

**ORIGINAL**Federal Communications Commission  
Washington, D. C. 20554Approved by OMB  
3060-0627  
Expires 01/31/98FOR  
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. *Bm ml-20000302ACK***SECTION I - APPLICANT FEE INFORMATION**

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

MAILING ADDRESS (Line 1) (Maximum 35 characters)

MAILING ADDRESS (Line 2) (Maximum 35 characters)

CITY

STATE OR COUNTRY (if foreign address)

ZIP CODE

TELEPHONE NUMBER (include area code)

CALL LETTERS

OTHER FCC IDENTIFIER (If applicable)

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			
0	0	0	1

(C)

FEE DUE FOR FEE TYPE CODE IN COLUMN (A)
\$

FOR FCC USE ONLY

--

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)

0	0	0	1
---	---	---	---

(C)

\$
----

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

\$

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ONLY

FCC 302-AM  
APPLICATION FOR AM  
BROADCAST STATION LICENSE

(Please read instructions before filling out form)

FOR COMMISSION USE ONLY

FILE NO.

SECTION I - APPLICANT FEE INFORMATION

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

CBS Corporation

MAILING ADDRESS (Line 1) (Maximum 35 characters)

Suite 350

MAILING ADDRESS (Line 2) (Maximum 35 characters)

2175 K St NW

CITY

Washington

STATE OR COUNTRY (if foreign address)

DC

ZIP CODE

21046

TELEPHONE NUMBER (include area code)

202 457-4518

CALL LETTERS

WIP

OTHER FCC IDENTIFIER (if applicable)

FAC ID 28626

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		
M	M	R

(B)

FEE MULTIPLE			
0	0	0	1

(C)

FEE DUE FOR FEE TYPE CODE IN COLUMN (A)
\$ 615

FOR FCC USE ONLY

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

(A)

M	O	R
---	---	---

(B)

0	0	0	1
---	---	---	---

(C)

\$ 705
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FOR FCC USE ONLY

ADD ALL AMOUNTS SHOWN IN COLUMN C, AND ENTER THE TOTAL HERE. THIS AMOUNT SHOULD EQUAL YOUR ENCLOSED REMITTANCE.

TOTAL AMOUNT REMITTED WITH THIS APPLICATION

\$ 1320

FOR FCC USE ONLY

<b>SECTION II - APPLICANT INFORMATION</b>		
1. NAME OF APPLICANT CBS Radio Inc of Philadelphia		
MAILING ADDRESS 3176 K ST. NW		
CITY Washington	STATE DC	ZIP CODE 20007

2. This application is for:

- ☐ Commercial
 ☐ Noncommercial  
☒ AM Directional
 ☐ AM Non-Directional

Call letters WUP	Community of License Philadelphia	Construction Permit File No.	Modification of Construction Permit File No(s).	Expiration Date of Last Construction Permit
---------------------	--------------------------------------	------------------------------	--	--

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

☒ Yes ☐ No

Exhibit No.

If No, explain in an Exhibit.

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

☐ Yes ☐ No

Exhibit No.

If No, state exceptions in an Exhibit.

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

Exhibit No.

If Yes, explain in an Exhibit.

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

Exhibit No.

If No, explain in an Exhibit.

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

Exhibit 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.

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).

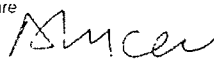
The APPLICANT acknowledges that all the statements made in this application and attached exhibits are considered material representations and that all the exhibits are a material part hereof and are incorporated herein as set out in full in

#### 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 Anne Lucey	Signature 	
Title Assistant Secretary	Date 2/24/10	Telephone Number 202-457-4505

**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 INC. OF PHILADELPHIA

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) N/A	Frequency (kHz) 610	Hours of Operation  UNLIMITED	Power in kilowatts	
				Night 5.0	Day 5.0

**2. Station location**

State  PENNSYLVANIA	City or Town  PHILADELPHIA
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**3. Transmitter location**

State  NJ	County  CAMDEN	City or Town  BELLMAWR	Street address (or other identification) 775 CREEK ROAD
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**4. Main studio location**

State  PA	County  MONTGOMERY	City or Town  BALA CYNWYD	Street address (or other identification) 333 CITY AVENUE
-----------------	--------------------------	---------------------------------	--

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

State  PA	County  MONTGOMERY	City or Town  BALA CYNWYD	Street address (or other identification) 333 CITY AVENUE
-----------------	--------------------------	---------------------------------	--

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.

ENG

**8. Operating constants:**

RF common point or antenna current (in amperes) without modulation for night system 10.4		RF common point or antenna current (in amperes) without modulation for day system 10.4	
Measured antenna or common point resistance (in ohms) at operating frequency Night 50	Day 50	Measured antenna or common point reactance (in ohms) at operating frequency Night -3.8	Day -3.8

**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 (SW)	0.0	0.0	1.000	1.000		
2 (NE)	-7.5	-7.5	.674	.674		

Manufacturer and type of antenna monitor:

POTOMAC INSTRUMENTS AM 19 (204)

### 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  SELF SUPPORTING TOWER	Overall height in meters of radiator above base insulator, or above base, if grounded.  83.9	Overall height in meters above ground (without obstruction lighting)  85.0	Overall height in meters above ground (include obstruction lighting)  85.3	If antenna is either top loaded or sectionalized, describe fully in an Exhibit.  Exhibit No. ENG
--	--	--	--	---

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 39 ° 51 ' 56.0 "	West Longitude 75 ° 06 ' 43.0 "
---------------------------------	---------------------------------

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.  
ENG

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

Exhibit No.  
ENG

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

N/A

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

EQUIPMENT CHANGES

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) KURT GORMAN	Signature (check appropriate box below) Kurt Gorman <small>Digitally signed by Kurt Gorman DN: cn=Kurt Gorman, o=Phasetek Inc., email=kurt.gorman@phasetek.com, c=US Date: 2010.02.22 14:41:07 -0500</small>
Address (include ZIP Code) PHASETEK INC. 550 CALIFORNIA RD, UNIT 11 QUAKERTOWN, PA 18951	Date FEBRUARY 22, 2010  Telephone No. (Include Area Code) 215-536-6648

☐ Technical Director

☐ Registered Professional Engineer

☐ Chief Operator

☒ Technical Consultant

☐ Other (specify)

**ENGINEERING STATEMENT CONCERNING**

**APPLICATION FOR LICENSE INFORMATION**

**EMPLOYING MOMENT METHOD MODELING**

**WIP, 610 KHZ, DA-1**

**PHILADELPHIA, PENNSLVANIA**

**FEBRUARY, 2010**

***PHASETEK INC.***

**ENGINEERING STATEMENT CONCERNING  
APPLICATION FOR LICENSE INFORMATION  
EMPLOYING MOMENT METHOD MODELING  
WIP, 610 KHZ, DA-1  
PHILADELPHIA, PA  
FEBRUARY, 2010**

**TABLE OF CONTENTS**

**302-AM**

**ENGINEERING STATEMENT**

<b>FIGURE 1:</b>	<b>ANTENNA SYSTEM AS ADJUSTED</b>
<b>FIGURE 2:</b>	<b>SAMPLING SYSTEM DESCRIPTION/MEASUREMENTS</b>
<b>FIGURE 3:</b>	<b>POTOMAC INSTRUMENTS RECOMMENDATIONS</b>
<b>FIGURE 4:</b>	<b>TOWER IMPEDANCE MEASUREMENTS VS. MODELED</b>
<b>FIGURE 5:</b>	<b>MOMENT MODEL PARAMETERS</b>
<b>FIGURE 6A – 6B:</b>	<b>MOMENT MODEL SUMMARY FOR INDIVIDUAL TOWERS</b>
<b>FIGURE 7:</b>	<b>DERIVED DIRECTIONAL PARAMETERS</b>
<b>FIGURE 8:</b>	<b>MOMENT MODEL ARRAY SYNTHESIS</b>
<b>FIGURE 9:</b>	<b>MOMENT MODEL SUMMARY FOR DIRECTIONAL MODE</b>
<b>FIGURE 10:</b>	<b>TOWER BASE CIRCUIT ANALYSIS MODEL</b>
<b>FIGURE 11A – 11B:</b>	<b>CIRCUIT ANALYSIS FOR INDIVIDUAL TOWERS</b>
<b>FIGURE 12A – 12B:</b>	<b>CIRCUIT ANALYSIS FOR DIRECTIONAL MODE</b>
<b>FIGURE 13:</b>	<b>REFERENCE FIELD INTENSITY MEASUREMENTS</b>



## ***PHASETEK INC.***

### **ENGINEERING STATEMENT CONCERNING APPLICATION FOR LICENSE INFORMATION EMPLOYING MOMENT METHOD MODELING WIP, 610 KHZ, DA-1 PHILADELPHIA, PA FEBRUARY, 2010**

#### **SUMMARY**

Adjustment of the Antenna System and a Proof of Performance employing Moment Method Modeling was performed on Radio Station WIP, 610 kHz, Philadelphia, Pennsylvania, after replacement of Antenna Phasing equipment, Transmission and Sampling Lines, and new Tower Feed Assemblies. This report was prepared on behalf of CBS Radio Inc., of Philadelphia, licensee of Radio Station WIP.

#### **SITE MODIFICATIONS**

The WIP Transmitter site remains that as previously licensed. Due to the age of the equipment, new Transmission Lines, Sampling Lines, and Antenna Phasing and Branching equipment have been installed. The Towers have not been changed except for maintenance of Tower lighting conduits, Tower repainting, and new feed connection at base. In conjunction of these upgrades, a License Application employing Moment Method Modeling as set forth in Section 73.151(C) has been done.

#### **REFERENCE POINTS**

Reference Points were measured at pattern minima and maxima for the Directional mode of operation. These Points and their measured field intensity are shown in Figure 13.

#### **MEASURING EQUIPMENT AND PERSONNEL**

All Resistance and Reactance measurements were made with a Delta Electronics OIB-3 Operating Impedance Bridge. Before use, tests of known impedances were made to verify operation. All Field Intensity Measurements were made with a Potomac Instruments Field Intensity Meter; FIM-41, Serial Number 2181, calibrated on June 27, 2006. The meter was calibrated by Potomac Instruments, Silver Spring, Maryland. All measurements were taken by Phasetek Inc. personnel supervised by Kurt Gorman of Phasetek Inc.

***PHASETEK INC.***

**ENGINEERING STATEMENT CONCERNING  
APPLICATION FOR LICENSE INFORMATION  
EMPLOYING MOMENT METHOD MODELING  
WIP, 610 KHZ, DA-1  
PHILADELPHIA, PA  
FEBRUARY, 2010**

**CONCLUSION**

It is believed that the WIP Antenna System has been adjusted in accordance with all applicable Commission rules and regulations. The foregoing was prepared on behalf of CBS Radio, Inc. of Philadelphia, under the immediate supervision of Kurt Gorman, Phasetek Inc., Quakertown, Pennsylvania, whose qualifications are a matter of record with the Federal Communications Commission. The statements herein are true and correct of his knowledge, except such statements made on information and belief, and as to these statements he believes them to be true and correct.

Kurt Gorman

Digitally signed by Kurt Gorman  
DN: cn=Kurt Gorman, o=Phasetek Inc.,  
ou,email=robin\_phasetek@verizon.net,  
c=US  
Date: 2010.02.23 16:40:33 -05'00'

---

**Kurt Gorman, President  
Phasetek Inc.  
Quakertown, Pennsylvania**

## FIGURE 1

### ANTENNA SYSTEM AS ADJUSTED

#### APPLICATION FOR LICENSE INFORMATION EMPLOYING MOMENT METHOD MODELING WIP, 610 KHZ, DA-1 PHILADELPHIA, PA

##### ANTENNA SYSTEM DESCRIPTION

1. The Antenna System consists of two (2), self-supporting, tapered, vertical steel transmitting Towers. Both Towers stand 83.9M (61.4°) above their Base Insulators. Both Towers are top loaded with a 9.15M Top Hat. Both Towers have aviation obstruction lighting. The Towers are arranged with Tower 1 as a reference; Tower 2 is spaced 181.0° on a bearing of 50.0°T. Lighting for both Towers is isolated at each base by a Ring Isolation Transformer. Additionally, a "Star" Feed Assembly, attached to all (4) legs, is connected at the base and provides the connection to each Antenna Tuning Unit.
2. The Ground System for each Tower consists of (120) buried copper Radials, 122M in length, except where they intersect with copper transverse straps between Towers or property boundaries. Additionally, a 12.2M x 12.2M copper ground screen is installed at the base of each Tower. Copper strap connects all Towers to the main Transmitter grounding point.
3. The Sampling System consists of two (2), Delta Electronics TCT-1, 0.5 V/A Toroidal Current Transformers. Both TCT's are at the Output of each Antenna Tuning Unit. These TCT's are connected to a Potomac Instruments AM19 (204) Phase Monitor via two (2) equal lengths of Andrew, LDF-2, 3/8" phase stabilized foam coaxial cable.

##### TOWER PARAMETERS (DIRECTIONAL)

Theoretical			Modeled TCT		Operating *	
<u>Tower</u>	<u>Field</u>	<u>Phase</u>	<u>Amplitude</u>	<u>Phase</u>	<u>Amplitude</u>	<u>Phase</u>
1 (SW)	1.540	0.0°	1.000	0.0°	1.000	0.0°
2 (NE)	1.000	0.0°	.674	-0.7°	.674	-7.5°

\* As indicated on Potomac Instruments AM19 (204) Antenna Monitor with additional jumper for Tower #2. See Figures 2 and 3.

**FIGURE 1**  
**ANTENNA SYSTEM AS ADJUSTED**

**APPLICATION FOR LICENSE INFORMATION**  
**EMPLOYING MOMENT METHOD MODELING**  
**WIP, 610 KHZ, DA-1**  
**PHILADELPHIA, PA**  
**CONTINUED**

**ANTENNA SYSTEM DESCRIPTION – Continued**

**DIRECTIONAL OPERATION**

**COMMON POINT**

Impedance = 50.0 – j 3.8 ohms  
Current = 10.4 Amperes  
Power = 5,400 Watts

Directional Antenna Monitor indications are within  $\pm 5\%$  and  $\pm 3^\circ$  of the modeled TCT values.

**TOWER REGISTRATION NUMBERS**

Tower #1 (SW): 1040104  
Tower #2 (NE): 1040105

## FIGURE 2

### WIP SAMPLING SYSTEM DESCRIPTION/MEASUREMENTS

#### SAMPLING SYSTEM DESCRIPTION

The Sampling System consists of Delta Electronics TCT-1 Toroidal Sampling Transformers (0.5 volt/amp) mounted at the base of each Tower. The sampling devices are connected to the Phase Monitor with equal lengths of Andrew LDF-2. Each Sample Line was ordered and tested by the manufacturer to be phase stabilized and of equal lengths. The Phase Monitor is a Potomac Instruments Model AM-19 (204), Serial Number 546.

Toroidal sample devices were tested for accuracy by the manufacturer prior to shipment as being within 1 percent ratio and 1 degree phase accuracy.

#### SAMPLE SYSTEM MEASUREMENTS

Impedance measurements were made of the Antenna Sampling System using an Array Solutions Model AIM4170C Vector Network Analyzer (VNA) and verified with a Delta Electronics OIB-3 Operating Impedance Bridge and Potomac Instruments SD-31/RX-31 RF Generator/Detector. Measurements were done with the lines open circuited and then connected to the TCT's.

The table below shows the frequencies above and below the carrier frequency where resonance, defined as zero reactance corresponding with low resistance, was found. Frequencies of resonance occur at odd multiples of 90 degrees electrical length, the Sample Line length at the resonant frequency below the carrier frequency, which is the closest one to the carrier frequency, was found to be 270 electrical degrees. The electrical length at carrier frequency appearing in the table below was calculated by ratioing the frequencies.

WIP Tower Sample Line Measurements				
	Resonant Frequency (kHz) below 610 kHz	Resonant Frequency (kHz) above 610 kHz	Calculated Electrical Length (deg) at 610 kHz	Measured Impedance Connected to TCT
Tower 1	566.3	929.0	290.8	50.0 +j0.7
Tower 2	566.6	928.9	290.7	50.5 +j0.6

## FIGURE 2 WIP SAMPLING SYSTEM DESCRIPTION/MEASUREMENTS CONTINUED

### SAMPLE SYSTEM MEASUREMENTS (CONTINUED)

To determine the characteristic impedance values of the Sample Lines, open-circuited measurements were made with frequencies offset to produce  $\pm 45$  degrees of electrical length from resonance. The characteristic impedance was calculated using the following formula, where  $R_1 + jX_1$  and  $R_2 + jX_2$  are the measured impedances at the +45 and -45 degree offset frequencies, respectively:

$$Z_0 = ((R_1^2 + X_1^2)^{1/2} \times (R_2^2 + X_2^2)^{1/2})^{1/2}$$

### WIP TOWER SAMPLE LINE MEASUREMENTS

	+ 45 Degree Offset Frequency (kHz)	+45 Degree Measured Impedance (Ohms)	- 45 Degree Offset Frequency (kHz)	-45 Degree Measured Impedance (Ohms)	Calculated Characteristic Impedance (Ohms)
Tower 1	660.7	9.8 +j51.93	471.9	6.51 -j48.97	51.09
Tower 2	661.0	9.6 +j51.10	472.2	6.49 -j48.70	50.54
Impedance Delta					0.55

Due to the nature of the WIP Array, the required phase indication on the Antenna Monitor is close to  $0^\circ$ . This situation provides difficulty in accurate measurement with the Potomac Instruments AM19 (204) Antenna Monitor. A short jumper constructed of RG-58/U, 50 ohm, coaxial cable is installed at the Antenna Monitor in series with the Tower #2 (non-reference) Sample Line. Measurement of this jumper yields an open circuit resonant frequency of 8.1044 MHz. This corresponds to a lagging phase of  $6.8^\circ$  at 610 kHz. The jumper is mounted in the equipment rack and at constant environmental conditions. Attached as Figure 3 are the recommendations as found in the Potomac Instruments Instruction Manual.

### FIGURE 3

## WIP POTOMAC INSTRUMENTS RECOMMENDATIONS

(PAGE 3-3 FROM TYPE 19 ANTENNA MONITOR INSTRUCTION MANUAL)

When installing the Sampling Lines, it is recommended that the cable lengths be as nearly equal as possible; both to preserve the absolute accuracy of the phase measurements, and also to “cancel” variations in line characteristics due to temperature changes and other causes.

An important exception to this rule is sometimes made for those arrays which produce measured phase angles near 0 degrees. In this case, the sense (leading or lagging) indication of a phase angle must be interpreted carefully, and also the monitor is most susceptible to interference at these angles. If desired, these effects may be eliminated by inserting an extra length of coaxial cable in series with the sampling lines from the towers in question. The length of the extra cables should be sufficient to affect a phase delay of about 5 degrees as determined from the following formula:

$$\text{LENGTH OF CABLE (FEET)} = \frac{2733 \cdot V \cdot \text{PHASE DELAY (DEGREES)}}{\text{OPERATING FREQUENCY (KILOCYCLES)}}$$

V (Cable Velocity Factor) = 0.85 for air-spaced dielectric  
 = 0.67 for solid polyethylene dielectric  
 (ei. RG-8/U, RG-58/U, RG-59/U)  
 = 0.695 for solid teflon dielectric

EXAMPLE: Use 9.15 feet of .RG-8/U for .5 degrees delay at 1000 kHz

The 'extra' cable should be installed in a protected location where temperature extremes are minimized.

### 3 -4.2 Non-Directional Voltage Limit

In a DA-D or DA-N system, it is important to determine the sampling line voltage from both the powered and unpowered towers during Non-Directional operation. To avoid damage in cases where the specified voltage limit is exceeded, a coaxial relay can be utilized to transfer the sampling lines from each overloaded input receptacle to a dissipating resistance during Non-Directional operation. The relay coils can be energized by a Phasor contactor utilizing either the 24 volt supply in the monitor (pins 23 and 24 of J1) or an external power source.

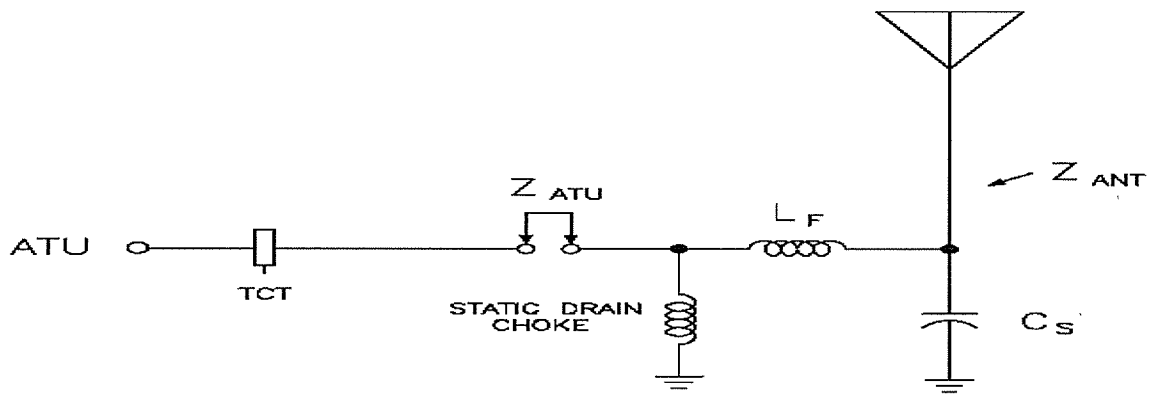
### 3.4.3 Input Module Connections

The coaxial cables from the antenna sampling loops are connected to UHF receptacles on the rear of the AM-19. Each coaxial receptacle is mounted on an input module which contains the switching relays and critical RF circuits repeated for each tower. The input modules are assembled across the rear of the monitor with one module provided for each antenna tower up to a maximum of 12.

Two types of input modules are utilized in the AM-1.9. These are designated either as reference tower input modules or as non-reference tower input modules.

In a monitor equipped for a single pattern system, that is for a DA-1

**FIGURE 4**  
**WIP TOWER IMPEDANCE MEASUREMENTS COMPARED TO**  
**METHOD OF MOMENTS MODEL**



TOWER	Specified Cs (pf)	Measured L <sub>F</sub> (μH)	Measured X <sub>F</sub> (Ω)	Modeled Z <sub>ANT</sub> (Ω)	Modeled Z <sub>ATU</sub> (Ω)	Measured Z <sub>ATU</sub> (Ω)
1	40	5.22	+20.0	15.2 -j66.4	15.1 -j45.8	15.0 -j45.1
2	40	6.65	+25.5	14.8 -j67.8	14.7 -j41.7	14.5 -j41.5

Above "measured" impedance values were measured with Delta Electronics OIB-3 Operating Impedance Bridge with other Tower open circuited.



**FIGURE 5**  
**WIP MOMENT MODEL PARAMETERS**

<u>Tower #</u>	<u>Wire #</u>	<u># of Segments</u>	<u>Base Node</u>	<u>Radius (m)</u>	<u>Tower Model Length (°)</u>	<u>Tower Physical Length (°)</u>
1	1	10	1	3.0076	70.1	61.4
1	2	10	-	2.3810	-	-
1	3	10	-	1.7544	-	-
1	4	10	-	1.1278	-	-
1	5	10	-	.5013	-	-
1	6	2	-	.100	-	-
1	7	2	-	.100	-	-
1	8	2	-	.100	-	-
2	9	10	57	3.0076	69.5	61.4
2	10	10	-	2.3810	-	-
2	11	10	-	1.7544	-	-
2	12	10	-	1.1278	-	-
2	13	10	-	.5013	-	-
2	14	2	-	.100	-	-
2	15	2	-	.100	-	-
2	16	2	-	.100	-	-

**Note:** Wires 6 – 8 and 14 – 16 represent Top Hat Top Loading and lengths are equal to physical Radius.

Both Towers are four (4) sided, tapered, self-supporting, with a 15.5 ft. base and 31.0 inch top face widths. Each Tower has four (4) Base Insulators at an approximate capacitance of 10pf each. The Output of each Antenna Tuning Unit has a Phasetek Inc. P600-161-2 Static Drain Choke which measures +j32.000 ohms (8,349.1uH) @ 610kHz. Base and top radius values are 100% of equivalent radius of the sum of face widths.

FIGURE 6A

WIP MOMENT MODEL SUMMARY FOR INDIVIDUAL TOWERS  
TOWER 1

WIP TOWER 1 INDIVIDUAL

GEOMETRY

wire coordinates in degrees; other dimensions in meters

Environment: perfect ground

wire	caps	Radius	Angle	Z	radius	segs
1	none	0	0	0	3.0076	10
		0	0	13.6		
2	none	0	0	13.6	2.381	10
		0	0	27.3		
3	none	0	0	27.3	1.7544	10
		0	0	40.9		
4	none	0	0	40.9	1.1278	10
		0	0	54.5		
5	none	0	0	54.5	.5013	10
		0	0	70.1		
6	none	0	0	70.1	.1	2
		3.35	0	70.1		
7	none	0	0	70.1	.1	2
		3.35	120.	70.1		
8	none	0	0	70.1	.1	2
		3.35	240.	70.1		
9	none	181.	50.	0	3.0076	10
		181.	50.	13.6		
10	none	181.	50.	13.6	2.381	10
		181.	50.	27.3		
11	none	181.	50.	27.3	1.7544	10
		181.	50.	40.9		
12	none	181.	50.	40.9	1.1278	10
		181.	50.	54.5		
13	none	181.	50.	54.5	.5013	10
		181.	50.	69.5		
14	none	181.	50.	69.5	.1	2
		183.17	49.2	69.5		
15	none	181.	50.	69.5	.1	2
		177.7	49.8	69.5		
16	none	181.	50.	69.5	.1	2
		182.17	51.	69.5		

Number of wires = 16  
current nodes = 112

	minimum	maximum
Individual wires	wire value	wire value
segment length	16 1.68914	4 1.36
radius	6 .1	1 3.0076

ELECTRICAL DESCRIPTION

Frequencies ( MHz)

no.	frequency	step	no. of steps	segment length (wavelengths)
	lowest			minimum maximum
1	.61	0	1	3.78E-03 4.69E-03

Sources

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

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	57	0	-6,522.7	0	0	0

FIGURE 6A

## WIP MOMENT MODEL SUMMARY FOR INDIVIDUAL TOWERS

## TOWER 1

## CONTINUED

WIP TOWER 1 INDIVIDUAL Cont'd

## IMPEDANCE

normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR dB	S11 dB	S12 dB
source = .61	1; node 1, sector 1						
.61	15.193	-66.39	68.106	-77.11	9.2891	-1.8774	-14.227

## CURRENT rms

Frequency = .61 MHz

Input power = .00163777 watts

Efficiency = 100. %

## current

no.	X	Y	Z	mag (amps)	phase (deg)	real (amps)	imaginary (amps)
GND	0	0	0	.0103825	77.11	2.32E-03	.0101208
2	0	0	1.36	.0100487	76.68	2.31E-03	9.78E-03
3	0	0	2.72	9.43E-03	75.81	2.31E-03	9.14E-03
4	0	0	4.08	9.2E-03	75.48	2.31E-03	8.9E-03
5	0	0	5.44	9.02E-03	75.25	2.3E-03	8.72E-03
6	0	0	6.8	8.85E-03	75.02	2.29E-03	8.55E-03
7	0	0	8.16	8.68E-03	74.8	2.27E-03	8.38E-03
8	0	0	9.52	8.51E-03	74.6	2.26E-03	8.21E-03
9	0	0	10.88	8.34E-03	74.4	2.24E-03	8.04E-03
10	0	0	12.24	8.17E-03	74.21	2.22E-03	7.86E-03
END	0	0	13.6	8.E-03	74.02	2.2E-03	7.69E-03
2J1	0	0	13.6	8.E-03	74.02	2.2E-03	7.69E-03
12	0	0	14.97	7.85E-03	73.88	2.18E-03	7.55E-03
13	0	0	16.34	7.71E-03	73.74	2.16E-03	7.41E-03
14	0	0	17.71	7.56E-03	73.6	2.14E-03	7.26E-03
15	0	0	19.08	7.41E-03	73.46	2.11E-03	7.1E-03
16	0	0	20.45	7.25E-03	73.32	2.08E-03	6.95E-03
17	0	0	21.82	7.09E-03	73.18	2.05E-03	6.78E-03
18	0	0	23.19	6.92E-03	73.05	2.02E-03	6.62E-03
19	0	0	24.56	6.74E-03	72.91	1.98E-03	6.44E-03
20	0	0	25.93	6.55E-03	72.77	1.94E-03	6.26E-03
END	0	0	27.3	6.36E-03	72.63	1.9E-03	6.07E-03
2J2	0	0	27.3	6.36E-03	72.63	1.9E-03	6.07E-03
22	0	0	28.66	6.21E-03	72.53	1.87E-03	5.93E-03
23	0	0	30.02	6.06E-03	72.43	1.83E-03	5.78E-03
24	0	0	31.38	5.9E-03	72.32	1.79E-03	5.62E-03
25	0	0	32.74	5.73E-03	72.22	1.75E-03	5.46E-03
26	0	0	34.1	5.56E-03	72.11	1.71E-03	5.29E-03
27	0	0	35.46	5.38E-03	72.	1.66E-03	5.12E-03
28	0	0	36.82	5.2E-03	71.9	1.62E-03	4.94E-03
29	0	0	38.18	5.01E-03	71.79	1.57E-03	4.76E-03
30	0	0	39.54	4.81E-03	71.68	1.51E-03	4.56E-03
END	0	0	40.9	4.59E-03	71.56	1.45E-03	4.35E-03
2J3	0	0	40.9	4.59E-03	71.56	1.45E-03	4.35E-03
32	0	0	42.26	4.44E-03	71.48	1.41E-03	4.21E-03
33	0	0	43.62	4.28E-03	71.4	1.36E-03	4.06E-03
34	0	0	44.98	4.11E-03	71.31	1.32E-03	3.89E-03
35	0	0	46.34	3.93E-03	71.23	1.27E-03	3.72E-03
36	0	0	47.7	3.75E-03	71.14	1.21E-03	3.55E-03
37	0	0	49.06	3.57E-03	71.05	1.16E-03	3.37E-03
38	0	0	50.42	3.38E-03	70.97	1.1E-03	3.19E-03
39	0	0	51.78	3.18E-03	70.88	1.04E-03	3.E-03
40	0	0	53.14	2.97E-03	70.78	9.78E-04	2.81E-03
END	0	0	54.5	2.72E-03	70.67	9.01E-04	2.57E-03
2J4	0	0	54.5	2.72E-03	70.67	9.01E-04	2.57E-03

# WIP MOMENT MODEL SUMMARY FOR INDIVIDUAL TOWERS

## TOWER 1 CONTINUED

### WIP TOWER 1 INDIVIDUAL Cont'd

current				mag	phase	real	imaginary
no.	X	Y	Z	(amps)	(deg)	(amps)	(amps)
42	0	0	56.06	2.57E-03	70.61	8.54E-04	2.43E-03
43	0	0	57.62	2.4E-03	70.53	7.98E-04	2.26E-03
44	0	0	59.18	2.21E-03	70.46	7.39E-04	2.08E-03
45	0	0	60.74	2.02E-03	70.38	6.77E-04	1.9E-03
46	0	0	62.3	1.82E-03	70.31	6.13E-04	1.71E-03
47	0	0	63.86	1.62E-03	70.24	5.47E-04	1.52E-03
48	0	0	65.42	1.41E-03	70.17	4.79E-04	1.33E-03
49	0	0	66.98	1.2E-03	70.11	4.09E-04	1.13E-03
50	0	0	68.54	9.94E-04	70.06	3.39E-04	9.35E-04
END	0	0	70.1	8.34E-04	70.03	2.85E-04	7.84E-04
2J5	0	0	70.1	2.78E-04	70.03	9.49E-05	2.61E-04
52	1.675	0	70.1	1.77E-04	70.06	6.05E-05	1.67E-04
END	3.35	0	70.1	0	0	0	0
2J5	0	0	70.1	2.78E-04	70.03	9.49E-05	2.61E-04
54	-.8375	1.45059	70.1	1.77E-04	70.06	6.05E-05	1.67E-04
END	-1.675	2.90119	70.1	0	0	0	0
2J5	0	0	70.1	2.78E-04	70.04	9.49E-05	2.61E-04
56	-.8375	-1.45059	70.1	1.77E-04	70.06	6.05E-05	1.67E-04
END	-1.675	-2.90119	70.1	0	0	0	0
GND	116.345	138.654	0	9.6E-06	-133.91	-6.66E-06	-6.91E-06
58	116.345	138.654	1.36	1.41E-04	-133.91	-9.75E-05	-1.01E-04
59	116.345	138.654	2.72	1.73E-04	-133.92	-1.2E-04	-1.25E-04
60	116.345	138.654	4.08	1.87E-04	-133.92	-1.29E-04	-1.34E-04
61	116.345	138.654	5.44	1.99E-04	-133.93	-1.38E-04	-1.43E-04
62	116.345	138.654	6.8	2.1E-04	-133.94	-1.46E-04	-1.52E-04
63	116.345	138.654	8.16	2.2E-04	-133.95	-1.53E-04	-1.59E-04
64	116.345	138.654	9.52	2.29E-04	-133.96	-1.59E-04	-1.65E-04
65	116.345	138.654	10.88	2.37E-04	-133.97	-1.64E-04	-1.7E-04
66	116.345	138.654	12.24	2.44E-04	-133.99	-1.69E-04	-1.75E-04
END	116.345	138.654	13.6	2.5E-04	-134.	-1.74E-04	-1.8E-04
2J9	116.345	138.654	13.6	2.5E-04	-134.	-1.74E-04	-1.8E-04
68	116.345	138.654	14.97	2.54E-04	-134.01	-1.76E-04	-1.83E-04
69	116.345	138.654	16.34	2.57E-04	-134.03	-1.79E-04	-1.85E-04
70	116.345	138.654	17.71	2.6E-04	-134.04	-1.81E-04	-1.87E-04
71	116.345	138.654	19.08	2.63E-04	-134.06	-1.83E-04	-1.89E-04
72	116.345	138.654	20.45	2.64E-04	-134.08	-1.84E-04	-1.9E-04
73	116.345	138.654	21.82	2.65E-04	-134.1	-1.85E-04	-1.91E-04
74	116.345	138.654	23.19	2.66E-04	-134.12	-1.85E-04	-1.91E-04
75	116.345	138.654	24.56	2.66E-04	-134.14	-1.85E-04	-1.91E-04
76	116.345	138.654	25.93	2.65E-04	-134.16	-1.85E-04	-1.9E-04
END	116.345	138.654	27.3	2.64E-04	-134.19	-1.84E-04	-1.89E-04
2J10	116.345	138.654	27.3	2.64E-04	-134.19	-1.84E-04	-1.89E-04
78	116.345	138.654	28.66	2.63E-04	-134.21	-1.83E-04	-1.88E-04
79	116.345	138.654	30.02	2.61E-04	-134.23	-1.82E-04	-1.87E-04
80	116.345	138.654	31.38	2.58E-04	-134.25	-1.8E-04	-1.85E-04
81	116.345	138.654	32.74	2.55E-04	-134.27	-1.78E-04	-1.83E-04
82	116.345	138.654	34.1	2.52E-04	-134.3	-1.76E-04	-1.8E-04
83	116.345	138.654	35.46	2.48E-04	-134.32	-1.73E-04	-1.77E-04
84	116.345	138.654	36.82	2.43E-04	-134.35	-1.7E-04	-1.74E-04
85	116.345	138.654	38.18	2.38E-04	-134.37	-1.67E-04	-1.7E-04
86	116.345	138.654	39.54	2.32E-04	-134.4	-1.63E-04	-1.66E-04
END	116.345	138.654	40.9	2.26E-04	-134.44	-1.58E-04	-1.61E-04
2J11	116.345	138.654	40.9	2.26E-04	-134.44	-1.58E-04	-1.61E-04
88	116.345	138.654	42.26	2.21E-04	-134.46	-1.55E-04	-1.58E-04
89	116.345	138.654	43.62	2.15E-04	-134.49	-1.51E-04	-1.54E-04
90	116.345	138.654	44.98	2.09E-04	-134.51	-1.47E-04	-1.49E-04
91	116.345	138.654	46.34	2.02E-04	-134.54	-1.42E-04	-1.44E-04
92	116.345	138.654	47.7	1.95E-04	-134.57	-1.37E-04	-1.39E-04
93	116.345	138.654	49.06	1.88E-04	-134.6	-1.32E-04	-1.34E-04
94	116.345	138.654	50.42	1.79E-04	-134.63	-1.26E-04	-1.28E-04

# WIP MOMENT MODEL SUMMARY FOR INDIVIDUAL TOWERS

## TOWER 1 CONTINUED

### WIP TOWER 1 INDIVIDUAL Cont'd

current no.	X	Y	Z	mag (amps)	phase (deg)	real (amps)	imaginary (amps)
95	116.345	138.654	51.78	1.71E-04	-134.66	-1.2E-04	-1.21E-04
96	116.345	138.654	53.14	1.61E-04	-134.7	-1.13E-04	-1.15E-04
END	116.345	138.654	54.5	1.49E-04	-134.74	-1.05E-04	-1.06E-04
2J12	116.345	138.654	54.5	1.49E-04	-134.74	-1.05E-04	-1.06E-04
98	116.345	138.654	56.	1.42E-04	-134.77	-1.E-04	-1.01E-04
99	116.345	138.654	57.5	1.34E-04	-134.8	-9.44E-05	-9.51E-05
100	116.345	138.654	59.	1.25E-04	-134.83	-8.81E-05	-8.86E-05
101	116.345	138.654	60.5	1.15E-04	-134.86	-8.13E-05	-8.17E-05
102	116.345	138.654	62.	1.05E-04	-134.89	-7.41E-05	-7.44E-05
103	116.345	138.654	63.5	9.44E-05	-134.92	-6.66E-05	-6.68E-05
104	116.345	138.654	65.	8.32E-05	-134.95	-5.88E-05	-5.89E-05
105	116.345	138.654	66.5	7.18E-05	-134.98	-5.07E-05	-5.08E-05
106	116.345	138.654	68.	6.01E-05	-135.01	-4.25E-05	-4.25E-05
END	116.345	138.654	69.5	5.1E-05	-135.02	-3.61E-05	-3.61E-05
2J13	116.345	138.654	69.5	1.67E-05	-134.49	-1.17E-05	-1.19E-05
108	118.016	138.656	69.5	1.06E-05	-134.36	-7.41E-06	-7.58E-06
END	119.687	138.659	69.5	0	0	0	0
2J13	116.345	138.654	69.5	1.73E-05	-135.79	-1.24E-05	-1.21E-05
110	115.521	137.19	69.5	1.1E-05	-135.95	-7.92E-06	-7.66E-06
END	114.698	135.727	69.5	0	0	0	0
2J13	116.345	138.654	69.5	1.7E-05	-134.74	-1.2E-05	-1.21E-05
112	115.494	140.113	69.5	1.08E-05	-134.67	-7.58E-06	-7.67E-06
END	114.643	141.573	69.5	0	0	0	0

**FIGURE 6B**  
**WIP MOMENT MODEL SUMMARY FOR INDIVIDUAL TOWERS**  
**TOWER 2**

WIP - TOWER 2 INDIVIDUAL

GEOMETRY

Wire coordinates in degrees; other dimensions in meters

Environment: perfect ground

wire	caps	Radius	Angle	Z	radius	segs
1	none	0	0	0	3.0076	10
		0	0	13.6		
2	none	0	0	13.6	2.381	10
		0	0	27.3		
3	none	0	0	27.3	1.7544	10
		0	0	40.9		
4	none	0	0	40.9	1.1278	10
		0	0	54.5		
5	none	0	0	54.5	.5013	10
		0	0	70.1		
6	none	0	0	70.1	.1	2
		3.35	0	70.1		
7	none	0	0	70.1	.1	2
		3.35	120.	70.1		
8	none	0	0	70.1	.1	2
		3.35	240.	70.1		
9	none	181.	50.	0	3.0076	10
		181.	50.	13.6		
10	none	181.	50.	13.6	2.381	10
		181.	50.	27.3		
11	none	181.	50.	27.3	1.7544	10
		181.	50.	40.9		
12	none	181.	50.	40.9	1.1278	10
		181.	50.	54.5		
13	none	181.	50.	54.5	.5013	10
		181.	50.	69.5		
14	none	181.	50.	69.5	.1	2
		183.17	49.2	69.5		
15	none	181.	50.	69.5	.1	2
		177.7	49.8	69.5		
16	none	181.	50.	69.5	.1	2
		182.17	51.	69.5		

Number of wires = 16  
current nodes = 112

	minimum	maximum
Individual wires	wire value	wire value
segment length	16 1.68914	4 1.36
radius	6 .1	1 3.0076

ELECTRICAL DESCRIPTION

Frequencies ( MHz)

no.	frequency	step	no. of steps	segment length (wavelengths)
	lowest			minimum maximum
1	.61	0	1	3.78E-03 4.69E-03

Sources

source	node	sector	magnitude	phase	type
1	57	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	0	-6,522.7	0	0	0

**FIGURE 6B**  
**WIP MOMENT MODEL SUMMARY FOR INDIVIDUAL TOWERS**  
**TOWER 2**  
**CONTINUED**

**WIP - TOWER 2 INDIVIDUAL Con'td**

**IMPEDANCE**

normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR dB	S11 dB	S12 dB
source = 1; node 57, sector 1							
.61	14.817	-67.844	69.443	-77.68	9.7816	-1.7822	-14.633

**CURRENT rms**

Frequency = .61 MHz

Input power = .00153626 watts

Efficiency = 100. %

current no.	X	Y	Z	mag (amps)	phase (deg)	real (amps)	imaginary (amps)
GND	0	0	0	9.43E-06	-133.37	-6.48E-06	-6.85E-06
2	0	0	1.36	1.38E-04	-133.37	-9.48E-05	-1.E-04
3	0	0	2.72	1.7E-04	-133.37	-1.17E-04	-1.23E-04
4	0	0	4.08	1.83E-04	-133.38	-1.26E-04	-1.33E-04
5	0	0	5.44	1.96E-04	-133.39	-1.34E-04	-1.42E-04
6	0	0	6.8	2.07E-04	-133.4	-1.42E-04	-1.5E-04
7	0	0	8.16	2.17E-04	-133.41	-1.49E-04	-1.57E-04
8	0	0	9.52	2.25E-04	-133.42	-1.55E-04	-1.64E-04
9	0	0	10.88	2.33E-04	-133.43	-1.6E-04	-1.69E-04
10	0	0	12.24	2.4E-04	-133.44	-1.65E-04	-1.74E-04
END	0	0	13.6	2.46E-04	-133.46	-1.69E-04	-1.78E-04
2J1	0	0	13.6	2.46E-04	-133.46	-1.69E-04	-1.78E-04
12	0	0	14.97	2.5E-04	-133.47	-1.72E-04	-1.81E-04
13	0	0	16.34	2.53E-04	-133.49	-1.74E-04	-1.84E-04
14	0	0	17.71	2.56E-04	-133.5	-1.76E-04	-1.86E-04
15	0	0	19.08	2.58E-04	-133.52	-1.78E-04	-1.87E-04
16	0	0	20.45	2.6E-04	-133.54	-1.79E-04	-1.89E-04
17	0	0	21.82	2.61E-04	-133.56	-1.8E-04	-1.89E-04
18	0	0	23.19	2.62E-04	-133.58	-1.81E-04	-1.9E-04
19	0	0	24.56	2.62E-04	-133.6	-1.81E-04	-1.9E-04
20	0	0	25.93	2.62E-04	-133.62	-1.8E-04	-1.89E-04
END	0	0	27.3	2.6E-04	-133.65	-1.8E-04	-1.88E-04
2J2	0	0	27.3	2.6E-04	-133.65	-1.8E-04	-1.88E-04
22	0	0	28.66	2.59E-04	-133.67	-1.79E-04	-1.87E-04
23	0	0	30.02	2.57E-04	-133.69	-1.78E-04	-1.86E-04
24	0	0	31.38	2.55E-04	-133.71	-1.76E-04	-1.84E-04
25	0	0	32.74	2.52E-04	-133.73	-1.74E-04	-1.82E-04
26	0	0	34.1	2.49E-04	-133.75	-1.72E-04	-1.8E-04
27	0	0	35.46	2.45E-04	-133.78	-1.7E-04	-1.77E-04
28	0	0	36.82	2.41E-04	-133.81	-1.67E-04	-1.74E-04
29	0	0	38.18	2.36E-04	-133.83	-1.63E-04	-1.7E-04
30	0	0	39.54	2.3E-04	-133.86	-1.59E-04	-1.66E-04
END	0	0	40.9	2.24E-04	-133.9	-1.55E-04	-1.61E-04
2J3	0	0	40.9	2.24E-04	-133.9	-1.55E-04	-1.61E-04
32	0	0	42.26	2.19E-04	-133.92	-1.52E-04	-1.58E-04
33	0	0	43.62	2.14E-04	-133.94	-1.48E-04	-1.54E-04
34	0	0	44.98	2.08E-04	-133.97	-1.44E-04	-1.49E-04
35	0	0	46.34	2.01E-04	-134.	-1.4E-04	-1.45E-04
36	0	0	47.7	1.94E-04	-134.03	-1.35E-04	-1.4E-04
37	0	0	49.06	1.87E-04	-134.06	-1.3E-04	-1.34E-04
38	0	0	50.42	1.79E-04	-134.09	-1.25E-04	-1.29E-04
39	0	0	51.78	1.71E-04	-134.12	-1.19E-04	-1.22E-04
40	0	0	53.14	1.62E-04	-134.16	-1.13E-04	-1.16E-04
END	0	0	54.5	1.5E-04	-134.2	-1.05E-04	-1.08E-04
2J4	0	0	54.5	1.5E-04	-134.2	-1.05E-04	-1.08E-04
42	0	0	56.06	1.43E-04	-134.23	-9.98E-05	-1.03E-04
43	0	0	57.62	1.35E-04	-134.26	-9.39E-05	-9.64E-05

**FIGURE 6B**  
**WIP MOMENT MODEL SUMMARY FOR INDIVIDUAL TOWERS**  
**TOWER 2**  
**CONTINUED**

**WIP - TOWER 2 INDIVIDUAL Con'td**

current				mag	phase	real	imaginary
no.	X	Y	Z	(amps)	(deg)	(amps)	(amps)
44	0	0	59.18	1.25E-04	-134.29	-8.75E-05	-8.97E-05
45	0	0	60.74	1.16E-04	-134.32	-8.07E-05	-8.26E-05
46	0	0	62.3	1.05E-04	-134.36	-7.35E-05	-7.52E-05
47	0	0	63.86	9.43E-05	-134.39	-6.6E-05	-6.74E-05
48	0	0	65.42	8.3E-05	-134.42	-5.81E-05	-5.93E-05
49	0	0	66.98	7.12E-05	-134.45	-4.99E-05	-5.09E-05
50	0	0	68.54	5.93E-05	-134.48	-4.15E-05	-4.23E-05
END	0	0	70.1	4.99E-05	-134.49	-3.49E-05	-3.56E-05
2J5	0	0	70.1	1.68E-05	-135.	-1.19E-05	-1.19E-05
52	1.675	0	70.1	1.07E-05	-135.09	-7.58E-06	-7.56E-06
END	3.35	0	70.1	0	0	0	0
2J5	0	0	70.1	1.67E-05	-134.76	-1.18E-05	-1.19E-05
54	-.8375	1.45059	70.1	1.06E-05	-134.81	-7.5E-06	-7.55E-06
END	-1.675	2.90119	70.1	0	0	0	0
2J5	0	0	70.1	1.63E-05	-133.69	-1.13E-05	-1.18E-05
56	-.8375	-1.45059	70.1	1.04E-05	-133.5	-7.13E-06	-7.51E-06
END	-1.675	-2.90119	70.1	0	0	0	0
GND	116.345	138.654	0	.0101825	77.68	2.17E-03	9.95E-03
58	116.345	138.654	1.36	9.85E-03	77.26	2.17E-03	9.61E-03
59	116.345	138.654	2.72	9.23E-03	76.41	2.17E-03	8.97E-03
60	116.345	138.654	4.08	9.E-03	76.09	2.16E-03	8.73E-03
61	116.345	138.654	5.44	8.82E-03	75.86	2.15E-03	8.55E-03
62	116.345	138.654	6.8	8.65E-03	75.64	2.15E-03	8.38E-03
63	116.345	138.654	8.16	8.48E-03	75.42	2.13E-03	8.2E-03
64	116.345	138.654	9.52	8.31E-03	75.22	2.12E-03	8.04E-03
65	116.345	138.654	10.88	8.14E-03	75.03	2.1E-03	7.87E-03
66	116.345	138.654	12.24	7.97E-03	74.84	2.08E-03	7.69E-03
END	116.345	138.654	13.6	7.8E-03	74.66	2.06E-03	7.52E-03
2J9	116.345	138.654	13.6	7.8E-03	74.66	2.06E-03	7.52E-03
68	116.345	138.654	14.97	7.66E-03	74.51	2.04E-03	7.38E-03
69	116.345	138.654	16.34	7.52E-03	74.38	2.02E-03	7.24E-03
70	116.345	138.654	17.71	7.37E-03	74.24	2.E-03	7.09E-03
71	116.345	138.654	19.08	7.21E-03	74.1	1.98E-03	6.94E-03
72	116.345	138.654	20.45	7.06E-03	73.96	1.95E-03	6.78E-03
73	116.345	138.654	21.82	6.89E-03	73.83	1.92E-03	6.62E-03
74	116.345	138.654	23.19	6.73E-03	73.7	1.89E-03	6.46E-03
75	116.345	138.654	24.56	6.55E-03	73.56	1.85E-03	6.29E-03
76	116.345	138.654	25.93	6.37E-03	73.42	1.82E-03	6.1E-03
END	116.345	138.654	27.3	6.18E-03	73.29	1.78E-03	5.92E-03
2J10	116.345	138.654	27.3	6.18E-03	73.29	1.78E-03	5.92E-03
78	116.345	138.654	28.66	6.03E-03	73.19	1.74E-03	5.77E-03
79	116.345	138.654	30.02	5.88E-03	73.09	1.71E-03	5.63E-03
80	116.345	138.654	31.38	5.72E-03	72.98	1.67E-03	5.47E-03
81	116.345	138.654	32.74	5.56E-03	72.88	1.64E-03	5.31E-03
82	116.345	138.654	34.1	5.39E-03	72.77	1.6E-03	5.14E-03
83	116.345	138.654	35.46	5.21E-03	72.67	1.55E-03	4.97E-03
84	116.345	138.654	36.82	5.03E-03	72.56	1.51E-03	4.8E-03
85	116.345	138.654	38.18	4.84E-03	72.46	1.46E-03	4.62E-03
86	116.345	138.654	39.54	4.64E-03	72.35	1.41E-03	4.42E-03
END	116.345	138.654	40.9	4.42E-03	72.23	1.35E-03	4.21E-03
2J11	116.345	138.654	40.9	4.42E-03	72.23	1.35E-03	4.21E-03
88	116.345	138.654	42.26	4.28E-03	72.15	1.31E-03	4.07E-03
89	116.345	138.654	43.62	4.12E-03	72.07	1.27E-03	3.92E-03
90	116.345	138.654	44.98	3.95E-03	71.99	1.22E-03	3.76E-03
91	116.345	138.654	46.34	3.78E-03	71.9	1.17E-03	3.59E-03
92	116.345	138.654	47.7	3.6E-03	71.82	1.12E-03	3.42E-03
93	116.345	138.654	49.06	3.42E-03	71.73	1.07E-03	3.25E-03
94	116.345	138.654	50.42	3.23E-03	71.64	1.02E-03	3.07E-03
95	116.345	138.654	51.78	3.04E-03	71.56	9.61E-04	2.88E-03



**FIGURE 6B**  
**WIP MOMENT MODEL SUMMARY FOR INDIVIDUAL TOWERS**  
**TOWER 2**  
**CONTINUED**

WIP - TOWER 2 INDIVIDUAL Con'td

current no.	X	Y	Z	mag (amps)	phase (deg)	real (amps)	imaginary (amps)
96	116.345	138.654	53.14	2.83E-03	71.46	9.01E-04	2.69E-03
END	116.345	138.654	54.5	2.59E-03	71.36	8.28E-04	2.45E-03
2J12	116.345	138.654	54.5	2.59E-03	71.36	8.28E-04	2.45E-03
98	116.345	138.654	56.	2.45E-03	71.29	7.85E-04	2.32E-03
99	116.345	138.654	57.5	2.28E-03	71.22	7.34E-04	2.16E-03
100	116.345	138.654	59.	2.11E-03	71.15	6.8E-04	1.99E-03
101	116.345	138.654	60.5	1.93E-03	71.08	6.24E-04	1.82E-03
102	116.345	138.654	62.	1.74E-03	71.01	5.66E-04	1.64E-03
103	116.345	138.654	63.5	1.55E-03	70.94	5.06E-04	1.46E-03
104	116.345	138.654	65.	1.36E-03	70.88	4.44E-04	1.28E-03
105	116.345	138.654	66.5	1.16E-03	70.82	3.81E-04	1.1E-03
106	116.345	138.654	68.	9.65E-04	70.77	3.18E-04	9.11E-04
END	116.345	138.654	69.5	8.18E-04	70.75	2.7E-04	7.72E-04
2J13	116.345	138.654	69.5	2.71E-04	70.75	8.93E-05	2.56E-04
108	118.016	138.656	69.5	1.73E-04	70.78	5.68E-05	1.63E-04
END	119.687	138.659	69.5	0	0	0	0
2J13	116.345	138.654	69.5	2.72E-04	70.75	8.98E-05	2.57E-04
110	115.521	137.19	69.5	1.74E-04	70.77	5.72E-05	1.64E-04
END	114.698	135.727	69.5	0	0	0	0
2J13	116.345	138.654	69.5	2.75E-04	70.75	9.05E-05	2.59E-04
112	115.494	140.113	69.5	1.75E-04	70.78	5.75E-05	1.65E-04
END	114.643	141.573	69.5	0	0	0	0

**FIGURE 7**  
**WIP DERIVED DIRECTIONAL PARAMETERS**

<u>Tower</u>	Normalized Base Current Moment		Base Network Input/Output		Normalized TCT Value	
	<u>Ratio</u>	<u>Phase</u>	<u>Ratio</u>	<u>Phase</u>	<u>Ratio</u>	<u>Phase</u>
1	1.000	0.0°	1.0092	+0.1°	1.000	0.0°
2	.673	-0.7°	1.0101	+0.1°	.674	-0.7°

## FIGURE 8

### WIP MOMENT MODEL ARRAY SYNTHESIS

#### MEDIUM WAVE ARRAY SYNTHESIS FROM FIELD RATIOS

Frequency = .61 MHz

	field ratio	
tower	magnitude	phase (deg)
1	1.54	0
2	1.	0

#### VOLTAGES AND CURRENTS - rms

source voltage			current	
node	magnitude	phase (deg)	magnitude	phase (deg)
1	1,209.7	-76.23	18.3489	4.17
57	878.301	-79.89	12.4271	3.28

Sum of square of source currents = 982.23

Total power = 5,000. watts

#### TOWER ADMITTANCE MATRIX

admittance	real (mhos)	imaginary (mhos)
Y(1, 1)	.00339788	.0154716
Y(1, 2)	-.00114843	-.000785242
Y(2, 1)	-.00114842	-.000785236
Y(2, 2)	.0031929	.0152287

#### TOWER IMPEDANCE MATRIX

impedance	real (ohms)	imaginary (ohms)
Z(1, 1)	13.0626	-61.7879
Z(1, 2)	-2.98045	-4.79593
Z(2, 1)	-2.98047	-4.79597
Z(2, 2)	12.6988	-63.0256

**FIGURE 9**  
**WIP MOMENT MODEL SUMMARY FOR DIRECTIONAL MODE**

WIP DIRECTIONAL

GEOMETRY

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

wire	caps	Radius	Angle	Z	radius	segs
1	none	0	0	0	3.0076	10
		0	0	13.6		
2	none	0	0	13.6	2.381	10
		0	0	27.3		
3	none	0	0	27.3	1.7544	10
		0	0	40.9		
4	none	0	0	40.9	1.1278	10
		0	0	54.5		
5	none	0	0	54.5	.5013	10
		0	0	70.1		
6	none	0	0	70.1	.1	2
		3.35	0	70.1		
7	none	0	0	70.1	.1	2
		3.35	120.	70.1		
8	none	0	0	70.1	.1	2
		3.35	240.	70.1		
9	none	181.	50.	0	3.0076	10
		181.	50.	13.6		
10	none	181.	50.	13.6	2.381	10
		181.	50.	27.3		
11	none	181.	50.	27.3	1.7544	10
		181.	50.	40.9		
12	none	181.	50.	40.9	1.1278	10
		181.	50.	54.5		
13	none	181.	50.	54.5	.5013	10
		181.	50.	69.5		
14	none	181.	50.	69.5	.1	2
		183.17	49.2	69.5		
15	none	181.	50.	69.5	.1	2
		177.7	49.8	69.5		
16	none	181.	50.	69.5	.1	2
		182.17	51.	69.5		

Number of wires = 16  
current nodes = 112

	minimum	maximum
Individual wires	wire value	wire value
segment length	16 1.68914	4 1.36
radius	6 .1	1 3.0076

ELECTRICAL DESCRIPTION

Frequencies ( MHz)

no.	frequency	step	no. of steps	segment length (wavelengths)
	lowest			minimum maximum
1	.61	0	1	3.78E-03 4.69E-03

Sources

source	node	sector	magnitude	phase	type
1	1	1	1,710.77	-76.23	voltage
2	57	1	1,242.11	-79.89	voltage

IMPEDANCE

normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR dB	S11 dB	S12 dB
source = 1; node 1, sector 1							

# **FIGURE 9** **WIP MOMENT MODEL SUMMARY FOR DIRECTIONAL MODE** **CONTINUED**

## WIP DIRECTIONAL Cont'd

.61      12.889    -70.22    71.393    -79.6    11.703    -1.488    -16.058  
source =    2; node 57, sector 1  
.61      9.9899    -76.395    77.045    -82.55    16.83    -1.0334    -19.002

Parallel combination of all sources.  
.61      5.78698    -36.6134    37.0679    -81.02    13.314    -1.3073    -17.094

## CURRENT rms

Frequency    = .61 MHz

Input power   = 5,000. watts

Efficiency    = 100. %

current	no.	X	Y	Z	mag (amps)	phase (deg)	real (amps)	imaginary (amps)
GND	0	0	0	0	16.9465	3.37	16.9173	.994739
2	0	0	0	1.36	16.3709	3.	16.3485	.857316
3	0	0	0	2.72	15.3022	2.26	15.2903	.603064
4	0	0	0	4.08	14.9033	1.98	14.8945	.513991
5	0	0	0	5.44	14.6027	1.77	14.5957	.451631
6	0	0	0	6.8	14.3079	1.58	14.3025	.393586
7	0	0	0	8.16	14.0195	1.39	14.0153	.340033
8	0	0	0	9.52	13.736	1.21	13.733	.290739
9	0	0	0	10.88	13.4512	1.04	13.449	.244532
10	0	0	0	12.24	13.1573	.87	13.1558	.200144
END	0	0	0	13.6	12.8704	.71	12.8694	.159599
2J1	0	0	0	13.6	12.8704	.71	12.8694	.159599
12	0	0	0	14.97	12.6334	.58	12.6328	.128461
13	0	0	0	16.34	12.3987	.46	12.3983	.099959
14	0	0	0	17.71	12.1508	.34	12.1506	.0719688
15	0	0	0	19.08	11.8943	.22	11.8942	.0451079
16	0	0	0	20.45	11.6309	.1	11.6309	.0195904
17	0	0	0	21.82	11.3604	-.02	11.3604	-4.57E-03
18	0	0	0	23.19	11.0823	-.14	11.0823	-.0274211
19	0	0	0	24.56	10.7943	-.26	10.7942	-.0490998
20	0	0	0	25.93	10.4861	-.38	10.4858	-.0701904
END	0	0	0	27.3	10.1717	-.51	10.1713	-.0898461
2J2	0	0	0	27.3	10.1717	-.51	10.1713	-.0898461
22	0	0	0	28.66	9.93173	-.6	9.93119	-.103439
23	0	0	0	30.02	9.68592	-.69	9.68523	-.115968
24	0	0	0	31.38	9.42323	-.78	9.42236	-.128055
25	0	0	0	32.74	9.15101	-.87	9.14995	-.139228
26	0	0	0	34.1	8.87045	-.97	8.86919	-.149402
27	0	0	0	35.46	8.58177	-1.06	8.5803	-.158536
28	0	0	0	36.82	8.28446	-1.15	8.28278	-.166612
29	0	0	0	38.18	7.97761	-1.25	7.97572	-.173624
30	0	0	0	39.54	7.65075	-1.35	7.64864	-.179665
END	0	0	0	40.9	7.29568	-1.45	7.29334	-.184773
2J3	0	0	0	40.9	7.29568	-1.45	7.29334	-.184773
32	0	0	0	42.26	7.05886	-1.52	7.05638	-.187273
33	0	0	0	43.62	6.80222	-1.59	6.79959	-.189072
34	0	0	0	44.98	6.52986	-1.67	6.52709	-.19007
35	0	0	0	46.34	6.24819	-1.74	6.2453	-.190152
36	0	0	0	47.7	5.95821	-1.82	5.95521	-.189285
37	0	0	0	49.06	5.66024	-1.9	5.65714	-.187435
38	0	0	0	50.42	5.35388	-1.98	5.35069	-.184569
39	0	0	0	51.78	5.03717	-2.05	5.03393	-.180624
40	0	0	0	53.14	4.70885	-2.14	4.70558	-.175544
END	0	0	0	54.5	4.31322	-2.23	4.30994	-.168126
2J4	0	0	0	54.5	4.31322	-2.23	4.30994	-.168126
42	0	0	0	56.06	4.07363	-2.29	4.07037	-.162919

**FIGURE 9**  
**WIP MOMENT MODEL SUMMARY FOR DIRECTIONAL MODE**  
**CONTINUED**

**WIP DIRECTIONAL Cont'd**

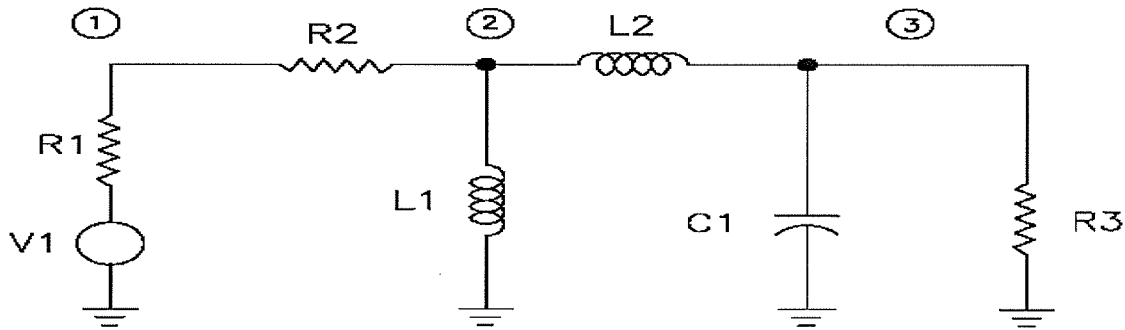
current				mag	phase	real	imaginary
no.	X	Y	Z	(amps)	(deg)	(amps)	(amps)
43	0	0	57.62	3.79207	-2.36	3.78886	-.156026
44	0	0	59.18	3.49661	-2.42	3.49348	-.14794
45	0	0	60.74	3.19109	-2.49	3.18807	-.138711
46	0	0	62.3	2.87732	-2.56	2.87446	-.128353
47	0	0	63.86	2.5564	-2.62	2.55373	-.116872
48	0	0	65.42	2.22949	-2.68	2.22705	-.104285
49	0	0	66.98	1.89952	-2.74	1.89736	-.0906926
50	0	0	68.54	1.57055	-2.78	1.56869	-.0762367
END	0	0	70.1	1.31727	-2.8	1.3157	-.0643636
2J5	0	0	70.1	.438984	-2.77	.43847	-.0212211
52	1.675	0	70.1	.280014	-2.74	.279693	-.0133996
END	3.35	0	70.1	0	0	0	0
2J5	0	0	70.1	.439035	-2.78	.438517	-.0213316
54	-.8375	1.45059	70.1	.280054	-2.76	.279729	-.0134852
END	-1.675	2.90119	70.1	0	0	0	0
2J5	0	0	70.1	.43925	-2.85	.438709	-.0218109
56	-.8375	-1.45059	70.1	.280219	-2.83	.279876	-.0138549
END	-1.675	-2.90119	70.1	0	0	0	0
GND	116.345	138.654	0	11.4013	2.66	11.389	.528732
58	116.345	138.654	1.36	10.9804	2.38	10.971	.45515
59	116.345	138.654	2.72	10.1988	1.79	10.1938	.319018
60	116.345	138.654	4.08	9.90874	1.57	9.90502	.271354
61	116.345	138.654	5.44	9.69147	1.41	9.68855	.238008
62	116.345	138.654	6.8	9.47929	1.25	9.47703	.206986
63	116.345	138.654	8.16	9.27267	1.1	9.27095	.178384
64	116.345	138.654	9.52	9.0706	.96	9.06933	.152077
65	116.345	138.654	10.88	8.86848	.82	8.86756	.127438
66	116.345	138.654	12.24	8.66098	.69	8.66036	.103791
END	116.345	138.654	13.6	8.45913	.56	8.45873	.0822133
2J9	116.345	138.654	13.6	8.45913	.56	8.45873	.0822133
68	116.345	138.654	14.97	8.29316	.45	8.2929	.065658
69	116.345	138.654	16.34	8.12948	.36	8.12932	.0505233
70	116.345	138.654	17.71	7.95727	.26	7.95719	.0356766
71	116.345	138.654	19.08	7.77971	.16	7.77968	.0214477
72	116.345	138.654	20.45	7.59801	.06	7.598	7.95E-03
73	116.345	138.654	21.82	7.41194	-.04	7.41194	-4.81E-03
74	116.345	138.654	23.19	7.22137	-.13	7.22135	-.0168588
75	116.345	138.654	24.56	7.02456	-.23	7.02451	-.0282662
76	116.345	138.654	25.93	6.81459	-.33	6.81447	-.0393388
END	116.345	138.654	27.3	6.60094	-.43	6.60075	-.0496335
2J10	116.345	138.654	27.3	6.60094	-.43	6.60075	-.0496335
78	116.345	138.654	28.66	6.43833	-.5	6.43808	-.0567341
79	116.345	138.654	30.02	6.27218	-.58	6.27186	-.0632581
80	116.345	138.654	31.38	6.09501	-.65	6.09461	-.0695316
81	116.345	138.654	32.74	5.91184	-.73	5.91136	-.0753075
82	116.345	138.654	34.1	5.72348	-.81	5.72291	-.0805414
83	116.345	138.654	35.46	5.53006	-.88	5.5294	-.0852118
84	116.345	138.654	36.82	5.33131	-.96	5.33057	-.0893093
85	116.345	138.654	38.18	5.12655	-1.04	5.12571	-.0928304
86	116.345	138.654	39.54	4.90884	-1.12	4.90791	-.0958176
END	116.345	138.654	40.9	4.67281	-1.21	4.67178	-.0982858
2J11	116.345	138.654	40.9	4.67281	-1.21	4.67178	-.0982858
88	116.345	138.654	42.26	4.51568	-1.26	4.51459	-.0994484
89	116.345	138.654	43.62	4.34566	-1.32	4.34451	-.100224
90	116.345	138.654	44.98	4.1655	-1.38	4.16429	-.100562
91	116.345	138.654	46.34	3.97949	-1.45	3.97822	-.100407
92	116.345	138.654	47.7	3.78827	-1.51	3.78696	-.0997426
93	116.345	138.654	49.06	3.59206	-1.57	3.59071	-.098551
94	116.345	138.654	50.42	3.3906	-1.64	3.38922	-.0968141

**FIGURE 9**  
**WIP MOMENT MODEL SUMMARY FOR DIRECTIONAL MODE**  
**CONTINUED**

**WIP DIRECTIONAL Cont'd**

current no.	X	Y	Z	mag (amps)	phase (deg)	real (amps)	imaginary (amps)
95	116.345	138.654	51.78	3.18262	-1.7	3.18122	-.0944987
96	116.345	138.654	53.14	2.96736	-1.77	2.96595	-.0915766
END	116.345	138.654	54.5	2.70783	-1.85	2.70642	-.0873574
2J12	116.345	138.654	54.5	2.70783	-1.85	2.70642	-.0873574
98	116.345	138.654	56.	2.55811	-1.89	2.55671	-.0845682
99	116.345	138.654	57.5	2.38224	-1.95	2.38087	-.0809156
100	116.345	138.654	59.	2.19778	-2.	2.19645	-.0766674
101	116.345	138.654	60.5	2.00731	-2.05	2.00602	-.0718556
102	116.345	138.654	62.	1.812	-2.1	1.81078	-.0664912
103	116.345	138.654	63.5	1.6126	-2.15	1.61146	-.0605799
104	116.345	138.654	65.	1.40991	-2.2	1.40887	-.0541354
105	116.345	138.654	66.5	1.20591	-2.24	1.20499	-.0472159
106	116.345	138.654	68.	1.00301	-2.28	1.00221	-.0398908
END	116.345	138.654	69.5	.849595	-2.29	.848915	-.0339951
2J13	116.345	138.654	69.5	.281476	-2.36	.281236	-.0116144
108	118.016	138.656	69.5	.179549	-2.36	.179397	-7.4E-03
END	119.687	138.659	69.5	0	0	0	0
2J13	116.345	138.654	69.5	.28281	-2.18	.282604	-.0107761
110	115.521	137.19	69.5	.180195	-2.14	.180069	-6.74E-03
END	114.698	135.727	69.5	0	0	0	0
2J13	116.345	138.654	69.5	.285311	-2.33	.285075	-.0116046
112	115.494	140.113	69.5	.181627	-2.32	.181478	-7.36E-03
END	114.643	141.573	69.5	0	0	0	0

**FIGURE 10**  
**WIP TOWER BASE CIRCUIT ANALYSIS MODEL**



The above circuit was analyzed with the Engineering Circuit Analysis program (ECA) for each Tower. Resistors R1 (100k  $\Omega$ ) and R2 (0.1  $\Omega$ ) were located in the circuit for measurement locations of impedance and current.

For each of the individual Tower impedance calculations, the complex value of R3 was that obtained from the program Expert Mininec Broadcast Professional Version 6.0 for that specific Tower. The input impedance to the circuit was calculated to represent the value at the test jack located at the Antenna Tuning Unit (ATU) output.

In the case of the Directional Array, the complex value of R3 for each Tower was set to the Expert Mininec Broadcast Professional Version 6.0 calculated impedance at each source location. The current magnitude and phase variation was calculated for each Tower from the input to the output of each circuit. These values, once normalized, were used to modify the calculated source current magnitude and phase to determine the sampling TCT values.



# **FIGURE 11A** **WIP CIRCUIT ANALYSIS FOR INDIVIDUAL TOWERS**

## WIP TOWER 1 (OTHER OPEN)

BRANCH	LABEL	NODES	VALUE
1	V1	0 0	100.
2	R1	1 0	100.K
3	R2	1 2	0.1
4	L1	2 0	0.0083491
5	L2	2 3	5.22u
6	C1	3 0	40.p
7	R3	3 0	15.2 J-66.4

FREQ.	PROBE	VALUE	dB	PHASE	PHASE DELAY
610.K	V:1	0.0482143	-26.336	-71.803	326.972n
610.K	V:2	0.0481833	-26.342	-71.916	327.487n
610.K	V:3	0.0675173	-23.412	-77.185	351.482n
610.K	Z:R1	48.2143	16.832	-71.803	326.972n

$$Z \text{ (IN)} = 15.1 -j 45.8$$

# **FIGURE 11B** **WIP CIRCUIT ANALYSIS FOR INDIVIDUAL TOWERS**

## WIP TOWER 2 (OTHER OPEN)

BRANCH	LABEL	NODES	VALUE
1	V1	0 0	100.
2	R1	1 0	100.K
3	R2	1 2	0.1
4	L1	2 0	0.0083491
5	L2	2 3	6.65u
6	C1	3 0	40.p
7	R3	3 0	14.8      j-67.8

FREQ.	PROBE	VALUE	dB	PHASE	PHASE DELAY
610.K	V:1	0.0441823	-27.095	-70.635	321.654n
610.K	V:2	0.0441493	-27.102	-70.758	322.212n
610.K	V:3	0.0687619	-23.253	-77.765	354.121n
610.K	Z:R1	44.1823	16.452	-70.635	321.654n

$$Z \text{ (IN)} = 14.7 -j \text{ 41.7}$$

**FIGURE 12A**  
**WIP CIRCUIT ANALYSIS FOR DIRECTIONAL MODE**

**WIP TOWER 1 DIRECTIONAL**

BRANCH	LABEL	NODES	VALUE	
1	V1	0 0	100.	
2	R1	1 0	100.K	
3	R2	1 2	0.1	
4	L1	2 0	0.0083491	
5	L2	2 3	5.22u	
6	C1	3 0	40.p	
7	R3	3 0	12.9	j-70.2

FREQ.	PROBE	VALUE	dB	PHASE	PHASE DELAY
610.K	V:1	0.0511537	-25.822	-75.522	343.908n
610.K	V:2	0.0511288	-25.827	-75.631	344.402n
610.K	V:3	0.0707156	-23.010	-79.649	362.698n
610.K	Z:R1	51.1537	17.089	-75.522	343.908n
610.K	I:R2	999.872u	-60.001	0.028	-129.243p
610.K	I:R3	990.756u	-60.081	-0.061	278.151p

Z (IN) = 12.8 -j 49.5

I (IN/OUT) = 1.0092, +0.1 DEG.

**FIGURE 12B**  
**WIP CIRCUIT ANALYSIS FOR DIRECTIONAL MODE**

WIP TOWER 2 DIRECTIONAL

BRANCH	LABEL	NODES	VALUE	
1	V1	0 0	100.	
2	R1	1 0	100.K	
3	R2	1 2	0.1	
4	L1	2 0	0.0083491	
5	L2	2 3	6.65u	
6	C1	3 0	40.p	
7	R3	3 0	10.	J-76.4

FREQ.	PROBE	VALUE	dB	PHASE	PHASE DELAY
610.K	V:1	0.0510814	-25.835	-78.797	358.82n
610.K	V:2	0.0510621	-25.838	-78.907	359.321n
610.K	V:3	0.0762713	-22.353	-82.584	376.063n
610.K	Z:R1	51.0814	17.083	-78.797	358.82n
610.K	I:R2	999.901u	-60.001	0.029	-130.75p
610.K	I:R3	989.872u	-60.088	-0.041	184.837p

Z (IN) = 9.9 -j 50.1

I (IN/OUT) = 1.0101, +0.1 DEG.

**FIGURE 13**  
**WIP REFERENCE FIELD INTENSITY MEASUREMENTS**

**WIP REFERENCE POINT MEASUREMENTS – FEBRUARY 3, 2010**

<u>Radial</u>		<u>Dist</u> <u>km</u>	<u>mV/m</u>	<u>Time</u>	<u>CO-ORD NAD27</u>			<u>Description</u>
					<u>Deg</u>	<u>Min</u>	<u>Sec</u>	
<b>N 44 E</b>	1	2.82	56.5	1145	N 39 W 75	53 5	1.2 11.2	NJ 168 behind Midas Muffler shop -- on edge of grass in line with home plate of softball field
	2	3.16	67.0	1153	N 39 W 755	53 5	8.6 0.2	Near int of Lake + Maple on sidewalk next to creek at end of guard rail
	3	3.83	41.5	1200	N 39 W 75	53 4	25.1 41.9	N side of Cedarcroft @ Audubon -- on sidewalk in front of house #125
	1	2.92	52.0	1223	N 39 W 75	52 4	48.3 51.4	Wayne + St. Martins -- NE corner @ street sign
	2	3.99	39.0	1216	N 39 W 75	53 4	8.5 14.6	Walnut S of Wyoming -- E sidewalk in front of wooden garage building
	3	4.61	35.8	1209	N 39 W 75	53 3	19.3 52.4	On sidewalk in front of 23 W. Vassar
	1	3.55	213.0	1249	N 39 W 75	50 4	27.9 57.0	At driveway 932 Evesham
	2	4.35	180.0	1255	N 39 W 75	50 4	7.8 35.8	Ridge + Front @ street sign + pole 5176
	3	5.04	163.0	1303	N 39 W 75	49 4	50.6 17.3	Cemetery entrance off Lower Landing Rd -- at drain inside gate

**FIGURE 13**  
**WIP REFERENCE FIELD INTENSITY MEASUREMENTS**  
**CONTINUED**

**WIP REFERENCE POINT MEASUREMENTS – FEBRUARY 3, 2010**

<u>Radial</u>		<u>Dist km</u>	<u>mV/m</u>	<u>Time</u>	<u>CO-ORD NAD27</u>			<u>Description</u>
					<u>Deg</u>	<u>Min</u>	<u>Sec</u>	
<b>N 218 E</b>	1	4.49	43.0	1328	N 39 W 75	50 8	0.9 29.5	Between 510 + 532 Cooper -- 15' W of pole # 61965WB on sidewalk
	2	5.41	38.7	1340	N 39 W 75	49 8	37.4 53.5	On sidewalk in front of house "33 Andy Snyder" (at corner of Elm)
	3	6.21	39.0	1347	N 39 W 75	49 9	16.6 13.3	At driveway of 425 Holly
	1	3.99	41.5	1429	N 39 W 75	50 9	54.7 1.6	On sidewalk in front of 107 Hess
	2	4.68	49.0	1423	N 39 W 75	50 9	44.5 27.8	On sidewalk in front of 20 Lynn
	3	5.58	29.5	1403	N 39 W 75	50 10	30.7 0.9	Childs N of Delaware -- on E sidewalk at first tree past speed limit sign
<b>N 320 E</b>	1	6.15	144.0	1506	N 39 W 75	54 9	27.9 19.9	Packer Ave @ produce market (terminal) entrance @ stop sign
	2	7.34	85.0	1516	N 39 W 75	54 9	56.8 53.2	10th + Oregon on S sidewalk 20' E of 10th
	3	8.10	99.0	1525	N 39 W 75	55 10	14.6 15.5	Broad + Ritner NW corner