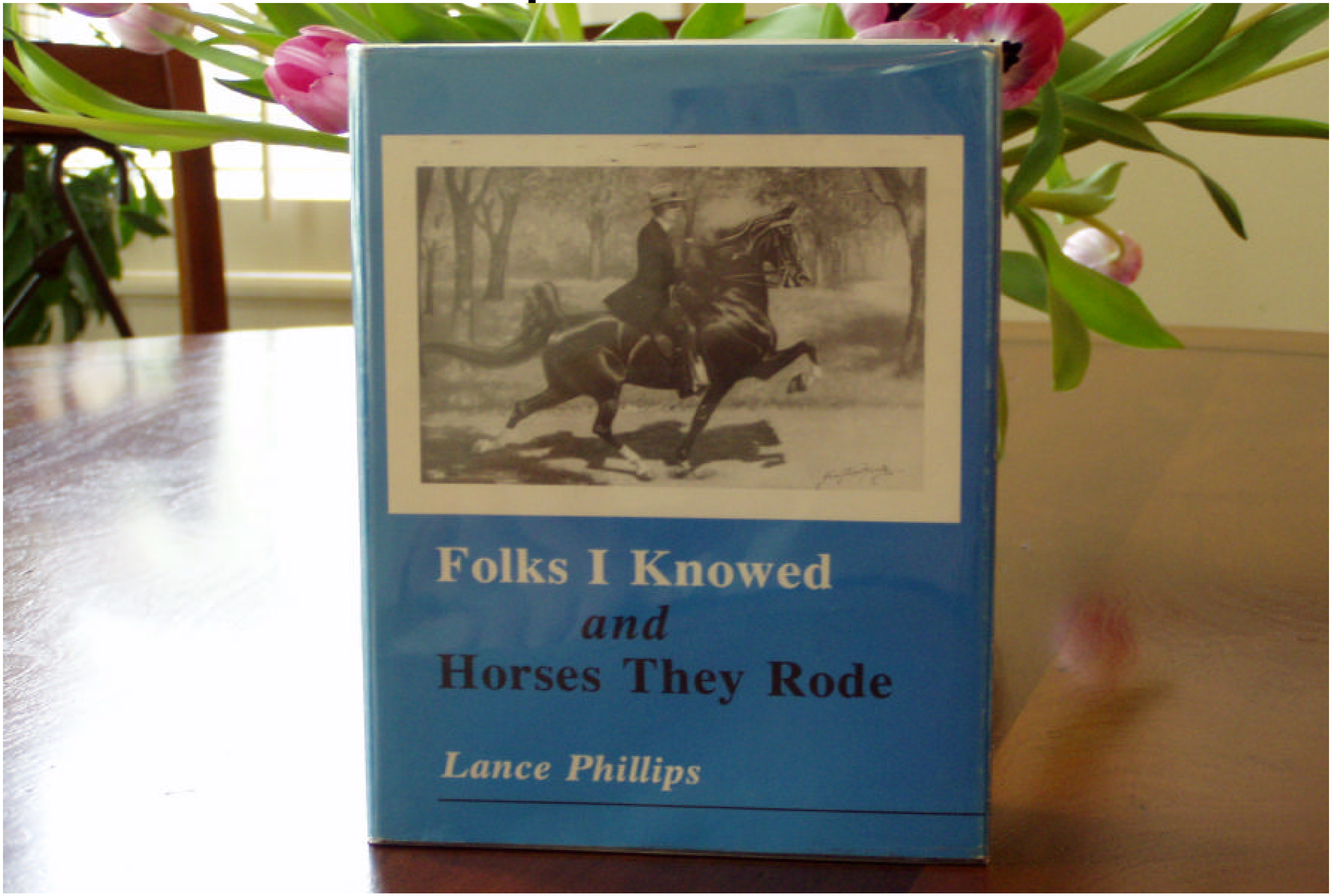
People I know ….
and Antennas they Grow

Dayton Hamvention Antenna Forum
May 18, 2007

Ted Rappaport, N9NB
Austin, Texas

Inspiration….




Howard
Schatzberg


DX
HANDBOOK
POPULAR ELECTRONICS
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COMMUNICATIONS HANDBOOK 1975
EQUIPMENT BUYING DIRECTORY
INCLUDING LATEST MODELS, FEATURES AND PRICES
A COMPLETE GUIDE TO:
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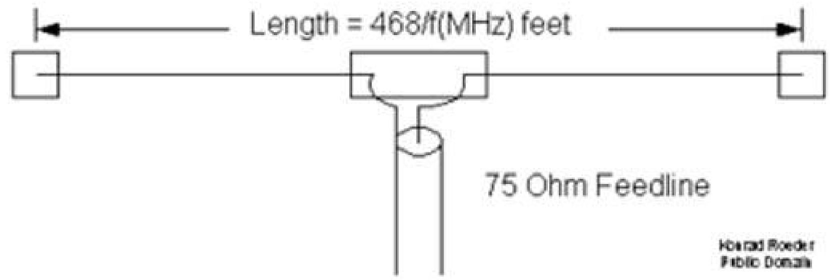

Heinrech Hertz
1887

American Electrician, July, 1899, pages 344-346:

THE APPARATUS FOR WIRELESS TELEGRAPHY.

BY PROF. JEROME J. GREEN.

The apparatus for demonstrating the effectiveness of telegraphing by means of Hertz waves is comparatively simple. In the experiments recently conducted at the University of Notre Dame all the essential parts of the sending and receiving stations were found in the regular equipment of the electrical and physical laboratories, except a few details which were constructed in the workshops by the students.

It has been known for several years that electric waves are propagated from an insulated conductor when this conductor is rapidly charged and discharged in such a way as to produce a series of very sudden disturbances in the surrounding ether. The waves are said to travel with about the velocity of light, but their length is much greater than the length of light waves, and this length depends on the character of the spark produced at the discharging terminals. These terminals, as used in wireless telegraphy, are always spherical in shape, with great variations as to size.

These electric waves of various lengths may be refracted or reflected like the waves of heat and light. They pass through many substances but are absorbed or reflected by metals.

The parts required for a complete sending station are an induction coil capable of producing a stream of sparks from one to ten or more inches in length. A smaller coil will of course answer if the receiving station is located close to the sending apparatus--a suitable primary or secondary battery to operate the coil and a discharger or oscillator. The oscillator may be two large metal spheres placed about half an inch apart on insulating supports. The space between them is sometimes filled with a heavy petroleum oil, but this is not essential. Additional spheres or plates may be connected with each of the large spheres between which the discharge takes place. These additions increase the capacity of the oscillator and change the character of the spark produced.

A simpler and more easily constructed oscillator is the vertical wire with a metal sphere at its upper end, in connection with two small spheres about an inch in diameter. This is the apparatus Mr. Marconi used. The lower end of the vertical wire is attached to one of the spheres and the other is fastened to a steam or water pipe.

An easy way to make this form of oscillator is to drill holes in two small metal spheres and put these spheres on the adjustable points, with which all induction coils are supplied, at the terminals of the secondary windings.

The vertical wire should be attached to one of the terminals of the secondary coil, and the ground wire to the other. (See Fig. 1). Then adjust the distance between the spheres, and the tension on the vibrating interrupter spring until a stream of thick, white, noisy sparks is produced when the primary switch is closed.

For the receiving station there is needed a coherer with a decohering tapper, a sensitive relay, and a sounder or a Morse recorder.

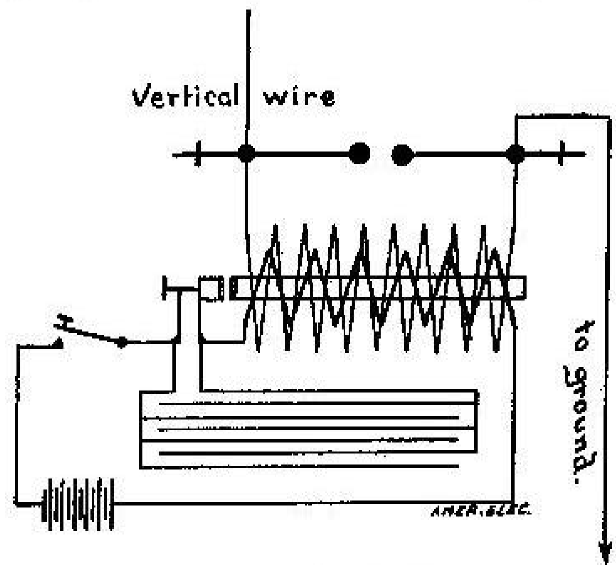

FIG. 1.—CIRCUITS OF TRANSMITTER.

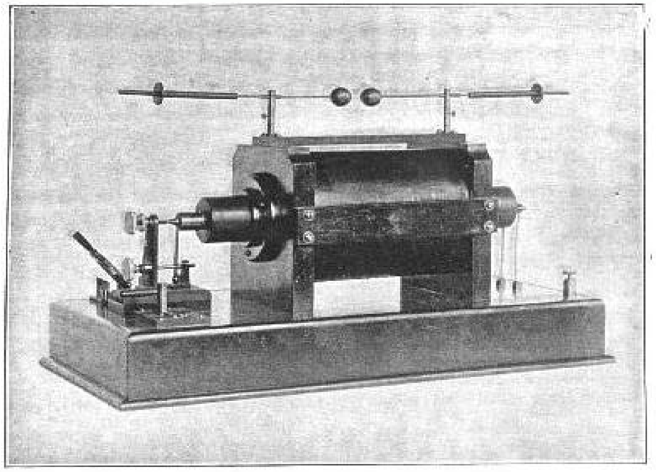

FIG. 2.–A HERTZ WAVE TRANSMITTER.

The coherer is, of course, the essential part of the receiving station. It may be made from a small glass tube, of, say, one-eighth of an inch internal diameter, and it may be about an inch and a half or two inches long. Into the ends should be fitted brass rods, and these plugs of metal should have a space between their ends near the middle of the tube, which space can be increased or decreased in length by sliding out and in one of the metal plugs. To complete the coherer a small quantity of filings of metal, such as silver or nickel, or a mixture of these metals, is put in the space between the plugs in the glass tube. Filings from the ordinary five-cent piece will answer very well.

This contrivance has the property of changing its resistance when it is acted on by the waves. A space in such a tube one-fourth of an inch in length, loosely filled with filings in their normal condition, will have a resistance of several megohms, but when the waves from the sending station strike the vertical wire attached to one of the terminals of the coherer the resistance of the coherer falls to about ten ohms. The coherer is put in circuit with a high-resistance relay, and a dry battery of one or two cells. When no waves are passing, the coherer has so high a resistance as to virtually open this circuit; but when the action of the waves begins, the decrease of the resistance closes the circuit, and the armature of the relay is drawn down and closes the circuit on a sounder, or on whatever we wish to add to the receiving set. The resistance of the coherer remains at this low value even after the waves have ceased to strike the vertical wire, but it becomes very high again when the filings are shaken. A little tapper like that on an ordinary electric bell is made to strike the side of the tube for this purpose. The relay in circuit with the coherer may close a circuit to operate such a decohering tapper or the filings may be shaken by tapping the tube with a lead pencil or by other mechanical means.

From the diagram, Fig. 3, it will be seen that the minute oscillating current produced in the vertical wire set up by the passing of the waves has the choice of two paths to earth; through the coherer, C, or through the relay, R. To prevent its passing to the relay and leaking across through the metal, well insulated choking coils A & A are placed in the circuit with the relay. The rubber-covered spools of a four-ohm telegraph sounder will do for these coils. The small current is then forced to go through the filings to ground, and this causes them to cohere as long as it is passing, even though they are shaken. It is well to put some non-inductive resistance (such as the lamp shown in the diagram) across the points of the vibrating tapper and the tongue of the relay to prevent a spark there. It is especially important that the spark be prevented at the tapper, as it is so close to the filings that if considerable sparking occurred here it would set up waves which would cause the filings to cohere to some extent and prevent the decohering action of the tapper. The great difficulty in the first experiments at Notre Dame was to make the filings decohere quickly. If this action is not prompt it is impossible to make dots and dashes so that they can be distinguished.

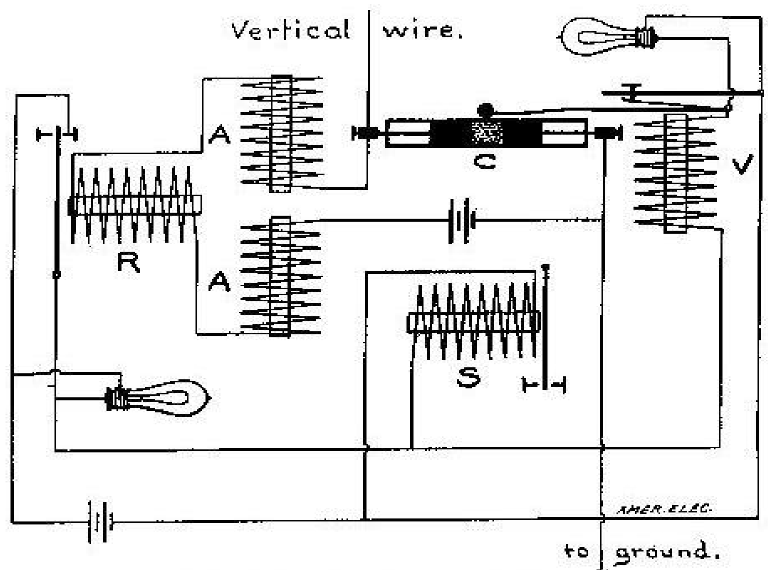

FIG. 3.–CIRCUITS OF RECEIVING APPARATUS.

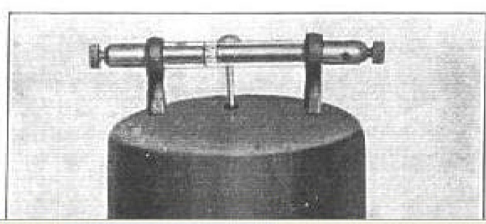

Fig. 4 shows the coherer tube mounted on hard rubber supports on the top of the metal cover of an ordinary buzzer. An extension from the armature of the buzzer reaches through the cover and strikes the tube.

We employed in all our experiments an eight-inch induction coil of American make, with a heavy Apps vibrating circuit breaker

MARCONI INTERNATIONAL FELLOWSHIP

GIOIA MARCONI BRAGA
(Mrs. George Atkinson Braga)

rconi Braga, daughter of the late Marchese, Senatore Guglielmo Marconi and the late
le Beatrice O'Brien, daughter of the 14th Baron Inchiquin of Dromoland Castle, County
land, was born in London, England. She was educated in Italy, attending the Poggio
College in Florence. During World War II she served as a voluntary nurse in the Italian
received a Certificate of Merit.

a worked in radio and television as a producer and occasionally as an announcer of cur-
and educational programs in Rome for the RAI and later from 1952 to 1954 for NBC

COMSAT

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Wednesday, April 25, 1990
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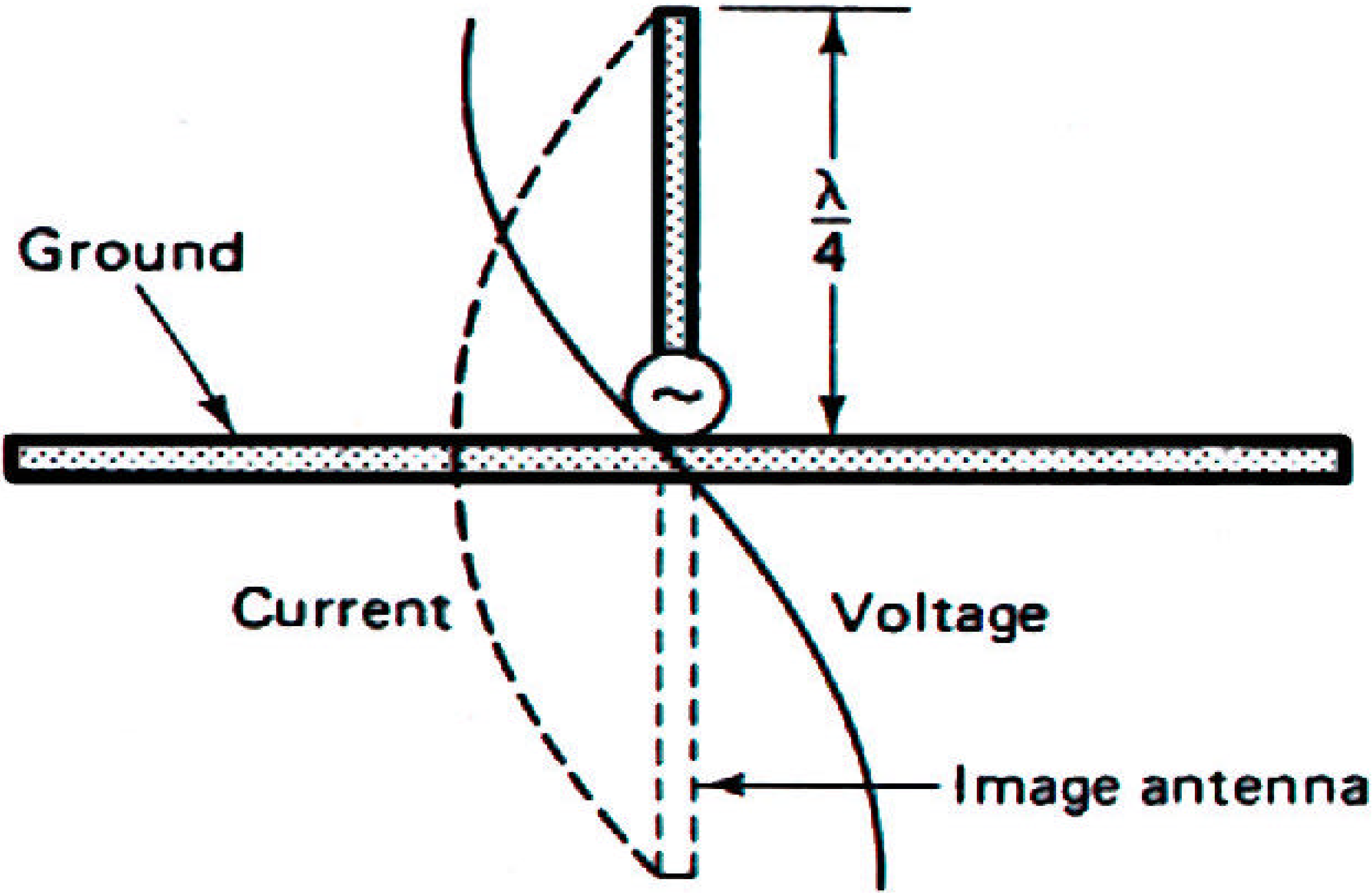
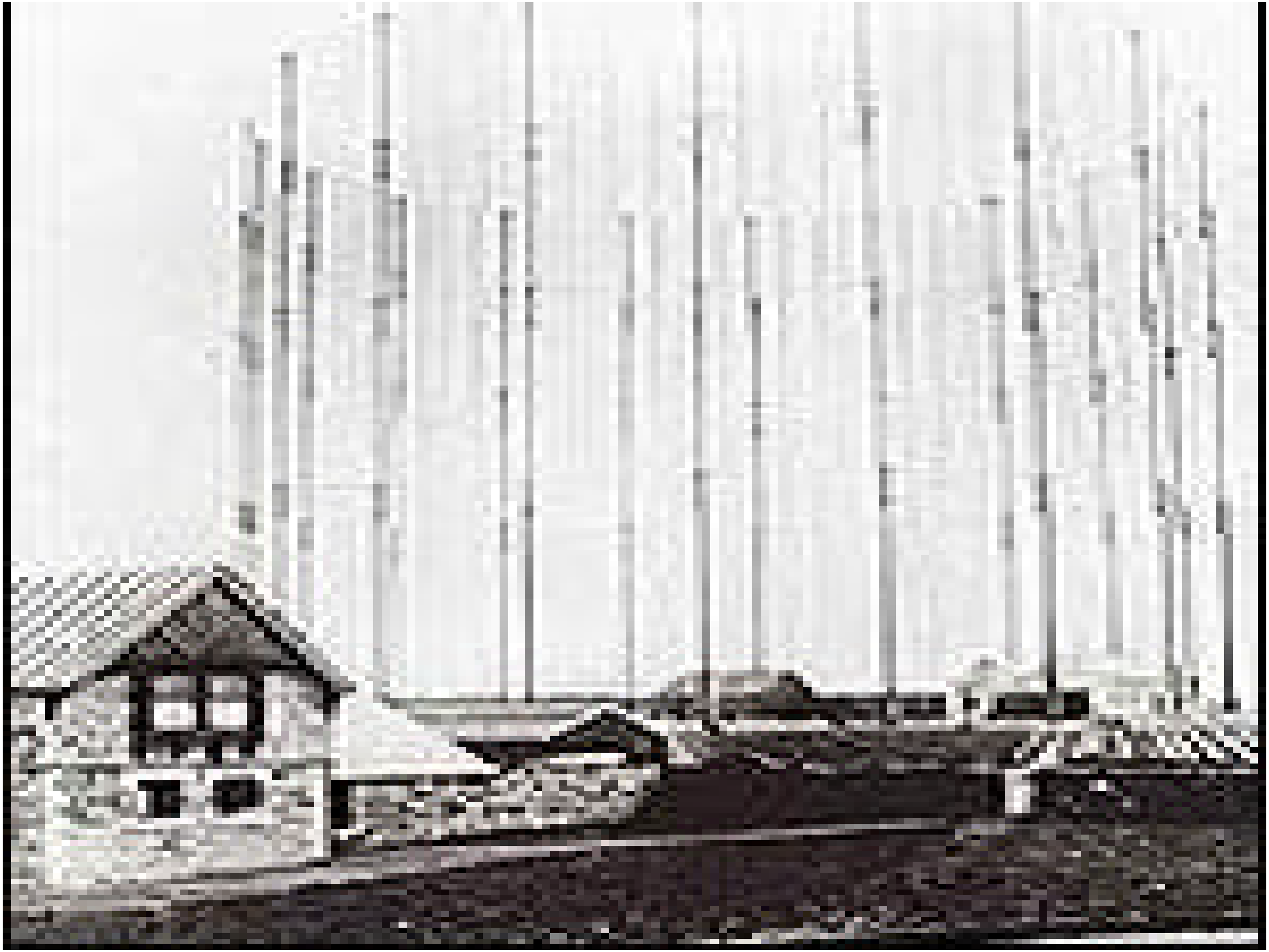
DOCTORS VITERBI AND RAPPAPORT NAME

AWARD WINNERS

WASHINGTON, D.C. -- Dr. Andrew J. Vit
Dr. Theodore S. Rappaport have been named
prestigious Marconi Awards. The announce
Gioia Marconi Braga, Chairperson of the



Grounded Marconi Antenna



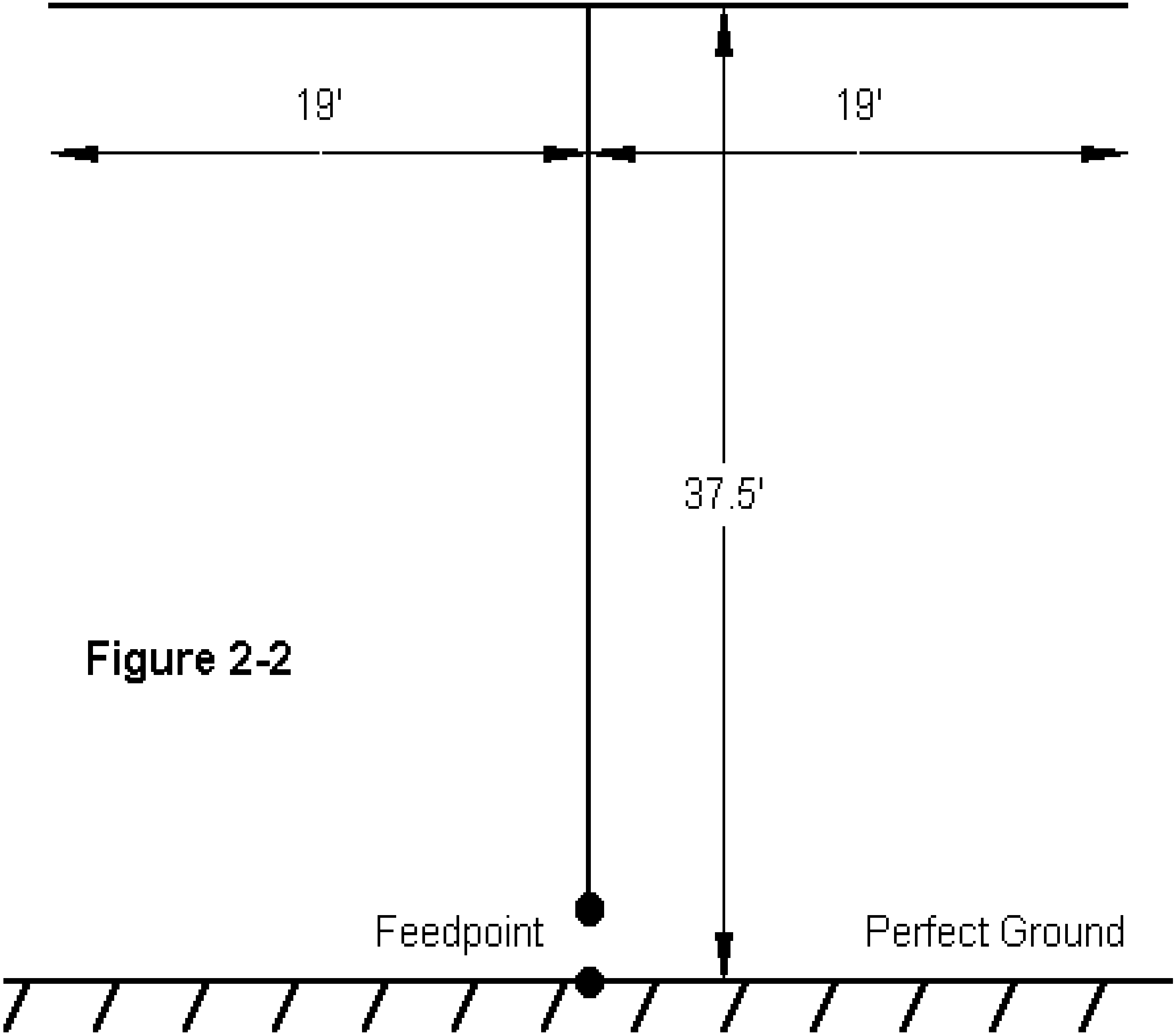


Figure 2-2

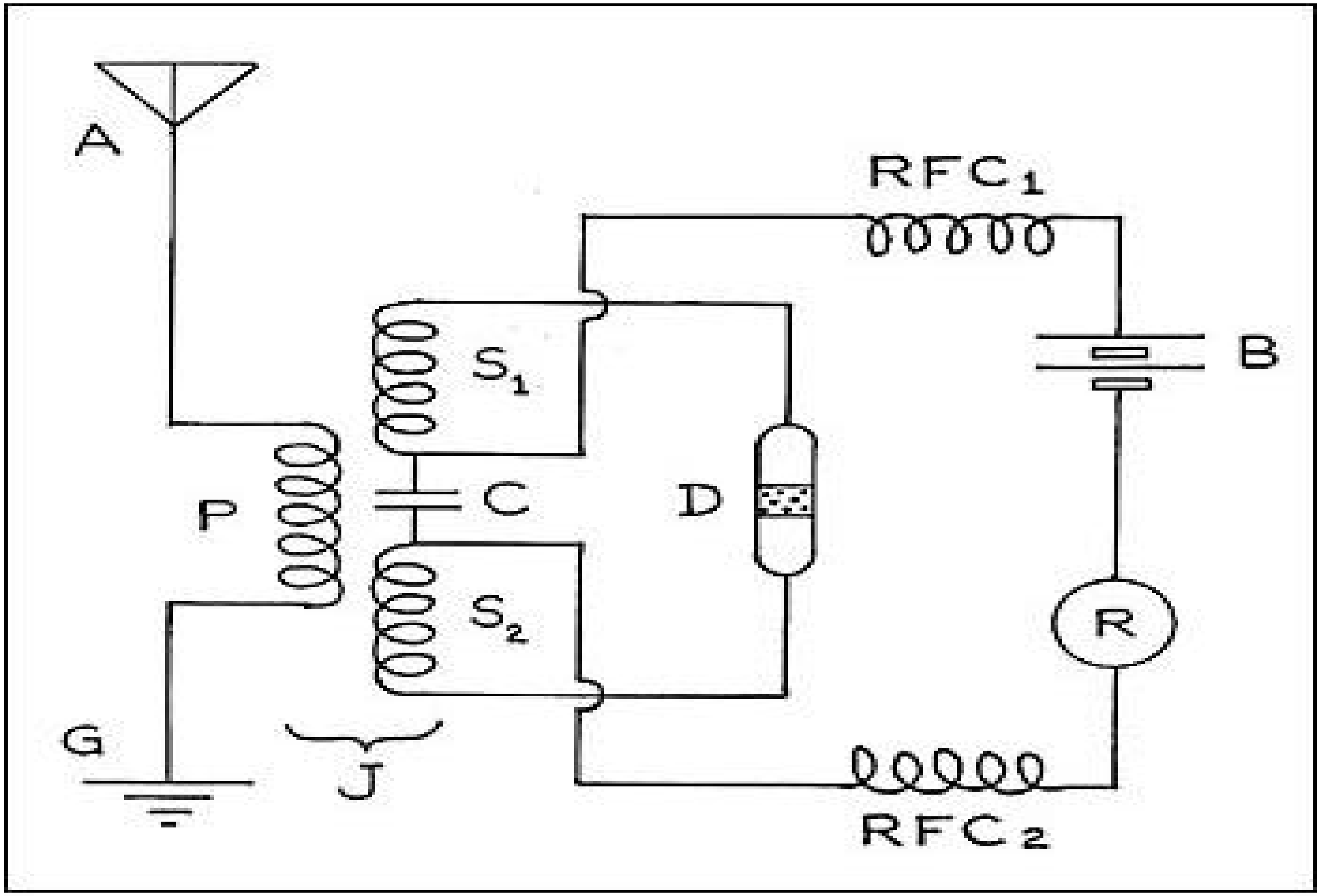


Fig. 1. Schematic of untuned receiver. A = antenna; g = ground; J = r.f. antenna transformer (called a "jigger"); P = primary coil; S1, S2 = halves of split secondary coil; D = coherer detector; C = r.f. bypass capacitor; RFC1, RFC2 = r.f. chokes; B = Battery; R = relay. When triggered by an r.f. signal voltage from J, the resistance of the coherer dropped,, increasing the current in the d.c. circuit consisting of D, S1, S2, RFC1, RFC2, B and R. The relay circuit was isolated from the r.f. circuit by RFC1, RFC2 and C. The relay typically activated a paper chart recorder and a tapper (not shown). The tapper decohered the metal filings in the coherer to restore it to a sensitive (high resistance) state for the next signal.

MARCONI WIRELESS TELEGRAPH COMPANY

OF AMERICA

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This is to Certify that

is the owner of shares of the par value of Five Dollars each fully paid and non-assessable in the Capital Stock of Marconi Wireless Telegraph Company of America transferable on the books of the Company in person or by duly authorized attorney on surrender of this Certificate properly endorsed. This Certificate shall not be valid until countersigned by the Transfer Agent and the Registrar.

Witness the seal of the Company and the signatures of its duly authorized officers this day of 19

CAPITAL STOCK

Marconi International Fellowship

Administered by
Polytechnic University

333 Jay Street
Brooklyn, New York 11201 USA
718-260-3280
Fax: 718-260-3136

April 25, 1990

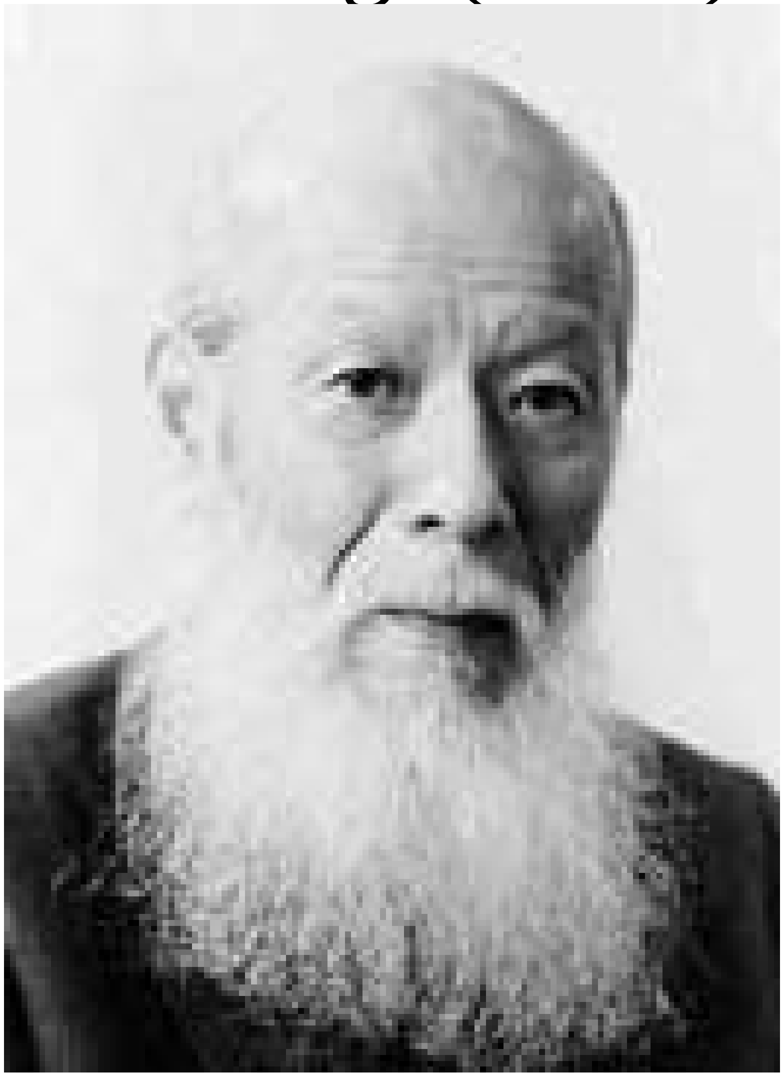
Dear Dr. Rappaport,

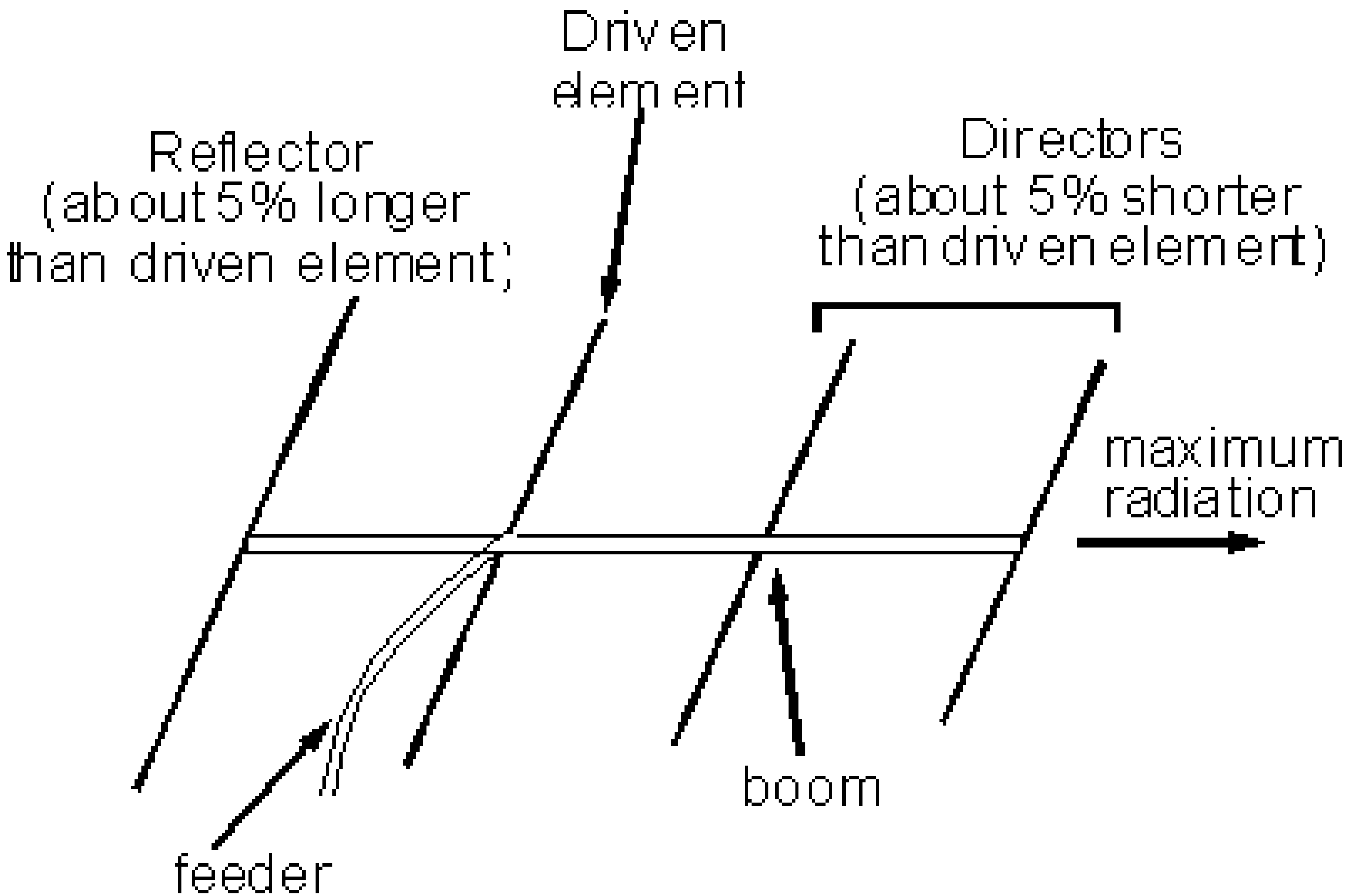
This Marconi Young Scientist grant is presented to you on behalf of the Marconi Fellowship Council with their warmest wishes for a full and rewarding career.

Sincerely,

Gioia Marconi Braga
Chairperson

Prof. Yagi (1928)

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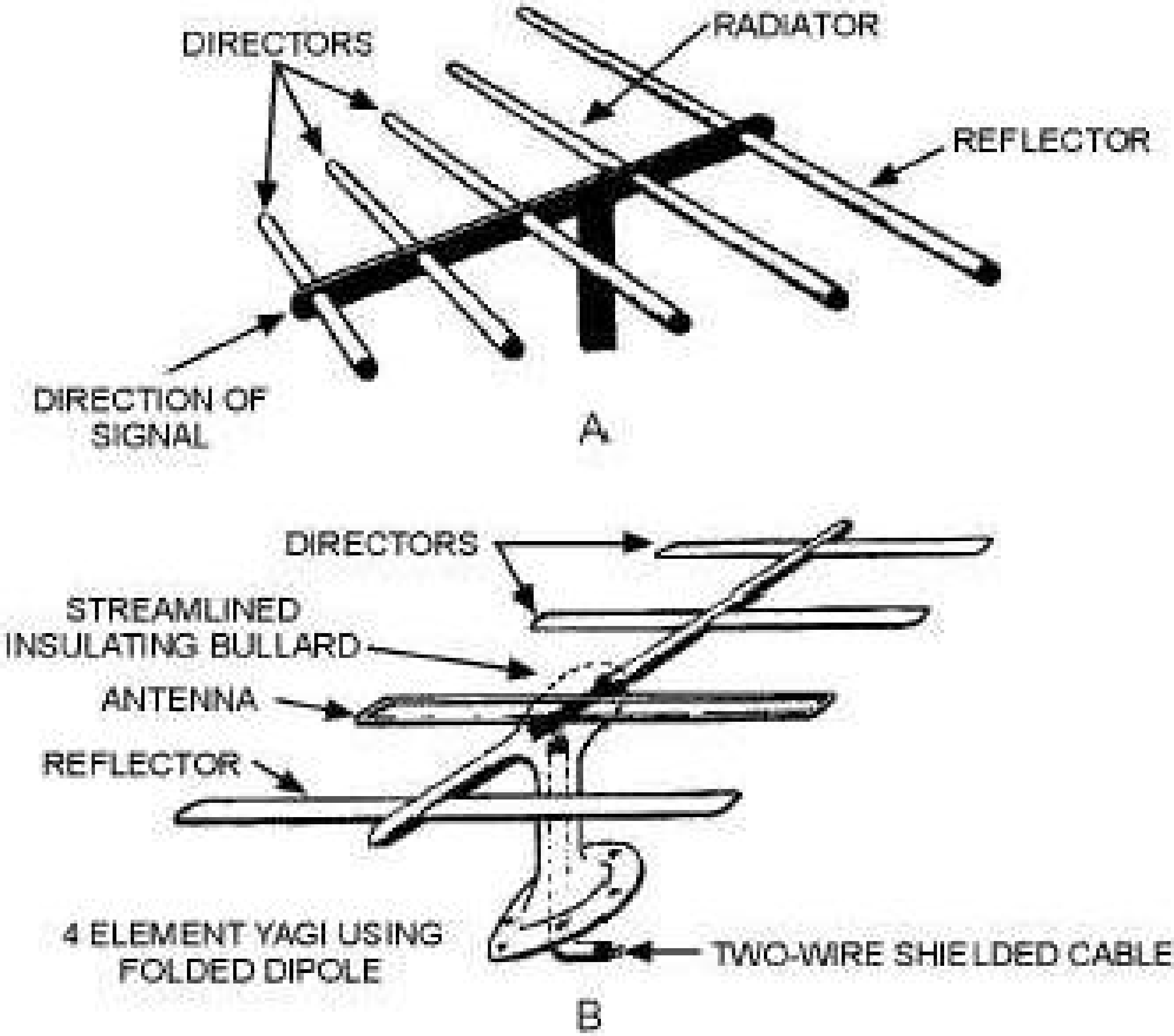
DIRECTORS
RADIATOR
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A
DIRECTORS
STREAMLINED INSULATING BULLARD
ANTENNA
REFLECTOR
4 ELEMENT YAGI USING FOLDED DIPOLE
TWO-WIRE SHIELDED CABLE
B

The Rhombic - 1931

June 9, 1942. E. BRUCE **2,285,565**

DIRECTIVE ANTENNA

Filed Feb. 3, 1931

FIG. 1

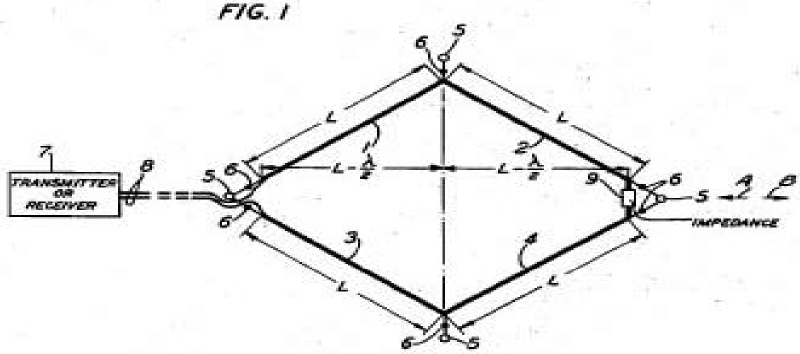
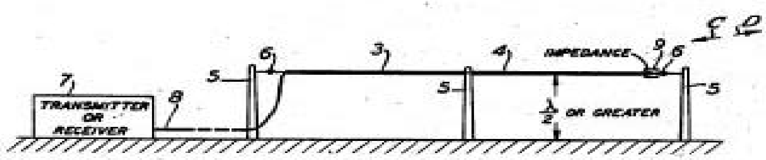
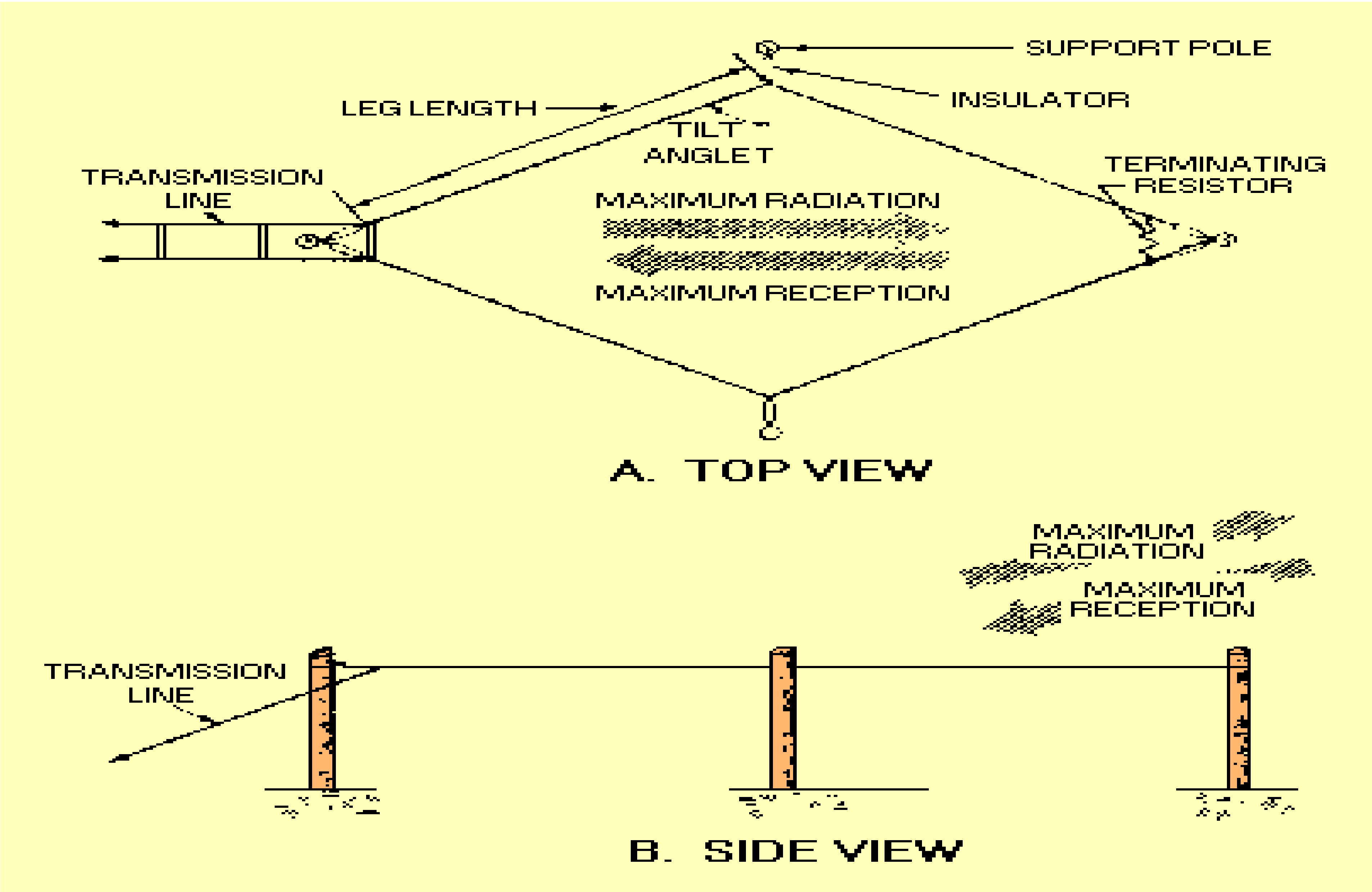


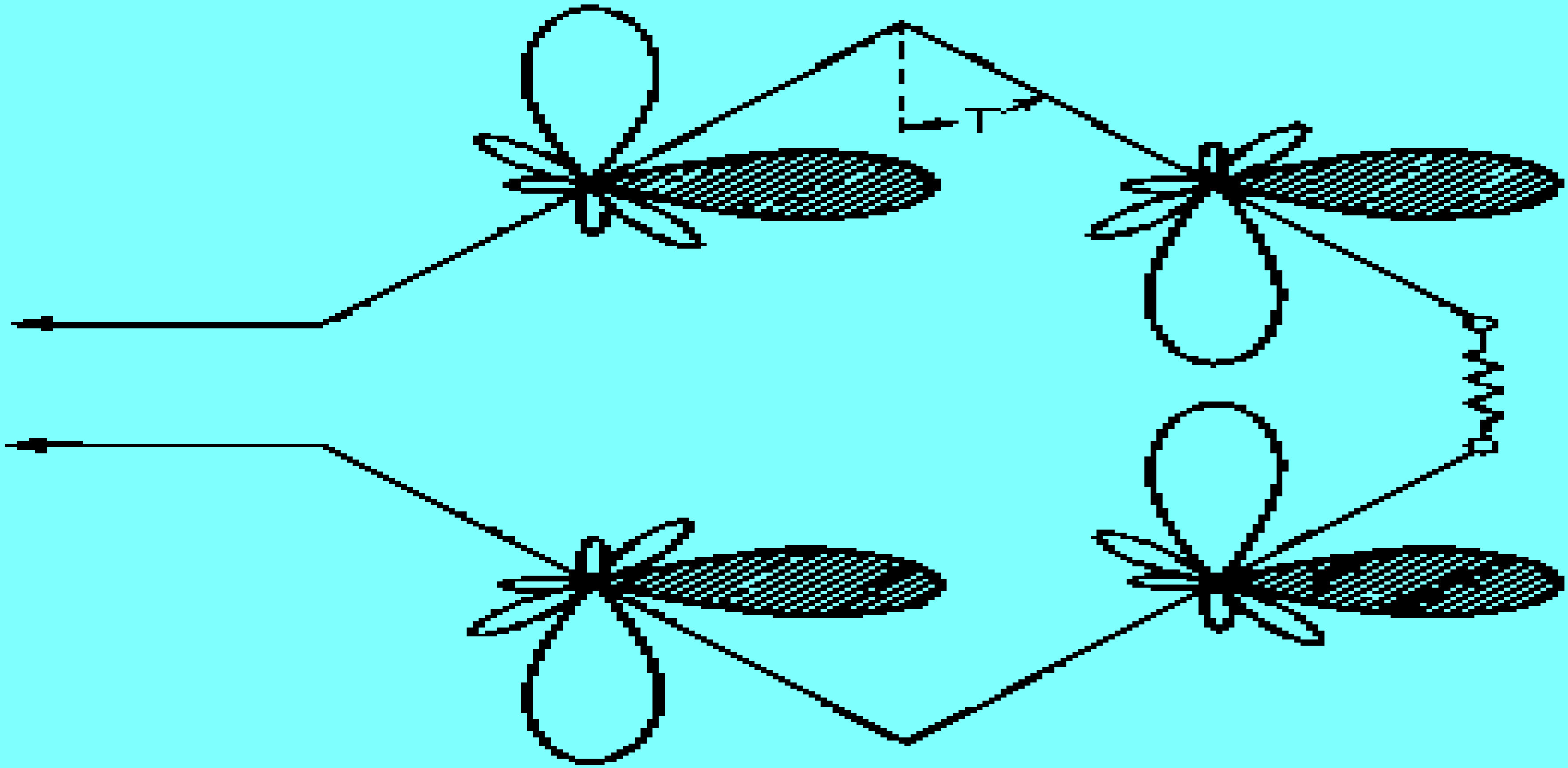
FIG. 2



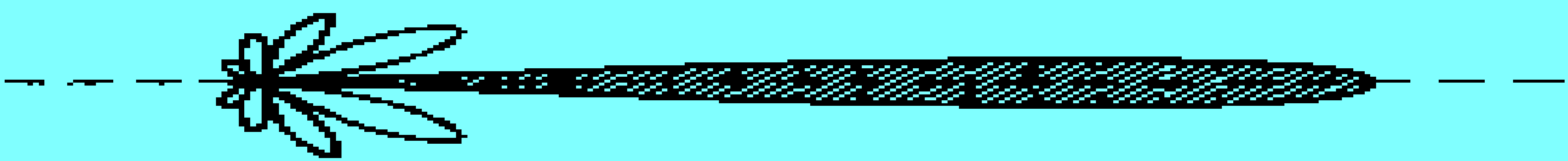
INVENTOR
E. BRUCE
BY Guy T. Morris
ATTORNEY

The Rhombic – Transmission Line





A. INDIVIDUAL RADIATION PATTERNS

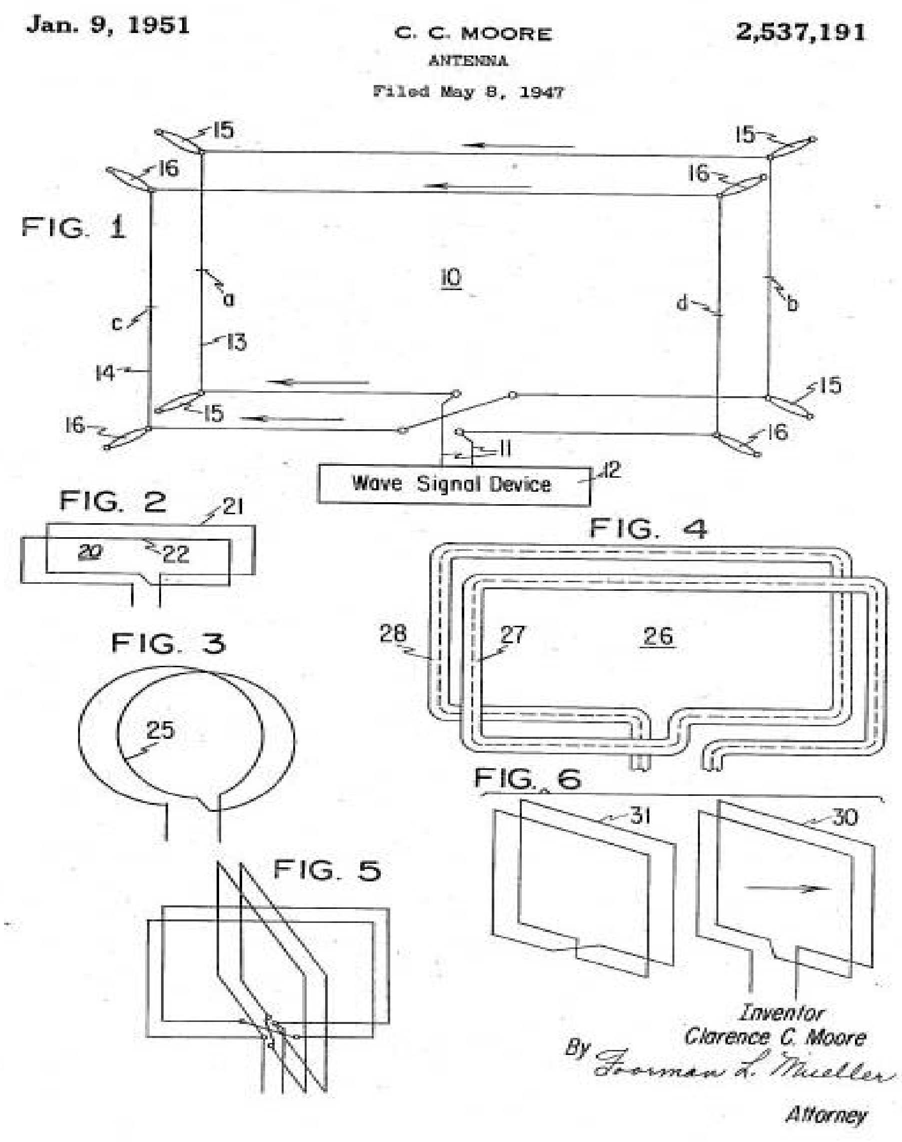


B. RESULTANT RADIATION PATTERNS

The Quad Antenna

- Invented in 1942 by Clarence Moore, W9LZX
- Created for HCJB, Quito, Ecuador
  - “The Voice of the Andes”
- Low Voltages: eliminates high voltage end-points in air
- Ideal for high altitude, prevents discharge and rain static

The Cubical Quad - 1942



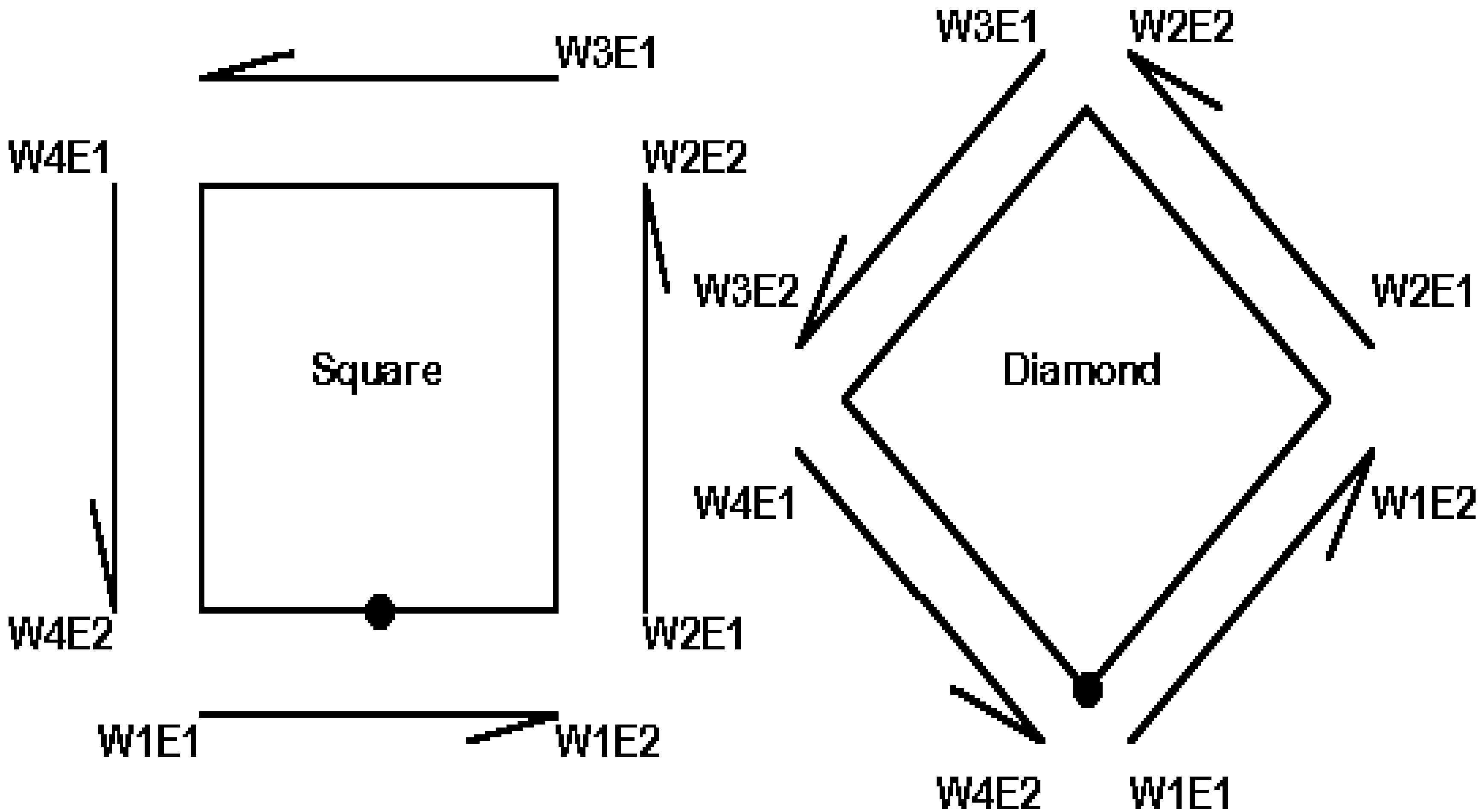


Fig. 1 The Usual Convention

Horizontal Wire Loops - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.cebik.com/wire/horloop.html

EE 360K - Spring 2007 | TSR Home Page | WNCG | UT ECE | ECE Calendar | UT Main | Google | Weather | Main Page - Wikipedia... | Office Depot | Merriam-Webster Online | Statesman

Horizontal Wire Loops
How Big? How High? What Shape?

L. B. Cebik, W4RNL

A number of years ago, I provided some extensive notes on horizontally oriented, horizontally polarized wire loop antennas (HOHPLs). See **Horizontally Oriented, Horizontally Polarized Large Wire Loop Antennas**. I have received enough e-mail as a result of those notes to convince me that perhaps there is such a things as cramming in too much information so that the result is a collection of difficulties in sorting it all out. As well, when I wrote those notes, the most common practice with horizontal loops was using a 1-wavelength circumference at the lowest operating frequency. Since then, I have changed the recommendation that I usually make, depending on the space available to the loop builder.

So let's begin again and work with a different plan. My plan of attack is based on the 3 most asked questions:

- How Big?
- How High?
- What Shape?

Since we shall defer the question of shape until last, we shall need a paradigm model with which to begin. Let's use a nearly perfectly circular loop as our starting point, as outlined in **Fig. 1**. The loop uses 40 wires to form the circle, so the approximation is quite good. For our first 2 questions, the feedpoint will be on the right, in the +X direction. (We shall alter that for our last question for reasons that will become apparent when we arrive at questions of shape.) Note the orientation of the X, Y, and Z axes in the outline drawing. These axes lines will be important to orienting ourselves to some of the patterns in upcoming figures.

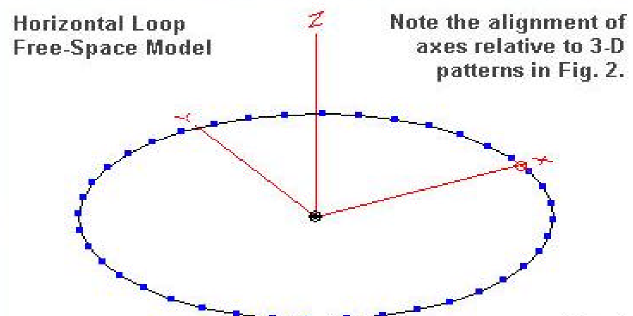
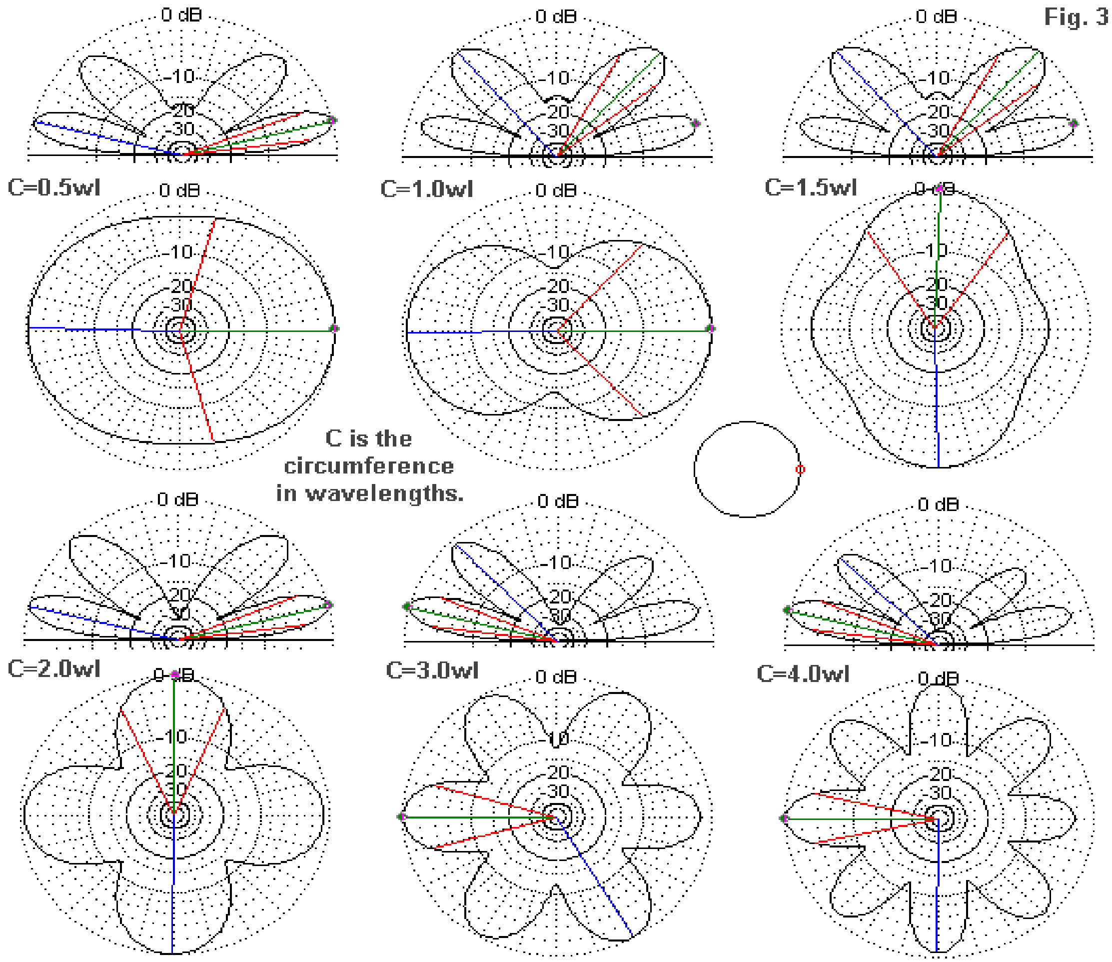


Fig. 1

A circular loop as a starting point has some advantages over beginning with other shapes. With both regular and irregular polygons, we tend to find performance differences depending on whether we feed the antenna at a corner or somewhere within a side. Since a circle has no sides (or infinitesimal ones, at best), we can avoid those differences until we reach our last question.

Done

Horizontal Loops above ground



Elevation and Azimuth Patterns of Circular Loops of Various Sizes at 1 WL Above Ground


SCRAP PAPER
FEB 84


FLAMMABLE
82
W9YB
FD
FLAMMABLE
POISON


GMC


MICHELOB

Ham Radio Magazine, May 1985, pp. 87-91

By Ted S. Rappaport, N9NB, Box 283, Electrical Engineering, Purdue University, West Lafayette, Indiana 47907

160-meter transmission line antenna

If height or space is a problem, try this

with the coaxial cable or ladder line that fee
antenna — something that "carries power
antenna," and not something that should, its
ate RF. Of course, it is undesirable to have ou

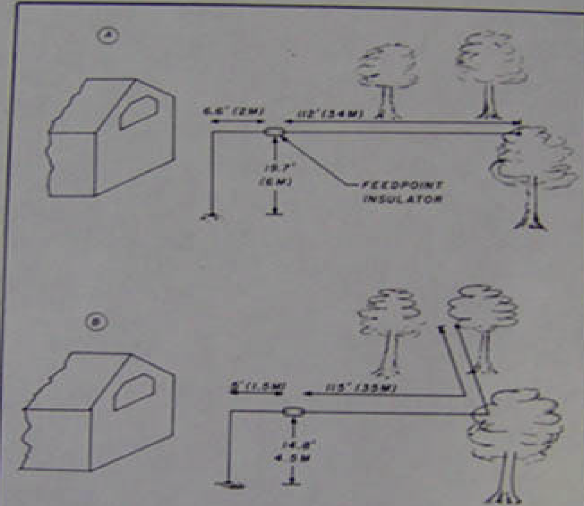


fig. 5. Low profile antenna dimensions for 160-meter operation at N9NB: (A) low-profile antenna for 1850 kHz — 100 kHz bandwidth (dimensions: x = 8 meters, y = 34 meters, height = 6 meters); (B) low-profile antenna for 1850 kHz — 75 kHz bandwidth (dimensions x = 6 meters, y = 35 meters, height = 4.5 meters).

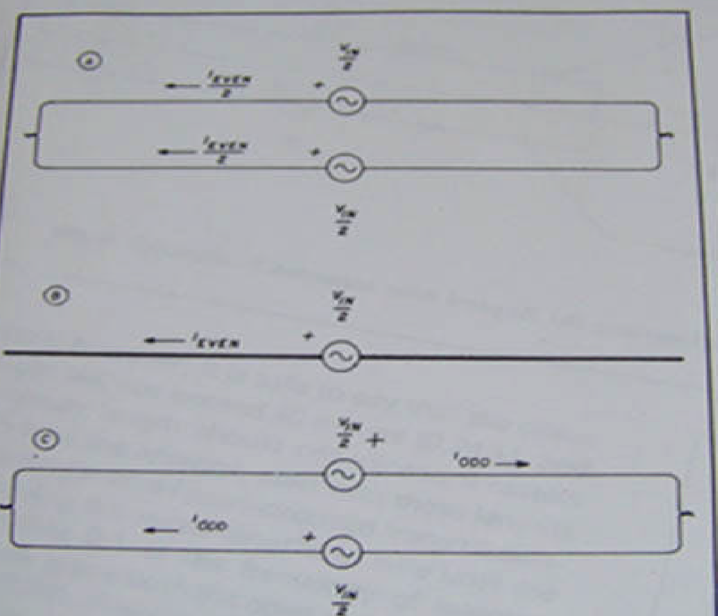


fig. 3. Even and odd antenna mode configurations for a folded dipole: (A) even-mode excitation; (B) even-mode simplification — dipole antenna; and (C) odd-mode excitation.

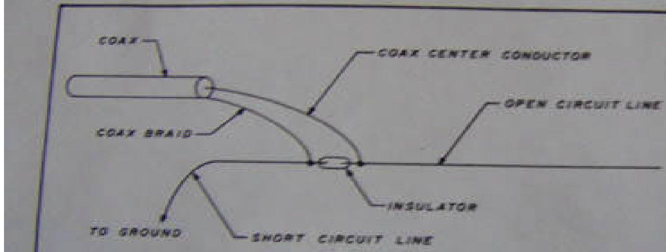


fig. 6. Simple feed method.

RF Design, April 1988, pp. 37-41

rf featured technology

Wide-Band Test Antennas

Simple-to-Build Discones Provide an Excellent Match at L Band

By Theodore S. Rappaport
Virginia Polytechnic Institute and
State University

As part of an indoor multipath measure- ment system, discone antennas featuring simple N-connector feed systems have been designed for the 1.0 to 2.0 GHz band. Extensive experimentation reveals that excellent performance (VSWR < 1.5:1 across the band) can be obtained with a simple "snap-on" feed/mount method, and that VSWR is most sensitive to the diameter of the disc feed conductor. Per- formance data from over 70 discone an- tennas having a variety of flare angles, disc-to-cone spacings and feed conductor diameters are summarized here. Data shows that for N-connector mounts, best flare angles range between 45° and 75°, and that the disc feed conductor should be 0.33 times the diameter of the cone top. The empirical data reveals that the anten- ...

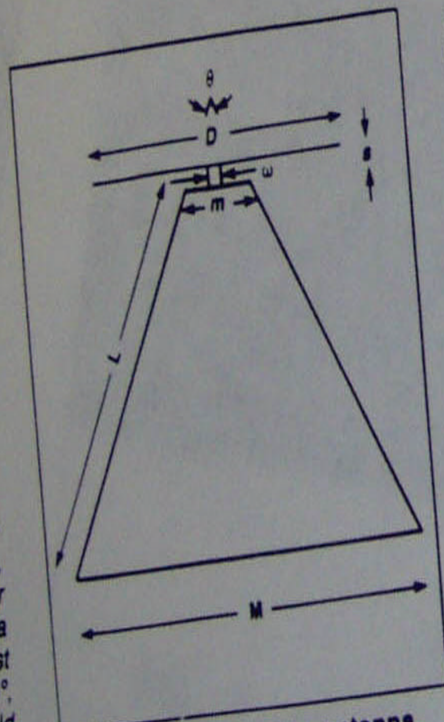
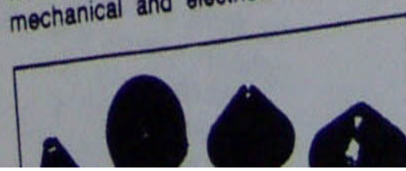


Figure 1. The discone antenna.

mulas were found to be helpful but incomplete.

Four cones made of pliable copper sheet were built with flare angles (θ) of 45°, 60°, 75° and 90°. The cones were formed by cutting and rolling the copper sheet around a wooden conical block of the desired flare angle, and then by soldering the sheet onto itself so that the cone would keep its shape. The four cone dimensions are given in Table 1. Slant lengths of all four cones were cut for λ/4 at 1000 MHz.

Each cone was soldered to the body of a UG-21D/U N-connector, giving each an- tenna a minimum cone diameter (m) of 19.0 mm (¾"). With the rear end of the connector made flush with the (small) top of the cone, solder was carefully applied to the connector/cone junction to form a mechanical and electrical connection.



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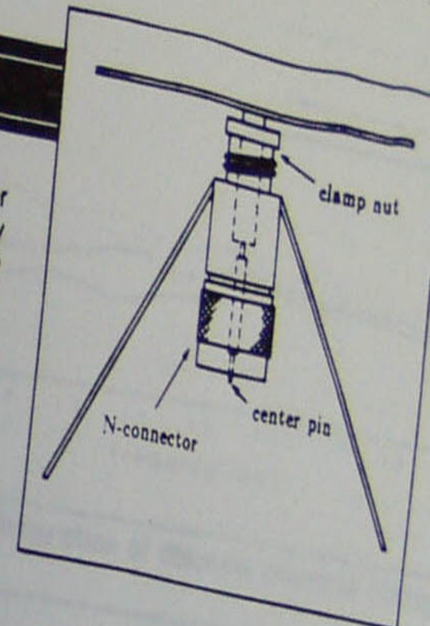


of the antenna feed cable as well as the frequency dependent variations of the equipment. Antenna return loss measure- nents were made at 50 MHz intervals cross the 1000-2000 MHz band. Care as taken to insure power levels were suf- ient to provide reliable measurements. tenna performances were evaluated by average value of the reflection coeffi- t across the 1.20 to 2.0 GHz band.

lts

iation 1 was first used to develop scones described in Table 1. Of par- importance, the antennas had ters $s = 0.33\ m$ and $\omega = 0.16\ m$. uts were not installed on the con- and a value of $D = 0.7M$ was used antenna. The antenna ...

Al Gross – Walkie Talkie Pioneer

Al Gross in 1991; St. Louis

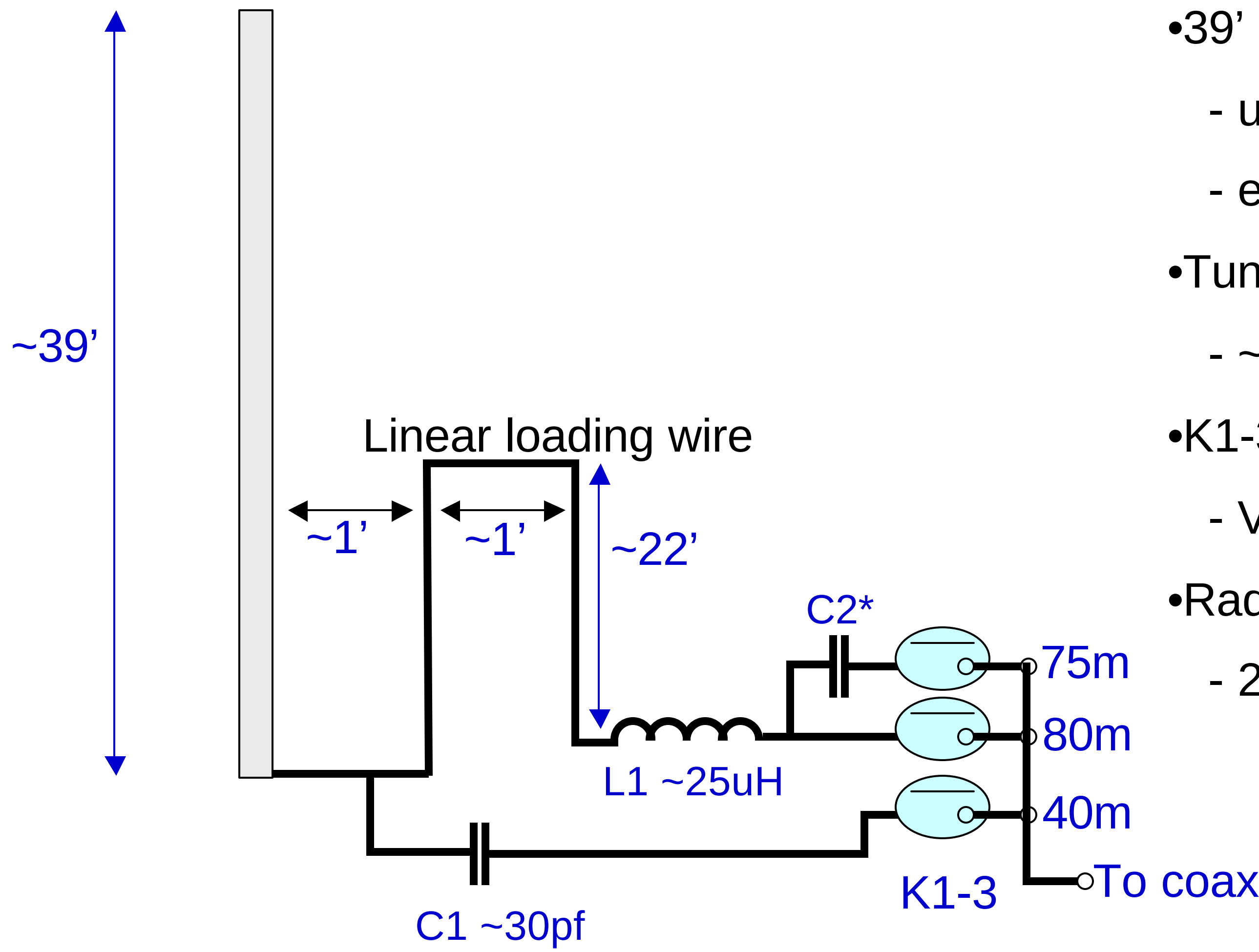
Jack Kilby– Inventor of the IC

N9NC Linear Loaded Rooftop Vertical

LL Vertical at 3A/N9NC

- Rooftop mounted
- Aluminum tubing, ~13meters
- Linear loading for 80m
- 2 quarter wave radials
- Tuning/relay box at feedpoint

N9NC Linear Loaded Rooftop Vertical

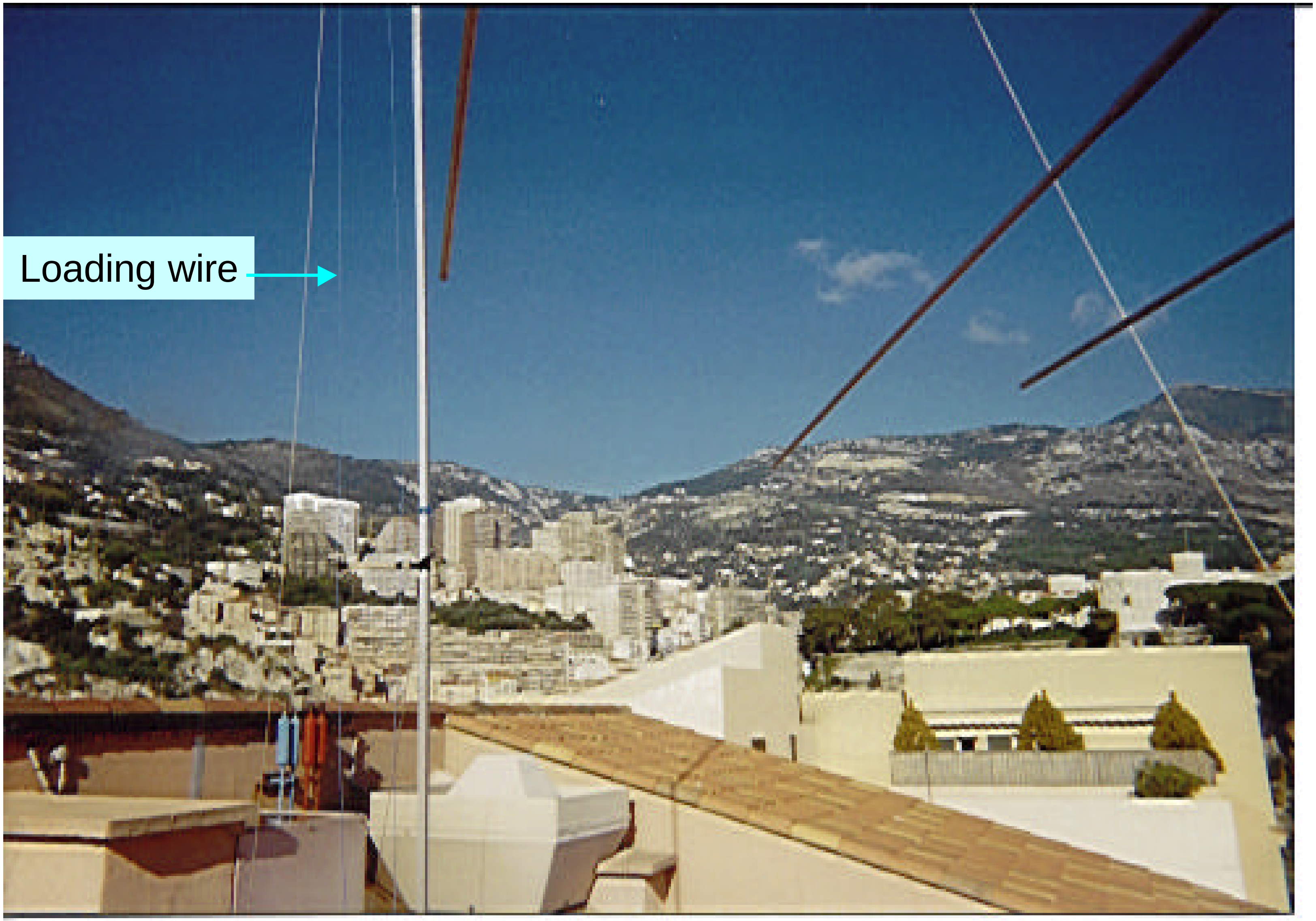


- 39’ main element
  - used ½ Titanex V80
  - enables tuning by C1 value
- Tune C2 for SSB freq
  - ~70-120 pF
- K1-3 Vacuum relay
  - V1V or equivalent
- Radials
  - 2 enough on a tall roof

DX Fishing Vertical by N9NC/SU

View to North from SU1KM shack, 3rd floor balcony
Alexandria, Egypt

- Balcony mounted at 45 deg.
- 9m fiberglass fishing pole
- ½ 40m dipole helically wound
- Other half goes straight down
- Coax balun at feedpoint
- Built in 40min at midnight
- By DL1BDF, SU1KM, SU9NC

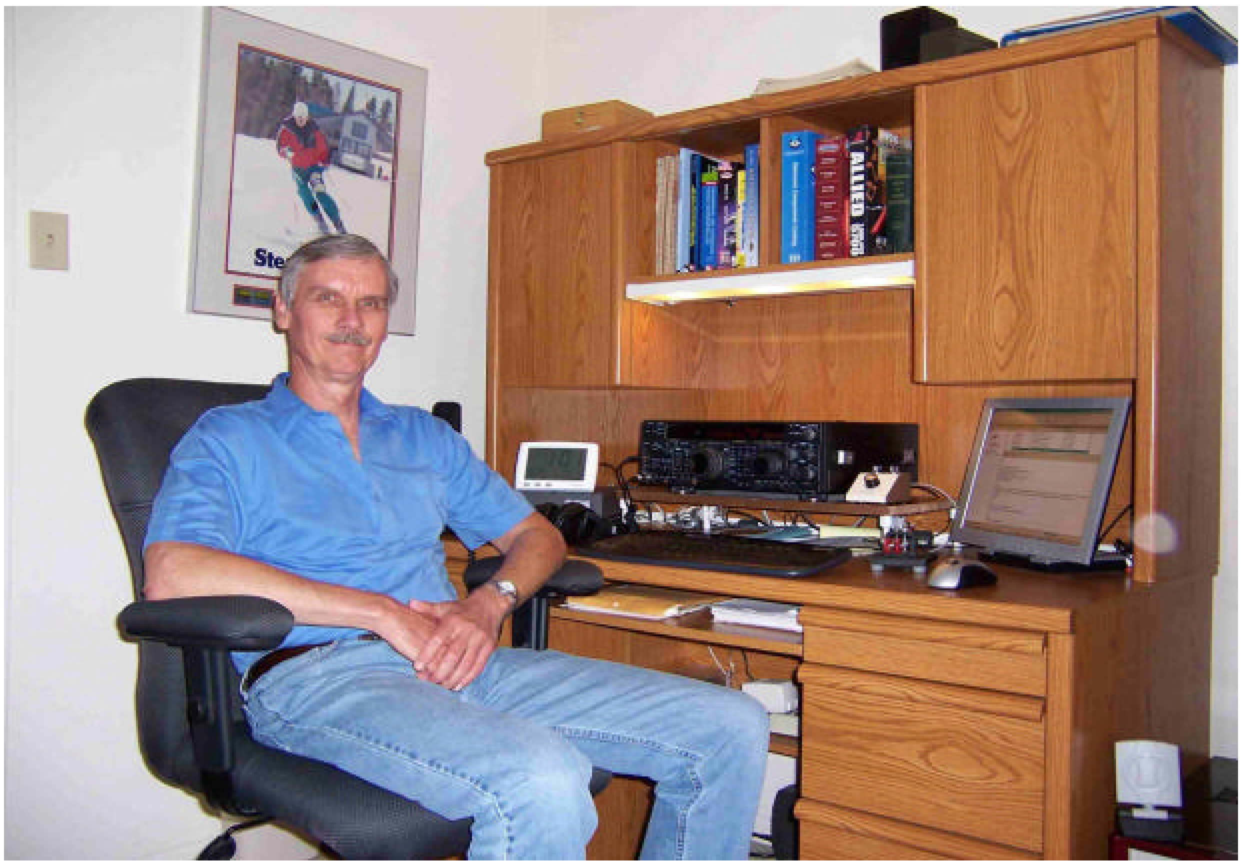


Shot to NW NA VE7, W7

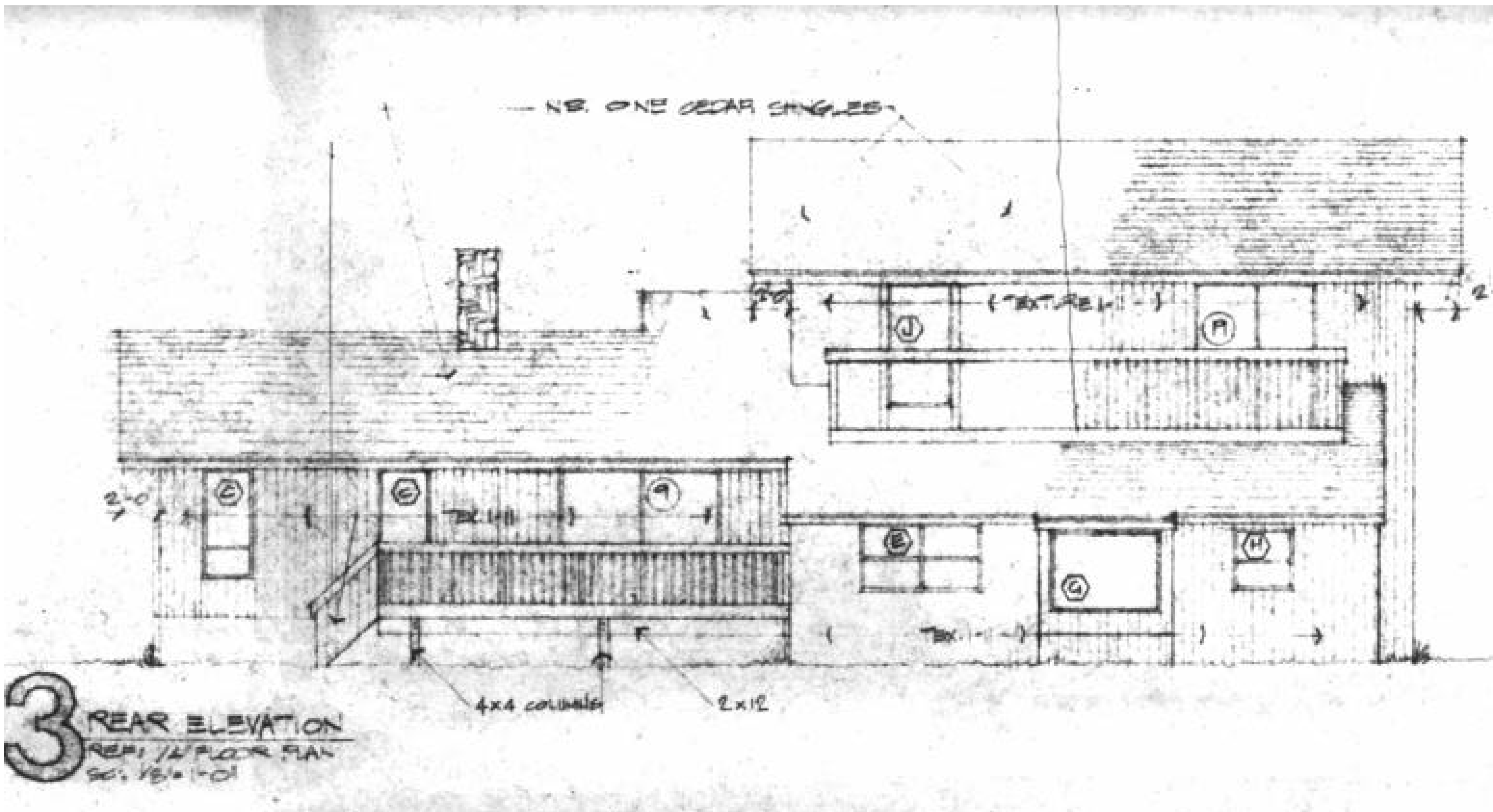
Antennas for Restricted Space

Some Amazing Examples

By W5JAW



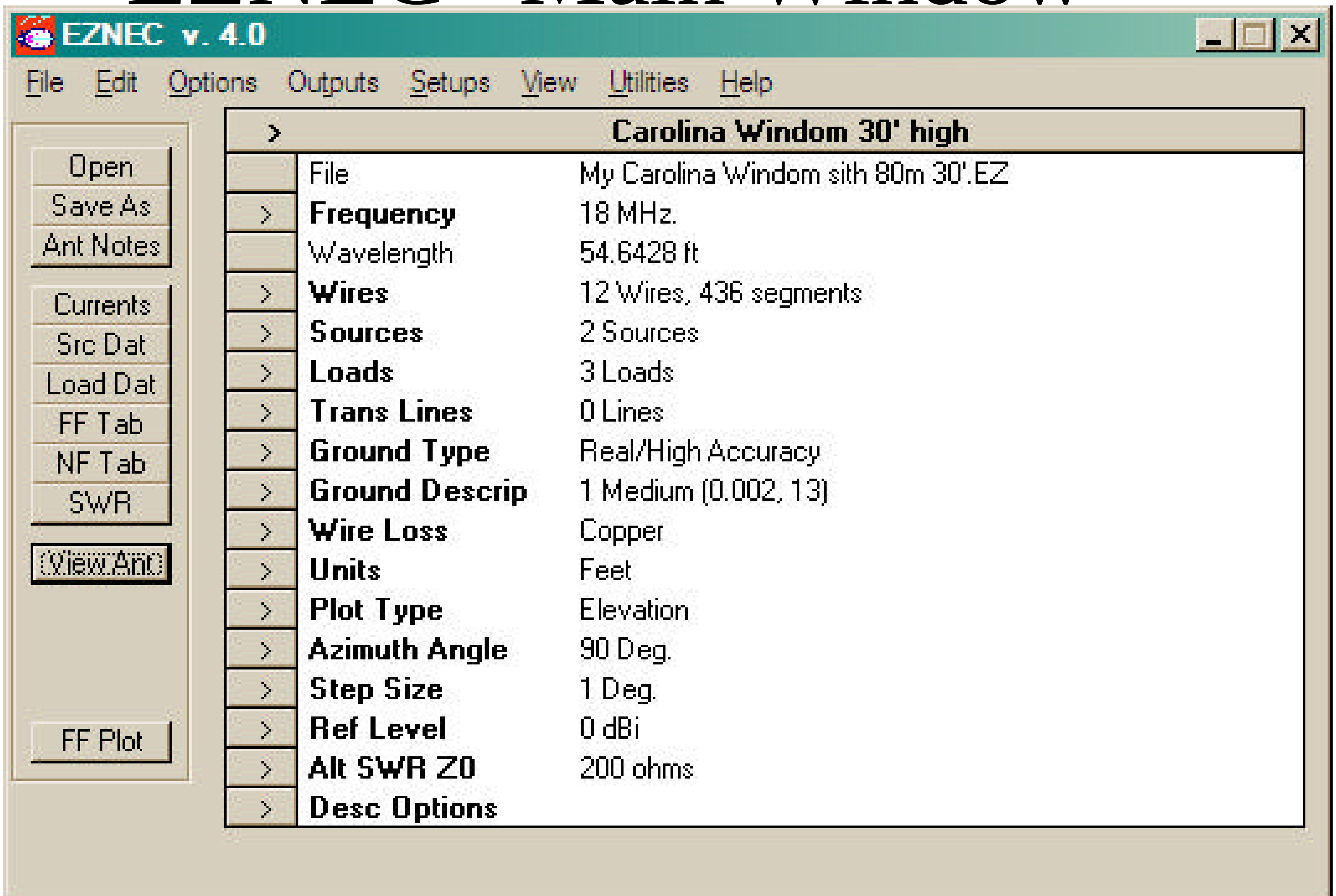
To Understand Why….



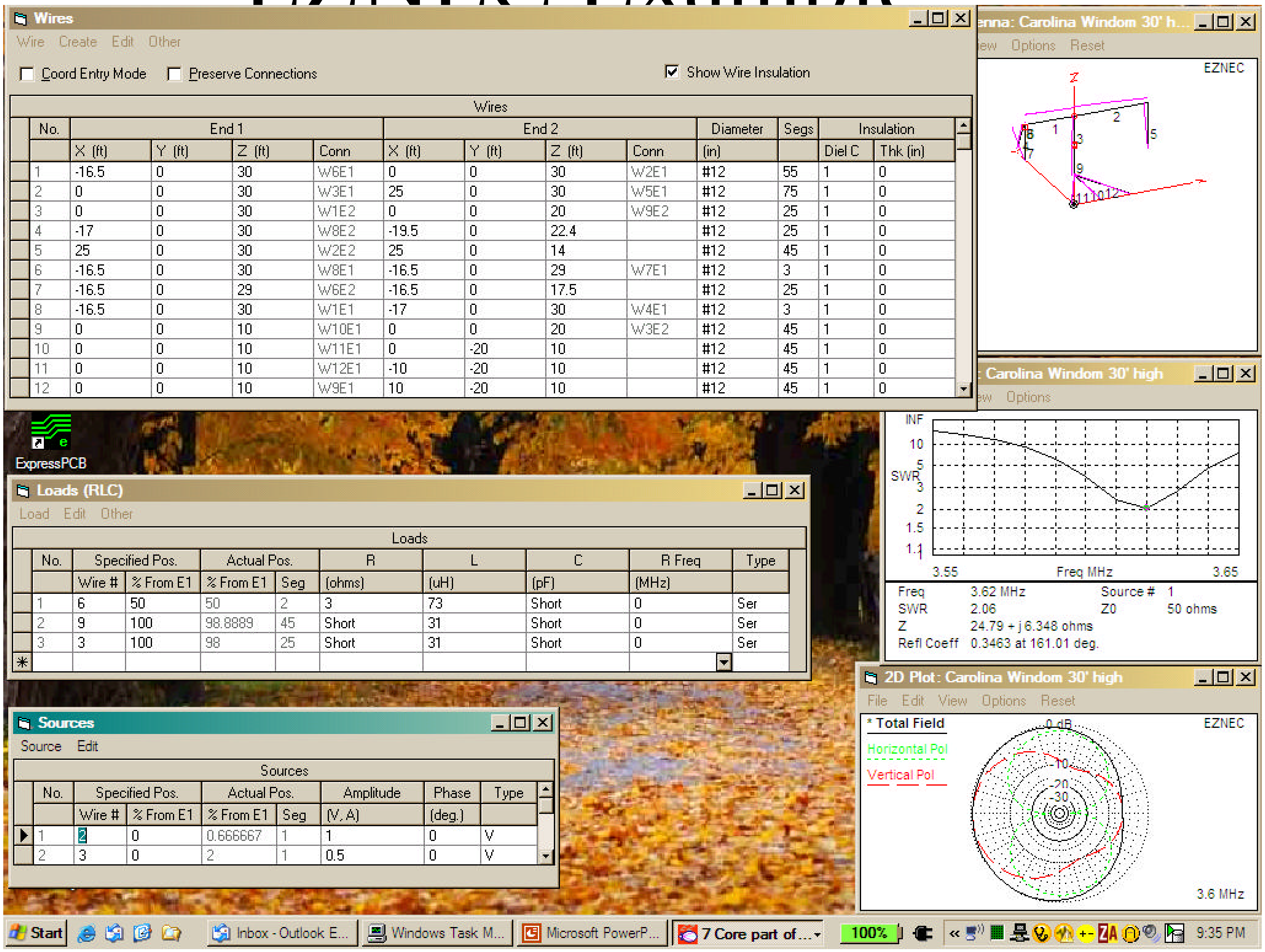
Initial Goals

- Single all band antenna for 80-10m, including WARC bands
- Fit within width of house (no external supports available!)
- Semi stealth

EZNEC –Main Window



EZNEC Example



Wires

No.	End 1 X (ft)	End 1 Y (ft)	End 1 Z (ft)	End 1 Conn	End 2 X (ft)	End 2 Y (ft)	End 2 Z (ft)	End 2 Conn	Diameter (in)	Segs	Insulation Diel C	Insulation Thk (in)
1	-16.5	0	30	W6E1	0	0	30	W2E1	#12	55	1	0
2	0	0	30	W3E1	25	0	30	W5E1	#12	75	1	0
3	0	0	30	W1E2	0	0	20	W9E2	#12	25	1	0
4	-17	0	30	W8E2	-19.5	0	22.4		#12	25	1	0
5	25	0	30	W2E2	25	0	14		#12	45	1	0
6	-16.5	0	30	W8E1	-16.5	0	29	W7E1	#12	3	1	0
7	-16.5	0	29	W6E2	-16.5	0	17.5		#12	25	1	0
8	-16.5	0	30	W1E1	-17	0	30	W4E1	#12	3	1	0
9	0	0	10	W10E1	0	0	20	W3E2	#12	45	1	0
10	0	0	10	W11E1	0	-20	10		#12	45	1	0
11	0	0	10	W12E1	-10	-20	10		#12	45	1	0
12	0	0	10	W9E1	10	-20	10		#12	45	1	0

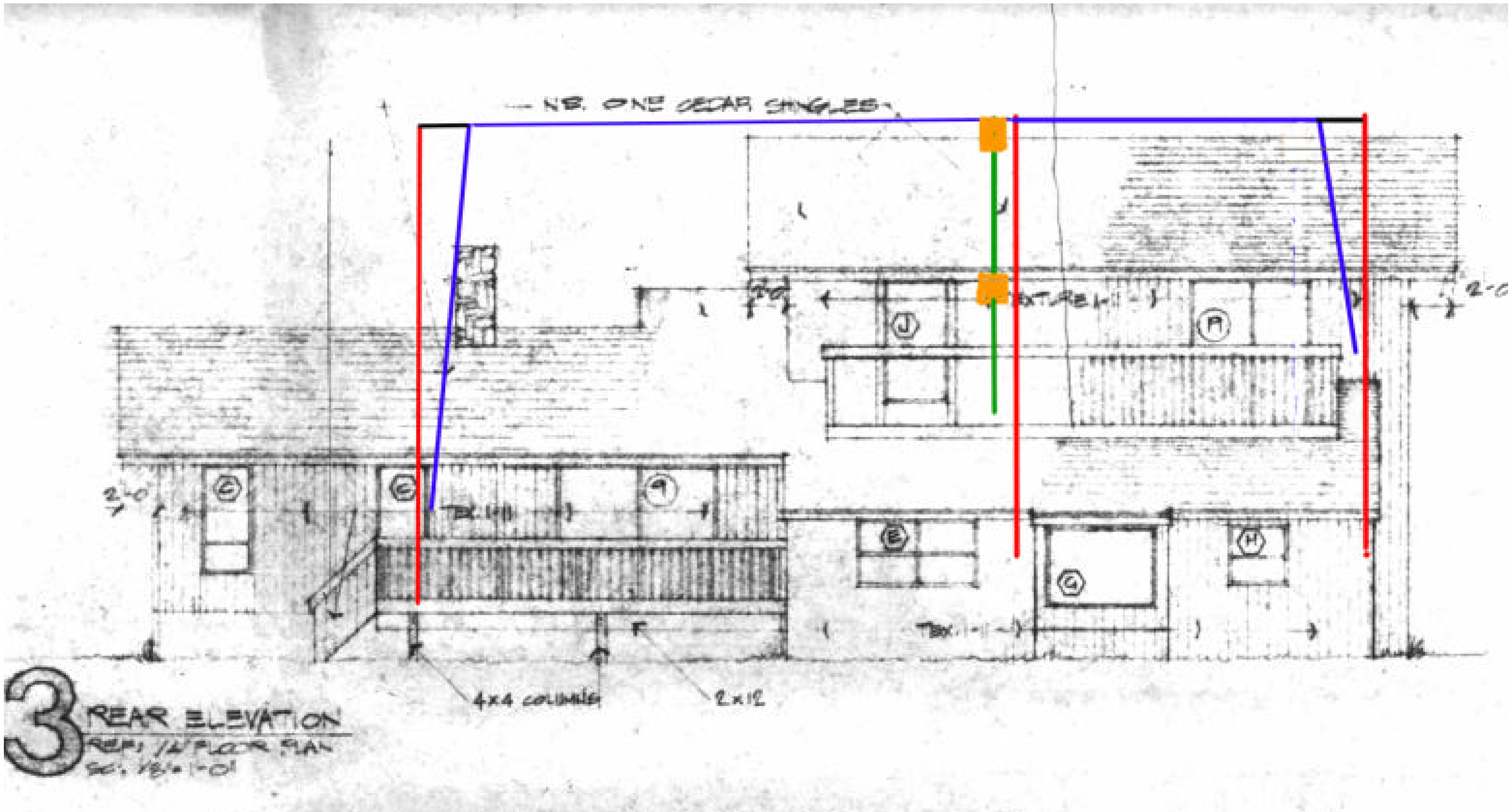
Loads

No.	Specified Pos. Wire #	Specified Pos. % From E1	Actual Pos. % From E1	Actual Pos. Seg	R (ohms)	L (uH)	C (pF)	R Freq (MHz)	Type
1	6	50	50	2	3	73	Short	0	Ser
2	9	100	98.8889	45	Short	31	Short	0	Ser
3	3	100	98	25	Short	31	Short	0	Ser

Sources

No.	Specified Pos. Wire #	Specified Pos. % From E1	Actual Pos. % From E1	Actual Pos. Seg	Amplitude (V, A)	Phase (deg.)	Type
1	2	0	0.666667	1	1	0	V
2	3	0	2	1	0.5	0	V

Phase 1 Solution – Bent Carolina Windom



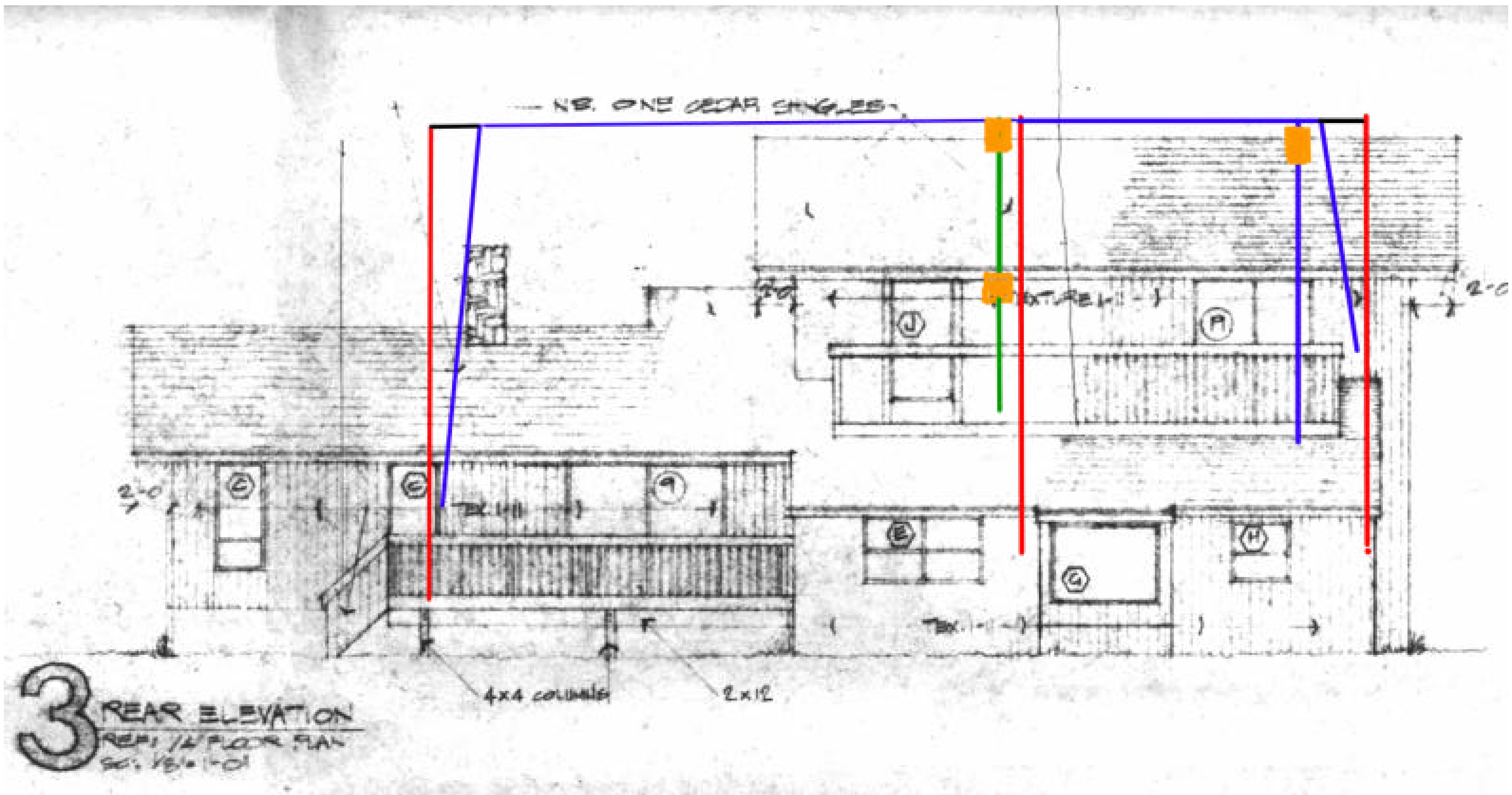
Dimensions of C.Windom

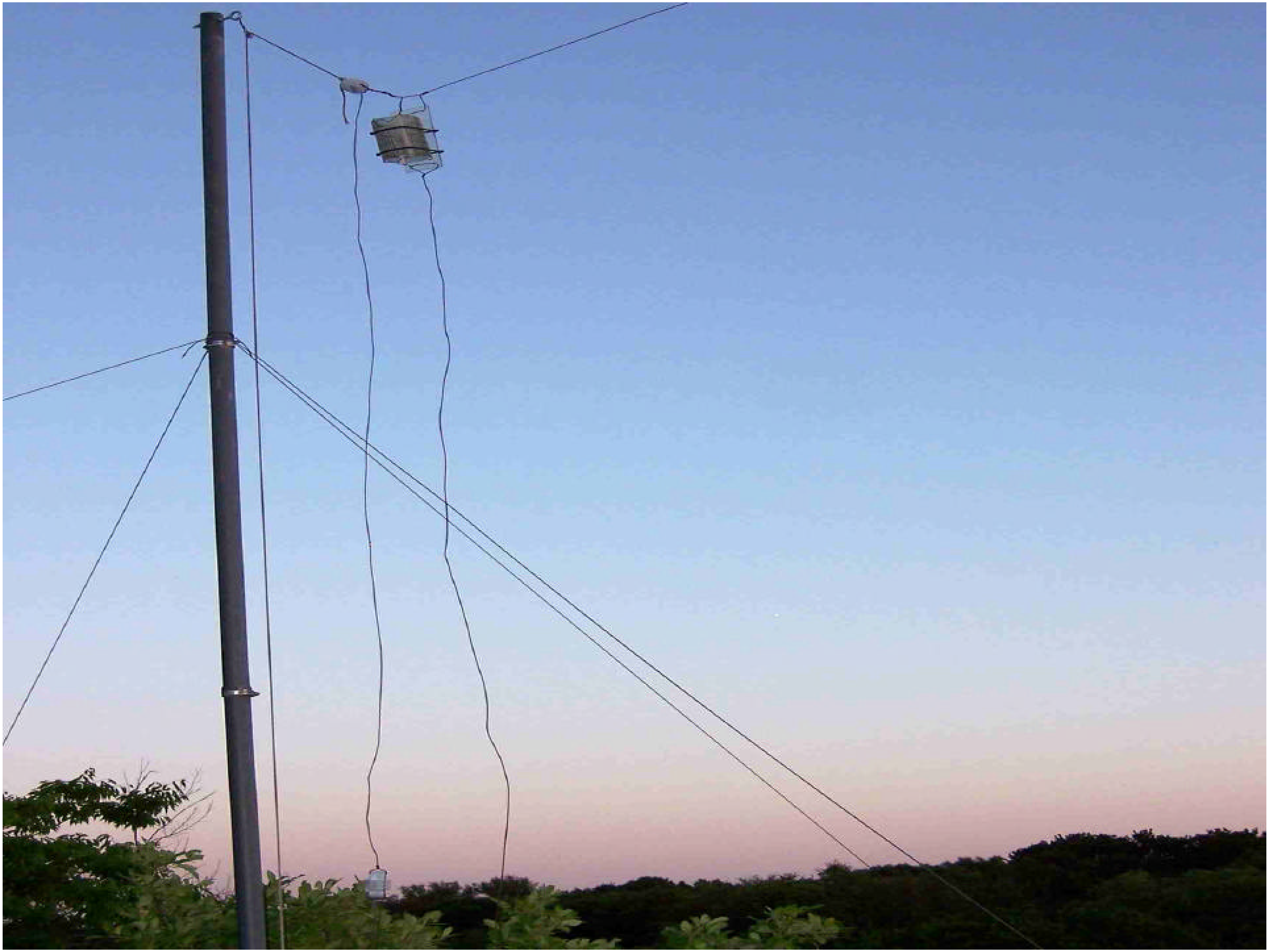
- Horizontal   42 ft (25 +17 ft)
- Left Vertical Section   16 ft
- Right Vertical Section   8 ft
- Center Vertical Section   10 ft
- Height   30 ft
- Works well on 10-40m, not well on 80m

80m Bent Carolina Windom

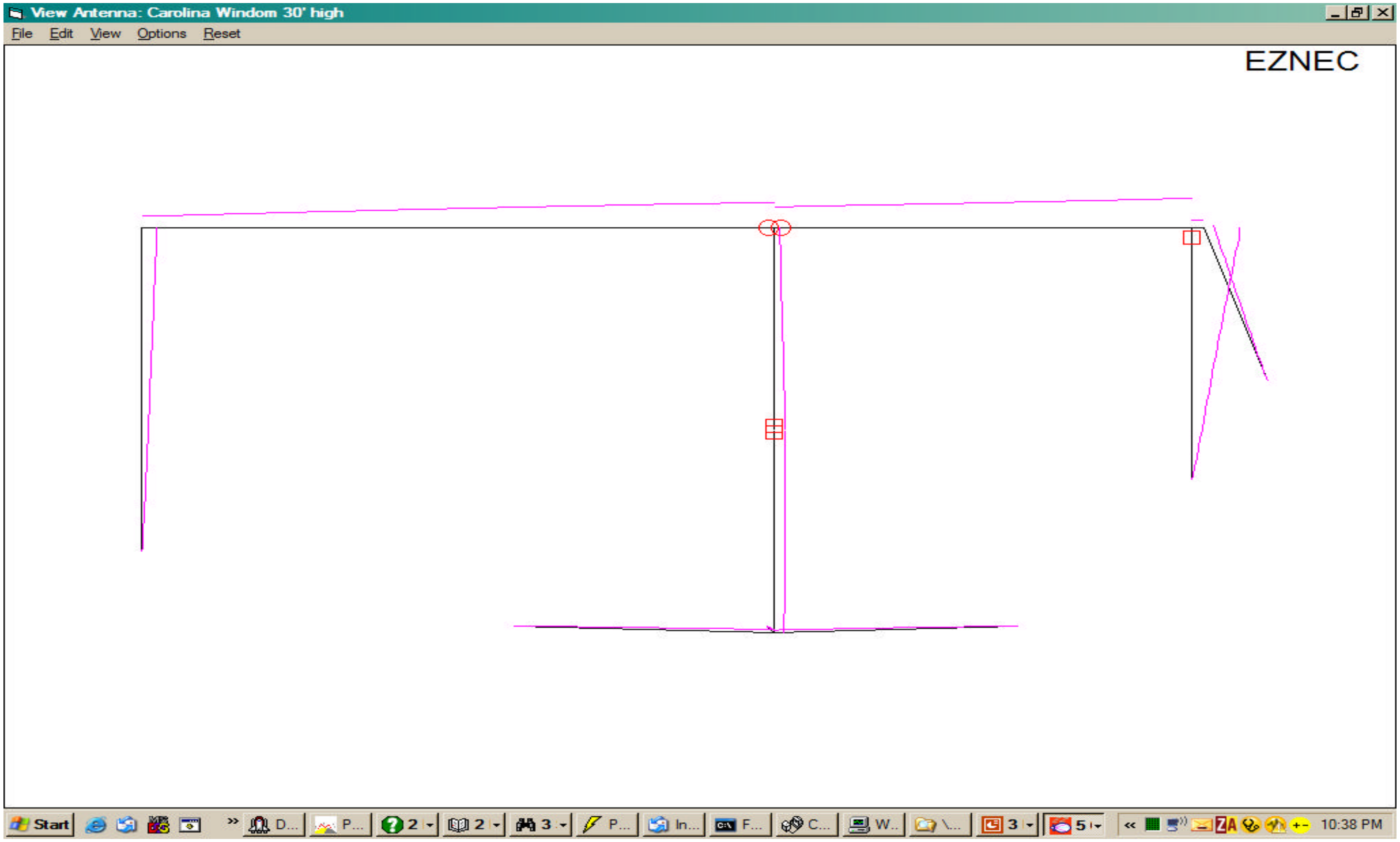
75 uHy inductor (4” Air Dux)

12 ft vertical wire at 8 ft bend

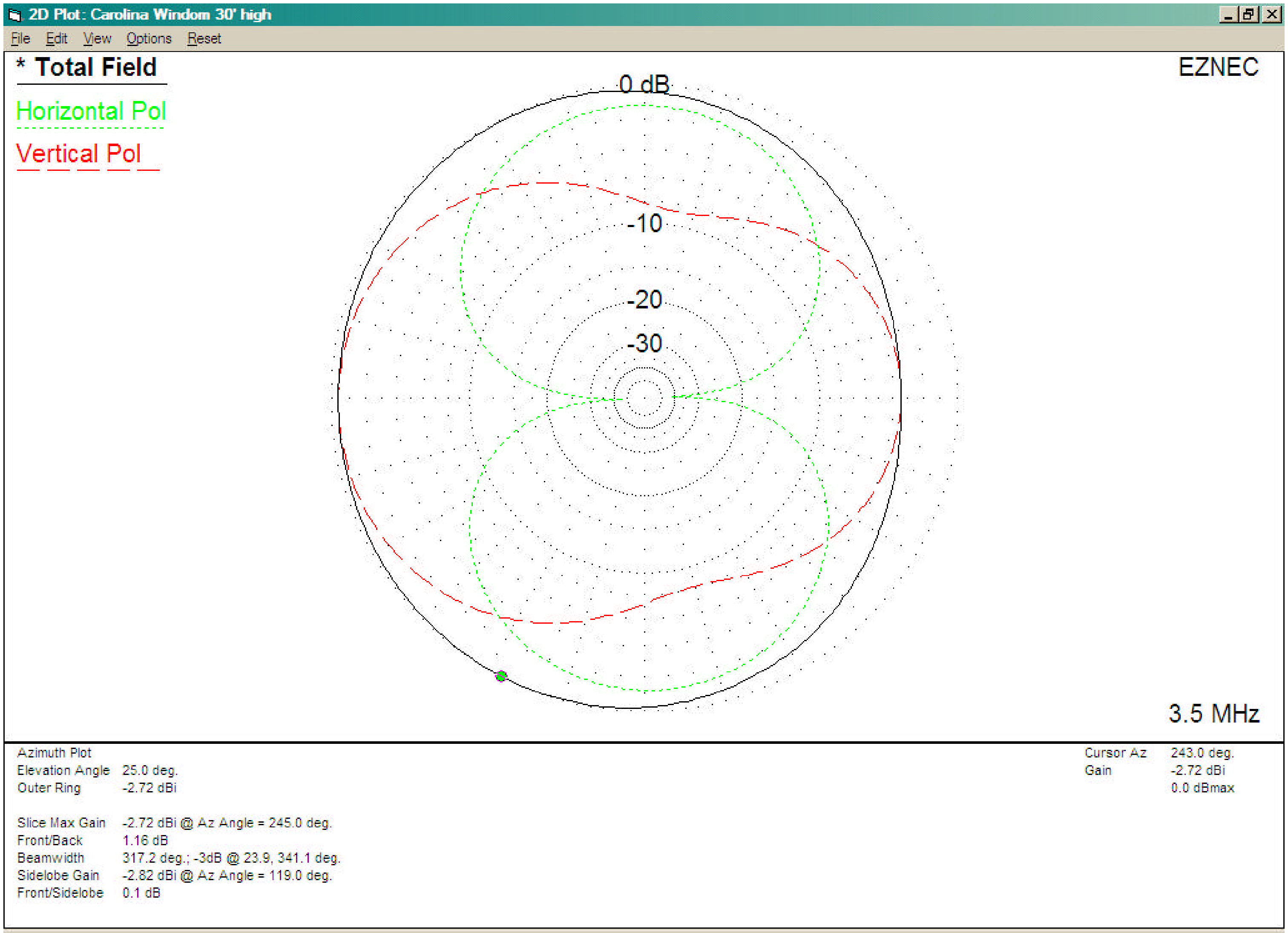




Current Distribution—80m



80m Azimuth Plot



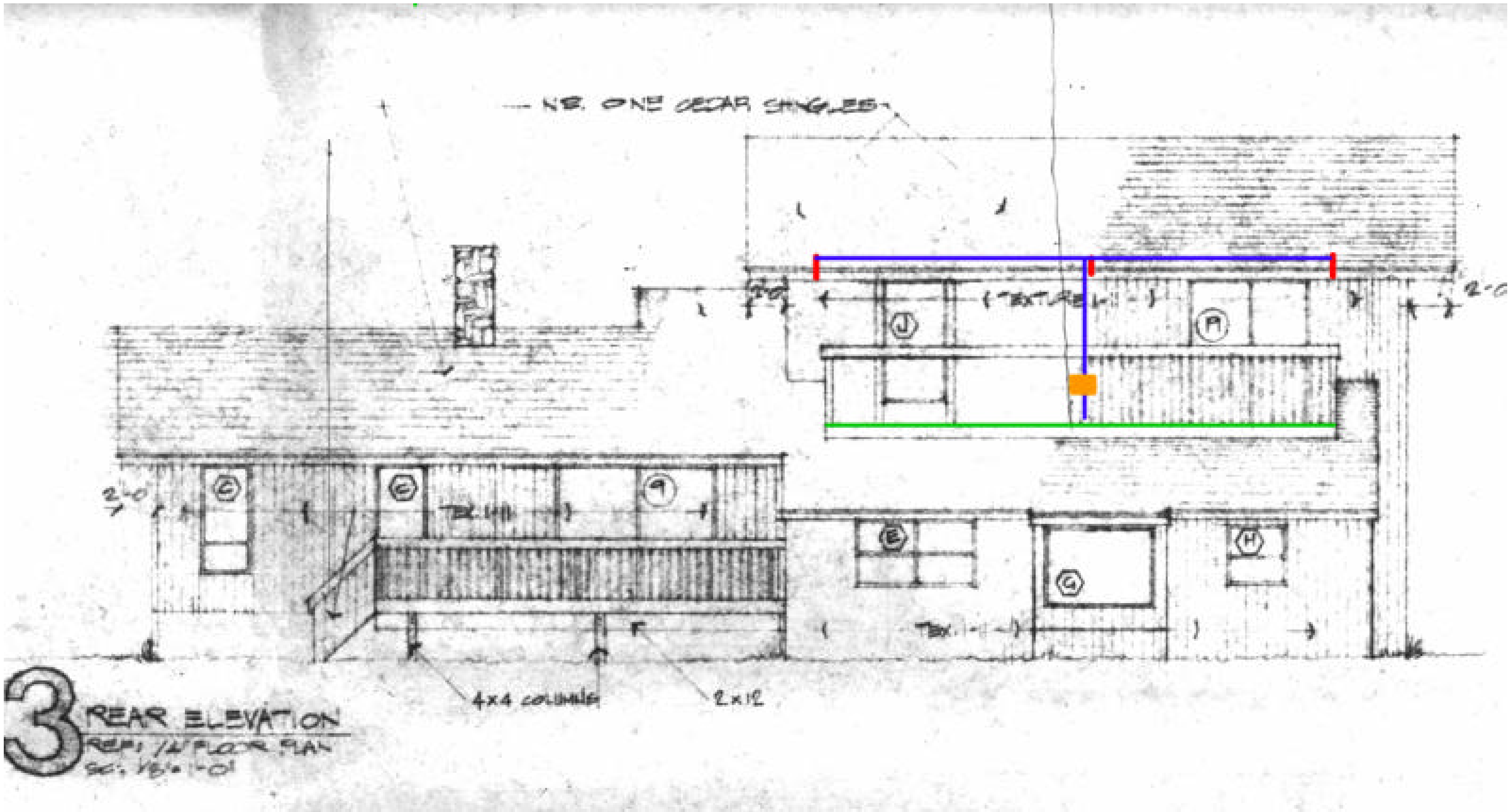
160 Meter???

- Good enough to work a few mults during contests
- Semi stealth

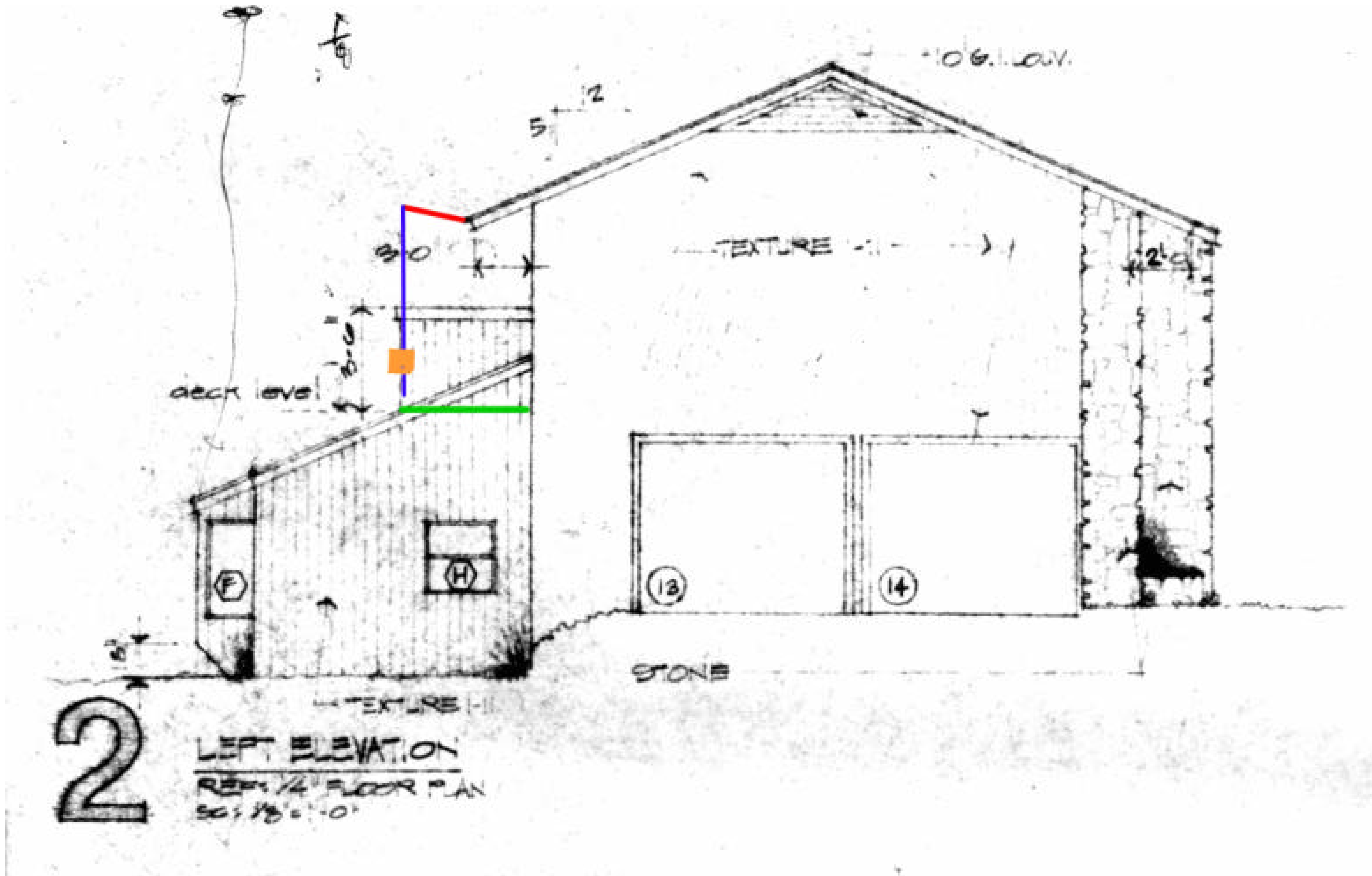
160m Project
Model #1

- Quick and simple 1-2 day project
- Model on EZNEC
- Collect parts
- Install
- Try it out (Stew Perry)

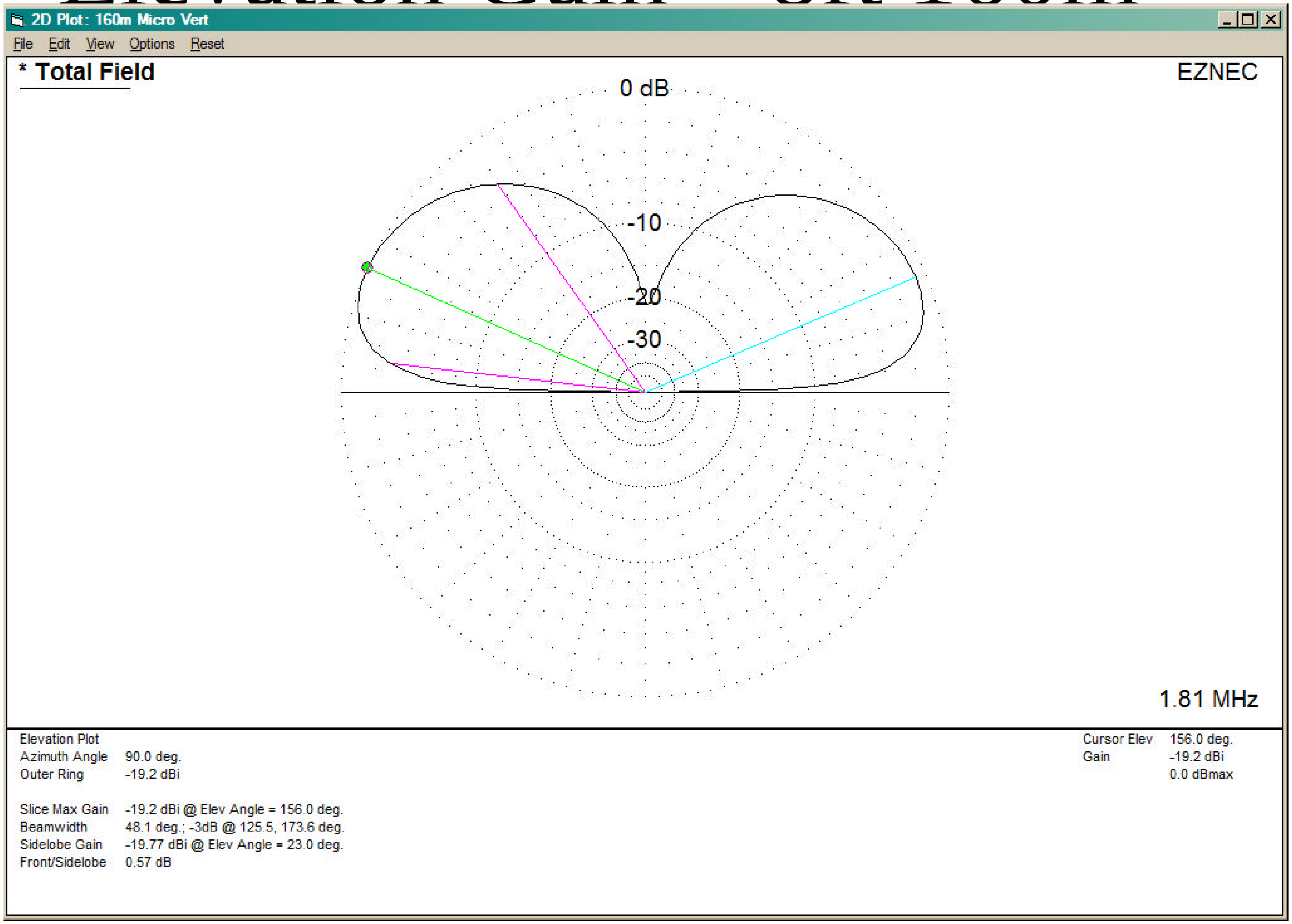
160m #1 Front View



160m #1 Side View



Elevation Gain – 8ft 160m



Results with Model #1

- Worked 43 States, 5 VE Provinces and 6 countries that night
- Worked 45 countries over the rest of the winter, on all continents
- Decided to try improvements for next season

Design Goals for Model #2

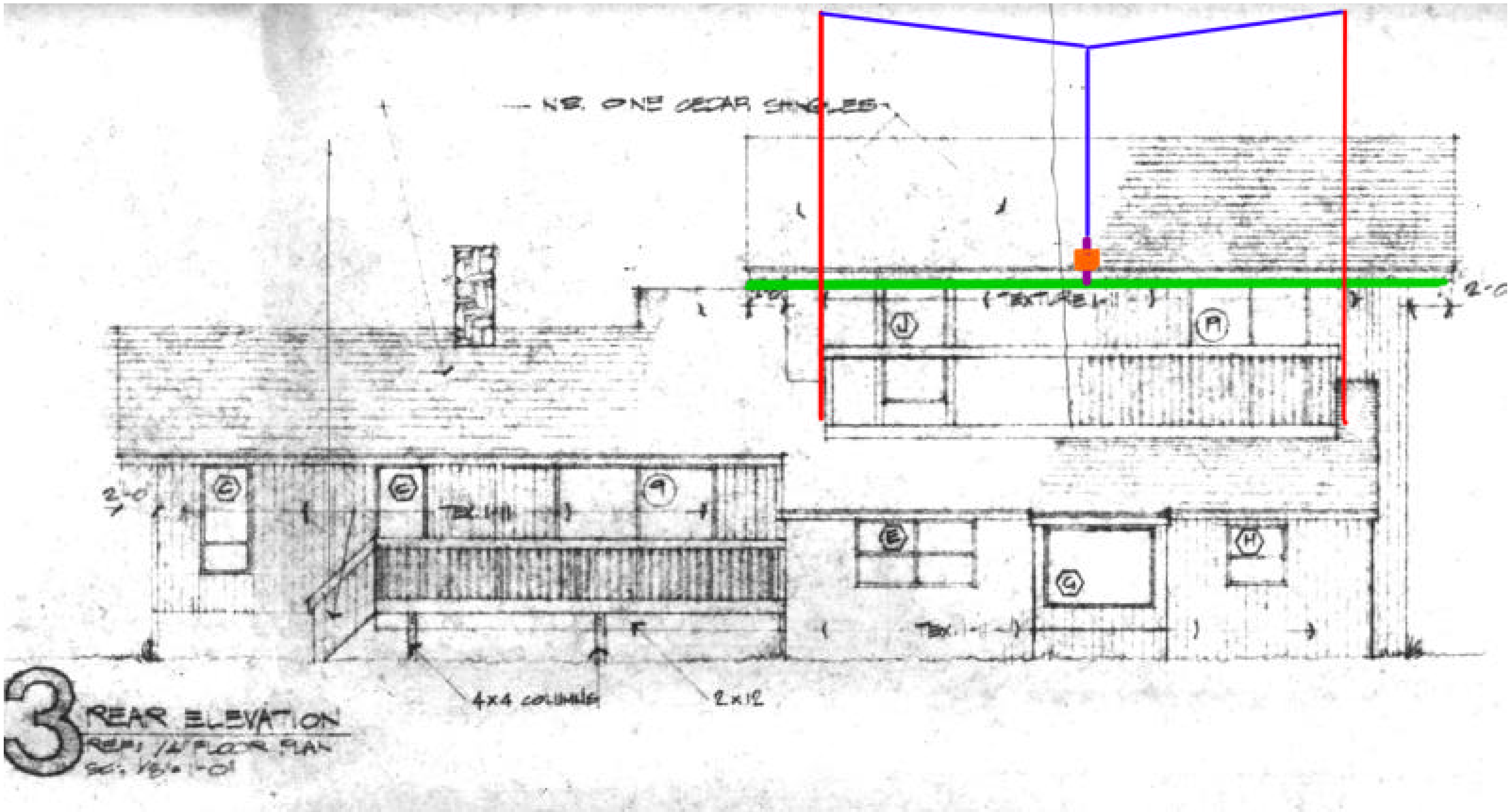
- Raise base above edge of 2nd level roof
- Add some length to vertical section
- Design and build Auto Tuner (ATU) to cover entire band
- Build into and use resources of LDG Auto Tuner

Auto Tuned 160m Antenna

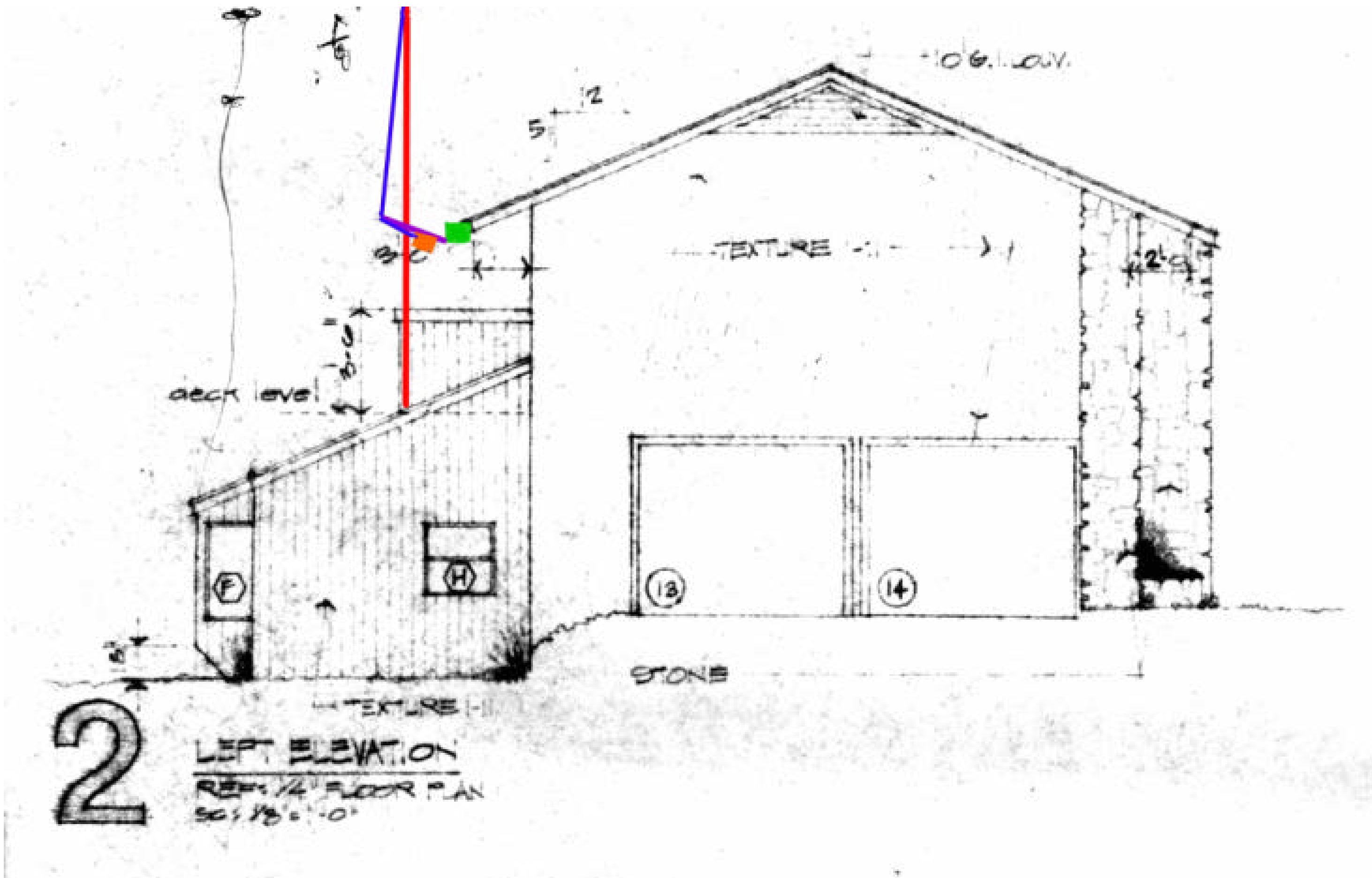
Major Tasks and Project Flow

- Model antenna (EZNEC) 3 Weeks
  -- Compare to old antenna
  -- Determine tuning requirements
- Mechanical design and build of antenna Few Days
- Design and build the base loading unit 3 Weeks
  -- Mechanical
  -- Electrical

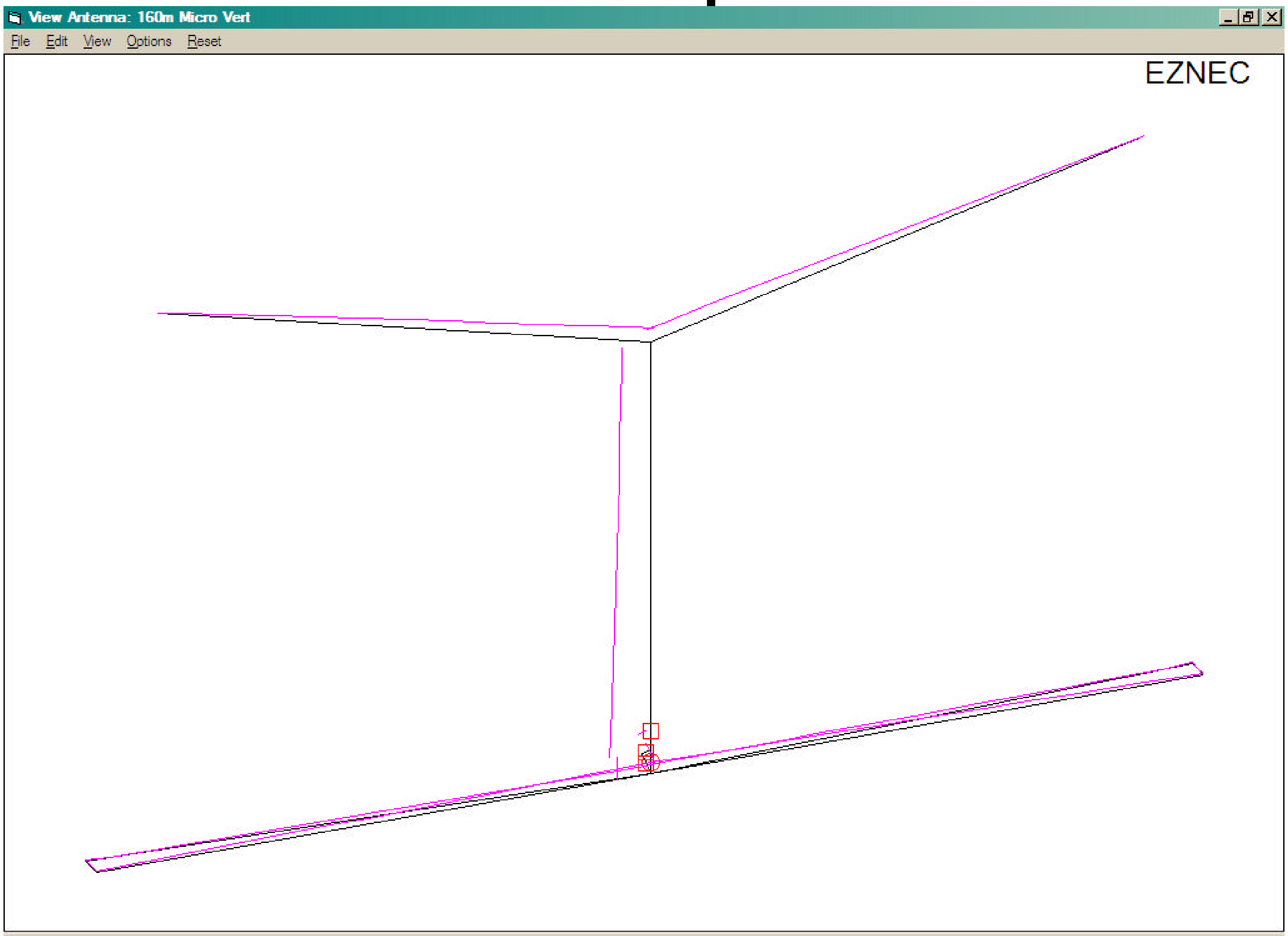
160m #2 Front View



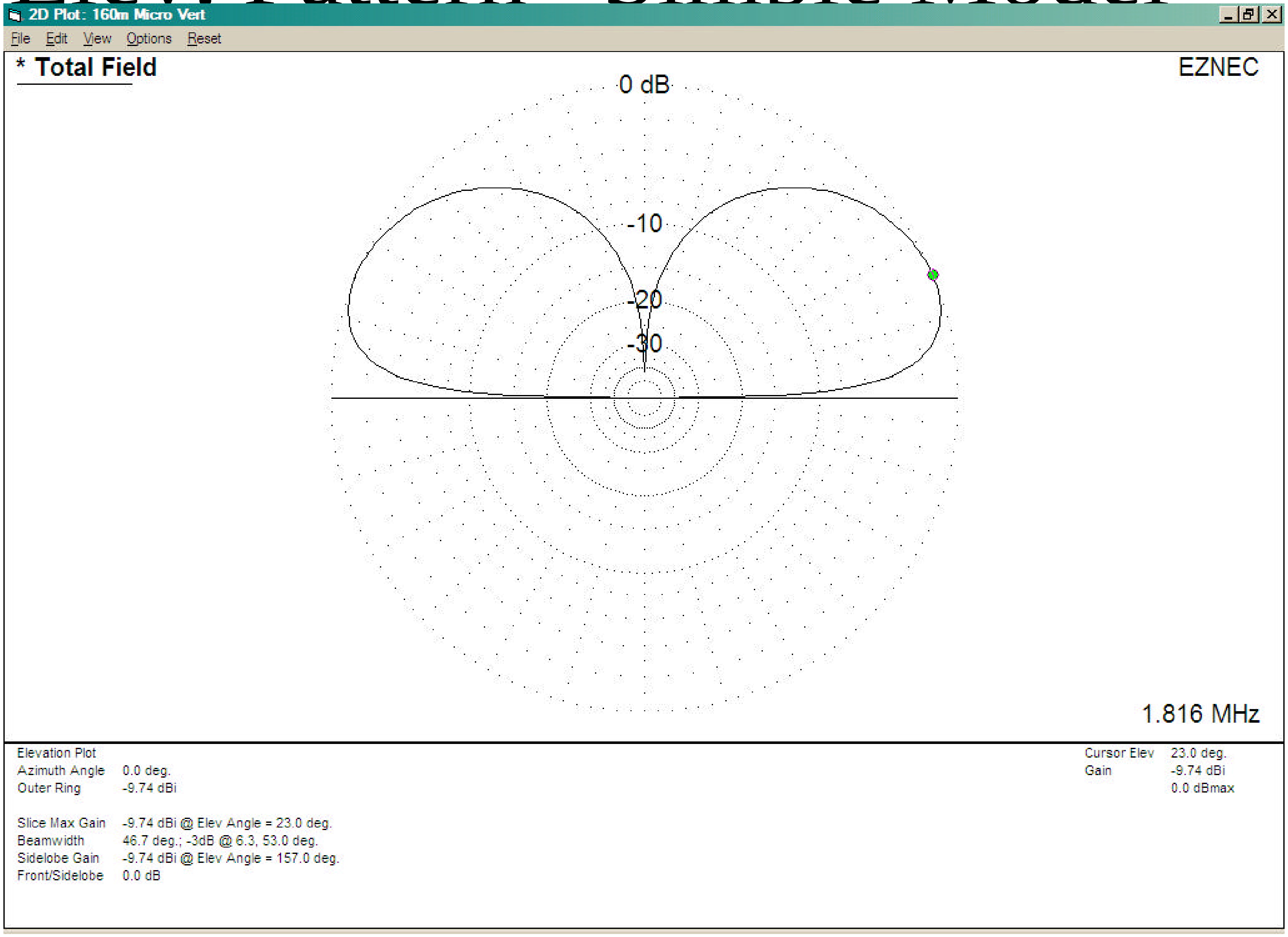
160m #2 Side View



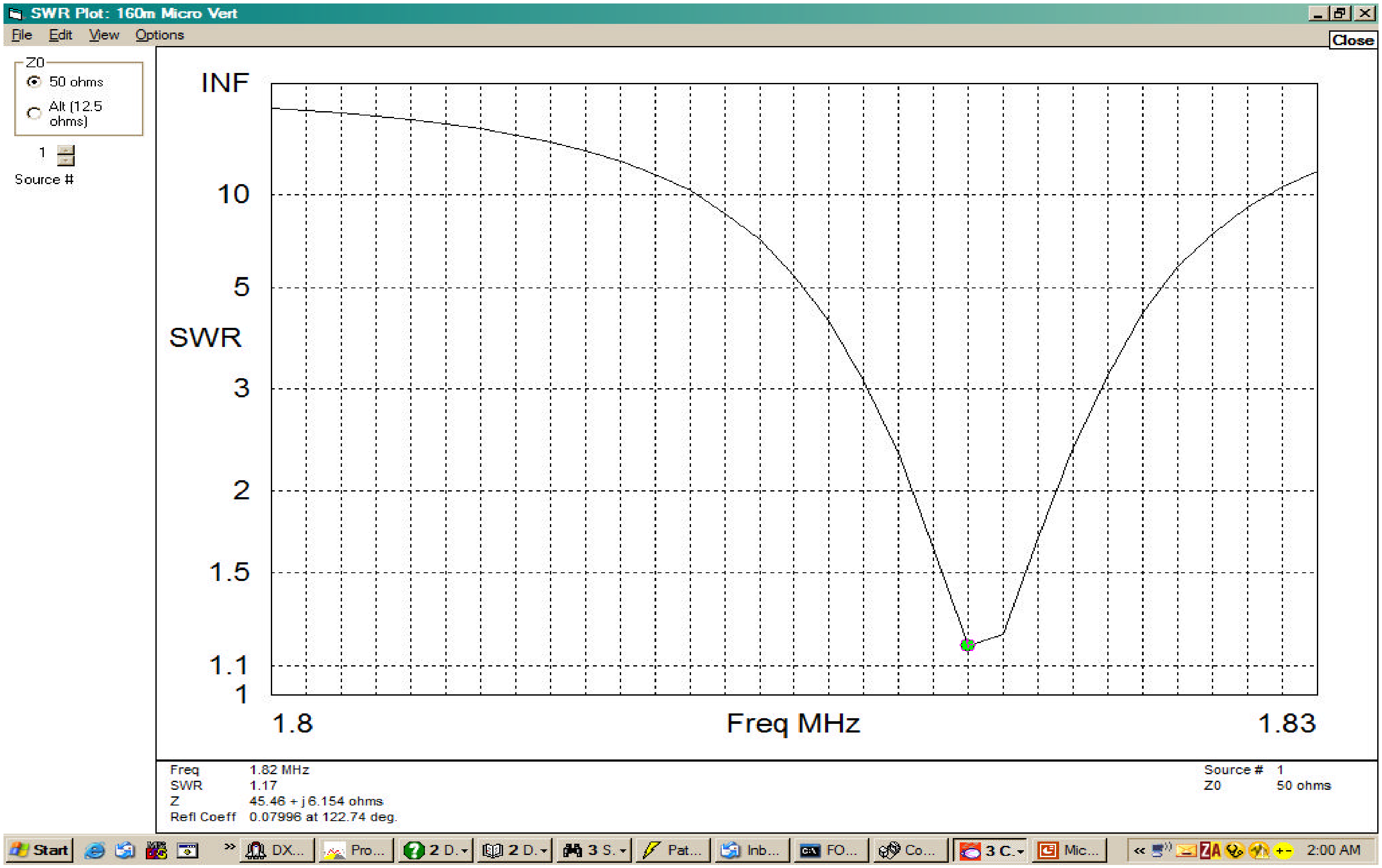
160m 12 ft Simple Model



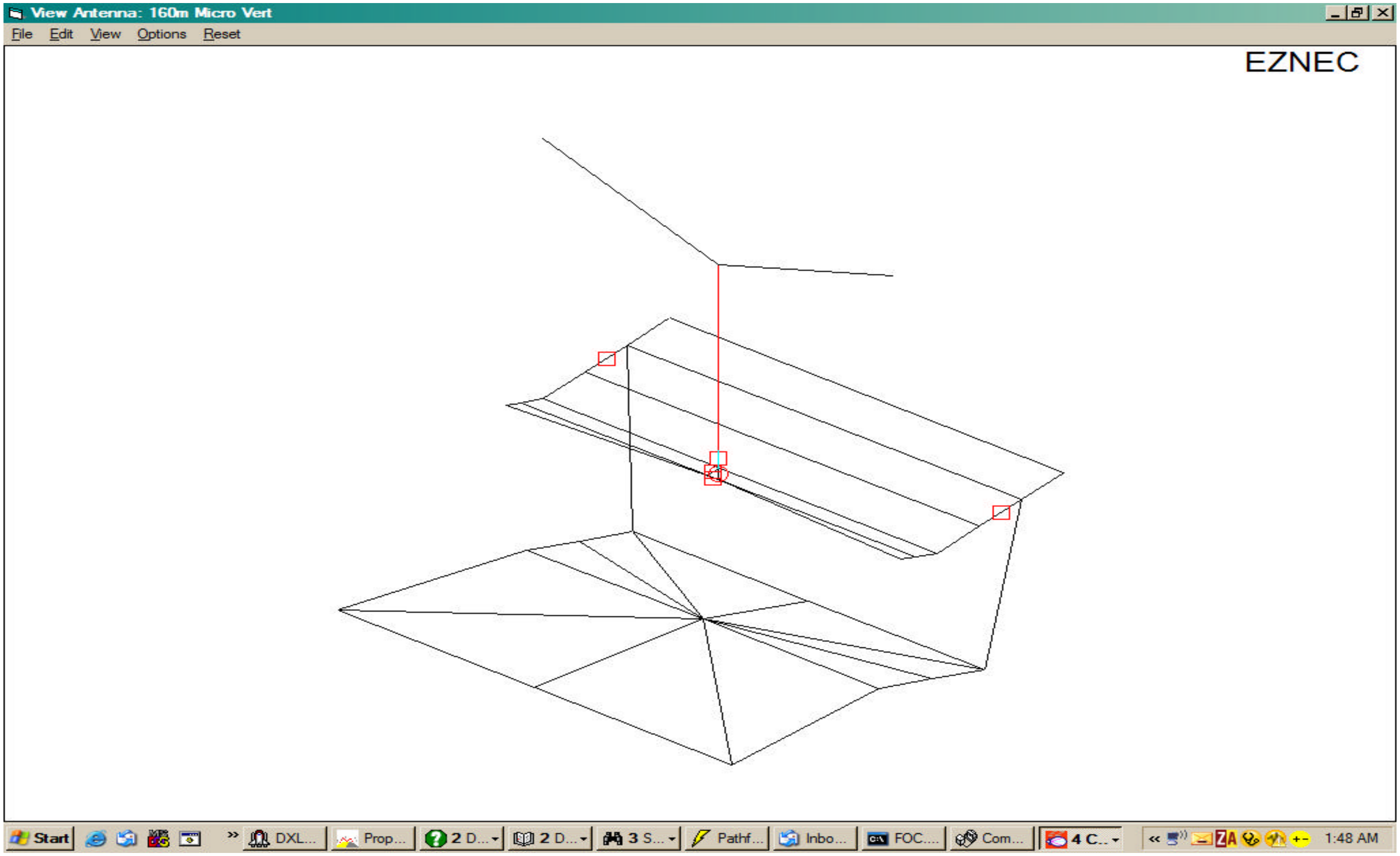
Elev. Pattern –Simple Model



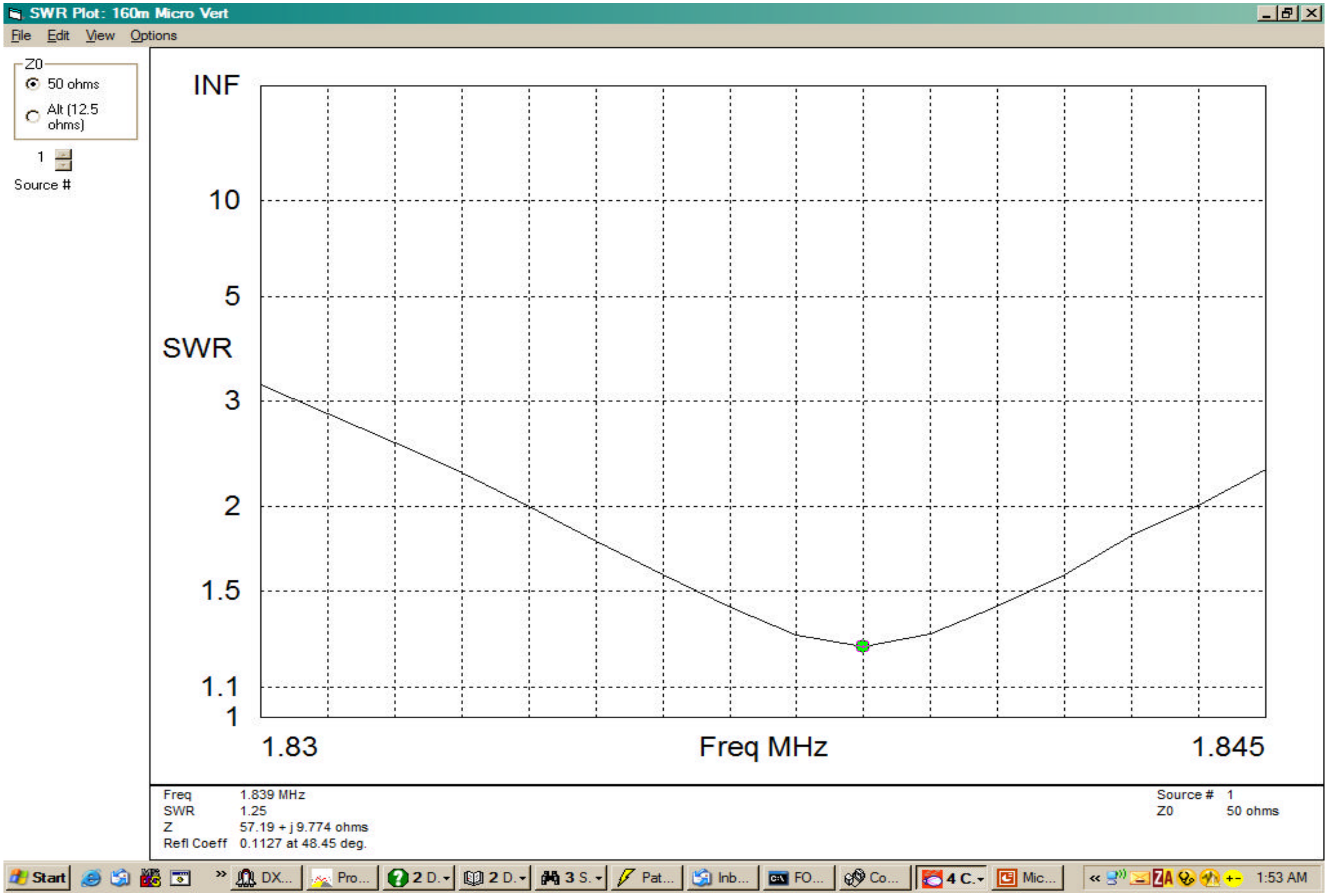
SWR – Simple Model 12 ft



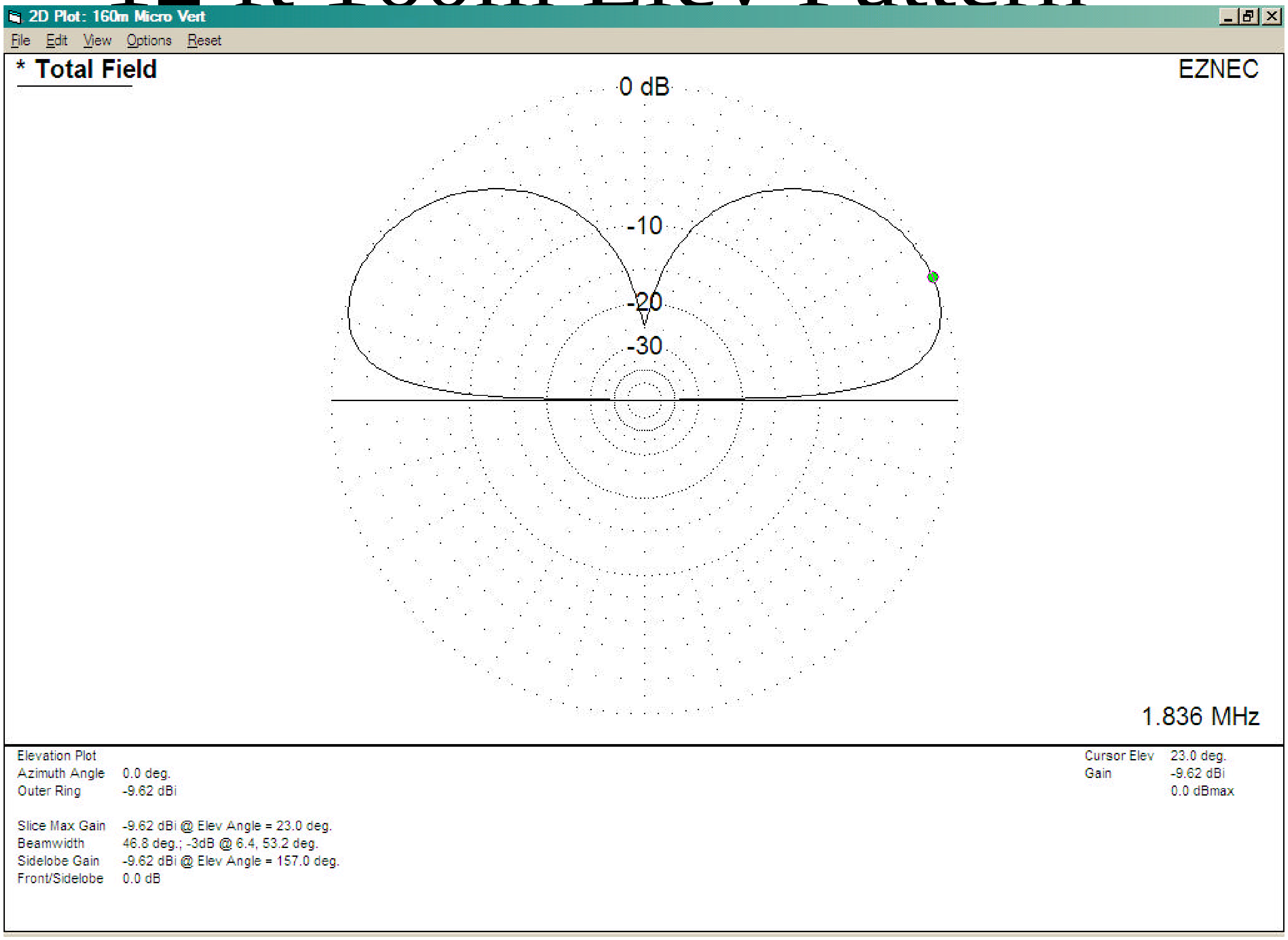
12 ft 160m Model w/ Roof



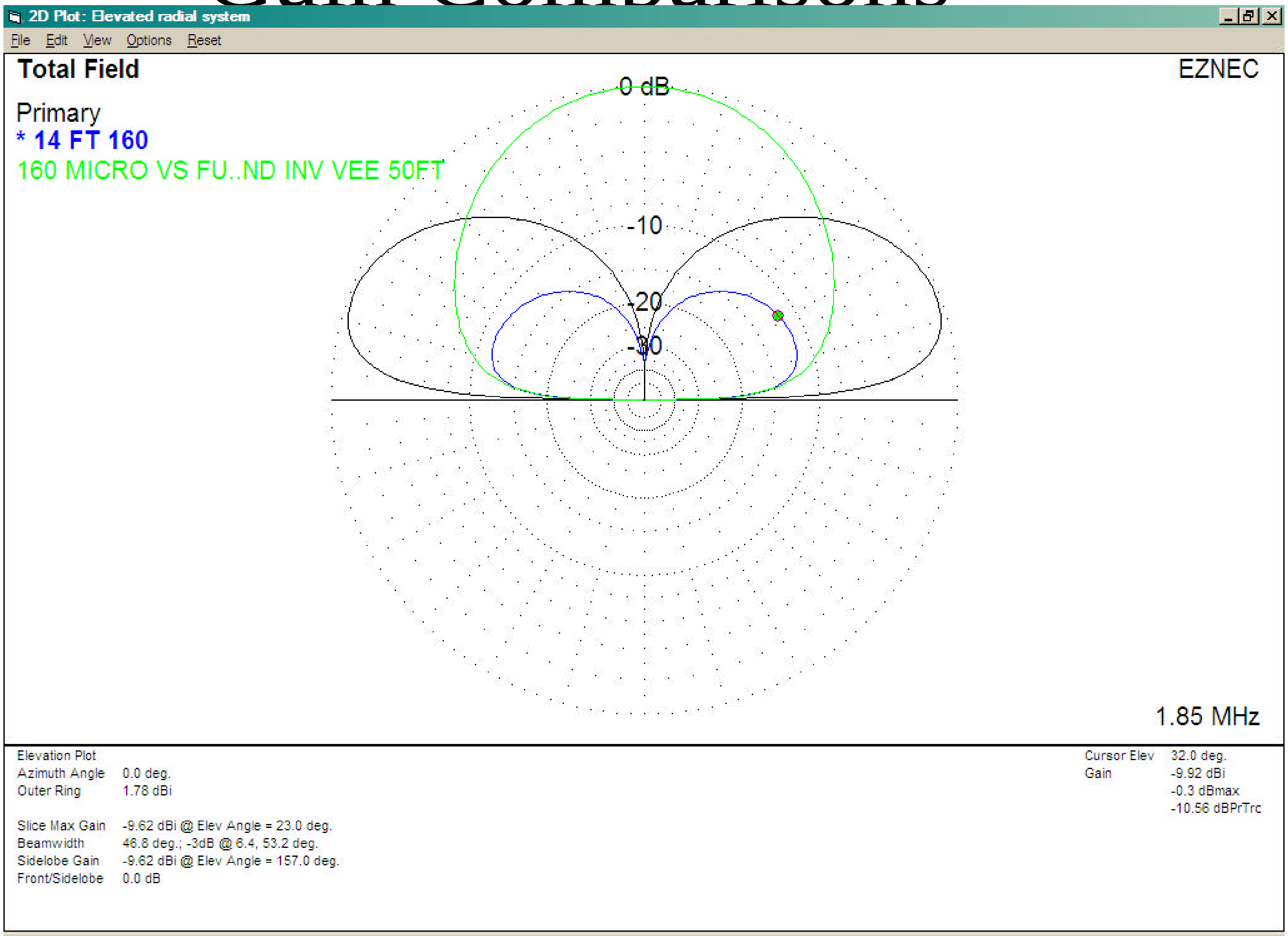
12 ft 160m Vertical SWR



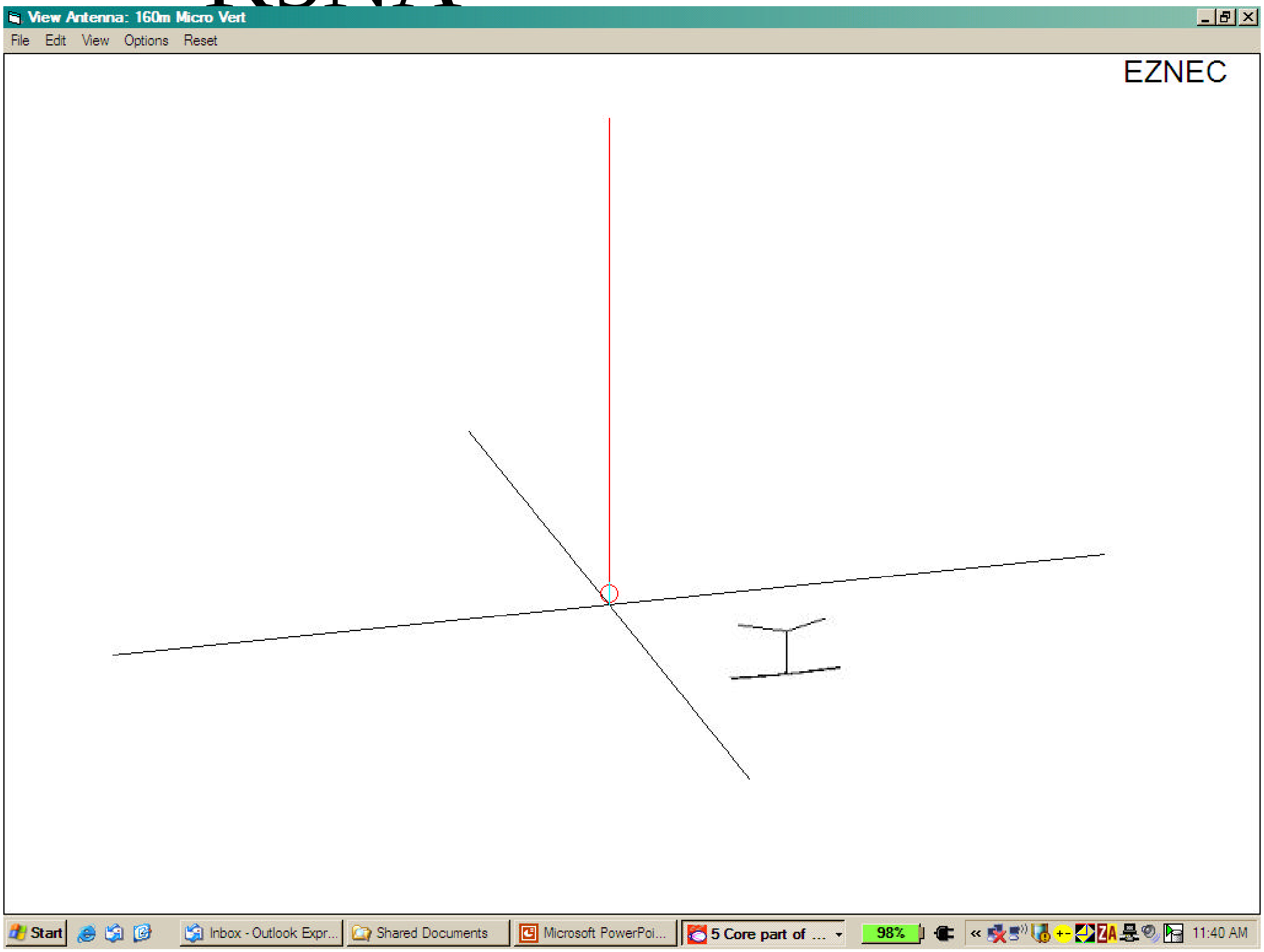
12 ft 160m Elev Pattern



Gain Comparisons



K5NA VS. W5JAW



The Farm --1

N5TW 160M Challenge

Score =
Countries/Radiator Length
(countries per foot)

K5NA	274/135=2.09
N5TW	177/135=1.31
W5JAW	71/12=5.92

Success with Small LF Ants.

- Don’t be constrained to conventional configurations
- Minimize losses in system
- Use modeling tools
- Be in right place at right time
- Be patient

Ice? – No Problem!

DXCC Summary (includes deleted countries)

	Worked	Confirmed	Verified
HR Mixed	276		
HR Phone	115		
HR CW	272		
HR RTTY			
Mixed	276		
Phone	115		
CW	272		
RTTY			
PSK			
160M	77		
80M	140		
40M	240		
30M	206		
20M	245		
17M	208		
15M	191		
12M	152		
10M	155		
6M			
2M			
HF BandCountries	1614	0	0
HF ModeCountries	387	0	0
HF BandModes	2001	0	0
DXCC Challenge	1614	0	0

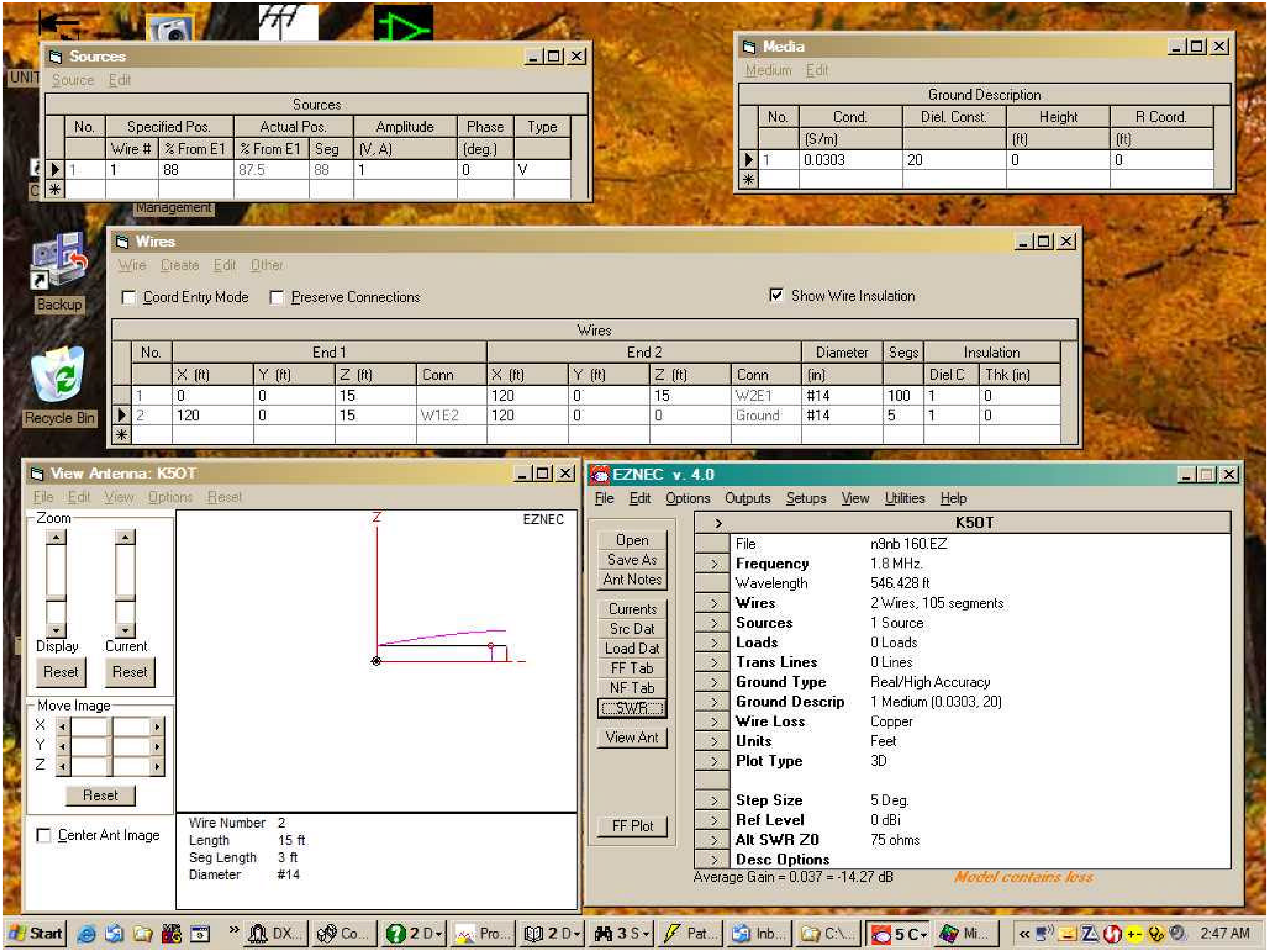
Award Program - include deleted countries?

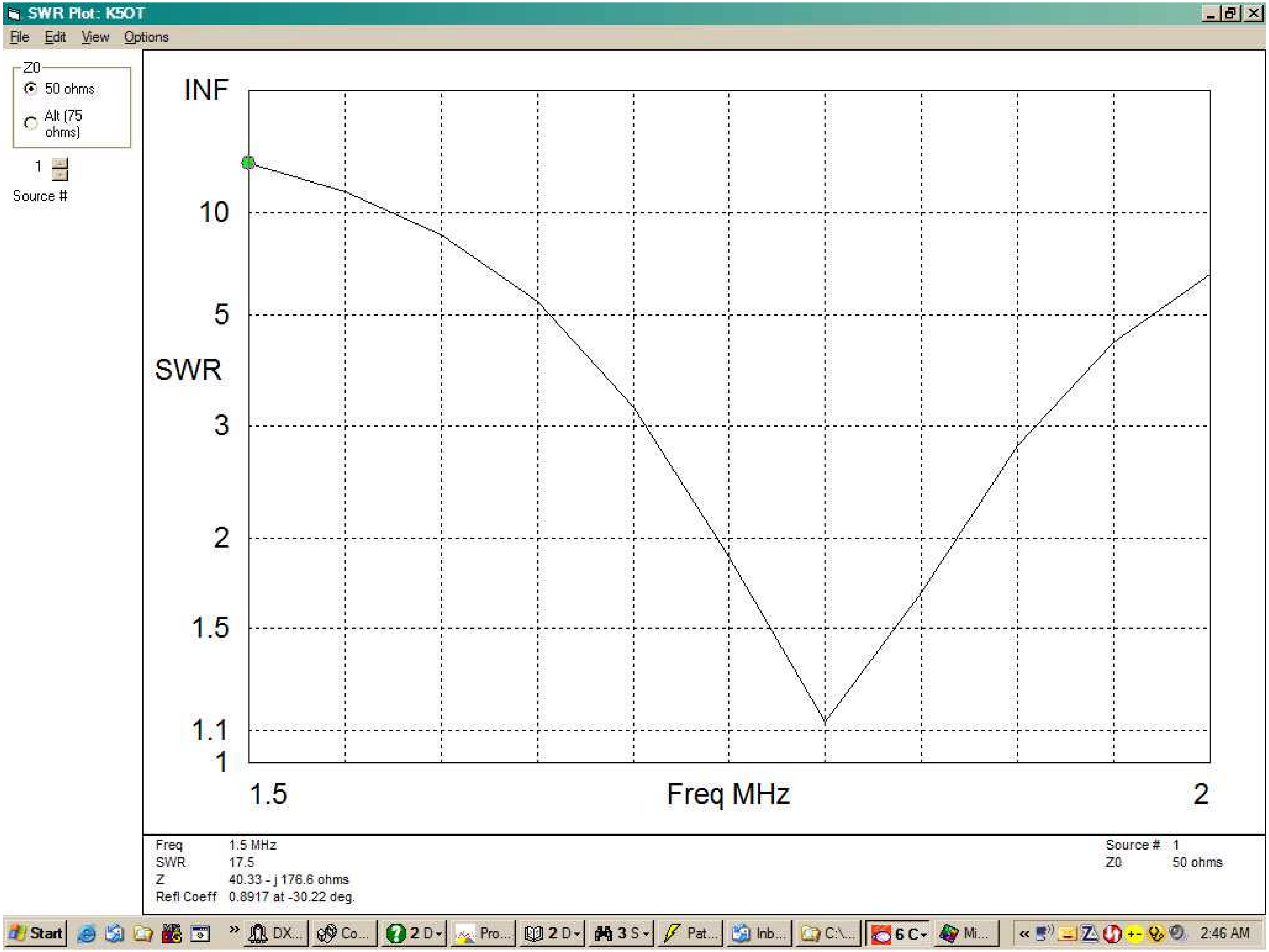
(•) DXCC (includes deleted) TOP (non-deleted only) ( )

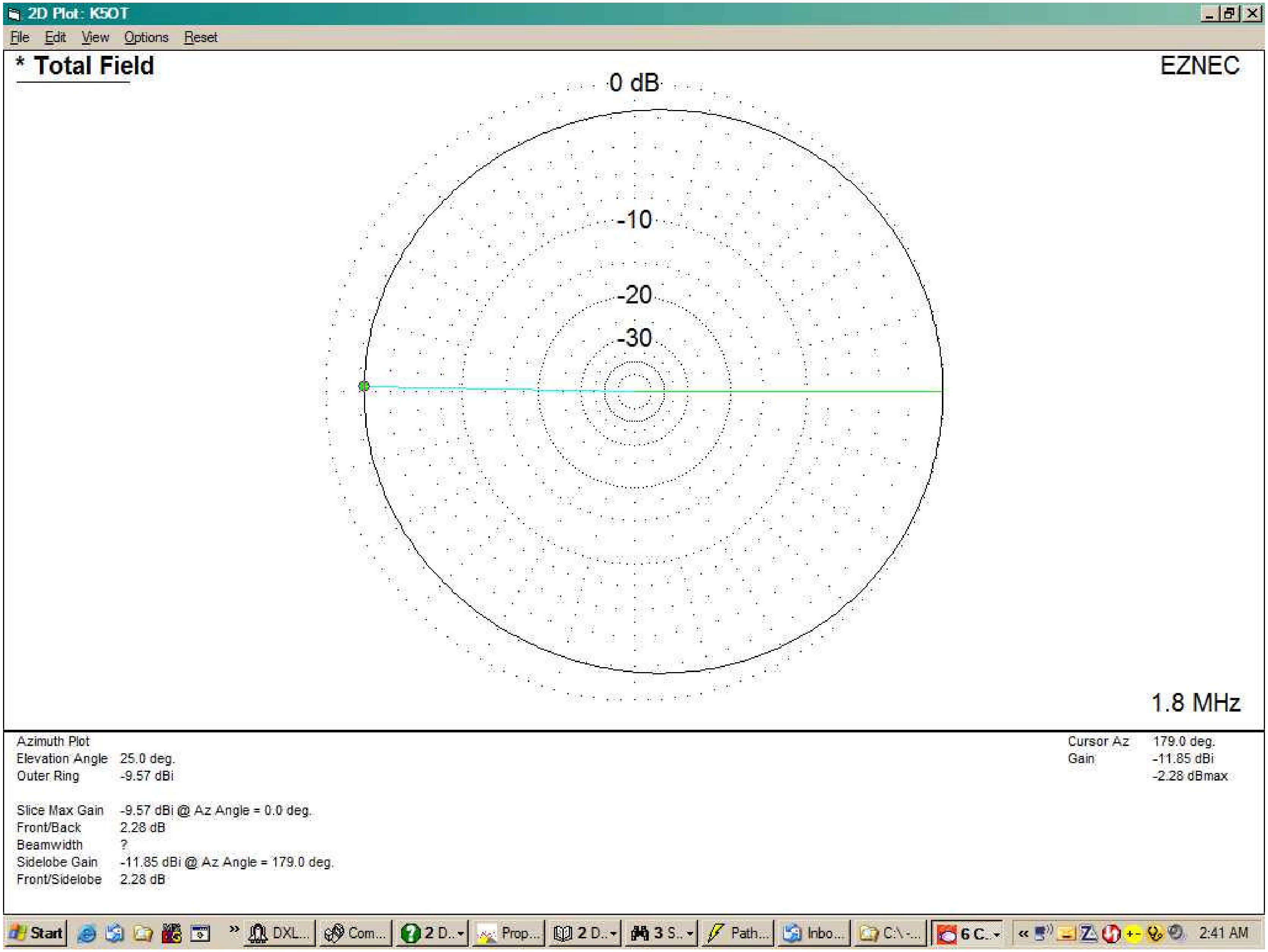
Summary [Update]

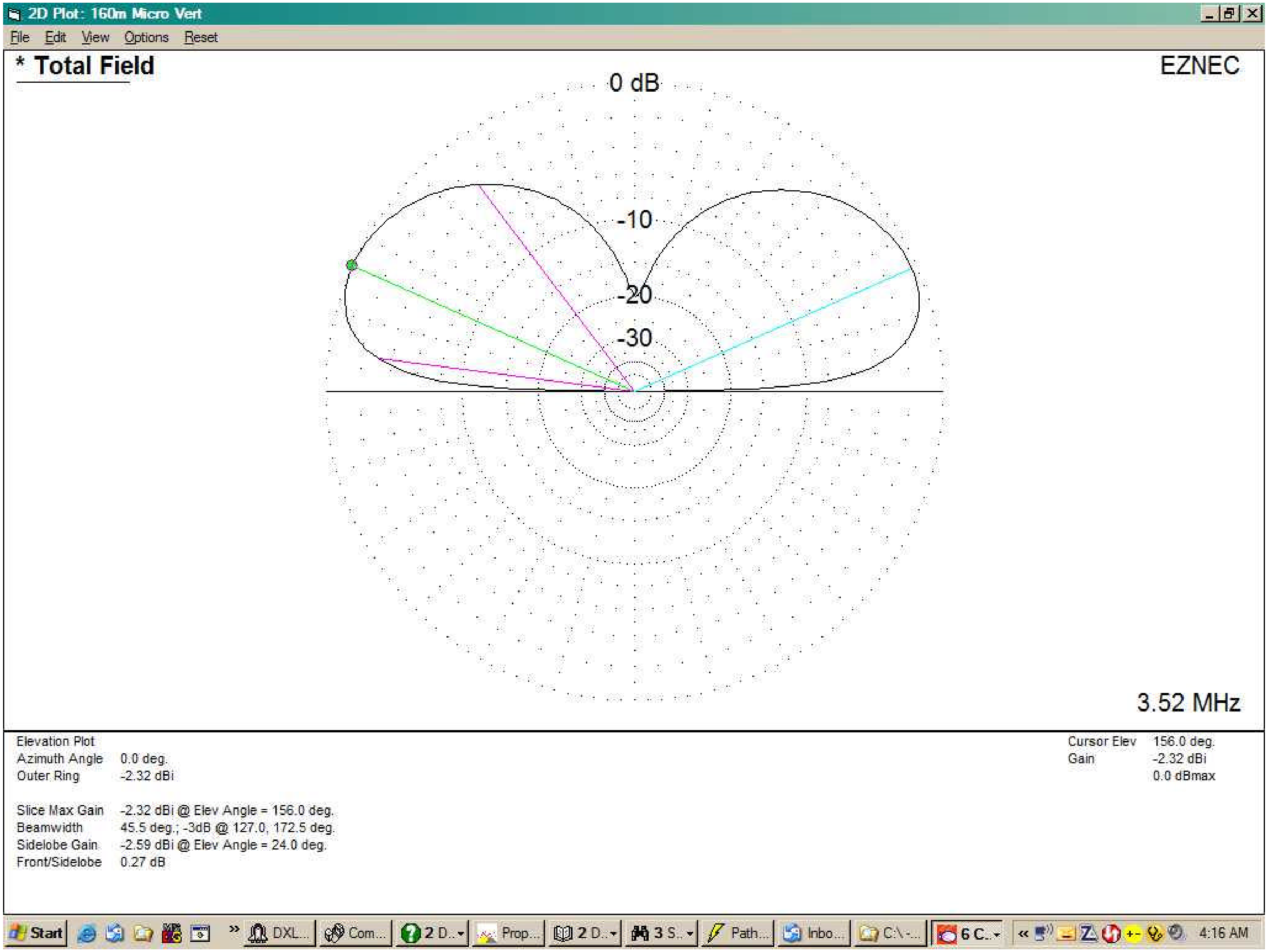
Generate Reports [Progress] [Summary]

W5JAW Low Power for 2 seasons!


Sources
Source Edit
Sources
No. Specified Pos. Actual Pos. Amplitude Phase Type
Wire # % From E1 % From E1 Seg (V, A) (deg.)
1 1 88 87.5 88 1 0 V
Media
Medium Edit
Ground Description
No. Cond. Diel. Const. Height R Coord.
(S/m) (ft) (ft)
1 0.0303 20 0 0
Wires
Wire Create Edit Other
Coord Entry Mode
Preserve Connections
Show Wire Insulation
Wires
No. End 1 End 2 Diameter Segs Insulation
X (ft) Y (ft) Z (ft) Conn X (ft) Y (ft) Z (ft) Conn (in) Diel C Thk (in)
1 0 0 15 120 0 15 W2E1 #14 100 1 0
2 120 0 15 W1E2 120 0 0 Ground #14 5 1 0
Backup
Recycle Bin
View Antenna: K5OT
File Edit View Options Reset
Zoom
Display
Current
Reset
Reset
Move Image
X
Y
Z
Reset
Center Ant Image
Z
EZNEC
Wire Number 2
Length 15 ft
Seg Length 3 ft
Diameter #14
EZNEC v. 4.0
File Edit Options Outputs Setups View Utilities Help
Open
Save As
Ant Notes
Currents
Src Dat
Load Dat
FF Tab
NF Tab
SWR
View Ant
FF Plot
K5OT
File n9nb 160.EZ
Frequency 1.8 MHz.
Wavelength 546.428 ft
Wires 2 Wires, 105 segments
Sources 1 Source
Loads 0 Loads
Trans Lines 0 Lines
Ground Type Real/High Accuracy
Ground Descrip 1 Medium (0.0303, 20)
Wire Loss Copper
Units Feet
Plot Type 3D
Step Size 5 Deg.
Ref Level 0 dBi
Alt SWR Z0 75 ohms
Desc Options
Average Gain = 0.037 = -14.27 dB
Model contains loss
Start
2:47 AM


SWR Plot: K5OT
File Edit View Options
Z0
50 ohms
Alt (75 ohms)
1
Source #
INF
10
5
SWR
3
2
1.5
1.1
1
1.5
Freq MHz
2
Freq 1.5 MHz
SWR 17.5
Z 40.33 - j 176.6 ohms
Refl Coeff 0.8917 at -30.22 deg.
Source # 1
Z0 50 ohms
Start
2:46 AM


2D Plot: K5OT
File Edit View Options Reset
* Total Field
EZNEC
0 dB
-10
-20
-30
1.8 MHz
Azimuth Plot
Elevation Angle 25.0 deg.
Outer Ring -9.57 dBi
Slice Max Gain -9.57 dBi @ Az Angle = 0.0 deg.
Front/Back 2.28 dB
Beamwidth ?
Sidelobe Gain -11.85 dBi @ Az Angle = 179.0 deg.
Front/Sidelobe 2.28 dB
Cursor Az 179.0 deg.
Gain -11.85 dBi
-2.28 dBmax
Start
2:41 AM


2D Plot: 160m Micro Vert
File Edit View Options Reset
* Total Field
EZNEC
0 dB
-10
-20
-30
3.52 MHz
Elevation Plot
Azimuth Angle 0.0 deg.
Outer Ring -2.32 dBi
Slice Max Gain -2.32 dBi @ Elev Angle = 156.0 deg.
Beamwidth 45.5 deg.; -3dB @ 127.0, 172.5 deg.
Sidelobe Gain -2.59 dBi @ Elev Angle = 24.0 deg.
Front/Sidelobe 0.27 dB
Cursor Elev 156.0 deg.
Gain -2.32 dBi
0.0 dBmax
Start
4:16 AM