A 6 Meter Stealth Antenna

Gary (III) DePalma
AC8NE

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or

You never know what's lurking in the woods

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AC8NE

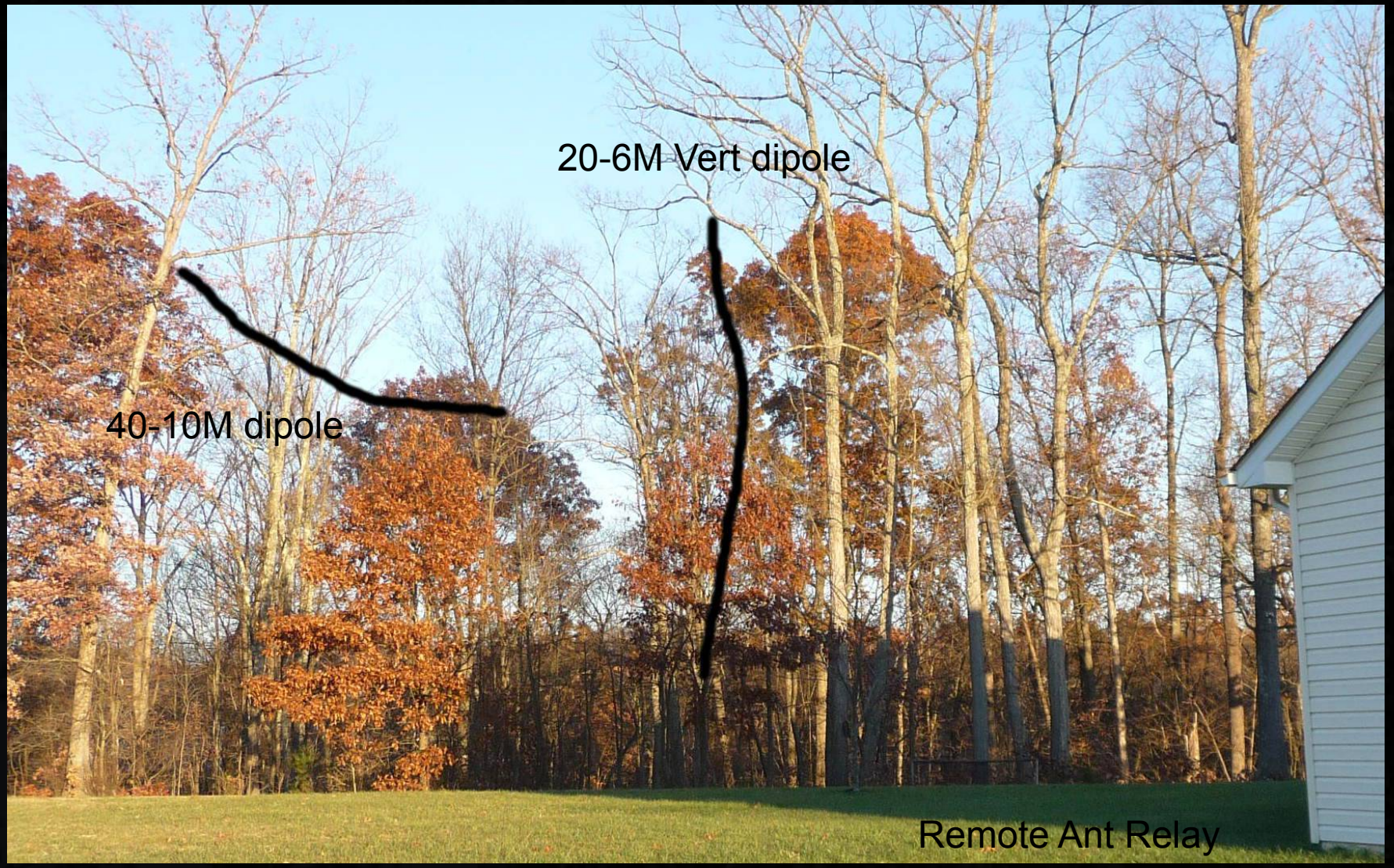
Ham License + HOA = Trouble

- 2009 – Moved to the area
  - With expired ham license
- 2013 – Re-licensed as AC8NE
- 2013 – Read the HOA agreement
  - NO ANTENNAS ALLOWED except for TV
- 2013 – 40-10 M dipole and 2M J-pole in attic
  - Situation OK but no DXCC etc.
- 2015 – HF antenna stopped working

Faraday Cage

Switch to a Stealth Antenna Farm

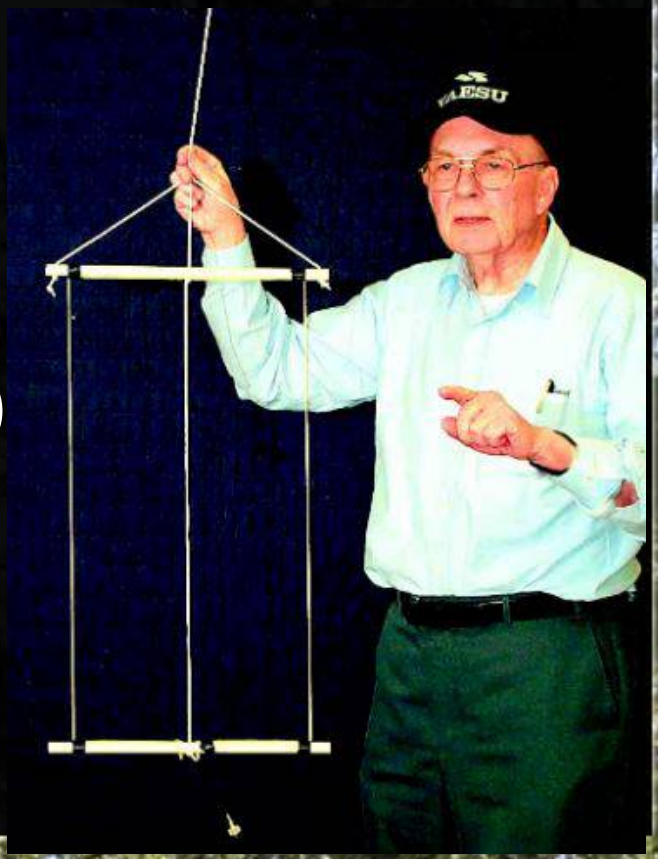
Stealth Antenna Farm



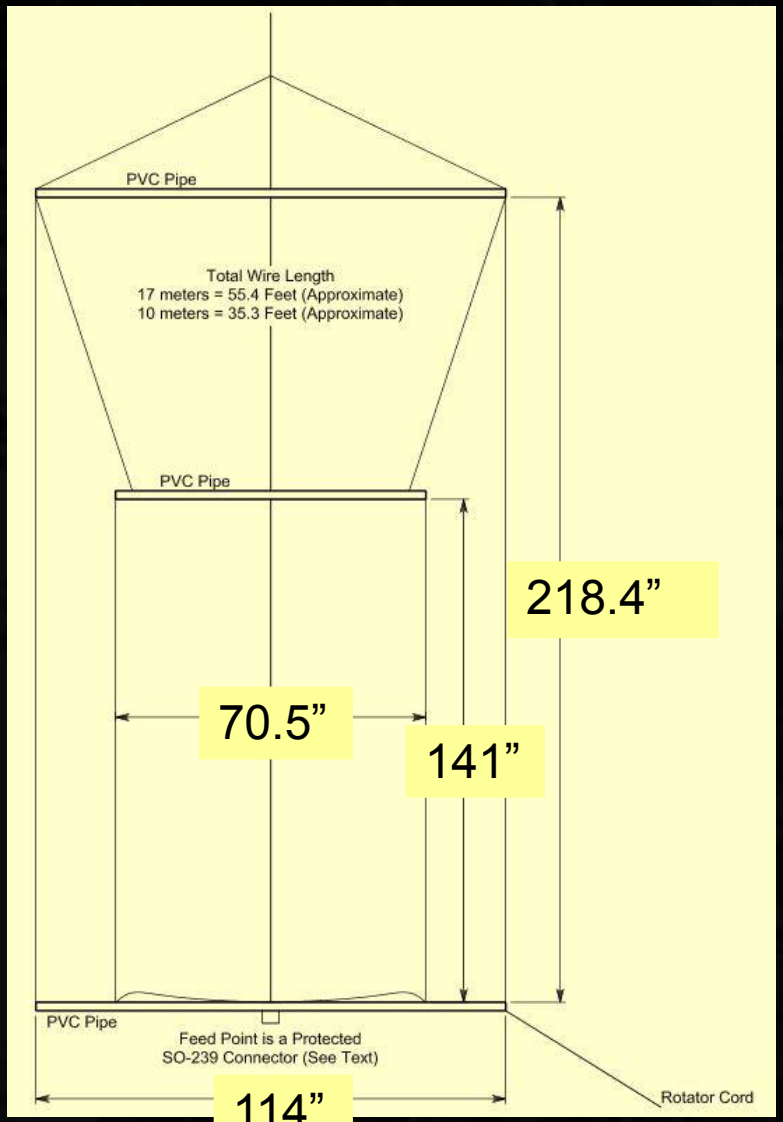
Needed Ant for 6 Meter Sporadic-E

- "A 10/17 Meter Hanging Loop Antenna"; Sam Kennedy, KT4QW; QST, October 2004
- Horizontal polarization
- 3dB gain and rotate-able
  - arm-strong
- Single support (hangs down)
- Resonant, 50 Ohm, Hi Q
- Almost stealth

Can it be adapted to 6M?

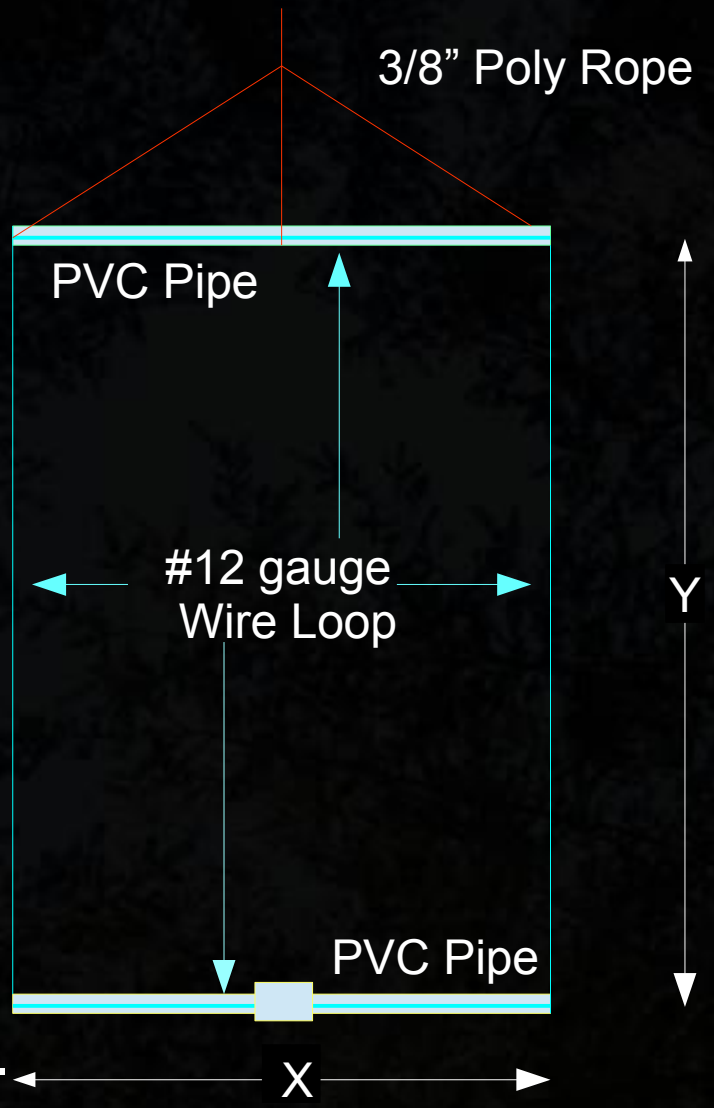


Sam's Original Design



Just Need Values for X and Y

- Start with
  - X=70.5*6/10=42.3
  - Y=141*6/10=84.6
- Try +/- to get results
- Physical Design Risks
  - Cut wire too short
  - Excessive Exercise
  - Lurking dangers
    - Snakes, bears,...



… Wild Cats

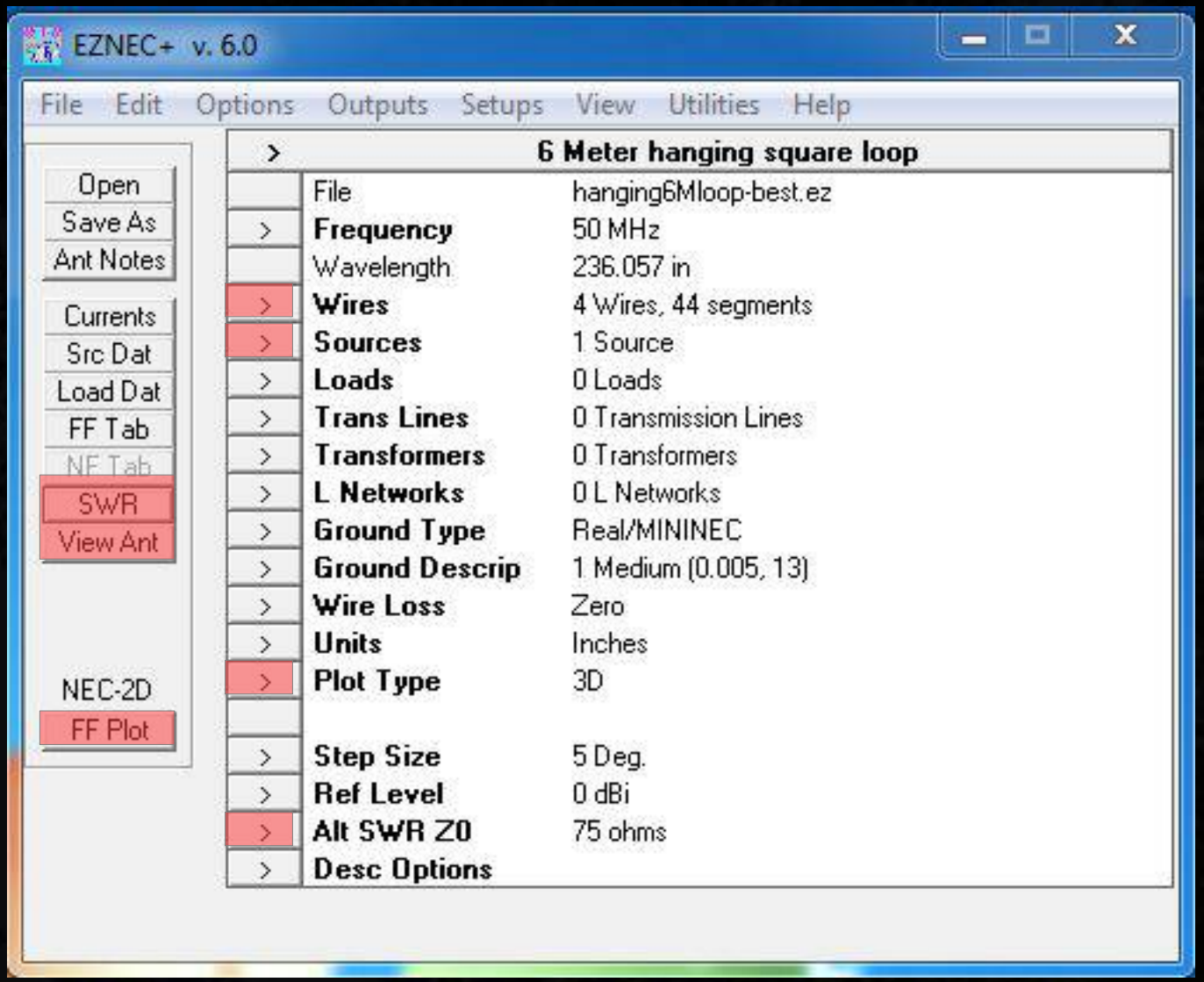
NEC to the Rescue

- Numerical Electromagnetics Code
  - NEC-1 and NEC2 open source
  - NEC-4 big bucks and hard to use
- EzNEC Antenna Design SW (based on NEC2)
  - by W7EL, Roy Lewallen, eznec.com
  - Free demo version or $99
- 4NEC2 – free NEC2 and NEC4 by Arie Voors
  - qsl.net/4NEC2 - 4NEC2 plus Gnuplot
  - Some problems with 4NEC2X version

NEC Design Cycle

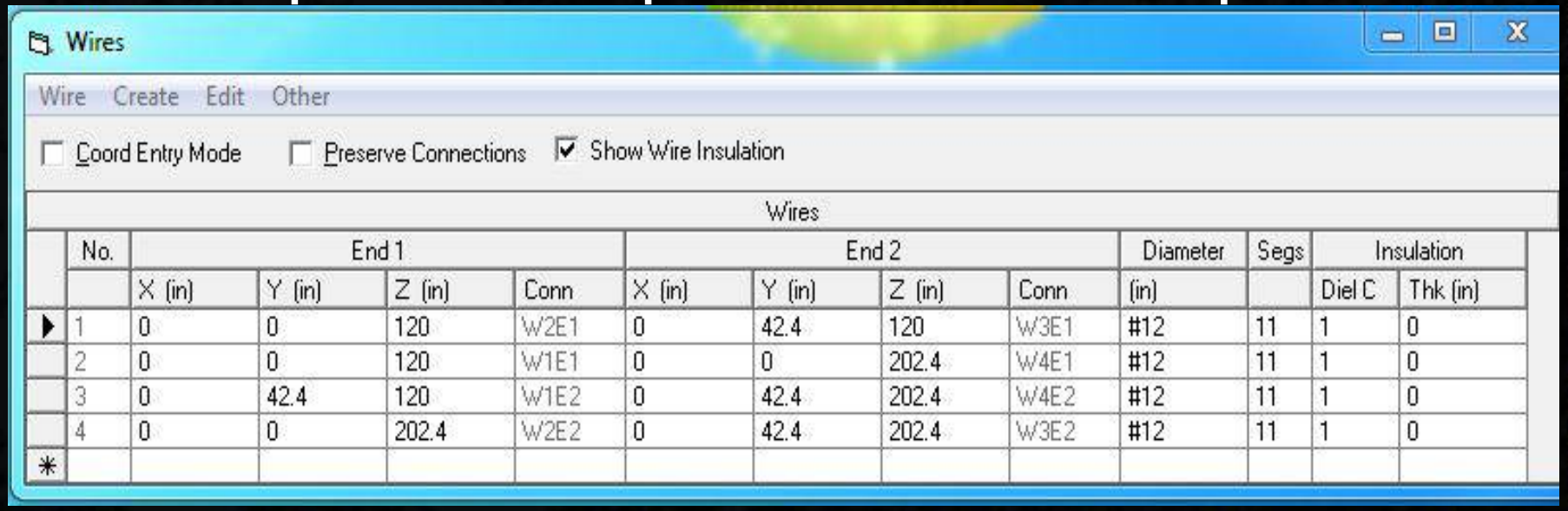
- Enter dimensions of element(s) [Wires]
- Set parameters (Source, freq range, gnd. etc.)
- Request a plot (SWR vs. f or field strength)
- Analyze results
- Modify design, plot and analyze again
  - Wash, Rinse and Repeat

EZNEC Main Control Panel



Wires

- “Straight” pieces of wire, tubing, rods, etc.
- Defined by endpoints (x,y,z)(x,y,z), diameter
- Wires automatically connect if same endpoint
- Can import from spreadsheet for experiments

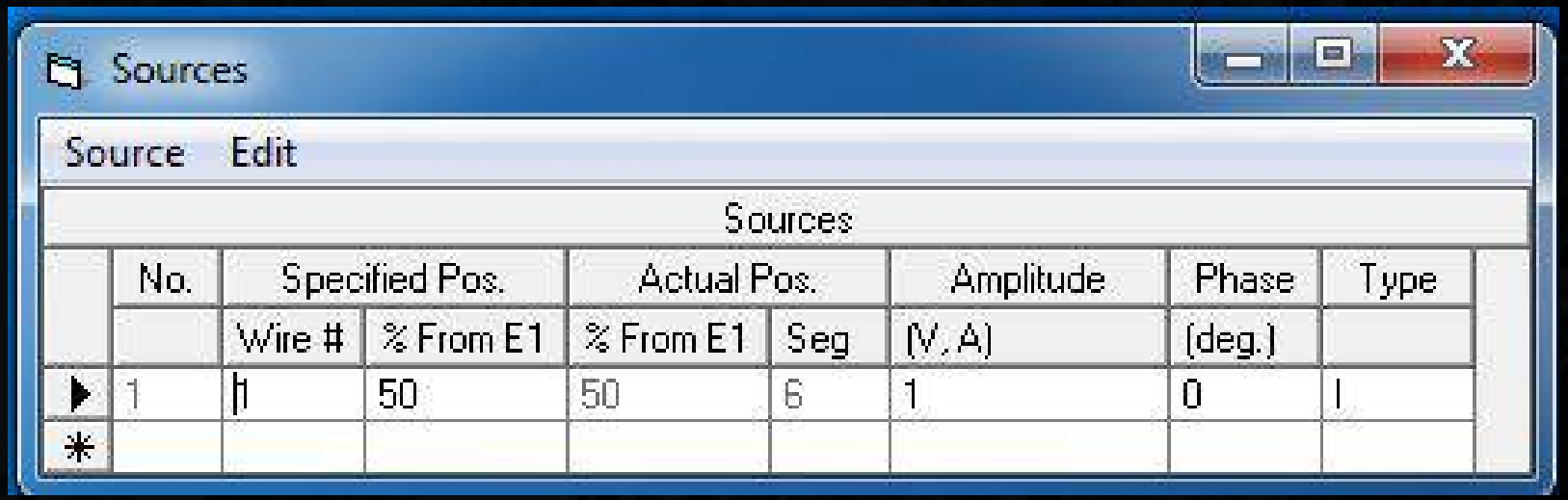


Wires

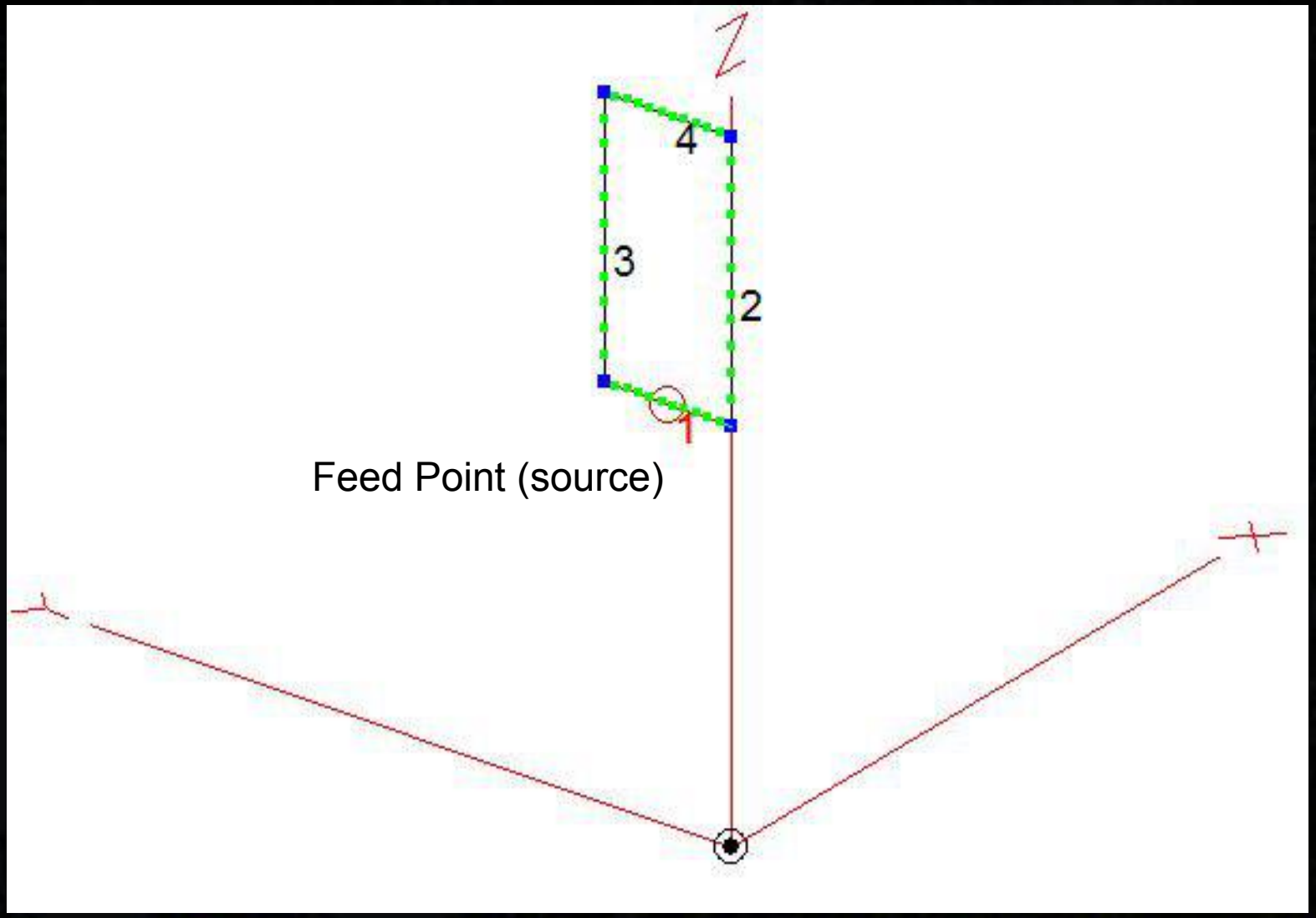
	No.	End 1				End 2				Diameter	Segs	Insulation	
		X (in)	Y (in)	Z (in)	Conn	X (in)	Y (in)	Z (in)	Conn	(in)		Diel C	Thk (in)
▶	1	0	0	120	W2E1	0	42.4	120	W3E1	#12	11	1	0
	2	0	0	120	W1E1	0	0	202.4	W4E1	#12	11	1	0
	3	0	42.4	120	W1E2	0	42.4	202.4	W4E2	#12	11	1	0
	4	0	0	202.4	W2E2	0	42.4	202.4	W3E2	#12	11	1	0
*													

Add Source(s) (feed point)

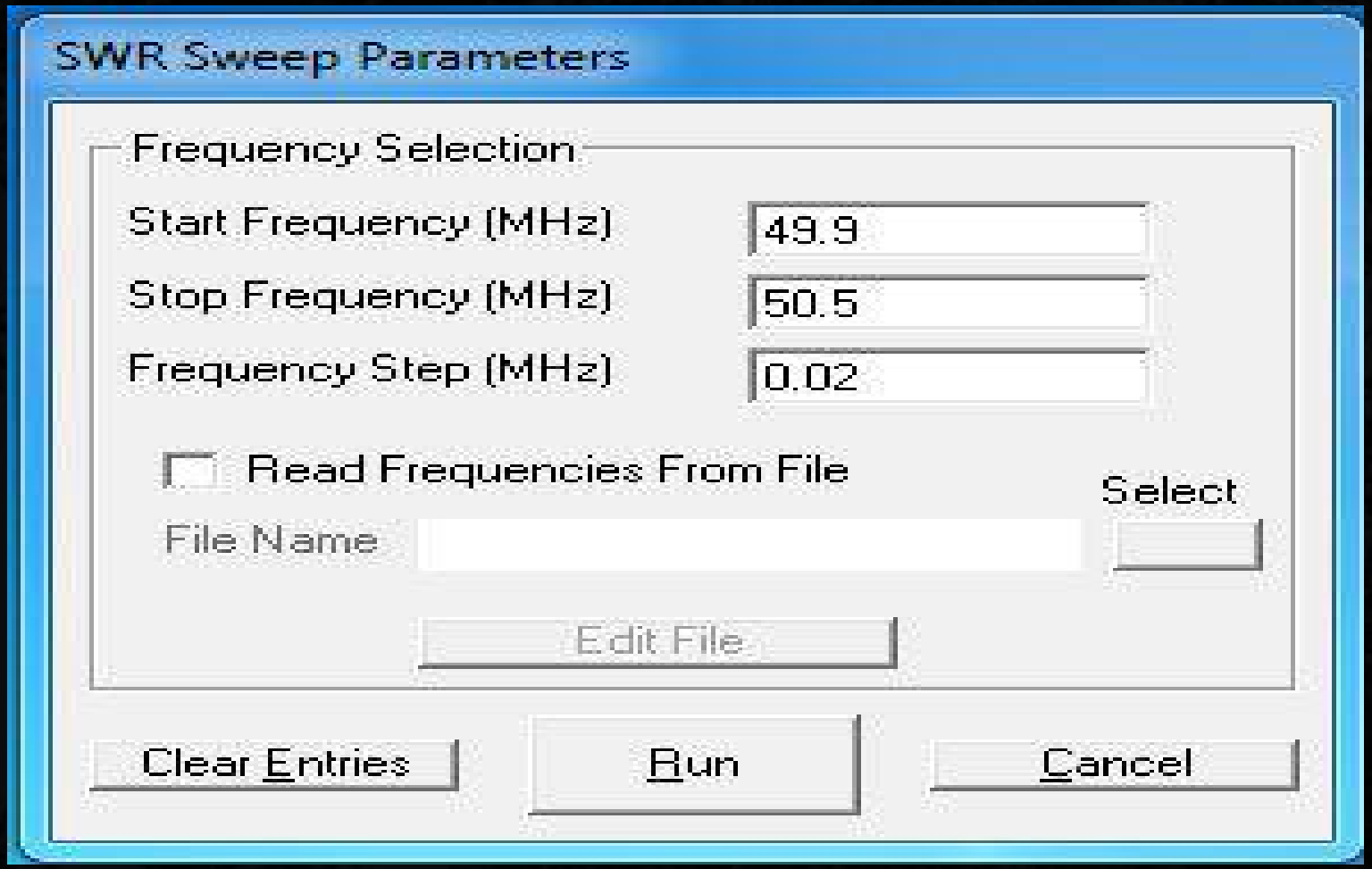
- Sources can be phased (phased array)
- Can be voltage or current
  - Irrelevant if only one feed point



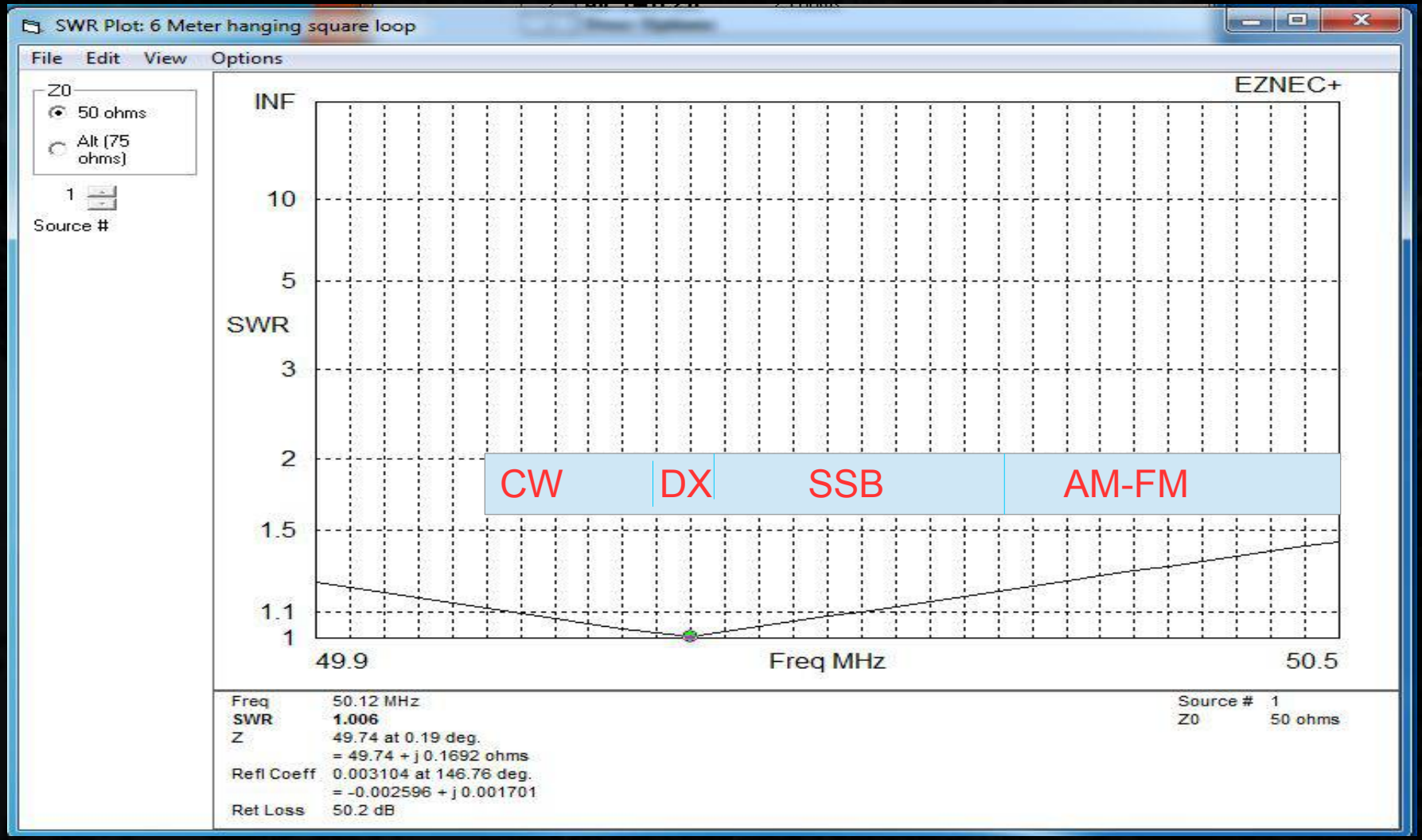
View Antenna Window



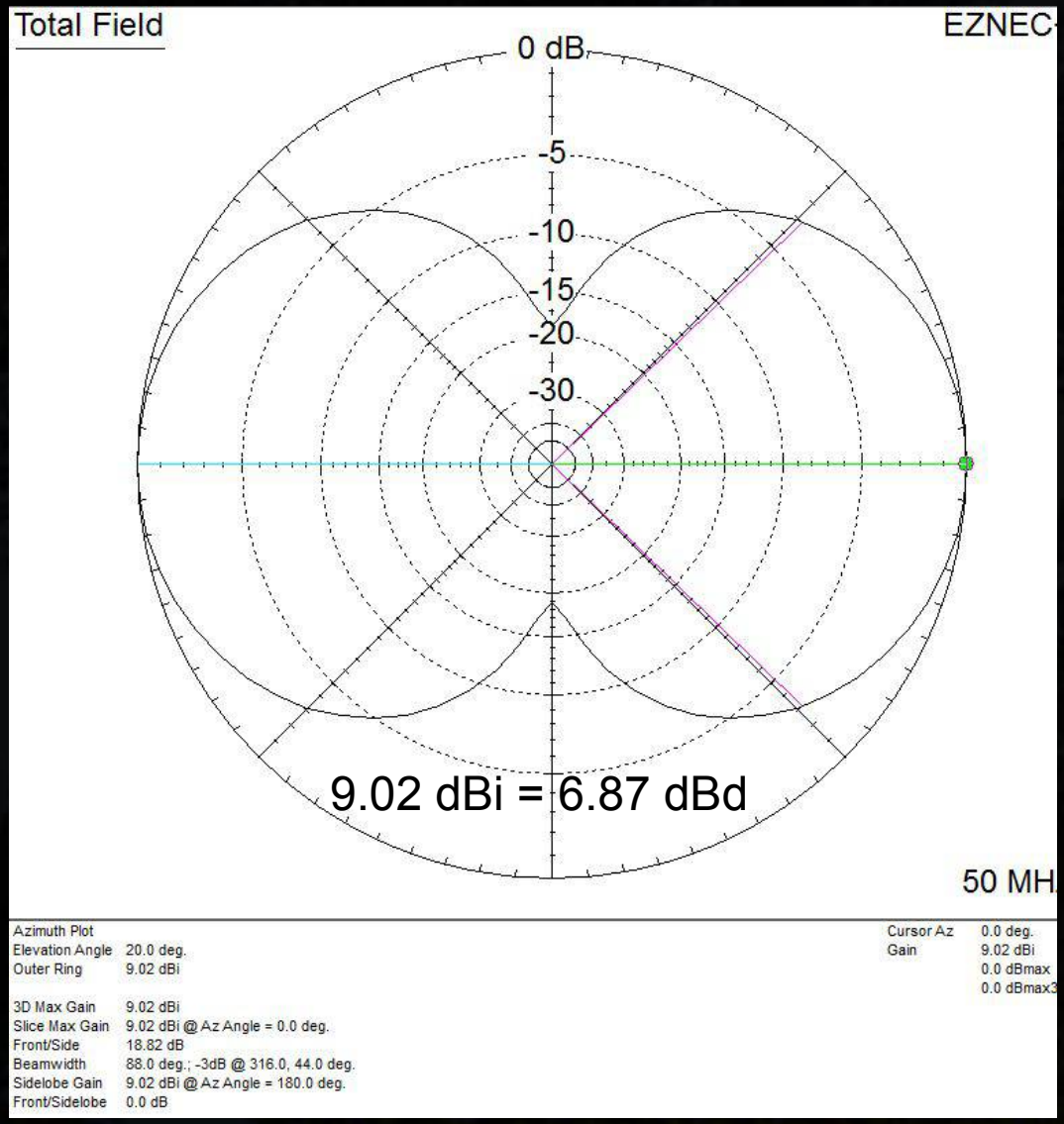
SWR Plot

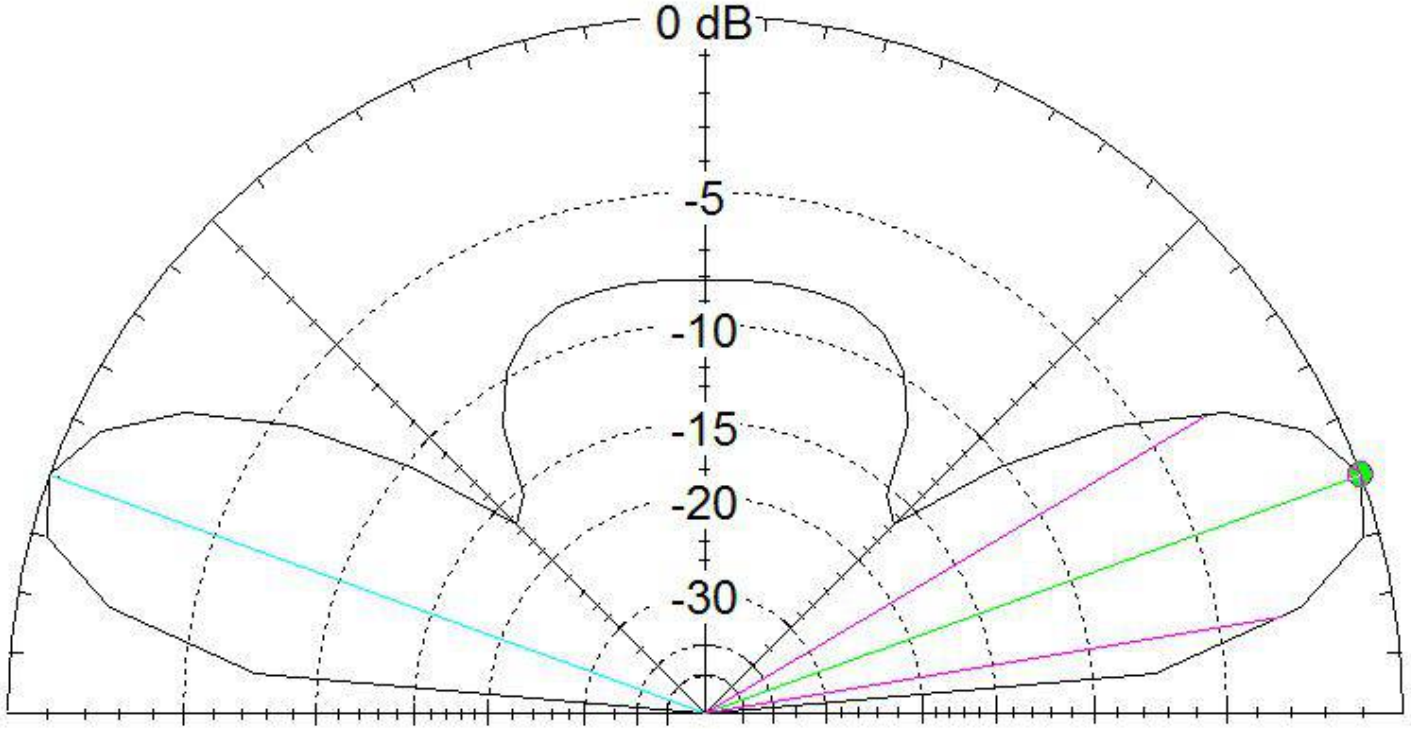

SWR Sweep Parameters
Frequency Selection
Start Frequency (MHz)
49.9
Stop Frequency (MHz)
50.5
Frequency Step (MHz)
0.02
Read Frequencies From File
Select
File Name
Edit File
Clear Entries
Run
Cancel

SWR Plot Results



Azimuth Gain (20 Degrees Elevation)





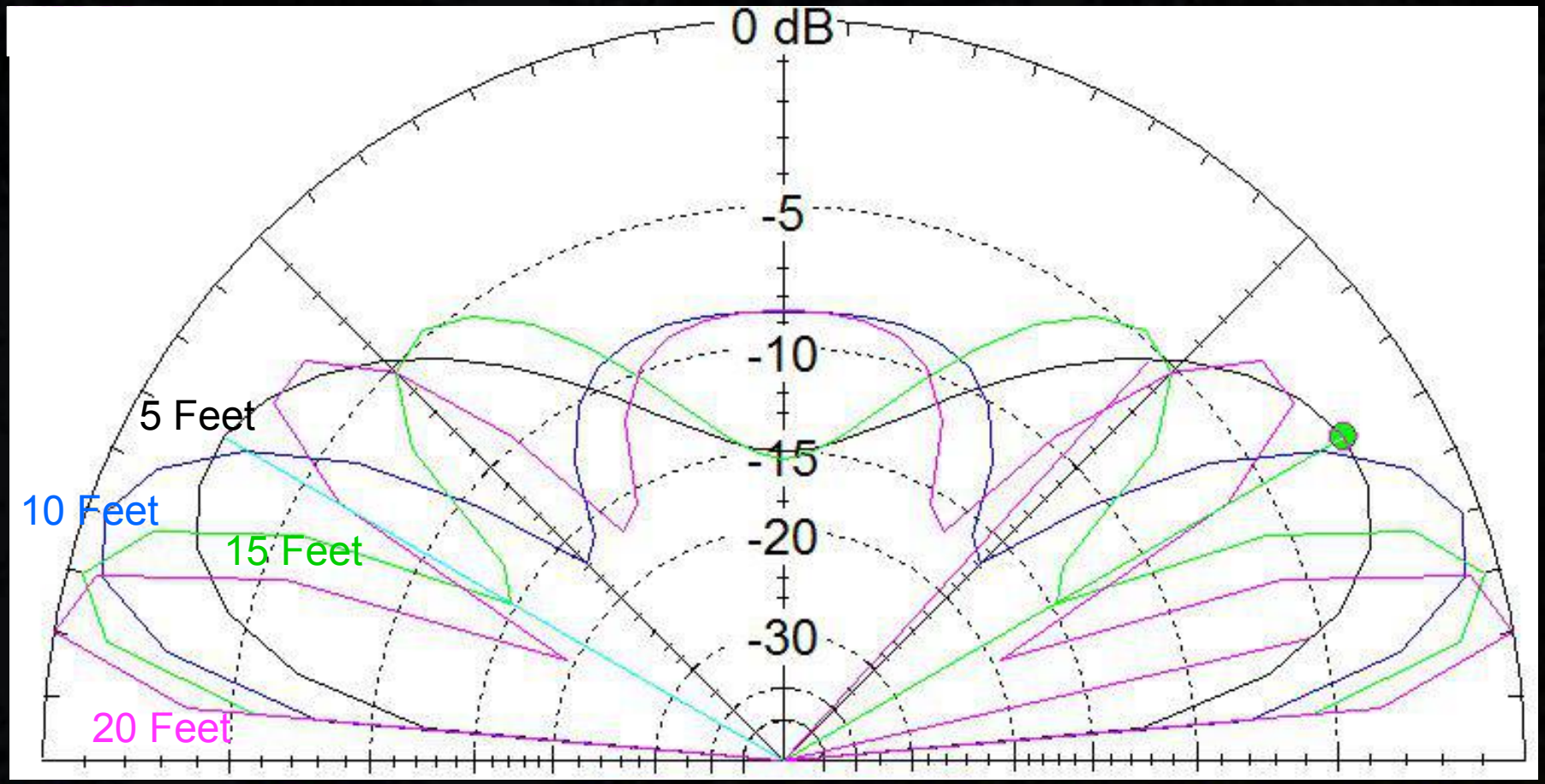
9.02 dBi = 6.87 dBd

50 MHz

Elevation Plot		Cursor Elev	20.0 deg.
Azimuth Angle	0.0 deg.	Gain	9.02 dBi
Outer Ring	9.02 dBi		0.0 dBmax
			0.0 dBmax3D
3D Max Gain	9.02 dBi		
Slice Max Gain	9.02 dBi @ Elev Angle = 20.0 deg.		
Beamwidth	21.3 deg.; -3dB @ 9.4, 30.7 deg.		
Sidelobe Gain	9.02 dBi @ Elev Angle = 160.0 deg.		
Front/Sidelobe	0.0 dB		

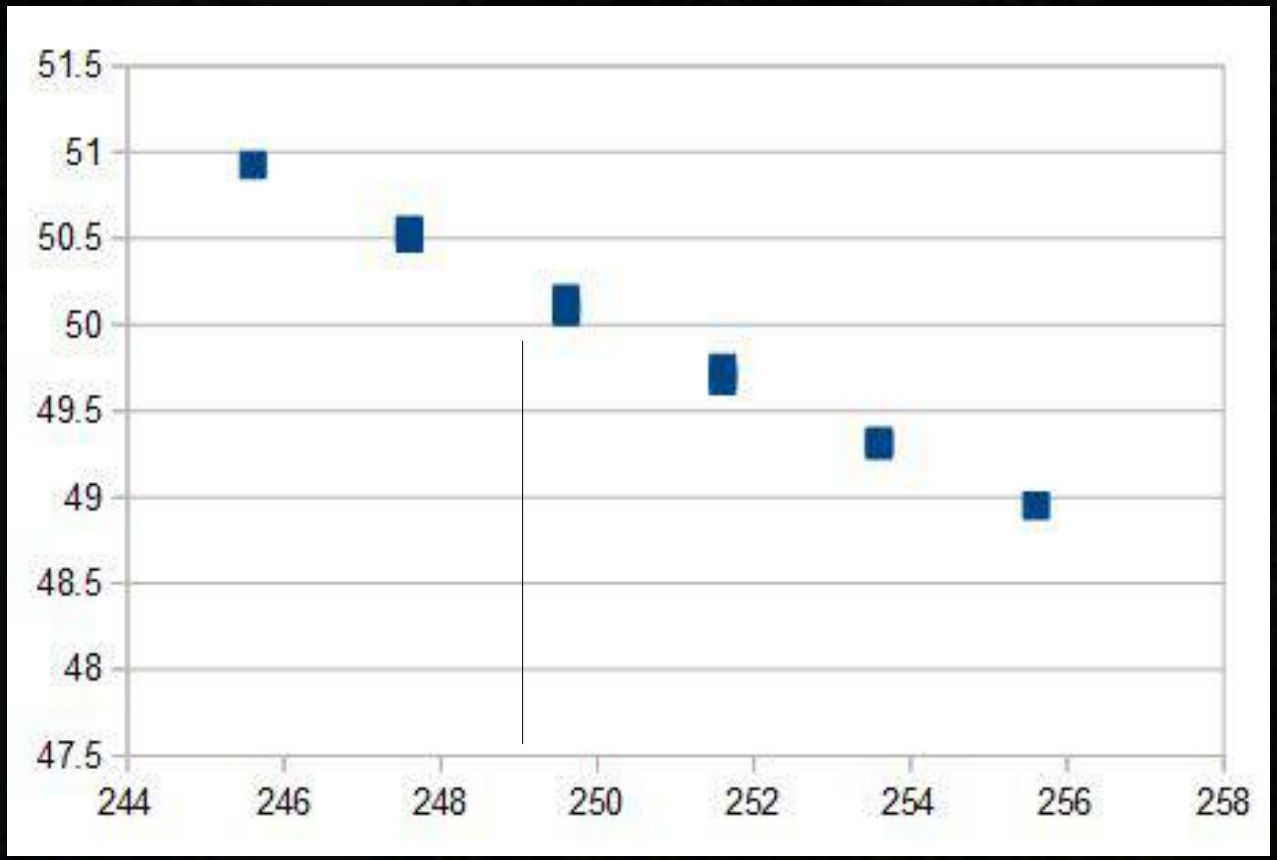
Height of Feed Point

Elevation Plot



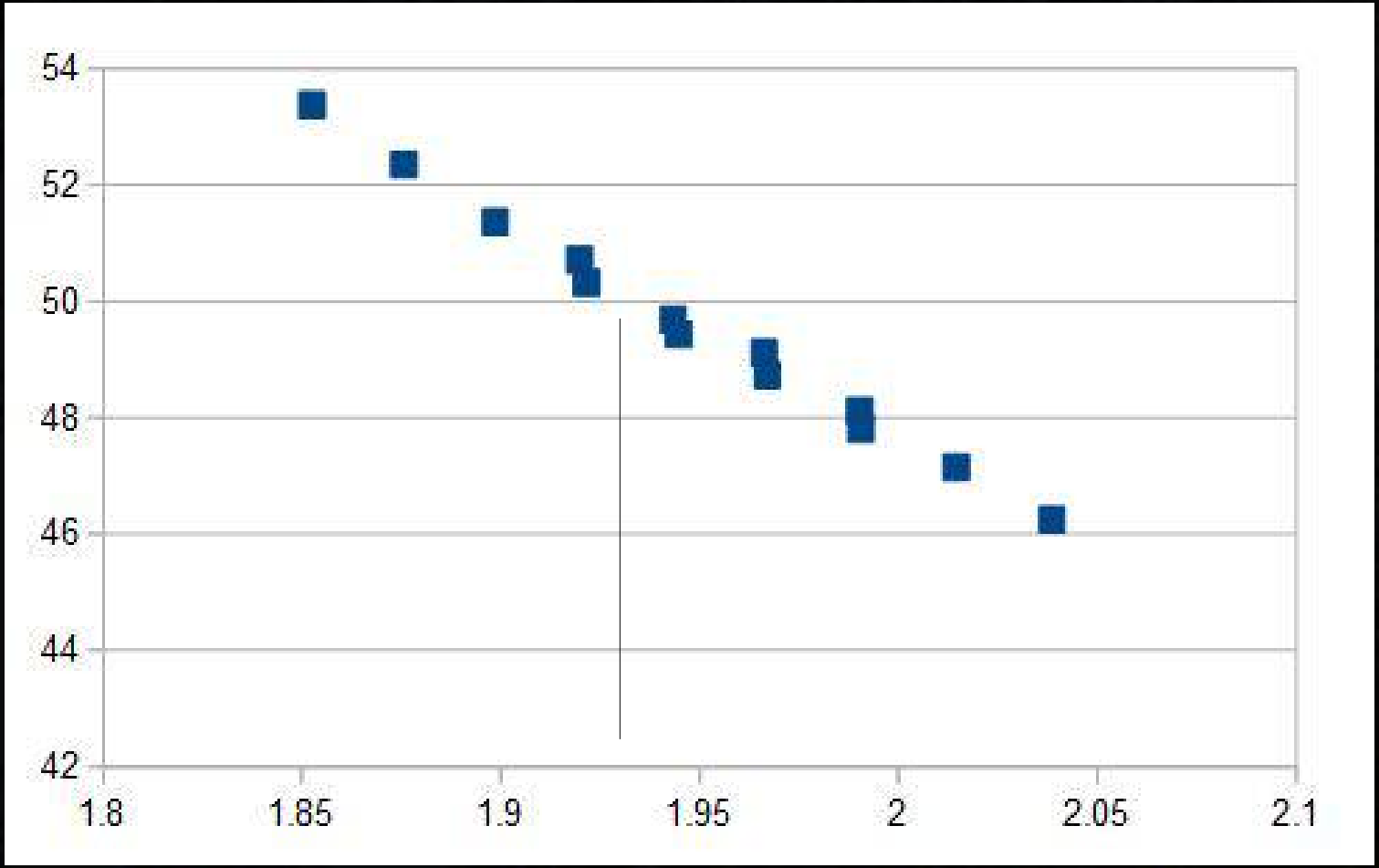
Analyze the Data

- Plot Resonant Frequency vs. total length (X+Y)*2 at various aspect ratios (Y / X)



Analyze the Data

- Plot impedance vs. Aspect Ratio (Y / X)



Built First Antenna Making it Stealth

- Black wire and black poly rope
- Remove center rope support
- Camo paint for the PVC pipe
- Grey electrical box for coax
  - May be adding a 1:1 Balun
- Built to Specifications
- Suspended it in a clearing in the forest

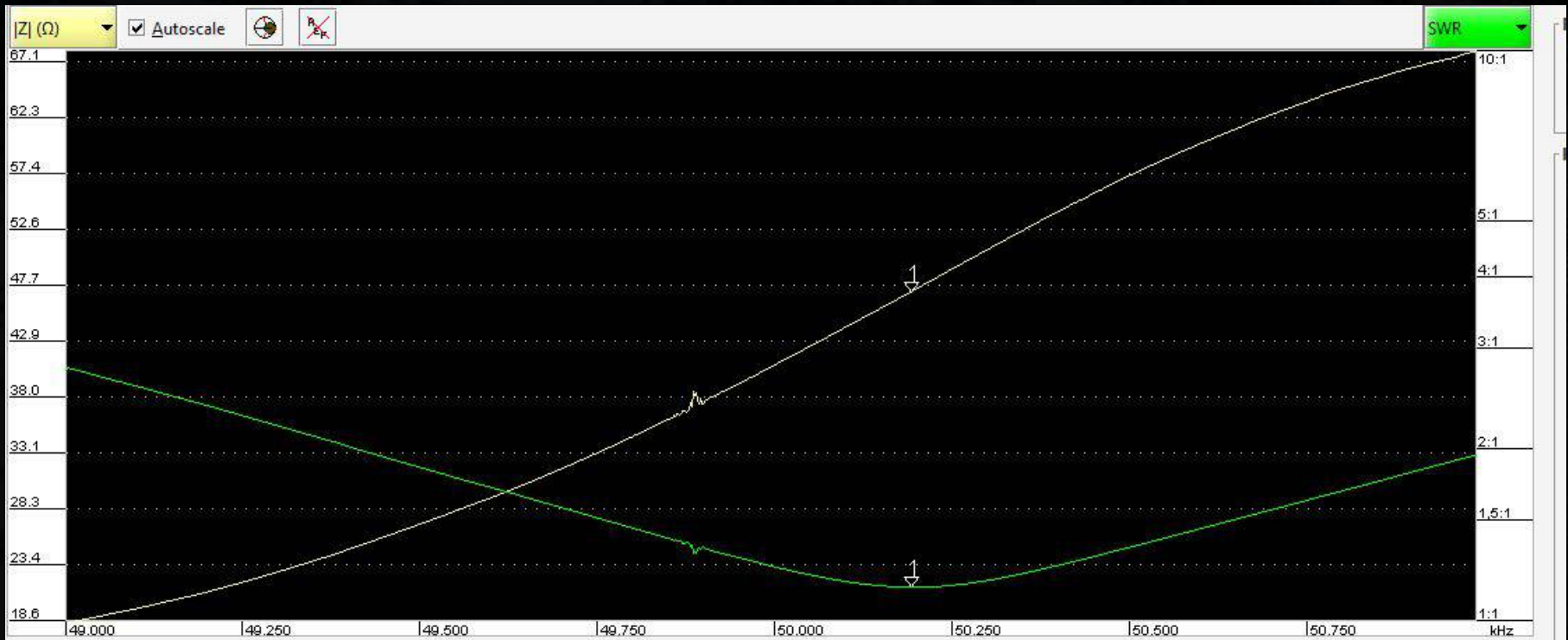
Actual Results

- “Essentially, all models are wrong, but some are useful”
  - George E. P Box 1919-2013 British Mathematician
- Antenna Resonated at 48.9 MHz (not 50.1)
  - Estimated the length was 6” too long
- Only had to take antenna down once
  - Cut off the 6” & reset aspect ratio to 1.93
- Rehung and Ran VNA on the antenna

Final Measurement

Fr = 50.197 MHz
SWR = 1.15:1

Desired Band 50.0 – 50.4 MHz
SWR < 1.25:1

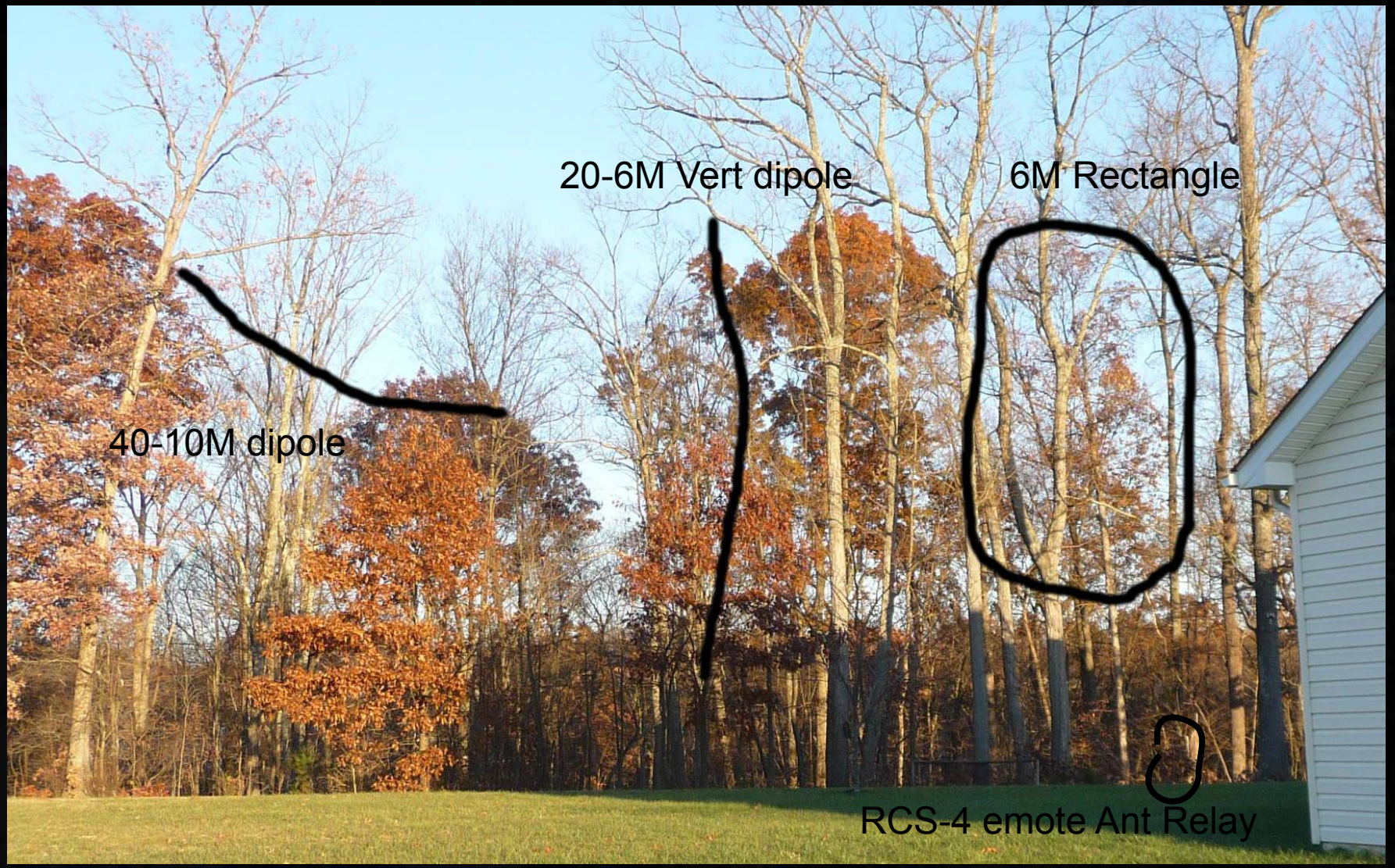


	Freq. (Hz)	RL (dB)	RP (°)	TL (dB)	TP (°)	|Z| (Ω)	Rs (Ω)	Xs (Ω)	SWR
M									
1	50,197,900	-23.31	-119.98	0.00	0.00	46.7	46.4	-5.5	1.15:1

Practical 6M Results

- Between 6 /14/17 and 7/1/17
  - Caught 7 days of sporadic E openings
    - 26 States Worked
    - + Canada and Mexico
- Farthest Contact 2256 Miles (KG7P)
- All contacts <40W using JT65, JT9 or FT8
- I was happy but...
- What about the HOA?

Mr. HOA, What Antenna?



NEC Help

- AutoEZ : a spreadsheet front end
  - AC6LA.com/autoez.html $79
- 4NEC2 Definitive Guide
  - by KA6WKE Mark Schoonover
    leanpub.com/4nec2definitiveguide

Live demo

- Questions?