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April 5, 2011

Via Hand Delivery

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
The Portals, Room TW-A325
445 12th Street, SW
Washington, D.C. 20554

FILED/ACCEPTED **ORIGINAL**

APR - 5 2011

Federal Communications Commission
Office of the Secretary

**Re: Townsquare Media Cheyenne License, LLC
KGAB(AM), Orchard Valley, WY, Facility No. 30224
BMML-20101015ACO**

Dear Ms. Dortch:

On behalf of Townsquare Media Cheyenne License, LLC, the licensee of AM broadcast station KGAB, Orchard Valley, WY, this is to amend the above-referenced, pending application in response to the December 23 letter from the FCC staff.

Please note that, since this application was originally submitted, the licensee's name was changed from GAP Broadcasting Cheyenne License, LLC to Townsquare Media Cheyenne License, LLC. Also, the licensee's address now is 240 Greenwich Avenue, Greenwich CT 06830.

Please contact Howard Liberman of this firm at 202-842-8876 or me with any questions.

Sincerely,

Alisa R. Lahey

cc: Ann Gallagher, Audio Division, Media Bureau (via e-mail)

FOR
FCC
USE
ONLY

30224

FCC 302-AM
APPLICATION FOR AM
BROADCAST STATION LICENSE

(Please read instructions before filling out form.)

FOR COMMISSION USE ONLY

FILE NO.

20101015ACO

SECTION I - APPLICANT FEE INFORMATION

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

TOWNSQUARE MEDIA CHEYENNE LICENSE, LLC

FILED/ACCEPTED

MAILING ADDRESS (Line 1) (Maximum 35 characters)

C/O TOWNSQUARE MEDIA, INC.

APR - 5 2011

MAILING ADDRESS (Line 2) (Maximum 35 characters)

240 GREENWICH AVENUE

Federal Communications Commission
Office of the Secretary

CITY

GREENWICH

STATE OR COUNTRY (if foreign address)

CT

ZIP CODE

06830

TELEPHONE NUMBER (include area code)

(203) 861-0900

CALL LETTERS

KGAB

OTHER FCC IDENTIFIER (If applicable)

30224

2. A. Is a fee submitted with this application?

☐ Yes ☒ No

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

☐

Governmental Entity

☐

Noncommercial educational licensee

☒

Other (Please explain):

C. If Yes, provide the following information:

**AMENDMENT TO
BMML-20101015ACO**

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

(A)

| FEE TYPE CODE | | |
|------------------|--|--|
| | | |

(B)

| FEE MULTIPLE | | | |
|--------------|---|---|---|
| 0 | 0 | 0 | 1 |

(C)

| FEE DUE FOR FEE TYPE CODE IN COLUMN (A) |
|---|
| \$ 0 |

FOR FCC USE ONLY

| |
|--|
| |
|--|

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

(A)

| | | |
|--|--|--|
| | | |
|--|--|--|

(B)

| | | | |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
|---|---|---|---|

(C)

| |
|------|
| \$ 0 |
|------|

FOR FCC USE ONLY

| |
|--|
| |
|--|

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

TOTAL AMOUNT
REMITTED WITH THIS
APPLICATION

\$ 0

FOR FCC USE ONLY

| |
|--|
| |
|--|

| | | |
|--|-------------|-------------------|
| SECTION II - APPLICANT INFORMATION | | |
| 1. NAME OF APPLICANT TOWNSQUARE MEDIA CHEYENNE LICENSE, LLC | | |
| MAILING ADDRESS C/O TOWNSQUARE MEDIA, INC. 240 GREENWICH AVENUE | | |
| CITY GREENWICH | STATE CT | ZIP CODE 06830 |

2. This application is for:

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

| | | | | |
|----------------------|--|-------------------------------------|--|--|
| Call letters KGAB | Community of License ORHCARD VALLEY, WY | Construction Permit File No. N/A | Modification of Construction Permit File No(s). N/A | Expiration Date of Last Construction Permit 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. N/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

If No, explain in an Exhibit.

☒ Does not apply

| |
|--------------------|
| Exhibit No. N/A |
|--------------------|

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. N/A |
|--------------------|

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).

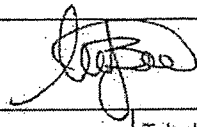
The APPLICANT acknowledges that all the statements made in this application and attached exhibits are considered material representations and that all the exhibits are a material part hereof and are incorporated herein as set out in full in

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 ALEX BERKETT | Signature  | |
| Title SVP | Date 3/31/11 | Telephone Number 203-861-0900 |

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

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

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

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

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

SECTION III - LICENSE APPLICATION ENGINEERING DATA

Name of Applicant

TOWNSQUARE MEDIA CHEYENNE LICENSE, LLC

PURPOSE OF AUTHORIZATION APPLIED FOR: (check one)



Station License



Direct Measurement of Power

| | | | | | |
|---|--|----------------------------------|---|---------------------|-------------------|
| 1. Facilities authorized in construction permit | | | | | |
| Call Sign KGAB | File No. of Construction Permit (if applicable) | Frequency (kHz) 650 | Hours of Operation UNLIMITED | Power in kilowatts | |
| | | | | Night 0.5 | Day 8.5 |
| 2. Station location | | | | | |
| State WYOMING | | | City or Town ORCHARD VALLEY | | |
| 3. Transmitter location | | | | | |
| State WY | County LARAMIE | City or Town CHEYENNE | Street address (or other identification) 2002 TERRY RANCH RD | | |
| 4. Main studio location | | | | | |
| State WY | County LARAMIE | City or Town CHEYENNE | Street address (or other identification) 1912 CAPITAL AVENUE | | |
| 5. Remote control point location (specify only if authorized directional antenna) | | | | | |
| State WY | County LARAMIE | City or Town CHEYENNE | Street address (or other identification) 1912 CAPITAL AVENUE | | |

6. Has type-approved stereo generating equipment been installed?



Yes



No

7. Does the sampling system meet the requirements of 47 C.F.R. Section 73.68?



Yes



No



Not Applicable

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

Exhibit No.

| 8. Operating constants: | | | | | | |
|---|---|-----|---|-----|-----------------------|-----|
| RF common point or antenna current (in amperes) without modulation for night system 3.28 | | | RF common point or antenna current (in amperes) without modulation for day system 21.2 | | | |
| Measured antenna or common point resistance (in ohms) at operating frequency Night 50 Day 19.0 | | | Measured antenna or common point reactance (in ohms) at operating frequency Night 0 Day -J76.3 | | | |
| 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 EAST | 131.4 | | 0.577 | | | |
| 2 CENTER | 0.0 REF | | 1.00 REF | | | |
| 3 WEST | -132.2 | | 0.486 | | | |
| | | | | | | |
| | | | | | | |
| Manufacturer and type of antenna monitor: POTOMAC INSTRUMENTS AM19 (TYPE 204) | | | | | | |

SECTION III - Page 2

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

| Type Radiator | 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 TOWER | ALL 85.2M | ALL 86.0M | ALL 86.8M | Exhibit No. |

Excitation ☒ Series ☐ Shunt

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

| | |
|-------------------------------|--------------------------------|
| North Latitude 41 ° 03 ' 11 " | West Longitude 104 ° 49 ' 57 " |
|-------------------------------|--------------------------------|

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.

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

Exhibit No.

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

NONE

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

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) TIMOTHY C CUTFORTH | Signature (check appropriate box below) <i>Timothy C Cutforth</i> |
| Address (include ZIP Code) VIR JAMES ENGINEERS 965 S. IRVING STREET DENVER, CO 80219 | Date 03/24/2011 |
| | Telephone No. (Include Area Code) 303-937-1900 |

| | |
|---|--|
| <input type="checkbox"/> Technical Director | <input checked="" type="checkbox"/> Registered Professional Engineer |
| <input type="checkbox"/> Chief Operator | <input type="checkbox"/> Technical Consultant |
| <input type="checkbox"/> Other (specify) | |

EXHIBIT E-1

APPLICATION FOR LICENSE INFORMATION
RADIO STATION KGAB
CHEYENNE, WYOMING

GAP BROADCASTING CHEYENNE LICENSE, LLC.

Amended March 24, 2011

650 kHz 8.5 kW-D/0.5 kW-N DA-N

EXECUTIVE SUMMARY

This engineering exhibit supports an application for modification of license for the existing nighttime directional antenna system of radio station KGAB in Cheyenne, Wyoming (FCC FID No. 30224) pursuant to the recently enacted AM technical rules permitting moment-method modeling of eligible AM directional arrays.

KGAB operates on 650 kHz and has been operating pursuant to the terms of its license (BL-20080313ADW). The instant application Proposes only to change to Method of Moment (MoM) proof of performance for the KGAB nighttime array. No changes have been made or proposed to the night site or antenna or to the day or night operating system previously described.

Information is provided herein showing that the directional antenna parameters for the nighttime pattern authorized by the FCC have been determined in accordance with the requirements of 47 C.F.R. §73.151(c). The system has been adjusted to produce antenna monitor parameters within ± 5 percent in ratio and ± 3 degrees in phase of the modeled values, as required by the Rules. A modified station license is requested herewith specifying the new nighttime operating parameters.

Analysis of Tower Impedance Measurements to Verify Method of Moments Model

Tower base impedance measurements were made at the final J-plugs within the Antenna Tuning Units (ATUs) using a Delta OIB-1 impedance bridge. The other towers were all open-circuited at the same points where the impedance measurements were made for them. The static drain chokes at the ATU outputs were reconnected inside the ATU after the sample transformer and were therefore not part of the model. This arrangement left only the short feed tubing between the ATU outputs and the tower base in series in the impedance measurements except on towers 1 and 4 which have an FM isocoupler across the base of the tower. The fourth tower on the site is not part of the AM array but is left from a prior 1530 kHz AM operation on the site and is located 83.5 electrical degrees from the reference tower at a bearing of 67 degrees true.

ACSModel (MININEC 3.1 core) was used to model the KGAB nighttime array.

A lumped load with a reactance of $-j10,000$ was modeled at the base of the other towers to simulate an open circuit at each tower base.

Towers 1, 2, and 3 are physically 85.3m tall (86.8m overall AGL) for an electrical height of 66.5degrees and tower 4 is 58.5m tall (59.5m overall AGL) for an electrical height of 45.6 degrees. All towers are base insulated. Tower 4 is not used for the KGAB AM array and has an FM isocoupler across the base that was used for a temporary emergency antenna for KLEN (FM) when the number 1 tower for KGAB which supported the KLEN (FM) main antenna fell some time back. This extra tower is quite short and is effectively detuned in its normal mode with the base open circuited and has no effect on the KGAB array as shown in the modeling.

The tower heights were adjusted in the model in order to achieve calibration of the model with the measured base impedances. All modeled tower heights were within 75 to 125 percent of the physical tower height as required by the FCC Rules.

The radius for each tower is the physical radius of the tower as determined by the formula $3T/2\pi$, where T is the tower face width in meters. The KGAB radiators are uniform cross-section triangular towers and tower 1 has a face width of 24 inches, towers 2 and 3 have face widths of 18 inches. The tower radius computes to 0.2917 meter for tower 1, and 0.2188 meter for towers 2 and 3. Tower 4 has face width of 12 inches for a radius of 0.1456 meter. Towers 1, 2, and 3 are fed with a short length of large-diameter copper tubing that exhibits a small amount of series inductive reactance. This tubing connects to each tower immediately above the base insulator. Tower 4 has no AM feed and therefore has no ATU or feed connection as installed therefore no ATU input impedance correction was necessary for tower 4 but the tower radius was modeled as 0.17 meter to better match the measured impedance in the model.

The tower measured reactances differ significantly due to significantly different ATU mounting locations relative to the tower base pier. Towers 1 and 2 have 2 turn drip loops from the tower base to the antenna tuning unit bowl insulator. Tower 1 ATU is elevated so that the input to the bowl insulator is located higher than the other two ATU's and with a larger diameter feed tubing routed directly to the ATU with no loop resulting in a lower series inductance. Tower 4 does not have a feed to an ATU and the impedance was measured to verify the detuning by connecting directly from the top of the base insulator of the tower to the ground strap on the concrete base and there are no other connections to the tower with the exception of the ERI FM isocoupler. Tower 1 has the KLEN (FM) main antenna mounted atop the tower and has an ERI FM isocoupler permanently mounted across the base. The model calibration process was able to compensate for these differences well within the allowable tolerances specified in the rules.

A circuit model was constructed for each tower using the assumed series feed tubing and includes the relatively small shunt capacitance of the base insulator shown as 0.0001 mfd. This model was used with the Westberg Circuit Analysis Program (WCAP) to determine the effects of these reactances on the ATU output impedance at each tower. In each of the WCAP tabulations, node 2 represents the ATU output reference point and node 3 represents the tower base. Node 0 represents ground potential. The ATU output impedances can be found in the "TO NODE IMPEDANCE" column of each WCAP tabulation, following the phantom 1.0 ohm resistor inserted in the model to provide a calculation point for the impedance. The complex base impedance of each tower from the moment method model is represented in each case by the complex load from node 3 to ground. The WCAP circuit model tabulation immediately follows the model for each tower. As the connection to tower 4 which is not used in the array, the measured impedance is direct to the tower base without an ATU therefore no WCAP circuit model is required for tower 4.

§73.151(c)(1)(vii) permits the use of a lumped series inductance of 10 uH or less between the output port of each antenna tuning unit and the associated tower. In each case, the value of lumped series inductance was below this 10 uH limit.

The modeled and measured impedances at the ATU output J-plugs with the other towers open-circuited at their ATU output J-plugs agree within ± 2 ohms and ± 4 percent as required by the FCC rules.

Table 1 – Analysis of Tower Impedance Measurements to Verify Moment Method Model

| Twr. | Z_{BASE} (Modeled) | Z_{ATU} (Modeled) | Z_{ATU} (Measured) | Series L (uH) | Phys. Height (deg.) | Model Height (deg.) | % Phys. Height |
|------|--------------------------------|-------------------------------|--------------------------------|---------------------|---------------------------|---------------------------|----------------------|
| 1 | 17.9 -j94.9 | 15.6 -j59.1 | 16.0 -j59.1 | 7.3 | 66.5 | 69.0 | 103.8 |
| 2 | 20.1 -j84.5 | 18.8 -j76.3 | 19.0 -j76.3 | 1.35 | 66.5 | 72.0 | 108.3 |
| 3 | 20.4 -j84.1 | 19.3 -j76.0 | 19.5 -j76.0 | 1.46 | 66.5 | 72.0 | 108.3 |
| 4 | 9.07 -j217.3 | No ATU | 8.5 -j216.4 | No ATU | 45.6 | 52.7 | 115.6 |

 ACSModel
 (MININEC 3.1 Core)
 03-17-2011 12:08:53

KGAB4MOM
 CALIBRATION
 twr 1driven twr 2, 3 , 4 floated

Frequency = 0.650 MHz Wavelength = 461.23079 Meters

No. of Wires: 4

| Wire No. 1 | Coordinates | | | Radius | End Connection | No. of |
|------------|-------------|----------|--------|--------|----------------|--------|
| X | Y | Z | | | | |
| Segments | | | | | | |
| 0 | 0 | 0 | | -1 | | |
| 0 | 0 | 88.40257 | 0.2917 | 0 | | 28 |
| Wire No. 2 | Coordinates | | | Radius | End Connection | No. of |
| X | Y | Z | | | | |
| Segments | | | | | | |
| 55.34171 | -65.95368 | 0 | | -2 | | |
| 55.34171 | -65.95368 | 92.24615 | 0.2188 | 0 | | 28 |
| Wire No. 3 | Coordinates | | | Radius | End Connection | No. of |
| X | Y | Z | | | | |
| Segments | | | | | | |
| 110.6834 | -131.9074 | 0 | | -3 | | |
| 110.6834 | -131.9074 | 92.24615 | 0.2188 | 0 | | 28 |
| Wire No. 4 | Coordinates | | | Radius | End Connection | No. of |
| X | Y | Z | | | | |
| Segments | | | | | | |
| 41.80038 | 98.47553 | 0 | | -4 | | |
| 41.80038 | 98.47553 | 67.51907 | 0.17 | 0 | | 20 |

**** ANTENNA GEOMETRY ****

| Wire No. 1 | Coordinates | | | Radius | Connection | | Pulse |
|------------|-------------|----------|--------|--------|------------|-----|-------|
| X | Y | Z | | End1 | End2 | No. | |
| 0 | 0 | 0 | 0.2917 | -1 | 1 | 1 | |
| 0 | 0 | 3.157234 | 0.2917 | 1 | 1 | 2 | |
| 0 | 0 | 6.314469 | 0.2917 | 1 | 1 | 3 | |
| 0 | 0 | 9.471704 | 0.2917 | 1 | 1 | 4 | |
| 0 | 0 | 12.62894 | 0.2917 | 1 | 1 | 5 | |
| 0 | 0 | 15.78617 | 0.2917 | 1 | 1 | 6 | |
| 0 | 0 | 18.94341 | 0.2917 | 1 | 1 | 7 | |
| 0 | 0 | 22.10064 | 0.2917 | 1 | 1 | 8 | |
| 0 | 0 | 25.25788 | 0.2917 | 1 | 1 | 9 | |
| 0 | 0 | 28.41511 | 0.2917 | 1 | 1 | 10 | |
| 0 | 0 | 31.57234 | 0.2917 | 1 | 1 | 11 | |
| 0 | 0 | 34.72958 | 0.2917 | 1 | 1 | 12 | |
| 0 | 0 | 37.88681 | 0.2917 | 1 | 1 | 13 | |
| 0 | 0 | 41.04405 | 0.2917 | 1 | 1 | 14 | |
| 0 | 0 | 44.20128 | 0.2917 | 1 | 1 | 15 | |
| 0 | 0 | 47.35852 | 0.2917 | 1 | 1 | 16 | |

| | | | | | | |
|---|---|----------|--------|---|---|----|
| 0 | 0 | 50.51575 | 0.2917 | 1 | 1 | 17 |
| 0 | 0 | 53.67299 | 0.2917 | 1 | 1 | 18 |
| 0 | 0 | 56.83022 | 0.2917 | 1 | 1 | 19 |
| 0 | 0 | 59.98745 | 0.2917 | 1 | 1 | 20 |
| 0 | 0 | 63.14469 | 0.2917 | 1 | 1 | 21 |
| 0 | 0 | 66.30193 | 0.2917 | 1 | 1 | 22 |
| 0 | 0 | 69.45916 | 0.2917 | 1 | 1 | 23 |
| 0 | 0 | 72.61639 | 0.2917 | 1 | 1 | 24 |
| 0 | 0 | 75.77363 | 0.2917 | 1 | 1 | 25 |
| 0 | 0 | 78.93086 | 0.2917 | 1 | 1 | 26 |
| 0 | 0 | 82.0881 | 0.2917 | 1 | 1 | 27 |
| 0 | 0 | 85.24532 | 0.2917 | 1 | 0 | 28 |

| Wire No. | 2 | Coordinates | | | Connection | | Pulse |
|----------|---|-------------|----------|--------|------------|------|-------|
| X | | Y | Z | Radius | End1 | End2 | No. |
| 55.34171 | | -65.95368 | 0 | 0.2188 | -2 | 2 | 29 |
| 55.34171 | | -65.95368 | 3.294506 | 0.2188 | 2 | 2 | 30 |
| 55.34171 | | -65.95368 | 6.589011 | 0.2188 | 2 | 2 | 31 |
| 55.34171 | | -65.95368 | 9.883516 | 0.2188 | 2 | 2 | 32 |
| 55.34171 | | -65.95368 | 13.17802 | 0.2188 | 2 | 2 | 33 |
| 55.34171 | | -65.95368 | 16.47253 | 0.2188 | 2 | 2 | 34 |
| 55.34171 | | -65.95368 | 19.76703 | 0.2188 | 2 | 2 | 35 |
| 55.34171 | | -65.95368 | 23.06154 | 0.2188 | 2 | 2 | 36 |
| 55.34171 | | -65.95368 | 26.35604 | 0.2188 | 2 | 2 | 37 |
| 55.34171 | | -65.95368 | 29.65055 | 0.2188 | 2 | 2 | 38 |
| 55.34171 | | -65.95368 | 32.94506 | 0.2188 | 2 | 2 | 39 |
| 55.34171 | | -65.95368 | 36.23956 | 0.2188 | 2 | 2 | 40 |
| 55.34171 | | -65.95368 | 39.53407 | 0.2188 | 2 | 2 | 41 |
| 55.34171 | | -65.95368 | 42.82857 | 0.2188 | 2 | 2 | 42 |
| 55.34171 | | -65.95368 | 46.12308 | 0.2188 | 2 | 2 | 43 |
| 55.34171 | | -65.95368 | 49.41758 | 0.2188 | 2 | 2 | 44 |
| 55.34171 | | -65.95368 | 52.71209 | 0.2188 | 2 | 2 | 45 |
| 55.34171 | | -65.95368 | 56.00659 | 0.2188 | 2 | 2 | 46 |
| 55.34171 | | -65.95368 | 59.3011 | 0.2188 | 2 | 2 | 47 |
| 55.34171 | | -65.95368 | 62.59561 | 0.2188 | 2 | 2 | 48 |
| 55.34171 | | -65.95368 | 65.89011 | 0.2188 | 2 | 2 | 49 |
| 55.34171 | | -65.95368 | 69.18462 | 0.2188 | 2 | 2 | 50 |
| 55.34171 | | -65.95368 | 72.47912 | 0.2188 | 2 | 2 | 51 |
| 55.34171 | | -65.95368 | 75.77363 | 0.2188 | 2 | 2 | 52 |
| 55.34171 | | -65.95368 | 79.06813 | 0.2188 | 2 | 2 | 53 |
| 55.34171 | | -65.95368 | 82.36263 | 0.2188 | 2 | 2 | 54 |
| 55.34171 | | -65.95368 | 85.65714 | 0.2188 | 2 | 2 | 55 |
| 55.34171 | | -65.95368 | 88.95165 | 0.2188 | 2 | 0 | 56 |

| Wire No. | 3 | Coordinates | | | Connection | | Pulse |
|----------|---|-------------|----------|--------|------------|------|-------|
| X | | Y | Z | Radius | End1 | End2 | No. |
| 110.6834 | | -131.9074 | 0 | 0.2188 | -3 | 3 | 57 |
| 110.6834 | | -131.9074 | 3.294506 | 0.2188 | 3 | 3 | 58 |
| 110.6834 | | -131.9074 | 6.589011 | 0.2188 | 3 | 3 | 59 |
| 110.6834 | | -131.9074 | 9.883516 | 0.2188 | 3 | 3 | 60 |
| 110.6834 | | -131.9074 | 13.17802 | 0.2188 | 3 | 3 | 61 |
| 110.6834 | | -131.9074 | 16.47253 | 0.2188 | 3 | 3 | 62 |
| 110.6834 | | -131.9074 | 19.76703 | 0.2188 | 3 | 3 | 63 |
| 110.6834 | | -131.9074 | 23.06154 | 0.2188 | 3 | 3 | 64 |
| 110.6834 | | -131.9074 | 26.35604 | 0.2188 | 3 | 3 | 65 |
| 110.6834 | | -131.9074 | 29.65055 | 0.2188 | 3 | 3 | 66 |
| 110.6834 | | -131.9074 | 32.94506 | 0.2188 | 3 | 3 | 67 |

| | | | | | | |
|----------|-----------|----------|--------|---|---|----|
| 110.6834 | -131.9074 | 36.23956 | 0.2188 | 3 | 3 | 68 |
| 110.6834 | -131.9074 | 39.53407 | 0.2188 | 3 | 3 | 69 |
| 110.6834 | -131.9074 | 42.82857 | 0.2188 | 3 | 3 | 70 |
| 110.6834 | -131.9074 | 46.12308 | 0.2188 | 3 | 3 | 71 |
| 110.6834 | -131.9074 | 49.41758 | 0.2188 | 3 | 3 | 72 |
| 110.6834 | -131.9074 | 52.71209 | 0.2188 | 3 | 3 | 73 |
| 110.6834 | -131.9074 | 56.00659 | 0.2188 | 3 | 3 | 74 |
| 110.6834 | -131.9074 | 59.3011 | 0.2188 | 3 | 3 | 75 |
| 110.6834 | -131.9074 | 62.59561 | 0.2188 | 3 | 3 | 76 |
| 110.6834 | -131.9074 | 65.89011 | 0.2188 | 3 | 3 | 77 |
| 110.6834 | -131.9074 | 69.18462 | 0.2188 | 3 | 3 | 78 |
| 110.6834 | -131.9074 | 72.47912 | 0.2188 | 3 | 3 | 79 |
| 110.6834 | -131.9074 | 75.77363 | 0.2188 | 3 | 3 | 80 |
| 110.6834 | -131.9074 | 79.06813 | 0.2188 | 3 | 3 | 81 |
| 110.6834 | -131.9074 | 82.36263 | 0.2188 | 3 | 3 | 82 |
| 110.6834 | -131.9074 | 85.65714 | 0.2188 | 3 | 3 | 83 |
| 110.6834 | -131.9074 | 88.95165 | 0.2188 | 3 | 0 | 84 |

| Wire No. | 4 | Coordinates | | | Connection | | Pulse |
|----------|---|-------------|----------|--------|------------|------|-------|
| X | | Y | Z | Radius | End1 | End2 | No. |
| 41.80038 | | 98.47553 | 0 | 0.17 | -4 | 4 | 85 |
| 41.80038 | | 98.47553 | 3.375953 | 0.17 | 4 | 4 | 86 |
| 41.80038 | | 98.47553 | 6.751906 | 0.17 | 4 | 4 | 87 |
| 41.80038 | | 98.47553 | 10.12786 | 0.17 | 4 | 4 | 88 |
| 41.80038 | | 98.47553 | 13.50381 | 0.17 | 4 | 4 | 89 |
| 41.80038 | | 98.47553 | 16.87977 | 0.17 | 4 | 4 | 90 |
| 41.80038 | | 98.47553 | 20.25572 | 0.17 | 4 | 4 | 91 |
| 41.80038 | | 98.47553 | 23.63167 | 0.17 | 4 | 4 | 92 |
| 41.80038 | | 98.47553 | 27.00763 | 0.17 | 4 | 4 | 93 |
| 41.80038 | | 98.47553 | 30.38358 | 0.17 | 4 | 4 | 94 |
| 41.80038 | | 98.47553 | 33.75953 | 0.17 | 4 | 4 | 95 |
| 41.80038 | | 98.47553 | 37.13549 | 0.17 | 4 | 4 | 96 |
| 41.80038 | | 98.47553 | 40.51144 | 0.17 | 4 | 4 | 97 |
| 41.80038 | | 98.47553 | 43.88739 | 0.17 | 4 | 4 | 98 |
| 41.80038 | | 98.47553 | 47.26334 | 0.17 | 4 | 4 | 99 |
| 41.80038 | | 98.47553 | 50.6393 | 0.17 | 4 | 4 | 100 |
| 41.80038 | | 98.47553 | 54.01525 | 0.17 | 4 | 4 | 101 |
| 41.80038 | | 98.47553 | 57.3912 | 0.17 | 4 | 4 | 102 |
| 41.80038 | | 98.47553 | 60.76716 | 0.17 | 4 | 4 | 103 |
| 41.80038 | | 98.47553 | 64.14311 | 0.17 | 4 | 0 | 104 |

Sources: 1

Pulse No., Voltage Magnitude, Phase (Degrees): 1, 100.0, 0.0

Number of Loads: 3

Pulse No., Resistance, Reactance: 85 , 0 , -10000

Pulse No., Resistance, Reactance: 29 , 0 , -10000

Pulse No., Resistance, Reactance: 57 , 0 , -10000

```

***** SOURCE DATA *****
Pulse 1 Voltage = (100.0, 0.0j)
        Current = (0.1923, 1.0171j)
        Impedance = (17.945, -94.927j)
        Power = 9.61 Watts

```

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = kgab-1.cir

| | | | | | | |
|----|---------|---|---|----------|-------|-------|
| I | 1.0000 | 0 | 1 | .0000 | .0000 | .0000 |
| R | 1.0000 | 1 | 2 | .0000 | .0000 | .0000 |
| L | 7.3000 | 2 | 3 | .0000 | .0000 | .0000 |
| C | .0002 | 3 | 0 | .0000 | .0000 | .0000 |
| R | 17.9000 | 3 | 0 | -94.9000 | .0000 | .0000 |
| EX | .0000 | 0 | 0 | .0000 | .0000 | .0000 |

FREQ = .650

| NODE | | VOLT MAG | VOLT PHASE | | BRANCH CURRENT FROM NODE IMPEDANCE TO NODE IMPEDANCE | | | | | |
|------|------|----------|------------|----------|--|-------|------------|-----------|------------|-----------|
| | | | MAG | PHASE | MAG | PHASE | RESISTANCE | REACTANCE | RESISTANCE | REACTANCE |
| 1 | | 61.3878 | | -74.2733 | | | | | | |
| 2 | | 61.1243 | | -75.1756 | | | | | | |
| 3 | | 90.2686 | | -80.0231 | | | | | | |
| | | | | | BRANCH VOLTAGE | | | | | |
| | | | | | MAG | PHASE | | | | |
| VSWR | | | | | | | | | | |
| R | 1- 2 | 1.000 | 1.00 | .000 | 1.00 | .000 | 16.64 | -59.09 | 16.64 | -59.09 |
| L | 2- 3 | 7.300 | 29.81 | 90.000 | 1.00 | .000 | 15.64 | -59.09 | 15.64 | -88.90 |
| C | 3- 0 | .000 | 90.27 | -80.023 | .07 | 9.977 | .00 | -1360.30 | .00 | .00 |
| R | 3- 0 | 17.900 | 90.27 | -80.023 | .93 | -.705 | 17.90 | -94.90 | .00 | .00 |

 ACSModel
 (MININEC 3.1 Core)
 03-17-2011 12:07:30

KGAB4MOM
 CALIBRATION
 twr 2 driven twr1, 3, 4 floated

Frequency = 0.650 MHz Wavelength = 461.23079 Meters

No. of Wires: 4

| Wire No. | Coordinates X Y Z | Radius | End Connection | No. of Segments |
|----------|----------------------|--------|-------------------|--------------------|
| 1 | 0 0 0 | 0.2917 | -1 0 | 28 |
| 2 | 55.34171 -65.95368 0 | 0.2188 | -2 0 | 28 |
| 3 | 110.6834 -131.9074 0 | 0.2188 | -3 0 | 28 |
| 4 | 41.80038 98.47553 0 | 0.17 | -4 0 | 20 |

**** ANTENNA GEOMETRY ****

| Wire No. | Coordinates X Y Z | Radius | Connection End1 End2 | Pulse No. |
|----------|----------------------|--------|-------------------------|--------------|
| 0 | 0 0 0 | 0.2917 | -1 1 | 1 |
| 0 | 0 0 3.157234 | 0.2917 | 1 1 | 2 |
| 0 | 0 0 6.314469 | 0.2917 | 1 1 | 3 |
| 0 | 0 0 9.471704 | 0.2917 | 1 1 | 4 |
| 0 | 0 0 12.62894 | 0.2917 | 1 1 | 5 |
| 0 | 0 0 15.78617 | 0.2917 | 1 1 | 6 |
| 0 | 0 0 18.94341 | 0.2917 | 1 1 | 7 |
| 0 | 0 0 22.10064 | 0.2917 | 1 1 | 8 |
| 0 | 0 0 25.25788 | 0.2917 | 1 1 | 9 |
| 0 | 0 0 28.41511 | 0.2917 | 1 1 | 10 |
| 0 | 0 0 31.57234 | 0.2917 | 1 1 | 11 |
| 0 | 0 0 34.72958 | 0.2917 | 1 1 | 12 |
| 0 | 0 0 37.88681 | 0.2917 | 1 1 | 13 |
| 0 | 0 0 41.04405 | 0.2917 | 1 1 | 14 |
| 0 | 0 0 44.20128 | 0.2917 | 1 1 | 15 |
| 0 | 0 0 47.35852 | 0.2917 | 1 1 | 16 |

| | | | | | | |
|---|---|----------|--------|---|---|----|
| 0 | 0 | 50.51575 | 0.2917 | 1 | 1 | 17 |
| 0 | 0 | 53.67299 | 0.2917 | 1 | 1 | 18 |
| 0 | 0 | 56.83022 | 0.2917 | 1 | 1 | 19 |
| 0 | 0 | 59.98745 | 0.2917 | 1 | 1 | 20 |
| 0 | 0 | 63.14469 | 0.2917 | 1 | 1 | 21 |
| 0 | 0 | 66.30193 | 0.2917 | 1 | 1 | 22 |
| 0 | 0 | 69.45916 | 0.2917 | 1 | 1 | 23 |
| 0 | 0 | 72.61639 | 0.2917 | 1 | 1 | 24 |
| 0 | 0 | 75.77363 | 0.2917 | 1 | 1 | 25 |
| 0 | 0 | 78.93086 | 0.2917 | 1 | 1 | 26 |
| 0 | 0 | 82.0881 | 0.2917 | 1 | 1 | 27 |
| 0 | 0 | 85.24532 | 0.2917 | 1 | 0 | 28 |

| Wire No. | 2 | Coordinates | | | Connection | | Pulse |
|----------|---|-------------|----------|--------|------------|------|-------|
| X | | Y | Z | Radius | End1 | End2 | No. |
| 55.34171 | | -65.95368 | 0 | 0.2188 | -2 | 2 | 29 |
| 55.34171 | | -65.95368 | 3.294506 | 0.2188 | 2 | 2 | 30 |
| 55.34171 | | -65.95368 | 6.589011 | 0.2188 | 2 | 2 | 31 |
| 55.34171 | | -65.95368 | 9.883516 | 0.2188 | 2 | 2 | 32 |
| 55.34171 | | -65.95368 | 13.17802 | 0.2188 | 2 | 2 | 33 |
| 55.34171 | | -65.95368 | 16.47253 | 0.2188 | 2 | 2 | 34 |
| 55.34171 | | -65.95368 | 19.76703 | 0.2188 | 2 | 2 | 35 |
| 55.34171 | | -65.95368 | 23.06154 | 0.2188 | 2 | 2 | 36 |
| 55.34171 | | -65.95368 | 26.35604 | 0.2188 | 2 | 2 | 37 |
| 55.34171 | | -65.95368 | 29.65055 | 0.2188 | 2 | 2 | 38 |
| 55.34171 | | -65.95368 | 32.94506 | 0.2188 | 2 | 2 | 39 |
| 55.34171 | | -65.95368 | 36.23956 | 0.2188 | 2 | 2 | 40 |
| 55.34171 | | -65.95368 | 39.53407 | 0.2188 | 2 | 2 | 41 |
| 55.34171 | | -65.95368 | 42.82857 | 0.2188 | 2 | 2 | 42 |
| 55.34171 | | -65.95368 | 46.12308 | 0.2188 | 2 | 2 | 43 |
| 55.34171 | | -65.95368 | 49.41758 | 0.2188 | 2 | 2 | 44 |
| 55.34171 | | -65.95368 | 52.71209 | 0.2188 | 2 | 2 | 45 |
| 55.34171 | | -65.95368 | 56.00659 | 0.2188 | 2 | 2 | 46 |
| 55.34171 | | -65.95368 | 59.3011 | 0.2188 | 2 | 2 | 47 |
| 55.34171 | | -65.95368 | 62.59561 | 0.2188 | 2 | 2 | 48 |
| 55.34171 | | -65.95368 | 65.89011 | 0.2188 | 2 | 2 | 49 |
| 55.34171 | | -65.95368 | 69.18462 | 0.2188 | 2 | 2 | 50 |
| 55.34171 | | -65.95368 | 72.47912 | 0.2188 | 2 | 2 | 51 |
| 55.34171 | | -65.95368 | 75.77363 | 0.2188 | 2 | 2 | 52 |
| 55.34171 | | -65.95368 | 79.06813 | 0.2188 | 2 | 2 | 53 |
| 55.34171 | | -65.95368 | 82.36263 | 0.2188 | 2 | 2 | 54 |
| 55.34171 | | -65.95368 | 85.65714 | 0.2188 | 2 | 2 | 55 |
| 55.34171 | | -65.95368 | 88.95165 | 0.2188 | 2 | 0 | 56 |

| Wire No. | 3 | Coordinates | | | Connection | | Pulse |
|----------|---|-------------|----------|--------|------------|------|-------|
| X | | Y | Z | Radius | End1 | End2 | No. |
| 110.6834 | | -131.9074 | 0 | 0.2188 | -3 | 3 | 57 |
| 110.6834 | | -131.9074 | 3.294506 | 0.2188 | 3 | 3 | 58 |
| 110.6834 | | -131.9074 | 6.589011 | 0.2188 | 3 | 3 | 59 |
| 110.6834 | | -131.9074 | 9.883516 | 0.2188 | 3 | 3 | 60 |
| 110.6834 | | -131.9074 | 13.17802 | 0.2188 | 3 | 3 | 61 |
| 110.6834 | | -131.9074 | 16.47253 | 0.2188 | 3 | 3 | 62 |
| 110.6834 | | -131.9074 | 19.76703 | 0.2188 | 3 | 3 | 63 |
| 110.6834 | | -131.9074 | 23.06154 | 0.2188 | 3 | 3 | 64 |
| 110.6834 | | -131.9074 | 26.35604 | 0.2188 | 3 | 3 | 65 |
| 110.6834 | | -131.9074 | 29.65055 | 0.2188 | 3 | 3 | 66 |
| 110.6834 | | -131.9074 | 32.94506 | 0.2188 | 3 | 3 | 67 |

| | | | | | | |
|----------|-----------|----------|--------|---|---|----|
| 110.6834 | -131.9074 | 36.23956 | 0.2188 | 3 | 3 | 68 |
| 110.6834 | -131.9074 | 39.53407 | 0.2188 | 3 | 3 | 69 |
| 110.6834 | -131.9074 | 42.82857 | 0.2188 | 3 | 3 | 70 |
| 110.6834 | -131.9074 | 46.12308 | 0.2188 | 3 | 3 | 71 |
| 110.6834 | -131.9074 | 49.41758 | 0.2188 | 3 | 3 | 72 |
| 110.6834 | -131.9074 | 52.71209 | 0.2188 | 3 | 3 | 73 |
| 110.6834 | -131.9074 | 56.00659 | 0.2188 | 3 | 3 | 74 |
| 110.6834 | -131.9074 | 59.3011 | 0.2188 | 3 | 3 | 75 |
| 110.6834 | -131.9074 | 62.59561 | 0.2188 | 3 | 3 | 76 |
| 110.6834 | -131.9074 | 65.89011 | 0.2188 | 3 | 3 | 77 |
| 110.6834 | -131.9074 | 69.18462 | 0.2188 | 3 | 3 | 78 |
| 110.6834 | -131.9074 | 72.47912 | 0.2188 | 3 | 3 | 79 |
| 110.6834 | -131.9074 | 75.77363 | 0.2188 | 3 | 3 | 80 |
| 110.6834 | -131.9074 | 79.06813 | 0.2188 | 3 | 3 | 81 |
| 110.6834 | -131.9074 | 82.36263 | 0.2188 | 3 | 3 | 82 |
| 110.6834 | -131.9074 | 85.65714 | 0.2188 | 3 | 3 | 83 |
| 110.6834 | -131.9074 | 88.95165 | 0.2188 | 3 | 0 | 84 |

| Wire No. | 4 | Coordinates | | | Connection | | Pulse |
|----------|---|-------------|----------|--------|------------|------|-------|
| X | | Y | Z | Radius | End1 | End2 | No. |
| 41.80038 | | 98.47553 | 0 | 0.17 | -4 | 4 | 85 |
| 41.80038 | | 98.47553 | 3.375953 | 0.17 | 4 | 4 | 86 |
| 41.80038 | | 98.47553 | 6.751906 | 0.17 | 4 | 4 | 87 |
| 41.80038 | | 98.47553 | 10.12786 | 0.17 | 4 | 4 | 88 |
| 41.80038 | | 98.47553 | 13.50381 | 0.17 | 4 | 4 | 89 |
| 41.80038 | | 98.47553 | 16.87977 | 0.17 | 4 | 4 | 90 |
| 41.80038 | | 98.47553 | 20.25572 | 0.17 | 4 | 4 | 91 |
| 41.80038 | | 98.47553 | 23.63167 | 0.17 | 4 | 4 | 92 |
| 41.80038 | | 98.47553 | 27.00763 | 0.17 | 4 | 4 | 93 |
| 41.80038 | | 98.47553 | 30.38358 | 0.17 | 4 | 4 | 94 |
| 41.80038 | | 98.47553 | 33.75953 | 0.17 | 4 | 4 | 95 |
| 41.80038 | | 98.47553 | 37.13549 | 0.17 | 4 | 4 | 96 |
| 41.80038 | | 98.47553 | 40.51144 | 0.17 | 4 | 4 | 97 |
| 41.80038 | | 98.47553 | 43.88739 | 0.17 | 4 | 4 | 98 |
| 41.80038 | | 98.47553 | 47.26334 | 0.17 | 4 | 4 | 99 |
| 41.80038 | | 98.47553 | 50.6393 | 0.17 | 4 | 4 | 100 |
| 41.80038 | | 98.47553 | 54.01525 | 0.17 | 4 | 4 | 101 |
| 41.80038 | | 98.47553 | 57.3912 | 0.17 | 4 | 4 | 102 |
| 41.80038 | | 98.47553 | 60.76716 | 0.17 | 4 | 4 | 103 |
| 41.80038 | | 98.47553 | 64.14311 | 0.17 | 4 | 0 | 104 |

Sources: 1

Pulse No., Voltage Magnitude, Phase (Degrees): 29, 100.0, 0.0

Number of Loads: 3

Pulse No., Resistance, Reactance: 85 , 0 , -10000

Pulse No., Resistance, Reactance: 1 , 0 , -10000

Pulse No., Resistance, Reactance: 57 , 0 , -10000

```

***** SOURCE DATA *****
Pulse 29 Voltage = (100.0, 0.0j)
          Current = (0.2666, 1.1201j)
          Impedance = (20.113, -84.49j)
          Power = 13.33 Watts

```

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = kgab-2.cir

| | | | | | | |
|----|---------|---|---|----------|-------|-------|
| I | 1.0000 | 0 | 1 | .0000 | .0000 | .0000 |
| R | 1.0000 | 1 | 2 | .0000 | .0000 | .0000 |
| L | 1.3500 | 2 | 3 | .0000 | .0000 | .0000 |
| C | .0001 | 3 | 0 | .0000 | .0000 | .0000 |
| R | 20.1000 | 3 | 0 | -84.5000 | .0000 | .0000 |
| EX | .0000 | 0 | 0 | .0000 | .0000 | .0000 |

FREQ = .650

| NODE | | VOLT MAG | VOLT PHASE | | | | | | | |
|------|------|----------------|------------|----------------|-------|---------------------|-----------|-------------------|-----------|--------|
| 1 | | 78.8384 | -75.4695 | | | | | | | |
| 2 | | 78.5935 | -76.1752 | | | | | | | |
| 3 | | 83.9576 | -77.0744 | | | | | | | |
| | | BRANCH VOLTAGE | | BRANCH CURRENT | | FROM NODE IMPEDANCE | | TO NODE IMPEDANCE | | |
| | | MAG | PHASE | MAG | PHASE | RESISTANCE | REACTANCE | RESISTANCE | REACTANCE | |
| VSWR | | | | | | | | | | |
| R | 1- 2 | 1.000 | 1.00 | .000 | 1.00 | .000 | 19.78 | -76.32 | 18.78 | -76.32 |
| L | 2- 3 | 1.350 | 5.51 | 90.000 | 1.00 | .000 | 18.78 | -76.32 | 18.78 | -81.83 |
| C | 3- 0 | .000 | 83.96 | -77.074 | .03 | 12.926 | .00 | -2448.54 | .00 | .00 |
| R | 3- 0 | 20.100 | 83.96 | -77.074 | .97 | -.455 | 20.10 | -84.50 | .00 | .00 |

```

*****
                        ACSModel
                      (MININEC 3.1 Core)
                    03-17-2011      12:10:09
*****

```

KGAB4MOM
 CALIBRATION
 twr 3 driven twr1, 2, 4 floated

Frequency = 0.650 MHz Wavelength = 461.23079 Meters

No. of Wires: 4

| Wire No. | Coordinates X | Y | Z | Radius | End Connection | No. of Segments |
|----------|------------------|-----------|----------|--------|-------------------|--------------------|
| 1 | 0 | 0 | 0 | 0.2917 | -1 | 28 |
| | 0 | 0 | 88.40257 | 0.2917 | 0 | |
| 2 | 55.34171 | -65.95368 | 0 | 0.2188 | -2 | 28 |
| | 55.34171 | -65.95368 | 92.24615 | 0.2188 | 0 | |
| 3 | 110.6834 | -131.9074 | 0 | 0.2188 | -3 | 28 |
| | 110.6834 | -131.9074 | 92.24615 | 0.2188 | 0 | |
| 4 | 41.80038 | 98.47553 | 0 | 0.17 | -4 | 20 |
| | 41.80038 | 98.47553 | 67.51907 | 0.17 | 0 | |

**** ANTENNA GEOMETRY ****

| Wire No. | Coordinates X | Y | Z | Radius | Connection End1 End2 | Pulse No. |
|----------|------------------|---|----------|--------|-------------------------|--------------|
| 0 | 0 | 0 | 0 | 0.2917 | -1 1 | 1 |
| 0 | 0 | 0 | 3.157234 | 0.2917 | 1 1 | 2 |
| 0 | 0 | 0 | 6.314469 | 0.2917 | 1 1 | 3 |
| 0 | 0 | 0 | 9.471704 | 0.2917 | 1 1 | 4 |
| 0 | 0 | 0 | 12.62894 | 0.2917 | 1 1 | 5 |
| 0 | 0 | 0 | 15.78617 | 0.2917 | 1 1 | 6 |
| 0 | 0 | 0 | 18.94341 | 0.2917 | 1 1 | 7 |
| 0 | 0 | 0 | 22.10064 | 0.2917 | 1 1 | 8 |
| 0 | 0 | 0 | 25.25788 | 0.2917 | 1 1 | 9 |
| 0 | 0 | 0 | 28.41511 | 0.2917 | 1 1 | 10 |
| 0 | 0 | 0 | 31.57234 | 0.2917 | 1 1 | 11 |
| 0 | 0 | 0 | 34.72958 | 0.2917 | 1 1 | 12 |
| 0 | 0 | 0 | 37.88681 | 0.2917 | 1 1 | 13 |
| 0 | 0 | 0 | 41.04405 | 0.2917 | 1 1 | 14 |
| 0 | 0 | 0 | 44.20128 | 0.2917 | 1 1 | 15 |
| 0 | 0 | 0 | 47.35852 | 0.2917 | 1 1 | 16 |

| | | | | | | |
|---|---|----------|--------|---|---|----|
| 0 | 0 | 50.51575 | 0.2917 | 1 | 1 | 17 |
| 0 | 0 | 53.67299 | 0.2917 | 1 | 1 | 18 |
| 0 | 0 | 56.83022 | 0.2917 | 1 | 1 | 19 |
| 0 | 0 | 59.98745 | 0.2917 | 1 | 1 | 20 |
| 0 | 0 | 63.14469 | 0.2917 | 1 | 1 | 21 |
| 0 | 0 | 66.30193 | 0.2917 | 1 | 1 | 22 |
| 0 | 0 | 69.45916 | 0.2917 | 1 | 1 | 23 |
| 0 | 0 | 72.61639 | 0.2917 | 1 | 1 | 24 |
| 0 | 0 | 75.77363 | 0.2917 | 1 | 1 | 25 |
| 0 | 0 | 78.93086 | 0.2917 | 1 | 1 | 26 |
| 0 | 0 | 82.0881 | 0.2917 | 1 | 1 | 27 |
| 0 | 0 | 85.24532 | 0.2917 | 1 | 0 | 28 |

| Wire No. | 2 | Coordinates | | | Connection | | Pulse |
|----------|---|-------------|----------|--------|------------|------|-------|
| X | | Y | Z | Radius | End1 | End2 | No. |
| 55.34171 | | -65.95368 | 0 | 0.2188 | -2 | 2 | 29 |
| 55.34171 | | -65.95368 | 3.294506 | 0.2188 | 2 | 2 | 30 |
| 55.34171 | | -65.95368 | 6.589011 | 0.2188 | 2 | 2 | 31 |
| 55.34171 | | -65.95368 | 9.883516 | 0.2188 | 2 | 2 | 32 |
| 55.34171 | | -65.95368 | 13.17802 | 0.2188 | 2 | 2 | 33 |
| 55.34171 | | -65.95368 | 16.47253 | 0.2188 | 2 | 2 | 34 |
| 55.34171 | | -65.95368 | 19.76703 | 0.2188 | 2 | 2 | 35 |
| 55.34171 | | -65.95368 | 23.06154 | 0.2188 | 2 | 2 | 36 |
| 55.34171 | | -65.95368 | 26.35604 | 0.2188 | 2 | 2 | 37 |
| 55.34171 | | -65.95368 | 29.65055 | 0.2188 | 2 | 2 | 38 |
| 55.34171 | | -65.95368 | 32.94506 | 0.2188 | 2 | 2 | 39 |
| 55.34171 | | -65.95368 | 36.23956 | 0.2188 | 2 | 2 | 40 |
| 55.34171 | | -65.95368 | 39.53407 | 0.2188 | 2 | 2 | 41 |
| 55.34171 | | -65.95368 | 42.82857 | 0.2188 | 2 | 2 | 42 |
| 55.34171 | | -65.95368 | 46.12308 | 0.2188 | 2 | 2 | 43 |
| 55.34171 | | -65.95368 | 49.41758 | 0.2188 | 2 | 2 | 44 |
| 55.34171 | | -65.95368 | 52.71209 | 0.2188 | 2 | 2 | 45 |
| 55.34171 | | -65.95368 | 56.00659 | 0.2188 | 2 | 2 | 46 |
| 55.34171 | | -65.95368 | 59.3011 | 0.2188 | 2 | 2 | 47 |
| 55.34171 | | -65.95368 | 62.59561 | 0.2188 | 2 | 2 | 48 |
| 55.34171 | | -65.95368 | 65.89011 | 0.2188 | 2 | 2 | 49 |
| 55.34171 | | -65.95368 | 69.18462 | 0.2188 | 2 | 2 | 50 |
| 55.34171 | | -65.95368 | 72.47912 | 0.2188 | 2 | 2 | 51 |
| 55.34171 | | -65.95368 | 75.77363 | 0.2188 | 2 | 2 | 52 |
| 55.34171 | | -65.95368 | 79.06813 | 0.2188 | 2 | 2 | 53 |
| 55.34171 | | -65.95368 | 82.36263 | 0.2188 | 2 | 2 | 54 |
| 55.34171 | | -65.95368 | 85.65714 | 0.2188 | 2 | 2 | 55 |
| 55.34171 | | -65.95368 | 88.95165 | 0.2188 | 2 | 0 | 56 |

| Wire No. | 3 | Coordinates | | | Connection | | Pulse |
|----------|---|-------------|----------|--------|------------|------|-------|
| X | | Y | Z | Radius | End1 | End2 | No. |
| 110.6834 | | -131.9074 | 0 | 0.2188 | -3 | 3 | 57 |
| 110.6834 | | -131.9074 | 3.294506 | 0.2188 | 3 | 3 | 58 |
| 110.6834 | | -131.9074 | 6.589011 | 0.2188 | 3 | 3 | 59 |
| 110.6834 | | -131.9074 | 9.883516 | 0.2188 | 3 | 3 | 60 |
| 110.6834 | | -131.9074 | 13.17802 | 0.2188 | 3 | 3 | 61 |
| 110.6834 | | -131.9074 | 16.47253 | 0.2188 | 3 | 3 | 62 |
| 110.6834 | | -131.9074 | 19.76703 | 0.2188 | 3 | 3 | 63 |
| 110.6834 | | -131.9074 | 23.06154 | 0.2188 | 3 | 3 | 64 |
| 110.6834 | | -131.9074 | 26.35604 | 0.2188 | 3 | 3 | 65 |
| 110.6834 | | -131.9074 | 29.65055 | 0.2188 | 3 | 3 | 66 |
| 110.6834 | | -131.9074 | 32.94506 | 0.2188 | 3 | 3 | 67 |

| | | | | | | |
|----------|-----------|----------|--------|---|---|----|
| 110.6834 | -131.9074 | 36.23956 | 0.2188 | 3 | 3 | 68 |
| 110.6834 | -131.9074 | 39.53407 | 0.2188 | 3 | 3 | 69 |
| 110.6834 | -131.9074 | 42.82857 | 0.2188 | 3 | 3 | 70 |
| 110.6834 | -131.9074 | 46.12308 | 0.2188 | 3 | 3 | 71 |
| 110.6834 | -131.9074 | 49.41758 | 0.2188 | 3 | 3 | 72 |
| 110.6834 | -131.9074 | 52.71209 | 0.2188 | 3 | 3 | 73 |
| 110.6834 | -131.9074 | 56.00659 | 0.2188 | 3 | 3 | 74 |
| 110.6834 | -131.9074 | 59.3011 | 0.2188 | 3 | 3 | 75 |
| 110.6834 | -131.9074 | 62.59561 | 0.2188 | 3 | 3 | 76 |
| 110.6834 | -131.9074 | 65.89011 | 0.2188 | 3 | 3 | 77 |
| 110.6834 | -131.9074 | 69.18462 | 0.2188 | 3 | 3 | 78 |
| 110.6834 | -131.9074 | 72.47912 | 0.2188 | 3 | 3 | 79 |
| 110.6834 | -131.9074 | 75.77363 | 0.2188 | 3 | 3 | 80 |
| 110.6834 | -131.9074 | 79.06813 | 0.2188 | 3 | 3 | 81 |
| 110.6834 | -131.9074 | 82.36263 | 0.2188 | 3 | 3 | 82 |
| 110.6834 | -131.9074 | 85.65714 | 0.2188 | 3 | 3 | 83 |
| 110.6834 | -131.9074 | 88.95165 | 0.2188 | 3 | 0 | 84 |

| Wire No. | 4 | Coordinates | | | Connection | | Pulse |
|----------|---|-------------|----------|--------|------------|------|-------|
| X | | Y | Z | Radius | End1 | End2 | No. |
| 41.80038 | | 98.47553 | 0 | 0.17 | -4 | 4 | 85 |
| 41.80038 | | 98.47553 | 3.375953 | 0.17 | 4 | 4 | 86 |
| 41.80038 | | 98.47553 | 6.751906 | 0.17 | 4 | 4 | 87 |
| 41.80038 | | 98.47553 | 10.12786 | 0.17 | 4 | 4 | 88 |
| 41.80038 | | 98.47553 | 13.50381 | 0.17 | 4 | 4 | 89 |
| 41.80038 | | 98.47553 | 16.87977 | 0.17 | 4 | 4 | 90 |
| 41.80038 | | 98.47553 | 20.25572 | 0.17 | 4 | 4 | 91 |
| 41.80038 | | 98.47553 | 23.63167 | 0.17 | 4 | 4 | 92 |
| 41.80038 | | 98.47553 | 27.00763 | 0.17 | 4 | 4 | 93 |
| 41.80038 | | 98.47553 | 30.38358 | 0.17 | 4 | 4 | 94 |
| 41.80038 | | 98.47553 | 33.75953 | 0.17 | 4 | 4 | 95 |
| 41.80038 | | 98.47553 | 37.13549 | 0.17 | 4 | 4 | 96 |
| 41.80038 | | 98.47553 | 40.51144 | 0.17 | 4 | 4 | 97 |
| 41.80038 | | 98.47553 | 43.88739 | 0.17 | 4 | 4 | 98 |
| 41.80038 | | 98.47553 | 47.26334 | 0.17 | 4 | 4 | 99 |
| 41.80038 | | 98.47553 | 50.6393 | 0.17 | 4 | 4 | 100 |
| 41.80038 | | 98.47553 | 54.01525 | 0.17 | 4 | 4 | 101 |
| 41.80038 | | 98.47553 | 57.3912 | 0.17 | 4 | 4 | 102 |
| 41.80038 | | 98.47553 | 60.76716 | 0.17 | 4 | 4 | 103 |
| 41.80038 | | 98.47553 | 64.14311 | 0.17 | 4 | 0 | 104 |

Sources: 1

Pulse No., Voltage Magnitude, Phase (Degrees): 57, 100.0, 0.0

Number of Loads: 3

Pulse No., Resistance, Reactance: 85 , 0 , -10000

Pulse No., Resistance, Reactance: 1 , 0 , -10000

Pulse No., Resistance, Reactance: 29 , 0 , -10000

```

***** SOURCE DATA *****
Pulse 57 Voltage = (100.0, 0.0j)
          Current = (0.2724, 1.1235j)
          Impedance = (20.38, -84.07j)
          Power = 13.62 Watts

```

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = kgab-3.cir

| | | | | | | |
|----|---------|---|---|----------|-------|-------|
| I | 1.0000 | 0 | 1 | .0000 | .0000 | .0000 |
| R | 1.0000 | 1 | 2 | .0000 | .0000 | .0000 |
| L | 1.4600 | 2 | 3 | .0000 | .0000 | .0000 |
| C | .0001 | 3 | 0 | .0000 | .0000 | .0000 |
| R | 20.4000 | 3 | 0 | -84.1000 | .0000 | .0000 |
| EX | .0000 | 0 | 0 | .0000 | .0000 | .0000 |

FREQ = .650

| NODE | | VOLT MAG | VOLT PHASE | | | | | | | | |
|------|----|----------|------------|----------------|----------------|------|---------------------|------------|-------------------|------------|-----------|
| 1 | | 78.6834 | -75.0317 | | | | | | | | |
| 2 | | 78.4311 | -75.7375 | | | | | | | | |
| 3 | | 84.2228 | -76.7369 | | | | | | | | |
| | | | | BRANCH VOLTAGE | BRANCH CURRENT | | FROM NODE IMPEDANCE | | TO NODE IMPEDANCE | | |
| | | | | MAG | PHASE | MAG | PHASE | RESISTANCE | REACTANCE | RESISTANCE | REACTANCE |
| VSWR | | | | | | | | | | | |
| R | 1- | 2 | 1.000 | 1.00 | .000 | 1.00 | .000 | 20.32 | -76.01 | 19.32 | -76.01 |
| L | 2- | 3 | 1.460 | 5.96 | 90.000 | 1.00 | .000 | 19.32 | -76.01 | 19.32 | -81.98 |
| C | 3- | 0 | .000 | 84.22 | -76.737 | .03 | 13.263 | .00 | -3060.67 | .00 | .00 |
| R | 3- | 0 | 20.400 | 84.22 | -76.737 | .97 | -.372 | 20.40 | -84.10 | .00 | .00 |

"

DETUNING OF TOWER 4

Once the model was calibrated for all four towers, the model was run with the towers 1-3 producing the theoretical fields with tower 4 set for zero field. The resultant reactance for zero field on tower 4 was computed to be $+j1084$ Ohms. Therefore an inductor of $+j1084$ Ohms was inserted at the base of tower 4 to permanently detune it for zero field(detuned for minimum reradiation).

 ACSModel
 (MININEC 3.1 Core)
 03-17-2011 14:02:00

KGAB4MOM
 4TOWER MODEL
 TO FIND DETUNING LOAD FOR TWR 4

Frequency = 0.650 MHz Wavelength = 461.23079 Meters

No. of Wires: 4

| Wire No. 1 | Coordinates | | | Radius | End Connection | No. of |
|------------|-------------|----------|--------|--------|----------------|--------|
| X | Y | Z | | | | |
| Segments | | | | | | |
| 0 | 0 | 0 | | -1 | | |
| 0 | 0 | 88.40257 | 0.2917 | 0 | | 28 |
| Wire No. 2 | Coordinates | | | Radius | End Connection | No. of |
| X | Y | Z | | | | |
| Segments | | | | | | |
| 55.34171 | -65.95368 | 0 | | -2 | | |
| 55.34171 | -65.95368 | 92.24615 | 0.2188 | 0 | | 28 |
| Wire No. 3 | Coordinates | | | Radius | End Connection | No. of |
| X | Y | Z | | | | |
| Segments | | | | | | |
| 110.6834 | -131.9074 | 0 | | -3 | | |
| 110.6834 | -131.9074 | 92.24615 | 0.2188 | 0 | | 28 |
| Wire No. 4 | Coordinates | | | Radius | End Connection | No. of |
| X | Y | Z | | | | |
| Segments | | | | | | |
| 41.80038 | 98.47553 | 0 | | -4 | | |
| 41.80038 | 98.47553 | 67.51907 | 0.17 | 0 | | 20 |

**** ANTENNA GEOMETRY ****

| Wire No. 1 | Coordinates | | | Radius | Connection | | Pulse |
|------------|-------------|----------|--------|--------|------------|-----|-------|
| X | Y | Z | | End1 | End2 | No. | |
| 0 | 0 | 0 | 0.2917 | -1 | 1 | 1 | |
| 0 | 0 | 3.157234 | 0.2917 | 1 | 1 | 2 | |
| 0 | 0 | 6.314469 | 0.2917 | 1 | 1 | 3 | |
| 0 | 0 | 9.471704 | 0.2917 | 1 | 1 | 4 | |
| 0 | 0 | 12.62894 | 0.2917 | 1 | 1 | 5 | |
| 0 | 0 | 15.78617 | 0.2917 | 1 | 1 | 6 | |
| 0 | 0 | 18.94341 | 0.2917 | 1 | 1 | 7 | |
| 0 | 0 | 22.10064 | 0.2917 | 1 | 1 | 8 | |
| 0 | 0 | 25.25788 | 0.2917 | 1 | 1 | 9 | |
| 0 | 0 | 28.41511 | 0.2917 | 1 | 1 | 10 | |
| 0 | 0 | 31.57234 | 0.2917 | 1 | 1 | 11 | |
| 0 | 0 | 34.72958 | 0.2917 | 1 | 1 | 12 | |
| 0 | 0 | 37.88681 | 0.2917 | 1 | 1 | 13 | |
| 0 | 0 | 41.04405 | 0.2917 | 1 | 1 | 14 | |
| 0 | 0 | 44.20128 | 0.2917 | 1 | 1 | 15 | |

| | | | | | | |
|---|---|----------|--------|---|---|----|
| 0 | 0 | 47.35852 | 0.2917 | 1 | 1 | 16 |
| 0 | 0 | 50.51575 | 0.2917 | 1 | 1 | 17 |
| 0 | 0 | 53.67299 | 0.2917 | 1 | 1 | 18 |
| 0 | 0 | 56.83022 | 0.2917 | 1 | 1 | 19 |
| 0 | 0 | 59.98745 | 0.2917 | 1 | 1 | 20 |
| 0 | 0 | 63.14469 | 0.2917 | 1 | 1 | 21 |
| 0 | 0 | 66.30193 | 0.2917 | 1 | 1 | 22 |
| 0 | 0 | 69.45916 | 0.2917 | 1 | 1 | 23 |
| 0 | 0 | 72.61639 | 0.2917 | 1 | 1 | 24 |
| 0 | 0 | 75.77363 | 0.2917 | 1 | 1 | 25 |
| 0 | 0 | 78.93086 | 0.2917 | 1 | 1 | 26 |
| 0 | 0 | 82.0881 | 0.2917 | 1 | 1 | 27 |
| 0 | 0 | 85.24532 | 0.2917 | 1 | 0 | 28 |

| Wire No. | 2 | Coordinates | | | Connection | | Pulse |
|----------|---|-------------|----------|--------|------------|------|-------|
| X | | Y | Z | Radius | End1 | End2 | No. |
| 55.34171 | | -65.95368 | 0 | 0.2188 | -2 | 2 | 29 |
| 55.34171 | | -65.95368 | 3.294506 | 0.2188 | 2 | 2 | 30 |
| 55.34171 | | -65.95368 | 6.589011 | 0.2188 | 2 | 2 | 31 |
| 55.34171 | | -65.95368 | 9.883516 | 0.2188 | 2 | 2 | 32 |
| 55.34171 | | -65.95368 | 13.17802 | 0.2188 | 2 | 2 | 33 |
| 55.34171 | | -65.95368 | 16.47253 | 0.2188 | 2 | 2 | 34 |
| 55.34171 | | -65.95368 | 19.76703 | 0.2188 | 2 | 2 | 35 |
| 55.34171 | | -65.95368 | 23.06154 | 0.2188 | 2 | 2 | 36 |
| 55.34171 | | -65.95368 | 26.35604 | 0.2188 | 2 | 2 | 37 |
| 55.34171 | | -65.95368 | 29.65055 | 0.2188 | 2 | 2 | 38 |
| 55.34171 | | -65.95368 | 32.94506 | 0.2188 | 2 | 2 | 39 |
| 55.34171 | | -65.95368 | 36.23956 | 0.2188 | 2 | 2 | 40 |
| 55.34171 | | -65.95368 | 39.53407 | 0.2188 | 2 | 2 | 41 |
| 55.34171 | | -65.95368 | 42.82857 | 0.2188 | 2 | 2 | 42 |
| 55.34171 | | -65.95368 | 46.12308 | 0.2188 | 2 | 2 | 43 |
| 55.34171 | | -65.95368 | 49.41758 | 0.2188 | 2 | 2 | 44 |
| 55.34171 | | -65.95368 | 52.71209 | 0.2188 | 2 | 2 | 45 |
| 55.34171 | | -65.95368 | 56.00659 | 0.2188 | 2 | 2 | 46 |
| 55.34171 | | -65.95368 | 59.3011 | 0.2188 | 2 | 2 | 47 |
| 55.34171 | | -65.95368 | 62.59561 | 0.2188 | 2 | 2 | 48 |
| 55.34171 | | -65.95368 | 65.89011 | 0.2188 | 2 | 2 | 49 |
| 55.34171 | | -65.95368 | 69.18462 | 0.2188 | 2 | 2 | 50 |
| 55.34171 | | -65.95368 | 72.47912 | 0.2188 | 2 | 2 | 51 |
| 55.34171 | | -65.95368 | 75.77363 | 0.2188 | 2 | 2 | 52 |
| 55.34171 | | -65.95368 | 79.06813 | 0.2188 | 2 | 2 | 53 |
| 55.34171 | | -65.95368 | 82.36263 | 0.2188 | 2 | 2 | 54 |
| 55.34171 | | -65.95368 | 85.65714 | 0.2188 | 2 | 2 | 55 |
| 55.34171 | | -65.95368 | 88.95165 | 0.2188 | 2 | 0 | 56 |

| Wire No. | 3 | Coordinates | | | Connection | | Pulse |
|----------|---|-------------|----------|--------|------------|------|-------|
| X | | Y | Z | Radius | End1 | End2 | No. |
| 110.6834 | | -131.9074 | 0 | 0.2188 | -3 | 3 | 57 |
| 110.6834 | | -131.9074 | 3.294506 | 0.2188 | 3 | 3 | 58 |
| 110.6834 | | -131.9074 | 6.589011 | 0.2188 | 3 | 3 | 59 |
| 110.6834 | | -131.9074 | 9.883516 | 0.2188 | 3 | 3 | 60 |
| 110.6834 | | -131.9074 | 13.17802 | 0.2188 | 3 | 3 | 61 |
| 110.6834 | | -131.9074 | 16.47253 | 0.2188 | 3 | 3 | 62 |
| 110.6834 | | -131.9074 | 19.76703 | 0.2188 | 3 | 3 | 63 |
| 110.6834 | | -131.9074 | 23.06154 | 0.2188 | 3 | 3 | 64 |
| 110.6834 | | -131.9074 | 26.35604 | 0.2188 | 3 | 3 | 65 |
| 110.6834 | | -131.9074 | 29.65055 | 0.2188 | 3 | 3 | 66 |

| | | | | | | |
|----------|-----------|----------|--------|---|---|----|
| 110.6834 | -131.9074 | 32.94506 | 0.2188 | 3 | 3 | 67 |
| 110.6834 | -131.9074 | 36.23956 | 0.2188 | 3 | 3 | 68 |
| 110.6834 | -131.9074 | 39.53407 | 0.2188 | 3 | 3 | 69 |
| 110.6834 | -131.9074 | 42.82857 | 0.2188 | 3 | 3 | 70 |
| 110.6834 | -131.9074 | 46.12308 | 0.2188 | 3 | 3 | 71 |
| 110.6834 | -131.9074 | 49.41758 | 0.2188 | 3 | 3 | 72 |
| 110.6834 | -131.9074 | 52.71209 | 0.2188 | 3 | 3 | 73 |
| 110.6834 | -131.9074 | 56.00659 | 0.2188 | 3 | 3 | 74 |
| 110.6834 | -131.9074 | 59.3011 | 0.2188 | 3 | 3 | 75 |
| 110.6834 | -131.9074 | 62.59561 | 0.2188 | 3 | 3 | 76 |
| 110.6834 | -131.9074 | 65.89011 | 0.2188 | 3 | 3 | 77 |
| 110.6834 | -131.9074 | 69.18462 | 0.2188 | 3 | 3 | 78 |
| 110.6834 | -131.9074 | 72.47912 | 0.2188 | 3 | 3 | 79 |
| 110.6834 | -131.9074 | 75.77363 | 0.2188 | 3 | 3 | 80 |
| 110.6834 | -131.9074 | 79.06813 | 0.2188 | 3 | 3 | 81 |
| 110.6834 | -131.9074 | 82.36263 | 0.2188 | 3 | 3 | 82 |
| 110.6834 | -131.9074 | 85.65714 | 0.2188 | 3 | 3 | 83 |
| 110.6834 | -131.9074 | 88.95165 | 0.2188 | 3 | 0 | 84 |

| Wire No. | 4 | Coordinates | | | Connection | | Pulse |
|----------|---|-------------|----------|--------|------------|------|-------|
| X | | Y | Z | Radius | End1 | End2 | No. |
| 41.80038 | | 98.47553 | 0 | 0.17 | -4 | 4 | 85 |
| 41.80038 | | 98.47553 | 3.375953 | 0.17 | 4 | 4 | 86 |
| 41.80038 | | 98.47553 | 6.751906 | 0.17 | 4 | 4 | 87 |
| 41.80038 | | 98.47553 | 10.12786 | 0.17 | 4 | 4 | 88 |
| 41.80038 | | 98.47553 | 13.50381 | 0.17 | 4 | 4 | 89 |
| 41.80038 | | 98.47553 | 16.87977 | 0.17 | 4 | 4 | 90 |
| 41.80038 | | 98.47553 | 20.25572 | 0.17 | 4 | 4 | 91 |
| 41.80038 | | 98.47553 | 23.63167 | 0.17 | 4 | 4 | 92 |
| 41.80038 | | 98.47553 | 27.00763 | 0.17 | 4 | 4 | 93 |
| 41.80038 | | 98.47553 | 30.38358 | 0.17 | 4 | 4 | 94 |
| 41.80038 | | 98.47553 | 33.75953 | 0.17 | 4 | 4 | 95 |
| 41.80038 | | 98.47553 | 37.13549 | 0.17 | 4 | 4 | 96 |
| 41.80038 | | 98.47553 | 40.51144 | 0.17 | 4 | 4 | 97 |
| 41.80038 | | 98.47553 | 43.88739 | 0.17 | 4 | 4 | 98 |
| 41.80038 | | 98.47553 | 47.26334 | 0.17 | 4 | 4 | 99 |
| 41.80038 | | 98.47553 | 50.6393 | 0.17 | 4 | 4 | 100 |
| 41.80038 | | 98.47553 | 54.01525 | 0.17 | 4 | 4 | 101 |
| 41.80038 | | 98.47553 | 57.3912 | 0.17 | 4 | 4 | 102 |
| 41.80038 | | 98.47553 | 60.76716 | 0.17 | 4 | 4 | 103 |
| 41.80038 | | 98.47553 | 64.14311 | 0.17 | 4 | 0 | 104 |

Sources: 4

Pulse No., Voltage Magnitude, Phase (Degrees): 1, 553.5, -88.7
Pulse No., Voltage Magnitude, Phase (Degrees): 29, 778.4, 146.7
Pulse No., Voltage Magnitude, Phase (Degrees): 57, 259.0, 4.1
Pulse No., Voltage Magnitude, Phase (Degrees): 85, 19.0, -101.9

Number of Loads: 0

***** SOURCE DATA *****

Pulse 1 Voltage = (12.42, -553.4011j)
 Current = (5.3943, 0.0288j)
 Impedance = (1.755, -102.6j)
 Power = 25.53 Watts

Pulse 29 Voltage = (-650.3742, 427.7657j)
 Current = (-6.3709, -7.3605j)
 Impedance = (10.498, -79.273j)
 Power = 497.43 Watts

Pulse 57 Voltage = (258.3227, 18.3618j)
 Current = (-0.5159, 4.7572j)
 Impedance = (-2.005, -54.084j)
 Power = -22.959855 Watts

Pulse 85 Voltage = (-3.9165, -18.5575j)
 Current = (0.0172, -0.0034j)
 Impedance = (-11.034, -1083.613j)
 Power = -0.001690 Watts

Total Power = 500.000 Watts

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

Wire No. 1 :

| Pulse No. | Real (Amps) | Imaginary (Amps) | Magnitude (Amps) | Phase (Degrees) |
|-----------|-------------|------------------|------------------|-----------------|
| 1 | 5.3943 | 0.0288 | 5.3943 | 0.306 |
| 2 | 5.2054 | 0.0246 | 5.2054 | 0.271 |
| 3 | 5.076 | 0.0219 | 5.076 | 0.2468 |
| 4 | 4.9507 | 0.0193 | 4.9507 | 0.2234 |
| 5 | 4.8242 | 0.0168 | 4.8242 | 0.1999 |
| 6 | 4.6938 | 0.0144 | 4.6938 | 0.1756 |
| 7 | 4.5584 | 0.012 | 4.5584 | 0.1503 |
| 8 | 4.4173 | 0.0095 | 4.4173 | 0.1238 |
| 9 | 4.2701 | 0.0071 | 4.2701 | 0.0959 |
| 10 | 4.1168 | 0.0048 | 4.1168 | 0.0665 |
| 11 | 3.9572 | 0.0025 | 3.9572 | 0.0356 |
| 12 | 3.7914 | 0.0002 | 3.7914 | 0.003 |
| 13 | 3.6194 | -0.002 | 3.6194 | -0.0312 |
| 14 | 3.4414 | -0.004 | 3.4414 | -0.067 |
| 15 | 3.2575 | -0.0059 | 3.2575 | -0.1045 |
| 16 | 3.0678 | -0.0077 | 3.0678 | -0.1438 |
| 17 | 2.8724 | -0.0093 | 2.8724 | -0.1847 |
| 18 | 2.6716 | -0.0106 | 2.6716 | -0.2273 |
| 19 | 2.4655 | -0.0117 | 2.4655 | -0.2717 |
| 20 | 2.2541 | -0.0125 | 2.2542 | -0.3176 |
| 21 | 2.0376 | -0.013 | 2.0377 | -0.3653 |
| 22 | 1.8159 | -0.0131 | 1.816 | -0.4145 |
| 23 | 1.589 | -0.0129 | 1.5891 | -0.4653 |
| 24 | 1.3565 | -0.0123 | 1.3565 | -0.5178 |
| 25 | 1.1178 | -0.0112 | 1.1178 | -0.5718 |
| 26 | 0.8717 | -0.0095 | 0.8717 | -0.6274 |
| 27 | 0.6154 | -0.0074 | 0.6155 | -0.6849 |
| 28 | 0.3432 | -0.0045 | 0.3433 | -0.7453 |

| | | | | |
|---|-----|-----|-----|-----|
| E | 0.0 | 0.0 | 0.0 | 0.0 |
|---|-----|-----|-----|-----|

Wire No. 2 :

| Pulse No. | Real (Amps) | Imaginary (Amps) | Magnitude (Amps) | Phase (Degrees) |
|-----------|-------------|------------------|------------------|-----------------|
| 29 | -6.3709 | -7.3605 | 9.7348 | -130.8777 |
| 30 | -6.2359 | -7.1585 | 9.4937 | -131.0598 |
| 31 | -6.1303 | -7.0074 | 9.3104 | -131.1805 |
| 32 | -6.0207 | -6.8566 | 9.1248 | -131.2862 |
| 33 | -5.9034 | -6.7002 | 8.9299 | -131.3825 |
| 34 | -5.7766 | -6.5357 | 8.7227 | -131.472 |
| 35 | -5.6396 | -6.3618 | 8.5017 | -131.5562 |
| 36 | -5.492 | -6.178 | 8.2662 | -131.636 |
| 37 | -5.3337 | -5.9839 | 8.0159 | -131.712 |
| 38 | -5.1646 | -5.7794 | 7.7508 | -131.7849 |
| 39 | -4.9849 | -5.5646 | 7.4709 | -131.8549 |
| 40 | -4.7947 | -5.3396 | 7.1764 | -131.9223 |
| 41 | -4.5941 | -5.1045 | 6.8675 | -131.9874 |
| 42 | -4.3834 | -4.8597 | 6.5445 | -132.0505 |
| 43 | -4.1628 | -4.6052 | 6.2078 | -132.1117 |
| 44 | -3.9326 | -4.3414 | 5.8577 | -132.1713 |
| 45 | -3.693 | -4.0686 | 5.4947 | -132.2293 |
| 46 | -3.4442 | -3.787 | 5.1189 | -132.2858 |
| 47 | -3.1865 | -3.4968 | 4.7309 | -132.3412 |
| 48 | -2.92 | -3.1984 | 4.3309 | -132.3953 |
| 49 | -2.645 | -2.8918 | 3.919 | -132.4485 |
| 50 | -2.3615 | -2.5771 | 3.4954 | -132.5007 |
| 51 | -2.0693 | -2.2542 | 3.06 | -132.552 |
| 52 | -1.7683 | -1.9228 | 2.6123 | -132.6027 |
| 53 | -1.4575 | -1.5821 | 2.1512 | -132.6528 |
| 54 | -1.1357 | -1.2306 | 1.6746 | -132.7024 |
| 55 | -0.7994 | -0.8648 | 1.1777 | -132.7518 |
| 56 | -0.4412 | -0.4764 | 0.6493 | -132.8017 |
| E | 0.0 | 0.0 | 0.0 | 0.0 |

Wire No. 3 :

| Pulse No. | Real (Amps) | Imaginary (Amps) | Magnitude (Amps) | Phase (Degrees) |
|-----------|-------------|------------------|------------------|-----------------|
| 57 | -0.5159 | 4.7572 | 4.7851 | 96.1894 |
| 58 | -0.5099 | 4.6744 | 4.7021 | 96.2248 |
| 59 | -0.5045 | 4.6068 | 4.6344 | 96.2502 |
| 60 | -0.4985 | 4.5343 | 4.5617 | 96.2744 |
| 61 | -0.4917 | 4.4546 | 4.4817 | 96.2986 |
| 62 | -0.4839 | 4.3667 | 4.3934 | 96.3234 |
| 63 | -0.4751 | 4.2702 | 4.2965 | 96.349 |
| 64 | -0.4654 | 4.1648 | 4.1907 | 96.3756 |
| 65 | -0.4546 | 4.0505 | 4.0759 | 96.4035 |
| 66 | -0.4428 | 3.9274 | 3.9522 | 96.4326 |
| 67 | -0.43 | 3.7955 | 3.8198 | 96.463 |
| 68 | -0.4161 | 3.655 | 3.6786 | 96.4947 |
| 69 | -0.4012 | 3.506 | 3.5289 | 96.5279 |
| 70 | -0.3852 | 3.3488 | 3.3708 | 96.5624 |
| 71 | -0.3682 | 3.1834 | 3.2046 | 96.5983 |
| 72 | -0.3502 | 3.0102 | 3.0305 | 96.6356 |
| 73 | -0.3311 | 2.8293 | 2.8486 | 96.6743 |
| 74 | -0.3109 | 2.6409 | 2.6592 | 96.7143 |
| 75 | -0.2897 | 2.4453 | 2.4624 | 96.7556 |
| 76 | -0.2673 | 2.2426 | 2.2584 | 96.7982 |

| | | | | |
|----|---------|--------|--------|---------|
| 77 | -0.2439 | 2.0328 | 2.0474 | 96.8419 |
| 78 | -0.2194 | 1.8162 | 1.8294 | 96.8868 |
| 79 | -0.1936 | 1.5925 | 1.6043 | 96.9328 |
| 80 | -0.1667 | 1.3617 | 1.3718 | 96.9799 |
| 81 | -0.1385 | 1.1231 | 1.1316 | 97.028 |
| 82 | -0.1087 | 0.8756 | 0.8823 | 97.0771 |
| 83 | -0.0771 | 0.6167 | 0.6215 | 97.1273 |
| 84 | -0.0429 | 0.3405 | 0.3432 | 97.1793 |
| E | 0.0 | 0.0 | 0.0 | 0.0 |

Wire No. 4 :

| Pulse No. | Real (Amps) | Imaginary (Amps) | Magnitude (Amps) | Phase (Degrees) |
|-----------|-------------|------------------|------------------|-----------------|
| 85 | 0.0172 | -0.0034 | 0.0175 | -11.3339 |
| 86 | 0.0121 | -0.0024 | 0.0124 | -11.1043 |
| 87 | 0.0089 | -0.0017 | 0.009 | -10.8536 |
| 88 | 0.0062 | -0.0011 | 0.0063 | -10.504 |
| 89 | 0.0039 | -0.0007 | 0.004 | -9.9219 |
| 90 | 0.002 | -0.0003 | 0.002 | -8.5378 |
| 91 | 0.0003 | 0.0 | 0.0003 | 5.4324 |
| 92 | -0.0011 | 0.0003 | 0.0011 | 164.796 |
| 93 | -0.0022 | 0.0005 | 0.0023 | 167.2259 |
| 94 | -0.0031 | 0.0007 | 0.0032 | 168.0378 |
| 95 | -0.0038 | 0.0008 | 0.0038 | 168.5159 |
| 96 | -0.0042 | 0.0008 | 0.0043 | 168.8769 |
| 97 | -0.0045 | 0.0009 | 0.0045 | 169.1889 |
| 98 | -0.0045 | 0.0008 | 0.0046 | 169.4805 |
| 99 | -0.0044 | 0.0008 | 0.0045 | 169.7663 |
| 100 | -0.0041 | 0.0007 | 0.0042 | 170.055 |
| 101 | -0.0036 | 0.0006 | 0.0037 | 170.3521 |
| 102 | -0.003 | 0.0005 | 0.0031 | 170.6623 |
| 103 | -0.0022 | 0.0004 | 0.0023 | 170.9896 |
| 104 | -0.0013 | 0.0002 | 0.0013 | 171.3416 |
| E | 0.0 | 0.0 | 0.0 | 0.0 |

***** BASE OPERATING PARAMETERS *****

| Twr. | Ratio | Phase |
|------|-------|--------|
| 1 | 1.000 | 0.0 |
| 2 | 1.805 | -131.2 |
| 3 | 0.887 | 95.9 |
| 4 | 0.003 | -11.6 |

Derivation of Operating Parameters for Nighttime Directional Antenna

Once calibrated against the measured individual open-circuited base impedances, the moment method model was utilized for nighttime directional antenna calculations.

The theoretical parameters from the Construction Permit and the CDBS database specify tower one as the reference but tower two is clearly the high current tower. Therefore for ease of operation and in keeping with the limitations of the AM19 antenna monitor the parameters have been normalized to use tower two as the reference as follows:

| TOWER | RATIO (CDBS) | PHASE (CDBS) | RATIO (normalized) | PHASE (normalized) |
|------------|-----------------|-----------------|-----------------------|-----------------------|
| 1 (SE) | 1.00 ref | 0.0 ref | 0.510 | +131.8 |
| 2 (Center) | 1.959 | -131.8 | 1.00 ref | 0.0 ref |
| 3 (NW) | 1.00 | -263.5 | 0.510 | -131.7 |

The nighttime model source parameters were thus determined using the tower 2 normalized theoretical parameters.

Twentyeight segments were used for each of the KGAB towers and twenty segments for the unused tower so that the segment size was very nearly equal for all towers. The KGAB towers are base sampled, which is permitted for towers of 120 electrical degrees or less. As such, the first (ground) segment of each tower was used to determine the model operating parameters of the array.

These calculations were made to determine the complex voltage source values to be applied at ground level for each tower of the array to produce the current moment sums for the towers which, when normalized to the reference tower, equate to the theoretical field parameters of the authorized directional pattern. These voltage sources were then applied in the model and the tower currents were calculated.

A circuit model was constructed to determine the effect of the series feed inductance and base insulator shunt capacitance on the ATU output current. The static drain chokes are 630 microhenry and are connected inboard of the sample point so are not included in the WCAP base model. Again, this model was used with the Westberg Circuit Analysis Program (WCAP).

This effect was, as expected, minimal, and the results are tabulated in the table below along with the base operating parameters for the nighttime array.

| Twr | Node | Current Magnitude (amperes) | Current Magnitude Ratio | Current Phase (degrees) | WCAP Current Offset for Unity I_{BASE} | WCAP Phase Offset for Unity ϕ_{BASE} (degrees) | Antenna Monitor Ratio | Antenna Monitor Phase (degrees) |
|-----|------|-----------------------------------|-------------------------------|-------------------------------|---|--|-----------------------------|--|
| 1 | 1 | 5.39 | 0.554 | 132.1 | 1.074 | +0.07 | 0.577 | +131.4 |
| 2 | 21 | 9.73 | 1.00 Ref | 0.9 | 1.032 | +0.24 | 1.000 | 0.0 |
| 3 | 41 | 4.79 | 0.492 | -132.0 | 1.019 | -.96 | 0.486 | -132.2 |

 ACSModel
 (MININEC 3.1 Core)
 03-24-2011 08:08:12

KGAB4MOM
 kgab parameters setup
 towers 1-3 driven and twr 4 detuned

Frequency = 0.650 MHz Wavelength = 461.23079 Meters

No. of Wires: 4

| Wire No. 1 | Coordinates | | | Radius | End Connection | No. of |
|------------|-------------|----------|--------|--------|----------------|--------|
| X | Y | Z | | | | |
| Segments | | | | | | |
| 0 | 0 | 0 | | -1 | | |
| 0 | 0 | 88.40257 | 0.2917 | 0 | | 28 |
| Wire No. 2 | Coordinates | | | Radius | End Connection | No. of |
| X | Y | Z | | | | |
| Segments | | | | | | |
| 55.34171 | -65.95368 | 0 | | -2 | | |
| 55.34171 | -65.95368 | 92.24615 | 0.2188 | 0 | | 28 |
| Wire No. 3 | Coordinates | | | Radius | End Connection | No. of |
| X | Y | Z | | | | |
| Segments | | | | | | |
| 110.6834 | -131.9074 | 0 | | -3 | | |
| 110.6834 | -131.9074 | 92.24615 | 0.2188 | 0 | | 28 |
| Wire No. 4 | Coordinates | | | Radius | End Connection | No. of |
| X | Y | Z | | | | |
| Segments | | | | | | |
| 41.80038 | 98.47553 | 0 | | -4 | | |
| 41.80038 | 98.47553 | 67.51907 | 0.17 | 0 | | 20 |

**** ANTENNA GEOMETRY ****

| Wire No. 1 | Coordinates | | | Radius | Connection | | Pulse |
|------------|-------------|----------|--------|--------|------------|-----|-------|
| X | Y | Z | | End1 | End2 | No. | |
| 0 | 0 | 0 | 0.2917 | -1 | 1 | 1 | |
| 0 | 0 | 3.157234 | 0.2917 | 1 | 1 | 2 | |
| 0 | 0 | 6.314469 | 0.2917 | 1 | 1 | 3 | |
| 0 | 0 | 9.471704 | 0.2917 | 1 | 1 | 4 | |
| 0 | 0 | 12.62894 | 0.2917 | 1 | 1 | 5 | |
| 0 | 0 | 15.78617 | 0.2917 | 1 | 1 | 6 | |
| 0 | 0 | 18.94341 | 0.2917 | 1 | 1 | 7 | |
| 0 | 0 | 22.10064 | 0.2917 | 1 | 1 | 8 | |
| 0 | 0 | 25.25788 | 0.2917 | 1 | 1 | 9 | |
| 0 | 0 | 28.41511 | 0.2917 | 1 | 1 | 10 | |
| 0 | 0 | 31.57234 | 0.2917 | 1 | 1 | 11 | |
| 0 | 0 | 34.72958 | 0.2917 | 1 | 1 | 12 | |
| 0 | 0 | 37.88681 | 0.2917 | 1 | 1 | 13 | |
| 0 | 0 | 41.04405 | 0.2917 | 1 | 1 | 14 | |
| 0 | 0 | 44.20128 | 0.2917 | 1 | 1 | 15 | |
| 0 | 0 | 47.35852 | 0.2917 | 1 | 1 | 16 | |

| | | | | | | |
|---|---|----------|--------|---|---|----|
| 0 | 0 | 50.51575 | 0.2917 | 1 | 1 | 17 |
| 0 | 0 | 53.67299 | 0.2917 | 1 | 1 | 18 |
| 0 | 0 | 56.83022 | 0.2917 | 1 | 1 | 19 |
| 0 | 0 | 59.98745 | 0.2917 | 1 | 1 | 20 |
| 0 | 0 | 63.14469 | 0.2917 | 1 | 1 | 21 |
| 0 | 0 | 66.30193 | 0.2917 | 1 | 1 | 22 |
| 0 | 0 | 69.45916 | 0.2917 | 1 | 1 | 23 |
| 0 | 0 | 72.61639 | 0.2917 | 1 | 1 | 24 |
| 0 | 0 | 75.77363 | 0.2917 | 1 | 1 | 25 |
| 0 | 0 | 78.93086 | 0.2917 | 1 | 1 | 26 |
| 0 | 0 | 82.0881 | 0.2917 | 1 | 1 | 27 |
| 0 | 0 | 85.24532 | 0.2917 | 1 | 0 | 28 |

| Wire No. | 2 | Coordinates | | | Connection | | Pulse |
|----------|---|-------------|----------|--------|------------|------|-------|
| X | | Y | Z | Radius | End1 | End2 | No. |
| 55.34171 | | -65.95368 | 0 | 0.2188 | -2 | 2 | 29 |
| 55.34171 | | -65.95368 | 3.294506 | 0.2188 | 2 | 2 | 30 |
| 55.34171 | | -65.95368 | 6.589011 | 0.2188 | 2 | 2 | 31 |
| 55.34171 | | -65.95368 | 9.883516 | 0.2188 | 2 | 2 | 32 |
| 55.34171 | | -65.95368 | 13.17802 | 0.2188 | 2 | 2 | 33 |
| 55.34171 | | -65.95368 | 16.47253 | 0.2188 | 2 | 2 | 34 |
| 55.34171 | | -65.95368 | 19.76703 | 0.2188 | 2 | 2 | 35 |
| 55.34171 | | -65.95368 | 23.06154 | 0.2188 | 2 | 2 | 36 |
| 55.34171 | | -65.95368 | 26.35604 | 0.2188 | 2 | 2 | 37 |
| 55.34171 | | -65.95368 | 29.65055 | 0.2188 | 2 | 2 | 38 |
| 55.34171 | | -65.95368 | 32.94506 | 0.2188 | 2 | 2 | 39 |
| 55.34171 | | -65.95368 | 36.23956 | 0.2188 | 2 | 2 | 40 |
| 55.34171 | | -65.95368 | 39.53407 | 0.2188 | 2 | 2 | 41 |
| 55.34171 | | -65.95368 | 42.82857 | 0.2188 | 2 | 2 | 42 |
| 55.34171 | | -65.95368 | 46.12308 | 0.2188 | 2 | 2 | 43 |
| 55.34171 | | -65.95368 | 49.41758 | 0.2188 | 2 | 2 | 44 |
| 55.34171 | | -65.95368 | 52.71209 | 0.2188 | 2 | 2 | 45 |
| 55.34171 | | -65.95368 | 56.00659 | 0.2188 | 2 | 2 | 46 |
| 55.34171 | | -65.95368 | 59.3011 | 0.2188 | 2 | 2 | 47 |
| 55.34171 | | -65.95368 | 62.59561 | 0.2188 | 2 | 2 | 48 |
| 55.34171 | | -65.95368 | 65.89011 | 0.2188 | 2 | 2 | 49 |
| 55.34171 | | -65.95368 | 69.18462 | 0.2188 | 2 | 2 | 50 |
| 55.34171 | | -65.95368 | 72.47912 | 0.2188 | 2 | 2 | 51 |
| 55.34171 | | -65.95368 | 75.77363 | 0.2188 | 2 | 2 | 52 |
| 55.34171 | | -65.95368 | 79.06813 | 0.2188 | 2 | 2 | 53 |
| 55.34171 | | -65.95368 | 82.36263 | 0.2188 | 2 | 2 | 54 |
| 55.34171 | | -65.95368 | 85.65714 | 0.2188 | 2 | 2 | 55 |
| 55.34171 | | -65.95368 | 88.95165 | 0.2188 | 2 | 0 | 56 |

| Wire No. | 3 | Coordinates | | | Connection | | Pulse |
|----------|---|-------------|----------|--------|------------|------|-------|
| X | | Y | Z | Radius | End1 | End2 | No. |
| 110.6834 | | -131.9074 | 0 | 0.2188 | -3 | 3 | 57 |
| 110.6834 | | -131.9074 | 3.294506 | 0.2188 | 3 | 3 | 58 |
| 110.6834 | | -131.9074 | 6.589011 | 0.2188 | 3 | 3 | 59 |
| 110.6834 | | -131.9074 | 9.883516 | 0.2188 | 3 | 3 | 60 |
| 110.6834 | | -131.9074 | 13.17802 | 0.2188 | 3 | 3 | 61 |
| 110.6834 | | -131.9074 | 16.47253 | 0.2188 | 3 | 3 | 62 |
| 110.6834 | | -131.9074 | 19.76703 | 0.2188 | 3 | 3 | 63 |
| 110.6834 | | -131.9074 | 23.06154 | 0.2188 | 3 | 3 | 64 |
| 110.6834 | | -131.9074 | 26.35604 | 0.2188 | 3 | 3 | 65 |
| 110.6834 | | -131.9074 | 29.65055 | 0.2188 | 3 | 3 | 66 |
| 110.6834 | | -131.9074 | 32.94506 | 0.2188 | 3 | 3 | 67 |
| 110.6834 | | -131.9074 | 36.23956 | 0.2188 | 3 | 3 | 68 |

| | | | | | | |
|----------|-----------|----------|--------|---|---|----|
| 110.6834 | -131.9074 | 39.53407 | 0.2188 | 3 | 3 | 69 |
| 110.6834 | -131.9074 | 42.82857 | 0.2188 | 3 | 3 | 70 |
| 110.6834 | -131.9074 | 46.12308 | 0.2188 | 3 | 3 | 71 |
| 110.6834 | -131.9074 | 49.41758 | 0.2188 | 3 | 3 | 72 |
| 110.6834 | -131.9074 | 52.71209 | 0.2188 | 3 | 3 | 73 |
| 110.6834 | -131.9074 | 56.00659 | 0.2188 | 3 | 3 | 74 |
| 110.6834 | -131.9074 | 59.3011 | 0.2188 | 3 | 3 | 75 |
| 110.6834 | -131.9074 | 62.59561 | 0.2188 | 3 | 3 | 76 |
| 110.6834 | -131.9074 | 65.89011 | 0.2188 | 3 | 3 | 77 |
| 110.6834 | -131.9074 | 69.18462 | 0.2188 | 3 | 3 | 78 |
| 110.6834 | -131.9074 | 72.47912 | 0.2188 | 3 | 3 | 79 |
| 110.6834 | -131.9074 | 75.77363 | 0.2188 | 3 | 3 | 80 |
| 110.6834 | -131.9074 | 79.06813 | 0.2188 | 3 | 3 | 81 |
| 110.6834 | -131.9074 | 82.36263 | 0.2188 | 3 | 3 | 82 |
| 110.6834 | -131.9074 | 85.65714 | 0.2188 | 3 | 3 | 83 |
| 110.6834 | -131.9074 | 88.95165 | 0.2188 | 3 | 0 | 84 |

| Wire No. | 4 | Coordinates | | | Connection | | Pulse |
|----------|----------|-------------|--------|------|------------|-----|-------|
| X | Y | Z | Radius | End1 | End2 | No. | |
| 41.80038 | 98.47553 | 0 | 0.17 | -4 | 4 | 85 | |
| 41.80038 | 98.47553 | 3.375953 | 0.17 | 4 | 4 | 86 | |
| 41.80038 | 98.47553 | 6.751906 | 0.17 | 4 | 4 | 87 | |
| 41.80038 | 98.47553 | 10.12786 | 0.17 | 4 | 4 | 88 | |
| 41.80038 | 98.47553 | 13.50381 | 0.17 | 4 | 4 | 89 | |
| 41.80038 | 98.47553 | 16.87977 | 0.17 | 4 | 4 | 90 | |
| 41.80038 | 98.47553 | 20.25572 | 0.17 | 4 | 4 | 91 | |
| 41.80038 | 98.47553 | 23.63167 | 0.17 | 4 | 4 | 92 | |
| 41.80038 | 98.47553 | 27.00763 | 0.17 | 4 | 4 | 93 | |
| 41.80038 | 98.47553 | 30.38358 | 0.17 | 4 | 4 | 94 | |
| 41.80038 | 98.47553 | 33.75953 | 0.17 | 4 | 4 | 95 | |
| 41.80038 | 98.47553 | 37.13549 | 0.17 | 4 | 4 | 96 | |
| 41.80038 | 98.47553 | 40.51144 | 0.17 | 4 | 4 | 97 | |
| 41.80038 | 98.47553 | 43.88739 | 0.17 | 4 | 4 | 98 | |
| 41.80038 | 98.47553 | 47.26334 | 0.17 | 4 | 4 | 99 | |
| 41.80038 | 98.47553 | 50.6393 | 0.17 | 4 | 4 | 100 | |
| 41.80038 | 98.47553 | 54.01525 | 0.17 | 4 | 4 | 101 | |
| 41.80038 | 98.47553 | 57.3912 | 0.17 | 4 | 4 | 102 | |
| 41.80038 | 98.47553 | 60.76716 | 0.17 | 4 | 4 | 103 | |
| 41.80038 | 98.47553 | 64.14311 | 0.17 | 4 | 0 | 104 | |

Sources: 3

Pulse No., Voltage Magnitude, Phase (Degrees): 1, 553.5, 43.1

Pulse No., Voltage Magnitude, Phase (Degrees): 29, 778.4, -81.5

Pulse No., Voltage Magnitude, Phase (Degrees): 57, 259.0, 135.9

Number of Loads: 1

Pulse No., Resistance, Reactance: 85 , 0 , 1083

***** SOURCE DATA *****

Pulse 1 Voltage = (404.268, 378.1178j)
 Current = (-3.6169, 4.0021j)
 Impedance = (1.754, -102.6j)
 Power = 25.52 Watts

Pulse 29 Voltage = (114.6063, -769.9564j)
 Current = (9.7335, 0.1567j)
 Impedance = (10.498, -79.273j)
 Power = 497.43 Watts

Pulse 57 Voltage = (-185.8684, 180.3343j)
 Current = (-3.2025, -3.5554j)
 Impedance = (-2.005, -54.084j)
 Power = -22.957537 Watts

Total Power = 500.000 Watts

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

Wire No. 1 :

| Pulse No. | Real (Amps) | Imaginary (Amps) | Magnitude (Amps) | Phase (Degrees) |
|-----------|-------------|------------------|------------------|-----------------|
| 1 | -3.6169 | 4.0021 | 5.3943 | 132.1061 |
| 2 | -3.4879 | 3.864 | 5.2054 | 132.0711 |
| 3 | -3.3996 | 3.7694 | 5.076 | 132.047 |
| 4 | -3.3142 | 3.6777 | 4.9507 | 132.0236 |
| 5 | -3.228 | 3.5851 | 4.8242 | 132.0001 |
| 6 | -3.1393 | 3.4895 | 4.6938 | 131.9758 |
| 7 | -3.0472 | 3.3902 | 4.5584 | 131.9505 |
| 8 | -2.9514 | 3.2866 | 4.4173 | 131.924 |
| 9 | -2.8515 | 3.1785 | 4.2701 | 131.8961 |
| 10 | -2.7475 | 3.0658 | 4.1168 | 131.8667 |
| 11 | -2.6394 | 2.9484 | 3.9572 | 131.8358 |
| 12 | -2.5272 | 2.8263 | 3.7914 | 131.8032 |
| 13 | -2.411 | 2.6995 | 3.6194 | 131.769 |
| 14 | -2.2908 | 2.5682 | 3.4414 | 131.7332 |
| 15 | -2.1668 | 2.4323 | 3.2575 | 131.6957 |
| 16 | -2.039 | 2.2921 | 3.0678 | 131.6564 |
| 17 | -1.9077 | 2.1475 | 2.8724 | 131.6155 |
| 18 | -1.7728 | 1.9987 | 2.6716 | 131.5729 |
| 19 | -1.6346 | 1.8457 | 2.4655 | 131.5286 |
| 20 | -1.4931 | 1.6887 | 2.2541 | 131.4826 |
| 21 | -1.3484 | 1.5276 | 2.0376 | 131.435 |
| 22 | -1.2006 | 1.3625 | 1.816 | 131.3857 |
| 23 | -1.0495 | 1.1932 | 1.589 | 131.3349 |
| 24 | -0.895 | 1.0194 | 1.3565 | 131.2824 |
| 25 | -0.7367 | 0.8407 | 1.1178 | 131.2284 |
| 26 | -0.5739 | 0.6562 | 0.8717 | 131.1728 |
| 27 | -0.4047 | 0.4637 | 0.6154 | 131.1153 |
| 28 | -0.2255 | 0.2589 | 0.3433 | 131.0549 |
| E | 0.0 | 0.0 | 0.0 | 0.0 |

Wire No. 2 :

| Pulse No. | Real (Amps) | Imaginary (Amps) | Magnitude (Amps) | Phase (Degrees) |
|-----------|-------------|------------------|------------------|-----------------|
| 29 | 9.7335 | 0.1567 | 9.7347 | 0.9223 |
| 30 | 9.4929 | 0.1226 | 9.4937 | 0.7402 |
| 31 | 9.3098 | 0.1007 | 9.3104 | 0.6194 |
| 32 | 9.1244 | 0.0818 | 9.1248 | 0.5137 |
| 33 | 8.9297 | 0.0651 | 8.9299 | 0.4175 |
| 34 | 8.7225 | 0.0499 | 8.7226 | 0.328 |
| 35 | 8.5015 | 0.0362 | 8.5016 | 0.2438 |
| 36 | 8.2661 | 0.0237 | 8.2661 | 0.164 |
| 37 | 8.0159 | 0.0123 | 8.0159 | 0.0879 |
| 38 | 7.7508 | 0.002 | 7.7508 | 0.0151 |
| 39 | 7.4709 | -0.0072 | 7.4709 | -0.0549 |
| 40 | 7.1763 | -0.0153 | 7.1763 | -0.1224 |

| | | | | |
|----|--------|---------|--------|---------|
| 41 | 6.8674 | -0.0225 | 6.8674 | -0.1875 |
| 42 | 6.5444 | -0.0286 | 6.5445 | -0.2506 |
| 43 | 6.2077 | -0.0338 | 6.2078 | -0.3118 |
| 44 | 5.8576 | -0.038 | 5.8577 | -0.3713 |
| 45 | 5.4945 | -0.0412 | 5.4946 | -0.4293 |
| 46 | 5.1187 | -0.0434 | 5.1189 | -0.4859 |
| 47 | 4.7307 | -0.0447 | 4.7309 | -0.5412 |
| 48 | 4.3306 | -0.045 | 4.3308 | -0.5954 |
| 49 | 3.9187 | -0.0444 | 3.919 | -0.6485 |
| 50 | 3.4951 | -0.0427 | 3.4954 | -0.7007 |
| 51 | 3.0597 | -0.0402 | 3.06 | -0.7521 |
| 52 | 2.612 | -0.0366 | 2.6122 | -0.8028 |
| 53 | 2.1509 | -0.032 | 2.1512 | -0.8528 |
| 54 | 1.6743 | -0.0264 | 1.6745 | -0.9024 |
| 55 | 1.1775 | -0.0196 | 1.1776 | -0.9518 |
| 56 | 0.6492 | -0.0114 | 0.6493 | -1.0018 |
| E | 0.0 | 0.0 | 0.0 | 0.0 |

Wire No. 3 :

| Pulse No. | Real (Amps) | Imaginary (Amps) | Magnitude (Amps) | Phase (Degrees) |
|-----------|-------------|------------------|------------------|-----------------|
| 57 | -3.2025 | -3.5554 | 4.7851 | -132.0108 |
| 58 | -3.1448 | -3.4957 | 4.7021 | -131.9754 |
| 59 | -3.098 | -3.4467 | 4.6344 | -131.95 |
| 60 | -3.048 | -3.3939 | 4.5617 | -131.9258 |
| 61 | -2.9931 | -3.3357 | 4.4817 | -131.9016 |
| 62 | -2.9328 | -3.2713 | 4.3934 | -131.8768 |
| 63 | -2.8666 | -3.2004 | 4.2965 | -131.8512 |
| 64 | -2.7946 | -3.1228 | 4.1907 | -131.8246 |
| 65 | -2.7166 | -3.0386 | 4.0759 | -131.7967 |
| 66 | -2.6326 | -2.9478 | 3.9522 | -131.7677 |
| 67 | -2.5429 | -2.8503 | 3.8198 | -131.7373 |
| 68 | -2.4474 | -2.7463 | 3.6786 | -131.7055 |
| 69 | -2.3463 | -2.6359 | 3.5289 | -131.6724 |
| 70 | -2.2397 | -2.5192 | 3.3708 | -131.6378 |
| 71 | -2.1277 | -2.3964 | 3.2046 | -131.6019 |
| 72 | -2.0106 | -2.2674 | 3.0305 | -131.5646 |
| 73 | -1.8885 | -2.1326 | 2.8486 | -131.5259 |
| 74 | -1.7615 | -1.992 | 2.6592 | -131.4859 |
| 75 | -1.6299 | -1.8458 | 2.4624 | -131.4446 |
| 76 | -1.4936 | -1.694 | 2.2584 | -131.4021 |
| 77 | -1.3529 | -1.5368 | 2.0474 | -131.3583 |
| 78 | -1.2077 | -1.3741 | 1.8294 | -131.3134 |
| 79 | -1.0581 | -1.2058 | 1.6043 | -131.2674 |
| 80 | -0.904 | -1.0319 | 1.3718 | -131.2203 |
| 81 | -0.7449 | -0.8518 | 1.1316 | -131.1722 |
| 82 | -0.5803 | -0.6646 | 0.8823 | -131.1231 |
| 83 | -0.4083 | -0.4685 | 0.6215 | -131.073 |
| 84 | -0.2252 | -0.2589 | 0.3432 | -131.021 |
| E | 0.0 | 0.0 | 0.0 | 0.0 |

Wire No. 4 :

| Pulse No. | Real (Amps) | Imaginary (Amps) | Magnitude (Amps) | Phase (Degrees) |
|-----------|-------------|------------------|------------------|-----------------|
| 85 | -0.0087 | 0.0152 | 0.0175 | 119.7373 |
| 86 | -0.0061 | 0.0108 | 0.0124 | 119.7275 |
| 87 | -0.0045 | 0.0079 | 0.0091 | 119.6845 |
| 88 | -0.0031 | 0.0055 | 0.0063 | 119.5689 |

| | | | | |
|-----|---------|---------|--------|----------|
| 89 | -0.0019 | 0.0035 | 0.004 | 119.2705 |
| 90 | -0.0009 | 0.0018 | 0.002 | 118.3114 |
| 91 | -0.0001 | 0.0003 | 0.0003 | 106.915 |
| 92 | 0.0006 | -0.0009 | 0.0011 | -55.5319 |
| 93 | 0.0012 | -0.0019 | 0.0023 | -57.353 |
| 94 | 0.0017 | -0.0027 | 0.0032 | -57.7596 |
| 95 | 0.002 | -0.0032 | 0.0038 | -57.858 |
| 96 | 0.0023 | -0.0036 | 0.0043 | -57.8323 |
| 97 | 0.0024 | -0.0038 | 0.0045 | -57.7389 |
| 98 | 0.0025 | -0.0039 | 0.0046 | -57.6006 |
| 99 | 0.0024 | -0.0038 | 0.0045 | -57.4279 |
| 100 | 0.0023 | -0.0035 | 0.0042 | -57.2258 |
| 101 | 0.002 | -0.0031 | 0.0037 | -56.9967 |
| 102 | 0.0017 | -0.0026 | 0.0031 | -56.7413 |
| 103 | 0.0013 | -0.0019 | 0.0023 | -56.4588 |
| 104 | 0.0007 | -0.0011 | 0.0013 | -56.1444 |
| E | 0.0 | 0.0 | 0.0 | 0.0 |

***** BASE OPERATING PARAMETERS *****

| Twr. | Ratio | Phase |
|------|-------|--------|
| 1 | 0.554 | 131.2 |
| 2 | 1.000 | 0.0 |
| 3 | 0.492 | -132.9 |
| 4 | 0.002 | 118.8 |

Current Moments (amp-meters) Peak

Frequency: 650 kHz
Input Power: 500 Watts

| Wire | Real | Imag | Magnitude | Phase |
|------|-----------|-----------|-----------|---------|
| 1 | -180.8840 | 202.3063 | 271.3796 | 131.80 |
| 2 | 532.1173 | -0.0005 | 532.1173 | 0.00 |
| 3 | -180.5313 | -202.6223 | 271.3805 | -131.70 |
| 4 | 0.0067 | 0.0044 | 0.0080 | 33.58 |

Medium wave array vertical current moment (amps-meters) peak
(Calculation assumes tower wires are grouped together.
The first wire of each group must contain the source.)

| Tower | Real | Imag | Magnitude | Phase |
|-------|-----------|-----------|-----------|---------|
| 1 | -180.8840 | 202.3063 | 271.3796 | 131.80 |
| 2 | 532.1173 | -0.0005 | 532.1173 | 0.00 |
| 3 | -180.5313 | -202.6223 | 271.3805 | -131.70 |
| 4 | 0.0067 | 0.0044 | 0.0080 | 33.58 |

| Tower | Real | Imag | Magnitude | Phase |
|-------|---------|---------|-----------|---------|
| 1 | 0.5100 | 0.0000 | 0.5100 | 0.00 |
| 2 | -0.6665 | -0.7455 | 1.0000 | -131.80 |
| 3 | -0.0577 | 0.5067 | 0.5100 | 96.50 |
| 4 | -0.0002 | 0.0000 | 0.0002 | 171.83 |

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = kgab-1n.cir

| | | | | | | |
|----|--------|---|---|-----------|-------|-------|
| I | 5.3940 | 0 | 1 | 132.1060 | .0000 | .0000 |
| R | 1.0000 | 1 | 2 | .0000 | .0000 | .0000 |
| L | 7.0000 | 2 | 3 | .0000 | .0000 | .0000 |
| C | .0001 | 3 | 0 | .0000 | .0000 | .0000 |
| C | .0001 | 3 | 0 | .0000 | .0000 | .0000 |
| R | 1.7540 | 3 | 0 | -102.6000 | .0000 | .0000 |
| EX | .0000 | 0 | 0 | .0000 | .0000 | .0000 |

FREQ = .650

| NODE | | VOLT MAG | VOLT PHASE | | | | | | | | |
|------|------|----------------|------------|----------|-------|----------------|-----------|---------------------|-----------|-------------------|-----------|
| 1 | | 360.6691 | 44.2630 | | | | | | | | |
| 2 | | 360.5064 | 43.4063 | | | | | | | | |
| 3 | | 514.6849 | 43.0167 | | | | | | | | |
| | | BRANCH VOLTAGE | | | | BRANCH CURRENT | | FROM NODE IMPEDANCE | | TO NODE IMPEDANCE | |
| | | MAG | PHASE | MAG | PHASE | RESISTANCE | REACTANCE | RESISTANCE | REACTANCE | RESISTANCE | REACTANCE |
| R | 1- 2 | 1.000 | 5.39 | 132.106 | 5.39 | 132.106 | 2.52 | -66.82 | 1.52 | -66.82 | |
| L | 2- 3 | 7.000 | 154.21 | -137.894 | 5.39 | 132.106 | 1.52 | -66.82 | 1.52 | -95.41 | |
| C | 3- 0 | .000 | 514.68 | 43.017 | .17 | 133.017 | .00 | -3060.67 | .00 | .00 | |
| C | 3- 0 | .000 | 514.68 | 43.017 | .21 | 133.017 | .00 | -2448.54 | .00 | .00 | |
| R | 3- 0 | 1.754 | 514.68 | 43.017 | 5.02 | 132.037 | 1.75 | -102.60 | .00 | .00 | |

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = kgab-2n.cir

| | | | | | | |
|----|---------|---|---|----------|-------|-------|
| I | 9.7347 | 0 | 1 | .9223 | .0000 | .0000 |
| R | 1.0000 | 1 | 2 | .0000 | .0000 | .0000 |
| L | 1.3500 | 2 | 3 | .0000 | .0000 | .0000 |
| C | .0001 | 3 | 0 | .0000 | .0000 | .0000 |
| R | 10.4980 | 3 | 0 | -79.2730 | .0000 | .0000 |
| EX | .0000 | 0 | 0 | .0000 | .0000 | .0000 |

FREQ = .650

| NODE | | VOLT MAG | VOLT PHASE | | | | | | | | |
|------|------|----------------|------------|---------|-------|----------------|-----------|---------------------|-----------|-------------------|-----------|
| 1 | | 702.2126 | -80.4271 | | | | | | | | |
| 2 | | 700.8145 | -81.2139 | | | | | | | | |
| 3 | | 754.0178 | -81.7719 | | | | | | | | |
| | | BRANCH VOLTAGE | | | | BRANCH CURRENT | | FROM NODE IMPEDANCE | | TO NODE IMPEDANCE | |
| | | MAG | PHASE | MAG | PHASE | RESISTANCE | REACTANCE | RESISTANCE | REACTANCE | RESISTANCE | REACTANCE |
| R | 1- 2 | 1.000 | 9.73 | .923 | 9.73 | .923 | 10.85 | -71.31 | 9.85 | -71.31 | |
| L | 2- 3 | 1.350 | 53.67 | 90.922 | 9.73 | .922 | 9.85 | -71.31 | 9.85 | -76.83 | |
| C | 3- 0 | .000 | 754.02 | -81.772 | .31 | 8.228 | .00 | -2448.54 | .00 | .00 | |
| R | 3- 0 | 10.498 | 754.02 | -81.772 | 9.43 | .684 | 10.50 | -79.27 | .00 | .00 | |

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = kgab-3n.cir

| | | | | | | |
|----|---------|---|---|-----------|-------|-------|
| I | 4.7850 | 0 | 1 | -132.0100 | .0000 | .0000 |
| R | 1.0000 | 1 | 2 | .0000 | .0000 | .0000 |
| L | 1.4600 | 2 | 3 | .0000 | .0000 | .0000 |
| C | .0001 | 3 | 0 | .0000 | .0000 | .0000 |
| R | -2.0050 | 3 | 0 | -54.0840 | .0000 | .0000 |
| EX | .0000 | 0 | 0 | .0000 | .0000 | .0000 |

FREQ = .650

| NODE | | VOLT MAG | VOLT PHASE | | | | | | | | |
|------|------|----------------|------------|----------|-------|----------------|-----------|---------------------|-----------|-------------------|-----------|
| 1 | | 225.8171 | 136.8536 | | | | | | | | |
| 2 | | 225.9627 | 135.6404 | | | | | | | | |
| 3 | | 254.4731 | 135.9038 | | | | | | | | |
| | | BRANCH VOLTAGE | | | | BRANCH CURRENT | | FROM NODE IMPEDANCE | | TO NODE IMPEDANCE | |
| | | MAG | PHASE | MAG | PHASE | RESISTANCE | REACTANCE | RESISTANCE | REACTANCE | RESISTANCE | REACTANCE |
| R | 1- 2 | 1.000 | 4.78 | -132.010 | 4.78 | -132.010 | -.94 | -47.18 | -1.94 | -47.18 | |
| L | 2- 3 | 1.460 | 28.53 | -42.010 | 4.79 | -132.010 | -1.94 | -47.18 | -1.94 | -53.15 | |
| C | 3- 0 | .000 | 254.47 | 135.904 | .08 | -134.096 | .00 | -3060.67 | .00 | .00 | |
| R | 3- 0 | -2.005 | 254.47 | 135.904 | 4.70 | -131.973 | -2.00 | -54.08 | .00 | .00 | |

Sampling System

The sampling system consists of three identical Delta Electronics current transformers installed at the output of each antenna tuning unit, immediately adjacent to the final J-plug. Samples from the current transformers are fed to the antenna monitor via equal lengths of 3/8-inch foam-dielectric coaxial transmission lines. The antenna monitor is a Potomac Instruments AM19 Type 204. The monitor calibration was verified using the internal calibrator according to the operating manual.

Impedance measurements were made of the antenna sampling system using an AIM 4170 network analyzer. The measurements were made looking into the antenna monitor ends of the sample lines with the tower ends of the sample lines open-circuited.

The table below shows the frequencies above and below the carrier frequency where resonance, defined as zero reactance corresponding with low resistance, was found. As the length of distortionless transmission line is 180 electrical degrees at the difference frequency between adjacent frequencies of resonance, and frequencies of resonance occur at odd multiples of 90 degrees electrical length, the sample line length at the resonant frequency above carrier frequency, which is the closest one to the carrier frequency, was found to be 270 electrical degrees. The electrical length at carrier frequency appearing in the table below was calculated by ratioing the frequencies.

| Twr. | Sample Line Open-Circuited 90 degree Resonance Below 650 kHz (kHz) | Sample Line Open-Circuited 270 degree Resonance Above 650 kHz (kHz) | Sample Line Calculated Electrical Length At 650 kHz (deg.) |
|------|---|--|--|
| 1 | 286.2 | 867.2 | 202.4 |
| 2 | 285.6 | 865.9 | 202.7 |
| 3 | 286.2 | 866.1 | 202.6 |

Because the electrical lengths were found to have a maximum variation between lines of 0.3 electrical degrees, the sample lines meet the requirement in the Rules that they be equal in length within 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 $R_1 + j X_1$ and $R_2 + j X_2$ are the measured impedances at the +45 and -45 degree offset frequencies, respectively:

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

| Twr. | + 45 Deg. Offset Frequency (kHz) | +45 Deg. Measured Impedance (ohms) | - 45 Deg. Offset Frequency (kHz) | -45 Deg. Measured Impedance (ohms) | Calculated Characteristic Impedance (ohms) |
|------|----------------------------------|------------------------------------|----------------------------------|------------------------------------|--|
| 1 | 1010 | 6.8 +j51.2 | 722 | 5.7 -j50.5 | 51.2 |
| 2 | 1010 | 7.1 +j51.8 | 722 | 5.7 -j49.8 | 51.2 |
| 3 | 1010 | 7.0 +j52.5 | 722 | 5.4 -j48.8 | 51.0 |

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

The calibration of the Delta current transformers was verified by removing them all from the ATUs and installing them on a test jig so that each was located very close to the adjacent transformer (spacing of less than two inches). Short transmission lines of equal length were connected between the outputs of the current transformers and the inputs of the antenna monitor. The Potomac AM19 antenna monitor was calibrated using the internal calibration function. A single source of RF current on the carrier frequency was fed through a conductor passing through all of the current transformers, and the differential phases and ratios were noted on the antenna monitor as follows:

| Twr | Serial No. | Ratio | Phase (deg.) |
|-----|------------|-------|--------------|
| 1 | 2002 | 1.010 | 0.0 |
| 2 | 1526 | Ref. | Ref. |
| 3 | 1636 | 1.000 | +0.5 |

The requirement that the sample current transformers are accurate to within the manufacturer's specification ($\pm 2\%$ ratio and ± 2 degrees phase) has thus been demonstrated.

The impedance of each of the sample lines was measured at the operating frequency with the sample current transformers attached. These impedances are tabulated below:

| Twr. | R (ohms) | X (ohms) |
|------|----------|----------|
| 1 | 52.7 | +j1.9 |
| 2 | 52.8 | +j1.9 |
| 3 | 52.6 | +j1.4 |

Direct Measurement of Power

Common point impedance measurements were made using a Delta OIB-1 bridge installed in the j-plug adjacent to the common point ammeter on the common point bus of the phasing and coupling system. The resistance value was adjusted to 50 ohms and the reactance value was adjusted to zero.