5136
59	25.5807	-1.7717	25.642	-3.962
60	26.874	-2.4383	26.9844	-5.1843
61	27.9427	-3.0515	28.1088	-6.2323
62	28.7787	-3.6068	29.0039	-7.1435
63	29.3758	-4.0999	29.6605	-7.9452
64	29.7292	-4.5271	30.0719	-8.6583
65	29.836	-4.8851	30.2333	-9.2986
66	29.6951	-5.1712	30.142	-9.8785
67	29.307	-5.383	29.7972	-10.4079
68	28.6739	-5.5189	29.2002	-10.8946
69	27.7998	-5.5776	28.3538	-11.3449
70	26.6901	-5.5585	27.2628	-11.7642
71	25.3519	-5.4613	25.9335	-12.1569
72	23.7932	-5.2864	24.3734	-12.5265
73	22.0232	-5.0344	22.5913	-12.8762
74	20.0516	-4.7063	20.5965	-13.2088
75	17.8878	-4.3033	18.3982	-13.5266
76	15.5406	-3.8263	16.0047	-13.8318
77	13.0154	-3.2756	13.4213	-14.1264
78	10.311	-2.6498	10.646	-14.4125
79	7.4074	-1.9423	7.6578	-14.6928
80	4.2622	-1.1402	4.4121	-14.9767
E	0.0	0.0	0.0	0.0

Wire No. 7 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
81	15.1844	10.5659	18.4987	34.8317
J	14.2067	8.8516	16.7386	31.9254

Wire No. 8 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	14.2067	8.8516	16.7386	31.9254
J	13.4273	7.5144	15.387	29.233

Wire No. 9 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	13.4273	7.5144	15.387	29.233
84	12.0227	5.178	13.0904	23.3009
85	10.7881	3.205	11.2541	16.5463
86	9.5982	1.3772	9.6965	8.1656
87	8.4292	-0.3495	8.4364	-2.3742
88	7.2722	-1.9933	7.5405	-15.3282
89	6.1257	-3.5604	7.0852	-30.166
90	4.9917	-5.0512	7.1015	-45.3397
91	3.8741	-6.4633	7.5355	-59.0611
92	2.7783	-7.7924	8.2729	-70.3769
93	1.71	-9.0335	9.1939	-79.2813
94	0.6755	-10.1813	10.2036	-86.2043
95	-0.3188	-11.2302	11.2347	-91.6259
96	-1.2663	-12.1749	12.2406	-95.9378
97	-2.1607	-13.0106	13.1888	-99.4293
98	-2.996	-13.7327	14.0557	-102.3072
99	-3.7664	-14.3372	14.8236	-104.7189
100	-4.4663	-14.8208	15.4792	-106.7704
101	-5.0909	-15.1808	16.0117	-108.539
102	-5.6358	-15.4154	16.4133	-110.0821
103	-6.0969	-15.5232	16.6776	-111.4428
104	-6.4709	-15.504	16.8002	-112.6543
105	-6.7551	-15.3579	16.7778	-113.7422
106	-6.9474	-15.086	16.6089	-114.7271
107	-7.0463	-14.6903	16.2928	-115.6251
108	-7.0508	-14.173	15.83	-116.4495
109	-6.9607	-13.5374	15.2221	-117.2113
110	-6.776	-12.787	14.4715	-117.9197
111	-6.4975	-11.9258	13.5809	-118.5829
112	-6.126	-10.9576	12.5537	-119.2079
113	-5.6622	-9.8859	11.3926	-119.802
114	-5.1061	-8.7125	10.0985	-120.373
115	-4.4559	-7.4358	8.6687	-120.9318
J	-3.6638	-5.974	7.008	-121.5202

Wire No. 10 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
J	-3.6638	-5.974	7.008	-121.5202
117	-3.1279	-5.0304	5.9236	-121.8731
118	-2.4995	-3.9631	4.6855	-122.2396
119	-1.7997	-2.8141	3.3404	-122.6006
120	-1.0162	-1.5671	1.8678	-122.961
E	0.0	0.0	0.0	0.0

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SECTION-3

ANTENNA MONITORING AND SAMPLING SYSTEM

The Antenna Monitoring System uses a new Potomac Instruments model 1901 Antenna Monitor. The antenna monitor is not equipped with factory installed filters for Station KEEL which is located approximately 1.5 miles from the KWKH array. Past experience indicates that filters are not necessary in this case. No evidence of interference from KEEL was noted during adjustment of the KWKH array

The antenna monitor is connected to Kintronic Laboratories model VSU-1-HV Voltage Sampling Units located at the bases of each of the three towers. The VSU-1's are connected to the Antenna Monitor by Andrew LDF-4-50A foam filled solid outer conductor coaxial cables of equal electrical length within the tolerances permitted by the Rules. The cables have factory installed connectors on each end of the run where they terminate in the bulkhead connector at the VSU-1 and at a bulkhead panel in the transmitter room equipment rack. In the transmitter room, a short length of double shielded coaxial cable is used to connect the Sample Lines to the Antenna Monitor.

The sample lines are run overhead on messenger cables from the transmitter building beneath the main transmission line located below the 350 ohm transmission line to the phasor building at Tower-2. From that point the #2 line enters a conduit and runs down the terminal pole to grade level, then beneath the ground cover to the base pier where it emerges from the conduit and connects to the VSU-1 terminal. The conduit is grounded at the top of the pole to the grounding conductor, at the bottom of the pole where it enters the ground and at the exit point at the tower base.

The other lines to Towers 1 and 3 are run along a messenger cable beneath the transmission line to each tower and then run to the base pier mounted VSU in the same manner as for Tower-2. All excess sample line cable is stored on the overhead runs using CATV "Coaxial Turnaround" fixtures to reverse directions. Each of the lines is grounded to the station grounding system at the terminal poles and at alternate supporting poles

enroute to the appropriate towers. Thus all lines are exposed to the same environmental conditions.

The cables as a system were individually measured with the distant end open circuited at the VSU's to determine the electrical length and impedance using a Hewlett Packard model 8753C Vector Network Analyzer connected to an RF Power Amplifier in a Calibrated Network Analyzer System. The system was set to sweep from 100 kilohertz to 1.6 megahertz allowing inspection of the line characteristics to determine the relevant odd multiples of ninety electrical degrees at the series resonant zero crossings nearest the operating frequency of 1130 kilohertz. The 630 degree series resonant zero crossing was determined to be the nearest frequency to the carrier frequency.

The following tables tabulate the electrical length and impedance of each of the Sampling Lines used in the system.

KWKH SAMPLE LINE MEASUREMENTS
INCLUDING JUMPERS AT THE ANTENNA MONITOR
SAMPLE LINE LENGTH MEASUREMENTS

TOWER	RESONANCE BELOW 1130 KHZ (F-1) (450°)	RESONANCE ABOVE 1130 KHZ (F-2) (630°)	RATIO (1130/F-2)X630 °	CALCULATED ELECTRICAL LENGTH (DEG)	DEVIATION REFERENCE: TOWER-2 (DEG)
1	944.0	1323.6	0.8537	537.9	-0.1
2	943.6	1323.2	0.8540	538.0	REF = 0.0
3	943.1	1322.3	0.8546	538.4	+0.4

SAMPLE LINE IMPEDANCE MEASUREMENTS

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)	SAMPLE LINE TERMINATED BY VSU-1 (OHMS)
1	1229.7	9.7 - j48.9	1418.1	11.3 + j49.1	50.1	5.4 + j1.4
2	1229.3	8.8 – j48.8	1417.9	10.6 + j48.9	49.8	5.4 + j0.8
3	1228.1	9.4 - j49.2	1416.7	11.3 + j49.2	50.3	5.4 + j2.7

The sample lines comply with the requirements of the Rules with respect to differential lengths and impedance.

The Kintronics Labs VSU-1's were set up in pairs and connected in alternate pairs to the output of a directional coupler fed from the Calibrated Network Analyzer System.

The reference VSU-1, serial number, (LA-002) output was connected to the A receiver input of the Network Analyzer. The second (unknown) VSU-1 was connected to the B receiver of the Network Analyzer. Equal length cables made from RG-223/U double shielded cable were employed for both VSU's. The Network Analyzer was set up to read the Ratio and Phase of the unknown unit referenced to the unit connected to Receiver A.

The inputs to the VSU-1's were driven in parallel by the Directional Coupler of the Calibrated Network Analyzer System.

The relative magnitudes and phase differences were recorded for each unit referenced to Serial Number LA-002.

VSU-1 CALIBRATION VERIFICATION-NIGHTTIME MODE

TOWER	VSU-1 S/N	VSU-1 RATIO	VSU-1 PHASE (DEGREES)
1	LA-001	0.999	-00.1
2 (REF)	LA-002	1.000	REF
3	LA-003	0.999	-00.3

The installed VSU-1's are Kintronic Laboratories type VSU-1. All are within the KTL specified tolerances of +/- 1 percent magnitude tracking accuracy and +/-1 degree phase tracking accuracy.

The Antenna Monitoring System, including the VSU-1's, the sample lines and the flexible pigtails at the end of the sample lines are listed in the table below to determine the total monitoring system ratio and phase deviations:

SAMPLE SYSTEM PERFORMANCE-NIGHTTIME SYSTEM

TOWER	VSU-1 RATIO DEVIATION (RATIO)	VSU-1 DEVIATION (DEGREES)	SAMPLE LINE DEVIATION (DEGREES)	SYSTEM DEVIATION (RATIO/PHASE)	SYSTEM CORRECTION FACTOR
1	0.999	-00.1	-0.1	0.999/-0.2	1.001/-0.2
2 (REF)	1.000	00.0	REF	REF	REF = 0.0°
3	0.999	-00.3	+0.4	0.999/+0.37	1.001/+0.1

The Sample System is constructed in compliance with the requirements of Sections 73.68 and 73.151© of the Rules with the system magnitude deviations within 1.0 percent and phase deviations within 1.0 degree.

ANTENNA MONITOR VERIFICATION

The individual inputs of the Potomac Instruments Model 1901-3 Antenna Monitor were fed from the reference tower (2) though a precision power divider and a pair of equal length cables for verification of proper operation. The Reference input (2) was fed

from one of the outputs while Input-1 was fed from the other output of the power divider. The resulting ratio and phase indications for Tower-1 were recorded; then the two leads were reversed as a cross check. The lead to Input-1 was then transferred to Input-3 and procedure repeated. The results are shown in the table below. The monitor meets all of the Manufacturer's Specifications.

ANTENNA MONITOR VERIFICATION TESTS

TOWER	RATIO DEVIATION	PHASE DEVIATION (DEGREES)
1	1.001	-00.1°
2 (REF)	1.000	-00.1°
3	1.001	00.0°

MANUFACTURER'S TEST DATA

Test data for the Kintronic Laboratories model VSU-1 Voltage Samplers appears on the following page.

Date: March 8, 2013

Product report: VSU-1 Systems for KWKH Radio
Prepared by: Larry Arnold, Staff Engineer, Kintronic Labs. Inc.
Requested: Jack Sellmeyer

Preliminary Information:

Radio Station: KWKH, Frequency: 1130 kHz, Location: Shreveport, Louisiana 71129

Design Vendor: Kintronic Laboratories Inc, Date: September 22, 2011

KTL Product Item: VSU-1, Voltage Sampling Unit

Application: 50 kW, Three Tower AM Array, RF Hi-Voltage on tall towers.

Quantity: Three (3) VSU-1 Units as deliverable
One (1) VSU-1 Unit for Kintronic reference; (no charge to customer, stored at Kintronic).

Serial Numbers: S/N LA-001, LA-002 (reference unit), LA-003, and LA-004 (non-deliverable).

Quotation: E-Mail (no customer inquiry listed)

Purchase Order: G09033

KTL Job Number: 108410 date: Sept. 22, 2011

FOB Shipping Date: December 22, 2011

VSU-1 System Test Data for special RF-Hi-Voltage Application:

RF Test Power: 50 to 80 watts RMS (Provided by ENI Model 2100L RF Amplifier)

VSU-1 Voltage Ratio, (Input, Hi-Z / Output, 50+j0): **Approximately 600:1**

Tracking Data (unit to unit with S/N-002 used for the reference):

Ref.	Serial Number	Amplitude (Output)	Phase (Output)	Input Voltage (1130kHz)	Test Date
1.0	S/N LA-001	98.0 mV RMS	- 00.1 degrees	59.8 VRMS	12-19-2011
2.0	S/N LA-002	98.1 mV RMS	(reference unit)	59.8 VRMS	"
3.0	S/N LA-003	98.0 mV RMS	- 00.3 degrees	59.8 VRMS	"

Input Capacitance: **33 pF**

Pseudo Bandwidth (+/-50 kHz): Amplitude < +/- 0.15%; Phase < +/- 0.2^{O}; **(~ flat)**

Temperature (Standard VSU-1): **-50^{o} C to $+77^{o}$ C**, Amplitude +/- 0.91%, Phase +/- 0.4^{O} (tracking)

High Voltage Testing: **60Hz, 50.0 KV Peak**, in dark room for corona verification, no faults noted.

External Arc-gaps: **Preset to 42.5 KV at 60Hz**, final adjustments to be made at site application.

Note: Other test data can be supplied, if needed, and photos are included with this report.

lfa

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SECTION-4

DIRECT MEASUREMENT OF POWER – NON DIRECTIONAL DAYTIME ANTENNA

Impedance measurements were made at the output terminals of the Daytime Antenna Coupler located inside the Antenna Coupler Building adjacent to tower-2 (C). A Delta Electronics TCA-20-EHV Toroidal Ammeter is connected in series with the feeder to the tower at this point. An RF test Jack is located adjacent to the current transformer for the Antenna Current Ammeter at this location. The impedance was measured using a Hewlett Packard model 8753C network analyzer which was utilized for all of the system impedance measurements.

The input impedance was determined to be 82.5 ohms –j193 at this location..

The power for the authorized daytime antenna system is 50,000 watts.

The Operating Power is 50,000 watts into the array.

As the Antenna Resistance is 82.5 ohms:

$$(Icp)^2\ (82.5) = 50{,}000 \text{ Watts}$$

Therefore:

$$I_{BASE} = 24.6 \text{ Amperes for 50 KW}$$

This represents a small change in impedance from that last reported in 2008. The change is due to the removal of an unused Austin Isolation Transformer across the base insulator and the subsequent addition of a Kintronic Laboratories Model VSU-1-HV Voltage sampling Unit for the Antenna Monitoring System in its place.

DIRECT MEASUREMENT OF POWER – NIGHTTIME DIRECTIONAL ARRAY

Common Point Impedance measurements were made at the input terminals to the Common Point Meter in the Transmission Line Termination Panel in the transmitter building. An RF test Jack is located adjacent to the current transformer for the Common Point Ammeter at this location. The impedance was measured using a Hewlett Packard model 8753C network analyzer which was utilized for all of the system impedance measurements.

The input impedance was adjusted to 50 ohms –j1.4 at this location.

The Common Point power for the authorized nighttime directional antenna system is 50,000 watts plus the five percent adjustment factor for system losses of the phasing and coupling equipment.

The Operating Power is 52500 watts into the array.

As the Common Point Resistance was set to 50.0 ohms:

$$(Icp)^2\ (50.0)\ =\ 52{,}500\ \text{Watts}$$

Therefore:

$$Icp\ =\ 32.4A$$

TABLE OF COMMON POINT OPERATING VALUES			
MODE	**RESISTANCE (OHMS)**	**REACTANCE (OHMS)**	**CURRENT (AMPERES)**
ND-D	**82.5**	**-j193**	**24.6**
DA-N	**50.0**	**-j1.4**	**32.4**

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SECTION-5
RFR PROTECTION INFORMATION
TOWER REGISTRATION & SIGNAGE
RADIO STATION KWKH

The KWKH Nighttime directive array utilizes three towers, which are identical in height and cross section, with the exception of Tower-3 (SW) which has an unused RCA BF-14, FM Pylon Antenna atop the skeletal tower and an overall electrical height of 184 degrees vs 198 degrees for towers 1 and 2.

The maximum power in any one tower is 50.0 kilowatts in tower-2 (C) during daytime hours.

Tower-2 (C) is fenced with an octagonal fence. The closest dimension to the tower is 56 feet (17 meters).

Towers 1 and 3 are fenced with rectangular fences which are extended on the interior ends to join the octagonal fence at tower-2 (C). All fences are constructed with chain link fence fabric, six feet in height topped with barbed wire. The narrowest point on the fence with respect to the tower is 56 feet (17 meters). From OST Bulletin 65, Edition 97-01, August, 1997, Supplement A, Table 2, a vertical radiator 0.5 to 0.625 wavelength in height, operating with 50 kilowatts at the 1130 kilohertz channel requires a minimum compliance distance of 4 meters (13.12 Feet). Thus, the 17 meter diameter of the KWKH fences far exceeds this requirement.

For security reasons, the fences at all three towers are joined on both sides of the line of towers from end to end with additional chain link fences.

Each of the tower compounds is securely locked with a heavy chain wrapped around the supporting pole and the gate frame. Thus all of the tower compounds exceed the RFR requirements of the Rules.

The fences and coupler buildings are marked with the required RF Radiation warning signs. The ASR data for each tower is current and the ASR numbers are current and are posted on individual fences.

It is the opinion of the undersigned that the KWKH Transmitter Plant is in full compliance with the RFR requirements outlined in OET Bulletin 65, Edition 97-01 and the Rules of the Commission.

TOWER REGISTRATION INFORMATION

The three towers of the KWKH Directive array are registered with the FCC as follows:

KWKH TOWER DATA							
TWR #	ASR #	HT AGL W/O LIGHTS (MTRS)	OVERALL HT AGL (MTRS)	GND ELEV (MTRS)	LIGHTS	COORDINATES-NAD-83	
						N.L.	W.L.
1	1033733	146.1	147.2	52.4	YES	32-42-20.6	93-52-54.3
2	1033734	145.4	146.3	52.5	NO	32-42-18.2	93-52-55.7
3	1033735	136.1	137.2	52.4	YES	32-42-15.7	93-52-57.1

SECTION-6 POST CONSTRUCTION SURVEY

The KWKH Antenna System was constructed on the present site in 1939 using the same towers as the present system with no changes in the physical locations. The station has been licensed as a DA-N operation with no changes in the locations of the three nighttime towers since its inception on the 1100 kHz channel together with the subsequent NARBA frequency change in 1941 and, as such, is exempt from requirements for a new survey.

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SECTION-7

REFERENCE POINT MEASUREMENTS

RADIO STATION KWKH
1130 KHZ, 50 KW DA-N, UNL
SHREVEPORT, LOUISIANA

REVISION-1
SEPTEMBER 1, 2014

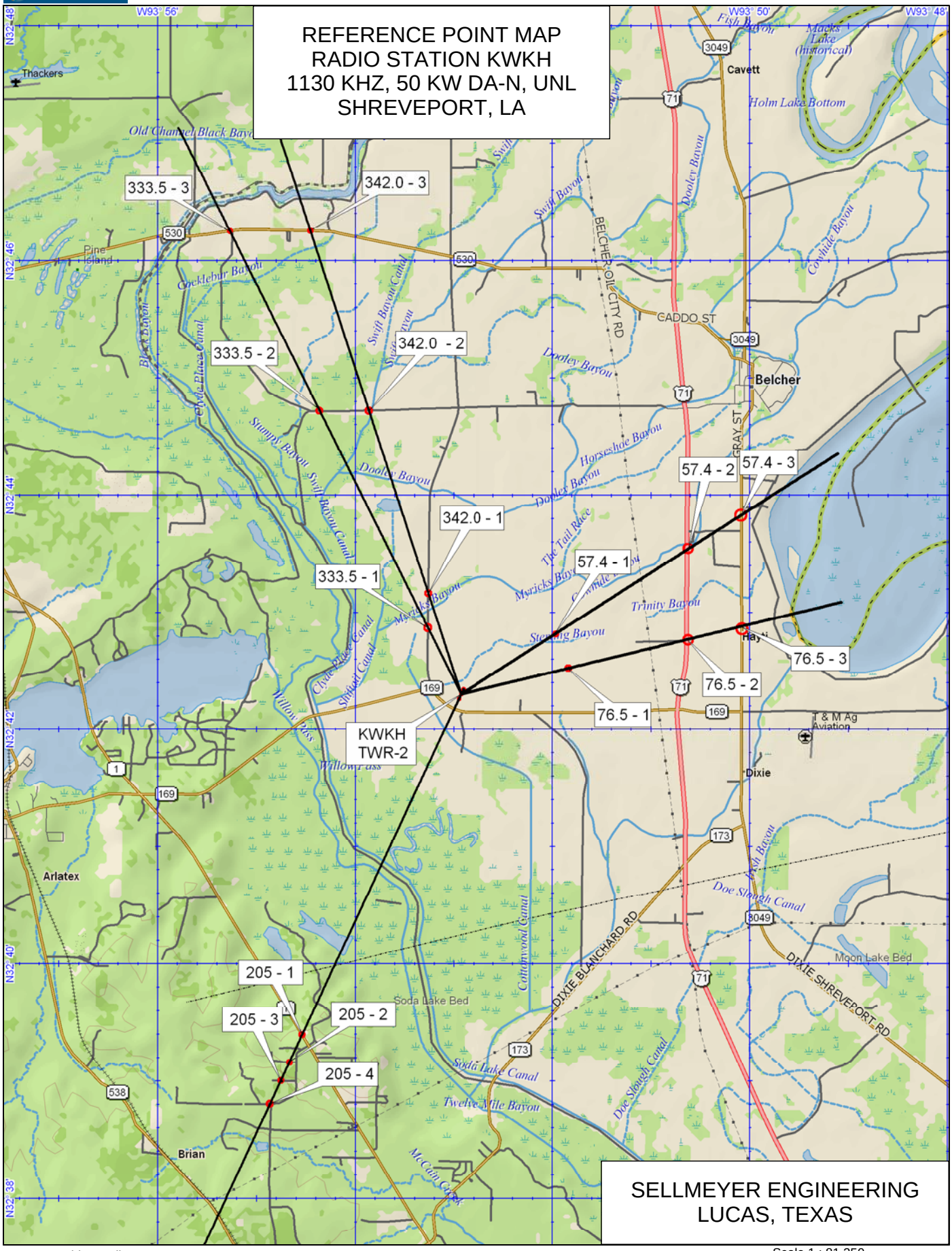
SECTION-7 RADIO STATION KWKH 1130 KHz DAYTIME FIELD REFERENCE POINT MEASUREMENTS, SHEET-1 of 1							
Radial	PT	Distance (km)	Field (mV/m)	Time & Date	Coordinates (NAD-27)		Description
57.4°	1	1.79	31	8-28-14 14:16	32-42-48.8	93-51-57.0	0.9 mi. N. of beginning of on ramp of I-49 N. from LA169
	2	4.30	8.4	8-28-14 15:21	32-43-34.8	93-50-37.5	1.6 mi. N. of intersection of LA169 and HWY 71 on Hwy 71
	3	5.27	10.6	8-28-14 15:30	32-43-50.2	93-50-04.6	0.2 mi. N. of intersection of LA169 and LA3049 on LA3049
76.5°	1	1.76	48	8-28-14 14:08	32-42-30.9	93-51-49.2	0.5 mi. N. of beginning of on ramp of I-49 N. from LA169
	2	3.67	17.3	8-28-14 15:12	32-42-46.1	93-50-37.9	0.65 mi. N. of intersection of LA169 and HWY 71 on Hwy 71
	3	4.57	20.3	8-28-14 15:38	32-42-52.8	93-50-04.5	0.9 mi. N. of intersection of LA169 and LA3049 on LA3049
205°	1	5.97	343	9-1-14 14:37	32-39-22.8	93-54-31.9	Southbound side of Hwy 1. W. Side of rd. 200 yds N. of McCain Rd
	2	6.44	268	9-1-14 14:40	32-39-09.0	93-54-39.5	Middle of Calgary Dr. Opposite of 7534 Calgary Drive.
	3	6.75	284	9-1-14 14:48	32-38-59.8	93-54-44.4	Middle of Rd. in front of driveway of 7552 Whistler Dr.
	4	7.14	170	9-1-14 14:54	32-38-47.8	93-54-51.2	50 ft W. of McCain and Grimm Lot of P/L near.
333.5°	1	1.18	163	8-28-14 10:43	32-42-51.8	93-53-15.2	0.6 mi. N. of intersection of LA169 & Gamm on Gamm Rd.
	2	5.00	46	8-28-14 11:10	32-44-42.8	93-54-21.4	1.3 mi. W. of intersection of Gamm and Self Rd on Self Rd.
	3	8.19	28.5	8-28-14 11:38	32-46-14.5	93-55-15.8	1.6 mi. W. side of On/Off Ramp to I-49, on LA530
342.0°	1	1.66	143	8-28-14 10:49	32-43-08.8	93-53-15.0	0.9 mi. N. of intersection of LA169 & Gamm on Gamm Rd.
	2	4.73	60	8-28-14 11:00	32-44-42.9	93-53-51.7	0.9 mi. W. of intersection of Gamm and Self Rd on Self Rd.
	3	7.72	18.5	8-28-14 11:24	32-46-15.4	93-54-26.7	0.9 mi. W. side of On/Off Ramp to I-49, on LA530

BEARINGS ARE REFERENCED TO TOWER-2 COORDINATES:

NAD-27: 32° 42’ 18”/93° 52’ 55”

Use GPS system referenced to above NAD-27 coordinates for exact radial crossings of roads, then follow the above descriptions to locate the individual reference points.

All points were measured by Brian Heise, KWKH Contract Engineer on the dates and times listed, using a Potomac Instruments Model FIM-41 Field Intensity Meter, Serial Number 1600 calibrated by Potomac Instruments, Inc. on August 5, 2014.



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LUCAS, TEXAS

TN
MN (1.8°E)

Scale 1 : 81,250

1 cm = 812.5 m Data Zoom 11-3

POTOMAC INSTRUMENTS, inc.
Frederick, Maryland

CERTIFICATE OF CALIBRATION

Field Intensity Meter Type FIM-41 Serial Number 1600

This instrument was calibrated in an induction field of 220.0 millivolts per meter. At each measurement frequency the measured field was recorded and a correction factor K was computed; the indicated field must be multiplied by K to obtain the true field.

kHz	K	kHz	K	MHz	K	MHz	K
540	1.009	1100	1.000	1.6	1.009	3.5	1.000
600	1.005	1200	1.000	1.9	1.005	3.8	0.995
700	1.000	1300	1.000	2.2	1.000	4.1	1.000
800	1.000	1400	0.995	2.5	1.000	4.4	1.000
900	1.000	1500	0.995	2.8	1.000	4.7	1.000
1000	1.000	1600	0.995	3.2	1.000	5.0	1.005

The calibrating field is maintained equal to the National Institute of Standards and Technology (NIST) standard field within an accuracy of 1.0 percent. NIST states that the absolute accuracy of its field is "believed to be within 3.0 percent."

The error at points on the meter scale other than the calibration point is less than 3.0 percent. The attenuator ratios are correct within 2.0 percent. These accuracies apply for battery voltages that are indicated by the instrument's battery check circuit to be useable.

NEXT RECOMMENDED CALIBRATION DATE: August 4, 2016

Calibrated by _____ Date: Aug. 5, 2014
STATE OF MARYLAND

Technician Zachary Babendreier, personally appeared before me on Aug. 5, 2014, and testified under oath that the above calibration was made either by himself or under his direction and that the statements in the above certificate are true to the best of his knowledge and belief.

MARCELLA R. LALIBERTE NOTARY PUBLIC MY COMMISSION EXPIRES 12/17/2016 FREDERICK COUNTY, MD

Marcella R. Laliberte
Notary Public