**Fletcher, Heald & Hildreth**

1300 NORTH 17th STREET, 11th FLOOR
ARLINGTON, VIRGINIA 22209

OFFICE: (703) 812-0400
FAX: (703) 812-0486
www.fhhlaw.com
www.commlawblog.com

ORIGINAL

2018 APR 19 PM 12:52

MARK N. LIPP
(703) 812-0445
LIPP@FHHLAW.COM

April 17, 2018

Accepted / Filed

APR 17 2018

Federal Communications Commission
Office of the Secretary

Marlene H. Dortch, Esq.
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

**Attention: Media Bureau**

Re: Application for Modification of Moment Method License on FCC Form 302-AM
Multicultural Radio Broadcasting License, LLC
Station WZRC(AM), New York, NY
Facility Identifier Number 27398

Dear Ms. Dortch:

Transmitted herewith on behalf of Multicultural Radio Broadcasting Licensee, LLC ("MRBL"), the licensee of Station WZRC(AM) identified above, are an original and two copies of its application for modification of the license for its directional antenna system. This Form 302-AM specifies new directional antenna parameters based on a Method of Moments proof-of-performance.

The associated filing fees totaling $1,505.00 were paid using FCC Fee Filer and proof of payment is included as part of this submission.

If there are any questions about his Application, please contact undersigned counsel for Multicultural Radio Broadcasting Licensee, LLC.

Sincerely,

Mark Lipp

Enclosures

cc: Mr. Jerome Manarchuck, Audio Division, Media Bureau, FCC

# Agency Tracking ID:PGC3084128
# Authorization Number:249851
# Successful Authorization -- Date Paid: 4/17/18
# FILE COPY ONLY!!

| READ INSTRUCTIONS CAREFULLY BEFORE PROCEEDING<br>(1) LOCKBOX #**979089** | FEDERAL COMMUNICATIONS COMMISSION<br>**REMITTANCE ADVICE**<br>**FORM 159**<br>PAGE NO 1 OF 1 | APPROVED BY OMB 3060-059<br>SPECIAL USE<br>FCC USE ONLY |
|---|---|---|

**SECTION A - Payer Information**

| (2) PAYER NAME (if paying by credit card, enter name exactly as it appears on your card) | (3) TOTAL AMOUNT PAID (dollars and cents) |
|---|---|
| **Multicultural Radio Broadcasting Licensee, LLC** | **$700.00** |

(4) STREET ADDRESS LINE NO. 1
**27 William Street**

(5) STREET ADDRESS LINE NO. 2
**11th Floor**

| (6) CITY | (7) STATE | (8) ZIP CODE |
|---|---|---|
| **New York** | **NY** | **10005** |

| (9) DAYTIME TELEPHONE NUMBER (INCLUDING AREA CODE) | (10) COUNTRY CODE (IF NOT IN U.S.A.) |
|---|---|
| **212-9661059** | **US** |

**FCC REGISTRATION NUMBER (FRN) AND TAX IDENTIFICATION NUMBER (TIN) REQUIRED**

| (11) PAYER (FRN) | (12) FCC USE ONLY |
|---|---|
| **0010215812** | |

**IF PAYER NAME AND THE APPLICANT NAME ARE DIFFERENT, COMPLETE SECTION B**
**IF MORE THAN ONE APPLICANT, USE CONTINUATION SHEETS (FORM 159-C)**

(13) APPLICANT NAME
**Multicultural Radio Broadcasting Licensee, LLC**

(14) STREET ADDRESS LINE NO. 1
**27 William Street**

(15) STREET ADDRESS LINE NO. 2
**11th Floor**

| (16) CITY | (17) STATE | (18) ZIP CODE |
|---|---|---|
| **New York** | **NY** | **10005** |

| (19) DAYTIME TELEPHONE NUMBER (INCLUDING AREA CODE) | (20) COUNTRY CODE (IF NOT IN U.S.A.) |
|---|---|
| **212-9661059** | **US** |

**FCC REGISTRATION NUMBER (FRN) AND TAX IDENTIFICATION NUMBER (TIN) REQUIRED**

| (21) APPLICANT (FRN) | (22) FCC USE ONLY |
|---|---|
| **0010215812** | |

**COMPLETE SECTION C FOR EACH SERVICE, IF MORE BOXES ARE NEEDED, USE CONTINUATION SHEET**

| (23A) FCC Call Sign/Other ID | (24A) Payment Type Code(PTC) | (25A) Quantity |
|---|---|---|
| **WZRC** | **MMR** | **1** |

| (26A) Fee Due for (PTC) | (27A) Total Fee | FCC Use Only |
|---|---|---|
| **$700.00** | **$700.00** | |

| (28A) FCC CODE 1 | (29A) FCC CODE 2 |
|---|---|
| **27398** | **NY,NEWYORK** |

| (23B) FCC Call Sign/Other ID | (24B) Payment Type Code(PTC) | (25B) Quantity |
|---|---|---|
| (26B) Fee Due for (PTC) | (27B) Total Fee | FCC Use Only |

| (28B) FCC CODE 1 | (29B) FCC CODE 2 |
|---|---|

Federal Communications Commission

Fee Filer System

## Fee Filer System



Logged in as FRN: Multicultural Radio Broadcasting Licensee, LLC (0010215812) [Log Out]



# Submission Confirmation

You successfully filed your application fee obligation. The Remittance ID associated with this filling is **3084128**. Submitting fee information and paying fees are two separate actions. You have not yet paid your fee. Click Continue to pay online or print Form 159. If you choose to mail your payment to the FCC rather than pay online, you must print and include Form 159 with your payment.

**Total Amount: $700.00**

CONTINUE GENERATE REPORT APP FEE MANAGER

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**Customer Service**



**Financial Operations Help Desk: (877) 480-3201, option 6; (Mon.-Fri. 8 a.m.-6:00 p.m. ET)**

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Federal Communications Commission

# Fee Filer

FCC | Fees | Fee Filer

## Report for Submitted Fees

**Report Date : 04/17/2018 12:10:05**

- The FCC has not yet received payment for the fees reflected in this report. Click here to continue to pay online or print your Form 159-E.
- Proceed to the Payment Selection screen to pay online by credit card, ACH payment, or wire transfer.

**Payer FRN : 0010215812** **Payer Name :Multicultural Radio Broadcasting License** PRINT
**Remittance ID: 3084128**
**Amount filed : $700.00**

| Licensee : Multicultural Radio Broadcasting Licensee, LLC (FRN: 0010215812) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Call Sign | P T C | Quantity | FCC Code 1 | FCC Code 2 | Bill Number | Amount | Late Fees |
| WZRC | MMR | 1 | 27398 | NY, NEW YORK | N/A | $700.00 | $0.00 |
| **Total:** | ***** | **1** | ******** | ******** | ******** | **$700.00** | **$0.00** |

CLOSE PRINT

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**Customer Service**

Frequently Asked Questions | Fee Filer Help | Filing Resources | Web Policies / Privacy Policy | Paperwork Reduction Act

**Financial Operations Help Desk: (877) 480-3201, option 6; (Mon.-Fri. 8 a.m.-6:00 p.m. ET)**

Fee Filer has a dedicated staff of customer service representatives standing by to answer your questions or concerns.
You can email us at arinquiries@fcc.gov.

# Agency Tracking ID:PGC3084136
# Authorization Number:228720
# Successful Authorization -- Date Paid: 4/17/18
# FILE COPY ONLY!!

| READ INSTRUCTIONS CAREFULLY BEFORE PROCEEDING<br>(1) LOCKBOX #**979089** | FEDERAL COMMUNICATIONS COMMISSION<br>**REMITTANCE ADVICE**<br>**FORM 159**<br>PAGE NO 1 OF 1 | APPROVED BY OMB 3060-059<br>SPECIAL USE<br>FCC USE ONLY |
|---|---|---|

**SECTION A - Payer Information**

| (2) PAYER NAME (if paying by credit card, enter name exactly as it appears on your card) | (3) TOTAL AMOUNT PAID (dollars and cents) |
|---|---|
| **Multicultural Radio Broadcasting Licensee, LLC** | **$805.00** |

(4) STREET ADDRESS LINE NO. 1
**27 William Street**

(5) STREET ADDRESS LINE NO. 2
**11th Floor**

| (6) CITY | (7) STATE | (8) ZIP CODE |
|---|---|---|
| **New York** | **NY** | **10005** |

| (9) DAYTIME TELEPHONE NUMBER (INCLUDING AREA CODE) | (10) COUNTRY CODE (IF NOT IN U.S.A.) |
|---|---|
| **212-9661059** | **US** |

**FCC REGISTRATION NUMBER (FRN) AND TAX IDENTIFICATION NUMBER (TIN) REQUIRED**

| (11) PAYER (FRN) | (12) FCC USE ONLY |
|---|---|
| **0010215812** | |

**IF PAYER NAME AND THE APPLICANT NAME ARE DIFFERENT, COMPLETE SECTION B**
**IF MORE THAN ONE APPLICANT, USE CONTINUATION SHEETS (FORM 159-C)**

(13) APPLICANT NAME
**Multicultural Radio Broadcasting Licensee, LLC**

(14) STREET ADDRESS LINE NO. 1
**27 William Street**

(15) STREET ADDRESS LINE NO. 2
**11th Floor**

| (16) CITY | (17) STATE | (18) ZIP CODE |
|---|---|---|
| **New York** | **NY** | **10005** |

| (19) DAYTIME TELEPHONE NUMBER (INCLUDING AREA CODE) | (20) COUNTRY CODE (IF NOT IN U.S.A.) |
|---|---|
| **212-9661059** | **US** |

**FCC REGISTRATION NUMBER (FRN) AND TAX IDENTIFICATION NUMBER (TIN) REQUIRED**

| (21) APPLICANT (FRN) | (22) FCC USE ONLY |
|---|---|
| **0010215812** | |

**COMPLETE SECTION C FOR EACH SERVICE, IF MORE BOXES ARE NEEDED, USE CONTINUATION SHEET**

| (23A) FCC Call Sign/Other ID | (24A) Payment Type Code(PTC) | (25A) Quantity |
|---|---|---|
| **WZRC** | **MOR** | **1** |

| (26A) Fee Due for (PTC) | (27A) Total Fee | FCC Use Only |
|---|---|---|
| **$805.00** | **$805.00** | |

| (28A) FCC CODE 1 | (29A) FCC CODE 2 |
|---|---|
| **27398** | **NY,NEWYORK302-AM** |

| (23B) FCC Call Sign/Other ID | (24B) Payment Type Code(PTC) | (25B) Quantity |
|---|---|---|
| (26B) Fee Due for (PTC) | (27B) Total Fee | FCC Use Only |

| (28B) FCC CODE 1 | (29B) FCC CODE 2 |
|---|---|

Federal Communications Commission

# Fee Filer

FCC | Fees | Fee Filer

## Report for Submitted Fees

**Report Date : 04/17/2018 12:12:37**

- The FCC has not yet received payment for the fees reflected in this report. Click here to continue to pay online or print your Form 159-E.
- Proceed to the Payment Selection screen to pay online by credit card, ACH payment, or wire transfer.

**Payer FRN : 0010215812** **Payer Name :Multicultural Radio Broadcasting License** PRINT
**Remittance ID: 3084136**
**Amount filed : $805.00**

| Licensee : Multicultural Radio Broadcasting Licensee, LLC (FRN: 0010215812) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Call Sign | P T C | Quantity | FCC Code 1 | FCC Code 2 | Bill Number | Amount | Late Fees |
| WZRC | MOR | 1 | 27398 | NY, NEW YORK 302-AM | N/A | $805.00 | $0.00 |
| **Total:** | ***** | **1** | ******** | ******** | ******** | **$805.00** | **$0.00** |

CLOSE PRINT

**Customer Service**

Frequently Asked Questions | Fee Filer Help | Filing Resources | Web Policies / Privacy Policy | Paperwork Reduction Act

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Federal Communications Commission

Fee Filer System

## Fee Filer System

Main Menu | Submission Confirmation

Logged in as FRN: Multicultural Radio Broadcasting Licensee, LLC (0010215812) [Log Out] Back | Print | Help

# Submission Confirmation

You successfully filed your application fee obligation. The Remittance ID associated with this filling is **3084136**. Submitting fee information and paying fees are two separate actions. You have not yet paid your fee. Click Continue to pay online or print Form 159. If you choose to mail your payment to the FCC rather than pay online, you must print and include Form 159 with your payment.

**Total Amount: $805.00**

CONTINUE GENERATE REPORT APP FEE MANAGER

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**Customer Service**

Frequently Asked Questions | Fee Filer Help | Filing Resources | Web Policies / Privacy Policy | Paperwork Reduction Act

**Financial Operations Help Desk: (877) 480-3201, option 6; (Mon.-Fri. 8 a.m.-6:00 p.m. ET)**

Fee Filer has a dedicated staff of customer service representatives standing by to answer your questions or concerns. You can email us at arinquiries@fcc.gov.

Accepted / Filed

APR 17 2018

Federal Communications Commission
Office of the Secretary

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. BNML-20180417AAZ

## SECTION I - APPLICANT FEE INFORMATION

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

Multicultural Radio Broadcasting Licensee, LLC

MAILING ADDRESS (Line 1) (Maximum 35 characters)
40 Exchange Place

MAILING ADDRESS (Line 2) (Maximum 35 characters)
11th Floor

| CITY | STATE OR COUNTRY (if foreign address) | ZIP CODE |
|---|---|---|
| New York | NY | 10005 |

| TELEPHONE NUMBER (include area code) | CALL LETTERS | OTHER FCC IDENTIFIER (If applicable) |
|---|---|---|
| 2124314300 | WZRC | 27398 |

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): Filing fees paid using FCC Fee Filer.

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 |
|---|---|---|---|
| | 0001 | $ | |

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 |
|---|---|---|---|
| | 0001 | $ | |

| | 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. | $ | |

| SECTION II - APPLICANT INFORMATION | | |
|---|---|---|
| 1. NAME OF APPLICANT<br>Multicultural Radio Broadcasting Licensee, LLC | | |
| MAILING ADDRESS<br>40 Exchange Place 11th Floor | | |
| CITY<br>New York | STATE<br>NY | ZIP CODE<br>10005 |

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 |
|---|---|---|---|---|
| WZRC | New York | N/A | N/A | N/A |

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. A

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. N/A

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. N/A

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.

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 | |
|---|---|---|
| Arthur Liu | | |
| Title | Date | Telephone Number |
| President | 4/17/2018 | 212-431-4300 |

**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.

**Exhibit A to Form 302-AM**
**Response to Question 3, Section II**

Station WZRC(AM) is currently operating pursuant to Special Temporary Authority (BSTA-20160816AAK) in order to accommodate the construction of the diplex operation for Station WWRV(AM).

## SECTION III - LICENSE APPLICATION ENGINEERING DATA

Name of Applicant
Multicultural Radio Broadcasting Licensee, LLC

PURPOSE OF AUTHORIZATION APPLIED FOR: (check one)

☐ Station License ☑ Direct Measurement of Power

1. Facilities authorized in construction permit

| Call Sign | File No. of Construction Permit (if applicable) | Frequency (kHz) | Hours of Operation | Power in kilowatts | |
|---|---|---|---|---|---|
| | | | | Night | Day |
| WZRC | N/A | 1480 | Unlimited | 5.0 | 5.0 |

2. Station location

| State | City or Town |
|---|---|
| New York | New York |

3. Transmitter location

| State | County | City or Town | Street address (or other identification) |
|---|---|---|---|
| NJ | Bergen | Ridgefield Park | End of Birch Street |

4. Main studio location

| State | County | City or Town | Street address (or other identification) |
|---|---|---|---|
| NY | New York | New York | 27 William Street |

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

| State | County | City or Town | Street address (or other identification) |
|---|---|---|---|
| NY | New York | New York | 27 William Street |

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. See Eng.

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 |
|---|---|
| 10.39 | 10.39 |

| 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 | 50 | 0 | 0 |

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 SE | -143.9 | -153.4 | 0.452 | 0.798 | | |
| 2 SC | 0.0 | 0.0 | 1.000 | 1.000 | | |
| 3 NC | 161.4 | 155.8 | 0.868 | 0.568 | | |
| 4 NW | -26.5 | -62.5 | 0.240 | 0.106 | | |
| | | | | | | |
| | | | | | | |

Manufacturer and type of antenna monitor: Gorman Redlich CMR

CLEAR ALL PAGES

**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. |
|---|---|---|---|---|
| Guyed towers | 87.8 | 89.0 | 89.9 | Exhibit No. See 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 40 ° 50 ' 42 " | West Longitude 74 ° 01 ' 12 " |
|---|---|

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. See Eng.

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

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

N/A

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

No 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) | Signature (check appropriate box below) |
|---|---|
| Charles A. Hecht | Charles A. Hecht |
| Address (include ZIP Code)<br>Charles A. Hecht & Associates, Inc.<br>19 Mackenzie Court<br>Freehold, NJ 07728 | Date<br>April 9, 2018<br>Telephone No. (Include Area Code)<br>732 577-0711 |

☐ Technical Director

☐ Registered Professional Engineer

☐ Chief Operator

☑ Technical Consultant

☐ Other (specify)



CLEAR ALL PAGES

ENGINEERING REPORT IN SUPPORT OF

APPLICATION FOR MODIFICATION OF LICENSE

EMPLOYING MOMENT METHOD MODELING

WZRC 1480 KHZ 5 KW DA-2 U

NEW YORK, NEW YORK

APRIL 2018

ENGINEERING REPORT IN SUPPORT OF
APPLICATION FOR MODIFICATION OF LICENSE
EMPLOYING MOMENT METHOD MODELING
WZRC 1480 KHZ 5 KW DA-2 U
NEW YORK, NEW YORK

SUMMARY

This engineering report is submitted on behalf of Multicultural Radio Broadcasting Licensee, LLC., (hereinafter referred to as "MRBL"), licensee of AM station WZRC, New York, New York in support of an application for modification of license for WZRC. WZRC is licensed to operate on an unlimited time basis on 1480 kilohertz with power of 5 kilowatts employing a dual mode directional antenna.

WZRC is presently operating under Special Temporary Authority as per the terms of file BSTA-20160816AAK. The STA was necessary to accommodate construction of the diplex operation for station WWRV in accordance with construction permit BP-20131104AQW. Construction has been completed and included replacement of the towers, sample and transmission lines as well as the installation of diplexing equipment.

In support thereof, contained in this report is a complete method of moments proof of performance for the WZRC directional antenna system with associated engineering exhibits, including spurious emissions measurements, and the Engineering section of FCC Form 302-AM.

METHODOLOGY

The antenna system has been adjusted to produce monitoring system parameters in compliance with the method of moments ("MoM") calculated values (as calculated using Expert Mininec Broadcast Professional Version 23 and the antenna monitoring system has been adjusted to produce monitoring system parameters which are within ± 5% in field ratio and ± 3° in phase of the modeled values as required by Section 73.151(c)(2)(ii) of the rules.

All test and impedance measurements, field strength measurements, antenna adjustments and antenna modeling presented in this report were done by Kurt R. Gorman of Phasetek, Inc. and the undersigned.

SAMPLE SYSTEM

Tower currents were sampled with new Phasetek, Inc. model P600-206-3 voltage sampling units (VSU) with a sensitivity ratio of 1:500 volts mounted in a metal cabinet located at the base of each tower. The voltage sampling units were calibrated by the manufacturer and were certified as being within 2% amplitude and 2° phase accuracy. In addition, the units were measured with a Hewlett Packard 8753ES vector network analyzer and found to be within the manufacturer's specifications as shown in the following table.

| VSU | SN | Impedance 1480 khz* | Amplitude 1480 Khz | Phase 1480 Khz |
|---|---|---|---|---|
| 1 | 1480-1 | -j86k | 1.000 | 0.1° |
| 2 | 1480-2 | -j86k | 1.000 | 0.0° |
| 3 | 1480-3 | -j86k | 1.001 | 0.1° |
| 4 | 1480-4 | -j86k | 1.002 | 0.2° |

*Since this is a diplex operation there is a voltage sampling unit for each frequency. Each measures -j86k. Therefore, with the two units across the base in parallel, the impedance becomes -j43k.

The voltage sampling units are connected to the antenna monitor with equal lengths of Radio Frequency Systems LCF12-50J foam coaxial cable. The sample lines are equal in length, buried and exposed to similar environmental conditions. Manufacturer specifications were verified following installation. The antenna monitor is a new Gorman Redlich CMR, serial number 1056-B. The antenna monitor was calibrated with a "T" connector and two equal length cables. The results are within the manufacturer's rated maximum accuracy of ± 2% amplitude

and ± 1° phase and are provided in the table below. The sample system as installed meets FCC type approval requirements.

| INPUT | Amplitude 1480 Khz | Phase 1480 Khz |
|---|---|---|
| 1 | 1.001 | - 0.1° |
| 2 | 1.000 | 0.0° |
| 3 | 1.000 | 0.2° |
| 4 | 1.001 | 0.1° |

Impedance measurements were made on the antenna sampling system using a Hewlett Packard 8753ES vector network analyzer with a Tunwall directional coupler. The measurements were made looking into the antenna monitor ends of the sample lines with the tower ends open-circuited, and also with them connected to the voltage samplers, and measured at a frequency of 1480 kilohertz. All connectors were installed on the sample lines and readings were normalized to include the test leads.

The table below shows the frequencies above and below the carrier frequency where resonance, defined as zero reactance corresponding with low resistance, was found. The electrical length at carrier frequency appearing in the table below was calculated by ratioing the frequencies.

| Tower | Resonance Below 1480 Khz | Resonance Above 1480 Khz | Calculated Electrical Length @1480 khz |
|---|---|---|---|
| 1 | 565.3 khz | 1704.0 khz | 234.5° |
| 2 | 565.5 khz | 1703.8 khz | 234.5° |
| 3 | 565.0 khz | 1705.8 khz | 234.3° |
| 4 | 565.0 khz | 1783.8 khz | 233.9° |

Based upon the measurements shown above, the sample lines are within the required tolerance of one electrical degree.

To determine the characteristic impedance values of the sample lines, open-circuited measurements were made with frequencies offset to produce ± 45 degrees of electrical length from resonance. The characteristic impedance was calculated using the following formula, where R1 +j X1 and R2 +j X2 are the measured impedances at the +45 and -45 degree offset frequencies, respectively:

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

| Tower | +45 Degree Offset Frequency (KHz) | +45 Degree Measured Impedance (Ohms) | -45 Degree Offset Frequency (KHz) | -45 Degree Measured Impedance (Ohms) | Calculated Characteristic Impedance (Ohms) | 1480 khz Impedance connected to VSU (Ohms) |
|---|---|---|---|---|---|---|
| 1 | 1988.1 | 4.5 +j 49.8 | 1419.9 | 3.3 –j 50.3 | 50.1 | 51.8 +j0.1 |
| 2 | 1987.8 | 4.5 +j 49.7 | 1419.7 | 3.3 –j 50.1 | 50.1 | 51.9 +j0.3 |
| 3 | 1990.1 | 4.6 +j 50.1 | 1421.4 | 3.3 -j 50.3 | 50.4 | 51.7 +j0.2 |
| 4 | 1993.6 | 4.6 +j 49.7 | 1423.9 | 3.2 –j 49.8 | 49.9 | 51.8 +j0.1 |
| | | | | Max Impedance | 50.4 | |
| | | | | Min Impedance | 49.9 | |
| | | | MAXIMUM IMPEDANCE DELTA | | 0.5 | |

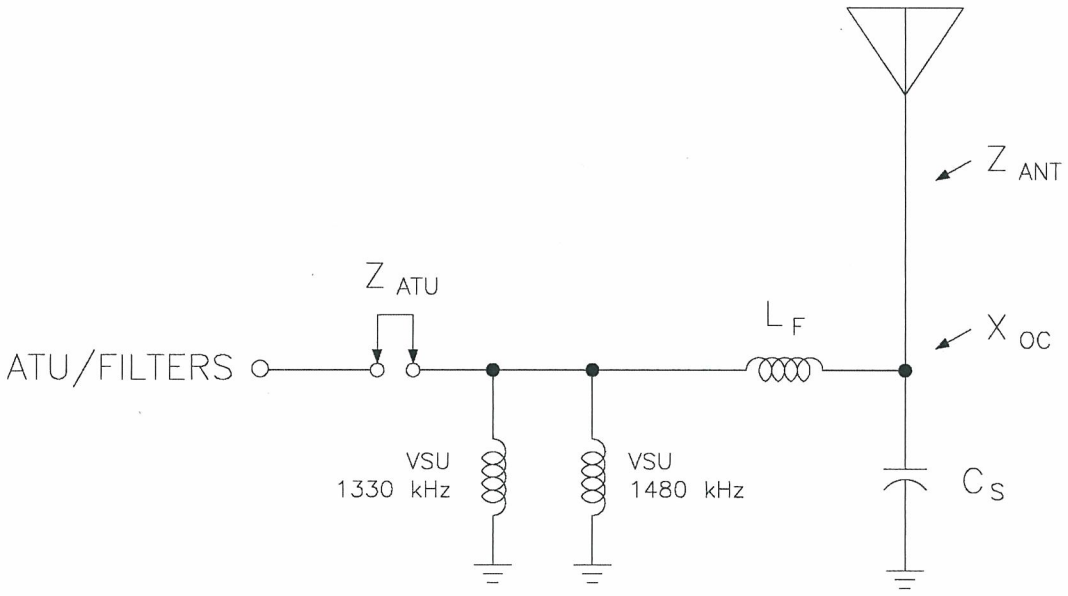
As shown above, the sample lines measured characteristic impedance meets the requirement that they be within 2 ohms.

TOWER BASE IMPEDANCE MEASUREMENTS

The impedance of each tower was measured at the output of the filter networks at the base of each tower. All impedance measurements were obtained with a Delta Electronics OIB-3 Operating Impedance Bridge. Before use, tests of known impedances were made to verify accurate operation. Measurements were taken with the test leads shorted (for reference), and from the filter network output to the tower with the tower base shorted. All measurements were taken for each tower with all other tower filter network ouputs open-circuited. The following exhibits describe the measurement conditions and assumptions used in the MoM analysis.

# EXHIBIT 1

## WZRC TOWER IMPEDANCE MEASUREMENTS COMPARED TO METHOD OF MOMENTS MODEL




| TOWER | Specified Cs (pf) | Measured $L_F$ (µH) | Measured $X_F$ (Ω) | Modeled $Z_{ANT}$ (Ω) | Modeled $Z_{ATU}$ (Ω) | Measured $Z_{ATU}$ (Ω) |
|---|---|---|---|---|---|---|
| 1 | 10 | 2.39 | +j22.2 | 146.5 –j 357.1 | 135.2 –j 323.2 | 131.0 –j 316.7 |
| 2 | 10 | 5.03 | +j46.8 | 161.4 –j 354.6 | 149.1 –j 297.1 | 145.0 –j 296.0 |
| 3 | 10 | 4.79 | +j44.5 | 146.8 –j 342.2 | 136.0 –j 287.5 | 134.0 –j 279.9 |
| 4 | 10 | 3.35 | +j31.2 | 157.4 –j 375.8 | 144.6 –j 331.9 | 148.0 –j 326.7 |

| Tower | Calculated $X_{OC}$ (Ω) |
|---|---|
| 1 | -j 8,588.2 |
| 2 | -j 8,572.4 |
| 3 | -j 8,573.9 |
| 4 | -j 8,582.4 |

# EXHIBIT II

## WZRC MOM MODEL PARAMETERS

| Tower # | Wire # | # of Segments | Base Node |
|---|---|---|---|
| 1 | 1-4 | 42 | 1 |
| 2 | 5-8 | 42 | 43 |
| 3 | 9-12 | 42 | 85 |
| 4 | 12-16 | 42 | 127 |

| Tower # | Physical Height Degrees* | Modeled Height Degrees* | Modeled Radius Meters | % of Equivalent Radius |
|---|---|---|---|---|
| 1 | 156.0 | 169.5 | .40 | 137.4 |
| 2 | 156.0 | 159.0 | .40 | 137.4 |
| 3 | 156.0 | 161.9 | .40 | 137.4 |
| 4 | 156.0 | 162.4 | .40 | 137.4 |

*PLUS TOP LOADING

NOTES

1. ALL TOWERS ARE UNIFORM CROSS SECTION, GUYED, INCORPORATE GUY WIRE TOP LOADING AND ARE BASE INSULATED. TOWERS HAVE A TRIANGULAR FACE WITH A WIDTH OF 24 INCHES.

2. TOWER BASE INSULATORS ARE AUSTIN A-0881 WITH AN ASSUMED CAPACITANCE OF 10 PF.

3. TOWER TOP LOADING IS MODELED AT 100% OF THE PHYSICAL LENGTH. THE DIFFERENCE IN DIAMETER BETWEEN THE GUY WIRE TOP LOADING AND THE TOWER YIELDS A "WARNING" MESSAGE FOR THE MODEL. A CONVERGENCE TEST WAS PERFORMED ON THE TOWER 1 MODEL TO VERIFY THE MODEL. THIS IS SHOWN IN EXHIBIT 7. ALL OTHER TOWER MODELS ARE SIMILAR.

# EXHIBIT III

# WZRC DERIVED OPERATING PARAMETERS

## WZRC Calculated Day Parameters

| Tower | Theoretical Field/Phase | Base Network Input Voltage | Normalized VSU Value Ratio/ Phase |
|---|---|---|---|
| 1 (SE) | 0.680/236.0° | 2428.6/87.30° | 0.798/-153.4° |
| 2 (SC) | 1.000/0.0° | 3044.3/-119.26° | 1.000/0.0° |
| 3 (NC) | 0.680/236.0° | 1729.0/36.55° | 0.568/155.8° |
| 4 (NW) | 1.000/0.0° | 321.2/178.23° | 0.106/-62.5° |

## WZRC Calculated Night Parameters

| Tower | Theoretical Field/Phase | Base Network Input Voltage | Normalized VSU Value Ratio/ Phase |
|---|---|---|---|
| 1 (SE) | 0.680/236.0° | 1508.8/100.04° | 0.452/-143.9° |
| 2 (SC) | 1.000/0.0° | 3339.8/-116.03° | 1.000/0.0° |
| 3 (NC) | 0.680/236.0° | 2891.4/45.33° | 0.868/161.4° |
| 4 (NW) | 1.000/0.0° | 799.8/-142.56° | 0.240/-26.5° |

METHOD OF MOMENTS DETAIL

Four wires were used to represent each of the four towers including the top-loading. Towers were driven individually to verify the model compared to measured impedance data. Once the model was verified, the day and night directional antenna systems were computed including the complex voltage values for sources located at ground level. These sources produce current moment sums for each tower that, when normalized, equate to the theoretical field parameters for each respective tower.

# EXHIBIT IV

# WZRC MOMENT MODELING

**WZRC TOWER 1 (OTHERS OPEN)**

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

| wire | caps | Distance | Angle | Z | radius | segs |
|---|---|---|---|---|---|---|
| 1 | none | 0 | 0 | 0 | .4 | 24 |
| | | | 0 | 0 | 169.5 | |
| 2 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | | 14.6 | 12. | 133.3 | |
| 3 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | | 14.1 | 134. | 133.3 | |
| 4 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | | 14.6 | 254. | 133.3 | |
| 5 | none | 100. | 327. | 0 | .4 | 24 |
| | | | 100. | 327. | 159. | |
| 6 | none | 100. | 327. | 159. | .01 | 6 |
| | | | 112.1 | 335.55 | 125.4 | |
| 7 | none | 100. | 327. | 159. | .01 | 6 |
| | | | 80.2 | 327.74 | 125.4 | |
| 8 | none | 100. | 327. | 159. | .01 | 6 |
| | | | 110.3 | 317.84 | 125.4 | |
| 9 | none | 200. | 327. | 0 | .4 | 24 |
| | | | 200. | 327. | 161.9 | |
| 10 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | | 190. | 331.99 | 128.3 | |
| 11 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | | 192.7 | 322.35 | 128.3 | |
| 12 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | | 219.7 | 327.27 | 128.3 | |
| 13 | none | 300. | 327. | 0 | .4 | 24 |
| | | | 300. | 327. | 162.4 | |
| 14 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | | 303.3 | 330.68 | 128.8 | |
| 15 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | | 282.1 | 325.38 | 128.8 | |
| 16 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | | 316.1 | 324.82 | 128.8 | |

Number of wires = 16
Current nodes = 168

| | | minimum | | maximum |
|---|---|---|---|---|
| Individual wires | wire | value | wire | value |
| segment length | 11 | 6.31567 | 1 | 7.0625 |
| radius | 2 | .01 | 1 | .4 |

ELECTRICAL DESCRIPTION
Frequencies (MHz)

| no. | frequency lowest | step | no. of steps | segment length (wavelengths) minimum | maximum |
|---|---|---|---|---|---|
| 1 | 1.48 | 0 | 1 | .0175435 | .0196181 |

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 | 43 | 0 | -8,572.4 | 0 | 0 | 0 |
| 2 | 85 | 0 | -8,573.9 | 0 | 0 | 0 |
| 3 | 127 | 0 | -8,582.4 | 0 | 0 | 0 |

IMPEDANCE
normalization = 50.

| freq (MHz) | resist (ohms) | react (ohms) | imped (ohms) | phase (deg) | VSWR | S11 dB | S12 dB |
|---|---|---|---|---|---|---|---|
| source = 1; node 1, sector 1 | | | | | | | |
| 1.48 | 146.51 | -357.11 | 386. | 292.3 | 20.632 | -.84265 | -7. |

**WZRC TOWER 2 (OTHERS OPEN)**

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

| wire | caps | Distance | Angle | Z | radius | segs |
|---|---|---|---|---|---|---|
| 1 | none | 0 | 0 | 0 | .4 | 24 |
| | | 0 | 0 | 169.5 | | |
| 2 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | 14.6 | 12. | 133.3 | | |
| 3 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | 14.1 | 134. | 133.3 | | |
| 4 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | 14.6 | 254. | 133.3 | | |
| 5 | none | 100. | 327. | 0 | .4 | 24 |
| | | 100. | 327. | 159. | | |
| 6 | none | 100. | 327. | 159. | .01 | 6 |
| | | 112.1 | 335.55 | 125.4 | | |
| 7 | none | 100. | 327. | 159. | .01 | 6 |
| | | 80.2 | 327.74 | 125.4 | | |
| 8 | none | 100. | 327. | 159. | .01 | 6 |
| | | 110.3 | 317.84 | 125.4 | | |
| 9 | none | 200. | 327. | 0 | .4 | 24 |
| | | 200. | 327. | 161.9 | | |
| 10 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | 190. | 331.99 | 128.3 | | |
| 11 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | 192.7 | 322.35 | 128.3 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 12 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | 219.7 | 327.27 | 128.3 | | |
| 13 | none | 300. | 327. | 0 | .4 | 24 |
| | | 300. | 327. | 162.4 | | |
| 14 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | 303.3 | 330.68 | 128.8 | | |
| 15 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | 282.1 | 325.38 | 128.8 | | |
| 16 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | 316.1 | 324.82 | 128.8 | | |

Number of wires = 16
Current nodes = 168

| | minimum | | maximum | |
|---|---|---|---|---|
| Individual wires | wire | value | wire | value |
| segment length | 11 | 6.31567 | 1 | 7.0625 |
| radius | 2 | .01 | 1 | .4 |

ELECTRICAL DESCRIPTION
Frequencies (MHz)

| | frequency | | no. of | segment length (wavelengths) | |
|---|---|---|---|---|---|
| no. | lowest | step | steps | minimum | maximum |
| 1 | 1.48 | 0 | 1 | .0175435 | .0196181 |

Sources

| source | node | sector | magnitude | phase | type |
|---|---|---|---|---|---|
| 1 | 43 | 1 | 1. | 0 | voltage |

Lumped loads

| load | node | resistance (ohms) | reactance (ohms) | inductance (mH) | capacitance (uF) | passive circuit |
|---|---|---|---|---|---|---|
| 1 | 1 | 0 | -8,588.2 | 0 | 0 | 0 |
| 2 | 85 | 0 | -8,573.9 | 0 | 0 | 0 |
| 3 | 127 | 0 | -8,582.4 | 0 | 0 | 0 |

IMPEDANCE
normalization = 50.

| freq (MHz) | resist (ohms) | react (ohms) | imped (ohms) | phase (deg) | VSWR | S11 dB | S12 dB |
|---|---|---|---|---|---|---|---|
| source = 1; node 43, sector 1 | | | | | | | |
| 1.48 | 161.37 | -354.57 | 389.57 | 294.5 | 19.066 | -.91197 | -7.226 |

**WZRC TOWER 3 (OTHERS OPEN)**

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

| wire | caps | Distance | Angle | Z | radius | segs |
|---|---|---|---|---|---|---|
| 1 | none | 0 | 0 | 0 | .4 | 24 |
| | | 0 | 0 | 169.5 | | |
| 2 | none | 0 | 0 | 169.5 | .01 | 6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 14.6 | 12. | 133.3 | | |
| 3 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | 14.1 | 134. | 133.3 | | |
| 4 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | 14.6 | 254. | 133.3 | | |
| 5 | none | 100. | 327. | 0 | .4 | 24 |
| | | 100. | 327. | 159. | | |
| 6 | none | 100. | 327. | 159. | .01 | 6 |
| | | 112.1 | 335.55 | 125.4 | | |
| 7 | none | 100. | 327. | 159. | .01 | 6 |
| | | 80.2 | 327.74 | 125.4 | | |
| 8 | none | 100. | 327. | 159. | .01 | 6 |
| | | 110.3 | 317.84 | 125.4 | | |
| 9 | none | 200. | 327. | 0 | .4 | 24 |
| | | 200. | 327. | 161.9 | | |
| 10 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | 190. | 331.99 | 128.3 | | |
| 11 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | 192.7 | 322.35 | 128.3 | | |
| 12 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | 219.7 | 327.27 | 128.3 | | |
| 13 | none | 300. | 327. | 0 | .4 | 24 |
| | | 300. | 327. | 162.4 | | |
| 14 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | 303.3 | 330.68 | 128.8 | | |
| 15 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | 282.1 | 325.38 | 128.8 | | |
| 16 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | 316.1 | 324.82 | 128.8 | | |

Number of wires = 16
Current nodes = 168

| | minimum | | maximum | |
|---|---|---|---|---|
| Individual wires | wire | value | wire | value |
| segment length | 11 | 6.31567 | 1 | 7.0625 |
| radius | 2 | .01 | 1 | .4 |

ELECTRICAL DESCRIPTION
Frequencies (MHz)

| | frequency | | no. of | segment length (wavelengths) | |
|---|---|---|---|---|---|
| no. | lowest | step | steps | minimum | maximum |
| 1 | 1.48 | 0 | 1 | .0175435 | .0196181 |

Sources

| source | node | sector | magnitude | phase | type |
|---|---|---|---|---|---|
| 1 | 85 | 1 | 1. | 0 | voltage |

Lumped loads

| load | node | resistance (ohms) | reactance (ohms) | inductance (mH) | capacitance (uF) | passive circuit |
|---|---|---|---|---|---|---|
| 1 | 1 | 0 | -8,588.2 | 0 | 0 | 0 |
| 2 | 43 | 0 | -8,572.4 | 0 | 0 | 0 |
| 3 | 127 | 0 | -8,582.4 | 0 | 0 | 0 |

IMPEDANCE
normalization = 50.

| freq (MHz) | resist (ohms) | react (ohms) | imped (ohms) | phase (deg) | VSWR | S11 dB | S12 dB |
|---|---|---|---|---|---|---|---|
| source = 1; node 85, sector 1 | | | | | | | |
| 1.48 | 146.81 | -342.2 | 372.36 | 293.2 | 19.177 | -.90669 | -7.2487 |

**WZRC TOWER 4 (OTHERS OPEN)**

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

| wire | caps | Distance | Angle | Z | radius | segs |
|---|---|---|---|---|---|---|
| 1 | none | 0 | 0 | 0 | .4 | 24 |
| | | 0 | 0 | 169.5 | | |
| 2 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | 14.6 | 12. | 133.3 | | |
| 3 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | 14.1 | 134. | 133.3 | | |
| 4 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | 14.6 | 254. | 133.3 | | |
| 5 | none | 100. | 327. | 0 | .4 | 24 |
| | | 100. | 327. | 159. | | |
| 6 | none | 100. | 327. | 159. | .01 | 6 |
| | | 112.1 | 335.55 | 125.4 | | |
| 7 | none | 100. | 327. | 159. | .01 | 6 |
| | | 80.2 | 327.74 | 125.4 | | |
| 8 | none | 100. | 327. | 159. | .01 | 6 |
| | | 110.3 | 317.84 | 125.4 | | |
| 9 | none | 200. | 327. | 0 | .4 | 24 |
| | | 200. | 327. | 161.9 | | |
| 10 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | 190. | 331.99 | 128.3 | | |
| 11 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | 192.7 | 322.35 | 128.3 | | |
| 12 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | 219.7 | 327.27 | 128.3 | | |
| 13 | none | 300. | 327. | 0 | .4 | 24 |
| | | 300. | 327. | 162.4 | | |
| 14 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | 303.3 | 330.68 | 128.8 | | |
| 15 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | 282.1 | 325.38 | 128.8 | | |
| 16 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | 316.1 | 324.82 | 128.8 | | |

Number of wires = 16
Current nodes = 168

| | minimum | | maximum | |
|---|---|---|---|---|
| Individual wires | wire | value | wire | value |
| segment length | 11 | 6.31567 | 1 | 7.0625 |
| radius | 2 | .01 | 1 | .4 |

ELECTRICAL DESCRIPTION
Frequencies (MHz)

| | frequency | | no. of | segment length (wavelengths) | |
|---|---|---|---|---|---|
| no. | lowest | step | steps | minimum | maximum |
| 1 | 1.48 | 0 | 1 | .0175435 | .0196181 |

Sources

| source | node | sector | magnitude | phase | type |
|---|---|---|---|---|---|
| 1 | 127 | 1 | 1. | 0 | voltage |

Lumped loads

| load | node | resistance (ohms) | reactance (ohms) | inductance (mH) | capacitance (uF) | passive circuit |
|---|---|---|---|---|---|---|
| 1 | 1 | 0 | -8,588.2 | 0 | 0 | 0 |
| 2 | 43 | 0 | -8,572.4 | 0 | 0 | 0 |
| 3 | 85 | 0 | -8,573.9 | 0 | 0 | 0 |

IMPEDANCE
normalization = 50.

| freq (MHz) | resist (ohms) | react (ohms) | imped (ohms) | phase (deg) | VSWR | S11 dB | S12 dB |
|---|---|---|---|---|---|---|---|
| source = 1; node 127, sector 1 | | | | | | | |
| 1.48 | 157.38 | -375.8 | 407.42 | 292.7 | 21.365 | -.81369 | -7.6738 |

**MEDIUM WAVE DAY ARRAY SYNTHESIS FROM FIELD RATIOS**

Frequency = 1.48 MHz

| tower | field ratio magnitude | phase (deg) |
|---|---|---|
| 1 | 1. | 0 |
| 2 | 1.33 | 155.6 |
| 3 | .88 | -52.1 |
| 4 | .23 | 97. |

VOLTAGES AND CURRENTS - rms

| source node | voltage magnitude | phase (deg) | current magnitude | phase (deg) |
|---|---|---|---|---|
| 1 | 2,587.41 | 87. | 6.93954 | 172.3 |
| 43 | 3,406.75 | 239.9 | 7.4975 | 322.6 |
| 85 | 1,887.99 | 36.4 | 3.39873 | 124.7 |
| 127 | 325.09 | 177.1 | .225748 | 202.8 |

Sum of square of source currents = 231.944
Total power = 5,000. watts

TOWER ADMITTANCE MATRIX

| admittance | real (mhos) | imaginary (mhos) |
|---|---|---|
| Y(1, 1) | .00096041 | .0022684 |
| Y(1, 2) | .000544224 | -.00016946 |
| Y(1, 3) | -6.8231E-05 | -.000296741 |
| Y(1, 4) | -.00016812 | 4.0166E-05 |
| Y(2, 1) | .000544231 | -.000169445 |
| Y(2, 2) | .00099652 | .00202713 |
| Y(2, 3) | .000602273 | -.000203431 |
| Y(2, 4) | -6.2411E-05 | -.00028967 |
| Y(3, 1) | -6.8223E-05 | -.000296747 |
| Y(3, 2) | .000602276 | -.000203424 |
| Y(3, 3) | .000995784 | .00214565 |
| Y(3, 4) | .000534934 | -.000168111 |
| Y(4, 1) | -.000168121 | 4.0163E-05 |
| Y(4, 2) | -6.2412E-05 | -.000289668 |
| Y(4, 3) | .000534938 | -.000168106 |
| Y(4, 4) | .000922669 | .00214683 |

TOWER IMPEDANCE MATRIX

| impedance | real (ohms) | imaginary (ohms) |
|---|---|---|
| Z(1, 1) | 145.528 | -356.583 |
| Z(1, 2) | 87.6105 | 53.615 |
| Z(1, 3) | 11.9373 | -21.3871 |
| Z(1, 4) | -9.74538 | -2.92694 |
| Z(2, 1) | 87.6115 | 53.6123 |
| Z(2, 2) | 158.892 | -353.294 |
| Z(2, 3) | 104.184 | 66.0851 |
| Z(2, 4) | 15.1008 | -22.5277 |
| Z(3, 1) | 11.9368 | -21.3868 |

**MEDIUM WAVE NIGHT ARRAY SYNTHESIS FROM FIELD RATIOS**

Frequency = 1.48 MHz

| tower | field ratio magnitude | phase (deg) |
|---|---|---|
| 1 | 1. | 0 |
| 2 | 2.524 | 158.8 |
| 3 | 2.376 | -41. |
| 4 | .798 | 119.9 |

VOLTAGES AND CURRENTS - rms

| source node | voltage magnitude | phase (deg) | current magnitude | phase (deg) |
|---|---|---|---|---|
| 1 | 1,621.45 | 100.5 | 4.95737 | 196.9 |
| 43 | 3,744.01 | 243.1 | 8.3677 | 325.6 |
| 85 | 3,203.16 | 44.7 | 6.74883 | 128.7 |
| 127 | 842.277 | 218.7 | 1.40809 | 332.3 |

Sum of square of source currents = 284.247
Total power = 5,000. watts

TOWER ADMITTANCE MATRIX

| admittance | real (mhos) | imaginary (mhos) |
|---|---|---|
| Y(1, 1) | .00096041 | .0022684 |
| Y(1, 2) | .000544224 | -.00016946 |
| Y(1, 3) | -6.8231E-05 | -.000296741 |
| Y(1, 4) | -.00016812 | 4.0166E-05 |
| Y(2, 1) | .000544231 | -.000169445 |
| Y(2, 2) | .00099652 | .00202713 |
| Y(2, 3) | .000602273 | -.000203431 |
| Y(2, 4) | -6.2411E-05 | -.00028967 |
| Y(3, 1) | -6.8223E-05 | -.000296747 |
| Y(3, 2) | .000602276 | -.000203424 |
| Y(3, 3) | .000995784 | .00214565 |
| Y(3, 4) | .000534934 | -.000168111 |
| Y(4, 1) | -.000168121 | 4.0163E-05 |
| Y(4, 2) | -6.2412E-05 | -.000289668 |
| Y(4, 3) | .000534938 | -.000168106 |
| Y(4, 4) | .000922669 | .00214683 |

TOWER IMPEDANCE MATRIX

| impedance | real (ohms) | imaginary (ohms) |
|---|---|---|
| Z(1, 1) | 145.528 | -356.583 |
| Z(1, 2) | 87.6105 | 53.615 |
| Z(1, 3) | 11.9373 | -21.3871 |
| Z(1, 4) | -9.74538 | -2.92694 |
| Z(2, 1) | 87.6115 | 53.6123 |
| Z(2, 2) | 158.892 | -353.294 |
| Z(2, 3) | 104.184 | 66.0851 |
| Z(2, 4) | 15.1008 | -22.5277 |
| Z(3, 1) | 11.9368 | -21.3868 |

**WZRC DAY GEOMETRY**

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

| wire | caps | Distance | Angle | Z | radius | segs |
|---|---|---|---|---|---|---|
| 1 | none | 0 | 0 | 0 | .4 | 24 |
| | | 0 | 0 | 169.5 | | |
| 2 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | 14.6 | 12. | 133.3 | | |
| 3 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | 14.1 | 134. | 133.3 | | |
| 4 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | 14.6 | 254. | 133.3 | | |
| 5 | none | 100. | 327. | 0 | .4 | 24 |
| | | 100. | 327. | 159. | | |
| 6 | none | 100. | 327. | 159. | .01 | 6 |
| | | 112.1 | 335.55 | 125.4 | | |
| 7 | none | 100. | 327. | 159. | .01 | 6 |
| | | 80.2 | 327.74 | 125.4 | | |
| 8 | none | 100. | 327. | 159. | .01 | 6 |
| | | 110.3 | 317.84 | 125.4 | | |
| 9 | none | 200. | 327. | 0 | .4 | 24 |
| | | 200. | 327. | 161.9 | | |
| 10 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | 190. | 331.99 | 128.3 | | |
| 11 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | 192.7 | 322.35 | 128.3 | | |
| 12 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | 219.7 | 327.27 | 128.3 | | |
| 13 | none | 300. | 327. | 0 | .4 | 24 |
| | | 300. | 327. | 162.4 | | |
| 14 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | 303.3 | 330.68 | 128.8 | | |
| 15 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | 282.1 | 325.38 | 128.8 | | |
| 16 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | 316.1 | 324.82 | 128.8 | | |

Number of wires = 16
Current nodes = 168

| | minimum | | maximum | |
|---|---|---|---|---|
| Individual wires | wire | value | wire | value |
| segment length | 11 | 6.31567 | 1 | 7.0625 |
| radius | 2 | .01 | 1 | .4 |

ELECTRICAL DESCRIPTION
Frequencies (MHz)

| | frequency | | no. of | segment length (wavelengths) | |
|---|---|---|---|---|---|
| no. | lowest | step | steps | minimum | maximum |
| 1 | 1.48 | 0 | 1 | .0175435 | .0196181 |

Sources

| source | node | sector | magnitude | phase | type |
|---|---|---|---|---|---|
| 1 | 1 | 1 | 3,659.16 | 87. | voltage |
| 2 | 43 | 1 | 4,817.87 | 239.9 | voltage |
| 3 | 85 | 1 | 2,670.02 | 36.4 | voltage |
| 4 | 127 | 1 | 459.747 | 177.1 | voltage |

IMPEDANCE
normalization = 50.

| freq (MHz) | resist (ohms) | react (ohms) | imped (ohms) | phase (deg) | VSWR | S11 dB | S12 dB |
|---|---|---|---|---|---|---|---|
| source = 1; node 1, sector 1 | | | | | | | |
| 1.48 | 30.591 | -371.59 | 372.85 | 274.7 | 92.511 | -.18779 | -13.735 |
| source = 2; node 43, sector 1 | | | | | | | |
| 1.48 | 58.103 | -450.66 | 454.39 | 277.3 | 71.916 | -.24157 | -12.668 |
| source = 3; node 85, sector 1 | | | | | | | |
| 1.48 | 16.852 | -555.24 | 555.5 | 271.7 | 369.19 | -4.7E-02 | -19.675 |
| source = 4; node 127, sector 1 | | | | | | | |
| 1.48 | 1,296.7 | -626.34 | 1,440.1 | 334.2 | 31.992 | -.54318 | -9.2972 |

CURRENT rms
Frequency = 1.48 MHz
Input power = 5,000. watts
Efficiency = 100. %
coordinates in degrees

| current no. | X | Y | Z | mag (amps) | phase (deg) | real (amps) | imaginary (amps) |
|---|---|---|---|---|---|---|---|
| GND | 0 | 0 | 0 | 6.93953 | 172.3 | -6.87659 | .932545 |
| 2 | 0 | 0 | 7.0625 | 4.32618 | 169.5 | -4.25327 | .790905 |
| 3 | 0 | 0 | 14.125 | 2.67363 | 165. | -2.58231 | .692766 |
| 4 | 0 | 0 | 21.1875 | 1.22311 | 150.8 | -1.06781 | .596465 |
| 5 | 0 | 0 | 28.25 | .607902 | 55.3 | .346483 | .499494 |
| 6 | 0 | 0 | 35.3125 | 1.72691 | 13.4 | 1.6796 | .401463 |
| 7 | 0 | 0 | 42.375 | 2.94834 | 5.9 | 2.93272 | .303051 |
| 8 | 0 | 0 | 49.4375 | 4.10523 | 2.9 | 4.10009 | .205404 |
| 9 | 0 | 0 | 56.5 | 5.17408 | 1.2 | 5.17291 | .109902 |
| 10 | 0 | 0 | 63.5625 | 6.14137 | .2 | 6.14135 | .0180168 |
| 11 | 0 | 0 | 70.625 | 6.99598 | 359.4 | 6.99564 | -.0687664 |
| 12 | 0 | 0 | 77.6875 | 7.72819 | 358.9 | 7.72676 | -.14902 |
| 13 | 0 | 0 | 84.75 | 8.32996 | 358.5 | 8.32702 | -.221427 |
| 14 | 0 | 0 | 91.8125 | 8.79521 | 358.1 | 8.7906 | -.284821 |
| 15 | 0 | 0 | 98.875 | 9.12002 | 357.9 | 9.11374 | -.338233 |
| 16 | 0 | 0 | 105.938 | 9.30341 | 357.7 | 9.29561 | -.380931 |
| 17 | 0 | 0 | 113. | 9.34842 | 357.5 | 9.33931 | -.412478 |
| 18 | 0 | 0 | 120.063 | 9.26387 | 357.3 | 9.25375 | -.432815 |
| 19 | 0 | 0 | 127.125 | 9.0684 | 357.2 | 9.0576 | -.442438 |
| 20 | 0 | 0 | 134.188 | 8.79361 | 357.1 | 8.78247 | -.442542 |
| 21 | 0 | 0 | 141.25 | 8.46687 | 357.1 | 8.45571 | -.434437 |
| 22 | 0 | 0 | 148.313 | 8.08627 | 357. | 8.07543 | -.418569 |
| 23 | 0 | 0 | 155.375 | 7.63763 | 357. | 7.62741 | -.39494 |
| 24 | 0 | 0 | 162.438 | 7.10942 | 357.1 | 7.10012 | -.363481 |
| J1 | 0 | 0 | 169.5 | 6.40505 | 357.2 | 6.39715 | -.318111 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2J1 | 0 | 0 | 169.5 | 2.18505 | 356.3 | 2.18038 | -.142793 |
| 26 | 2.38016 | -.505918 | 163.467 | 1.97659 | 356.3 | 1.9724 | -.128643 |
| 27 | 4.76032 | -1.01184 | 157.433 | 1.67394 | 356.3 | 1.67042 | -.108385 |
| 28 | 7.14048 | -1.51775 | 151.4 | 1.31991 | 356.3 | 1.31717 | -.0849793 |
| 29 | 9.52064 | -2.02367 | 145.367 | .925782 | 356.3 | .923883 | -.0592606 |
| 30 | 11.9008 | -2.52959 | 139.333 | .493652 | 356.4 | .49265 | -.0314263 |
| END | 14.281 | -3.03551 | 133.3 | 0 | 0 | 0 | 0 |
| 2J1 | 0 | 0 | 169.5 | 2.06171 | 358.5 | 2.06097 | -.0551819 |
| 32 | -1.63245 | -1.69045 | 163.467 | 1.86186 | 358.6 | 1.86134 | -.0439355 |
| 33 | -3.2649 | -3.3809 | 157.433 | 1.57245 | 358.9 | 1.57215 | -.030554 |
| 34 | -4.89734 | -5.07135 | 151.4 | 1.23619 | 359.1 | 1.23605 | -.018343 |
| 35 | -6.52979 | -6.7618 | 145.367 | .864458 | 359.4 | .864416 | -8.57E-03 |
| 36 | -8.16224 | -8.45224 | 139.333 | .459596 | 359.7 | .459591 | -2.12E-03 |
| END | -9.79468 | -10.1427 | 133.3 | 0 | 0 | 0 | 0 |
| 2J1 | 0 | 0 | 169.5 | 2.15915 | 356.8 | 2.1558 | -.120137 |
| 38 | -.670717 | 2.33907 | 163.467 | 1.95189 | 356.9 | 1.94897 | -.106649 |
| 39 | -1.34144 | 4.67814 | 157.433 | 1.65153 | 356.9 | 1.64918 | -.0880679 |
| 40 | -2.01215 | 7.01721 | 151.4 | 1.30097 | 357. | 1.29922 | -.0674794 |
| 41 | -2.68287 | 9.35628 | 145.367 | .911553 | 357.1 | .910399 | -.0458626 |
| 42 | -3.35359 | 11.6954 | 139.333 | .485538 | 357.2 | .484962 | -.0236314 |
| END | -4.0243 | 14.0344 | 133.3 | 0 | 0 | 0 | 0 |
| GND | 83.8671 | 54.4639 | 0 | 7.49746 | 322.6 | 5.9531 | -4.55769 |
| 44 | 83.8671 | 54.4639 | 6.625 | 4.20724 | 316.8 | 3.06499 | -2.88214 |
| 45 | 83.8671 | 54.4639 | 13.25 | 2.23949 | 304.8 | 1.27667 | -1.83995 |
| 46 | 83.8671 | 54.4639 | 19.875 | .958886 | 250.2 | -.324421 | -.902338 |
| 47 | 83.8671 | 54.4639 | 26.5 | 1.80241 | 181. | -1.80212 | -.0323821 |
| 48 | 83.8671 | 54.4639 | 33.125 | 3.27652 | 166.2 | -3.18128 | .784265 |
| 49 | 83.8671 | 54.4639 | 39.75 | 4.72834 | 160.9 | -4.46692 | 1.55041 |
| 50 | 83.8671 | 54.4639 | 46.375 | 6.09267 | 158.2 | -5.65628 | 2.26432 |
| 51 | 83.8671 | 54.4639 | 53. | 7.34912 | 156.6 | -6.74315 | 2.92224 |
| 52 | 83.8671 | 54.4639 | 59.625 | 8.48441 | 155.5 | -7.71997 | 3.51956 |
| 53 | 83.8671 | 54.4639 | 66.25 | 9.48763 | 154.7 | -8.57903 | 4.05158 |
| 54 | 83.8671 | 54.4639 | 72.875 | 10.3493 | 154.1 | -9.31308 | 4.51383 |
| 55 | 83.8671 | 54.4639 | 79.5 | 11.0618 | 153.7 | -9.9161 | 4.90244 |
| 56 | 83.8671 | 54.4639 | 86.125 | 11.6193 | 153.3 | -10.3836 | 5.21437 |
| 57 | 83.8671 | 54.4639 | 92.75 | 12.0185 | 153. | -10.7129 | 5.44771 |
| 58 | 83.8671 | 54.4639 | 99.375 | 12.2592 | 152.8 | -10.9044 | 5.60192 |
| 59 | 83.8671 | 54.4639 | 106. | 12.3449 | 152.6 | -10.9614 | 5.67832 |
| 60 | 83.8671 | 54.4639 | 112.625 | 12.2844 | 152.5 | -10.892 | 5.68065 |
| 61 | 83.8671 | 54.4639 | 119.25 | 12.0932 | 152.3 | -10.7103 | 5.61578 |
| 62 | 83.8671 | 54.4639 | 125.875 | 11.7927 | 152.2 | -10.435 | 5.49336 |
| 63 | 83.8671 | 54.4639 | 132.5 | 11.4024 | 152.2 | -10.084 | 5.32246 |
| 64 | 83.8671 | 54.4639 | 139.125 | 10.9315 | 152.1 | -9.66486 | 5.10759 |
| 65 | 83.8671 | 54.4639 | 145.75 | 10.3802 | 152.1 | -9.17781 | 4.84937 |
| 66 | 83.8671 | 54.4639 | 152.375 | 9.74417 | 152.2 | -8.61863 | 4.54622 |
| J5 | 83.8671 | 54.4639 | 159. | 8.97661 | 152.3 | -7.94638 | 4.17547 |
| 2J1 | 83.8671 | 54.4639 | 159. | 2.98877 | 151.9 | -2.63719 | 1.40641 |
| 68 | 86.8971 | 53.1196 | 153.4 | 2.69378 | 152. | -2.37883 | 1.26396 |
| 69 | 89.9271 | 51.7753 | 147.8 | 2.27557 | 152.1 | -2.01161 | 1.06378 |
| 70 | 92.9571 | 50.431 | 142.2 | 1.78987 | 152.3 | -1.58404 | .833352 |
| 71 | 95.9871 | 49.0867 | 136.6 | 1.25163 | 152.4 | -1.10901 | .580245 |
| 72 | 99.0172 | 47.7424 | 131. | .665161 | 152.5 | -.590102 | .30695 |
| END | 102.047 | 46.3981 | 125.4 | 0 | 0 | 0 | 0 |
| 2J1 | 83.8671 | 54.4639 | 159. | 3.02465 | 152.9 | -2.69272 | 1.3776 |
| 74 | 81.1925 | 52.5212 | 153.4 | 2.72953 | 153.1 | -2.43335 | 1.23659 |
| 75 | 78.518 | 50.5785 | 147.8 | 2.30957 | 153.3 | -2.06242 | 1.0395 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 76 | 75.8435 | 48.6358 | 142.2 | 1.81998 | 153.4 | -1.62804 | .813518 |
| 77 | 73.169 | 46.6931 | 136.6 | 1.27527 | 153.7 | -1.14278 | .566008 |
| 78 | 70.4944 | 44.7504 | 131. | .679211 | 153.9 | -.609723 | .299275 |
| END | 67.8199 | 42.8077 | 125.4 | 0 | 0 | 0 | 0 |
| 2J1 | 83.8671 | 54.4639 | 159. | 2.96345 | 152. | -2.61646 | 1.39147 |
| 80 | 83.5163 | 57.7255 | 153.4 | 2.67145 | 152.1 | -2.36067 | 1.25056 |
| 81 | 83.1655 | 60.9872 | 147.8 | 2.2568 | 152.2 | -1.99643 | 1.05234 |
| 82 | 82.8148 | 64.2488 | 142.2 | 1.77513 | 152.3 | -1.57218 | .82421 |
| 83 | 82.464 | 67.5105 | 136.6 | 1.24132 | 152.5 | -1.10077 | .573748 |
| 84 | 82.1132 | 70.7721 | 131. | .659686 | 152.6 | -.585753 | .303445 |
| END | 81.7625 | 74.0337 | 125.4 | 0 | 0 | 0 | 0 |
| GND | 167.734 | 108.928 | 0 | 3.39873 | 124.7 | -1.93384 | 2.79493 |
| 86 | 167.734 | 108.928 | 6.74583 | 1.53312 | 122.5 | -.824648 | 1.29244 |
| 87 | 167.734 | 108.928 | 13.4917 | .380545 | 110.3 | -.132266 | .35682 |
| 88 | 167.734 | 108.928 | 20.2375 | .686819 | 315.5 | .489679 | -.481596 |
| 89 | 167.734 | 108.928 | 26.9833 | 1.64685 | 310.3 | 1.06536 | -1.25583 |
| 90 | 167.734 | 108.928 | 33.7292 | 2.54669 | 309. | 1.6037 | -1.97833 |
| 91 | 167.734 | 108.928 | 40.475 | 3.38589 | 308.5 | 2.10597 | -2.65126 |
| 92 | 167.734 | 108.928 | 47.2208 | 4.16149 | 308.1 | 2.57046 | -3.27273 |
| 93 | 167.734 | 108.928 | 53.9667 | 4.86866 | 308. | 2.99416 | -3.83912 |
| 94 | 167.734 | 108.928 | 60.7125 | 5.50182 | 307.8 | 3.37355 | -4.34617 |
| 95 | 167.734 | 108.928 | 67.4583 | 6.05538 | 307.7 | 3.70512 | -4.78954 |
| 96 | 167.734 | 108.928 | 74.2042 | 6.52419 | 307.7 | 3.98564 | -5.16525 |
| 97 | 167.734 | 108.928 | 80.95 | 6.90398 | 307.6 | 4.21242 | -5.46997 |
| 98 | 167.734 | 108.928 | 87.6958 | 7.19159 | 307.6 | 4.38346 | -5.70125 |
| 99 | 167.734 | 108.928 | 94.4417 | 7.3853 | 307.5 | 4.4977 | -5.85776 |
| 100 | 167.734 | 108.928 | 101.188 | 7.48528 | 307.5 | 4.5552 | -5.93965 |
| 101 | 167.734 | 108.928 | 107.933 | 7.49408 | 307.5 | 4.55756 | -5.94894 |
| 102 | 167.734 | 108.928 | 114.679 | 7.41756 | 307.4 | 4.50837 | -5.89023 |
| 103 | 167.734 | 108.928 | 121.425 | 7.2661 | 307.4 | 4.41402 | -5.77172 |
| 104 | 167.734 | 108.928 | 128.171 | 7.05446 | 307.4 | 4.28358 | -5.60503 |
| 105 | 167.734 | 108.928 | 134.917 | 6.7967 | 307.4 | 4.12569 | -5.40128 |
| 106 | 167.734 | 108.928 | 141.663 | 6.49875 | 307.4 | 3.94405 | -5.1651 |
| 107 | 167.734 | 108.928 | 148.408 | 6.15941 | 307.4 | 3.73796 | -4.89551 |
| 108 | 167.734 | 108.928 | 155.154 | 5.77462 | 307.4 | 3.505 | -4.58926 |
| J9 | 167.734 | 108.928 | 161.9 | 5.3112 | 307.4 | 3.2252 | -4.21983 |
| 2J1 | 167.734 | 108.928 | 161.9 | 1.85725 | 307.7 | 1.1365 | -1.46893 |
| 110 | 167.736 | 105.645 | 156.3 | 1.6815 | 307.8 | 1.03004 | -1.32908 |
| 111 | 167.738 | 102.362 | 150.7 | 1.42915 | 307.8 | .8765 | -1.12881 |
| 112 | 167.739 | 99.0784 | 145.1 | 1.13154 | 307.9 | .694764 | -.893138 |
| 113 | 167.741 | 95.7952 | 139.5 | .796753 | 307.9 | .48971 | -.62849 |
| 114 | 167.743 | 92.5121 | 133.9 | .426467 | 308. | .262363 | -.336214 |
| END | 167.745 | 89.2289 | 128.3 | 0 | 0 | 0 | 0 |
| 2J1 | 167.734 | 108.928 | 161.9 | 1.69203 | 307.7 | 1.03411 | -1.33924 |
| 116 | 165.207 | 110.391 | 156.3 | 1.53489 | 307.7 | .938966 | -1.21418 |
| 117 | 162.68 | 111.855 | 150.7 | 1.30501 | 307.8 | .799199 | -1.03166 |
| 118 | 160.153 | 113.318 | 145.1 | 1.03329 | 307.8 | .633452 | -.816347 |
| 119 | 157.626 | 114.781 | 139.5 | .727612 | 307.9 | .446481 | -.574521 |
| 120 | 155.099 | 116.245 | 133.9 | .389541 | 307.9 | .239236 | -.307422 |
| END | 152.572 | 117.708 | 128.3 | 0 | 0 | 0 | 0 |
| 2J1 | 167.734 | 108.928 | 161.9 | 1.76209 | 306.8 | 1.05459 | -1.41167 |
| 122 | 170.581 | 110.571 | 156.3 | 1.58921 | 306.7 | .950711 | -1.27347 |
| 123 | 173.429 | 112.214 | 150.7 | 1.34448 | 306.7 | .803937 | -1.07764 |
| 124 | 176.276 | 113.858 | 145.1 | 1.05945 | 306.7 | .633229 | -.849383 |
| 125 | 179.123 | 115.501 | 139.5 | .742358 | 306.7 | .443531 | -.595295 |
| 126 | 181.971 | 117.144 | 133.9 | .395363 | 306.7 | .236128 | -.317105 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| END | 184.818 | 118.788 | 128.3 | 0 | 0 | 0 | 0 |
| GND | 251.601 | 163.392 | 0 | .225748 | 202.8 | -.208036 | -.0876528 |
| 128 | 251.601 | 163.392 | 6.76667 | .302521 | 129.4 | -.192148 | .233662 |
| 129 | 251.601 | 163.392 | 13.5333 | .470566 | 113. | -.183621 | .433262 |
| 130 | 251.601 | 163.392 | 20.3 | .636586 | 106.2 | -.177206 | .611424 |
| 131 | 251.601 | 163.392 | 27.0667 | .794043 | 102.5 | -.172372 | .775108 |
| 132 | 251.601 | 163.392 | 33.8333 | .942057 | 100.3 | -.168759 | .926818 |
| 133 | 251.601 | 163.392 | 40.6 | 1.0797 | 98.8 | -.166079 | 1.06685 |
| 134 | 251.601 | 163.392 | 47.3667 | 1.20583 | 97.8 | -.164058 | 1.19462 |
| 135 | 251.601 | 163.392 | 54.1333 | 1.31924 | 97.1 | -.162428 | 1.3092 |
| 136 | 251.601 | 163.392 | 60.9 | 1.41867 | 96.5 | -.16093 | 1.40952 |
| 137 | 251.601 | 163.392 | 67.6667 | 1.50299 | 96.1 | -.159319 | 1.49452 |
| 138 | 251.601 | 163.392 | 74.4333 | 1.57121 | 95.7 | -.157372 | 1.56331 |
| 139 | 251.601 | 163.392 | 81.2 | 1.62254 | 95.5 | -.154903 | 1.61513 |
| 140 | 251.601 | 163.392 | 87.9667 | 1.65649 | 95.3 | -.151765 | 1.64952 |
| 141 | 251.601 | 163.392 | 94.7333 | 1.67288 | 95.1 | -.147864 | 1.66633 |
| 142 | 251.601 | 163.392 | 101.5 | 1.67196 | 94.9 | -.143167 | 1.66582 |
| 143 | 251.601 | 163.392 | 108.267 | 1.65451 | 94.8 | -.137715 | 1.64877 |
| 144 | 251.601 | 163.392 | 115.033 | 1.62201 | 94.7 | -.13164 | 1.61666 |
| 145 | 251.601 | 163.392 | 121.8 | 1.57685 | 94.6 | -.125175 | 1.57188 |
| 146 | 251.601 | 163.392 | 128.567 | 1.52231 | 94.5 | -.118649 | 1.51768 |
| 147 | 251.601 | 163.392 | 135.333 | 1.46141 | 94.4 | -.112374 | 1.45708 |
| 148 | 251.601 | 163.392 | 142.1 | 1.39553 | 94.4 | -.106504 | 1.39146 |
| 149 | 251.601 | 163.392 | 148.867 | 1.32447 | 94.4 | -.101043 | 1.32061 |
| 150 | 251.601 | 163.392 | 155.633 | 1.24733 | 94.4 | -.0959352 | 1.24364 |
| J13 | 251.601 | 163.392 | 162.4 | 1.15875 | 94.5 | -.090946 | 1.15517 |
| 2J1 | 251.601 | 163.392 | 162.4 | .379976 | 94.1 | -.0270572 | .379012 |
| 152 | 253.742 | 160.913 | 156.8 | .346472 | 94.2 | -.025159 | .345558 |
| 153 | 255.883 | 158.435 | 151.2 | .296831 | 94.3 | -.0220073 | .296014 |
| 154 | 258.024 | 155.957 | 145.6 | .236902 | 94.3 | -.017897 | .236225 |
| 155 | 260.165 | 153.479 | 140. | .168122 | 94.4 | -.0129112 | .167626 |
| 156 | 262.306 | 151. | 134.4 | .0906897 | 94.5 | -7.07E-03 | .0904141 |
| END | 264.447 | 148.522 | 128.8 | 0 | 0 | 0 | 0 |
| 2J1 | 251.601 | 163.392 | 162.4 | .40845 | 96.7 | -.0477911 | .405644 |
| 158 | 248.36 | 162.871 | 156.8 | .37414 | 97. | -.0453304 | .371384 |
| 159 | 245.118 | 162.351 | 151.2 | .32238 | 97.2 | -.0406627 | .319806 |
| 160 | 241.876 | 161.831 | 145.6 | .258827 | 97.5 | -.033955 | .25659 |
| 161 | 238.634 | 161.31 | 140. | .184781 | 97.8 | -.0251645 | .18306 |
| 162 | 235.393 | 160.79 | 134.4 | .100263 | 98.1 | -.0141459 | .09926 |
| END | 232.151 | 160.27 | 128.8 | 0 | 0 | 0 | 0 |

**WZRC NIGHT GEOMETRY**

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

| wire | caps | Distance | Angle | Z | radius | segs |
|---|---|---|---|---|---|---|
| 1 | none | 0 | 0 | 0 | .4 | 24 |
| | | 0 | 0 | 169.5 | | |
| 2 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | 14.6 | 12. | 133.3 | | |
| 3 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | 14.1 | 134. | 133.3 | | |
| 4 | none | 0 | 0 | 169.5 | .01 | 6 |
| | | 14.6 | 254. | 133.3 | | |
| 5 | none | 100. | 327. | 0 | .4 | 24 |
| | | 100. | 327. | 159. | | |
| 6 | none | 100. | 327. | 159. | .01 | 6 |
| | | 112.1 | 335.55 | 125.4 | | |
| 7 | none | 100. | 327. | 159. | .01 | 6 |
| | | 80.2 | 327.74 | 125.4 | | |
| 8 | none | 100. | 327. | 159. | .01 | 6 |
| | | 110.3 | 317.84 | 125.4 | | |
| 9 | none | 200. | 327. | 0 | .4 | 24 |
| | | 200. | 327. | 161.9 | | |
| 10 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | 190. | 331.99 | 128.3 | | |
| 11 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | 192.7 | 322.35 | 128.3 | | |
| 12 | none | 200. | 327. | 161.9 | .01 | 6 |
| | | 219.7 | 327.27 | 128.3 | | |
| 13 | none | 300. | 327. | 0 | .4 | 24 |
| | | 300. | 327. | 162.4 | | |
| 14 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | 303.3 | 330.68 | 128.8 | | |
| 15 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | 282.1 | 325.38 | 128.8 | | |
| 16 | none | 300. | 327. | 162.4 | .01 | 6 |
| | | 316.1 | 324.82 | 128.8 | | |

Number of wires = 16
Current nodes = 168

| | minimum | | maximum | |
|---|---|---|---|---|
| Individual wires | wire | value | wire | value |
| segment length | 11 | 6.31567 | 1 | 7.0625 |
| radius | 2 | .01 | 1 | .4 |

ELECTRICAL DESCRIPTION
Frequencies (MHz)

| | frequency | | no. of | segment length (wavelengths) | |
|---|---|---|---|---|---|
| no. | lowest | step | steps | minimum | maximum |
| 1 | 1.48 | 0 | 1 | .0175435 | .0196181 |

Sources

| source | node | sector | magnitude | phase | type |
|---|---|---|---|---|---|
| 1 | 1 | 1 | 2,293.07 | 100.5 | voltage |
| 2 | 43 | 1 | 5,294.83 | 243.1 | voltage |
| 3 | 85 | 1 | 4,529.95 | 44.7 | voltage |
| 4 | 127 | 1 | 1,191.16 | 218.7 | voltage |

IMPEDANCE
normalization = 50.

| freq (MHz) | resist (ohms) | react (ohms) | imped (ohms) | phase (deg) | VSWR | S11 dB | S12 dB |
|---|---|---|---|---|---|---|---|
| source = 1; node 1, sector 1 | | | | | | | |
| 1.48 | -36.037 | -325.09 | 327.08 | 263.7 | **** | **** | **** |
| source = 2; node 43, sector 1 | | | | | | | |
| 1.48 | 58.251 | -443.63 | 447.44 | 277.5 | 69.581 | -.24968 | -12.528 |
| source = 3; node 85, sector 1 | | | | | | | |
| 1.48 | 50.084 | -471.97 | 474.62 | 276.1 | 90.944 | -.19102 | -13.662 |
| source = 4; node 127, sector 1 | | | | | | | |
| 1.48 | -239.13 | -548.29 | 598.17 | 246.4 | **** | **** | **** |

CURRENT rms
Frequency = 1.48 MHz
Input power = 5,000. watts
Efficiency = 100. %
coordinates in degrees

| current no. | X | Y | Z | mag (amps) | phase (deg) | real (amps) | imaginary (amps) |
|---|---|---|---|---|---|---|---|
| GND | 0 | 0 | 0 | 4.95736 | 196.9 | -4.74424 | -1.43793 |
| 2 | 0 | 0 | 7.0625 | 3.32342 | 200. | -3.12269 | -1.13751 |
| 3 | 0 | 0 | 14.125 | 2.28805 | 204.5 | -2.08266 | -.947478 |
| 4 | 0 | 0 | 21.1875 | 1.37374 | 214.4 | -1.13336 | -.776302 |
| 5 | 0 | 0 | 28.25 | .662385 | 248.7 | -.240531 | -.61717 |
| 6 | 0 | 0 | 35.3125 | .766142 | 322.4 | .607009 | -.467454 |
| 7 | 0 | 0 | 42.375 | 1.44663 | 347. | 1.40931 | -.326482 |
| 8 | 0 | 0 | 49.4375 | 2.17074 | 354.9 | 2.16202 | -.194337 |
| 9 | 0 | 0 | 56.5 | 2.85977 | 358.6 | 2.85888 | -.0714339 |
| 10 | 0 | 0 | 63.5625 | 3.49319 | .7 | 3.49294 | .0416726 |
| 11 | 0 | 0 | 70.625 | 4.05986 | 2. | 4.05729 | .144388 |
| 12 | 0 | 0 | 77.6875 | 4.55163 | 3. | 4.5455 | .236128 |
| 13 | 0 | 0 | 84.75 | 4.96209 | 3.7 | 4.952 | .316354 |
| 14 | 0 | 0 | 91.8125 | 5.2864 | 4.2 | 5.27239 | .384602 |
| 15 | 0 | 0 | 98.875 | 5.52132 | 4.6 | 5.50372 | .440506 |
| 16 | 0 | 0 | 105.938 | 5.66559 | 4.9 | 5.64489 | .483829 |
| 17 | 0 | 0 | 113. | 5.72044 | 5.2 | 5.69726 | .514524 |
| 18 | 0 | 0 | 120.063 | 5.69089 | 5.4 | 5.66589 | .532846 |
| 19 | 0 | 0 | 127.125 | 5.58806 | 5.5 | 5.56195 | .539578 |
| 20 | 0 | 0 | 134.188 | 5.43112 | 5.7 | 5.40458 | .536249 |
| 21 | 0 | 0 | 141.25 | 5.23692 | 5.7 | 5.2106 | .524376 |
| 22 | 0 | 0 | 148.313 | 5.00474 | 5.8 | 4.97928 | .504218 |
| 23 | 0 | 0 | 155.375 | 4.72657 | 5.8 | 4.70259 | .475476 |
| 24 | 0 | 0 | 162.438 | 4.39578 | 5.7 | 4.37392 | .437881 |
| J1 | 0 | 0 | 169.5 | 3.95158 | 5.6 | 3.93286 | .384167 |
| 2J1 | 0 | 0 | 169.5 | 1.36622 | 4.1 | 1.36277 | .0970714 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 26 | 2.38016 | -.505918 | 163.467 | 1.2346 | 3.8 | 1.23184 | .0824866 |
| 27 | 4.76032 | -1.01184 | 157.433 | 1.04413 | 3.5 | 1.04217 | .0639958 |
| 28 | 7.14048 | -1.51775 | 151.4 | .822056 | 3.2 | .8208 | .0454249 |
| 29 | 9.52064 | -2.02367 | 145.367 | .575661 | 2.8 | .574973 | .0281249 |
| 30 | 11.9008 | -2.52959 | 139.333 | .30644 | 2.4 | .306169 | .0128921 |
| END | 14.281 | -3.03551 | 133.3 | 0 | 0 | 0 | 0 |
| 2J1 | 0 | 0 | 169.5 | 1.24892 | 7.8 | 1.23722 | .170571 |
| 32 | -1.63245 | -1.69045 | 163.467 | 1.12375 | 7.9 | 1.11312 | .154218 |
| 33 | -3.2649 | -3.3809 | 157.433 | .944549 | 7.9 | .935493 | .130485 |
| 34 | -4.89734 | -5.07135 | 151.4 | .738669 | 8. | .731479 | .10281 |
| 35 | -6.52979 | -6.7618 | 145.367 | .513655 | 8.1 | .508568 | .0721084 |
| 36 | -8.16224 | -8.45224 | 139.333 | .271453 | 8.2 | .268709 | .038501 |
| END | -9.79468 | -10.1427 | 133.3 | 0 | 0 | 0 | 0 |
| 2J1 | 0 | 0 | 169.5 | 1.33796 | 5. | 1.33287 | .116525 |
| 38 | -.670717 | 2.33907 | 163.467 | 1.20734 | 4.8 | 1.20308 | .101436 |
| 39 | -1.34144 | 4.67814 | 157.433 | 1.01912 | 4.6 | 1.01585 | .0815624 |
| 40 | -2.01215 | 7.01721 | 151.4 | .800654 | 4.3 | .798357 | .0606066 |
| 41 | -2.68287 | 9.35628 | 145.367 | .559384 | 4.1 | .557967 | .0397824 |
| 42 | -3.35359 | 11.6954 | 139.333 | .297036 | 3.8 | .296383 | .0196909 |
| END | -4.0243 | 14.0344 | 133.3 | 0 | 0 | 0 | 0 |
| GND | 83.8671 | 54.4639 | 0 | 8.36766 | 325.6 | 6.90364 | -4.72836 |
| 44 | 83.8671 | 54.4639 | 6.625 | 4.75286 | 319.9 | 3.63304 | -3.06442 |
| 45 | 83.8671 | 54.4639 | 13.25 | 2.58801 | 308.4 | 1.60811 | -2.02776 |
| 46 | 83.8671 | 54.4639 | 19.875 | 1.11253 | 259.4 | -.204653 | -1.09355 |
| 47 | 83.8671 | 54.4639 | 26.5 | 1.89102 | 186.8 | -1.87757 | -.225184 |
| 48 | 83.8671 | 54.4639 | 33.125 | 3.48937 | 170.2 | -3.43888 | .591453 |
| 49 | 83.8671 | 54.4639 | 39.75 | 5.07953 | 164.5 | -4.89435 | 1.35902 |
| 50 | 83.8671 | 54.4639 | 46.375 | 6.57707 | 161.6 | -6.24095 | 2.07566 |
| 51 | 83.8671 | 54.4639 | 53. | 7.95745 | 159.9 | -7.47177 | 2.73747 |
| 52 | 83.8671 | 54.4639 | 59.625 | 9.20551 | 158.7 | -8.57832 | 3.33975 |
| 53 | 83.8671 | 54.4639 | 66.25 | 10.309 | 157.9 | -9.55193 | 3.8776 |
| 54 | 83.8671 | 54.4639 | 72.875 | 11.2575 | 157.3 | -10.3845 | 4.34645 |
| 55 | 83.8671 | 54.4639 | 79.5 | 12.0425 | 156.8 | -11.0694 | 4.74226 |
| 56 | 83.8671 | 54.4639 | 86.125 | 12.6577 | 156.4 | -11.6015 | 5.06187 |
| 57 | 83.8671 | 54.4639 | 92.75 | 13.0994 | 156.1 | -11.9779 | 5.3032 |
| 58 | 83.8671 | 54.4639 | 99.375 | 13.3672 | 155.9 | -12.1988 | 5.46557 |
| 59 | 83.8671 | 54.4639 | 106. | 13.4652 | 155.7 | -12.2681 | 5.55012 |
| 60 | 83.8671 | 54.4639 | 112.625 | 13.4027 | 155.5 | -12.1949 | 5.5604 |
| 61 | 83.8671 | 54.4639 | 119.25 | 13.1969 | 155.4 | -11.9948 | 5.50307 |
| 62 | 83.8671 | 54.4639 | 125.875 | 12.8708 | 155.3 | -11.689 | 5.38754 |
| 63 | 83.8671 | 54.4639 | 132.5 | 12.446 | 155.2 | -11.2972 | 5.2227 |
| 64 | 83.8671 | 54.4639 | 139.125 | 11.9325 | 155.2 | -10.8283 | 5.01307 |
| 65 | 83.8671 | 54.4639 | 145.75 | 11.3305 | 155.2 | -10.2824 | 4.75942 |
| 66 | 83.8671 | 54.4639 | 152.375 | 10.6355 | 155.2 | -9.65502 | 4.46037 |
| J5 | 83.8671 | 54.4639 | 159. | 9.79618 | 155.3 | -8.8999 | 4.09353 |
| 2J1 | 83.8671 | 54.4639 | 159. | 3.29027 | 154.8 | -2.97774 | 1.39962 |
| 68 | 86.8971 | 53.1196 | 153.4 | 2.96684 | 154.9 | -2.68684 | 1.25819 |
| 69 | 89.9271 | 51.7753 | 147.8 | 2.50754 | 155. | -2.27282 | 1.05928 |
| 70 | 92.9571 | 50.431 | 142.2 | 1.97338 | 155.1 | -1.79029 | .830113 |
| 71 | 95.9871 | 49.0867 | 136.6 | 1.38067 | 155.2 | -1.25377 | .578211 |
| 72 | 99.0172 | 47.7424 | 131. | .734113 | 155.4 | -.667294 | .306008 |
| END | 102.047 | 46.3981 | 125.4 | 0 | 0 | 0 | 0 |
| 2J1 | 83.8671 | 54.4639 | 159. | 3.24953 | 156.2 | -2.9725 | 1.3129 |
| 74 | 81.1925 | 52.5212 | 153.4 | 2.92859 | 156.4 | -2.6827 | 1.17464 |
| 75 | 78.518 | 50.5785 | 147.8 | 2.47405 | 156.6 | -2.27025 | .983286 |
| 76 | 75.8435 | 48.6358 | 142.2 | 1.94636 | 156.8 | -1.78929 | .765986 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 77 | 73.169 | 46.6931 | 136.6 | 1.36151 | 157.1 | -1.25399 | .530298 |
| 78 | 70.4944 | 44.7504 | 131. | .723897 | 157.3 | -.668013 | .278898 |
| END | 67.8199 | 42.8077 | 125.4 | 0 | 0 | 0 | 0 |
| 2J1 | 83.8671 | 54.4639 | 159. | 3.25695 | 154.9 | -2.94966 | 1.38102 |
| 80 | 83.5163 | 57.7255 | 153.4 | 2.93698 | 155. | -2.6618 | 1.24122 |
| 81 | 83.1655 | 60.9872 | 147.8 | 2.48205 | 155.1 | -2.25156 | 1.04453 |
| 82 | 82.8148 | 64.2488 | 142.2 | 1.95302 | 155.2 | -1.77341 | .818128 |
| 83 | 82.464 | 67.5105 | 136.6 | 1.36621 | 155.4 | -1.24184 | .569542 |
| 84 | 82.1132 | 70.7721 | 131. | .726318 | 155.5 | -.660902 | .301242 |
| END | 81.7625 | 74.0337 | 125.4 | 0 | 0 | 0 | 0 |
| GND | 167.734 | 108.928 | 0 | 6.74882 | 128.7 | -4.21524 | 5.27051 |
| 86 | 167.734 | 108.928 | 6.74583 | 3.61224 | 123.4 | -1.98609 | 3.01724 |
| 87 | 167.734 | 108.928 | 13.4917 | 1.71641 | 110.3 | -.59661 | 1.60939 |
| 88 | 167.734 | 108.928 | 20.2375 | .734851 | 27.8 | .649762 | .343242 |
| 89 | 167.734 | 108.928 | 26.9833 | 1.98414 | 335.3 | 1.80189 | -.83065 |
| 90 | 167.734 | 108.928 | 33.7292 | 3.46579 | 326.1 | 2.87809 | -1.93087 |
| 91 | 167.734 | 108.928 | 40.475 | 4.88161 | 322.7 | 3.88138 | -2.96057 |
| 92 | 167.734 | 108.928 | 47.2208 | 6.20209 | 320.8 | 4.80877 | -3.91685 |
| 93 | 167.734 | 108.928 | 53.9667 | 7.41344 | 319.7 | 5.6547 | -4.79411 |
| 94 | 167.734 | 108.928 | 60.7125 | 8.50425 | 318.9 | 6.41261 | -5.58576 |
| 95 | 167.734 | 108.928 | 67.4583 | 9.46419 | 318.4 | 7.07593 | -6.28507 |
| 96 | 167.734 | 108.928 | 74.2042 | 10.284 | 318. | 7.6385 | -6.88578 |
| 97 | 167.734 | 108.928 | 80.95 | 10.956 | 317.6 | 8.09522 | -7.38253 |
| 98 | 167.734 | 108.928 | 87.6958 | 11.4746 | 317.4 | 8.44248 | -7.77122 |
| 99 | 167.734 | 108.928 | 94.4417 | 11.8365 | 317.2 | 8.67816 | -8.0494 |
| 100 | 167.734 | 108.928 | 101.188 | 12.0414 | 317. | 8.8024 | -8.21656 |
| 101 | 167.734 | 108.928 | 107.933 | 12.0929 | 316.8 | 8.81823 | -8.27504 |
| 102 | 167.734 | 108.928 | 114.679 | 12.0002 | 316.7 | 8.73253 | -8.23084 |
| 103 | 167.734 | 108.928 | 121.425 | 11.7796 | 316.6 | 8.5576 | -8.0948 |
| 104 | 167.734 | 108.928 | 128.171 | 11.4546 | 316.5 | 8.31075 | -7.88288 |
| 105 | 167.734 | 108.928 | 134.917 | 11.048 | 316.5 | 8.0086 | -7.6105 |
| 106 | 167.734 | 108.928 | 141.663 | 10.5694 | 316.4 | 7.65823 | -7.28452 |
| 107 | 167.734 | 108.928 | 148.408 | 10.0175 | 316.4 | 7.25836 | -6.90405 |
| 108 | 167.734 | 108.928 | 155.154 | 9.38607 | 316.5 | 6.80439 | -6.46518 |
| J9 | 167.734 | 108.928 | 161.9 | 8.62042 | 316.5 | 6.25715 | -5.92956 |
| 2J1 | 167.734 | 108.928 | 161.9 | 2.99074 | 316.6 | 2.1745 | -2.0533 |
| 110 | 167.736 | 105.645 | 156.3 | 2.70159 | 316.7 | 1.96736 | -1.85151 |
| 111 | 167.738 | 102.362 | 150.7 | 2.28974 | 316.9 | 1.67059 | -1.56591 |
| 112 | 167.739 | 99.0784 | 145.1 | 1.80763 | 317. | 1.32139 | -1.23347 |
| 113 | 167.741 | 95.7952 | 139.5 | 1.26898 | 317.1 | .929419 | -.86399 |
| 114 | 167.743 | 92.5121 | 133.9 | .677137 | 317.2 | .496897 | -.460009 |
| END | 167.745 | 89.2289 | 128.3 | 0 | 0 | 0 | 0 |
| 2J1 | 167.734 | 108.928 | 161.9 | 2.72919 | 316.6 | 1.98448 | -1.87358 |
| 116 | 165.207 | 110.391 | 156.3 | 2.47052 | 316.7 | 1.79918 | -1.69306 |
| 117 | 162.68 | 111.855 | 150.7 | 2.09495 | 316.9 | 1.52858 | -1.43257 |
| 118 | 160.153 | 113.318 | 145.1 | 1.65411 | 317. | 1.20931 | -1.12856 |
| 119 | 157.626 | 114.781 | 139.5 | 1.16141 | 317.1 | .850796 | -.790586 |
| 120 | 155.099 | 116.245 | 133.9 | .619939 | 317.2 | .455042 | -.421024 |
| END | 152.572 | 117.708 | 128.3 | 0 | 0 | 0 | 0 |
| 2J1 | 167.734 | 108.928 | 161.9 | 2.90052 | 316.3 | 2.09817 | -2.00268 |
| 122 | 170.581 | 110.571 | 156.3 | 2.61411 | 316.4 | 1.89346 | -1.80233 |
| 123 | 173.429 | 112.214 | 150.7 | 2.20964 | 316.5 | 1.60313 | -1.52069 |
| 124 | 176.276 | 113.858 | 145.1 | 1.73961 | 316.6 | 1.26435 | -1.19484 |
| 125 | 179.123 | 115.501 | 139.5 | 1.21784 | 316.7 | .88678 | -.834723 |
| 126 | 181.971 | 117.144 | 133.9 | .648019 | 316.9 | .472776 | -.443184 |
| END | 184.818 | 118.788 | 128.3 | 0 | 0 | 0 | 0 |

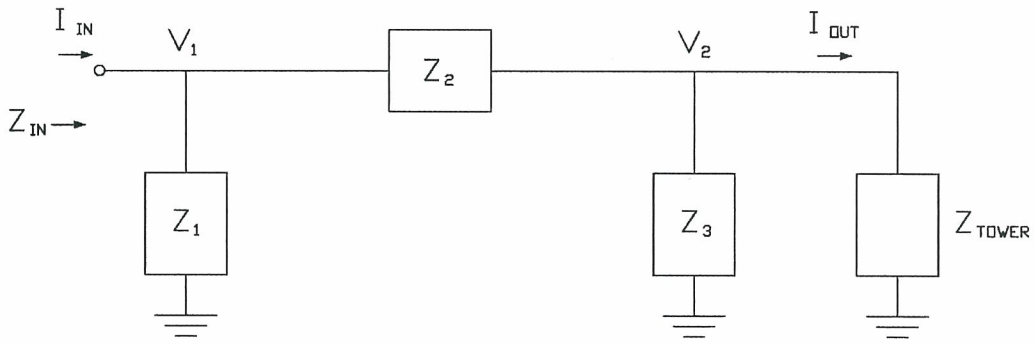
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| GND | 251.601 | 163.392 | 0 | 1.40809 | 332.3 | 1.24681 | -.654361 |
| 128 | 251.601 | 163.392 | 6.76667 | .722358 | 359.7 | .72235 | -3.47E-03 |
| 129 | 251.601 | 163.392 | 13.5333 | .560543 | 45.9 | .390007 | .402621 |
| 130 | 251.601 | 163.392 | 20.3 | .771761 | 83.5 | .0870665 | .766834 |
| 131 | 251.601 | 163.392 | 27.0667 | 1.12085 | 100.2 | -.197613 | 1.10329 |
| 132 | 251.601 | 163.392 | 33.8333 | 1.49233 | 108.3 | -.467892 | 1.41709 |
| 133 | 251.601 | 163.392 | 40.6 | 1.8559 | 113. | -.723962 | 1.70888 |
| 134 | 251.601 | 163.392 | 47.3667 | 2.20021 | 116. | -.964562 | 1.9775 |
| 135 | 251.601 | 163.392 | 54.1333 | 2.51872 | 118.1 | -1.18775 | 2.22108 |
| 136 | 251.601 | 163.392 | 60.9 | 2.80659 | 119.7 | -1.39135 | 2.43743 |
| 137 | 251.601 | 163.392 | 67.6667 | 3.05979 | 120.9 | -1.57316 | 2.62441 |
| 138 | 251.601 | 163.392 | 74.4333 | 3.27496 | 121.9 | -1.73111 | 2.78004 |
| 139 | 251.601 | 163.392 | 81.2 | 3.44938 | 122.7 | -1.86342 | 2.90274 |
| 140 | 251.601 | 163.392 | 87.9667 | 3.58102 | 123.3 | -1.96863 | 2.99135 |
| 141 | 251.601 | 163.392 | 94.7333 | 3.66869 | 123.9 | -2.04578 | 3.04533 |
| 142 | 251.601 | 163.392 | 101.5 | 3.71219 | 124.3 | -2.09448 | 3.06488 |
| 143 | 251.601 | 163.392 | 108.267 | 3.71257 | 124.7 | -2.11507 | 3.05117 |
| 144 | 251.601 | 163.392 | 115.033 | 3.67254 | 125. | -2.10891 | 3.00667 |
| 145 | 251.601 | 163.392 | 121.8 | 3.59695 | 125.3 | -2.07858 | 2.93556 |
| 146 | 251.601 | 163.392 | 128.567 | 3.49266 | 125.5 | -2.02795 | 2.84361 |
| 147 | 251.601 | 163.392 | 135.333 | 3.3663 | 125.6 | -1.9608 | 2.73628 |
| 148 | 251.601 | 163.392 | 142.1 | 3.221 | 125.7 | -1.87909 | 2.61608 |
| 149 | 251.601 | 163.392 | 148.867 | 3.05669 | 125.7 | -1.78306 | 2.48275 |
| 150 | 251.601 | 163.392 | 155.633 | 2.87175 | 125.6 | -1.67208 | 2.33476 |
| J13 | 251.601 | 163.392 | 162.4 | 2.65271 | 125.4 | -1.53791 | 2.16142 |
| 2J1 | 251.601 | 163.392 | 162.4 | .869125 | 125.4 | -.503019 | .708767 |
| 152 | 253.742 | 160.913 | 156.8 | .787028 | 125.1 | -.453022 | .643571 |
| 153 | 255.883 | 158.435 | 151.2 | .668627 | 124.9 | -.382224 | .548605 |
| 154 | 258.024 | 155.957 | 145.6 | .529017 | 124.6 | -.300175 | .435608 |
| 155 | 260.165 | 153.479 | 140. | .372153 | 124.3 | -.209525 | .307566 |
| 156 | 262.306 | 151. | 134.4 | .198986 | 123.9 | -.111119 | .165069 |
| END | 264.447 | 148.522 | 128.8 | 0 | 0 | 0 | 0 |
| 2J1 | 251.601 | 163.392 | 162.4 | .943705 | 125.7 | -.550365 | .766601 |
| 158 | 248.36 | 162.871 | 156.8 | .859381 | 125.5 | -.498962 | .699695 |
| 159 | 245.118 | 162.351 | 151.2 | .735366 | 125.3 | -.424581 | .600411 |
| 160 | 241.876 | 161.831 | 145.6 | .586301 | 125. | -.336506 | .480117 |
| 161 | 238.634 | 161.31 | 140. | .415752 | 124.8 | -.23715 | .341482 |
| 162 | 235.393 | 160.79 | 134.4 | .224131 | 124.5 | -.12703 | .184656 |

# EXHIBIT V

# TOWER BASE CIRCUIT ANALYSIS MODEL

## CIRCUIT ANALYSIS

Circuit analysis was performed on each tower of the WZRC model. "Phasetek" nodal circuit analysis program was used to compute base model input/output voltages and currents. For the directional mode, the calculated Mininec tower base drive voltage was used to determine the base network input voltage. This point is the location of the voltage sampling unit. "$Z_1$" represents the ATU shunt impedance, "$Z_2$" represents the tower feed impedance, and "$Z_3$" represents the tower base shunt impedance.



# EXHIBIT VI

# WZRC CIRCUIT ANALYSIS

**BASE NETWORK COMPUTATION**

**NETWORK ID: WZRC TOWER 1(OTHERS OPEN)**

FREQUENCY : 1480.00 kHz
ATU SHUNT IMPEDANCE (R,X) : 0.00,-43000.00 OHMS
TOWER FEED IMPEDANCE (R,X) : 0.00, 22.20 OHMS
TOWER SHUNT IMPEDANCE (R,X) : 0.00,-10753.70 OHMS
TOWER IMPEDANCE (R,X) : 146.51, -357.11 OHMS

| NODE | TO | NODE | IMPEDANCE (OHMS) R | X |
|---|---|---|---|---|
| 1 | | GROUND | 0.00 | -43000.00 |
| 2 | | GROUND | 137.22 | -347.44 |
| 1 | | 2 | 0.00 | 22.20 |

| NODE | VOLTAGE MAGNITUDE | PHASE |
|---|---|---|
| 1 | 100.00 | 0.00 |
| 2 | 105.82 | -1.32 |

| | REAL | IMAGINARY | MAGNITUDE | PHASE |
|---|---|---|---|---|
| INPUT IMPEDANCE (OHMS) : | 135.17 | -323.23 | 350.35 | -67.31 |
| INPUT CURRENT (AMPS) : | 0.11 | 0.26 | 0.29 | 67.31 |
| OUTPUT CURRENT (AMPS) : | 0.11 | 0.25 | 0.27 | 66.37 |

INPUT/OUTPUT CURRENT RATIO = 1.0411
INPUT/OUTPUT PHASE = 0.94 DEGREES

**BASE NETWORK COMPUTATION**

**NETWORK ID: WZRC TOWER 1 DAY**

FREQUENCY : 1480.00 kHz
ATU SHUNT IMPEDANCE (R,X) : 0.00,-43000.00 OHMS
TOWER FEED IMPEDANCE (R,X) : 0.00, 22.20 OHMS
TOWER SHUNT IMPEDANCE (R,X) : 0.00,-10753.70 OHMS
TOWER IMPEDANCE (R,X) : 30.59, -371.59 OHMS

| NODE | TO | NODE | IMPEDANCE (OHMS) R | X |
|---|---|---|---|---|
| 1 | | GROUND | 0.00 | -43000.00 |
| 2 | | GROUND | 28.58 | -359.26 |
| 1 | | 2 | 0.00 | 22.20 |

| NODE | VOLTAGE MAGNITUDE | PHASE |
|---|---|---|
| 1 | 2428.56 | 87.30 |
| 2 | 2587.41 | 87.00 |

| | REAL | IMAGINARY | MAGNITUDE | PHASE |
|---|---|---|---|---|
| INPUT IMPEDANCE (OHMS) : | 28.14 | -334.45 | 335.64 | -85.19 |
| INPUT CURRENT (AMPS) : | -7.17 | 0.95 | 7.24 | 172.49 |
| OUTPUT CURRENT (AMPS) : | -6.88 | 0.93 | 6.94 | 172.29 |

INPUT/OUTPUT CURRENT RATIO = 1.0427
INPUT/OUTPUT PHASE = 0.20 DEGREES

**BASE NETWORK COMPUTATION**

**NETWORK ID: WZRC TOWER 1 NIGHT**

FREQUENCY : 1480.00 kHz
ATU SHUNT IMPEDANCE (R,X) : 0.00,-43000.00 OHMS
TOWER FEED IMPEDANCE (R,X) : 0.00, 22.20 OHMS
TOWER SHUNT IMPEDANCE (R,X) : 0.00,-10753.70 OHMS
TOWER IMPEDANCE (R,X) : -36.04, -325.09 OHMS

| NODE | TO | NODE | IMPEDANCE (OHMS) R | X |
|---|---|---|---|---|
| 1 | | GROUND | 0.00 | -43000.00 |
| 2 | | GROUND | -33.95 | -315.66 |
| 1 | | 2 | 0.00 | 22.20 |

| NODE | VOLTAGE MAGNITUDE | PHASE |
|---|---|---|
| 1 | 1508.77 | 100.04 |
| 2 | 1621.45 | 100.50 |

| | REAL | IMAGINARY | MAGNITUDE | PHASE |
|---|---|---|---|---|
| INPUT IMPEDANCE (OHMS) : | -33.49 | -291.50 | 293.42 | -96.55 |
| INPUT CURRENT (AMPS) : | -4.93 | -1.47 | 5.14 | -163.41 |
| OUTPUT CURRENT (AMPS) : | -4.75 | -1.43 | 4.96 | -163.17 |

INPUT/OUTPUT CURRENT RATIO = 1.0373
INPUT/OUTPUT PHASE = -0.23 DEGREES

**BASE NETWORK COMPUTATION**

**NETWROK ID: WZRC TOWER 2(OTHERS OPEN)**

FREQUENCY : 1480.00 kHz
ATU SHUNT IMPEDANCE (R,X) : 0.00,-43000.00 OHMS
TOWER FEED IMPEDANCE (R,X) : 0.00, 46.80 OHMS
TOWER SHUNT IMPEDANCE (R,X) : 0.00,-10753.70 OHMS
TOWER IMPEDANCE (R,X) : 161.37, -354.57 OHMS

| NODE | TO | NODE | IMPEDANCE (OHMS) R | X |
|---|---|---|---|---|
| 1 | | GROUND | 0.00 | -43000.00 |
| 2 | | GROUND | 151.20 | -345.45 |
| 1 | | 2 | 0.00 | 46.80 |

| NODE | VOLTAGE MAGNITUDE | PHASE |
|---|---|---|
| 1 | 100.00 | 0.00 |
| 2 | 112.65 | -3.21 |

| | REAL | IMAGINARY | MAGNITUDE | PHASE |
|---|---|---|---|---|
| INPUT IMPEDANCE (OHMS) : | 149.12 | -297.11 | 332.43 | -63.35 |
| INPUT CURRENT (AMPS) : | 0.13 | 0.27 | 0.30 | 63.35 |
| OUTPUT CURRENT (AMPS) : | 0.13 | 0.26 | 0.29 | 62.32 |

INPUT/OUTPUT CURRENT RATIO = 1.0403
INPUT/OUTPUT PHASE = 1.03 DEGREES

**BASE NETWORK COMPUTATION**

**NETWORK ID: WZRC TOWER 2 DAY**

FREQUENCY : 1480.00 kHz
ATU SHUNT IMPEDANCE (R,X) : 0.00,-43000.00 OHMS
TOWER FEED IMPEDANCE (R,X) : 0.00, 46.80 OHMS
TOWER SHUNT IMPEDANCE (R,X) : 0.00,-10753.70 OHMS
TOWER IMPEDANCE (R,X) : 58.10, -450.66 OHMS

| NODE | TO NODE | IMPEDANCE (OHMS) R | X |
|---|---|---|---|
| 1 | GROUND | 0.00 | -43000.00 |
| 2 | GROUND | 53.52 | -432.81 |
| 1 | 2 | 0.00 | 46.80 |

| NODE | VOLTAGE MAGNITUDE | PHASE |
|---|---|---|
| 1 | 3044.26 | -119.26 |
| 2 | 3406.75 | 239.90 |

| | REAL | IMAGINARY | MAGNITUDE | PHASE |
|---|---|---|---|---|
| INPUT IMPEDANCE (OHMS) : | 52.57 | -382.64 | 386.24 | -82.18 |
| INPUT CURRENT (AMPS) : | 6.29 | -4.75 | 7.88 | -37.08 |
| OUTPUT CURRENT (AMPS) : | 5.95 | -4.56 | 7.50 | -37.45 |

INPUT/OUTPUT CURRENT RATIO = 1.0513
INPUT/OUTPUT PHASE = 0.37 DEGREES

**BASE NETWORK COMPUTATION**

**NETWORK ID: WZRC TOWER 2 NIGHT**

FREQUENCY : 1480.00 kHz
ATU SHUNT IMPEDANCE (R,X) : 0.00,-43000.00 OHMS
TOWER FEED IMPEDANCE (R,X) : 0.00, 46.80 OHMS
TOWER SHUNT IMPEDANCE (R,X) : 0.00,-10753.70 OHMS
TOWER IMPEDANCE (R,X) : 58.25, -443.63 OHMS

| NODE | TO NODE | IMPEDANCE (OHMS) R | X |
|---|---|---|---|
| 1 | GROUND | 0.00 | -43000.00 |
| 2 | GROUND | 53.73 | -426.33 |
| 1 | 2 | 0.00 | 46.80 |

| NODE | VOLTAGE MAGNITUDE | PHASE |
|---|---|---|
| 1 | 3339.83 | -116.03 |
| 2 | 3744.01 | 243.10 |

| | REAL | IMAGINARY | MAGNITUDE | PHASE |
|---|---|---|---|---|
| INPUT IMPEDANCE (OHMS) : | 52.79 | -376.28 | 379.96 | -82.01 |
| INPUT CURRENT (AMPS) : | 7.29 | -4.92 | 8.79 | -34.01 |
| OUTPUT CURRENT (AMPS) : | 6.91 | -4.73 | 8.37 | -34.38 |

INPUT/OUTPUT CURRENT RATIO = 1.0505
INPUT/OUTPUT PHASE = 0.37 DEGREES

**BASE NETWORK COMPUTATION**

**NETWORK ID: WZRC TOWER 3(OTHERS OPEN)**

FREQUENCY : 1480.00 kHz
ATU SHUNT IMPEDANCE (R,X) : 0.00,-43000.00 OHMS
TOWER FEED IMPEDANCE (R,X) : 0.00, 44.50 OHMS
TOWER SHUNT IMPEDANCE (R,X) : 0.00,-10753.70 OHMS
TOWER IMPEDANCE (R,X) : 146.81, -342.20 OHMS

| NODE | TO | NODE | IMPEDANCE (OHMS) R | X |
|---|---|---|---|---|
| 1 | | GROUND | 0.00 | -43000.00 |
| 2 | | GROUND | 137.87 | -333.47 |
| 1 | | 2 | 0.00 | 44.50 |

| NODE | VOLTAGE MAGNITUDE | PHASE |
|---|---|---|
| 1 | 100.00 | 0.00 |
| 2 | 112.70 | -3.04 |

| | REAL | IMAGINARY | MAGNITUDE | PHASE |
|---|---|---|---|---|
| INPUT IMPEDANCE (OHMS) : | 136.03 | -287.47 | 318.04 | -64.68 |
| INPUT CURRENT (AMPS) : | 0.13 | 0.28 | 0.31 | 64.68 |
| OUTPUT CURRENT (AMPS) : | 0.13 | 0.27 | 0.30 | 63.74 |

INPUT/OUTPUT CURRENT RATIO = 1.0389
INPUT/OUTPUT PHASE = 0.94 DEGREES

**BASE NETWORK COMPUTATION**

**NETWORK ID: WZRC TOWER 3 DAY**

FREQUENCY : 1480.00 kHz
ATU SHUNT IMPEDANCE (R,X) : 0.00,-43000.00 OHMS
TOWER FEED IMPEDANCE (R,X) : 0.00, 44.50 OHMS
TOWER SHUNT IMPEDANCE (R,X) : 0.00,-10753.70 OHMS
TOWER IMPEDANCE (R,X) : 16.85, -555.24 OHMS

| NODE | TO NODE | IMPEDANCE (OHMS) R | X |
|---|---|---|---|
| 1 | GROUND | 0.00 | -43000.00 |
| 2 | GROUND | 15.24 | -528.00 |
| 1 | 2 | 0.00 | 44.50 |

| NODE | VOLTAGE MAGNITUDE | PHASE |
|---|---|---|
| 1 | 1729.01 | 36.55 |
| 2 | 1887.99 | 36.40 |

| | REAL | IMAGINARY | MAGNITUDE | PHASE |
|---|---|---|---|---|
| INPUT IMPEDANCE (OHMS) : | 14.90 | -478.13 | 478.36 | -88.21 |
| INPUT CURRENT (AMPS) : | -2.06 | 2.97 | 3.61 | 124.77 |
| OUTPUT CURRENT (AMPS) : | -1.93 | 2.80 | 3.40 | 124.66 |

INPUT/OUTPUT CURRENT RATIO = 1.0635
INPUT/OUTPUT PHASE = 0.11 DEGREES

**BASE NETWORK COMPUTATION**

**NETWORK ID: WZRC TOWER 3 NIGHT**

FREQUENCY : 1480.00 kHz
ATU SHUNT IMPEDANCE (R,X) : 0.00,-43000.00 OHMS
TOWER FEED IMPEDANCE (R,X) : 0.00, 44.50 OHMS
TOWER SHUNT IMPEDANCE (R,X) : 0.00,-10753.70 OHMS
TOWER IMPEDANCE (R,X) : 50.08, -471.97 OHMS

| NODE | TO | NODE | IMPEDANCE (OHMS) R | X |
|---|---|---|---|---|
| 1 | | GROUND | 0.00 | -43000.00 |
| 2 | | GROUND | 45.96 | -452.33 |
| 1 | | 2 | 0.00 | 44.50 |

| NODE | VOLTAGE MAGNITUDE | PHASE |
|---|---|---|
| 1 | 2891.43 | 45.33 |
| 2 | 3203.16 | 44.70 |

| | REAL | IMAGINARY | MAGNITUDE | PHASE |
|---|---|---|---|---|
| INPUT IMPEDANCE (OHMS) : | 45.10 | -404.05 | 406.56 | -83.63 |
| INPUT CURRENT (AMPS) : | -4.47 | 5.53 | 7.11 | 128.96 |
| OUTPUT CURRENT (AMPS) : | -4.21 | 5.27 | 6.75 | 128.64 |

INPUT/OUTPUT CURRENT RATIO = 1.0538
INPUT/OUTPUT PHASE = 0.32 DEGREES

**BASE NETWORK COMPUTATION**

**NETWORK ID: WZRC TOWER 4(OTHERS OPEN)**

FREQUENCY : 1480.00 kHz
ATU SHUNT IMPEDANCE (R,X) : 0.00,-43000.00 OHMS
TOWER FEED IMPEDANCE (R,X) : 0.00, 31.20 OHMS
TOWER SHUNT IMPEDANCE (R,X) : 0.00,-10753.70 OHMS
TOWER IMPEDANCE (R,X) : 157.38, -375.80 OHMS

| NODE | TO | NODE | IMPEDANCE (OHMS) R | X |
|---|---|---|---|---|
| 1 | | GROUND | 0.00 | -43000.00 |
| 2 | | GROUND | 146.90 | -365.19 |
| 1 | | 2 | 0.00 | 31.20 |

| NODE | VOLTAGE MAGNITUDE | PHASE |
|---|---|---|
| 1 | 100.00 | 0.00 |
| 2 | 107.88 | -1.83 |

| | REAL | IMAGINARY | MAGNITUDE | PHASE |
|---|---|---|---|---|
| INPUT IMPEDANCE (OHMS) : | 144.64 | -331.90 | 362.05 | -66.45 |
| INPUT CURRENT (AMPS) : | 0.11 | 0.25 | 0.28 | 66.45 |
| OUTPUT CURRENT (AMPS) : | 0.11 | 0.24 | 0.26 | 65.45 |

INPUT/OUTPUT CURRENT RATIO = 1.0431
INPUT/OUTPUT PHASE = 1.00 DEGREES

**BASE NETWORK COMPUTATION**

**NETWORK ID: WZRC TOWER 4 DAY**

FREQUENCY : 1480.00 kHz
ATU SHUNT IMPEDANCE (R,X) : 0.00,-43000.00 OHMS
TOWER FEED IMPEDANCE (R,X) : 0.00, 31.20 OHMS
TOWER SHUNT IMPEDANCE (R,X) : 0.00,-10753.70 OHMS
TOWER IMPEDANCE (R,X) :1296.70, -626.34 OHMS

| NODE | TO | NODE | IMPEDANCE (OHMS) R | X |
|---|---|---|---|---|
| 1 | | GROUND | 0.00 | -43000.00 |
| 2 | | GROUND | 1143.05 | -722.11 |
| 1 | | 2 | 0.00 | 31.20 |

| NODE | VOLTAGE MAGNITUDE | PHASE |
|---|---|---|
| 1 | 321.15 | 178.23 |
| 2 | 325.09 | 177.10 |

| | REAL | IMAGINARY | MAGNITUDE | PHASE |
|---|---|---|---|---|
| INPUT IMPEDANCE (OHMS) : | 1106.43 | -708.93 | 1314.07 | -32.65 |
| INPUT CURRENT (AMPS) : | -0.21 | -0.13 | 0.24 | -149.12 |
| OUTPUT CURRENT (AMPS) : | -0.21 | -0.09 | 0.23 | -157.12 |

INPUT/OUTPUT CURRENT RATIO = 1.0826
INPUT/OUTPUT PHASE = 8.00 DEGREES

**BASE NETWORK COMPUTATION**

**NETWORK ID: WZRC TOWER 4 NIGHT**

FREQUENCY : 1480.00 kHz
ATU SHUNT IMPEDANCE (R,X) : 0.00,-43000.00 OHMS
TOWER FEED IMPEDANCE (R,X) : 0.00, 31.20 OHMS
TOWER SHUNT IMPEDANCE (R,X) : 0.00,-10753.70 OHMS
TOWER IMPEDANCE (R,X) :-239.13, -548.29 OHMS

| NODE | TO | NODE | IMPEDANCE (OHMS) R | X |
|---|---|---|---|---|
| 1 | | GROUND | 0.00 | -43000.00 |
| 2 | | GROUND | -216.39 | -526.27 |
| 1 | | 2 | 0.00 | 31.20 |

| NODE | VOLTAGE MAGNITUDE | PHASE |
|---|---|---|
| 1 | 799.76 | -142.56 |
| 2 | 842.28 | 218.70 |

| | REAL | IMAGINARY | MAGNITUDE | PHASE |
|---|---|---|---|---|
| INPUT IMPEDANCE (OHMS) : | -211.49 | -490.49 | 534.14 | -113.33 |
| INPUT CURRENT (AMPS) : | 1.31 | -0.73 | 1.50 | -29.23 |
| OUTPUT CURRENT (AMPS) : | 1.25 | -0.66 | 1.41 | -27.74 |

INPUT/OUTPUT CURRENT RATIO = 1.0633
INPUT/OUTPUT PHASE = -1.50 DEGREES

# EXHIBIT VII

## WZRC MODEL CONVERGENCE TEST

Frequency = 1.48 MHz

| number of unknowns | conductance (mhos) | susceptance (mhos) | resistance (ohms) | reactance (ohms) |
|---|---|---|---|---|
| source 1 of sector 1 | | | | |
| 42 | 9.15E-04 | 2.2E-03 | 161.238 | -387.577 |
| 63 | 9.16E-04 | 2.25E-03 | 154.909 | -381.061 |
| 84 | 9.12E-04 | 2.3E-03 | 149.387 | -376.036 |
| 105 | 9.08E-04 | 2.34E-03 | 144.225 | -371.646 |
| 126 | 9.02E-04 | 2.38E-03 | 139.468 | -367.673 |
| 147 | 8.97E-04 | 2.41E-03 | 135.52 | -364.293 |
| 168 | 8.93E-04 | 2.44E-03 | 132.018 | -361.204 |
| 189 | 8.89E-04 | 2.47E-03 | 128.893 | -358.341 |
| 210 | 8.87E-04 | 2.49E-03 | 126.81 | -356.245 |
| 231 | 8.83E-04 | 2.52E-03 | 123.673 | -353.252 |
| 252 | 8.82E-04 | 2.54E-03 | 121.993 | -351.393 |
| 273 | 8.79E-04 | 2.56E-03 | 119.641 | -348.948 |
| 294 | 8.78E-04 | 2.58E-03 | 117.859 | -346.958 |
| 315 | 8.77E-04 | 2.6E-03 | 116.256 | -345.108 |
| 336 | 8.76E-04 | 2.62E-03 | 114.812 | -343.395 |
| 357 | 8.75E-04 | 2.63E-03 | 113.58 | -341.861 |
| 378 | 8.74E-04 | 2.65E-03 | 112.243 | -340.244 |
| 399 | 8.73E-04 | 2.67E-03 | 110.844 | -338.579 |
| 420 | 8.75E-04 | 2.67E-03 | 110.789 | -338.106 |
| 441 | 8.75E-04 | 2.68E-03 | 109.878 | -336.902 |
| 462 | 8.73E-04 | 2.7E-03 | 108.164 | -334.979 |
| 483 | 8.75E-04 | 2.7E-03 | 108.307 | -334.735 |
| 504 | 8.72E-04 | 2.73E-03 | 106.442 | -332.681 |
| 525 | 8.74E-04 | 2.73E-03 | 106.387 | -332.281 |
| 546 | 8.72E-04 | 2.75E-03 | 104.699 | -330.393 |
| 567 | 8.73E-04 | 2.75E-03 | 104.638 | -330.005 |
| 588 | 8.75E-04 | 2.75E-03 | 104.725 | -329.765 |
| 609 | 8.75E-04 | 2.76E-03 | 104.116 | -328.891 |
| 630 | 8.72E-04 | 2.78E-03 | 102.497 | -327.067 |
| 651 | 8.76E-04 | 2.77E-03 | 103.533 | -327.732 |

FIELD STRENGTH MEASUREMENTS

Reference field strength measurements were made using a Potomac Instruments FIM-41 field strength meter, serial number 2181, calibrated October 9, 2009. The meter was compared with a Potomac Instruments FIM-4100, serial number 249, last calibrated January 21, 2016 and found to be within manufacturer's specifications on all pertinent operating scales. Measurements were taken at three locations along each pattern null radial determined from the WZRC standard daytime and nighttime patterns and on the major lobe radial of the pattern. The measured field strengths, descriptions, and GPS coordinates for the reference measurement points are shown below. All locations indicated are listed using NAD 27 datum.

**40° Radial Day**

| Point No. | Dist. Km. | Latitude | Longitude | Time Local | Field mV/m | Point Description |
|---|---|---|---|---|---|---|
| 1 | 0.70 | 40° 50' 58.9" | 74° 00' 52.3" | 1152 | 545 | NJ Tpk ramp center median 10' W of second stake |
| 2 | 0.89 | 40° 51' 03.6" | 74° 00' 47.2" | 1134 | 213 | N entrance office building at fire lane sign |
| 3 | 1.08 | 40° 51' 08.3" | 74° 00' 41.6" | 1142 | 195 | Middle of road SE corner office building near reserved parking area |

**68° Radial Day**

| Point No. | Dist. Km. | Latitude | Longitude | Time Local | Field mV/m | Point Description |
|---|---|---|---|---|---|---|
| 1 | 1.37 | 40° 51' 58.4" | 74° 00' 17.1" | 1459 | 177 | Center of drive left side Sushi House by door |
| 2 | 1.53 | 40° 51' 00.0" | 74° 00' 11.0" | 1503 | 182 | Opposite 159 Roosevelt Pl on sidewalk at sign |
| 3 | 1.64 | 40° 51' 01.4" | 74° 00' 06.5" | 1508 | 221 | SE corner W Central and Grand |

## 147° Radial Day

| Point No. | Dist. Km. | Latitude | Longitude | Time Local | Field mV/m | Point Description |
|---|---|---|---|---|---|---|
| 1 | 1.86 | 40° 49' 51.4" | 74° 00' 27.8" | | 680 | Sewer grate intersection Abbott and Linden Ct |
| 2 | 1.98 | 40° 49' 47.7" | 74° 00' 26.0" | | 530 | In front 459 Morris Ave |
| 3 | 2.15 | 40° 49' 42.9" | 74° 00' 22.2" | | 420 | Corner white fence by sign |

## 226° Radial Day

| Point No. | Dist. Km. | Latitude | Longitude | Time Local | Field mV/m | Point Description |
|---|---|---|---|---|---|---|
| 1 | 0.47 | 40° 50' 31.2" | 74° 01' 26.0" | 1533 | 330 | Right corner Kenworth parking area near riverbank |
| 2 | 2.58 | 40° 49' 43.8" | 74° 02' 30.8" | 1359 | 118 | Center rear parking lot Bind Rite Services |
| 3 | 2.67 | 40° 49' 42.1" | 74° 02' 34.4" | 1438 | 132 | Middle of road at hydrant rear left side 777 Central Blvd |

## 254° Radial Day

| Point No. | Dist. Km. | Latitude | Longitude | Time Local | Field mV/m | Point Description |
|---|---|---|---|---|---|---|
| 1 | 1.40 | 40° 50' 29.3" | 74° 02' 09.1" | 1304 | 178 | Street sign Maiden Lane and Dietrichs |
| 2 | 1.51 | 40° 50' 28.0" | 74° 02' 13.3" | 1257 | 161 | Left center parking lot opposite Dietrichs St |
| 3 | 1.92 | 40° 50' 24.7" | 74° 02' 30.5" | 1246 | 136 | In front of 115 Mehrhof Rd |

## 27° Radial Night

| Point No. | Dist. Km. | Latitude | Longitude | Time Local | Field mV/m | Point Description |
|---|---|---|---|---|---|---|
| 1 | 1.30 | 40° 51' 19.1" | 74° 00' 46.0" | 1110 | 142 | Streetlamp E side of park road |
| 2 | 2.45 | 40° 51' 52.2" | 74° 00' 23.2" | 1119 | 43 | Streetlamp E side of park road |
| 3 | 2.53 | 40° 51' 54.3" | 74° 00' 21.8" | 1123 | 40.5 | Streetlamp at 25 mph sign |

## 63° Radial Night

| Point No. | Dist. Km. | Latitude | Longitude | Time Local | Field mV/m | Point Description |
|---|---|---|---|---|---|---|
| 1 | 1.46 | 40° 51' 03.4" | 74° 00' 16.0" | 1521 | 217 | RR crossing buck on sewer grate NE side |
| 2 | 1.60 | 40° 51' 05.5" | 74° 00' 10.7" | 1517 | 155 | Curb opposite pole 61218 Commercial Avenue |
| 3 | 1.79 | 40° 51' 08.0" | 74° 00' 03.3" | 1512 | 153 | Edge of road by air pump Delta gas station |

## 147° Radial Night

| Point No. | Dist. Km. | Latitude | Longitude | Time Local | Field mV/m | Point Description |
|---|---|---|---|---|---|---|
| 1 | 1.86 | 40° 49' 51.4" | 74° 00' 27.8" | | 710 | Sewer grate intersection Abbott and Linden Ct |
| 2 | 1.98 | 40° 49' 47.7" | 74° 00' 26.0" | | 565 | In front 459 Morris Ave |
| 3 | 2.15 | 40° 49' 42.9" | 74° 00' 22.2" | | 430 | Corner white fence by sign |

## 231° Radial Night

| Point No. | Dist. Km. | Latitude | Longitude | Time Local | Field mV/m | Point Description |
|---|---|---|---|---|---|---|
| 1 | 2.35 | 40° 49' 53.5" | 74° 02' 29.1" | 1415 | 200 | Edge of road opposite Bergen County Utility Authority sign |
| 2 | 2.41 | 40° 49' 52.1" | 74° 02' 31.3" | 1343 | 134 | Center of parking lot near corner Horizon and Empire Blvd |
| 3 | 2.74 | 40° 49' 46.2" | 74° 02' 42.8" | 1421 | 138 | Drive to 800 Central Blvd |

## 267° Radial Night

| Point No. | Dist. Km. | Latitude | Longitude | Time Local | Field mV/m | Point Description |
|---|---|---|---|---|---|---|
| 1 | 1.40 | 40° 50' 39.1" | 74° 02' 11.1" | 1309 | 117 | Curb N side of Abend St cul-de-sac |
| 2 | 1.56 | 40° 50' 30.0" | 74° 02' 18.0" | 1320 | 106 | Sidewalk between 70 and 72 Mehrhof Rd |
| 3 | 1.98 | 40° 50' 37.1" | 74° 02' 34.5" | 1240 | 120 | Sidewalk at drive brick house Eckel Rd |

All measurements were conducted on March 6 and 19, 2018.

SPECIAL OPERATING CONDITION 4

In accordance with special operating condition 4 of the WWRV construction permit, spurious emissions measurements were conducted on WWRV and WZRC after construction was completed to demonstrate compliance with Section 73.44(d)(2) of the rules. A tabulation of the measurement data follows and documents the WWRV/WZRC diplex system is operating in compliance with Section 73.44(d)(2).

Filtering was installed and adjusted at all towers to prevent interaction and spurious radiation products. Filter circuits for the towers are located on the antenna tuning unit side of the voltage sampling units for both stations. The measured impedance was greater than 100 k ohms at 1480 kilohertz, therefore, it was not included in the model.

## DAY MODE SPURIOUS RADIATION MEASUREMENTS
## WWRV 1330 KHZ 10 KW DA
## WZRC 1480 KHZ 5 KW DA

| Frequency khz | Day Field (mV/m) | Attenuation (dB) relative to WWRV | WZRC |
|---|---|---|---|
| 1330 | 1620 | | |
| 1480 | 1400 | | |
| 300 | .0170 | 99.6 | 98.3 |
| 450 | .0160 | 100.1 | 98.8 |
| 1030 | .0607 | 88.6 | 87.3 |
| 1180 | .1290 | 82.0 | 80.7 |
| 1630 | .1280 | 82.1 | 80.8 |
| 1780 | .0185 | 98.9 | 97.6 |
| 2510 | .0160 | 100.1 | 98.8 |
| 2660 | .0250 | 96.3 | 95.0 |
| 2810 | .0495 | 90.6 | 89.3 |
| 2960 | .0690 | 87.5 | 86.2 |
| 3110 | .0117 | 102.9 | 101.6 |
| 3990 | .0558 | 89.3 | 88.0 |
| 4140 | .0616 | 88.4 | 87.1 |
| 4290 | .0272 | 95.5 | 94.2 |
| 4440 | .0107 | 103.6 | 102.3 |

Measurements taken with Potomac Instruments FIM-4100, serial number 249, last calibrated January 21, 2016. The distance from the array to the measuring point is 0.99 km on a bearing of 147.0° True. Point Coordinates (NAD27): N 40° 50' 15.3", W 74° 00' 48.5". Point description is: Bell Drive, north side at drain, approximately 75 feet west of entrance to house number 2, between house numbers 2 and 4.

Measurements meet required daytime attenuation of 80 dB for WZRC and WWRV.

## NIGHT MODE SPURIOUS RADIATION MEASUREMENTS
## WWRV 1330 KHZ 3.8 KW DA
## WZRC 1480 KHZ 5 KW DA

| Frequency khz | Day Field (mV/m) | Attenuation (dB) relative to WWRV | WZRC |
|---|---|---|---|
| 1330 | 1160 | | |
| 1480 | 1400 | | |
| 300 | .0173 | 96.6 | 98.2 |
| 450 | .0154 | 97.6 | 99.2 |
| 1030 | .0497 | 87.4 | 89.0 |
| 1180 | .1300 | 79.0 | 80.6 |
| 1630 | .1190 | 79.8 | 81.4 |
| 1780 | .0156 | 97.5 | 99.1 |
| 2510 | .0108 | 100.7 | 102.3 |
| 2660 | .0215 | 94.7 | 96.3 |
| 2810 | .0438 | 88.5 | 90.1 |
| 2960 | .0735 | 84.0 | 85.6 |
| 3110 | .0127 | 99.3 | 100.9 |
| 3990 | .0162 | 96.1 | 98.7 |
| 4140 | .0418 | 88.9 | 90.5 |
| 4290 | .0347 | 90.5 | 92.1 |
| 4440 | .0145 | 98.1 | 99.7 |

Measurements taken with Potomac Instruments FIM-4100, serial number 249, last calibrated January 21, 2016. The distance from the array to the measuring point is 0.99 km on a bearing of 147.0° True. Point Coordinates (NAD27): N 40° 50' 15.3", W 74° 00' 48.5". Point description is: Bell Drive, north side at drain, approximately 75 feet west of entrance to house number 2, between house numbers 2 and 4.

Measurements meet required nighttime attenuation of 80 dB for WZRC and 78.8 db for WWRV.

DECLARATION

The foregoing was prepared by or under the immediate supervision of Charles A. Hecht of Charles A. Hecht & Associates, Inc., Freehold, New Jersey, whose qualifications are a matter of record with the Federal Communications Commission. All statements herein are true and correct of his knowledge except such statements made on information and belief, and as to those statements, he believes them to be true and correct under the penalty of perjury.

Respectfully submitted,

/s/

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April 9, 2018