Federal Communications Commission
Washington, D. C. 20554

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

FOR FCC USE ONLY

ABR

FCC 302-AM
APPLICATION FOR AM BROADCAST STATION LICENSE

(Please read instructions before filling out form.

FOR COMMISSION USE ONLY
FILE NO. BAMF20140808ABR

SECTION I - APPLICANT FEE INFORMATION

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

CAPSTAR TX LLC

MAILING ADDRESS (Line 1) (Maximum 35 characters)
2625 S MEMORIAL DRIVE

MAILING ADDRESS (Line 2) (Maximum 35 characters)
SUITE A

CITY	STATE OR COUNTRY (if foreign address)	ZIP CODE
TULSA	OK	74129

TELEPHONE NUMBER (include area code)	CALL LETTERS	OTHER FCC IDENTIFIER (If applicable)
918-664-4581	WWNC	2946

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

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

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

C. If Yes, provide the following information:

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

(A) FEE TYPE CODE	(B) FEE MULTIPLE	(C) FEE DUE FOR FEE TYPE CODE IN COLUMN (A)	FOR FCC USE ONLY
MMR	0001	$ 690.00	

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
MOR	0001	$ 790.00	

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	FOR FCC USE ONLY
	$ 1,480.00	

SECTION II - APPLICANT INFORMATION		
1. NAME OF APPLICANT CAPSTAR TX LLC		
MAILING ADDRESS 2625 S MEMORIAL DRIVE, SUITE A		
CITY TULSA	STATE OK	ZIP CODE 74129

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
WWNC	ASHEVILLE, NC			

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

☐ Yes ☐ No

If No, explain in an Exhibit.

Exhibit No.

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

☐ Yes ☐ No

If No, state exceptions in an Exhibit.

Exhibit No.

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

☐ Yes ☐ No

If Yes, explain in an Exhibit.

Exhibit No.

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

☐ Yes ☐ No

☐ Does not apply

If No, explain in an Exhibit.

Exhibit No.

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

☐ Yes ☑ No

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

Exhibit No.

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	
Stephen G. Davis		
Title	Date	Telephone Number
SENIOR VP, FACILITIES/CAPITAL MGMT	8/8/2014	918-664-4581

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
Capstar TX 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
WWNC		570	Unlimited	5.0	5.0

2. Station location	
State	City or Town
NC	Asheville

3. Transmitter location			
State	County	City or Town	Street address (or other identification)
NC	Buncombe	Asheville	13 Summerlin Road

4. Main studio location			
State	County	City or Town	Street address (or other identification)
NC	Buncombe	Asheville	13 Summerlin Road

5. Remote control point location (specify only if authorized directional antenna)			
State	County	City or Town	Street address (or other identification)
NC	Buncombe	Asheville	13 Summerlin Road

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. Engineering

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	16.22
Measured antenna or common point resistance (in ohms) at operating frequency	**Measured antenna or common point reactance (in ohms) at operating frequency**
Night: 50 Day: 19.0	Night: +j 4.0 Day: -j 59

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 ASR 1007873	-84.6	N/A	0.580	N/A		
2 ASR 1007874	0	N/A	1.000	N/A		
3 ASR 1007875	-29.8	N/A	0.698	N/A		
4 ASR 1007876	-111.2	N/A	0.366	N/A		

Manufacturer and type of antenna monitor: Potomac Instruments 1901

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.
Uniform cross-section, guyed towers	All-97.5	1-99.2 2-99.4 3-99.4 4-99.4	All-100.3	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 35 ° 35 ' 49 "	West Longitude 82 ° 36 ' 24 "

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. Engineering

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? N/A

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

Tower 4 replaced - side mounted FM antenna, transmission line and isocoupler added to Tower 4.

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)
Randall L. Mullinax	
Address (include ZIP Code)	Date
2859 Cascade Dr.	8/7/2014
Gainesville, GA 30504	Telephone No. (Include Area Code)
e-mail randymullinax@clearchannel.com	770-534-1065

☑ Technical Director ☐ Registered Professional Engineer

☐ Chief Operator ☐ Technical Consultant

☐ Other (specify)

ENGINEERING EXHIBIT
APPLICATION FOR STATION LICENSE
CAPSTAR TX LLC
RADIO STATION WWNC
ASHEVILLE, NORTH CAROLINA

August 7, 2014

570 KHz 5.0 KW-U DA-N

Table of Contents

Engineering Statement

This application is being filed to relicense the existing operations of WWNC(AM), Asheville, NC following replacement of Tower 4 and the subsequent installation of an FM antenna on said tower. The applicant requests licensing of the nighttime directional operation of WWNC pursuant to sections of 47 CFR 73.151 which allow performance verification by computer modeling and sampling system verification. The only change to the WWNC radiators was the replacement of Tower 4 with a new tower of the same height and configuration and the installation of an FM transmitter antenna and associated isocoupler on Tower 4. All antenna system measurements included in this application were made by the undersigned from May 18-20, 2014 unless otherwise noted. The Reference Point field measurements were made by the undersigned on July 30-31, 2014.

Analysis of this antenna system was performed using a combination of a method of moments model and a circuit model. The method of moments model was produced using the computer program Expert MININEC Broadcast Professional version 14.5 by EM Scientific Inc. The circuit model was produced using the nodal analysis program WCAP Pro version 1.1 by Westberg Consulting. The method of moments models and the circuit models for each radiator were adjusted to produce the same matrix impedances as those measured by varying the electrical height of the radiators and by adding shunt capacitive loads and series inductance using the circuit model.

Once the models were adjusted to match the measured matrix impedances, the array synthesis module of the program was used to calculate the proper base drive voltages to generate the fields necessary to form the required pattern for nighttime operation. The current distribution was calculated for each radiator and given that the sampling system utilizes base current sampling devices the operating parameters calculated from the resulting currents at each base node and the associated circuit model. The unused radiators are detuned for daytime operation.

Program test authority is respectfully requested at the currently licensed power level.

Randall L. Mullinax
August 7, 2014

Description of Radiators

The WWNC(AM) radiators are triangular, uniform cross section, guyed towers 66.8 electrical degrees in height with a face width of 61.0 centimeters. Tower #2 supports two side-mounted RPU antennas and Tower #4 supports the side-mounted 4-bay FM antenna for WQNS(FM).

Tower #	ASRN	Face Width	Electrical Height
1	1007873	61.0 cm	66.8°
2	1007874	61.0 cm	66.8°
3	1007875	61.0 cm	66.8°
4	1007876	61.0 cm	66.8°

Description of Model

The overall model of the antenna system consists of two components: the method of moments model and the circuit model. The method of moments model was adjusted by varying the electrical height of the radiators to produce an impedance at the base node such that when combined with the circuit model produced an impedance within +/- 2Ω and +/- 4% of the measured matrix resistance and reactance at the sample point. The modeled electrical heights used fall within the range of 70-125% of the physical height. The effective radii used fall within the range of 80-150% of the radius of a circle with a circumference equal to the sum of the widths of the tower sides. The radius of wire representing the upper sections of tower 4 in the model was adjusted to account for the addition of the side mounted FM antenna to the structure.

The circuit model consists of a lumped series inductive reactance and a lumped shunt capacitive reactance combined with the calculated base impedance produced by the method of moments model.

Description of Ground System

No changes were made to the ground system which consists of 120, 131 meter equally spaced, buried copper wire radials about the base of each tower, plus a 14.6 meter square ground screen at the base of each tower. Radials shortened and bonded to copper strap where they would overlap between towers.

Description of Sampling System

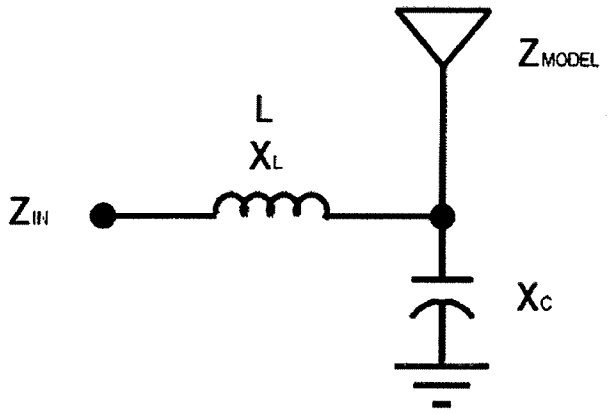
The sampling system consists of equal lengths of ½" solid outer jacket coaxial cable connected to Delta Electronics model TCT-4 toroidal current transformers near the base of each tower. The sample lines are buried over their entire length. The antenna monitor is a Potomac Instruments Model 1901 last calibrated by the manufacturer on January 23, 2002. An Agilent Technologies Model 4396B vector network analyzer was utilized to field-verify that the antenna monitor is operating within the manufacturer's specified tolerance.

Measured Matrix Impedances and WCAP Corrections

Tower 1 driven with Towers 2, 3 and 4 floated	19.1 -j75.8Ω
Tower 2 driven with Towers 1, 3 and 4 floated	21.8 -j68.8Ω
Tower 3 driven with Towers 1, 2 and 4 floated	18.0 –j78.9Ω
Tower 4 driven with Towers 1, 2 and 3 floated	18.5 –j59.6Ω

TOWER	Z_{MODEL}	Z_{IN} (MODEL)	Z_{IN} (MEASURED)	L(μH)	X_L	X_C
1	19.1 -j92.1	18.1 -j75.8	19.1 -j75.8	3.92	+j14.04	-j3490
2	22.0 -j71.1	20.7 -j67.1	21.8 -j68.8	0.61	+j2.18	-j2428*
3	18.2 -j99.5	17.8 -j78.9	18.0 -j78.9	5.53	+j19.81	-j11,167
4	19.3 -j88.8	18.1 -j61.3	18.5 -j59.6	6.95	+j24.89	-j2792*

***Towers 2 and 4, Xc Includes parallel reactance of isocoupler(s). The isocouplers were temporarily removed when the towers were floated.**



All measurements were made with an Agilent Technologies Model 4396B vector network analyzer with external directional coupler in a calibrated measurement system.

MoM Calculated Impedances and WCAP Calculations

MoM Calculated Impedance Tower 1 Driven with Towers 2, 3 and 4 Floated

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.29	9
		0	0	70.3		
2	none	110.	0	0	.29	9
		110.	0	74.		
3	none	309.6	23.24	0	.29	9
		309.6	23.24	69.		
4	none	213.	35.	0	.29	7
		213.	35.	59.5		
5	none	213.	35.	59.5	.69	2
		213.	35.	68.		

Number of wires = 5
current nodes = 36

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	5	4.25	4	8.5
radius	1	.29	5	.69

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	.57	0	1	.0118056	.0236111

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	19	0	-11,167.	0	0	0
2	10	0	-11,167.	0	0	0
3	28	0	-11,167.	0	0	0

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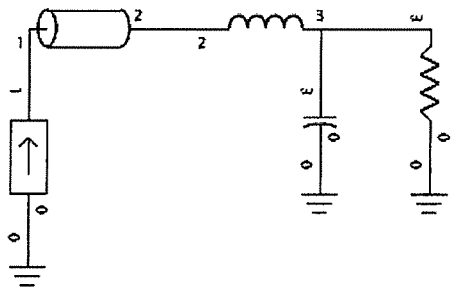
IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 1, sector 1							
.57	**19.064**	**-92.116**	94.068	281.7	11.821	-1.4731	-5.4114

WCAP Calculations - Tower 1 Driven with Towers 2, 3 and 4 Floated



WCAP OUTPUT AT FREQUENCY: 0.570 MHz

NODE VOLTAGES
Node: 1 77.9462 ∠ -76.5789° V
Node: 2 77.9462 ∠ -76.5789° V
Node: 3 91.6508 ∠ -78.6151° V

WCAP PART		CURRENT IN	CURRENT OUT
TL	1→2 50.00000000	1.00 ∠ -0.001° A	1.00 ∠ -0.001° A

WCAP PART		BRANCH VOLTAGE	BRANCH CURRENT
L	2→3 3.91740000	14.03 ∠ 90.000° V	1.00 ∠ -0.001° A
C	3→0 0.00008000	91.65 ∠ -78.615° V	0.03 ∠ 11.385° A
R	3→0 19.06000000	91.65 ∠ -78.615° V	0.97 ∠ -0.305° A

WCAP PART		FROM IMPEDANCE	TO IMPEDANCE
TL	1→2 50.00000000	18.09 - j 75.818	**18.09 - j 75.818**
L	2→3 3.91740000	18.09 - j 75.818	18.09 - j 89.847
C	3→0 0.00008000	0.00 - j 3490.240	0.00 + j 0.000
R	3→0 19.06000000	**19.06 - j 92.120**	0.00 + j 0.000

WCAP PART		VSWR
TL	1→2 50.00000000	9.3734

WCAP INPUT DATA:

```
   0.5700    0.00000000  0
I    1.00000000  0  1    0.00000000
TL   50.00000000  1  2   100.00000000    0.00001000    0.00000000
L    3.91740000  2  3    0.00000000
C    0.00008000  3  0
R    19.06000000  3  0  -92.12000000
```

Note: A mathematically insignificant length of transmission line was inserted into the circuit model at the sampling point to allow the program to calculate the impedance.

MoM Calculated Impedance Tower 2 Driven with Towers 1, 3 and 4 Floated

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.29	9
		0	0	70.3		
2	none	110.	0	0	.29	9
		110.	0	74.		
3	none	309.6	23.24	0	.29	9
		309.6	23.24	69.		
4	none	213.	35.	0	.29	7
		213.	35.	59.5		
5	none	213.	35.	59.5	.69	2
		213.	35.	68.		

Number of wires = 5
current nodes = 36

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	5	4.25	4	8.5
radius	1	.29	5	.69

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	.57	0	1	.0118056	.0236111

Sources

source	node	sector	magnitude	phase	type
1	10	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	19	0	-11,167.	0	0	0
2	1	0	-3,490.	0	0	0
3	28	0	-11,167.	0	0	0

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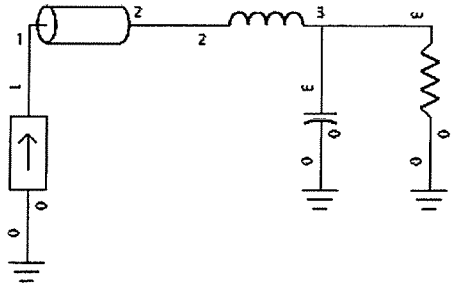
IMPEDANCE
normalization = 50.

freq	resist	react	imped	phase	VSWR	S11	S12
(MHz)	(ohms)	(ohms)	(ohms)	(deg)		dB	dB
source = 1; node 10, sector 1							
.57	**21.965**	**-71.105**	74.42	287.2	7.1798	-2.4354	-3.6731

WCAP Calculations - Tower 2 Driven with Towers 1, 3 and 4 Floated



WCAP OUTPUT AT FREQUENCY: 0.570 MHz

NODE VOLTAGES
Node: 1 70.2159 ∠ -72.8235° V
Node: 2 70.2159 ∠ -72.8235° V
Node: 3 72.3060 ∠ -73.3347° V

	WCAP PART		CURRENT IN		CURRENT OUT	
TL	1→2	50.00000000	1.00 ∠	-0.000° A	1.00 ∠	-0.001° A

	WCAP PART		BRANCH VOLTAGE		BRANCH CURRENT	
L	2→3	0.61000000	2.18 ∠	90.000° V	1.00 ∠	-0.001° A
C	3→0	0.00011500	72.31 ∠	-73.335° V	0.03 ∠	16.665° A
R	3→0	21.97000000	72.31 ∠	-73.335° V	0.97 ∠	-0.504° A

	WCAP PART		FROM IMPEDANCE		TO IMPEDANCE	
TL	1→2	50.00000000	20.74 - j	67.084	**20.74 - j**	**67.084**
L	2→3	0.61000000	20.74 - j	67.084	20.74 - j	69.269
C	3→0	0.00011500	0.00 - j	2427.993	0.00 + j	0.000
R	3→0	21.97000000	**21.97 - j**	**71.110**	0.00 + j	0.000

	WCAP PART		VSWR
TL	1→2	50.00000000	7.0242

WCAP INPUT DATA:
0.5700 0.00000000 0
I 1.00000000 0 1 0.00000000
TL 50.00000000 1 2 100.00000000 0.00001000 0.00000000
L 0.61000000 2 3 0.00000000
C 0.00011500 3 0
R 21.97000000 3 0 -71.11000000

Note: A mathematically insignificant length of transmission line was inserted into the circuit model at the sampling point to allow the program to calculate the impedance.

MoM Calculated Impedance Tower 3 Driven with Towers 1, 2 and 4 Floated

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.29	9
		0	0	70.3		
2	none	110.	0	0	.29	9
		110.	0	74.		
3	none	309.6	23.24	0	.29	9
		309.6	23.24	69.		
4	none	213.	35.	0	.29	7
		213.	35.	59.5		
5	none	213.	35.	59.5	.69	2
		213.	35.	68.		

Number of wires = 5
current nodes = 36

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	5	4.25	4	8.5
radius	1	.29	5	.69

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	.57	0	1	.0118056	.0236111

Sources

source	node	sector	magnitude	phase	type
1	19	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	10	0	-11,167.	0	0	0
2	1	0	-3,490.	0	0	0
3	28	0	-11,167.	0	0	0

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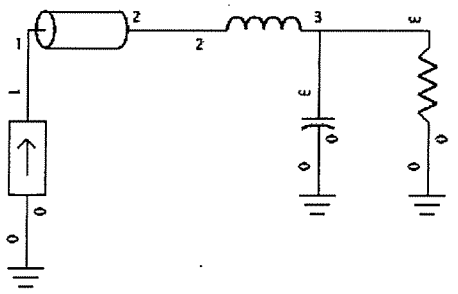
IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 19, sector 1							
.57	**18.156**	**-99.535**	101.18	280.3	13.959	-1.2466	-6.0288

WCAP Calculations - Tower 3 Driven with Towers 1, 2 and 4 Floated



WCAP OUTPUT AT FREQUENCY: 0.570 MHz

NODE VOLTAGES
Node: 1 80.8719 ∠ -77.2556° V
Node: 2 80.8719 ∠ -77.2556° V
Node: 3 100.2890 ∠ -79.7531° V

WCAP PART		CURRENT IN	CURRENT OUT
TL	1→2 50.00000000	1.00 ∠ -0.001° A	1.00 ∠ -0.001° A

WCAP PART		BRANCH VOLTAGE	BRANCH CURRENT
L	2→3 5.53130000	19.81 ∠ 90.000° V	1.00 ∠ -0.001° A
C	3→0 0.00002500	100.29 ∠ -79.753° V	0.01 ∠ 10.247° A
R	3→0 18.16000000	100.29 ∠ -79.753° V	0.99 ∠ -0.092° A

WCAP PART		FROM IMPEDANCE	TO IMPEDANCE
TL	1→2 50.00000000	17.84 - j 78.880	**17.84 - j 78.880**
L	2→3 5.53130000	17.84 - j 78.880	17.84 - j 98.689
C	3→0 0.00002500	0.00 - j 11168.768	0.00 + j 0.000
R	3→0 18.16000000	**18.16 - j 99.540**	0.00 + j 0.000

WCAP PART		VSWR
TL	1→2 50.00000000	10.0349

WCAP INPUT DATA:
0.5700 0.00000000 0
I 1.00000000 0 1 0.00000000
TL 50.00000000 1 2 100.00000000 0.00001000 0.00000000
L 5.53130000 2 3 0.00000000
C 0.00002500 3 0
R 18.16000000 3 0 -99.54000000

Note: A mathematically insignificant length of transmission line was inserted into the circuit model at the sampling point to allow the program to calculate the impedance.

MoM Calculated Impedance Tower 4 Driven with Towers 1, 2 and 3 Floated

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.29	9
		0	0	70.3		
2	none	110.	0	0	.29	9
		110.	0	74.		
3	none	309.6	23.24	0	.29	9
		309.6	23.24	69.		
4	none	213.	35.	0	.29	7
		213.	35.	59.5		
5	none	213.	35.	59.5	.69	2
		213.	35.	68.		

Number of wires = 5
current nodes = 36

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	5	4.25	4	8.5
radius	1	.29	5	.69

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	.57	0	1	.0118056	.0236111

Sources

source	node	sector	magnitude	phase	type
1	28	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	19	0	-11,167.	0	0	0
2	1	0	-3,490.	0	0	0
3	10	0	-11,167.	0	0	0

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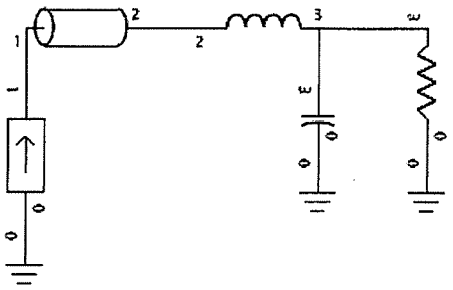
IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 28, sector 1							
.57	**19.313**	**-88.841**	90.916	282.3	11.058	-1.5752	-5.1683

WCAP Calculations - Tower 4 Driven with Towers 1, 2 and 3 Floated



WCAP OUTPUT AT FREQUENCY: 0.570 MHz

NODE VOLTAGES
Node: 1 63.9670 ∠ -73.5289° V
Node: 2 63.9670 ∠ -73.5289° V
Node: 3 88.1089 ∠ -78.1211° V

WCAP PART		CURRENT IN	CURRENT OUT
TL	1→2 50.00000000	1.00 ∠ -0.001° A	1.00 ∠ -0.001° A

WCAP PART		BRANCH VOLTAGE	BRANCH CURRENT
L	2→3 6.94700000	24.88 ∠ 90.000° V	1.00 ∠ -0.001° A
C	3→0 0.00010000	88.11 ∠ -78.121° V	0.03 ∠ 11.879° A
R	3→0 19.31000000	88.11 ∠ -78.121° V	0.97 ∠ -0.384° A

WCAP PART		FROM IMPEDANCE	TO IMPEDANCE
TL	1→2 50.00000000	18.14 - j 61.342	**18.14 - j 61.342**
L	2→3 6.94700000	18.14 - j 61.342	18.14 - j 86.222
C	3→0 0.00010000	0.00 - j 2792.192	0.00 + j 0.000
R	3→0 19.31000000	**19.31 - j 88.840**	0.00 + j 0.000

WCAP PART		VSWR
TL	1→2 50.00000000	7.1287

WCAP INPUT DATA:

```
  0.5700    0.00000000  0
I    1.00000000  0  1    0.00000000
TL   50.00000000  1  2  100.00000000    0.00001000    0.00000000
L    6.94700000  2  3    0.00000000
C    0.00010000  3  0
R    19.31000000  3  0  -88.84000000
```

Note: A mathematically insignificant length of transmission line was inserted into the circuit model at the sampling point to allow the program to calculate the impedance.

Nighttime Directional Operating Parameters
Derived from Modeled Currents

TOWER	Model Current Pulse	Model Current Magnitude (amperes)	Model Current Phase (degrees)	Model Drive Impedance (ohms)	Model Drive Power (watts)
1	1	7.65	+2.3	27.1 -j81.3	1586
2	10	13.09	+87.1	6.6 -j75.7	1131
3	19	9.33	+57.4	10.5 -j109.5	914
4	28	4.81	+334.9	59.0 -j71.6	1365

TOWER	Drive Impedance At Toroid (ohms)	Current Magnitude At Toroid (amperes)	Current Phase At Toroid (degrees)	Antenna Monitor Ratio	Antenna Monitor Phase (degrees)
1	25.9 -j65.6	7.83	+2.7	0.580	-84.6
2	6.2 -j71.3	13.5	+87.3	1.000	0
3	10.3 -j88.6	9.42	+57.5	0.698	-29.8
4	56.0 -j46.1	4.94	+336.1	0.366	-111.2

Nighttime Directional MoM Calculated Voltages and Currents

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MEDIUM WAVE ARRAY SYNTHESIS FROM FIELD RATIOS

Frequency = .57 MHz

tower	field ratio magnitude	phase (deg)
1	1.	0
2	1.8	86.5
3	1.15	56.5
4	.64	330.

VOLTAGES AND CURRENTS - rms

source node	voltage magnitude	phase (deg)	current magnitude	phase (deg)
1	655.529	290.7	7.64965	2.3
10	995.189	2.1	13.0908	87.1
19	1,026.2	332.9	9.32912	57.4
28	446.434	284.3	4.81223	334.9

Sum of square of source currents = 680.154
Total power = 5,000. watts

TOWER ADMITTANCE MATRIX

admittance	real (mhos)	imaginary (mhos)
Y(1, 1)	.00203917	.0106098
Y(1, 2)	.000279653	-.00189353
Y(1, 3)	.000114852	.000697455
Y(1, 4)	-.000892145	-3.0653E-05
Y(2, 1)	.000279491	-.00189359
Y(2, 2)	.00391275	.0132407
Y(2, 3)	-.0010605	-5.6896E-05
Y(2, 4)	-.000216636	-.00146872
Y(3, 1)	.000114866	.000697431
Y(3, 2)	-.00106048	-5.6935E-05
Y(3, 3)	.00170148	.00980489
Y(3, 4)	.000365367	-.00127961
Y(4, 1)	-.000892714	-3.0743E-05
Y(4, 2)	-.000216415	-.00146967
Y(4, 3)	.000365879	-.00128032
Y(4, 4)	.00228335	.0109943

TOWER IMPEDANCE MATRIX

impedance	real (ohms)	imaginary (ohms)
Z(1, 1)	19.0763	-92.121
Z(1, 2)	7.42926	-10.6957
Z(1, 3)	-2.85266	4.62965
Z(1, 4)	-6.25053	-4.23648
Z(2, 1)	7.43013	-10.6949
Z(2, 2)	22.0093	-71.1301
Z(2, 3)	-6.49807	-4.3985
Z(2, 4)	2.33097	-10.8192
Z(3, 1)	-2.85269	4.6297
Z(3, 2)	-6.49831	-4.39827
Z(3, 3)	18.1702	-99.542
Z(3, 4)	6.87158	-9.7756
Z(4, 1)	-6.24692	-4.23328
Z(4, 2)	2.32699	-10.8132
Z(4, 3)	6.86511	-9.77108
Z(4, 4)	19.3145	-88.8502

ELECTRICAL DESCRIPTION
Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	.57	0	1	.0118056	.0236111

Sources

source	node	sector	magnitude	phase	type
1	1	1	927.058	290.7	voltage
2	10	1	1,407.41	2.1	voltage
3	19	1	1,451.26	332.9	voltage
4	28	1	631.353	284.3	voltage

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IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 1, sector 1							
.57	**27.114**	**-81.291**	85.694	288.4	7.1203	-2.456	-3.6458
source = 2; node 10, sector 1							
.57	**6.5979**	**-75.735**	76.022	275.	25.057	-.69366	-8.3086
source = 3; node 19, sector 1							
.57	**10.542**	**-109.49**	110.	275.5	27.662	-.62828	-8.7067
source = 4; node 28, sector 1							
.57	**58.951**	**-71.633**	92.771	309.5	3.4807	-5.1354	-1.5897

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.29	9
		0	0	70.3		
2	none	110.	0	0	.29	9
		110.	0	74.		
3	none	309.6	23.24	0	.29	9
		309.6	23.24	69.		
4	none	213.	35.	0	.29	7
		213.	35.	59.5		
5	none	213.	35.	59.5	.69	2
		213.	35.	68.		

Number of wires = 5
current nodes = 36

	minimum wire	minimum value	maximum wire	maximum value
Individual wires				
segment length	5	4.25	4	8.5
radius	1	.29	5	.69

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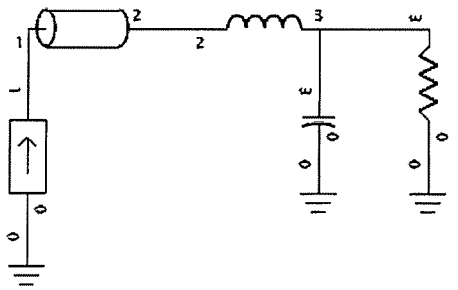
CURRENT rms
Frequency = .57 MHz
Input power = 5,000. watts
Efficiency = 100. %
coordinates in degrees

current no.	X	Y	Z	mag (amps)	phase (deg)	real (amps)	imaginary (amps)
GND	0	0	0	**7.64969**	**2.3**	7.64361	.304781
2	0	0	7.81111	7.16642	1.3	7.16469	.157328
3	0	0	15.6222	6.64762	.5	6.64733	.0624293
4	0	0	23.4333	6.02384	359.9	6.02384	-7.12E-03
5	0	0	31.2445	5.29092	359.4	5.29064	-.0551202
6	0	0	39.0556	4.45276	358.9	4.45199	-.0830744
7	0	0	46.8667	3.51547	358.5	3.51427	-.0918214
8	0	0	54.6778	2.48333	358.1	2.48198	-.0818815
9	0	0	62.4889	1.34982	357.7	1.34877	-.0531588
END	0	0	70.3	0	0	0	0
GND	110.	0	0	**13.0909**	**87.1**	.66026	13.0742
11	110.	0	8.22222	12.2812	86.8	.67518	12.2626
12	110.	0	16.4444	11.3935	86.7	.663765	11.3742
13	110.	0	24.6667	10.3179	86.5	.630601	10.2986
14	110.	0	32.8889	9.0509	86.3	.576722	9.03251
15	110.	0	41.1111	7.60264	86.2	.502918	7.58598
16	110.	0	49.3333	5.98709	86.1	.409893	5.97304
17	110.	0	57.5556	4.21554	85.9	.298019	4.20499
18	110.	0	65.7778	2.28143	85.8	.166293	2.27536
END	110.	0	74.	0	0	0	0
GND	284.479	-122.163	0	**9.32911**	**57.4**	5.02146	7.86239
20	284.479	-122.163	7.66667	8.58448	57.	4.67131	7.20224
21	284.479	-122.163	15.3333	7.86207	56.7	4.31197	6.57412
22	284.479	-122.163	23.	7.0473	56.5	3.89152	5.87541
23	284.479	-122.163	30.6667	6.13089	56.2	3.4063	5.09755
24	284.479	-122.163	38.3333	5.11562	56.	2.8583	4.24261
25	284.479	-122.163	46.	4.00761	55.8	2.25106	3.31567
26	284.479	-122.163	53.6667	2.8111	55.6	1.58691	2.32035
27	284.479	-122.163	61.3333	1.51829	55.4	.861249	1.25038
END	284.479	-122.163	69.	0	0	0	0
GND	174.479	-122.172	0	**4.81223**	**334.9**	4.35647	-2.04419
29	174.479	-122.172	8.5	4.51777	332.5	4.00784	-2.08505
30	174.479	-122.172	17.	4.1781	330.9	3.65017	-2.03292
31	174.479	-122.172	25.5	3.75288	329.5	3.23469	-1.90286
32	174.479	-122.172	34.	3.2407	328.4	2.75926	-1.6996
33	174.479	-122.172	42.5	2.64564	327.3	2.22745	-1.42754
34	174.479	-122.172	51.	1.9737	326.4	1.64468	-1.09112
END	174.479	-122.172	59.5	1.24148	325.7	1.02533	-.699976
2J4	174.479	-122.172	59.5	1.24148	325.7	1.02533	-.699976
36	174.479	-122.172	63.75	.685905	325.2	.563387	-.391229
END	174.479	-122.172	68.	0	0	0	0

Nighttime WCAP Calculations

Tower 1



WCAP OUTPUT AT FREQUENCY: 0.570 MHz

NODE VOLTAGES
Node: 1 552.1126 ∠ -65.7307° V
Node: 2 552.1126 ∠ -65.7307° V
Node: 3 655.5141 ∠ -69.2565° V

WCAP PART		CURRENT IN	CURRENT OUT
TL	1→2 50.00000000	**7.83 ∠ 2.735° A**	7.83 ∠ 2.735° A

WCAP PART		BRANCH VOLTAGE	BRANCH CURRENT
L	2→3 3.91740000	109.83 ∠ 92.735° V	7.83 ∠ 2.735° A
C	3→0 0.00008000	655.51 ∠ -69.256° V	0.19 ∠ 20.744° A
R	3→0 27.11000000	655.51 ∠ -69.256° V	**7.65 ∠ 2.300° A**

WCAP PART		FROM IMPEDANCE	TO IMPEDANCE
TL	1→2 50.00000000	25.89 - j 65.606	25.89 - j 65.606
L	2→3 3.91740000	25.89 - j 65.606	25.89 - j 79.636
C	3→0 0.00008000	0.00 - j 3490.240	0.00 + j 0.000
R	3→0 27.11000000	27.11 - j 81.290	0.00 + j 0.000

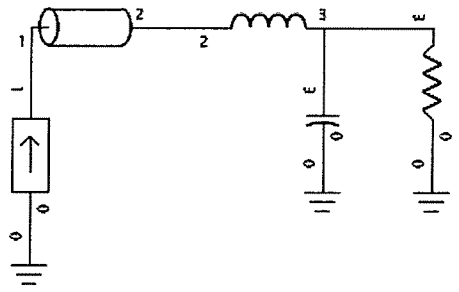
WCAP PART		VSWR
TL	1→2 50.00000000	5.5956

WCAP INPUT DATA:

```
  0.5700    0.00000000  0
I*    7.82810000  0  1    2.73500000
TL   50.00000000  1  2   100.00000000    0.00001000    0.00000000
L     3.91740000  2  3    0.00000000
C     0.00008000  3  0
R    27.11000000  3  0   -81.29000000
```

***current required to produce the current predicted by MoM model at base of radiator**
Note: A mathematically insignificant length of transmission line was inserted into the circuit model at the sampling point to allow the program to calculate the impedance.

Tower 2



WCAP OUTPUT AT FREQUENCY: 0.570 MHz

NODE VOLTAGES
Node: 1 965.7885 ∠ 2.2279° V
Node: 2 965.7885 ∠ 2.2279° V
Node: 3 995.2686 ∠ 2.0802° V

	WCAP PART		CURRENT IN	CURRENT OUT
TL	1→2	50.00000000	**13.50 ∠ 87.251° A**	13.50 ∠ 87.251° A

	WCAP PART		BRANCH VOLTAGE	BRANCH CURRENT
L	2→3	0.61200000	29.59 ∠ 177.251° V	13.50 ∠ 87.251° A
C	3→0	0.00011500	995.27 ∠ 2.080° V	0.41 ∠ 92.080° A
R	3→0	6.60000000	995.27 ∠ 2.080° V	**13.09 ∠ 87.100° A**

	WCAP PART		FROM IMPEDANCE	TO IMPEDANCE
TL	1→2	50.00000000	6.21 - j 71.273	6.21 - j 71.273
L	2→3	0.61200000	6.21 - j 71.273	6.21 - j 73.465
C	3→0	0.00011500	0.00 - j 2427.993	0.00 + j 0.000
R	3→0	6.60000000	6.60 - j 75.740	0.00 + j 0.000

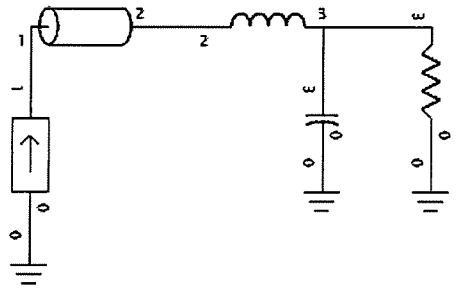
	WCAP PART		VSWR
TL	1→2	50.00000000	24.5082

WCAP INPUT DATA:

	0.5700	0.00000000	0			
I*	**13.49940000**	**0**	**1**	**87.25100000**		
TL	50.00000000	1	2	100.00000000	0.00001000	0.00000000
L	0.61200000	2	3	0.00000000		
C	0.00011500	3	0			
R	6.60000000	3	0	-75.74000000		

***current required to produce the current predicted by MoM model at base of radiator**
Note: A mathematically insignificant length of transmission line was inserted into the circuit model at the sampling point to allow the program to calculate the impedance.

Tower 3



WCAP OUTPUT AT FREQUENCY: 0.570 MHz

NODE VOLTAGES
Node: 1 840.5770 ∠ -25.8938° V
Node: 2 840.5771 ∠ -25.8938° V
Node: 3 1026.1694 ∠ -27.1009° V

WCAP PART		CURRENT IN	CURRENT OUT
TL 1→2	50.00000000	**9.42 ∠ 57.454° A**	9.42 ∠ 57.454° A

WCAP PART		BRANCH VOLTAGE	BRANCH CURRENT
L 2→3	5.53130000	186.62 ∠ 147.454° V	9.42 ∠ 57.454° A
C 3→0	0.00002500	1026.17 ∠ -27.101° V	0.09 ∠ 62.899° A
R 3→0	10.54000000	1026.17 ∠ -27.101° V	**9.33 ∠ 57.400° A**

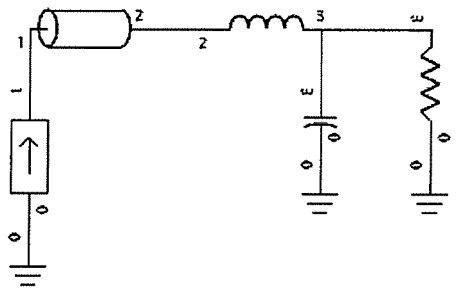
WCAP PART		FROM IMPEDANCE	TO IMPEDANCE
TL 1→2	50.00000000	10.34 - j 88.627	10.34 - j 88.627
L 2→3	5.53130000	10.34 - j 88.627	10.34 - j 108.437
C 3→0	0.00002500	0.00 - j 11168.768	0.00 + j 0.000
R 3→0	10.54000000	10.54 - j 109.490	0.00 + j 0.000

WCAP PART		VSWR
TL 1→2	50.00000000	20.1928

WCAP INPUT DATA:
0.5700 0.00000000 0
I* 9.42060000 0 1 57.45400000
TL 50.00000000 1 2 100.00000000 0.00001000 0.00000000
L 5.53130000 2 3 0.00000000
C 0.00002500 3 0
R 10.54000000 3 0 -109.49000000

***current required to produce the current predicted by MoM model at base of radiator**
Note: A mathematically insignificant length of transmission line was inserted into the circuit model at the sampling point to allow the program to calculate the impedance.

Tower 4



WCAP OUTPUT AT FREQUENCY: 0.570 MHz

NODE VOLTAGES
Node: 1 358.1693 ∠ -63.3825° V
Node: 2 358.1693 ∠ -63.3825° V
Node: 3 446.4200 ∠ -75.6466° V

	WCAP PART		CURRENT IN	CURRENT OUT
TL	1→2	50.00000000	**4.94 ∠ -23.921° A**	4.94 ∠ -23.921° A

	WCAP PART		BRANCH VOLTAGE	BRANCH CURRENT
L	2→3	6.94700000	122.83 ∠ 66.079° V	4.94 ∠ -23.921° A
C	3→0	0.00010000	446.42 ∠ -75.647° V	0.16 ∠ 14.353° A
R	3→0	58.95000000	446.42 ∠ -75.647° V	**4.81 ∠ -25.100° A**

	WCAP PART		FROM IMPEDANCE	TO IMPEDANCE
TL	1→2	50.00000000	56.01 - j 46.111	56.01 - j 46.111
L	2→3	6.94700000	56.01 - j 46.111	56.01 - j 70.991
C	3→0	0.00010000	0.00 - j 2792.192	0.00 + j 0.000
R	3→0	58.95000000	58.95 - j 71.630	0.00 + j 0.000

	WCAP PART		VSWR
TL	1→2	50.00000000	2.3458

WCAP INPUT DATA:
0.5700 0.00000000 0
I* 4.93670000 0 1 336.07900000
TL 50.00000000 1 2 100.00000000 0.00001000 0.00000000
L 6.94700000 2 3 0.00000000
C 0.00010000 3 0
R 58.95000000 3 0 -71.63000000

***current required to produce the current predicted by MoM model at base of radiator**
Note: A mathematically insignificant length of transmission line was inserted into the circuit model at the sampling point to allow the program to calculate the impedance.

Calculated Current Moments

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CURRENT MOMENTS(amp-degrees) rms

Frequency = .57 MHz
Input power = 5,000. watts

wire	magnitude	phase (deg)	vertical current moment magnitude	phase (deg)
1	657.597	360.	657.597	360.
2	1,183.67	86.5	1,183.67	86.5
3	756.234	56.5	756.234	56.5
4	409.425	330.1	409.425	330.1
5	11.4739	325.4	11.4739	325.4

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

tower	magnitude	phase (deg)
1	657.597	360.
2	1,183.67	86.5
3	756.234	56.5
4	420.861	330.

Normalized to Tower 1

tower	magnitude	phase (deg)
1	1.000	0.0
2	1.800	86.5
3	1.150	56.5
4	0.640	330.0

Measured and Calculated Sampling Line Characteristics

Measured open circuit resonant frequency at odd multiple of ¼ wavelength nearest the carrier frequency:

Tower 1	488.33 kHz	3/4 λ(270°)
Tower 2	488.51 kHz	3/4 λ(270°)
Tower 3	488.40 kHz	3/4 λ(270°)
Tower 4	487.65 kHz	3/4 λ(270°)

Measured impedance 1/8 wavelength above and below open circuit resonant frequency:

Tower 1	569.72 kHz	7.86 +j47.98 Ω	+1/8 λ
	406.94 kHz	5.24 –j48.04 Ω	-1/8 λ
Tower 2	569.93 kHz	7.89 +j49.54 Ω	+1/8 λ
	407.09 kHz	5.15 –j49.39 Ω	-1/8 λ
Tower 3	569.80 kHz	7.66 +j47.99 Ω	+1/8 λ
	407.00 kHz	5.05 –j47.80 Ω	-1/8 λ
Tower 4	568.93 kHz	8.82 +j47.95 Ω	+1/8 λ
	406.38 kHz	6.17 –j47.85 Ω	-1/8 λ

Calculated characteristic impedance using formula $Z_o = ((R_1^2 + X_1^2)^{-1/2} * (R_2^2 + X_2^2)^{1/2})^{1/2}$:

Tower 1	48.47 Ω
Tower 2	49.91 Ω
Tower 3	48.33 Ω
Tower 4	48.50 Ω

Calculated electrical length at f carrier :

Tower 1	L = (f carrier / f resonant) * 270° = (570 kHz / 488.33 kHz) * 270° = 315.16°
Tower 2	L = (f carrier / f resonant) * 270° = (570 kHz / 488.51 kHz) * 270° = 315.04°
Tower 3	L = (f carrier / f resonant) * 270° = (570 kHz / 488.40 kHz) * 270° = 315.11°
Tower 4	L = (f carrier / f resonant) * 270° = (570 kHz / 487.65 kHz) * 270° = 315.60°

Measured impedance at f carrier at the input of the sampling line with the sampling device connected:

Tower 1	46.8 +j0.5Ω
Tower 2	47.7 -j1.0Ω
Tower 3	46.1 +j1.2Ω
Tower 3	46.7 +j0.6Ω

All measurements above made with an Agilent Model 4396B vector network analyzer with an external directional coupler in a calibrated measurement system.

Sampling Transformer Calibration

Calibration of the Delta Electronics model TCT-3 toroidal current transformers was confirmed using an Agilent Model 4396B vector network analyzer.

The signal from the generator output of the vector network analyzer was connected to a conductor running through the transformers which was then terminated with a 50Ω load. The network analyzer was set to measure in "transmission" mode and the output of the Tower 2 reference toroidal current transformer was connected to the network analyzer "B" receiver input. A "response" calibration was performed, calibrating the network analyzer for the amplitude and phase characteristics of the reference transformer. The outputs of the remaining three toroidal current transformers were then connected in turn to the input of the "B" receiver of the analyzer and the amplitude and phase characteristics were recorded.

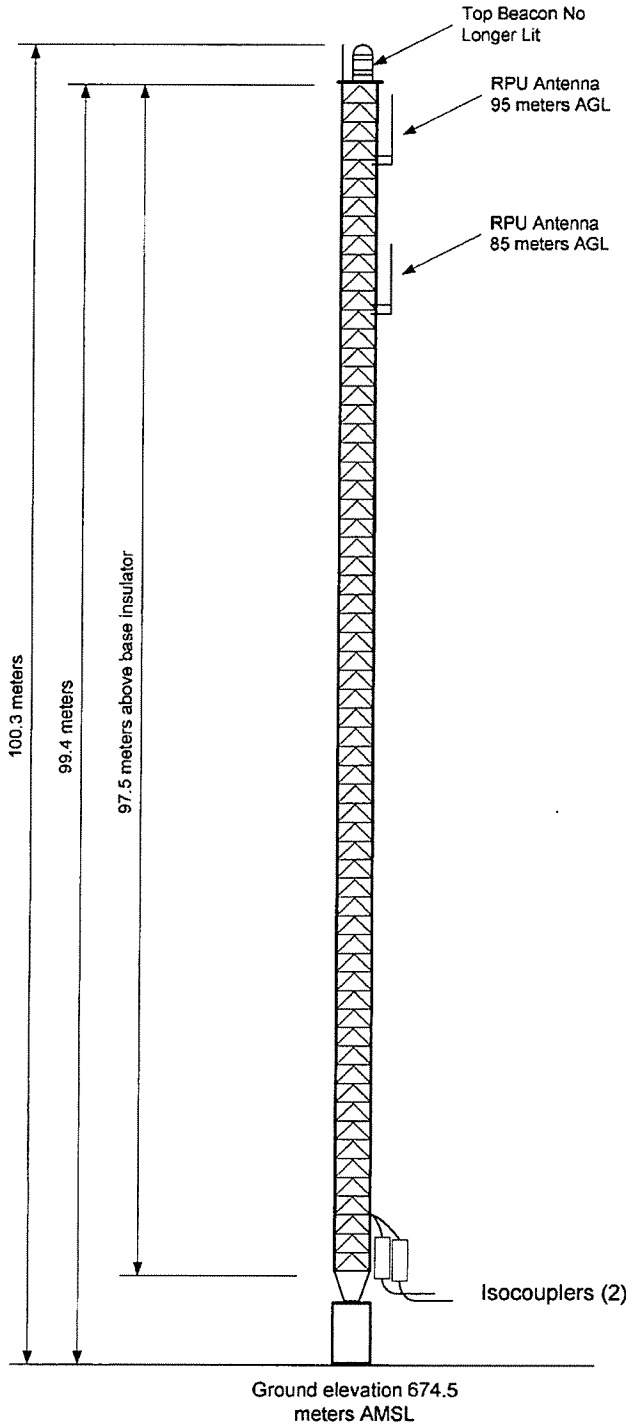
	Indicated Phase	Indicated Radio
T1 [SN 207]	+0.12°	0.998
T2 [SN 213]	0°	1.000
T3 [SN 212]	+0.07°	0.998
T3 [SN 206]	+0.14°	0.998

The manufacturer specifies these devices to be accurate to within +/- 2% absolute magnitude and +/- 2° absolute phase.

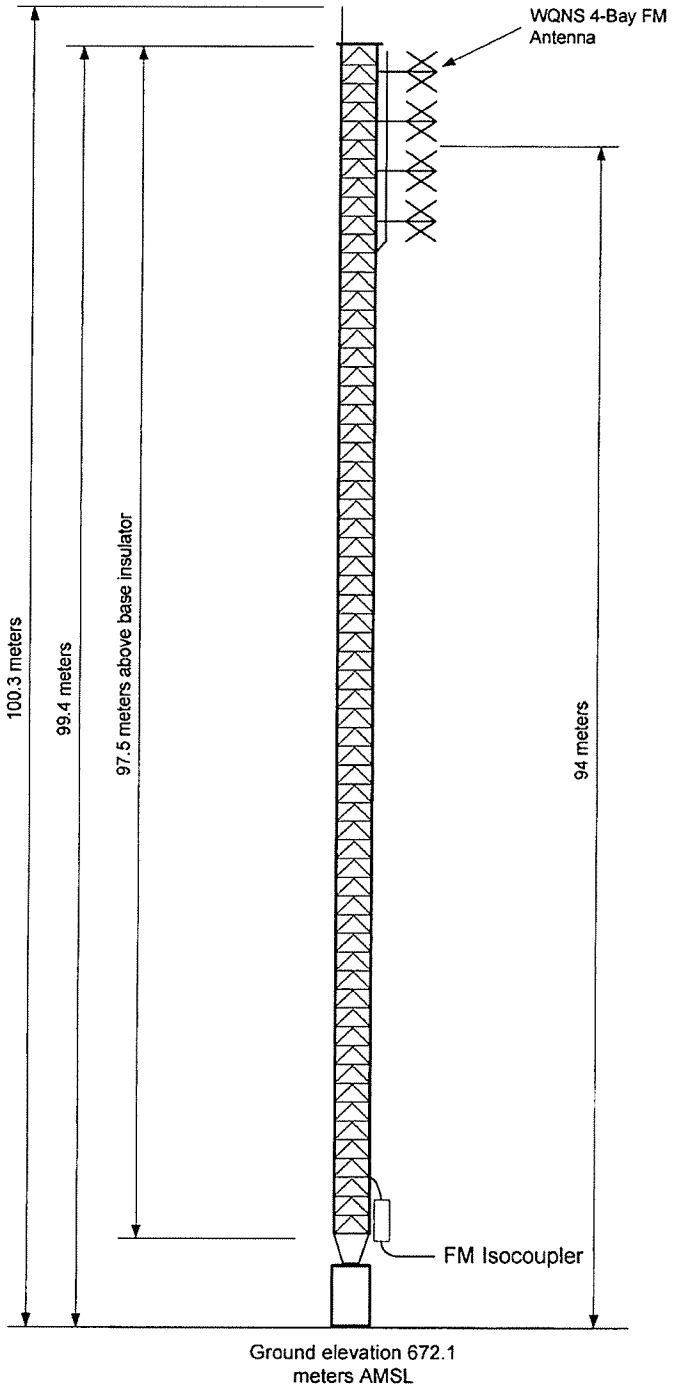
Environmental Statement

The WWNC radiators are surrounded by a secured fences restricting access by unauthorized personnel and signs are posted in the vicinity of the radiators, warning of potential radio frequency hazards at the site. Based on the charts and graphs supplied in Supplement A, Edition 97-01 to OET bulletin 65, Edition 97-01 the applicant certifies that the distance to the fences from the radiators complies with FCC OET65 regarding human exposure to non-ionizing electromagnetic radiation.

WWNC, Asheville, NC
Tower 2 Vertical Sketch
ASR No. 1007874
Not to Scale



WWNC, Asheville, NC
Tower 4 Vertical Sketch
ASR No. 1007876
Not to Scale



Reference Points Data

Field Meter Model	Serial Number	Calibration Date
FIM-41	2111	December 11, 2012

Azimuth	Point	Description	Distance (km)	Coordinates (NAD 83)	Measurement (mV/m)
14.5°T	1	End of Church Rd. in cemetery 25 ft. north of parking area at "Governor Waldrop WWI" grave marker (Former Monitor Point).	4.83	35° 38' 21.2" N 82° 35' 37.1" W	12.5
14.5°T	2	West bound on Future I-26 at Mile Marker 22.	7.83	35° 39' 55.3" N 82° 35' 06.2" W	6.6
14.5°T	3	19 Marlwood Ct. at storm drain beside fire hydrant.	9.08	35° 40' 34.3" N 82° 34' 53.3" W	4.9
50°T	1	At mailbox - 14 Ellenwood Drive	5.02	35° 37' 33.2" N 82° 33' 50.3" W	12.1
50°T	2	West edge of Gibson Rd. - 30 ft. east of Crabtree Ln. - even with manhole in yard (Former Monitor Point).	7.96	35° 38' 37.2" N 82° 32' 23.2" W	5.8
50°T	3	End of Pinecroft Road at mailbox cluster	9.29	35° 39' 01.1" N 82° 31' 39.1" W	1.32
120.5°T	1	Victoria Road - On AB Tech campus in parking lot at A19 Lamp Post	5.38	35° 34' 21.4" N 82° 33' 18.7" W	185
120.5°T	2	South side of Boston Way (Biltmore Village) - on sidewalk at exit sign from Suntrust dirve-through.	6.65	35° 34' 00.0" N 82° 32' 35.6" W	124
120.5°T	3	At mailbox - 28 Davidson Road	10.26	35° 33' 01.1" N 82° 30' 32.0" W	48

Azimuth	Point	Description	Distance (km)	Coordinates (NAD 83)	Measurement (mV/m)
169°T	1	Zephyr Drive over storm drain in Northeast quadrant of cul-de-sac (Former Monitor Point).	3.15	35° 34' 08.7" N 82° 36' 00.3" W	78
169°T	2	Clayton Road - Center of grass driveway to Camp Stevens at locked metal gate.	12.15	35° 29' 22.6" N 82° 34' 49.8" W	6.3
169°T	3	North side of Park South Blvd. at fire hydrant.	13.69	35° 28' 33.1" N 82° 34' 40.2" W	5.8
215.5°T	1	East side of Old Haywood Road at Right Turn sign.	4.02	35° 34' 03.5" N 82° 37' 56.9" W	155
215.5°T	2	US Hwy 19 - Behind Zaxby's - End of sidwalk at dumpster enclosure	5.34	35° 33' 28.3" N 82° 38' 27.3" W	106
215.5°T	3	Enka High School - South of guard house at Students Only/Auditorium sign.	9.01	35° 31' 52.1" N 82° 39' 52.9" W	40
261°T	1	Center of driveway to 205 Cowan Cove Road (Former Monitor Point).	3.08	35° 35' 34.2" N 82° 38' 24.5" W	57
261°T	2	30 Arrowwood Road - south edge of road at large tree with #30 sign.	5.26	35° 35' 22.4" N 82° 39' 50.0" W	20.1
261°T	3	At street sign - Milksick Cove Road at Kayce Drive	10.94	35° 34' 53.8" N 82° 43' 32.8" W	3.60

Azimuth	Point	Description	Distance (km)	Coordinates (NAD 83)	Measurement (mV/m)
293°T	1	West edge of Dix Creek Road No.1 - 90 ft. south of Janna Lane at 40 MPH sign.	5.08	35° 36' 53.8" N 82° 39' 29.1" W	36
293°T	2	East side of Dix Creek Road No. 2 - in center of driveway opposite mailbox 46.	6.14	35° 37' 06.3" N 82° 40' 08.7" W	28
293°T	3	Edge of road at center of driveway to 358 Gouges Branch Road	8.32	35° 37' 35.0" N 82° 41' 27.7" W	20.3
307°T	1	East edge of Dix Creek Chapel Road - center of Grady Ridge Drive (Former Monitor Point)	5.25	35° 37' 33.1" N 82° 39' 09.1" W	36
307°T	2	Gouges Branch Road over storm drain at pull-off to telephone terminal number LCSRNCU0012	7.82	35° 38' 22.8" N 82° 40' 30.7" W	18.4
307°T	3	Old Newfound Road - in Bell Cemetery 100 ft. south of flag pole in center of drive in line with "Gillespie" grave stone.	10.45	35° 39' 13.2" N 82° 41' 55.5" W	16.2