ORIGINAL

Ann 9

Federal Communications Commission
Washington, D. C. 20554

Approved by OMB
3060-0627
Expires 01/31/98

FOR FCC USE ONLY

FCC 302-AM
APPLICATION FOR AM BROADCAST STATION LICENSE

(Please read instructions before filling out form.)

FOR COMMISSION USE ONLY
FILE NO. BAML-20110329AEC

RECEIVED
2011 APR -4 A 6:35
FCC MAIL SERVICES DIVISION

SECTION I - APPLICANT FEE INFORMATION

1. PAYOR NAME (Last, First, Middle Initial)

CBS Corporation

MAILING ADDRESS (Line 1) (Maximum 35 characters)
1800 K St NW STE 920

MAILING ADDRESS (Line 2) (Maximum 35 characters)

CITY	STATE OR COUNTRY (if foreign address)	ZIP CODE
Washington	DC	20006

TELEPHONE NUMBER (include area code)	CALL LETTERS	OTHER FCC IDENTIFIER (If applicable)
202 457-4518	WAOK	FAC ID 6375

63778

2. A. Is a fee submitted with this application? [✓] Yes [ ] No

B. If No, indicate reason for fee exemption (see 47 C.F.R. Section

[ ] Governmental Entity [ ] Noncommercial educational licensee [ ] Other (Please explain):

C. If Yes, provide the following information:

Enter in Column (A) the correct Fee Type Code for the service you are applying for. Fee Type Codes may be found in the "Mass Media Services Fee Filing Guide." Column (B) lists the Fee Multiple applicable for this application. Enter fee amount due in Column (C).

(A) FEE TYPE CODE	(B) FEE MULTIPLE	(C) FEE DUE FOR FEE TYPE CODE IN COLUMN (A)	FOR FCC USE ONLY
M M R	0 0 0 1	$ 615	

To be used only when you are requesting concurrent actions which result in a requirement to list more than one Fee Type Code.

(A)	(B)	(C)	FOR FCC USE ONLY
M O R	0 0 0 1	$ 705	

	TOTAL AMOUNT REMITTED WITH THIS APPLICATION	FOR FCC USE ONLY
ADD ALL AMOUNTS SHOWN IN COLUMN C, AND ENTER THE TOTAL HERE. THIS AMOUNT SHOULD EQUAL YOUR ENCLOSED REMITTANCE.	$ 1320	

SECTION II - APPLICANT INFORMATION		
1. NAME OF APPLICANT CBS Radio East Inc.		
MAILING ADDRESS 1800 K ST NW STE 920		
CITY Washington	STATE DC	ZIP CODE 20006

2. This application is for:

☑ Commercial ☐ Noncommercial

☑ AM Directional ☐ AM Non-Directional

Call letters	Community of License	Construction Permit File No.	Modification of Construction Permit File No(s).	Expiration Date of Last Construction Permit
WAOK FAC ID 6375	Atlanta, GA			

3. Is the station now operating pursuant to automatic program test authority in accordance with 47 C.F.R. Section 73.1620?

☑ Yes ☐ No

If No, explain in an Exhibit.

Exhibit No.

4. Have all the terms, conditions, and obligations set forth in the above described construction permit been fully met?

☐ Yes ☐ No

If No, state exceptions in an Exhibit.

Exhibit No.

5. Apart from the changes already reported, has any cause or circumstance arisen since the grant of the underlying construction permit which would result in any statement or representation contained in the construction permit application to be now incorrect?

☐ Yes ☐ No

If Yes, explain in an Exhibit.

Exhibit No.

6. Has the permittee filed its Ownership Report (FCC Form 323) or ownership certification in accordance with 47 C.F.R. Section 73.3615(b)?

☐ Yes ☐ No

☑ Does not apply

If No, explain in an Exhibit.

Exhibit No.

7. Has an adverse finding been made or an adverse final action been taken by any court or administrative body with respect to the applicant or parties to the application in a civil or criminal proceeding, brought under the provisions of any law relating to the following: any felony; mass media related antitrust or unfair competition; fraudulent statements to another governmental unit; or discrimination?

☐ Yes ☑ No

If the answer is Yes, attach as an Exhibit a full disclosure of the persons and matters involved, including an identification of the court or administrative body and the proceeding (by dates and file numbers), and the disposition of the litigation. Where the requisite information has been earlier disclosed in connection with another application or as required by 47 U.S.C. Section 1.65(c), the applicant need only provide: (i) an identification of that previous submission by reference to the file number in the case of an application, the call letters of the station regarding which the application or Section 1.65 information was filed, and the date of filing; and (ii) the disposition of the previously reported matter.

Exhibit No.
1

8. Does the applicant, or any party to the application, have a petition on file to migrate to the expanded band (1605-1705 kHz) or a permit or license either in the existing band or expanded band that is held in combination (pursuant to the 5 year holding period allowed) with the AM facility proposed to be modified herein?

☐ Yes ☑ No

If Yes, provide particulars as an Exhibit.

Exhibit No.

The APPLICANT hereby waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because use of the same, whether by license or otherwise, and requests and authorization in accordance with this application. (See Section 304 of the Communications Act of 1934, as amended).

The APPLICANT acknowledges that all the statements made in this application and attached exhibits are considered material representations and that all the exhibits are a material part hereof and are incorporated herein as set out in full in

CERTIFICATION

1. By checking Yes, the applicant certifies, that, in the case of an individual applicant, he or she is not subject to a denial of federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. Section 862, or, in the case of a non-individual applicant (e.g., corporation, partnership or other unincorporated association), no party to the application is subject to a denial of federal benefits that includes FCC benefits pursuant to that section. For the definition of a "party" for these purposes, see 47 C.F.R. Section 1.2002(b).

☑ Yes ☐ No

2. I certify that the statements in this application are true, complete, and correct to the best of my knowledge and belief, and are made in good faith.

Name	Signature	
Jo Ann Haller	Jo Ann Haller	
Title	Date	Telephone Number
Senior Vice President	3/24/2011	202 457-4518

WILLFUL FALSE STATEMENTS ON THIS FORM ARE PUNISHABLE BY FINE AND/OR IMPRISONMENT (U.S. CODE, TITLE 18, SECTION 1001), AND/OR REVOCATION OF ANY STATION LICENSE OR CONSTRUCTION

FCC NOTICE TO INDIVIDUALS REQUIRED BY THE PRIVACY ACT AND THE PAPERWORK REDUCTION ACT

The solicitation of personal information requested in this application is authorized by the Communications Act of 1934, as amended. The Commission will use the information provided in this form to determine whether grant of the application is in the public interest. In reaching that determination, or for law enforcement purposes, it may become necessary to refer personal information contained in this form to another government agency. In addition, all information provided in this form will be available for public inspection. If information requested on the form is not provided, the application may be returned without action having been taken upon it or its processing may be delayed while a request is made to provide the missing information. Your response is required to obtain the requested authorization.

Public reporting burden for this collection of information is estimated to average 639 hours and 53 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, can be sent to the Federal Communications Commission, Records Management Branch, Paperwork Reduction Project (3060-0627), Washington, D. C. 20554. Do NOT send completed forms to this address.

THE FOREGOING NOTICE IS REQUIRED BY THE PRIVACY ACT OF 1974, P.L. 93-579, DECEMBER 31, 1974, 5 U.S.C. 552a(e)(3), AND THE PAPERWORK REDUCTION ACT OF 1980, P.L. 96-511, DECEMBER 11, 1980, 44 U.S.C. 3507.

SECTION III - LICENSE APPLICATION ENGINEERING DATA

Name of Applicant
CBS Radio East Inc.

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
WAOK		1380	Unlimited	4.2	5.0

2. Station location

State	City or Town
Georgia	Atlanta

3. Transmitter location

State	County	City or Town	Street address (or other identification)
Georgia	Fulton	Atlanta	174 Chalmers Drive

4. Main studio location

State	County	City or Town	Street address (or other identification)
Georgia	Fulton	Atlanta	1201 Peachtree Street, Suite 800

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

State	County	City or Town	Street address (or other identification)
Georgia	Fulton	Atlanta	1201 Peachtree Street, Suite 800

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. Section 6

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
9.52	10.66

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	44	- j0	- j142.1

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	-78.7		108.1			
2	0		100.0			
3	-60.8		53.5			
4	-161.8		49.3			

Manufacturer and type of antenna monitor: Potomac Instruments AM-19D serial number

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.
1,2-guyed tower 3,4-self supporting tower	1,2,3,4-108.25	T1,2-109.9 T3,4- 111.5	T1,2-110.9 T3,4- 112.5	Exhibit No.

Excitation ☑ Series ☐ Shunt

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

North Latitude					West Longitude				
33	o	45	'	36.0	"	84	o	28	'	45.0	"

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. no change

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

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.

Readjustment of night common point network

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)
M Donald Crain	M Donald Crain Digitally signed by M Donald Crain DN: cn=M Donald Crain, o=M Donald Crain Inc, ou, email=w4oc@aol.com, c=US Date: 2011.03.18 15:45:06 -04'00'
Address (include ZIP Code) 5 Green Acres Drive Boiling Springs, SC 29316	Date March 18,2011
	Telephone No. (Include Area Code) (864) 599 1819

☐ Technical Director ☐ Registered Professional Engineer

☐ Chief Operator ☑ Technical Consultant

☐ Other (specify)

110329
9089
830
001

CBS RADIO EAST INC.
RADIO STATION WAOK
1380 KHZ 5 KW LS, 4.2 KW DA-N
ATLANTA, GA

APPLICATION FOR LICENSE
MARCH 18, 2011

M DONALD CRAIN
TECHNICAL CONSULTANT
5 GREEN ACRES DRIVE
BOILING SPRINGS, SC 29316

CBS RADIO EAST INC.
RADIO STATION WAOK
1380 KHZ 5 KW LS, 4.2 KW DA-N
ATLANTA, GA

APPLICATION FOR LICENSE

TABLE OF CONTENTS

RADIO STATION WAOK
ATLANTA, GA

Technical Summary Statement

This technical summary is in support of the WAOK night directional antenna system, as currently licensed by the FCC, for conversion to Method of Moments directional proof of performance.

WAOK is currently operating with STA granted December 23, 2010 to permit operation with Method of Moments parameters prior to grant of Program Test Authority by the FCC.

This FCC license authorizes operation at the existing transmitter location with 5 kW day with a non-directional antenna system, and 4.2 kW night operating with a directional antenna system. No changes were made to the towers or ground system as specified in the existing station license. Operation of WAOK as described in this application is in compliance with the terms of the latest construction permit.

The information provided in this technical summary shows that the operating parameters for the day and night directional antenna patterns have been determined in compliance with the requirements of section 73.151(c) of the FCC rules. The system is adjusted to antenna monitor parameters within +/- 5 percent in ratio and +/- 3 degrees in phase of the Method of Moment Model values, as specified in the FCC Rules.

Method of Moments Model Stability Assessment information has been included as part of this amended application to verify the stability of the WAOK towers model.

The measurements and calculations contained in this technical summary for Radio Station WAOK were made under my direct supervision. All information contained in this report is true and correct to the best of my knowledge.

M Donald Crain

Digitally signed by M Donald Crain
DN: cn=M Donald Crain, o=M Donald Crain Inc, ou, email=w4oc@aol.com, c=US
Date: 2011.03.18 15:45:58 -04'00'

M. Donald Crain
5 Green Acres Drive
Boiling Springs, SC 29316
Telephone 864 599 1819

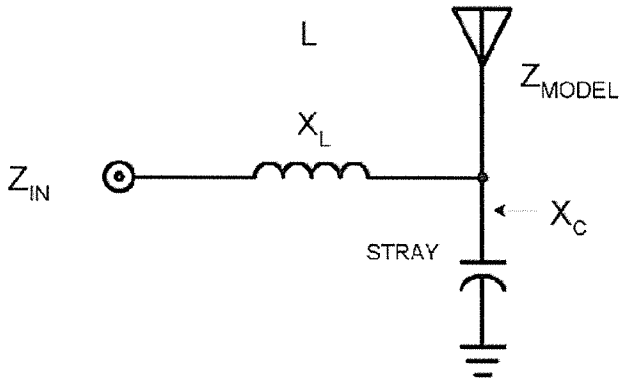
Section 1 - WAOK
Analysis of Measured Tower Impedance Data for Verification of Method of Moments Model

Tower base self impedance measurements were made at the output J-plug connection inside of each Voltage Sampling Unit (VSU) with a HP model 8751A network analyzer system using an external directional coupler and power amplifier. The network analyzer system was calibrated with known standards prior to measurements. The other towers were short circuited at the base insulator for these measurements.

The output connection J-plug in each VSU is located at the tower tubing connection of each VSU enclosure. No components are in the circuit from this point to the tower other than tubing to connect the VSU output connection to the tower (X_L). Circuit calculations were made to correlate the modeled base impedances (Z_{MODEL}) to the measured VSU output impedances ($Z_{IN(MEASURED)}$). The X_C value, which includes the tower base insulator(s), tower lighting chokes, and the tower 2 isocouplers capacitance, was used as a load at ground level in the driven tower for all tower self impedance models. All ATU networks, tower lighting chokes, and the tower 2 isocouplers are in separate enclosures, and are connected directly to the tower base. All ATU networks were open circuited for these measurements.

The measured and modeled base impedances at the VSU output connection with the other towers short circuited at its base insulator agree within the FCC Rule requirement of +/- 2 ohms and +/- 4 percent for resistance and reactance.

The schematic and table below show assumed values, and the results of the WCAP calculations that were used for correlation of the model data to measured data.



TOWER	L(uH)	X_L	X_C	Z (MODEL)	Z_{IN} (MODELED)	Z_{IN} (MEASURED)
1	4.700	+ j40.75	- j3335	182.81 – j370.60	147.71 – j300.07	147.71 – j300.07
2	5.668	+ j49.15	- j1759	166.46 – j389.49	110.91 – j278.33	110.91 – j278.32
3	1.534	+ j13.30	- j761	65.579 –j144.30	46.10 –j111.34	46.104 –j111.34
4	2.699	+ j23.40	- j790	62.740 –j148.15	44.29 –j104.31	44.293 –j104.32

Section 2 - WAOK
Method of Moments Model Details for Individual Tower Self Impedances

The WAOK array of towers was modeled using Expert MININEC Broadcast Professional Version 14.5. WAOK towers 1 and 2 are identical triangular guyed structures that are of uniform cross section construction, and towers 3 and 4 are identical triangular self supporting structures that are tapered cross section construction from the base insulator to 290 feet, and then uniform cross section construction for the remaining height. Each tower was modeled using 19 wire segments, with each wire segment representing the physical radius of that segment. The wire end points were specified using electrical degrees at 1380 kHz in the Geographic coordinate system with their locations taken from the theoretical directional antenna specifications. The towers are all physically 179.3 degrees in electrical height. The segment radii are specified in meters. WCAP, a nodal analysis program, was used for all other circuit calculations.

Each tower model was adjusted individually to provide correlation of the model impedance - when corrected by circuit calculations for the additional stray capacitances and VSU to tower connection series inductances – to the measured VSU output impedances with the other towers short circuited at each base insulator. The capacitance of the base insulator(s) at ground level and tower lighting chokes are included in the value of stray capacitance used for WCAP circuit calculations on each driven tower. Two isocouplers at the base of tower 2 are included in that tower's value of stray capacitance used for WCAP circuit calculations.

The modeled height of each tower relative to its physical height is within the required 75 to 125 percent range and the modeled radius of each tower is within the required 80 to 150 percent of the circle radius having a circumference equal to the sum of the widths of the tower sides. The wire segment model, when checked using the "problem definition evaluation" function, has no errors relative to the MININEC "geometry guidelines."

The WAOK Table of Tower Physical and Model Dimensions on the following page shows each tower by segment height and radius that was used in the model.

The WAOK Tower Self Impedance Method of Moments Model Details on the following pages lists the information used in the Method of Moments model for each tower with the other tower short circuited at its base.

The WAOK Tower Self Impedance WCAP Details on the following pages lists the calculations used to correct for strays and other assumed loads for each tower driven with the other tower short circuited. For each WCAP tabulation, node 2 represents the Z_{IN} reference point, node 3 represents the tower feedpoint (Z_{MODEL}), and node 0 represents ground potential. R 1-2 is a phantom 1.0 ohm resistor that is included in series with the drive current source. R 3-0 is the complex tower impedance from the method of moments model. L 2-3 is the X_L inductance value. C 3-0 is the X_C stray capacitive reactance value used for calculations. The $Z_{IN(MODEL)}$ calculated impedances appear under the "TO NODE IMPEDANCE" columns of the WCAP tabulations.

WAOK

Table of Tower Physical and Model Dimensions

TOWER SEGMENT	Physical Height (degrees)	Model Height (degrees)	Model Percent of Height	Model Radius (meters)	Percent Equivalent Radius
1-1 to 1-19	9.4368	10.1446	107.500	0.3669	100
1 - Overall	179.3	192.748	107.500	0.3669	100
2-1 to 2-19	9.4368	10.1446	107.500	0.3669	100
2 - Overall	179.3	192.748	107.500	0.3669	100
3-1 and 4-1	22.7200	24.5376	108.000	3.3479	100
3-2 and 4-2	22.7190	24.5365	107.999	2.8398	100
3-3 and 4-3	17.6710	19.0847	108.000	2.3881	100
3-4 and 4-4	15.1460	16.3577	108.000	2.0212	100
3-5 and 4-5	12.6220	13.6317	108.000	1.7106	100
3-6 and 4-6	10.0980	10.9058	107.999	1.4566	100
3-7 and 4-7	10.0970	10.9050	108.002	1.2308	100
3-8 and 4-8	7.5730	8.1790	108.002	1.0332	100
3-9 and 4-9	7.5740	8.1800	108.001	0.8638	100
3-10 and 4-10	7.5730	8.1780	107.989	0.6944	100
3-11 and 4-11	7.5730	8.1790	108.002	0.5250	100
3-12 and 4-12	5.0490	5.4530	108.002	0.3839	100
3-13 and 4-13	4.6979	5.0737	107.999	0.3274	100
3-14 and 4-14	4.6979	5.0737	107.999	0.3274	100
3-15 and 4-15	4.6979	5.0737	107.999	0.3274	100
3-16 and 4-16	4.6979	5.0737	107.999	0.3274	100
3-17 and 4-17	4.6979	5.0737	107.999	0.3274	100
3-18 and 4-18	4.6979	5.0737	107.999	0.3274	100
3-19 and 4-19	4.6979	5.0737	107.999	0.3274	100
3 and 4 Overall	179.3	193.644	108.0		100

WAOK

Tower 1 Self Impedance Method of Moments Model Details

Tower 1 Driven – Towers 2, 3, 4 Short Circuited at Base

C:\WAOK T1 Driven Others Shorted 03-15-2011 16:19:12

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	140.	172.5	0	.3669	1
		140.	172.5	10.1446		
2	none	140.	172.5	10.1446	.3669	1
		140.	172.5	20.2893		
3	none	140.	172.5	20.2893	.3669	1
		140.	172.5	30.4339		
4	none	140.	172.5	30.4339	.3669	1
		140.	172.5	40.5785		
5	none	140.	172.5	40.5785	.3669	1
		140.	172.5	50.7232		
6	none	140.	172.5	50.7232	.3669	1
		140.	172.5	60.8678		
7	none	140.	172.5	60.8678	.3669	1
		140.	172.5	71.0124		
8	none	140.	172.5	71.0124	.3669	1
		140.	172.5	81.1571		
9	none	140.	172.5	81.1571	.3669	1
		140.	172.5	91.3017		
10	none	140.	172.5	91.3017	.3669	1
		140.	172.5	101.446		
11	none	140.	172.5	101.446	.3669	1
		140.	172.5	111.591		
12	none	140.	172.5	111.591	.3669	1
		140.	172.5	121.736		
13	none	140.	172.5	121.736	.3669	1
		140.	172.5	131.88		
14	none	140.	172.5	131.88	.3669	1
		140.	172.5	142.025		
15	none	140.	172.5	142.025	.3669	1
		140.	172.5	152.17		
16	none	140.	172.5	152.17	.3669	1
		140.	172.5	162.314		
17	none	140.	172.5	162.314	.3669	1
		140.	172.5	172.459		
18	none	140.	172.5	172.459	.3669	1
		140.	172.5	182.603		
19	none	140.	172.5	182.603	.3669	1
		140.	172.5	192.748		
20	none	0	0	0	.3669	1
		0	0	10.1446		
21	none	0	0	10.1446	.3669	1
		0	0	20.2893		
22	none	0	0	20.2893	.3669	1
		0	0	30.4339		
23	none	0	0	30.4339	.3669	1
		0	0	40.5785		
24	none	0	0	40.5785	.3669	1
		0	0	50.7232		
25	none	0	0	50.7232	.3669	1
		0	0	60.8678		
26	none	0	0	60.8678	.3669	1
		0	0	71.0124		

27	none	0	0	71.0124	.3669	1
		0	0	81.1571		
28	none	0	0	81.1571	.3669	1
		0	0	91.3017		
29	none	0	0	91.3017	.3669	1
		0	0	101.446		
30	none	0	0	101.446	.3669	1
		0	0	111.591		
31	none	0	0	111.591	.3669	1
		0	0	121.736		
32	none	0	0	121.736	.3669	1
		0	0	131.88		
33	none	0	0	131.88	.3669	1
		0	0	142.025		
34	none	0	0	142.025	.3669	1
		0	0	152.17		
35	none	0	0	152.17	.3669	1
		0	0	162.314		
36	none	0	0	162.314	.3669	1
		0	0	172.459		
37	none	0	0	172.459	.3669	1
		0	0	182.603		
38	none	0	0	182.603	.3669	1
		0	0	192.748		
39	none	250.	284.4	0	3.3479	1
		250.	284.4	24.5376		
40	none	250.	284.4	24.5376	2.8398	1
		250.	284.4	49.0741		
41	none	250.	284.4	49.0741	2.3881	1
		250.	284.4	68.1588		
42	none	250.	284.4	68.1588	2.0212	1
		250.	284.4	84.5165		
43	none	250.	284.4	84.5165	1.7106	1
		250.	284.4	98.1482		
44	none	250.	284.4	98.1482	1.4566	1
		250.	284.4	109.054		
45	none	250.	284.4	109.054	1.2308	1
		250.	284.4	119.959		
46	none	250.	284.4	119.959	1.0332	1
		250.	284.4	128.138		
47	none	250.	284.4	128.138	.8638	1
		250.	284.4	136.318		
48	none	250.	284.4	136.318	.6944	1
		250.	284.4	144.496		
49	none	250.	284.4	144.496	.525	1
		250.	284.4	152.675		
50	none	250.	284.4	152.675	.3839	1
		250.	284.4	158.128		
51	none	250.	284.4	158.128	.3274	1
		250.	284.4	163.202		
52	none	250.	284.4	163.202	.3274	1
		250.	284.4	168.276		
53	none	250.	284.4	168.276	.3274	1
		250.	284.4	173.35		
54	none	250.	284.4	173.35	.3274	1
		250.	284.4	178.424		
55	none	250.	284.4	178.424	.3274	1
		250.	284.4	183.497		
56	none	250.	284.4	183.497	.3274	1
		250.	284.4	188.571		
57	none	250.	284.4	188.571	.3274	1
		250.	284.4	193.644		
58	none	236.6	251.1	0	3.3479	1
		236.6	251.1	24.5376		

59	none	236.6	251.1	24.5376	2.8398	1
		236.6	251.1	49.0741		
60	none	236.6	251.1	49.0741	2.3881	1
		236.6	251.1	68.1588		
61	none	236.6	251.1	68.1588	2.0212	1
		236.6	251.1	84.5165		
62	none	236.6	251.1	84.5165	1.7106	1
		236.6	251.1	98.1482		
63	none	236.6	251.1	98.1482	1.4566	1
		236.6	251.1	109.054		
64	none	236.6	251.1	109.054	1.2308	1
		236.6	251.1	119.959		
65	none	236.6	251.1	119.959	1.0332	1
		236.6	251.1	128.138		
66	none	236.6	251.1	128.138	.8638	1
		236.6	251.1	136.318		
67	none	236.6	251.1	136.318	.6944	1
		236.6	251.1	144.496		
68	none	236.6	251.1	144.496	.525	1
		236.6	251.1	152.675		
69	none	236.6	251.1	152.675	.3839	1
		236.6	251.1	158.128		
70	none	236.6	251.1	158.128	.3274	1
		236.6	251.1	163.202		
71	none	236.6	251.1	163.202	.3274	1
		236.6	251.1	168.276		
72	none	236.6	251.1	168.276	.3274	1
		236.6	251.1	173.35		
73	none	236.6	251.1	173.35	.3274	1
		236.6	251.1	178.424		
74	none	236.6	251.1	178.424	.3274	1
		236.6	251.1	183.497		
75	none	236.6	251.1	183.497	.3274	1
		236.6	251.1	188.571		
76	none	236.6	251.1	188.571	.3274	1
		236.6	251.1	193.644		

Number of wires = 76
current nodes = 76

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	55	5.073	39	24.5376
radius	51	.3274	39	3.3479

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	1.38	0	1	.0140917	.06816

Sources

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

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 1, sector 1							
1.38	182.81	-370.6	413.24	296.3	18.903	-.91984	-7.1925

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Tower 2 Self Impedance Method of Moments Model Details

Tower 2 Driven – Towers 1, 3, 4 Short Circuited at Base

C:\WAOK T2 Driven Others Shorted 03-15-2011 16:23:31

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	140.	172.5	0	.3669	1
		140.	172.5	10.1446		
2	none	140.	172.5	10.1446	.3669	1
		140.	172.5	20.2893		
3	none	140.	172.5	20.2893	.3669	1
		140.	172.5	30.4339		
4	none	140.	172.5	30.4339	.3669	1
		140.	172.5	40.5785		
5	none	140.	172.5	40.5785	.3669	1
		140.	172.5	50.7232		
6	none	140.	172.5	50.7232	.3669	1
		140.	172.5	60.8678		
7	none	140.	172.5	60.8678	.3669	1
		140.	172.5	71.0124		
8	none	140.	172.5	71.0124	.3669	1
		140.	172.5	81.1571		
9	none	140.	172.5	81.1571	.3669	1
		140.	172.5	91.3017		
10	none	140.	172.5	91.3017	.3669	1
		140.	172.5	101.446		
11	none	140.	172.5	101.446	.3669	1
		140.	172.5	111.591		
12	none	140.	172.5	111.591	.3669	1
		140.	172.5	121.736		
13	none	140.	172.5	121.736	.3669	1
		140.	172.5	131.88		
14	none	140.	172.5	131.88	.3669	1
		140.	172.5	142.025		
15	none	140.	172.5	142.025	.3669	1
		140.	172.5	152.17		
16	none	140.	172.5	152.17	.3669	1
		140.	172.5	162.314		
17	none	140.	172.5	162.314	.3669	1
		140.	172.5	172.459		
18	none	140.	172.5	172.459	.3669	1
		140.	172.5	182.603		
19	none	140.	172.5	182.603	.3669	1
		140.	172.5	192.748		
20	none	0	0	0	.3669	1
		0	0	10.1446		
21	none	0	0	10.1446	.3669	1
		0	0	20.2893		
22	none	0	0	20.2893	.3669	1
		0	0	30.4339		
23	none	0	0	30.4339	.3669	1
		0	0	40.5785		
24	none	0	0	40.5785	.3669	1
		0	0	50.7232		
25	none	0	0	50.7232	.3669	1
		0	0	60.8678		
26	none	0	0	60.8678	.3669	1
		0	0	71.0124		

27	none	0	0	71.0124	.3669	1
		0	0	81.1571		
28	none	0	0	81.1571	.3669	1
		0	0	91.3017		
29	none	0	0	91.3017	.3669	1
		0	0	101.446		
30	none	0	0	101.446	.3669	1
		0	0	111.591		
31	none	0	0	111.591	.3669	1
		0	0	121.736		
32	none	0	0	121.736	.3669	1
		0	0	131.88		
33	none	0	0	131.88	.3669	1
		0	0	142.025		
34	none	0	0	142.025	.3669	1
		0	0	152.17		
35	none	0	0	152.17	.3669	1
		0	0	162.314		
36	none	0	0	162.314	.3669	1
		0	0	172.459		
37	none	0	0	172.459	.3669	1
		0	0	182.603		
38	none	0	0	182.603	.3669	1
		0	0	192.748		
39	none	250.	284.4	0	3.3479	1
		250.	284.4	24.5376		
40	none	250.	284.4	24.5376	2.8398	1
		250.	284.4	49.0741		
41	none	250.	284.4	49.0741	2.3881	1
		250.	284.4	68.1588		
42	none	250.	284.4	68.1588	2.0212	1
		250.	284.4	84.5165		
43	none	250.	284.4	84.5165	1.7106	1
		250.	284.4	98.1482		
44	none	250.	284.4	98.1482	1.4566	1
		250.	284.4	109.054		
45	none	250.	284.4	109.054	1.2308	1
		250.	284.4	119.959		
46	none	250.	284.4	119.959	1.0332	1
		250.	284.4	128.138		
47	none	250.	284.4	128.138	.8638	1
		250.	284.4	136.318		
48	none	250.	284.4	136.318	.6944	1
		250.	284.4	144.496		
49	none	250.	284.4	144.496	.525	1
		250.	284.4	152.675		
50	none	250.	284.4	152.675	.3839	1
		250.	284.4	158.128		
51	none	250.	284.4	158.128	.3274	1
		250.	284.4	163.202		
52	none	250.	284.4	163.202	.3274	1
		250.	284.4	168.276		
53	none	250.	284.4	168.276	.3274	1
		250.	284.4	173.35		
54	none	250.	284.4	173.35	.3274	1
		250.	284.4	178.424		
55	none	250.	284.4	178.424	.3274	1
		250.	284.4	183.497		
56	none	250.	284.4	183.497	.3274	1
		250.	284.4	188.571		
57	none	250.	284.4	188.571	.3274	1
		250.	284.4	193.644		
58	none	236.6	251.1	0	3.3479	1
		236.6	251.1	24.5376		

59	none	236.6	251.1	24.5376	2.8398	1
		236.6	251.1	49.0741		
60	none	236.6	251.1	49.0741	2.3881	1
		236.6	251.1	68.1588		
61	none	236.6	251.1	68.1588	2.0212	1
		236.6	251.1	84.5165		
62	none	236.6	251.1	84.5165	1.7106	1
		236.6	251.1	98.1482		
63	none	236.6	251.1	98.1482	1.4566	1
		236.6	251.1	109.054		
64	none	236.6	251.1	109.054	1.2308	1
		236.6	251.1	119.959		
65	none	236.6	251.1	119.959	1.0332	1
		236.6	251.1	128.138		
66	none	236.6	251.1	128.138	.8638	1
		236.6	251.1	136.318		
67	none	236.6	251.1	136.318	.6944	1
		236.6	251.1	144.496		
68	none	236.6	251.1	144.496	.525	1
		236.6	251.1	152.675		
69	none	236.6	251.1	152.675	.3839	1
		236.6	251.1	158.128		
70	none	236.6	251.1	158.128	.3274	1
		236.6	251.1	163.202		
71	none	236.6	251.1	163.202	.3274	1
		236.6	251.1	168.276		
72	none	236.6	251.1	168.276	.3274	1
		236.6	251.1	173.35		
73	none	236.6	251.1	173.35	.3274	1
		236.6	251.1	178.424		
74	none	236.6	251.1	178.424	.3274	1
		236.6	251.1	183.497		
75	none	236.6	251.1	183.497	.3274	1
		236.6	251.1	188.571		
76	none	236.6	251.1	188.571	.3274	1
		236.6	251.1	193.644		

Number of wires = 76
current nodes = 76

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	55	5.073	39	24.5376
radius	51	.3274	39	3.3479

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	1.38	0	1	.0140917	.06816

Sources

source	node	sector	magnitude	phase	type
1	20	1	1.	0	voltage

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 20, sector 1							
1.38	166.46	-389.49	423.57	293.1	21.811	-.79704	-7.7555

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Tower 3 Self Impedance Method of Moments Model Details

Tower 3 Driven – Towers 1, 2, 4 Short Circuited at Base

C:\WAOK T3 Driven Others Shorted 03-15-2011 16:26:50

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	140.	172.5	0	.3669	1
		140.	172.5	10.1446		
2	none	140.	172.5	10.1446	.3669	1
		140.	172.5	20.2893		
3	none	140.	172.5	20.2893	.3669	1
		140.	172.5	30.4339		
4	none	140.	172.5	30.4339	.3669	1
		140.	172.5	40.5785		
5	none	140.	172.5	40.5785	.3669	1
		140.	172.5	50.7232		
6	none	140.	172.5	50.7232	.3669	1
		140.	172.5	60.8678		
7	none	140.	172.5	60.8678	.3669	1
		140.	172.5	71.0124		
8	none	140.	172.5	71.0124	.3669	1
		140.	172.5	81.1571		
9	none	140.	172.5	81.1571	.3669	1
		140.	172.5	91.3017		
10	none	140.	172.5	91.3017	.3669	1
		140.	172.5	101.446		
11	none	140.	172.5	101.446	.3669	1
		140.	172.5	111.591		
12	none	140.	172.5	111.591	.3669	1
		140.	172.5	121.736		
13	none	140.	172.5	121.736	.3669	1
		140.	172.5	131.88		
14	none	140.	172.5	131.88	.3669	1
		140.	172.5	142.025		
15	none	140.	172.5	142.025	.3669	1
		140.	172.5	152.17		
16	none	140.	172.5	152.17	.3669	1
		140.	172.5	162.314		
17	none	140.	172.5	162.314	.3669	1
		140.	172.5	172.459		
18	none	140.	172.5	172.459	.3669	1
		140.	172.5	182.603		
19	none	140.	172.5	182.603	.3669	1
		140.	172.5	192.748		
20	none	0	0	0	.3669	1
		0	0	10.1446		
21	none	0	0	10.1446	.3669	1
		0	0	20.2893		
22	none	0	0	20.2893	.3669	1
		0	0	30.4339		
23	none	0	0	30.4339	.3669	1
		0	0	40.5785		
24	none	0	0	40.5785	.3669	1
		0	0	50.7232		
25	none	0	0	50.7232	.3669	1
		0	0	60.8678		
26	none	0	0	60.8678	.3669	1
		0	0	71.0124		

27	none	0	0	71.0124	.3669	1
		0	0	81.1571		
28	none	0	0	81.1571	.3669	1
		0	0	91.3017		
29	none	0	0	91.3017	.3669	1
		0	0	101.446		
30	none	0	0	101.446	.3669	1
		0	0	111.591		
31	none	0	0	111.591	.3669	1
		0	0	121.736		
32	none	0	0	121.736	.3669	1
		0	0	131.88		
33	none	0	0	131.88	.3669	1
		0	0	142.025		
34	none	0	0	142.025	.3669	1
		0	0	152.17		
35	none	0	0	152.17	.3669	1
		0	0	162.314		
36	none	0	0	162.314	.3669	1
		0	0	172.459		
37	none	0	0	172.459	.3669	1
		0	0	182.603		
38	none	0	0	182.603	.3669	1
		0	0	192.748		
39	none	250.	284.4	0	3.3479	1
		250.	284.4	24.5376		
40	none	250.	284.4	24.5376	2.8398	1
		250.	284.4	49.0741		
41	none	250.	284.4	49.0741	2.3881	1
		250.	284.4	68.1588		
42	none	250.	284.4	68.1588	2.0212	1
		250.	284.4	84.5165		
43	none	250.	284.4	84.5165	1.7106	1
		250.	284.4	98.1482		
44	none	250.	284.4	98.1482	1.4566	1
		250.	284.4	109.054		
45	none	250.	284.4	109.054	1.2308	1
		250.	284.4	119.959		
46	none	250.	284.4	119.959	1.0332	1
		250.	284.4	128.138		
47	none	250.	284.4	128.138	.8638	1
		250.	284.4	136.318		
48	none	250.	284.4	136.318	.6944	1
		250.	284.4	144.496		
49	none	250.	284.4	144.496	.525	1
		250.	284.4	152.675		
50	none	250.	284.4	152.675	.3839	1
		250.	284.4	158.128		
51	none	250.	284.4	158.128	.3274	1
		250.	284.4	163.202		
52	none	250.	284.4	163.202	.3274	1
		250.	284.4	168.276		
53	none	250.	284.4	168.276	.3274	1
		250.	284.4	173.35		
54	none	250.	284.4	173.35	.3274	1
		250.	284.4	178.424		
55	none	250.	284.4	178.424	.3274	1
		250.	284.4	183.497		
56	none	250.	284.4	183.497	.3274	1
		250.	284.4	188.571		
57	none	250.	284.4	188.571	.3274	1
		250.	284.4	193.644		
58	none	236.6	251.1	0	3.3479	1
		236.6	251.1	24.5376		

59	none	236.6	251.1	24.5376	2.8398	1
		236.6	251.1	49.0741		
60	none	236.6	251.1	49.0741	2.3881	1
		236.6	251.1	68.1588		
61	none	236.6	251.1	68.1588	2.0212	1
		236.6	251.1	84.5165		
62	none	236.6	251.1	84.5165	1.7106	1
		236.6	251.1	98.1482		
63	none	236.6	251.1	98.1482	1.4566	1
		236.6	251.1	109.054		
64	none	236.6	251.1	109.054	1.2308	1
		236.6	251.1	119.959		
65	none	236.6	251.1	119.959	1.0332	1
		236.6	251.1	128.138		
66	none	236.6	251.1	128.138	.8638	1
		236.6	251.1	136.318		
67	none	236.6	251.1	136.318	.6944	1
		236.6	251.1	144.496		
68	none	236.6	251.1	144.496	.525	1
		236.6	251.1	152.675		
69	none	236.6	251.1	152.675	.3839	1
		236.6	251.1	158.128		
70	none	236.6	251.1	158.128	.3274	1
		236.6	251.1	163.202		
71	none	236.6	251.1	163.202	.3274	1
		236.6	251.1	168.276		
72	none	236.6	251.1	168.276	.3274	1
		236.6	251.1	173.35		
73	none	236.6	251.1	173.35	.3274	1
		236.6	251.1	178.424		
74	none	236.6	251.1	178.424	.3274	1
		236.6	251.1	183.497		
75	none	236.6	251.1	183.497	.3274	1
		236.6	251.1	188.571		
76	none	236.6	251.1	188.571	.3274	1
		236.6	251.1	193.644		

Number of wires = 76
current nodes = 76

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	55	5.073	39	24.5376
radius	51	.3274	39	3.3479

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	1.38	0	1	.0140917	.06816

Sources

source	node	sector	magnitude	phase	type
1	39	1	1.	0	voltage

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 39, sector 1							
1.38	65.579	-144.3	158.51	294.4	8.3043	-2.1021	-4.16

WAOK

Tower 4 Self Impedance Method of Moments Model Details

Tower 4 Driven – Towers 1, 2, 3 Short Circuited at Base

C:\WAOK T4 Driven Others Shorted 03-15-2011 16:28:56

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	140.	172.5	0	.3669	1
		140.	172.5	10.1446		
2	none	140.	172.5	10.1446	.3669	1
		140.	172.5	20.2893		
3	none	140.	172.5	20.2893	.3669	1
		140.	172.5	30.4339		
4	none	140.	172.5	30.4339	.3669	1
		140.	172.5	40.5785		
5	none	140.	172.5	40.5785	.3669	1
		140.	172.5	50.7232		
6	none	140.	172.5	50.7232	.3669	1
		140.	172.5	60.8678		
7	none	140.	172.5	60.8678	.3669	1
		140.	172.5	71.0124		
8	none	140.	172.5	71.0124	.3669	1
		140.	172.5	81.1571		
9	none	140.	172.5	81.1571	.3669	1
		140.	172.5	91.3017		
10	none	140.	172.5	91.3017	.3669	1
		140.	172.5	101.446		
11	none	140.	172.5	101.446	.3669	1
		140.	172.5	111.591		
12	none	140.	172.5	111.591	.3669	1
		140.	172.5	121.736		
13	none	140.	172.5	121.736	.3669	1
		140.	172.5	131.88		
14	none	140.	172.5	131.88	.3669	1
		140.	172.5	142.025		
15	none	140.	172.5	142.025	.3669	1
		140.	172.5	152.17		
16	none	140.	172.5	152.17	.3669	1
		140.	172.5	162.314		
17	none	140.	172.5	162.314	.3669	1
		140.	172.5	172.459		
18	none	140.	172.5	172.459	.3669	1
		140.	172.5	182.603		
19	none	140.	172.5	182.603	.3669	1
		140.	172.5	192.748		
20	none	0	0	0	.3669	1
		0	0	10.1446		
21	none	0	0	10.1446	.3669	1
		0	0	20.2893		
22	none	0	0	20.2893	.3669	1
		0	0	30.4339		
23	none	0	0	30.4339	.3669	1
		0	0	40.5785		
24	none	0	0	40.5785	.3669	1
		0	0	50.7232		
25	none	0	0	50.7232	.3669	1
		0	0	60.8678		
26	none	0	0	60.8678	.3669	1
		0	0	71.0124		

27	none	0	0	71.0124	.3669	1
		0	0	81.1571		
28	none	0	0	81.1571	.3669	1
		0	0	91.3017		
29	none	0	0	91.3017	.3669	1
		0	0	101.446		
30	none	0	0	101.446	.3669	1
		0	0	111.591		
31	none	0	0	111.591	.3669	1
		0	0	121.736		
32	none	0	0	121.736	.3669	1
		0	0	131.88		
33	none	0	0	131.88	.3669	1
		0	0	142.025		
34	none	0	0	142.025	.3669	1
		0	0	152.17		
35	none	0	0	152.17	.3669	1
		0	0	162.314		
36	none	0	0	162.314	.3669	1
		0	0	172.459		
37	none	0	0	172.459	.3669	1
		0	0	182.603		
38	none	0	0	182.603	.3669	1
		0	0	192.748		
39	none	250.	284.4	0	3.3479	1
		250.	284.4	24.5376		
40	none	250.	284.4	24.5376	2.8398	1
		250.	284.4	49.0741		
41	none	250.	284.4	49.0741	2.3881	1
		250.	284.4	68.1588		
42	none	250.	284.4	68.1588	2.0212	1
		250.	284.4	84.5165		
43	none	250.	284.4	84.5165	1.7106	1
		250.	284.4	98.1482		
44	none	250.	284.4	98.1482	1.4566	1
		250.	284.4	109.054		
45	none	250.	284.4	109.054	1.2308	1
		250.	284.4	119.959		
46	none	250.	284.4	119.959	1.0332	1
		250.	284.4	128.138		
47	none	250.	284.4	128.138	.8638	1
		250.	284.4	136.318		
48	none	250.	284.4	136.318	.6944	1
		250.	284.4	144.496		
49	none	250.	284.4	144.496	.525	1
		250.	284.4	152.675		
50	none	250.	284.4	152.675	.3839	1
		250.	284.4	158.128		
51	none	250.	284.4	158.128	.3274	1
		250.	284.4	163.202		
52	none	250.	284.4	163.202	.3274	1
		250.	284.4	168.276		
53	none	250.	284.4	168.276	.3274	1
		250.	284.4	173.35		
54	none	250.	284.4	173.35	.3274	1
		250.	284.4	178.424		
55	none	250.	284.4	178.424	.3274	1
		250.	284.4	183.497		
56	none	250.	284.4	183.497	.3274	1
		250.	284.4	188.571		
57	none	250.	284.4	188.571	.3274	1
		250.	284.4	193.644		
58	none	236.6	251.1	0	3.3479	1
		236.6	251.1	24.5376		

59	none	236.6	251.1	24.5376	2.8398	1
		236.6	251.1	49.0741		
60	none	236.6	251.1	49.0741	2.3881	1
		236.6	251.1	68.1588		
61	none	236.6	251.1	68.1588	2.0212	1
		236.6	251.1	84.5165		
62	none	236.6	251.1	84.5165	1.7106	1
		236.6	251.1	98.1482		
63	none	236.6	251.1	98.1482	1.4566	1
		236.6	251.1	109.054		
64	none	236.6	251.1	109.054	1.2308	1
		236.6	251.1	119.959		
65	none	236.6	251.1	119.959	1.0332	1
		236.6	251.1	128.138		
66	none	236.6	251.1	128.138	.8638	1
		236.6	251.1	136.318		
67	none	236.6	251.1	136.318	.6944	1
		236.6	251.1	144.496		
68	none	236.6	251.1	144.496	.525	1
		236.6	251.1	152.675		
69	none	236.6	251.1	152.675	.3839	1
		236.6	251.1	158.128		
70	none	236.6	251.1	158.128	.3274	1
		236.6	251.1	163.202		
71	none	236.6	251.1	163.202	.3274	1
		236.6	251.1	168.276		
72	none	236.6	251.1	168.276	.3274	1
		236.6	251.1	173.35		
73	none	236.6	251.1	173.35	.3274	1
		236.6	251.1	178.424		
74	none	236.6	251.1	178.424	.3274	1
		236.6	251.1	183.497		
75	none	236.6	251.1	183.497	.3274	1
		236.6	251.1	188.571		
76	none	236.6	251.1	188.571	.3274	1
		236.6	251.1	193.644		

Number of wires = 76
current nodes = 76

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	55	5.073	39	24.5376
radius	51	.3274	39	3.3479

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	1.38	0	1	.0140917	.06816

Sources

source	node	sector	magnitude	phase	type
1	58	1	1.	0	voltage

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 58, sector 1							
1.38	62.74	-148.15	160.89	293.	8.9363	-1.9521	-4.4123

WAOK
WCAP Calculation Details for Tower Self Impedance
One Tower Driven - Other Towers Short Circuited at Base

WAOK Tower 1 Driven – Towers 2, 3, 4 Short Circuited at Base

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = WAOK1SS.txt

I     1.0000     0     1      .0000      .0000      .0000
R     1.0000     1     2      .0000      .0000      .0000
L     4.7000     2     3      .0000      .0000      .0000
C      .0000     3     0      .0000      .0000      .0000
R   182.8100     3     0 -370.6000      .0000      .0000
EX     .0000     0     0      .0000      .0000      .0000


 FREQ = 1.380

   NODE       VOLT MAG      VOLT PHASE
     1        334.8993       -63.6373
     2        334.4565       -63.7908
     3        371.4556       -66.5681
                           BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                           MAG       PHASE      MAG       PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
 VSWR
R    1-  2     1.000      1.00       .000      1.00       .000    148.71   -300.07    147.71   -300.07
L    2-  3     4.700     40.75     90.000      1.00       .000    147.71   -300.07    147.71   -340.82
C    3-  0      .000    371.46    -66.568       .11     23.432       .00  -3334.96       .00       .00
R    3-  0   182.810    371.46    -66.568       .90     -2.824    182.81   -370.60       .00       .00
```

WAOK Tower 2 Driven – Towers 1, 3, 4 Short Circuited at Base

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = WAOK2SS.txt

I     1.0000     0     1      .0000      .0000      .0000
R     1.0000     1     2      .0000      .0000      .0000
L     5.6680     2     3      .0000      .0000      .0000
C      .0001     3     0      .0000      .0000      .0000
R   166.4600     3     0 -389.4900      .0000      .0000
EX     .0000     0     0      .0000      .0000      .0000


 FREQ = 1.380

   NODE       VOLT MAG      VOLT PHASE
     1        299.9850       -68.0957
     2        299.6133       -68.2731
     3        345.7470       -71.2894
                           BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                           MAG       PHASE      MAG       PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
 VSWR
R    1-  2     1.000      1.00       .000      1.00       .000    111.91   -278.33    110.91   -278.33
L    2-  3     5.668     49.15     90.000      1.00       .000    110.91   -278.33    110.91   -327.47
C    3-  0      .000    345.75    -71.289       .20     18.711       .00  -1759.01       .00       .00
R    3-  0   166.460    345.75    -71.289       .82     -4.430    166.46   -389.49       .00       .00
```

WAOK Tower 3 Driven – Towers 1, 2, 4 Short Circuited at Base

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = WAOK3SS.txt

I      1.0000     0     1      .0000      .0000      .0000
R      1.0000     1     2      .0000      .0000      .0000
L      1.5340     2     3      .0000      .0000      .0000
C       .0002     3     0      .0000      .0000      .0000
R     65.5790     3     0 -144.3000      .0000      .0000
EX      .0000     0     0      .0000      .0000      .0000


 FREQ = 1.380

   NODE       VOLT MAG      VOLT PHASE
     1        120.8893        -67.0710
     2        120.5032        -67.5089
     3        132.8900        -69.7032
                          BRANCH VOLTAGE        BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG       PHASE       MAG       PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
 VSWR
R     1-  2      1.000      1.00       .000      1.00       .000     47.10   -111.34     46.10   -111.34
L     2-  3      1.534     13.30     90.000      1.00       .000     46.10   -111.34     46.10   -124.64
C     3-  0       .000    132.89    -69.703       .17    20.297       .00   -761.00       .00       .00
R     3-  0     65.579    132.89    -69.703       .84    -4.143     65.58   -144.30       .00       .00
```

WAOK Tower 4 Driven – Towers 1, 2, 3 Short Circuited at Base

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = WAOK4SS.txt

I      1.0000     0     1      .0000      .0000      .0000
R      1.0000     1     2      .0000      .0000      .0000
L      2.6990     2     3      .0000      .0000      .0000
C       .0001     3     0      .0000      .0000      .0000
R     62.7400     3     0 -148.1500      .0000      .0000
EX      .0000     0     0      .0000      .0000      .0000


 FREQ = 1.380

   NODE       VOLT MAG      VOLT PHASE
     1        113.7221        -66.5305
     2        113.3275        -66.9942
     3        135.1785        -70.8739
                          BRANCH VOLTAGE        BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG       PHASE       MAG       PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
 VSWR
R     1-  2      1.000      1.00       .000      1.00       .000     45.29   -104.31     44.29   -104.31
L     2-  3      2.699     23.40     90.000      1.00       .000     44.29   -104.31     44.29   -127.72
C     3-  0       .000    135.18    -70.874       .17    19.126       .00   -790.00       .00       .00
R     3-  0     62.740    135.18    -70.874       .84    -3.826     62.74   -148.15       .00       .00
```

Section 3 - WAOK
Method of Moments Model Details for Model Stability Assessment

The WAOK array of towers was modeled using Expert MININEC Broadcast Professional Version 14.5. WAOK towers 1 and 2 are identical triangular guyed structures that are of uniform cross section construction, and towers 3 and 4 are identical triangular self supporting structures that are tapered cross section construction from the base insulator to 290 feet, and then uniform cross section construction for the remaining height. Each tower was modeled using 19 wire segments, with each wire segment representing the physical radius of that segment. The wire end points were specified using electrical degrees at 1380 kHz in the Geographic coordinate system with their locations taken from the theoretical directional antenna specifications. The towers are all physically 179.3 degrees in electrical height. The segment radii are specified in meters.

Each 19 segment tower model was adjusted individually to provide correlation of the model impedance - when corrected by circuit calculations for the additional stray capacitances and the VSU to tower connection series inductances – to the measured VSU J-plug impedances with the other towers short circuited at its base insulator(s). The capacitance of the base insulator(s) at ground level and tower lighting chokes are included in the value of stray capacitance used for WCAP circuit calculations on each driven tower. Two isocouplers at the base of tower 2 are included in that tower's value of stray capacitance used for WCAP circuit calculations.

With Towers 1, 2, and 4 models held constant as the 19 segment models described above, Tower 3 was then modeled with different numbers of segments with the same overall height as the 19 segment model to demonstrate the stability of the model relative to the base resistance and reactance with variable segment length to radius ratio. The radius used in each of these model segments is represented by the physical radius of the tower.

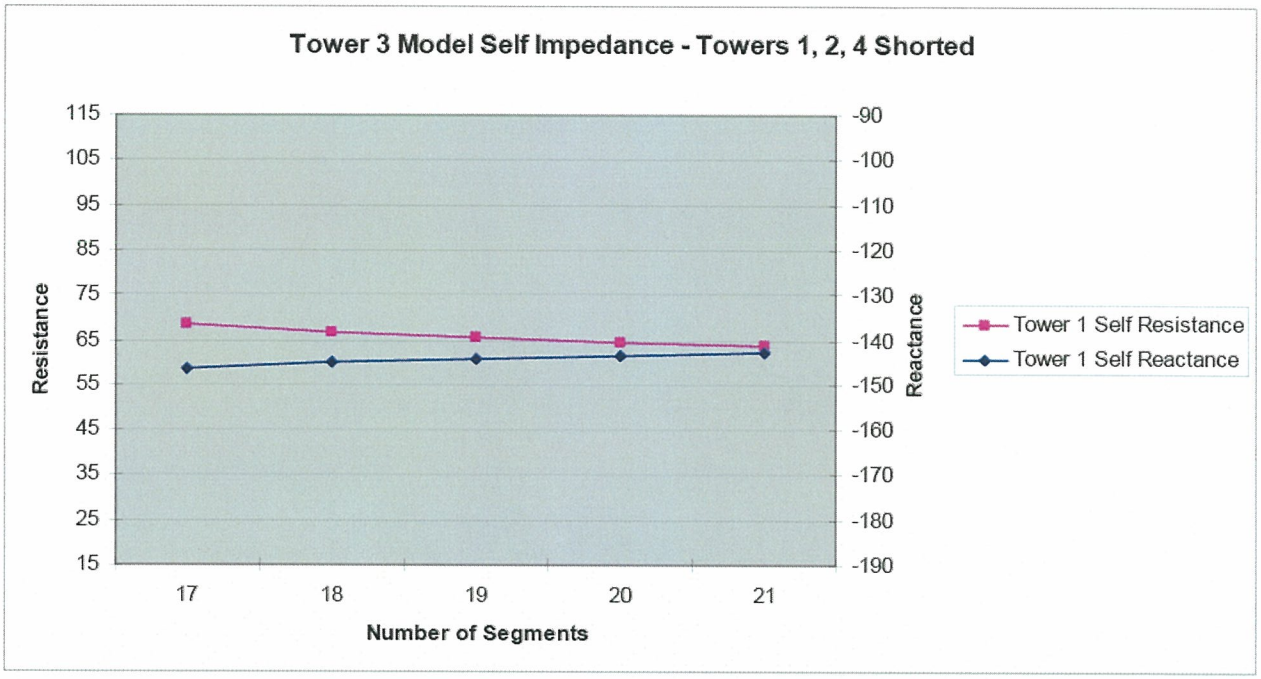
All wire segment models, when checked using the "problem definition evaluation" function, have no errors relative to the MININEC "geometry guidelines." MININEC Broadcast Professional does show warnings due to some segment lengths. This study was performed to determine the stability of the model relative to the segment lengths with the overall height held constant. It is shown in this study that both the real and imaginary components of the base impedance converge as the segment length is shortened, and remain essentially constant with the variations well below the required measurement tolerances through the range of segment length to radius ratios in the study. The model is therefore valid with regard to the characteristics of the tower as an antenna.

The WAOK Model Stability Assessment Graphs and Data Tables for Tower 3 driven with Towers 2, 3, 4 short circuited shows the modeled self resistance and reactance with the varying Tower 3 segment lengths and radius used in each case.

The WAOK Table of Tower Physical and Model Dimensions for Model Stability Assessment on the following page shows Tower 3 by segment height and radius that was used in each model.

The WAOK Tower 3 Self Impedance Method of Moments Model Details for Model Stability Assessment on the following pages lists the information used in the Method of Moments model for Tower 3 driven with the Towers 1, 2, and 4 short circuited at each base.

WAOK
Model Stability Assessment
Graphs and Data Tables
Resistance and Reactance
17 to 21 Segment Models
Tower 3 Model Self Impedance – Towers 1, 2, 4 Short Circuited at Base



Number of Segments	Tower 3 Self Resistance (Ohms)	Tower 3 Self Reactance (Ohms)
17	68.325	-j 146.29
18	66.596	-j 145.04
19	65.579	-j 144.30
20	64.438	-j 143.48
21	63.555	-j 142.86

WAOK

Model Stability Assessment

Table of Tower Physical and Model Dimensions

17 Segments

TOWER SEGMENT	Physical Height (degrees)	Model Height (degrees)	Model Percent of Height	Model Radius (meters)	Percent Equivalent Radius
3-1	23.9817	25.900	107.999	3.3338	100
3-2	23.9817	25.900	107.999	2.7974	100
3-3	18.9329	20.448	108.002	2.3176	100
3-4	16.4085	17.721	107.999	1.9224	100
3-5	13.8841	14.995	108.001	1.5836	100
3-6	11.3598	12.269	108.004	1.3013	100
3-7	11.3598	12.268	107.995	1.0473	100
3-8	8.8354	9.542	107.997	0.8214	100
3-9	8.8354	9.543	108.009	0.6238	100
3-10	8.8354	9.542	107.997	0.4264	100
3-11	4.6979	5.0737	107.999	0.3274	100
3-12	4.6979	5.0737	107.999	0.3274	100
3-13	4.6979	5.0737	107.999	0.3274	100
3-14	4.6979	5.0737	107.999	0.3274	100
3-15	4.6979	5.0737	107.999	0.3274	100
3-16	4.6979	5.0737	107.999	0.3274	100
3-17	4.6979	5.0737	107.999	0.3274	100
3 Overall	179.3	193.644	108.0		100

WAOK

Model Stability Assessment

Table of Tower Physical and Model Dimensions

18 Segments

TOWER SEGMENT	Physical Height (degrees)	Model Height (degrees)	Model Percent of Height	Model Radius (meters)	Percent Equivalent Radius
3-1	23.1784	25.033	108.001	3.3428	100
3-2	23.1784	25.032	107.997	2.8244	100
3-3	18.1297	19.580	108.000	2.3625	100
3-4	15.6053	16.854	108.002	1.9852	100
3-5	13.0814	14.128	108.001	1.6644	100
3-6	10.5560	11.401	108.005	1.4027	100
3-7	10.5560	11.401	108.005	1.1640	100
3-8	8.0326	8.675	107.998	0.9562	100
3-9	8.0321	8.674	107.992	0.7765	100
3-10	8.0326	8.675	107.998	0.5969	100
3-11	8.0326	8.675	107.998	0.4173	100
3-12	4.6979	5.0737	107.999	0.3274	100
3-13	4.6979	5.0737	107.999	0.3274	100
3-14	4.6979	5.0737	107.999	0.3274	100
3-15	4.6979	5.0737	107.999	0.3274	100
3-16	4.6979	5.0737	107.999	0.3274	100
3-17	4.6979	5.0737	107.999	0.3274	100
3-18	4.6979	5.0737	107.999	0.3274	100
3 Overall	179.3	193.644	108.0		100

WAOK

Model Stability Assessment

Table of Tower Physical and Model Dimensions

19 Segments

TOWER SEGMENT	Physical Height (degrees)	Model Height (degrees)	Model Percent of Height	Model Radius (meters)	Percent Equivalent Radius
3-1	22.7200	24.5376	108.000	3.3479	100
3-2	22.7190	24.5365	107.999	2.8398	100
3-3	17.6710	19.0847	108.000	2.3881	100
3-4	15.1460	16.3577	108.000	2.0212	100
3-5	12.6220	13.6317	108.000	1.7106	100
3-6	10.0980	10.9058	107.999	1.4566	100
3-7	10.0970	10.9050	108.002	1.2308	100
3-8	7.5730	8.1790	108.002	1.0332	100
3-9	7.5740	8.1800	108.001	0.8638	100
3-10	7.5730	8.1780	107.989	0.6944	100
3-11	7.5730	8.1790	108.002	0.5250	100
3-12	5.0490	5.4530	108.002	0.3839	100
3-13	4.6979	5.0737	107.999	0.3274	100
3-14	4.6979	5.0737	107.999	0.3274	100
3-15	4.6979	5.0737	107.999	0.3274	100
3-16	4.6979	5.0737	107.999	0.3274	100
3-17	4.6979	5.0737	107.999	0.3274	100
3-18	4.6979	5.0737	107.999	0.3274	100
3-19	4.6979	5.0737	107.999	0.3274	100
3 Overall	179.3	193.644	108.0		100

WAOK

Model Stability Assessment

Table of Tower Physical and Model Dimensions

20 Segments

TOWER SEGMENT	Physical Height (degrees)	Model Height (degrees)	Model Percent of Height	Model Radius (meters)	Percent Equivalent Radius
3-1	22.2146	23.992	108.001	3.3535	100
3-2	22.2146	23.992	108.001	2.8570	100
3-3	17.1659	18.539	107.999	2.4164	100
3-4	14.6415	15.813	108.001	2.0607	100
3-5	12.1171	13.086	107.996	1.7615	100
3-6	9.5927	10.360	107.999	1.5187	100
3-7	9.5927	10.360	107.999	1.3042	100
3-8	7.0683	7.634	108.003	1.1178	100
3-9	7.0683	7.634	108.003	0.9598	100
3-10	7.0683	7.633	107.989	0.8017	100
3-11	7.0683	7.634	108.003	0.6436	100
3-12	5.5537	5.998	108.000	0.5025	100
3-13	5.0488	5.453	108.006	0.3839	100
3-14	4.6979	5.0737	107.999	0.3274	100
3-15	4.6979	5.0737	107.999	0.3274	100
3-16	4.6979	5.0737	107.999	0.3274	100
3-17	4.6979	5.0737	107.999	0.3274	100
3-18	4.6979	5.0737	107.999	0.3274	100
3-19	4.6979	5.0737	107.999	0.3274	100
3-20	4.6979	5.0737	107.999	0.3274	100
3 Overall	179.3	193.644	108.0		100

WAOK

Model Stability Assessment

Table of Tower Physical and Model Dimensions

21 Segments

TOWER SEGMENT	Physical Height (degrees)	Model Height (degrees)	Model Percent of Height	Model Radius (meters)	Percent Equivalent Radius
3-1	21.8360	23.583	108.001	3.3578	100
3-2	21.8360	23.583	108.001	2.8694	100
3-3	16.7872	18.130	107.999	2.4376	100
3-4	14.2628	15.404	108.001	2.0903	100
3-5	11.7384	12.677	107.996	1.7996	100
3-6	9.2140	9.951	107.999	1.5653	100
3-7	9.2140	9.951	107.999	1.3592	100
3-8	6.6896	7.225	108.003	1.1814	100
3-9	6.8159	7.361	107.997	1.0303	100
3-10	6.5634	7.089	108.008	0.8821	100
3-11	5.6799	6.134	107.995	0.7438	100
3-12	5.6799	6.132	107.960	0.6168	100
3-13	5.0488	5.433	108.006	0.4968	100
3-14	5.0488	5.453	108.006	0.3839	100
3-15	4.6979	5.0737	107.999	0.3274	100
3-16	4.6979	5.0737	107.999	0.3274	100
3-17	4.6979	5.0737	107.999	0.3274	100
3-18	4.6979	5.0737	107.999	0.3274	100
3-19	4.6979	5.0737	107.999	0.3274	100
3-20	4.6979	5.0737	107.999	0.3274	100
3-21	4.6979	5.0737	107.999	0.3274	100
3 Overall	179.3	193.644	108.0		100

WAOK
Model Stability Assessment
Method of Moments Model Details
17 Segment Model
Tower 3 Self Impedance – Towers 1, 2, 4 Short Circuited at Base

C:\WAOK T3 Driven Others Shorted 17 Seg 03-15-2011 16:44:22

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	140.	172.5	0	.3669	1
		140.	172.5	10.1446		
2	none	140.	172.5	10.1446	.3669	1
		140.	172.5	20.2893		
3	none	140.	172.5	20.2893	.3669	1
		140.	172.5	30.4339		
4	none	140.	172.5	30.4339	.3669	1
		140.	172.5	40.5785		
5	none	140.	172.5	40.5785	.3669	1
		140.	172.5	50.7232		
6	none	140.	172.5	50.7232	.3669	1
		140.	172.5	60.8678		
7	none	140.	172.5	60.8678	.3669	1
		140.	172.5	71.0124		
8	none	140.	172.5	71.0124	.3669	1
		140.	172.5	81.1571		
9	none	140.	172.5	81.1571	.3669	1
		140.	172.5	91.3017		
10	none	140.	172.5	91.3017	.3669	1
		140.	172.5	101.446		
11	none	140.	172.5	101.446	.3669	1
		140.	172.5	111.591		
12	none	140.	172.5	111.591	.3669	1
		140.	172.5	121.736		
13	none	140.	172.5	121.736	.3669	1
		140.	172.5	131.88		
14	none	140.	172.5	131.88	.3669	1
		140.	172.5	142.025		
15	none	140.	172.5	142.025	.3669	1
		140.	172.5	152.17		
16	none	140.	172.5	152.17	.3669	1
		140.	172.5	162.314		
17	none	140.	172.5	162.314	.3669	1
		140.	172.5	172.459		
18	none	140.	172.5	172.459	.3669	1
		140.	172.5	182.603		
19	none	140.	172.5	182.603	.3669	1
		140.	172.5	192.748		
20	none	0	0	0	.3669	1
		0	0	10.1446		
21	none	0	0	10.1446	.3669	1
		0	0	20.2893		
22	none	0	0	20.2893	.3669	1
		0	0	30.4339		
23	none	0	0	30.4339	.3669	1
		0	0	40.5785		
24	none	0	0	40.5785	.3669	1
		0	0	50.7232		
25	none	0	0	50.7232	.3669	1

		0	0	60.8678		
26	none	0	0	60.8678	.3669	1
		0	0	71.0124		
27	none	0	0	71.0124	.3669	1
		0	0	81.1571		
28	none	0	0	81.1571	.3669	1
		0	0	91.3017		
29	none	0	0	91.3017	.3669	1
		0	0	101.446		
30	none	0	0	101.446	.3669	1
		0	0	111.591		
31	none	0	0	111.591	.3669	1
		0	0	121.736		
32	none	0	0	121.736	.3669	1
		0	0	131.88		
33	none	0	0	131.88	.3669	1
		0	0	142.025		
34	none	0	0	142.025	.3669	1
		0	0	152.17		
35	none	0	0	152.17	.3669	1
		0	0	162.314		
36	none	0	0	162.314	.3669	1
		0	0	172.459		
37	none	0	0	172.459	.3669	1
		0	0	182.603		
38	none	0	0	182.603	.3669	1
		0	0	192.748		
39	none	250.	284.4	0	3.3338	1
		250.	284.4	25.9		
40	none	250.	284.4	25.9	2.7974	1
		250.	284.4	51.8		
41	none	250.	284.4	51.8	2.3176	1
		250.	284.4	72.248		
42	none	250.	284.4	72.248	1.9224	1
		250.	284.4	89.969		
43	none	250.	284.4	89.969	1.5836	1
		250.	284.4	104.964		
44	none	250.	284.4	104.964	1.3013	1
		250.	284.4	117.233		
45	none	250.	284.4	117.233	1.0473	1
		250.	284.4	129.501		
46	none	250.	284.4	129.501	.8214	1
		250.	284.4	139.043		
47	none	250.	284.4	139.043	.6238	1
		250.	284.4	148.586		
48	none	250.	284.4	148.586	.4264	1
		250.	284.4	158.128		
49	none	250.	284.4	158.128	.3274	1
		250.	284.4	163.202		
50	none	250.	284.4	163.202	.3274	1
		250.	284.4	168.276		
51	none	250.	284.4	168.276	.3274	1
		250.	284.4	173.35		
52	none	250.	284.4	173.35	.3274	1
		250.	284.4	178.424		
53	none	250.	284.4	178.424	.3274	1
		250.	284.4	183.497		
54	none	250.	284.4	183.497	.3274	1
		250.	284.4	188.571		
55	none	250.	284.4	188.571	.3274	1
		250.	284.4	193.644		
56	none	236.6	251.1	0	3.3479	1
		236.6	251.1	24.5376		
57	none	236.6	251.1	24.5376	2.8398	1

		236.6	251.1	49.0741		
58	none	236.6	251.1	49.0741	2.3881	1
		236.6	251.1	68.1588		
59	none	236.6	251.1	68.1588	2.0212	1
		236.6	251.1	84.5165		
60	none	236.6	251.1	84.5165	1.7106	1
		236.6	251.1	98.1482		
61	none	236.6	251.1	98.1482	1.4566	1
		236.6	251.1	109.054		
62	none	236.6	251.1	109.054	1.2308	1
		236.6	251.1	119.959		
63	none	236.6	251.1	119.959	1.0332	1
		236.6	251.1	128.138		
64	none	236.6	251.1	128.138	.8638	1
		236.6	251.1	136.318		
65	none	236.6	251.1	136.318	.6944	1
		236.6	251.1	144.496		
66	none	236.6	251.1	144.496	.525	1
		236.6	251.1	152.675		
67	none	236.6	251.1	152.675	.3839	1
		236.6	251.1	158.128		
68	none	236.6	251.1	158.128	.3274	1
		236.6	251.1	163.202		
69	none	236.6	251.1	163.202	.3274	1
		236.6	251.1	168.276		
70	none	236.6	251.1	168.276	.3274	1
		236.6	251.1	173.35		
71	none	236.6	251.1	173.35	.3274	1
		236.6	251.1	178.424		
72	none	236.6	251.1	178.424	.3274	1
		236.6	251.1	183.497		
73	none	236.6	251.1	183.497	.3274	1
		236.6	251.1	188.571		
74	none	236.6	251.1	188.571	.3274	1
		236.6	251.1	193.644		

Number of wires = 74
current nodes = 74

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	53	5.073	39	25.9
radius	49	.3274	56	3.3479

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	1.38	0	1	.0140917	.0719445

Sources

source	node	sector	magnitude	phase	type
1	39	1	1.	0	voltage

IMPEDANCE
normalization = 50.

freq	resist	react	imped	phase	VSWR	S11	S12
(MHz)	(ohms)	(ohms)	(ohms)	(deg)		dB	dB
source = 1; node 39, sector 1							
1.38	68.325	-146.29	161.46	295.	8.241	-2.1184	-4.134

WAOK
Model Stability Assessment
Method of Moments Model Details
18 Segment Model
Tower 3 Self Impedance – Towers 1, 2, 4 Short Circuited at Base

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	140.	172.5	0	.3669	1
		140.	172.5	10.1446		
2	none	140.	172.5	10.1446	.3669	1
		140.	172.5	20.2893		
3	none	140.	172.5	20.2893	.3669	1
		140.	172.5	30.4339		
4	none	140.	172.5	30.4339	.3669	1
		140.	172.5	40.5785		
5	none	140.	172.5	40.5785	.3669	1
		140.	172.5	50.7232		
6	none	140.	172.5	50.7232	.3669	1
		140.	172.5	60.8678		
7	none	140.	172.5	60.8678	.3669	1
		140.	172.5	71.0124		
8	none	140.	172.5	71.0124	.3669	1
		140.	172.5	81.1571		
9	none	140.	172.5	81.1571	.3669	1
		140.	172.5	91.3017		
10	none	140.	172.5	91.3017	.3669	1
		140.	172.5	101.446		
11	none	140.	172.5	101.446	.3669	1
		140.	172.5	111.591		
12	none	140.	172.5	111.591	.3669	1
		140.	172.5	121.736		
13	none	140.	172.5	121.736	.3669	1
		140.	172.5	131.88		
14	none	140.	172.5	131.88	.3669	1
		140.	172.5	142.025		
15	none	140.	172.5	142.025	.3669	1
		140.	172.5	152.17		
16	none	140.	172.5	152.17	.3669	1
		140.	172.5	162.314		
17	none	140.	172.5	162.314	.3669	1
		140.	172.5	172.459		
18	none	140.	172.5	172.459	.3669	1
		140.	172.5	182.603		
19	none	140.	172.5	182.603	.3669	1
		140.	172.5	192.748		
20	none	0	0	0	.3669	1
		0	0	10.1446		
21	none	0	0	10.1446	.3669	1
		0	0	20.2893		
22	none	0	0	20.2893	.3669	1
		0	0	30.4339		
23	none	0	0	30.4339	.3669	1
		0	0	40.5785		
24	none	0	0	40.5785	.3669	1
		0	0	50.7232		
25	none	0	0	50.7232	.3669	1

		0	0	60.8678		
26	none	0	0	60.8678	.3669	1
		0	0	71.0124		
27	none	0	0	71.0124	.3669	1
		0	0	81.1571		
28	none	0	0	81.1571	.3669	1
		0	0	91.3017		
29	none	0	0	91.3017	.3669	1
		0	0	101.446		
30	none	0	0	101.446	.3669	1
		0	0	111.591		
31	none	0	0	111.591	.3669	1
		0	0	121.736		
32	none	0	0	121.736	.3669	1
		0	0	131.88		
33	none	0	0	131.88	.3669	1
		0	0	142.025		
34	none	0	0	142.025	.3669	1
		0	0	152.17		
35	none	0	0	152.17	.3669	1
		0	0	162.314		
36	none	0	0	162.314	.3669	1
		0	0	172.459		
37	none	0	0	172.459	.3669	1
		0	0	182.603		
38	none	0	0	182.603	.3669	1
		0	0	192.748		
39	none	250.	284.4	0	3.3428	1
		250.	284.4	25.033		
40	none	250.	284.4	25.033	2.8244	1
		250.	284.4	50.065		
41	none	250.	284.4	50.065	2.3625	1
		250.	284.4	69.645		
42	none	250.	284.4	69.645	1.9852	1
		250.	284.4	86.499		
43	none	250.	284.4	86.499	1.6644	1
		250.	284.4	100.627		
44	none	250.	284.4	100.627	1.4027	1
		250.	284.4	112.028		
45	none	250.	284.4	112.028	1.164	1
		250.	284.4	123.429		
46	none	250.	284.4	123.429	.9562	1
		250.	284.4	132.104		
47	none	250.	284.4	132.104	.7765	1
		250.	284.4	140.778		
48	none	250.	284.4	140.778	.5969	1
		250.	284.4	149.453		
49	none	250.	284.4	149.453	.4173	1
		250.	284.4	158.128		
50	none	250.	284.4	158.128	.3274	1
		250.	284.4	163.202		
51	none	250.	284.4	163.202	.3274	1
		250.	284.4	168.276		
52	none	250.	284.4	168.276	.3274	1
		250.	284.4	173.35		
53	none	250.	284.4	173.35	.3274	1
		250.	284.4	178.424		
54	none	250.	284.4	178.424	.3274	1
		250.	284.4	183.497		
55	none	250.	284.4	183.497	.3274	1
		250.	284.4	188.571		
56	none	250.	284.4	188.571	.3274	1
		250.	284.4	193.644		
57	none	236.6	251.1	0	3.3479	1

		236.6	251.1	24.5376		
58	none	236.6	251.1	24.5376	2.8398	1
		236.6	251.1	49.0741		
59	none	236.6	251.1	49.0741	2.3881	1
		236.6	251.1	68.1588		
60	none	236.6	251.1	68.1588	2.0212	1
		236.6	251.1	84.5165		
61	none	236.6	251.1	84.5165	1.7106	1
		236.6	251.1	98.1482		
62	none	236.6	251.1	98.1482	1.4566	1
		236.6	251.1	109.054		
63	none	236.6	251.1	109.054	1.2308	1
		236.6	251.1	119.959		
64	none	236.6	251.1	119.959	1.0332	1
		236.6	251.1	128.138		
65	none	236.6	251.1	128.138	.8638	1
		236.6	251.1	136.318		
66	none	236.6	251.1	136.318	.6944	1
		236.6	251.1	144.496		
67	none	236.6	251.1	144.496	.525	1
		236.6	251.1	152.675		
68	none	236.6	251.1	152.675	.3839	1
		236.6	251.1	158.128		
69	none	236.6	251.1	158.128	.3274	1
		236.6	251.1	163.202		
70	none	236.6	251.1	163.202	.3274	1
		236.6	251.1	168.276		
71	none	236.6	251.1	168.276	.3274	1
		236.6	251.1	173.35		
72	none	236.6	251.1	173.35	.3274	1
		236.6	251.1	178.424		
73	none	236.6	251.1	178.424	.3274	1
		236.6	251.1	183.497		
74	none	236.6	251.1	183.497	.3274	1
		236.6	251.1	188.571		
75	none	236.6	251.1	188.571	.3274	1
		236.6	251.1	193.644		

Number of wires = 75
current nodes = 75

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	54	5.073	39	25.033
radius	50	.3274	57	3.3479

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	1.38	0	1	.0140917	.0695361

Sources

source	node	sector	magnitude	phase	type
1	39	1	1.	0	voltage

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 39, sector 1							
1.38	66.596	-145.04	159.59	294.7	8.2792	-2.1085	-4.1497

WAOK
Model Stability Assessment
Method of Moments Model Details
19 Segment Model
Tower 3 Self Impedance – Towers 1, 2, 4 Short Circuited at Base

C:\WAOK T3 Driven Others Shorted 19 Seg 03-15-2011 16:26:50

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	140.	172.5	0	.3669	1
		140.	172.5	10.1446		
2	none	140.	172.5	10.1446	.3669	1
		140.	172.5	20.2893		
3	none	140.	172.5	20.2893	.3669	1
		140.	172.5	30.4339		
4	none	140.	172.5	30.4339	.3669	1
		140.	172.5	40.5785		
5	none	140.	172.5	40.5785	.3669	1
		140.	172.5	50.7232		
6	none	140.	172.5	50.7232	.3669	1
		140.	172.5	60.8678		
7	none	140.	172.5	60.8678	.3669	1
		140.	172.5	71.0124		
8	none	140.	172.5	71.0124	.3669	1
		140.	172.5	81.1571		
9	none	140.	172.5	81.1571	.3669	1
		140.	172.5	91.3017		
10	none	140.	172.5	91.3017	.3669	1
		140.	172.5	101.446		
11	none	140.	172.5	101.446	.3669	1
		140.	172.5	111.591		
12	none	140.	172.5	111.591	.3669	1
		140.	172.5	121.736		
13	none	140.	172.5	121.736	.3669	1
		140.	172.5	131.88		
14	none	140.	172.5	131.88	.3669	1
		140.	172.5	142.025		
15	none	140.	172.5	142.025	.3669	1
		140.	172.5	152.17		
16	none	140.	172.5	152.17	.3669	1
		140.	172.5	162.314		
17	none	140.	172.5	162.314	.3669	1
		140.	172.5	172.459		
18	none	140.	172.5	172.459	.3669	1
		140.	172.5	182.603		
19	none	140.	172.5	182.603	.3669	1
		140.	172.5	192.748		
20	none	0	0	0	.3669	1
		0	0	10.1446		
21	none	0	0	10.1446	.3669	1
		0	0	20.2893		
22	none	0	0	20.2893	.3669	1
		0	0	30.4339		
23	none	0	0	30.4339	.3669	1
		0	0	40.5785		
24	none	0	0	40.5785	.3669	1
		0	0	50.7232		
25	none	0	0	50.7232	.3669	1

		0	0	60.8678		
26	none	0	0	60.8678	.3669	1
		0	0	71.0124		
27	none	0	0	71.0124	.3669	1
		0	0	81.1571		
28	none	0	0	81.1571	.3669	1
		0	0	91.3017		
29	none	0	0	91.3017	.3669	1
		0	0	101.446		
30	none	0	0	101.446	.3669	1
		0	0	111.591		
31	none	0	0	111.591	.3669	1
		0	0	121.736		
32	none	0	0	121.736	.3669	1
		0	0	131.88		
33	none	0	0	131.88	.3669	1
		0	0	142.025		
34	none	0	0	142.025	.3669	1
		0	0	152.17		
35	none	0	0	152.17	.3669	1
		0	0	162.314		
36	none	0	0	162.314	.3669	1
		0	0	172.459		
37	none	0	0	172.459	.3669	1
		0	0	182.603		
38	none	0	0	182.603	.3669	1
		0	0	192.748		
39	none	250.	284.4	0	3.3479	1
		250.	284.4	24.5376		
40	none	250.	284.4	24.5376	2.8398	1
		250.	284.4	49.0741		
41	none	250.	284.4	49.0741	2.3881	1
		250.	284.4	68.1588		
42	none	250.	284.4	68.1588	2.0212	1
		250.	284.4	84.5165		
43	none	250.	284.4	84.5165	1.7106	1
		250.	284.4	98.1482		
44	none	250.	284.4	98.1482	1.4566	1
		250.	284.4	109.054		
45	none	250.	284.4	109.054	1.2308	1
		250.	284.4	119.959		
46	none	250.	284.4	119.959	1.0332	1
		250.	284.4	128.138		
47	none	250.	284.4	128.138	.8638	1
		250.	284.4	136.318		
48	none	250.	284.4	136.318	.6944	1
		250.	284.4	144.496		
49	none	250.	284.4	144.496	.525	1
		250.	284.4	152.675		
50	none	250.	284.4	152.675	.3839	1
		250.	284.4	158.128		
51	none	250.	284.4	158.128	.3274	1
		250.	284.4	163.202		
52	none	250.	284.4	163.202	.3274	1
		250.	284.4	168.276		
53	none	250.	284.4	168.276	.3274	1
		250.	284.4	173.35		
54	none	250.	284.4	173.35	.3274	1
		250.	284.4	178.424		
55	none	250.	284.4	178.424	.3274	1
		250.	284.4	183.497		
56	none	250.	284.4	183.497	.3274	1
		250.	284.4	188.571		
57	none	250.	284.4	188.571	.3274	1

		250.	284.4	193.644			
58	none	236.6	251.1	0	3.3479	1	
		236.6	251.1	24.5376			
59	none	236.6	251.1	24.5376	2.8398	1	
		236.6	251.1	49.0741			
60	none	236.6	251.1	49.0741	2.3881	1	
		236.6	251.1	68.1588			
61	none	236.6	251.1	68.1588	2.0212	1	
		236.6	251.1	84.5165			
62	none	236.6	251.1	84.5165	1.7106	1	
		236.6	251.1	98.1482			
63	none	236.6	251.1	98.1482	1.4566	1	
		236.6	251.1	109.054			
64	none	236.6	251.1	109.054	1.2308	1	
		236.6	251.1	119.959			
65	none	236.6	251.1	119.959	1.0332	1	
		236.6	251.1	128.138			
66	none	236.6	251.1	128.138	.8638	1	
		236.6	251.1	136.318			
67	none	236.6	251.1	136.318	.6944	1	
		236.6	251.1	144.496			
68	none	236.6	251.1	144.496	.525	1	
		236.6	251.1	152.675			
69	none	236.6	251.1	152.675	.3839	1	
		236.6	251.1	158.128			
70	none	236.6	251.1	158.128	.3274	1	
		236.6	251.1	163.202			
71	none	236.6	251.1	163.202	.3274	1	
		236.6	251.1	168.276			
72	none	236.6	251.1	168.276	.3274	1	
		236.6	251.1	173.35			
73	none	236.6	251.1	173.35	.3274	1	
		236.6	251.1	178.424			
74	none	236.6	251.1	178.424	.3274	1	
		236.6	251.1	183.497			
75	none	236.6	251.1	183.497	.3274	1	
		236.6	251.1	188.571			
76	none	236.6	251.1	188.571	.3274	1	
		236.6	251.1	193.644			

Number of wires = 76
current nodes = 76

Individual wires	minimum wire	minimum value	maximum wire	maximum value
segment length	55	5.073	39	24.5376
radius	51	.3274	39	3.3479

ELECTRICAL DESCRIPTION
Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	1.38	0	1	.0140917	.06816

Sources

source	node	sector	magnitude	phase	type
1	39	1	1.	0	voltage

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 39, sector 1							
1.38	65.579	-144.3	158.51	294.4	8.3043	-2.1021	-4.16

WAOK
Model Stability Assessment
Method of Moments Model Details
20 Segment Model
Tower 3 Self Impedance – Towers 1, 2, 4 Short Circuited at Base

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	140.	172.5	0	.3669	1
		140.	172.5	10.1446		
2	none	140.	172.5	10.1446	.3669	1
		140.	172.5	20.2893		
3	none	140.	172.5	20.2893	.3669	1
		140.	172.5	30.4339		
4	none	140.	172.5	30.4339	.3669	1
		140.	172.5	40.5785		
5	none	140.	172.5	40.5785	.3669	1
		140.	172.5	50.7232		
6	none	140.	172.5	50.7232	.3669	1
		140.	172.5	60.8678		
7	none	140.	172.5	60.8678	.3669	1
		140.	172.5	71.0124		
8	none	140.	172.5	71.0124	.3669	1
		140.	172.5	81.1571		
9	none	140.	172.5	81.1571	.3669	1
		140.	172.5	91.3017		
10	none	140.	172.5	91.3017	.3669	1
		140.	172.5	101.446		
11	none	140.	172.5	101.446	.3669	1
		140.	172.5	111.591		
12	none	140.	172.5	111.591	.3669	1
		140.	172.5	121.736		
13	none	140.	172.5	121.736	.3669	1
		140.	172.5	131.88		
14	none	140.	172.5	131.88	.3669	1
		140.	172.5	142.025		
15	none	140.	172.5	142.025	.3669	1
		140.	172.5	152.17		
16	none	140.	172.5	152.17	.3669	1
		140.	172.5	162.314		
17	none	140.	172.5	162.314	.3669	1
		140.	172.5	172.459		
18	none	140.	172.5	172.459	.3669	1
		140.	172.5	182.603		
19	none	140.	172.5	182.603	.3669	1
		140.	172.5	192.748		
20	none	0	0	0	.3669	1
		0	0	10.1446		
21	none	0	0	10.1446	.3669	1
		0	0	20.2893		
22	none	0	0	20.2893	.3669	1
		0	0	30.4339		
23	none	0	0	30.4339	.3669	1
		0	0	40.5785		
24	none	0	0	40.5785	.3669	1
		0	0	50.7232		
25	none	0	0	50.7232	.3669	1

		0	0	60.8678		
26	none	0	0	60.8678	.3669	1
		0	0	71.0124		
27	none	0	0	71.0124	.3669	1
		0	0	81.1571		
28	none	0	0	81.1571	.3669	1
		0	0	91.3017		
29	none	0	0	91.3017	.3669	1
		0	0	101.446		
30	none	0	0	101.446	.3669	1
		0	0	111.591		
31	none	0	0	111.591	.3669	1
		0	0	121.736		
32	none	0	0	121.736	.3669	1
		0	0	131.88		
33	none	0	0	131.88	.3669	1
		0	0	142.025		
34	none	0	0	142.025	.3669	1
		0	0	152.17		
35	none	0	0	152.17	.3669	1
		0	0	162.314		
36	none	0	0	162.314	.3669	1
		0	0	172.459		
37	none	0	0	172.459	.3669	1
		0	0	182.603		
38	none	0	0	182.603	.3669	1
		0	0	192.748		
39	none	250.	284.4	0	3.3535	1
		250.	284.4	23.992		
40	none	250.	284.4	23.992	2.857	1
		250.	284.4	47.984		
41	none	250.	284.4	47.984	2.4164	1
		250.	284.4	66.523		
42	none	250.	284.4	66.523	2.0607	1
		250.	284.4	82.336		
43	none	250.	284.4	82.336	1.7615	1
		250.	284.4	95.422		
44	none	250.	284.4	95.422	1.5187	1
		250.	284.4	105.782		
45	none	250.	284.4	105.782	1.3042	1
		250.	284.4	116.142		
46	none	250.	284.4	116.142	1.1178	1
		250.	284.4	123.776		
47	none	250.	284.4	123.776	.9598	1
		250.	284.4	131.41		
48	none	250.	284.4	131.41	.8017	1
		250.	284.4	139.043		
49	none	250.	284.4	139.043	.6436	1
		250.	284.4	146.677		
50	none	250.	284.4	146.677	.5025	1
		250.	284.4	152.675		
51	none	250.	284.4	152.675	.3839	1
		250.	284.4	158.128		
52	none	250.	284.4	158.128	.3274	1
		250.	284.4	163.202		
53	none	250.	284.4	163.202	.3274	1
		250.	284.4	168.276		
54	none	250.	284.4	168.276	.3274	1
		250.	284.4	173.35		
55	none	250.	284.4	173.35	.3274	1
		250.	284.4	178.424		
56	none	250.	284.4	178.424	.3274	1
		250.	284.4	183.497		
57	none	250.	284.4	183.497	.3274	1

		250.	284.4	188.571		
58	none	250.	284.4	188.571	.3274	1
		250.	284.4	193.644		
59	none	236.6	251.1	0	3.3479	1
		236.6	251.1	24.5376		
60	none	236.6	251.1	24.5376	2.8398	1
		236.6	251.1	49.0741		
61	none	236.6	251.1	49.0741	2.3881	1
		236.6	251.1	68.1588		
62	none	236.6	251.1	68.1588	2.0212	1
		236.6	251.1	84.5165		
63	none	236.6	251.1	84.5165	1.7106	1
		236.6	251.1	98.1482		
64	none	236.6	251.1	98.1482	1.4566	1
		236.6	251.1	109.054		
65	none	236.6	251.1	109.054	1.2308	1
		236.6	251.1	119.959		
66	none	236.6	251.1	119.959	1.0332	1
		236.6	251.1	128.138		
67	none	236.6	251.1	128.138	.8638	1
		236.6	251.1	136.318		
68	none	236.6	251.1	136.318	.6944	1
		236.6	251.1	144.496		
69	none	236.6	251.1	144.496	.525	1
		236.6	251.1	152.675		
70	none	236.6	251.1	152.675	.3839	1
		236.6	251.1	158.128		
71	none	236.6	251.1	158.128	.3274	1
		236.6	251.1	163.202		
72	none	236.6	251.1	163.202	.3274	1
		236.6	251.1	168.276		
73	none	236.6	251.1	168.276	.3274	1
		236.6	251.1	173.35		
74	none	236.6	251.1	173.35	.3274	1
		236.6	251.1	178.424		
75	none	236.6	251.1	178.424	.3274	1
		236.6	251.1	183.497		
76	none	236.6	251.1	183.497	.3274	1
		236.6	251.1	188.571		
77	none	236.6	251.1	188.571	.3274	1
		236.6	251.1	193.644		

Number of wires = 77
current nodes = 77

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	56	5.073	59	24.5376
radius	52	.3274	39	3.3535

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	1.38	0	1	.0140917	.06816

Sources

source	node	sector	magnitude	phase	type
1	39	1	1.	0	voltage

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 39, sector 1							
1.38	64.438	-143.48	157.29	294.2	8.3346	-2.0944	-4.1725

WAOK
Model Stability Assessment
Method of Moments Model Details
21 Segment Model
Tower 3 Self Impedance – Towers 1, 2, 4 Short Circuited at Base

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	140.	172.5	0	.3669	1
		140.	172.5	10.1446		
2	none	140.	172.5	10.1446	.3669	1
		140.	172.5	20.2893		
3	none	140.	172.5	20.2893	.3669	1
		140.	172.5	30.4339		
4	none	140.	172.5	30.4339	.3669	1
		140.	172.5	40.5785		
5	none	140.	172.5	40.5785	.3669	1
		140.	172.5	50.7232		
6	none	140.	172.5	50.7232	.3669	1
		140.	172.5	60.8678		
7	none	140.	172.5	60.8678	.3669	1
		140.	172.5	71.0124		
8	none	140.	172.5	71.0124	.3669	1
		140.	172.5	81.1571		
9	none	140.	172.5	81.1571	.3669	1
		140.	172.5	91.3017		
10	none	140.	172.5	91.3017	.3669	1
		140.	172.5	101.446		
11	none	140.	172.5	101.446	.3669	1
		140.	172.5	111.591		
12	none	140.	172.5	111.591	.3669	1
		140.	172.5	121.736		
13	none	140.	172.5	121.736	.3669	1
		140.	172.5	131.88		
14	none	140.	172.5	131.88	.3669	1
		140.	172.5	142.025		
15	none	140.	172.5	142.025	.3669	1
		140.	172.5	152.17		
16	none	140.	172.5	152.17	.3669	1
		140.	172.5	162.314		
17	none	140.	172.5	162.314	.3669	1
		140.	172.5	172.459		
18	none	140.	172.5	172.459	.3669	1
		140.	172.5	182.603		
19	none	140.	172.5	182.603	.3669	1
		140.	172.5	192.748		
20	none	0	0	0	.3669	1
		0	0	10.1446		
21	none	0	0	10.1446	.3669	1
		0	0	20.2893		
22	none	0	0	20.2893	.3669	1
		0	0	30.4339		
23	none	0	0	30.4339	.3669	1
		0	0	40.5785		
24	none	0	0	40.5785	.3669	1
		0	0	50.7232		
25	none	0	0	50.7232	.3669	1

		0	0	60.8678		
26	none	0	0	60.8678	.3669	1
		0	0	71.0124		
27	none	0	0	71.0124	.3669	1
		0	0	81.1571		
28	none	0	0	81.1571	.3669	1
		0	0	91.3017		
29	none	0	0	91.3017	.3669	1
		0	0	101.446		
30	none	0	0	101.446	.3669	1
		0	0	111.591		
31	none	0	0	111.591	.3669	1
		0	0	121.736		
32	none	0	0	121.736	.3669	1
		0	0	131.88		
33	none	0	0	131.88	.3669	1
		0	0	142.025		
34	none	0	0	142.025	.3669	1
		0	0	152.17		
35	none	0	0	152.17	.3669	1
		0	0	162.314		
36	none	0	0	162.314	.3669	1
		0	0	172.459		
37	none	0	0	172.459	.3669	1
		0	0	182.603		
38	none	0	0	182.603	.3669	1
		0	0	192.748		
39	none	250.	284.4	0	3.3578	1
		250.	284.4	23.583		
40	none	250.	284.4	23.583	2.8694	1
		250.	284.4	47.166		
41	none	250.	284.4	47.166	2.4376	1
		250.	284.4	65.296		
42	none	250.	284.4	65.296	2.0903	1
		250.	284.4	80.7		
43	none	250.	284.4	80.7	1.7996	1
		250.	284.4	93.377		
44	none	250.	284.4	93.377	1.5653	1
		250.	284.4	103.328		
45	none	250.	284.4	103.328	1.3592	1
		250.	284.4	113.279		
46	none	250.	284.4	113.279	1.1814	1
		250.	284.4	120.504		
47	none	250.	284.4	120.504	1.0303	1
		250.	284.4	127.865		
48	none	250.	284.4	127.865	.8821	1
		250.	284.4	134.954		
49	none	250.	284.4	134.954	.7438	1
		250.	284.4	141.088		
50	none	250.	284.4	141.088	.6168	1
		250.	284.4	147.222		
51	none	250.	284.4	147.222	.4968	1
		250.	284.4	152.675		
52	none	250.	284.4	152.675	.3839	1
		250.	284.4	158.128		
53	none	250.	284.4	158.128	.3274	1
		250.	284.4	163.202		
54	none	250.	284.4	163.202	.3274	1
		250.	284.4	168.276		
55	none	250.	284.4	168.276	.3274	1
		250.	284.4	173.35		
56	none	250.	284.4	173.35	.3274	1
		250.	284.4	178.424		
57	none	250.	284.4	178.424	.3274	1

		250.	284.4	183.497		
58	none	250.	284.4	183.497	.3274	1
		250.	284.4	188.571		
59	none	250.	284.4	188.571	.3274	1
		250.	284.4	193.644		
60	none	236.6	251.1	0	3.3479	1
		236.6	251.1	24.5376		
61	none	236.6	251.1	24.5376	2.8398	1
		236.6	251.1	49.0741		
62	none	236.6	251.1	49.0741	2.3881	1
		236.6	251.1	68.1588		
63	none	236.6	251.1	68.1588	2.0212	1
		236.6	251.1	84.5165		
64	none	236.6	251.1	84.5165	1.7106	1
		236.6	251.1	98.1482		
65	none	236.6	251.1	98.1482	1.4566	1
		236.6	251.1	109.054		
66	none	236.6	251.1	109.054	1.2308	1
		236.6	251.1	119.959		
67	none	236.6	251.1	119.959	1.0332	1
		236.6	251.1	128.138		
68	none	236.6	251.1	128.138	.8638	1
		236.6	251.1	136.318		
69	none	236.6	251.1	136.318	.6944	1
		236.6	251.1	144.496		
70	none	236.6	251.1	144.496	.525	1
		236.6	251.1	152.675		
71	none	236.6	251.1	152.675	.3839	1
		236.6	251.1	158.128		
72	none	236.6	251.1	158.128	.3274	1
		236.6	251.1	163.202		
73	none	236.6	251.1	163.202	.3274	1
		236.6	251.1	168.276		
74	none	236.6	251.1	168.276	.3274	1
		236.6	251.1	173.35		
75	none	236.6	251.1	173.35	.3274	1
		236.6	251.1	178.424		
76	none	236.6	251.1	178.424	.3274	1
		236.6	251.1	183.497		
77	none	236.6	251.1	183.497	.3274	1
		236.6	251.1	188.571		
78	none	236.6	251.1	188.571	.3274	1
		236.6	251.1	193.644		

Number of wires = 78
current nodes = 78

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	57	5.073	60	24.5376
radius	53	.3274	39	3.3578

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	1.38	0	1	.0140917	.06816

Sources

source	node	sector	magnitude	phase	type
1	39	1	1.	0	voltage

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 39, sector 1							
1.38	63.555	-142.86	156.35	294.	8.3602	-2.0879	-4.183

Section 4 - WAOK
Computation of Operating Parameters for Night Directional Antenna

The Method of Moments model of the WAOK antenna array was used for night directional antenna calculations after verification of the model with the one tower driven and other towers short circuited base impedance data. The complex voltage values needed at the sources located at ground level at the base of each tower to produce the current moment sums, when normalized, that are equal to the theoretical field parameters were calculated. The tower base drive voltages were then calculated from these voltage sources. The voltages which are sampled by the antenna monitor system at the Voltage Sampling Units were calculated from the Method of Moments directional antenna model. The sampling lines and Voltage Sampling Units are electrically identical, therefore the antenna monitor parameters needed to produce the theoretical antenna parameters can be calculated directly from the modeled voltages, which correspond to the location of the Voltage Sampling Unit at the base of each tower. Method of Moments model and WCAP circuit calculation details are included as Section 5 of this report.

TOWER	Model Current Pulse	Model Voltage Magnitude (amperes)	Model Voltage Phase (degrees)	Model Drive Impedance (ohms)	Model Drive Power (watts)
1	1	1218.04	+2.8	129.67 – j335.46	1487.316
2	20	1160.18	+82.7	81.076 – j411.30	620.970
3	39	573.908	+22.2	74.466 – j217.49	464.129
4	58	593.784	-85.1	72.681 – j102.29	1627.584

TOWER	Drive Impedance At VSU (ohms)	Voltage Magnitude At VSU (volts)	Voltage Phase At VSU (degrees)	Antenna Monitor Ratio	Antenna Monitor Phase
1	106.92 – j267.83	1075.607	+5.4851	108.1	-78.7
2	53.19 – j286.19	994.7057	+84.1663	100.0	0.0
3	44.78 – j159.26	532.5942	+23.3579	53.5	-60.8
4	56.60 – j71.77	490.1382	-77.5847	49.3	-161.8

Section 5 - WAOK
Method of Moments Model Details
for Night Directional Antenna

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MEDIUM WAVE ARRAY SYNTHESIS FROM FIELD RATIOS

Frequency = 1.38 MHz

tower	field ratio magnitude	phase (deg)
1	1.	-72.
2	1.	0
3	1.	-54.
4	.89	-126.

VOLTAGES AND CURRENTS - rms

source node	voltage magnitude	phase (deg)	current magnitude	phase (deg)
1	1,218.04	2.8	3.38674	71.7
20	1,160.18	82.7	2.76751	161.5
39	573.908	22.2	2.49655	93.3
58	593.784	274.9	4.73218	329.5

Sum of square of source currents = 95.5109
Total power = 4,200. watts

TOWER ADMITTANCE MATRIX

admittance	real (mhos)	imaginary (mhos)
Y(1, 1)	.00107051	.00217026
Y(1, 2)	.000237312	-.000334084
Y(1, 3)	-.000415238	.000102465
Y(1, 4)	-.000582236	-.000431336
Y(2, 1)	.000237321	-.0003341
Y(2, 2)	.000927808	.00217095
Y(2, 3)	-.000518641	-.000474341
Y(2, 4)	-.000468512	-.000635724
Y(3, 1)	-.000415012	.000101153
Y(3, 2)	-.000517435	-.000475654
Y(3, 3)	.0026102	.00574365
Y(3, 4)	.000901615	-.000491231
Y(4, 1)	-.00058137	-.000432696
Y(4, 2)	-.000467069	-.000636939
Y(4, 3)	.000901598	-.000491113
Y(4, 4)	.00242387	.0057235

TOWER IMPEDANCE MATRIX

impedance	real (ohms)	imaginary (ohms)
Z(1, 1)	182.611	-378.72
Z(1, 2)	65.4813	-31.2489
Z(1, 3)	-8.30078	-22.5403
Z(1, 4)	6.78419	-56.3699
Z(2, 1)	65.4692	-31.2496
Z(2, 2)	175.614	-420.413
Z(2, 3)	9.0586	-52.5278
Z(2, 4)	22.95	-63.4903
Z(3, 1)	-8.39399	-22.529
Z(3, 2)	8.91983	-52.5543
Z(3, 3)	62.957	-146.171
Z(3, 4)	22.441	-.548416
Z(4, 1)	6.6567	-56.3847
Z(4, 2)	22.8001	-63.5377
Z(4, 3)	22.4505	-.550436
Z(4, 4)	61.4999	-159.054

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	140.	172.5	0	.3669	1
		140.	172.5	10.1446		
2	none	140.	172.5	10.1446	.3669	1
		140.	172.5	20.2893		
3	none	140.	172.5	20.2893	.3669	1
		140.	172.5	30.4339		
4	none	140.	172.5	30.4339	.3669	1
		140.	172.5	40.5785		
5	none	140.	172.5	40.5785	.3669	1
		140.	172.5	50.7232		
6	none	140.	172.5	50.7232	.3669	1
		140.	172.5	60.8678		
7	none	140.	172.5	60.8678	.3669	1
		140.	172.5	71.0124		
8	none	140.	172.5	71.0124	.3669	1
		140.	172.5	81.1571		
9	none	140.	172.5	81.1571	.3669	1
		140.	172.5	91.3017		
10	none	140.	172.5	91.3017	.3669	1
		140.	172.5	101.446		
11	none	140.	172.5	101.446	.3669	1
		140.	172.5	111.591		
12	none	140.	172.5	111.591	.3669	1
		140.	172.5	121.736		
13	none	140.	172.5	121.736	.3669	1
		140.	172.5	131.88		
14	none	140.	172.5	131.88	.3669	1
		140.	172.5	142.025		
15	none	140.	172.5	142.025	.3669	1
		140.	172.5	152.17		
16	none	140.	172.5	152.17	.3669	1
		140.	172.5	162.314		
17	none	140.	172.5	162.314	.3669	1
		140.	172.5	172.459		
18	none	140.	172.5	172.459	.3669	1
		140.	172.5	182.603		
19	none	140.	172.5	182.603	.3669	1
		140.	172.5	192.748		
20	none	0	0	0	.3669	1
		0	0	10.1446		
21	none	0	0	10.1446	.3669	1
		0	0	20.2893		
22	none	0	0	20.2893	.3669	1
		0	0	30.4339		
23	none	0	0	30.4339	.3669	1
		0	0	40.5785		
24	none	0	0	40.5785	.3669	1
		0	0	50.7232		
25	none	0	0	50.7232	.3669	1
		0	0	60.8678		
26	none	0	0	60.8678	.3669	1
		0	0	71.0124		
27	none	0	0	71.0124	.3669	1
		0	0	81.1571		
28	none	0	0	81.1571	.3669	1
		0	0	91.3017		
29	none	0	0	91.3017	.3669	1
		0	0	101.446		
30	none	0	0	101.446	.3669	1
		0	0	111.591		

31	none	0	0	111.591	.3669	1
		0	0	121.736		
32	none	0	0	121.736	.3669	1
		0	0	131.88		
33	none	0	0	131.88	.3669	1
		0	0	142.025		
34	none	0	0	142.025	.3669	1
		0	0	152.17		
35	none	0	0	152.17	.3669	1
		0	0	162.314		
36	none	0	0	162.314	.3669	1
		0	0	172.459		
37	none	0	0	172.459	.3669	1
		0	0	182.603		
38	none	0	0	182.603	.3669	1
		0	0	192.748		
39	none	250.	284.4	0	3.3479	1
		250.	284.4	24.5376		
40	none	250.	284.4	24.5376	2.8398	1
		250.	284.4	49.0741		
41	none	250.	284.4	49.0741	2.3881	1
		250.	284.4	68.1588		
42	none	250.	284.4	68.1588	2.0212	1
		250.	284.4	84.5165		
43	none	250.	284.4	84.5165	1.7106	1
		250.	284.4	98.1482		
44	none	250.	284.4	98.1482	1.4566	1
		250.	284.4	109.054		
45	none	250.	284.4	109.054	1.2308	1
		250.	284.4	119.959		
46	none	250.	284.4	119.959	1.0332	1
		250.	284.4	128.138		
47	none	250.	284.4	128.138	.8638	1
		250.	284.4	136.318		
48	none	250.	284.4	136.318	.6944	1
		250.	284.4	144.496		
49	none	250.	284.4	144.496	.525	1
		250.	284.4	152.675		
50	none	250.	284.4	152.675	.3839	1
		250.	284.4	158.128		
51	none	250.	284.4	158.128	.3274	1
		250.	284.4	163.202		
52	none	250.	284.4	163.202	.3274	1
		250.	284.4	168.276		
53	none	250.	284.4	168.276	.3274	1
		250.	284.4	173.35		
54	none	250.	284.4	173.35	.3274	1
		250.	284.4	178.424		
55	none	250.	284.4	178.424	.3274	1
		250.	284.4	183.497		
56	none	250.	284.4	183.497	.3274	1
		250.	284.4	188.571		
57	none	250.	284.4	188.571	.3274	1
		250.	284.4	193.644		
58	none	236.6	251.1	0	3.3479	1
		236.6	251.1	24.5376		
59	none	236.6	251.1	24.5376	2.8398	1
		236.6	251.1	49.0741		
60	none	236.6	251.1	49.0741	2.3881	1
		236.6	251.1	68.1588		
61	none	236.6	251.1	68.1588	2.0212	1
		236.6	251.1	84.5165		
62	none	236.6	251.1	84.5165	1.7106	1
		236.6	251.1	98.1482		
63	none	236.6	251.1	98.1482	1.4566	1
		236.6	251.1	109.054		

13

64	none	236.6	251.1	109.054	1.2308	1
		236.6	251.1	119.959		
65	none	236.6	251.1	119.959	1.0332	1
		236.6	251.1	128.138		
66	none	236.6	251.1	128.138	.8638	1
		236.6	251.1	136.318		
67	none	236.6	251.1	136.318	.6944	1
		236.6	251.1	144.496		
68	none	236.6	251.1	144.496	.525	1
		236.6	251.1	152.675		
69	none	236.6	251.1	152.675	.3839	1
		236.6	251.1	158.128		
70	none	236.6	251.1	158.128	.3274	1
		236.6	251.1	163.202		
71	none	236.6	251.1	163.202	.3274	1
		236.6	251.1	168.276		
72	none	236.6	251.1	168.276	.3274	1
		236.6	251.1	173.35		
73	none	236.6	251.1	173.35	.3274	1
		236.6	251.1	178.424		
74	none	236.6	251.1	178.424	.3274	1
		236.6	251.1	183.497		
75	none	236.6	251.1	183.497	.3274	1
		236.6	251.1	188.571		
76	none	236.6	251.1	188.571	.3274	1
		236.6	251.1	193.644		

Number of wires = 76
current nodes = 76

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	55	5.073	39	24.5376
radius	51	.3274	39	3.3479

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	1.38	0	1	.0140917	.06816

Sources

source	node	sector	magnitude	phase	type
1	1	1	1,722.57	2.8	voltage
2	20	1	1,640.75	82.7	voltage
3	39	1	811.629	22.2	voltage
4	58	1	839.737	274.9	voltage

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 1, sector 1							
1.38	129.67	-335.46	359.65	291.1	20.287	-.85701	-7.4694
source = 2; node 20, sector 1							
1.38	81.076	-411.3	419.21	281.2	43.946	-.39537	-10.604
source = 3; node 39, sector 1							
1.38	74.466	-217.49	229.88	288.9	14.797	-1.1758	-6.2492
source = 4; node 58, sector 1							
1.38	72.681	-102.29	125.48	305.4	4.8127	-3.6629	-2.4431

CURRENT rms
Frequency = 1.38 MHz
Input power = 4,200. watts
Efficiency = 100. %
coordinates in degrees

current no.	X	Y	Z	mag (amps)	phase (deg)	real (amps)	imaginary (amps)
1	-138.802	-18.2737	0	3.38674	71.7	1.06496	3.21495
END	-138.802	-18.2737	10.1446	2.11685	57.9	1.12519	1.79305
2J1	-138.802	-18.2737	10.1446	2.11685	57.9	1.12519	1.79305
END	-138.802	-18.2737	20.2893	1.38785	34.3	1.14668	.78182
2J2	-138.802	-18.2737	20.2893	1.38785	34.3	1.14668	.78182
END	-138.802	-18.2737	30.4339	1.15447	353.1	1.14605	-.139167
2J3	-138.802	-18.2737	30.4339	1.15447	353.1	1.14605	-.139167
END	-138.802	-18.2737	40.5785	1.4983	318.7	1.12572	-.988769
2J4	-138.802	-18.2737	40.5785	1.4983	318.7	1.12572	-.988769
END	-138.802	-18.2737	50.7232	2.07133	301.7	1.0875	-1.76289
2J5	-138.802	-18.2737	50.7232	2.07133	301.7	1.0875	-1.76289
END	-138.802	-18.2737	60.8678	2.65881	292.9	1.03323	-2.44984
2J6	-138.802	-18.2737	60.8678	2.65881	292.9	1.03323	-2.44984
END	-138.802	-18.2737	71.0124	3.18578	287.6	.965046	-3.03609
2J7	-138.802	-18.2737	71.0124	3.18578	287.6	.965046	-3.03609
END	-138.802	-18.2737	81.1571	3.6187	284.2	.885319	-3.50874
2J8	-138.802	-18.2737	81.1571	3.6187	284.2	.885319	-3.50874
END	-138.802	-18.2737	91.3017	3.9381	281.7	.796655	-3.85668
2J9	-138.802	-18.2737	91.3017	3.9381	281.7	.796655	-3.85668
END	-138.802	-18.2737	101.446	4.13156	279.8	.701811	-4.07152
2J10	-138.802	-18.2737	101.446	4.13156	279.8	.701811	-4.07152
END	-138.802	-18.2737	111.591	4.19168	278.3	.603611	-4.14799
2J11	-138.802	-18.2737	111.591	4.19168	278.3	.603611	-4.14799
END	-138.802	-18.2737	121.736	4.11529	277.	.504894	-4.0842
2J12	-138.802	-18.2737	121.736	4.11529	277.	.504894	-4.0842
END	-138.802	-18.2737	131.88	3.90318	276.	.408416	-3.88175
2J13	-138.802	-18.2737	131.88	3.90318	276.	.408416	-3.88175
END	-138.802	-18.2737	142.025	3.55952	275.1	.31675	-3.5454
2J14	-138.802	-18.2737	142.025	3.55952	275.1	.31675	-3.5454
END	-138.802	-18.2737	152.17	3.09148	274.3	.232276	-3.08274
2J15	-138.802	-18.2737	152.17	3.09148	274.3	.232276	-3.08274
END	-138.802	-18.2737	162.314	2.50801	273.6	.157085	-2.50309
2J16	-138.802	-18.2737	162.314	2.50801	273.6	.157085	-2.50309
END	-138.802	-18.2737	172.459	1.81717	272.9	.0928997	-1.81479
2J17	-138.802	-18.2737	172.459	1.81717	272.9	.0928997	-1.81479
END	-138.802	-18.2737	182.603	1.0198	272.3	.0410106	-1.01897
2J18	-138.802	-18.2737	182.603	1.0198	272.3	.0410106	-1.01897
END	-138.802	-18.2737	192.748	0	0	0	0
20	0	0	0	2.76752	161.5	-2.62507	.876438
END	0	0	10.1446	1.4617	151.3	-1.2826	.70108
2J20	0	0	10.1446	1.4617	151.3	-1.2826	.70108
END	0	0	20.2893	.660419	120.3	-.333504	.570025
2J21	0	0	20.2893	.660419	120.3	-.333504	.570025
END	0	0	30.4339	.688272	40.2	.525491	.444497
2J22	0	0	30.4339	.688272	40.2	.525491	.444497
END	0	0	40.5785	1.35152	13.8	1.3125	.322411
2J23	0	0	40.5785	1.35152	13.8	1.3125	.322411
END	0	0	50.7232	2.03434	5.8	2.02402	.204569
2J24	0	0	50.7232	2.03434	5.8	2.02402	.204569
END	0	0	60.8678	2.65112	2.	2.6495	.0928014
2J25	0	0	60.8678	2.65112	2.	2.6495	.0928014
END	0	0	71.0124	3.17673	359.8	3.17671	-.0107143
2J26	0	0	71.0124	3.17673	359.8	3.17671	-.0107143
END	0	0	81.1571	3.59558	358.3	3.59408	-.103744
2J27	0	0	81.1571	3.59558	358.3	3.59408	-.103744
END	0	0	91.3017	3.89619	357.3	3.89184	-.184143
2J28	0	0	91.3017	3.89619	357.3	3.89184	-.184143
END	0	0	101.446	4.07045	356.5	4.06277	-.249972
2J29	0	0	101.446	4.07045	356.5	4.06277	-.249972

END	0	0	111.591	4.1136	355.8	4.10268	-.299565
2J30	0	0	111.591	4.1136	355.8	4.10268	-.299565
END	0	0	121.736	4.02424	355.3	4.01056	-.331572
2J31	0	0	121.736	4.02424	355.3	4.01056	-.331572
END	0	0	131.88	3.80436	354.8	3.78868	-.34501
2J32	0	0	131.88	3.80436	354.8	3.78868	-.34501
END	0	0	142.025	3.45897	354.4	3.44229	-.339269
2J33	0	0	142.025	3.45897	354.4	3.44229	-.339269
END	0	0	152.17	2.99574	354.	2.97923	-.314082
2J34	0	0	152.17	2.99574	354.	2.97923	-.314082
END	0	0	162.314	2.42397	353.6	2.40894	-.269446
2J35	0	0	162.314	2.42397	353.6	2.40894	-.269446
END	0	0	172.459	1.75187	353.3	1.7398	-.205307
2J36	0	0	172.459	1.75187	353.3	1.7398	-.205307
END	0	0	182.603	.980754	352.9	.973291	-.120763
2J37	0	0	182.603	.980754	352.9	.973291	-.120763
END	0	0	192.748	0	0	0	0
39	62.1725	242.146	0	2.49655	93.3	-.14393	2.4924
END	62.1725	242.146	24.5376	1.29191	330.4	1.12284	-.638956
2J39	62.1725	242.146	24.5376	1.29191	330.4	1.12284	-.638956
END	62.1725	242.146	49.0741	2.58505	309.3	1.6381	-1.99978
2J40	62.1725	242.146	49.0741	2.58505	309.3	1.6381	-1.99978
END	62.1725	242.146	68.1588	3.32136	304.5	1.88197	-2.73671
2J41	62.1725	242.146	68.1588	3.32136	304.5	1.88197	-2.73671
END	62.1725	242.146	84.5165	3.65851	302.4	1.95812	-3.09038
2J42	62.1725	242.146	84.5165	3.65851	302.4	1.95812	-3.09038
END	62.1725	242.146	98.1482	3.72343	301.2	1.92724	-3.18586
2J43	62.1725	242.146	98.1482	3.72343	301.2	1.92724	-3.18586
END	62.1725	242.146	109.054	3.63844	300.5	1.84416	-3.13645
2J44	62.1725	242.146	109.054	3.63844	300.5	1.84416	-3.13645
END	62.1725	242.146	119.959	3.43663	299.9	1.71181	-2.97996
2J45	62.1725	242.146	119.959	3.43663	299.9	1.71181	-2.97996
END	62.1725	242.146	128.138	3.21772	299.5	1.5851	-2.80021
2J46	62.1725	242.146	128.138	3.21772	299.5	1.5851	-2.80021
END	62.1725	242.146	136.318	2.94794	299.2	1.43793	-2.57347
2J47	62.1725	242.146	136.318	2.94794	299.2	1.43793	-2.57347
END	62.1725	242.146	144.496	2.63608	298.9	1.27463	-2.30743
2J48	62.1725	242.146	144.496	2.63608	298.9	1.27463	-2.30743
END	62.1725	242.146	152.675	2.29519	298.7	1.10138	-2.01367
2J49	62.1725	242.146	152.675	2.29519	298.7	1.10138	-2.01367
END	62.1725	242.146	158.128	2.06524	298.5	.986782	-1.81425
2J50	62.1725	242.146	158.128	2.06524	298.5	.986782	-1.81425
END	62.1725	242.146	163.202	1.84278	298.4	.877216	-1.6206
2J51	62.1725	242.146	163.202	1.84278	298.4	.877216	-1.6206
END	62.1725	242.146	168.276	1.59793	298.3	.757863	-1.40678
2J52	62.1725	242.146	168.276	1.59793	298.3	.757863	-1.40678
END	62.1725	242.146	173.35	1.33435	298.2	.630573	-1.17595
2J53	62.1725	242.146	173.35	1.33435	298.2	.630573	-1.17595
END	62.1725	242.146	178.424	1.05248	298.1	.495626	-.928481
2J54	62.1725	242.146	178.424	1.05248	298.1	.495626	-.928481
END	62.1725	242.146	183.497	.750851	298.	.352362	-.663037
2J55	62.1725	242.146	183.497	.750851	298.	.352362	-.663037
END	62.1725	242.146	188.571	.424135	297.9	.198348	-.374898
2J56	62.1725	242.146	188.571	.424135	297.9	.198348	-.374898
END	62.1725	242.146	193.644	0	0	0	0
58	-76.6388	223.844	0	4.73219	329.5	4.07676	-2.40283
END	-76.6388	223.844	24.5376	2.6636	282.3	.565196	-2.60295
2J58	-76.6388	223.844	24.5376	2.6636	282.3	.565196	-2.60295
END	-76.6388	223.844	49.0741	2.66871	247.4	-1.02584	-2.46367
2J59	-76.6388	223.844	49.0741	2.66871	247.4	-1.02584	-2.46367
END	-76.6388	223.844	68.1588	2.95693	229.	-1.9402	-2.23138
2J60	-76.6388	223.844	68.1588	2.95693	229.	-1.9402	-2.23138
END	-76.6388	223.844	84.5165	3.13092	218.9	-2.43758	-1.96492
2J61	-76.6388	223.844	84.5165	3.13092	218.9	-2.43758	-1.96492
END	-76.6388	223.844	98.1482	3.14931	212.9	-2.64474	-1.70983
2J62	-76.6388	223.844	98.1482	3.14931	212.9	-2.64474	-1.70983

END	-76.6388	223.844	109.054	3.06646	209.1	-2.67811	-1.49361
2J63	-76.6388	223.844	109.054	3.06646	209.1	-2.67811	-1.49361
END	-76.6388	223.844	119.959	2.89341	206.1	-2.59885	-1.27193
2J64	-76.6388	223.844	119.959	2.89341	206.1	-2.59885	-1.27193
END	-76.6388	223.844	128.138	2.70908	204.1	-2.47229	-1.10765
2J65	-76.6388	223.844	128.138	2.70908	204.1	-2.47229	-1.10765
END	-76.6388	223.844	136.318	2.48288	202.4	-2.29531	-.94671
2J66	-76.6388	223.844	136.318	2.48288	202.4	-2.29531	-.94671
END	-76.6388	223.844	144.496	2.22137	200.9	-2.07516	-.792596
2J67	-76.6388	223.844	144.496	2.22137	200.9	-2.07516	-.792596
END	-76.6388	223.844	152.675	1.93516	199.6	-1.82305	-.649088
2J68	-76.6388	223.844	152.675	1.93516	199.6	-1.82305	-.649088
END	-76.6388	223.844	158.128	1.74171	198.9	-1.64821	-.563
2J69	-76.6388	223.844	158.128	1.74171	198.9	-1.64821	-.563
END	-76.6388	223.844	163.202	1.55441	198.2	-1.47647	-.486044
2J70	-76.6388	223.844	163.202	1.55441	198.2	-1.47647	-.486044
END	-76.6388	223.844	168.276	1.3481	197.6	-1.28505	-.407428
2J71	-76.6388	223.844	168.276	1.3481	197.6	-1.28505	-.407428
END	-76.6388	223.844	173.35	1.12584	197.	-1.07678	-.328736
2J72	-76.6388	223.844	173.35	1.12584	197.	-1.07678	-.328736
END	-76.6388	223.844	178.424	.888069	196.4	-.852036	-.250402
2J73	-76.6388	223.844	178.424	.888069	196.4	-.852036	-.250402
END	-76.6388	223.844	183.497	.633546	195.8	-.609645	-.172376
2J74	-76.6388	223.844	183.497	.633546	195.8	-.609645	-.172376
END	-76.6388	223.844	188.571	.357841	195.2	-.34533	-.0937935
2J75	-76.6388	223.844	188.571	.357841	195.2	-.34533	-.0937935
END	-76.6388	223.844	193.644	0	0	0	0

WAOK
WCAP Calculation Details
for Night Directional Antenna

WAOK Tower 1 Night

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = WAOK1DA.txt

I      3.7299     0     1   73.7230      .0000      .0000
R      1.0000     1     2      .0000      .0000      .0000
L      4.7000     2     3      .0000      .0000      .0000
C       .0000     3     0      .0000      .0000      .0000
R    129.6700     3     0 -335.4600      .0000      .0000
EX      .0000     0     0      .0000      .0000      .0000


 FREQ = 1.380

   NODE       VOLT MAG      VOLT PHASE
    1       1076.9950          5.6694
    2       1075.6070          5.4851
    3       1218.0800          2.8334
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG       PHASE      MAG       PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
 VSWR
R     1-  2      1.000      3.73    73.723      3.73    73.723     107.92   -267.82    106.92   -267.82
L     2-  3      4.700    152.00   163.723      3.73    73.723     106.92   -267.82    106.92   -308.58
C     3-  0       .000   1218.08     2.833       .37    92.833        .00  -3334.96       .00       .00
R     3-  0    129.670   1218.08     2.833      3.39    71.700     129.67   -335.46       .00       .00
```

WAOK Tower 2 Night

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = WAOK2DA.txt

I      3.4171     0     1  163.6390      .0000      .0000
R      1.0000     1     2      .0000      .0000      .0000
L      5.6680     2     3      .0000      .0000      .0000
C       .0001     3     0      .0000      .0000      .0000
R     81.0760     3     0 -411.3000      .0000      .0000
EX      .0000     0     0      .0000      .0000      .0000


 FREQ = 1.380

   NODE       VOLT MAG      VOLT PHASE
    1        995.3358         84.3597
    2        994.7057         84.1663
    3       1160.2230         82.6509
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG       PHASE      MAG       PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
 VSWR
R     1-  2      1.000      3.42   163.639      3.42   163.639      54.19   -286.19     53.19   -286.19
L     2-  3      5.668    167.94  -106.361      3.42   163.639      53.18   -286.19     53.18   -335.34
C     3-  0       .000   1160.22    82.651       .66   172.651        .00  -1759.01       .00       .00
R     3-  0     81.076   1160.22    82.651      2.77   161.500      81.08   -411.30       .00       .00
```

WAOK Tower 3 Night

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = WAOK3DA.txt

I      3.2194     0     1    97.6520      .0000      .0000
R      1.0000     1     2      .0000      .0000      .0000
L      1.5340     2     3      .0000      .0000      .0000
C       .0002     3     0      .0000      .0000      .0000
R     74.4660     3     0  -217.4900      .0000      .0000
EX      .0000     0     0      .0000      .0000      .0000


 FREQ = 1.380

   NODE       VOLT MAG      VOLT PHASE
    1         533.4747        23.6907
    2         532.5942        23.3579
    3         573.9340        22.2006
                            BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                            MAG       PHASE      MAG       PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
 VSWR
R     1-  2      1.000       3.22     97.652      3.22     97.652     45.78   -159.26     44.78   -159.26
L     2-  3      1.534      42.82   -172.348      3.22     97.652     44.78   -159.26     44.78   -172.56
C     3-  0       .000     573.93     22.201       .75    112.201       .00   -761.00       .00       .00
R     3-  0     74.466     573.93     22.201      2.50     93.300     74.47   -217.49       .00       .00
```

WAOK Tower 4 Night

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = WAOK4DA.txt

I      5.3625     0     1   -25.8430      .0000      .0000
R      1.0000     1     2      .0000      .0000      .0000
L      2.6990     2     3      .0000      .0000      .0000
C       .0001     3     0      .0000      .0000      .0000
R     72.6810     3     0  -102.2900      .0000      .0000
EX      .0000     0     0      .0000      .0000      .0000


 FREQ = 1.380

   NODE       VOLT MAG      VOLT PHASE
    1         493.4766       -77.0958
    2         490.1382       -77.5847
    3         593.7867       -85.1044
                            BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                            MAG       PHASE      MAG       PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
 VSWR
R     1-  2      1.000       5.36    -25.843      5.36    -25.843     57.60    -71.77     56.60    -71.77
L     2-  3      2.699     125.49     64.157      5.36    -25.843     56.60    -71.77     56.60    -95.17
C     3-  0       .000     593.79    -85.104       .75      4.896       .00   -790.00       .00       .00
R     3-  0     72.681     593.79    -85.104      4.73    -30.500     72.68   -102.29       .00       .00
```

Section 6 - WAOK
Sampling System Information and Measurements

The antenna sampling system uses a Potomac Instruments AM-19D monitor connected to KTL Voltage Sampling Units located at the base of each tower. The antenna sampling coaxial lines are equal in electrical length. The in ground sections consist of copper clad 1/2 inch foam dielectric coaxial cable. Connectors for all cables are those recommended by the manufacturer.

Sampling system impedance measurements were made with a HP model 8751A network analyzer system using an external directional coupler and power amplifier. The network analyzer system was calibrated with known standards prior to measurements. Measurements were made from the antenna monitor end of the sampling lines with the lines open circuited and with the loops connected.

The table immediately below gives detail on the frequencies below the carrier frequency where resonance (low resistance and zero reactance) was indicated. These occur at odd multiples of 90 degrees, and the table gives data on the 90 degree and 450 degree resonant frequencies of the lines. The electrical line lengths at 1380 kHz in the table were calculated by multiplying the ratio of the two frequencies times 450. The measured impedance of each line with the Voltage Sampling Unit connected is also listed in this table.

TOWER	Sampling Line Open-Circuited 90 Degree Resonance (kHz)	Sampling Line Open-Circuited 450 Degree Resonance (kHz)	Sampling Line Calculated Electrical Length 1080 kHz (Degrees)	1380 kHz Measured Impedance with Voltage Sampling Unit Connected (Ohms)
1	246.105	1243.21	499.513	5.48 – j33.08
2	246.400	1244.744	498.898	5.42 – j33.13
3	246.725	1244.525	498.986	5.41 – j33.14
4	246.312	1243.951	499.216	5.44 – j31.91

The WAOK sampling lines meet the FCC Rule requirement that the measured lines be equal in length within one electrical degree.

The characteristic impedance of the WAOK sampling lines was calculated by using the formula:

$$Zo = \sqrt{(\sqrt{(R1^2 + X1^2)} \bullet \sqrt{(R2^2 + X2^2)})}$$

With R1 + X1 equal to the measured impedance at the +45 degree offset frequency and R2 + X2 equal to the measured impedance at the -45 degree offset frequency.

TOWER	+45 Degree Offset Frequency (kHz)	+45 Degree Measured Impedance (Ohms)	-45 Degree Offset Frequency (kHz)	-45 Degree Measured Impedance (Ohms)	Calculated Characteristic Impedance (Ohms)
1	1118.889	7.54 – j48.15	1367.531	9.18 + j48.11	48.86
2	1120.2696	7.51 – j47.81	1369.2184	9.01 + j47.65	48.44
3	1120.0725	7.45 – j47.53	1368.9775	9.00 + j47.47	48.21
4	1119.5559	7.49 – j47.91	1368.3641	9.10 + j47.92	48.66

The WAOK sampling lines meet the FCC Rule requirement that the measured characteristic impedances of the lines be equal within two ohms.

The WAOK antenna sampling system uses a Potomac Instruments AM-19D monitor serial number 2123. The operation and calibration of the monitor was verified as correct by the procedure in the manufacturer's manual.

Additionally, the operating parameters were measured with the Hewlett-Packard 8751A network analyzer in a calibrated measurement system. The tables below show the results of those measurements compared to the antenna monitor observed indications.

WAOK OBSERVED PARAMETERS NIGHT

TOWER	HP 8751A Analyzer Ratio (Night)	HP 8751A Analyzer Phase (Night)	Potomac AM-19D Ratio (Night)	Potomac AM-19D Phase (Night)
1	108.5	-78.54	108.1	-78.7
2	100.0	0.0	100.0	0.0
3	53.58	-60.77	53.5	-60.8
4	49.46	-161.73	49.3	-161.8

WAOK
VOLTAGE SAMPLER UNIT
CALIBRATION VERIFICATION

The Kintronic Labs Voltage Sampling Unit (VSU) voltage sampling transformers were tested for phase and current response at Kintronic Labs prior to shipment and verified on site with a Hewlitt-Packard 8751A network analyzer in a calibrated measurement system. This was done by passing a common reference signal at 1380 kHz generated by the analyzer to the input of the units placed side by side and feeding the output of each unit into the A and B receivers of the analyzer set up to the measure relative ratio and phase of their output voltages.

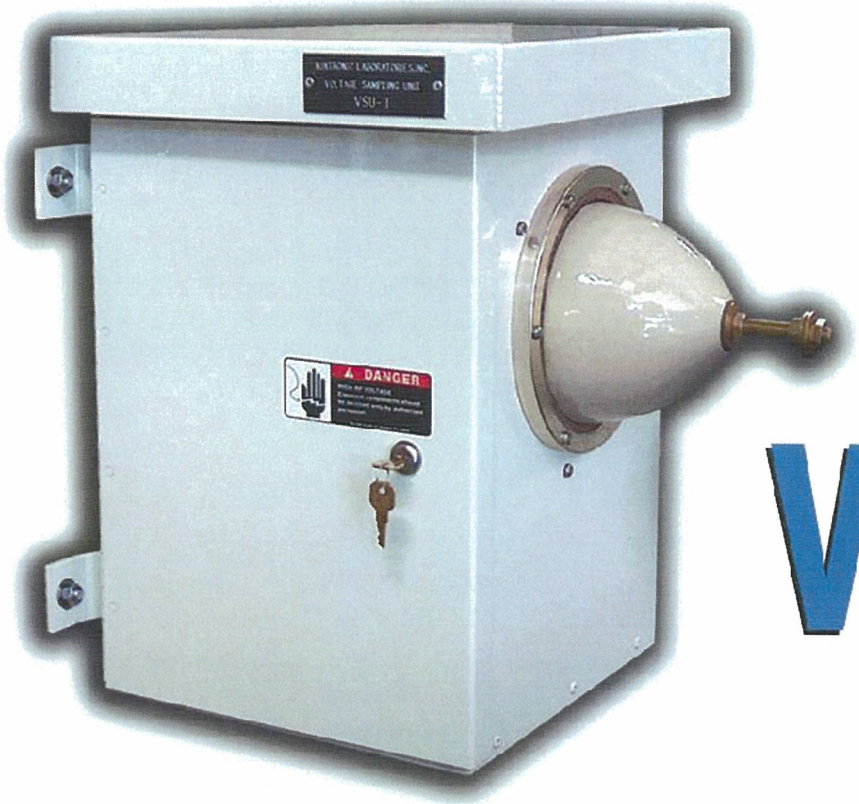
TOWER	KTL VSU-1 Ratio (KTL)	KTL VSU-1 Phase (KTL)	KTL VSU-1 Ratio (WAOK)	KTL VSU-1 Phase (WAOK)
1 (S/N G02)	1.001	+0.106	1.001	+0.110
2 (S/N G03)	1.000	0.0	1.000	0.0
3 (S/N G04)	1.003	+0.091	1.004	+0.082
4 (S/N G05)	1.006	-0.336	1.005	-0.350

The WAOK KTL VSU voltage sampling units are within the KTL specified ratings of +/- 2 percent magnitude and +/- 2 degrees.

NEW PRODUCT!!!

READY TO SHIP FALL 2010

KINTRONIC LABS IS PLEASED TO ANNOUNCE OUR NEW



VSU-1

VOLTAGE SAMPLING UNIT

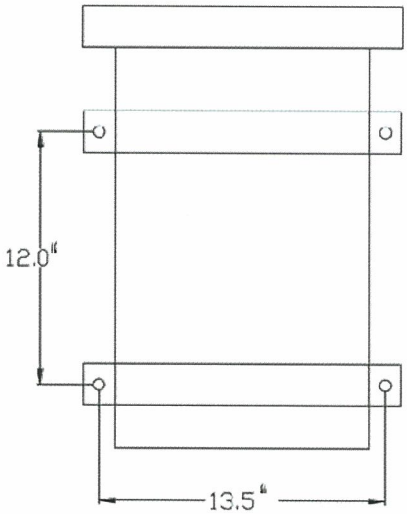
In accordance with FCC 08-228 Second Report and Order and Second Further Notice of Proposed Rulemaking released on September 26, 2008, Section 73.151 of the FCC Rules entitled "Directional Antenna Performance Verification" was modified to add among other things the following: "Samples may be obtained from base voltage sampling devices at the output of the antenna coupling and matching equipment for the base-fed towers whose actual electrical height is greater than 105 degrees." In response to this FCC Rulemaking Kintronic Labs has developed our new VSU-1 voltage sampling system. Pending final field testing and certification Kintronic Labs expects to commence delivery of these sampling systems by the third quarter of 2010.

The Model VSU-1 precision voltage divider will provide samples of the tower RF voltage Phase and Magnitude for measurements of AM Broadcast directional Multi-Tower arrays. The Sampling Units are designed to accommodate a maximum tower base voltage of 20kV Peak, to enable use with low to high power antenna arrays and standard to high antenna base drive impedances. These voltage sampling units have been developed to facilitate monitoring of AM directional arrays with tower electrical heights in excess of 105 electrical degrees.

The VSU-1 Divider is housed in a painted aluminum weatherproof enclosure with a 7" ceramic bowl insulator and stud assembly for interconnection with the tower. It is configured for installation at the output of an antenna tuning unit (ATU) to allow interconnection with the ATU Output Feed to the tower. The VSU-1 includes provisions for interconnection to the RF Feed Pipe and to the ATU RF Ground. The output connector of the unit is a Type N Female connector.

TECHNICAL SPECIFICATIONS

FREQUENCY RANGE:	0.5 TO 2MHz
FREQUENCY RESPONSE:	FLAT TO WITHIN +/- 0.25 db
OUTPUT IMPEDANCE:	50 ohms - type N female
OUTPUT AMPLITUDE:	At a Nominal 51.5dB below Sampled RF Voltage with multiple-unit factory calibration available.
ABSOLUTE MAGNITUDE ACCURACY:	+/- 2%
ABSOLUTE PHASE ACCURACY:	+/- 2
MAGNITUDE TRACKING ACCURACY:	+/- 1%
PHASE TRACKING ACCURACY:	+/- 1
MAX. VOLTAGE RATING	20 kV peak
TEMPERATUE:	-40 to +50 C
HUMIDITY:	0 - 95%
DIMENSIONS:	15"W x 14.5"D x 19"H(38.1cm x 36.8cm x 48.25cm)
WEIGHT:	28 lbs (12.7 kg)



MOUNTING DIMENSIONS

KINTRONIC LABORATORIES, INC.

144 PLEASANT GROVE RD.
BLUFF CITY, TN U.S.A
WWW.KINTRONIC.COM
423.878.3141

Section 7 – WAOK
Reference Field Intensity Measurements

Reference field intensity measurements were made on radials at the azimuth bearings with specified radiation limits and on the center azimuth bearing of the 2 major lobe radials. Measurements were made at three locations on each radial with a Potomac Instruments Field Intensity Meter of known calibration. The measured field intensity, distance from the antenna, GPS coordinates, and descriptions are included in the following table.

WAOK 1380 KHz Atlanta, GA

4200 W DA-N

Reference Field Strength Measurements

Radial	Point	Distance (km)	Field (mv/m)	Coordinates (NAD 27)		Description
28.5	1	1.61	10	33-46-07.8	84-28-21.3	Baker Dr at H.E. Holmes
	2	3.29	4.1	33-47-09.9	84-27-43.5	1127 Hollywood
	3	6.42	1.42	33-48-47.5	84-26-34.9	1600 Chattahoochie
48	1	3.17	7.7	33-46-34.1	84-27-11.5	Eugenia at Hollywood
	2	4.98	4.8	33-47-41.3	84-25-56.1	Marta Maint entrance
	3	5.84	3.4	33-47-21.9	84-26-21.3	Tacoma at Marietta St
109.5	1	3.14	95	33-45-00.8	84.26.41.6	MLK at R.D Abernathy Blvd
	2	4.69	77	33-44-48.2	84-25.48.3	Langhorn and I20 WB Exit end
	3	6.91	48	33-44-13.3	84-24-03.4	385 Smith Street
164.5	1	0.56	90	33-45-11.6	84-28-35.6	Peyton and MLK
	2	2.92	45	33-44-54.6	84-28-26.5	Peyton Dr and Payton Rd/Park
	3	4.32	22	33-43-17.7	84-27-52.2	Cascade at Beecher/Blvd Granada
210.5	1	1.64	180	33-44-48.2	84-29-14.1	Mailbox 3050 Lyndhurst
	2	3.1	125	33-44-08.6	84-29-43.3	B.Mayes at Braemer Ave
	3	4.1	77	33-43-39.9	84-30-04.2	Redbud and Hazelwood
262.5	1	1.93	34	33-45-28.7	84-27-45.5	212 Howell
	2	2.32	22	33-45-24.7	84-30-19.9	South DW Fairburn Ct Apts
	3	3.1	15	33-45-23.4	84-30-42.8	3795 Stamford
308.5	1	3.24	2.2	33-46-46.7	84-30-30.9	20 MPH sign, end of Mercury
	2	6.34	1.8	33-47-47.9	84-32-02.7	Creek under Queen Mill, southside
	3	6.96	1.25	33-47-58.9	84-32-18.9	25 MPH Sign on hill, Ivey Rd

Measurements were made March 8, 2011 by Robert LaFore using Potomac Instruments FIM-41, SN 1435 calibrated March 2007.

Section 8 - WAOK
Direct Measurement of Operating Power

All antenna resistance and reactance measurements were made with a HP model 8751A network analyzer system using an external directional coupler and power amplifier. The network analyzer system was calibrated with known standards prior to all measurements.

The non-directional antenna resistance measurements were made at the Tower 2 non-directional ATU cabinet J-plug located near the current meter for operating power determination.

The directional antenna resistance measurements were made at the phasor cabinet common point J-plug located near the common point current meter for operating power determination.

The reactance was adjusted to provide a non-reactive load at the transmitter output connection at 1380 kHz.

Section 9 - WAOK
RFR Protection Information

The operation of WAOK at 5 kW non-directional and 4.2 kW directional will not result in exposure of workers or the general public to radio frequency radiation in excess of the levels specified in 47 CFR 1.1310. Fences are installed around the entire site and around all tower bases to comply with the minimum distance of 2 meters as specified in OET bulletin 65 for this frequency, power level, and tower height to prevent electric and magnetic exposure greater than the permissible levels. These fences limit access by the general public. If it becomes necessary for workers to enter the tower base areas for maintenance, the station will either reduce power or cease operation to provide RFR safety for the workers.

Section 10 - WAOK
Exemption from Post Construction Survey Certification Requirement

The WAOK antenna site is an existing FCC licensed facility. No changes were made to the towers or ground system as described in the station license. This application for license is for a change to a Method of Moments proof of performance for directional night operation.

WAOK is therefore exempt from the Post Construction Survey Certification Requirement of the FCC rules.