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ENGINEERING REPORT:

KOAN(AM) SLANT WIRE SHUNT FEED ANTENNA SYSTEM MODELING

June 2020

Falcon Broadcasting LLC

INTRODUCTION

Falcon Broadcasting LLC ("Falcon"), licensee of KOAN(AM), 1080 kHz, Anchorage, AK proposes to relocate to a new antenna/transmitter site. The proposed new site is an existing tower owned by Vertical Bridge and supports the antennas for KMXS(FM) & KTVA(DT). The tower has a height of 394 feet, and is identified by Antenna Structure Registration number 1005016. This tower was previously used as the main antenna of AM station KBYR, 700 kHz. Sample excavations show that the AM ground system is still is reasonable condition. KOAN proposes to slant wire shunt feed this tower.

This tower has recently undergone an extensive structural upgrade. The city of Anchorage would not permit the tower to be completely replaced, the preferred and lower cost solution. Vertical Bridge "wrapped" the tower with a new tower structural component built over the existing tower to provide the strength needed to conform to current structural standards. This involved replacement of existing guys wires and addition of guy levels at the lower part of the tower. The lower guy wires are grounded whereas the upper guys wires are insulated with Phillystran insulated guy rope. The top section of the tower above the grounded guys (including the top mount KTVA TV antenna) is 159.3 feet (63.0 electrical degrees at 1080 kHz).

DETERMINATION OF ANTENNA RADIATION EFFICIENCY

Method of Moments modeling using *Expert MININEC Broadcast Professional V.14* was employed to determine the characteristics for this antenna. This antenna system was modeled over an ideal ground. Based on the modeling results, it was determined that the radiation efficiency in the horizontal plane of the proposed KOAN slant-fed antenna and ground system is 306.3 mV/m/kW at one kilometer (average of 72 radials).

The antenna will be fed near the 229-foot level. This level will be +/- 20 feet as determined in the field by mechanical constraints and electrical tuning for the desired load. This antenna behaves closely to a 90.8° radiator and should be licensed as such.

ANTENNA CURCULARITY FROM SLANT WIRE

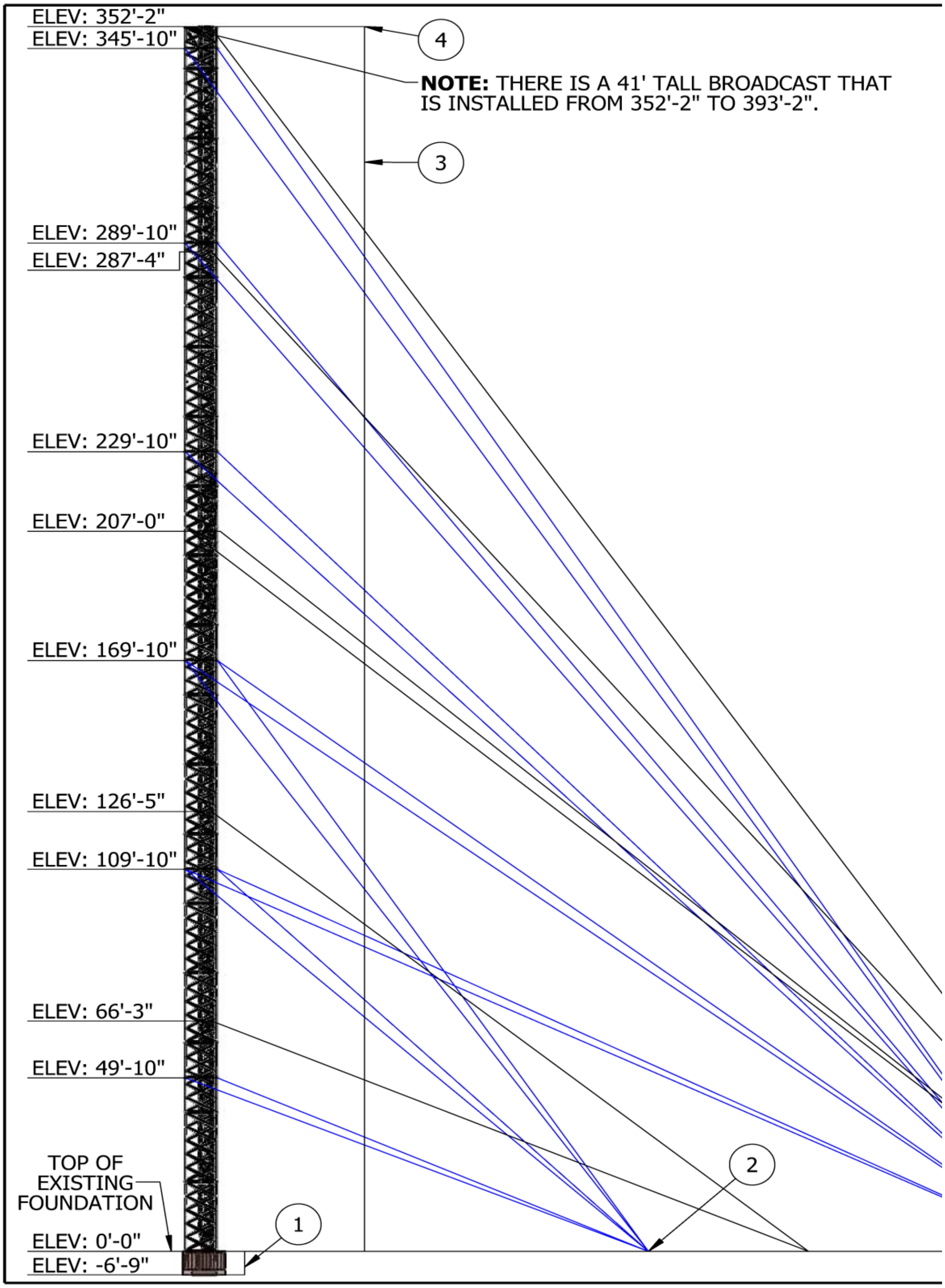
Using the same MININEC model the attenuated field strength in the horizontal plane varies from 287.2 mV/m to 325.5 mV/m providing a circularity of +0.53/-0.56 dB (maximum/average to minimum/average) in the horizontal plane.

The far field pattern was calculated using the MININEC model at 72 azimuths and elevation up to 70° at intervals of 5°. Comparing the performance to the 90° radiator (from FCC Figure 8) the expected horizontal theoretical field is 305.8 mV/m at 1 km. This tower is physically 155.8° but preforms much closer to a 90.8° radiator. This is a result of the grounding of the lower guy wires. We believe that this tower should be licensed as a 90.8° radiator. See attached drawing.

The following table compares the f(θ) calculations[1] for a radiator of 90.8° in height to the MININEC model. The vertical radiation characteristics for the two cases, therefore, are directly comparable. This table also compares the high angle circularity. The departure from circularity is +1.84 dB./-6.37 dB at an elevation angle of 35° all other elevations below 25° are below the +/- 2 dB limit for an omnidirectional antenna, as defined in 47 CFR § 1.30002(a), for all vertical angles of interest in nighttime allocation studies. There are no skywave limits from domestic or foreign stations at elevation angles above the horizon. It is not expected that the excess fields at the higher angles will produce any skywave interference.

	MNEC Calculated Field at 1 km for 1 kW for 72 Radials			FCC f(θ)	FCC Field	Shunt/FCC	Circularity	
Theta(θ)	Avg	Max	Min	90.8° Tower	Fig 8*f(θ)	dB	+ dB	- dB
0	306.3	325.5	287.2	1.000	306.8	-0.02	0.53	-0.56
5	300.7	321.1	281.9	0.994	305.1	-0.13	0.57	-0.56
10	287.6	308.3	271.1	0.978	300.0	-0.37	0.60	-0.51
15	268.1	288.9	249.7	0.951	291.7	-0.73	0.65	-0.62
20	243.8	265.1	213.2	0.914	280.5	-1.22	0.73	-1.17
25	216.8	239.9	170.9	0.869	266.6	-1.80	0.88	-2.06
30	189.2	216.4	125.2	0.816	250.5	-2.44	1.17	-3.58
35	163.1	201.4	78.3	0.758	232.5	-3.08	1.84	-6.37
40	139.7	201.1	32.5	0.695	213.1	-3.67	3.17	-12.67
45	122.1	206.9	9.0	0.628	192.6	-3.96	4.59	-22.62
50	118.9	216.7	7.2	0.559	171.5	-3.18	5.21	-24.37
55	123.0	228.1	1.3	0.489	149.9	-1.72	5.36	-39.33
60	130.1	238.9	9.1	0.418	128.2	0.13	5.28	-23.12
65	137.4	247.6	10.5	0.347	106.5	2.22	5.11	-22.32
70	143.8	253.5	11.9	0.277	84.8	4.58	4.92	-21.61

[1]47 CFR § 73.160 Vertical plane radiation characteristics, f(θ)



Note: Top two guys are Phillystran with the KTVA antenna which is 41-feet in length is mounted atop the tower.

(Drawing from Vertical Bridge & Bennett & Pless Structural Engineers)

STATEMENT OF ENGINEER

This Engineering Report prepared for KOAN has been prepared by me or under my direct supervision. All representations contained herein are true to the best of my knowledge. I am an experienced radio engineer whose qualifications are a matter of record with the Federal Communications Commission. I am a partner in the firm of Hatfield and Dawson Consulting Engineers and am Registered as a Professional Engineer in the States of Washington, Alaska, and Wyoming.

Stephen S. Lockwood

3 June 2020

Far Field calculations at 1 km with 1 kW

	Azimuth Angle																	
Elevation Angle	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
0	296.5	294.3	292.6	291.2	290.1	289.3	288.6	288.1	287.8	287.5	287.3	287.2	287.2	287.2	287.3	287.4	287.7	288.0
5	291.6	289.2	287.2	285.7	284.5	283.7	283.0	282.6	282.3	282.1	282.0	281.9	281.9	281.9	281.9	282.0	282.2	282.5
10	281.2	278.6	276.5	274.8	273.5	272.6	272.0	271.6	271.4	271.2	271.2	271.2	271.1	271.1	271.1	271.2	271.3	271.5
15	266.3	263.7	261.5	259.7	258.4	257.4	256.8	256.4	256.2	256.1	256.1	256.1	256.1	256.1	256.1	256.1	256.1	256.3
20	248.7	246.2	244.1	242.3	241.0	240.0	239.4	239.0	238.8	238.8	238.8	238.8	238.8	238.8	238.8	238.8	238.8	239.0
25	230.4	228.3	226.5	225.0	223.8	223.0	222.4	222.1	221.9	221.9	221.9	222.0	222.0	222.0	222.0	222.0	222.0	222.2
30	213.4	212.2	211.1	210.2	209.4	208.9	208.6	208.5	208.4	208.5	208.6	208.7	208.7	208.7	208.7	208.6	208.6	208.7
35	199.3	199.5	199.6	199.7	199.8	199.9	200.1	200.4	200.6	200.9	201.2	201.3	201.4	201.4	201.3	201.1	200.9	200.7
40	189.0	191.1	192.9	194.3	195.6	196.8	197.8	198.7	199.5	200.1	200.6	201.0	201.1	201.1	200.8	200.4	199.9	199.2
45	182.4	186.6	190.3	193.5	196.3	198.8	200.9	202.7	204.1	205.3	206.2	206.7	206.9	206.8	206.4	205.6	204.6	203.2
50	178.3	184.8	190.5	195.7	200.2	204.1	207.4	210.2	212.5	214.3	215.6	216.4	216.7	216.6	215.9	214.7	213.0	210.8
55	175.4	184.1	191.9	198.9	205.1	210.5	215.2	219.1	222.3	224.8	226.6	227.7	228.1	227.8	226.8	225.2	222.8	219.7
60	172.3	183.0	192.8	201.6	209.5	216.4	222.3	227.3	231.5	234.7	237.0	238.4	238.9	238.5	237.2	235.0	232.0	228.0
65	168.2	180.7	192.2	202.6	212.0	220.3	227.5	233.6	238.6	242.5	245.3	247.0	247.6	247.2	245.6	242.9	239.1	234.3
70	162.3	176.4	189.4	201.3	212.1	221.7	230.0	237.1	242.9	247.5	250.8	252.8	253.5	252.9	251.0	247.9	243.5	237.8

This table would be better understood if you put in one more row for the elevation and azimuth labels

	Azimuth Angle																	
Elevation Angle	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175
0	288.5	289.1	289.9	291.0	292.4	294.1	296.2	298.7	301.6	304.8	308.2	311.6	315.0	318.1	320.8	323.0	324.4	325.2
5	282.9	283.5	284.3	285.5	287.0	289.0	291.4	294.2	297.4	300.9	304.6	308.3	311.8	314.9	317.4	319.3	320.5	320.8
10	271.9	272.5	273.4	274.6	276.3	278.4	281.0	284.0	287.4	291.0	294.7	298.3	301.5	304.3	306.4	307.7	308.2	307.8
15	256.7	257.3	258.3	259.6	261.4	263.6	266.2	269.3	272.6	276.0	279.4	282.5	285.2	287.2	288.5	288.9	288.4	287.0
20	239.4	240.0	241.0	242.4	244.1	246.3	248.8	251.6	254.5	257.4	260.1	262.4	264.1	265.0	265.1	264.3	262.6	259.9
25	222.5	223.1	224.0	225.2	226.7	228.6	230.6	232.8	235.0	236.9	238.5	239.6	239.9	239.4	238.0	235.6	232.3	228.2
30	208.9	209.2	209.8	210.6	211.5	212.6	213.8	214.9	215.8	216.4	216.4	215.8	214.4	212.0	208.8	204.6	199.5	193.7
35	200.5	200.4	200.3	200.3	200.2	200.2	200.0	199.5	198.7	197.3	195.4	192.6	189.0	184.6	179.2	172.9	165.9	158.2
40	198.3	197.4	196.3	195.1	193.6	191.9	189.9	187.4	184.4	180.7	176.4	171.2	165.1	158.3	150.5	142.1	132.9	123.3
45	201.5	199.5	197.1	194.4	191.2	187.6	183.4	178.6	173.1	166.9	159.9	152.1	143.4	134.0	123.9	113.1	101.8	90.1
50	208.1	204.8	201.0	196.6	191.6	185.9	179.4	172.2	164.3	155.4	145.8	135.4	124.1	112.2	99.7	86.6	73.2	59.6
55	215.9	211.4	206.0	199.9	193.0	185.2	176.6	167.1	156.7	145.5	133.4	120.6	107.0	92.8	78.0	62.9	47.6	32.2
60	223.1	217.2	210.4	202.7	194.0	184.3	173.6	162.0	149.5	136.1	121.9	106.9	91.3	75.2	58.7	42.0	25.4	10.0
65	228.3	221.2	213.0	203.7	193.4	182.0	169.5	156.1	141.7	126.4	110.4	93.7	76.5	58.9	41.2	23.9	10.6	17.7
70	230.8	222.6	213.1	202.5	190.7	177.7	163.7	148.7	132.7	115.9	98.4	80.4	61.9	43.3	25.2	11.9	19.8	36.8

Elevation Angle	Azimuth Angle																	
	185	185	190	195	200	205	210	215	220	225	230	235	240	245	250	255	260	265
0	325.2	324.6	323.4	321.7	319.6	317.4	315.1	312.9	310.9	309.2	307.9	307.2	306.9	307.2	308.0	309.2	310.9	312.9
5	320.4	319.3	317.6	315.3	312.8	310.1	307.4	304.8	302.5	300.5	299.1	298.2	297.9	298.2	299.1	300.6	302.5	304.8
10	306.6	304.7	302.3	299.3	296.1	292.8	289.5	286.4	283.7	281.5	279.9	278.8	278.5	278.8	279.9	281.5	283.8	286.5
15	284.8	281.9	278.5	274.6	270.6	266.5	262.6	258.9	255.8	253.2	251.3	250.1	249.7	250.1	251.3	253.2	255.8	258.9
20	256.5	252.4	247.8	242.8	237.8	232.9	228.2	223.9	220.2	217.2	215.0	213.6	213.2	213.6	214.9	217.1	220.1	223.8
25	223.3	217.8	211.9	205.8	199.7	193.8	188.3	183.3	179.0	175.6	173.0	171.5	170.9	171.4	173.0	175.5	178.9	183.2
30	187.2	180.2	172.9	165.5	158.3	151.4	145.0	139.3	134.4	130.5	127.6	125.9	125.2	125.8	127.5	130.4	134.2	139.1
35	149.9	141.4	132.6	124.0	115.6	107.7	100.4	94.0	88.5	84.1	80.9	79.0	78.3	78.9	80.8	83.9	88.3	93.7
40	113.2	103.0	92.9	82.9	73.4	64.5	56.5	49.4	43.5	38.7	35.3	33.2	32.5	33.1	35.1	38.5	43.2	49.0
45	78.3	66.5	54.9	43.7	33.3	23.8	15.8	10.3	9.0	11.2	13.9	15.8	16.5	15.9	14.1	11.4	9.2	10.1
50	46.0	32.6	19.7	8.0	7.2	17.0	26.6	35.1	42.3	48.0	52.2	54.7	55.6	54.8	52.4	48.3	42.7	35.7
55	17.0	2.2	12.5	26.2	39.0	50.8	61.4	70.6	78.3	84.5	88.9	91.7	92.6	91.8	89.2	84.9	78.8	71.2
60	10.9	25.8	41.0	55.6	69.2	81.6	92.8	102.5	110.6	117.0	121.7	124.5	125.5	124.7	122.0	117.4	111.1	103.1
65	33.7	50.3	66.4	81.6	95.8	108.8	120.4	130.4	138.8	145.5	150.3	153.2	154.3	153.4	150.6	145.9	139.4	131.1
70	54.6	72.0	88.7	104.5	119.1	132.5	144.3	154.6	163.2	170.0	174.9	177.9	179.0	178.1	175.2	170.4	163.8	155.3

	Azimuth Angle																	
Elevation Angle	270	275	280	285	290	295	300	305	310	315	320	325	330	335	340	345	350	355
0	315.2	317.5	319.8	321.8	323.6	324.8	325.5	325.4	324.7	323.2	321.1	318.4	315.3	311.9	308.4	305.0	301.9	299.0
5	307.4	310.2	312.9	315.5	317.7	319.5	320.6	321.1	320.7	319.6	317.7	315.1	312.0	308.5	304.9	301.2	297.7	294.5
10	289.5	292.8	296.2	299.4	302.4	304.9	306.8	308.0	308.3	307.9	306.5	304.4	301.7	298.5	294.9	291.2	287.6	284.2
15	262.5	266.5	270.6	274.6	278.5	282.0	284.9	287.1	288.5	288.9	288.5	287.3	285.2	282.6	279.5	276.1	272.7	269.4
20	228.1	232.8	237.7	242.7	247.6	252.2	256.4	259.8	262.4	264.2	265.0	264.9	264.0	262.3	260.0	257.3	254.4	251.5
25	188.1	193.6	199.5	205.6	211.6	217.5	223.0	227.9	232.0	235.3	237.7	239.1	239.6	239.3	238.2	236.7	234.7	232.5
30	144.7	151.1	157.9	165.1	172.5	179.7	186.7	193.2	199.0	204.1	208.3	211.5	213.8	215.3	215.9	215.9	215.4	214.5
35	100.1	107.3	115.1	123.5	132.1	140.7	149.3	157.5	165.2	172.2	178.4	183.8	188.3	191.9	194.6	196.6	198.0	198.8
40	56.0	64.0	72.8	82.2	92.1	102.3	112.4	122.4	132.0	141.1	149.6	157.3	164.1	170.2	175.4	179.8	183.5	186.5
45	15.4	23.2	32.6	42.9	54.0	65.5	77.3	89.1	100.7	111.9	122.7	132.8	142.2	150.9	158.7	165.7	172.0	177.5
50	27.3	17.8	7.9	7.3	18.7	31.5	44.8	58.4	71.9	85.3	98.3	110.9	122.8	134.0	144.5	154.1	163.0	171.0
55	62.1	51.7	40.0	27.2	13.6	1.3	15.7	30.9	46.2	61.5	76.6	91.3	105.5	119.1	132.0	144.1	155.4	165.8
60	93.6	82.5	70.2	56.7	42.2	27.1	12.2	9.1	24.0	40.5	57.2	73.7	89.8	105.4	120.4	134.6	148.1	160.7
65	121.2	109.7	96.9	82.8	67.6	51.6	35.2	19.1	10.5	22.6	39.7	57.4	75.0	92.2	108.9	124.9	140.2	154.7
70	145.2	133.4	120.2	105.7	90.0	73.4	56.1	38.3	21.3	12.0	24.0	41.8	60.4	78.8	96.9	114.4	131.2	147.2

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GEOMETRY
Dimensions in feet
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	4.	3
		0	0	49.		
2	none	0	0	49.	4.	3
		0	0	109.		
3	none	0	0	109.	4.	3
		0	0	169.		
4	none	0	0	169.	4.	3
		0	0	229.		
5	none	0	0	229.	4.	3
		0	0	289.		
6	none	0	0	289.	4.	3
		0	0	345.		
7	none	0	0	345.	2.	3
		0	0	394.		
8	none	41.1	0	276.4	.04	5
		100.	0	0		
9	none	46.6	0	224.	.04	5
		100.	0	0		
10	none	0	0	229.	.04	5
		100.	0	0		
11	none	0	0	169.	.04	5
		100.	0	0		
12	none	0	0	169.	.04	5
		207.	0	0		
13	none	0	0	109.	.04	5
		207.	0	0		
14	none	0	0	49.	.04	5
		207.	0	0		
15	none	46.6	120.	224.	.04	5
		100.	120.	0		
16	none	41.1	120.	276.4	.04	5
		100.	120.	0		
17	none	0	0	229.	.04	5
		100.	120.	0		
18	none	0	0	169.	.04	5
		100.	120.	0		
19	none	0	0	169.	.04	5
		207.	120.	0		
20	none	0	0	109.	.04	5
		207.	120.	0		
21	none	0	0	49.	.04	5
		207.	120.	0		
22	none	41.1	240.	276.4	.04	5
		207.	240.	0		

23	none	46.6	240.	224.	.04	5
		207.	240.	0		
24	none	0	0	229.	.04	5
		207.	240.	0		
25	none	0	0	169.	.04	5
		207.	240.	0		
26	none	0	0	169.	.04	5
		100.	240.	0		
27	none	0	0	109.	.04	5
		100.	240.	0		
28	none	0	0	49.	.04	5
		100.	240.	0		
29	none	260.	60.	0	.1	5
		0	0	229.		

Number of wires = 29
current nodes = 147

Individual wires	minimum wire	minimum value	maximum wire	maximum value
segment length	1	16.3333	29	69.2939
segment/radius ratio	1	4.08333	22	1,611.83
radius	8	.04	1	4.

ELECTRICAL DESCRIPTION
Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	1.08	0	1	.0179342	.0760857

Sources

source	node	sector	magnitude	phase	type
1	142	1	1.	0	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 142, sector 1							
1.08	51.261	-385.1	388.49	277.6	59.844	-.29031	-11.894

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CURRENT rms
Frequency = 1.08 MHz
Input power = 1,000. watts
Efficiency = 100. %
coordinates in feet

current mag phase real imaginary

no.	X	Y	Z	(amps)	(deg)	(amps)	(amps)
GND	0	0	0	.332214	297.7	.154579	-.294061
2	0	0	16.3333	.328623	298.2	.155381	-.289569
3	0	0	32.6667	.317979	299.8	.157805	-.276058
END	0	0	49.	.310257	301.	.159603	-.266057
2J1	0	0	49.	.293431	320.3	.225904	-.187268
5	0	0	69.	.277535	326.6	.231778	-.152658
6	0	0	89.	.260195	337.6	.240489	-.0993297
END	0	0	109.	.254119	344.2	.244566	-.0690225
2J2	0	0	109.	.575013	31.9	.48811	.303956
8	0	0	129.	.616599	36.4	.496255	.365958
9	0	0	149.	.672077	41.3	.504572	.443953
END	0	0	169.	.672932	41.2	.506196	.4434
2J3	0	0	169.	1.84565	52.4	1.12718	1.46147
11	0	0	189.	1.92407	54.4	1.12137	1.56352
12	0	0	209.	2.00866	56.7	1.10399	1.67807
END	0	0	229.	2.08446	57.8	1.11087	1.76379
2J4	0	0	229.	3.58234	290.2	1.23542	-3.36258
14	0	0	249.	3.34949	290.2	1.15671	-3.14342
15	0	0	269.	3.04404	290.1	1.04438	-2.85927
END	0	0	289.	2.67611	289.9	.909593	-2.51678
2J5	0	0	289.	2.67611	289.9	.909593	-2.51678
17	0	0	307.667	2.28175	289.6	.766304	-2.14923
18	0	0	326.333	1.83801	289.3	.608194	-1.73446
END	0	0	345.	1.30378	288.9	.423376	-1.23312
2J6	0	0	345.	1.30378	288.9	.423376	-1.23312
20	0	0	361.333	.960727	288.7	.308145	-.909969
21	0	0	377.667	.552544	288.4	.174661	-.524212
END	0	0	394.	0	0	0	0
J8	41.1	0	276.4	.753842	256.6	-.174984	-.733252
22	52.88	0	221.12	.184782	258.9	-.0356687	-.181307
23	64.66	0	165.84	.340572	257.	-.0768973	-.331777
24	76.44	0	110.56	.523157	256.	-.126287	-.507686
25	88.22	0	55.28	.508839	255.5	-.12702	-.49273
GND	100.	0	0	.526765	255.8	-.129274	-.510656
END	46.6	0	224.	0	0	0	0
27	57.28	0	179.2	.0575948	248.	-.0215966	-.0533924
28	67.96	0	134.4	.139701	249.7	-.0484733	-.131022
29	78.64	0	89.6	.426334	255.9	-.103766	-.413513
30	89.32	0	44.8	.668112	256.5	-.156073	-.649627
31	100.	0	0	.753842	256.6	-.174984	-.733252
2J4	0	0	229.	.271245	253.5	-.0772215	-.260021
33	20.	0	183.2	.17866	232.1	-.109767	-.140963
34	40.	0	137.4	.15514	195.3	-.149606	-.0410655
35	60.	0	91.6	.188298	181.4	-.188246	-4.44E-03
36	80.	0	45.8	.214876	167.	-.209365	.0483513
GND	100.	0	0	.227284	165.4	-.21994	.0573085
2J3	0	0	169.	.0625045	102.9	-.0139953	.0609175
39	20.	0	135.2	.0923594	100.6	-.0169532	.0907901
40	40.	0	101.4	.142605	97.7	-.0191312	.141315
41	60.	0	67.6	.144787	103.8	-.0344798	.140622
42	80.	0	33.8	.16745	102.8	-.0370333	.163304
GND	100.	0	0	.182832	100.8	-.0341482	.179615

2J3	0	0	169.	.596585	247.4	-.228946	-.550906
45	41.4	0	135.2	.473821	242.8	-.216496	-.421468
46	82.8	0	101.4	.180515	203.4	-.165654	-.0717235
47	124.2	0	67.6	.206673	135.2	-.14673	.145547
48	165.6	0	33.8	.294108	118.7	-.14105	.258079
GND	207.	0	0	.32582	115.5	-.140105	.294159
2J2	0	0	109.	.227871	244.8	-.0969725	-.206208
51	41.4	0	87.2	.15759	237.5	-.0846325	-.132936
52	82.8	0	65.4	.0531227	196.5	-.0509222	-.0151311
53	124.2	0	43.6	.103349	105.4	-.0275282	.0996153
54	165.6	0	21.8	.149765	97.1	-.0183994	.148631
GND	207.	0	0	.162562	95.5	-.0154886	.161822
2J1	0	0	49.	.0613609	245.3	-.0256104	-.0557608
57	41.4	0	39.2	.0320512	230.2	-.0205115	-.0246284
58	82.8	0	29.4	.0230169	117.6	-.0106682	.0203953
59	124.2	0	19.6	.0744651	88.7	1.75E-03	.0744445
60	165.6	0	9.8	.0953406	86.1	6.4E-03	.0951253
GND	207.	0	0	.101311	85.4	8.07E-03	.100989
J15	-23.3	-40.3568	224.	.590015	257.	-.13259	-.574925
62	-28.64	-49.6059	179.2	.0714272	248.3	-.0264618	-.0663447
63	-33.98	-58.8551	134.4	.164858	249.6	-.057494	-.154508
64	-39.32	-68.1042	89.6	.468585	255.3	-.118642	-.453317
65	-44.66	-77.3534	44.8	.721419	255.8	-.176686	-.699448
GND	-50.	-86.6026	0	.795259	256.1	-.191403	-.771882
END	-20.55	-35.5937	276.4	0	0	0	0
67	-26.44	-45.7954	221.12	.22077	259.3	-.0409052	-.216947
68	-32.33	-55.9972	165.84	.40088	257.8	-.0848446	-.391799
69	-38.22	-66.199	110.56	.598475	256.9	-.135476	-.582939
70	-44.11	-76.4008	55.28	.575537	257.	-.129379	-.560806
71	-50.	-86.6026	0	.590015	257.	-.13259	-.574925
2J4	0	0	229.	.160172	250.8	-.0526676	-.151266
73	-10.	-17.3205	183.2	.0936663	202.9	-.0862763	-.0364661
74	-20.	-34.641	137.4	.138725	158.6	-.129134	.0506861
75	-30.	-51.9615	91.6	.184579	160.	-.173395	.0632755
76	-40.	-69.282	45.8	.218915	157.	-.201578	.0853805
GND	-50.	-86.6026	0	.228234	169.9	-.224722	.0398872
2J3	0	0	169.	.0670505	101.6	-.0134373	.0656902
79	-10.	-17.3205	135.2	.0975143	99.6	-.016268	.0961478
80	-20.	-34.641	101.4	.150492	96.8	-.0178537	.14943
81	-30.	-51.9615	67.6	.151036	102.8	-.0335273	.147268
82	-40.	-69.282	33.8	.180001	101.	-.0344231	.176679
GND	-50.	-86.6026	0	.213054	97.4	-.0273571	.21129
2J3	0	0	169.	.618696	247.8	-.234053	-.572716
85	-20.7	-35.8535	135.2	.48964	243.3	-.220321	-.437271
86	-41.4	-71.7069	101.4	.178443	202.4	-.16499	-.0679724
87	-62.1	-107.56	67.6	.213039	132.9	-.14507	.156014
88	-82.8	-143.414	33.8	.305088	117.1	-.139039	.271564
GND	-103.5	-179.267	0	.338002	114.1	-.138084	.30851
2J2	0	0	109.	.244793	245.5	-.101473	-.222771
91	-20.7	-35.8535	87.2	.171512	238.9	-.0885808	-.146866
92	-41.4	-71.7069	65.4	.0531727	194.6	-.0514488	-.0134297
93	-62.1	-107.56	43.6	.109582	104.2	-.0269572	.106215
94	-82.8	-143.414	21.8	.157715	96.4	-.0176377	.156725

GND	-103.5	-179.267	0	.170923	94.9	-.0147368	.170287
2J1	0	0	49.	.0668216	244.9	-.0283817	-.0604947
97	-20.7	-35.8535	39.2	.0367821	231.1	-.023121	-.0286066
98	-41.4	-71.7069	29.4	.0234559	122.2	-.0124845	.0198574
99	-62.1	-107.56	19.6	.0773223	89.5	7.18E-04	.0773189
100	-82.8	-143.414	9.8	.0988298	86.8	5.45E-03	.0986796
GND	-103.5	-179.267	0	.104906	86.1	7.06E-03	.104669
J22	-20.55	35.5936	276.4	.544855	210.1	-.471531	-.272995
102	-37.14	64.3284	221.12	.0560644	265.8	-4.11E-03	-.0559133
103	-53.73	93.0631	165.84	.0946155	270.	-3.18E-05	-.0946155
104	-70.32	121.798	110.56	.136618	268.7	-3.19E-03	-.136581
105	-86.91	150.533	55.28	.157862	271.7	4.69E-03	-.157792
GND	-103.5	179.267	0	.147883	281.5	.0293978	-.144932
END	-23.3	40.3568	224.	0	0	0	0
107	-39.34	68.1389	179.2	.143185	198.6	-.135669	-.0457812
108	-55.38	95.921	134.4	.275715	200.7	-.25795	-.0973678
109	-71.42	123.703	89.6	.388659	203.1	-.357402	-.152706
110	-87.46	151.485	44.8	.475665	206.	-.427508	-.208552
111	-103.5	179.267	0	.544855	210.1	-.471531	-.272995
2J4	0	0	229.	.217335	288.7	.0695654	-.205901
113	-20.7	35.8535	183.2	8.22E-03	242.7	-3.77E-03	-7.31E-03
114	-41.4	71.7069	137.4	.239675	108.8	-.0770652	.226948
115	-62.1	107.56	91.6	.447937	108.6	-.14283	.424555
116	-82.8	143.414	45.8	.593962	107.8	-.182033	.565381
GND	-103.5	179.267	0	.665932	106.5	-.188695	.638639
2J3	0	0	169.	.0605475	260.7	-9.82E-03	-.0597461
119	-20.7	35.8535	135.2	.0175387	143.	-.0140061	.0105563
120	-41.4	71.7069	101.4	.103105	96.8	-.0122482	.102374
121	-62.1	107.56	67.6	.182558	92.2	-7.14E-03	.182419
122	-82.8	143.414	33.8	.236099	90.5	-1.91E-03	.236091
GND	-103.5	179.267	0	.254962	89.1	4.04E-03	.25493
2J3	0	0	169.	.12678	162.2	-.120731	.0386933
125	-10.	17.3205	135.2	.134919	152.2	-.119367	.0628849
126	-20.	34.641	101.4	.15328	137.7	-.11337	.103159
127	-30.	51.9615	67.6	.173824	127.9	-.106799	.137145
128	-40.	69.282	33.8	.188473	122.7	-.10187	.158571
GND	-50.	86.6025	0	.193107	121.2	-.1001	.165137
2J2	0	0	109.	.0719019	128.8	-.0450987	.056
131	-10.	17.3205	87.2	.0814277	120.9	-.0418213	.0698674
132	-20.	34.641	65.4	.0967133	112.1	-.0363566	.0896196
133	-30.	51.9615	43.6	.109482	106.7	-.0314928	.104855
134	-40.	69.282	21.8	.117006	104.	-.0282847	.113535
GND	-50.	86.6025	0	.118862	103.3	-.0272465	.115697
2J1	0	0	49.	.0394362	108.2	-.0123089	.0374661
137	-10.	17.3205	39.2	.0432154	104.7	-.0110015	.0417916
138	-20.	34.641	29.4	.0489556	100.5	-8.94E-03	.048132
139	-30.	51.9615	19.6	.053393	97.7	-7.18E-03	.0529074
140	-40.	69.282	9.8	.0559612	96.2	-6.03E-03	.0556359
GND	-50.	86.6025	0	.056403	95.7	-5.65E-03	.0561194
GND	130.	-225.167	0	4.41677	82.4	.582792	4.37815
143	104.	-180.133	45.8	1.38611	66.9	.543109	1.27528
144	78.	-135.1	91.6	1.61104	285.9	.442256	-1.54915
145	52.	-90.0666	137.4	3.89369	274.5	.304093	-3.8818

146	26.	-45.0333	183.2	5.34167	271.8	.16469	-5.33913
END	0	0	229.	5.74391	270.6	.0642319	-5.74355