Backyard Antennas

Who am I ?

Survey

Visualize your backyard

Antenna Modeling Overview

Antenna Analyzers

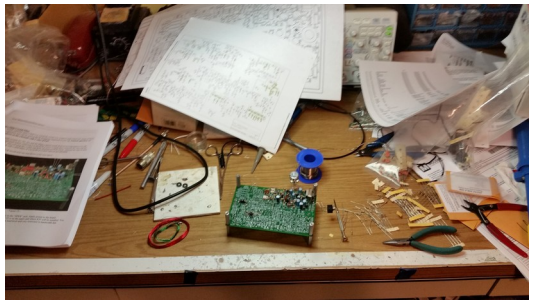
Horizontal Antennas

Vertical Antennas

Links

Who am I ?

Dave Redfearn, N4ELM



First licensed in 1980, currently Extra Class

Mostly active on HF, occasionally on VHF

Mainly operate QRP CW, Digital, and some SSB

Build & repair radios

Experiment with portable & fixed Antennas

Participate in portable operations – Go Kit days, SOTA, & NPOTA

W5DDL NPOTA in Eunice, LA

Survey – My backyard

Fence

Suburban

Reasonable size – 130’ X 80’

DX & Local Contacts

Operating Modes : CW, Digital, some SSB

Trees along the back & side

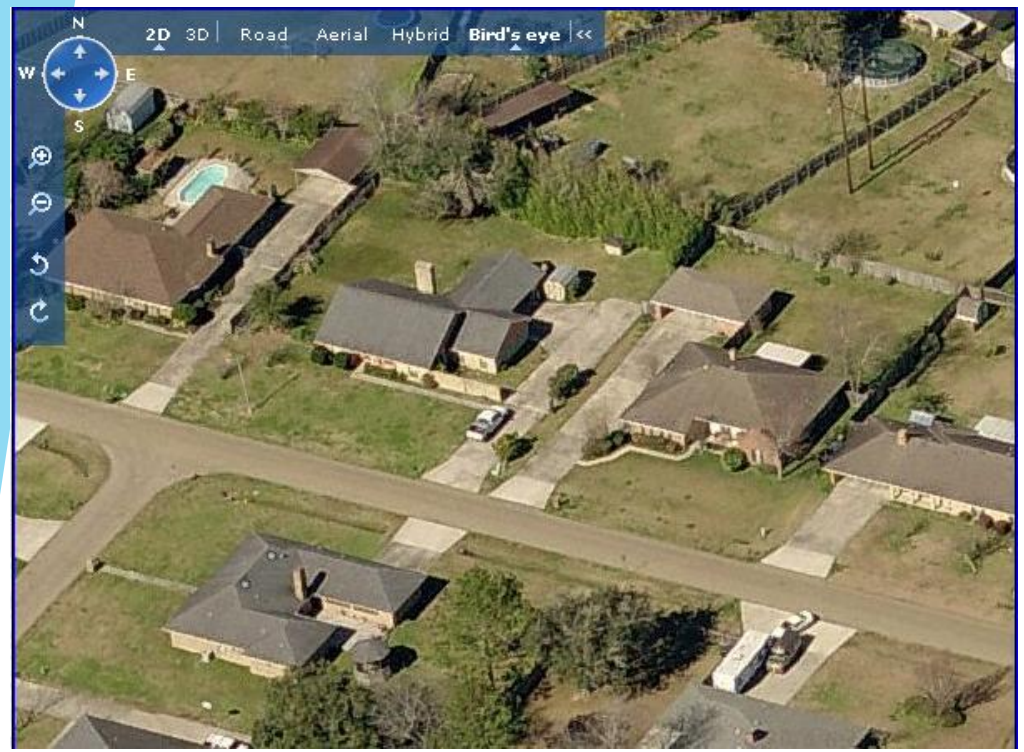
No HOAs, Parish tower height restrictions

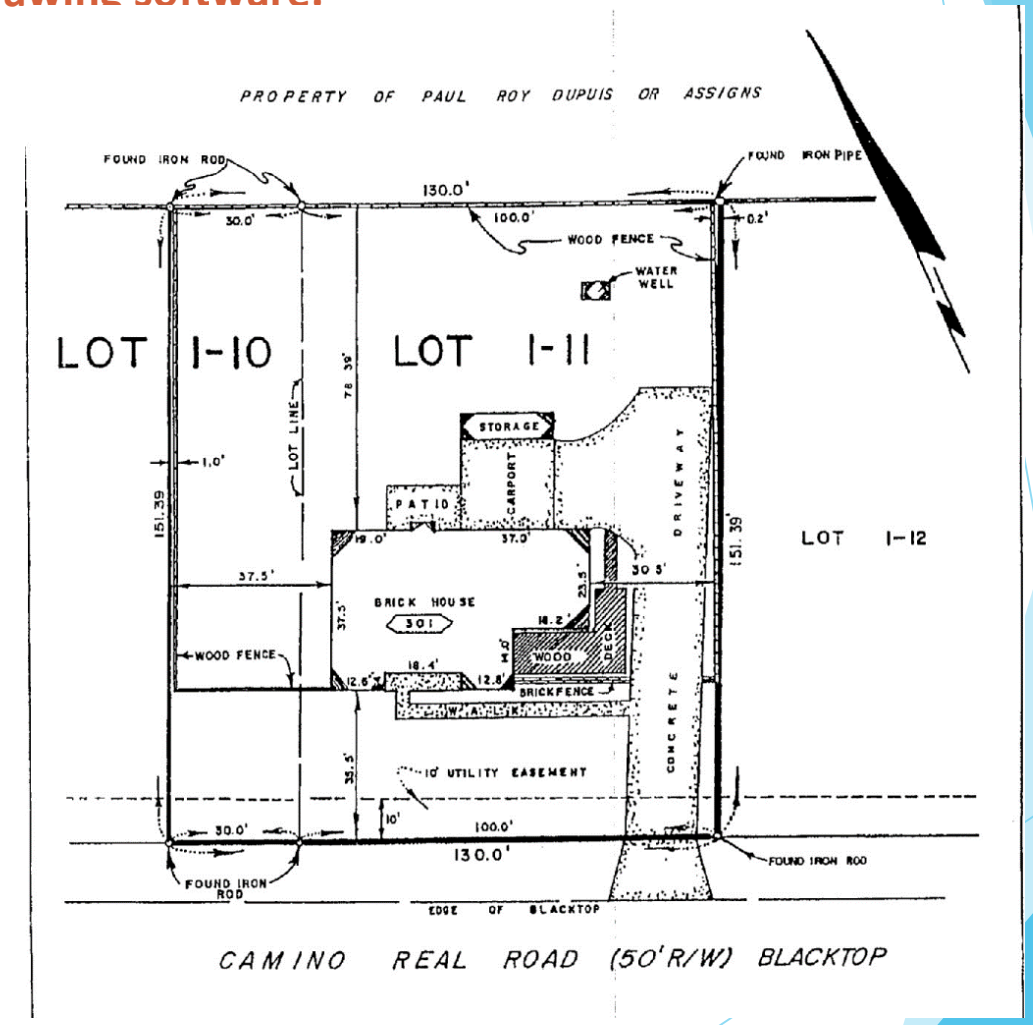
Operate on all HF Bands

Nearby Power lines

Visualize your Backyard

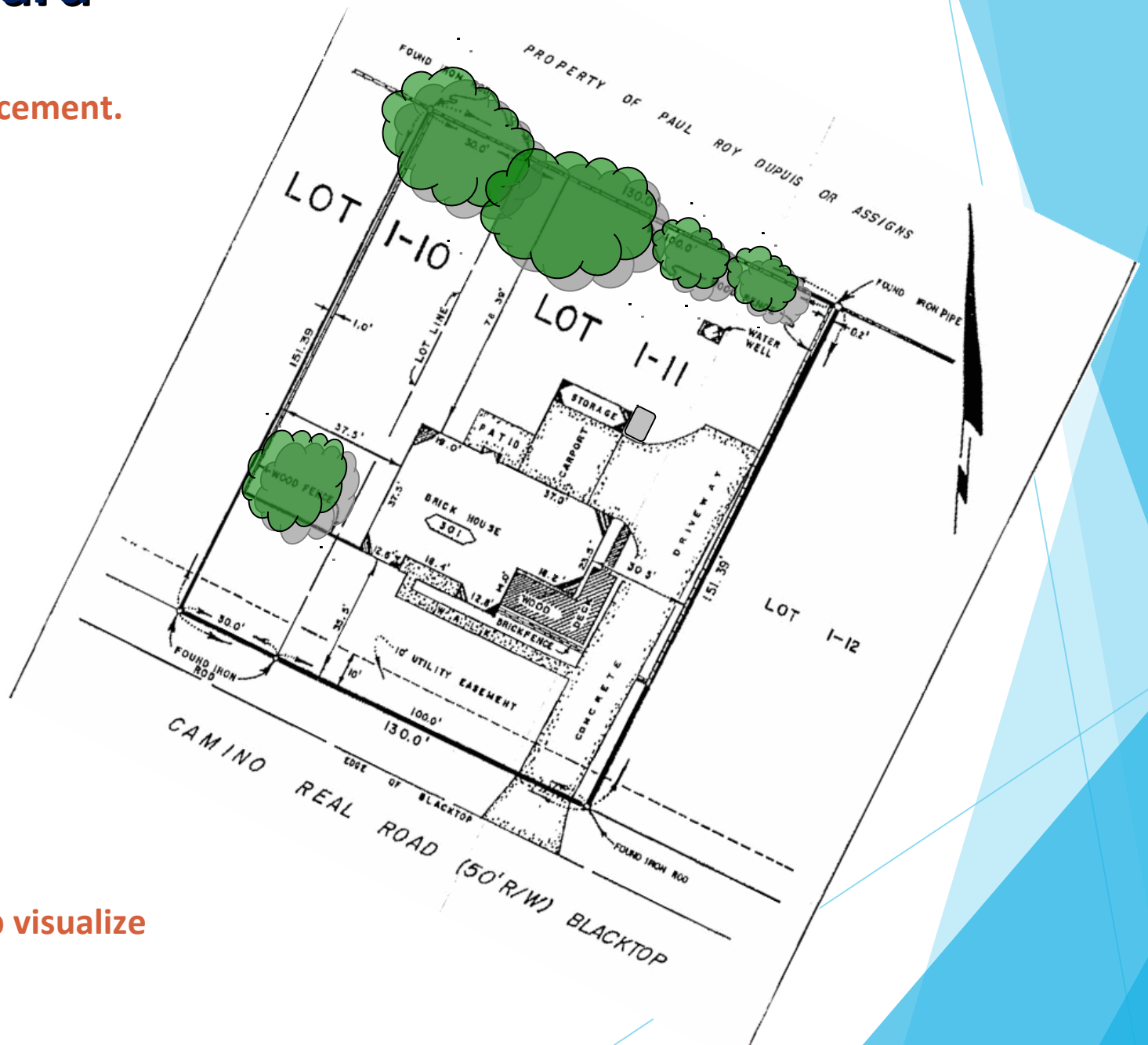
Create a drawing: on paper, from the web, from drawing software.





Visualize your Backyard

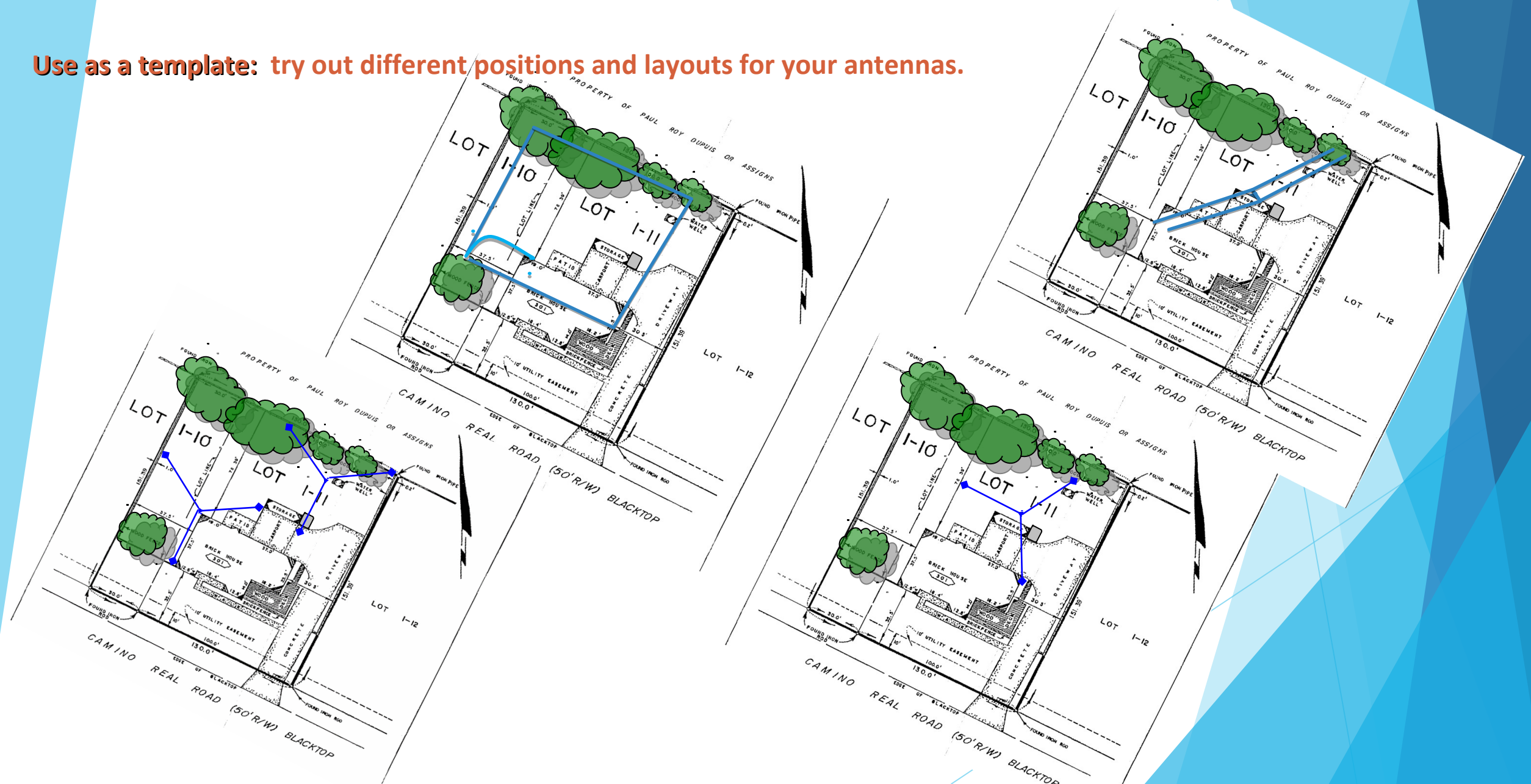
Add: details that affect antenna placement.



Orient: position the drawing to help visualize where the antenna will radiate.

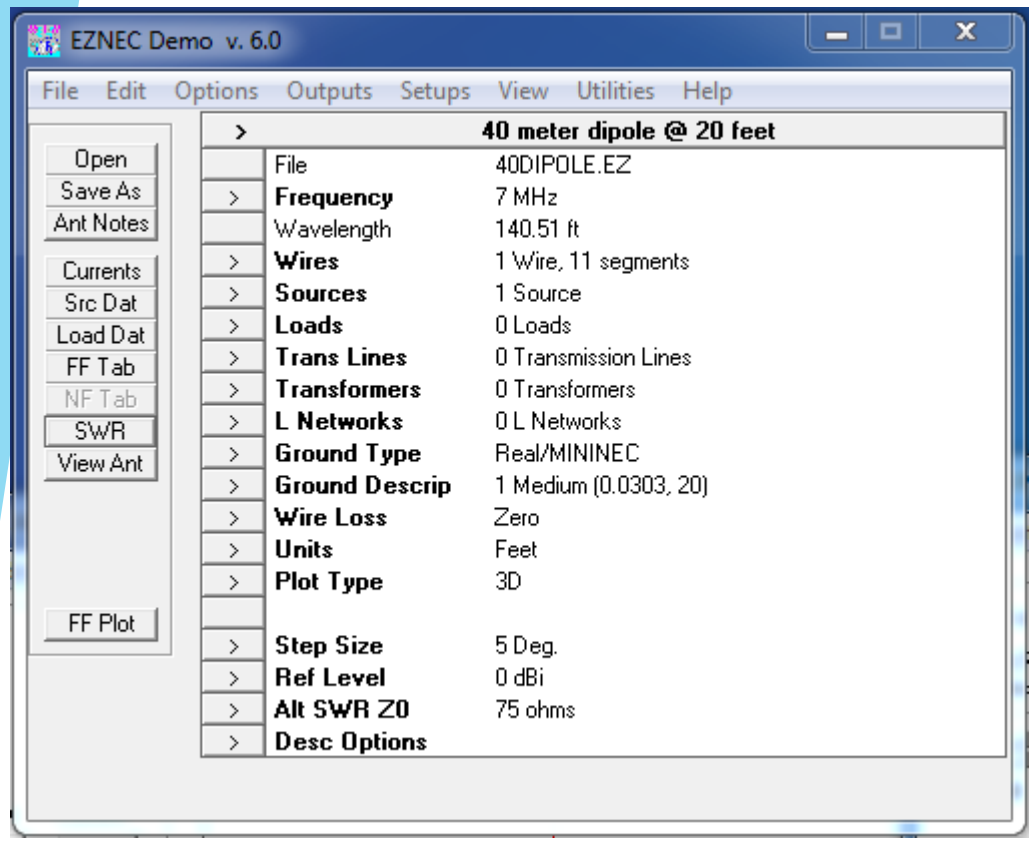
Visualize your Backyard

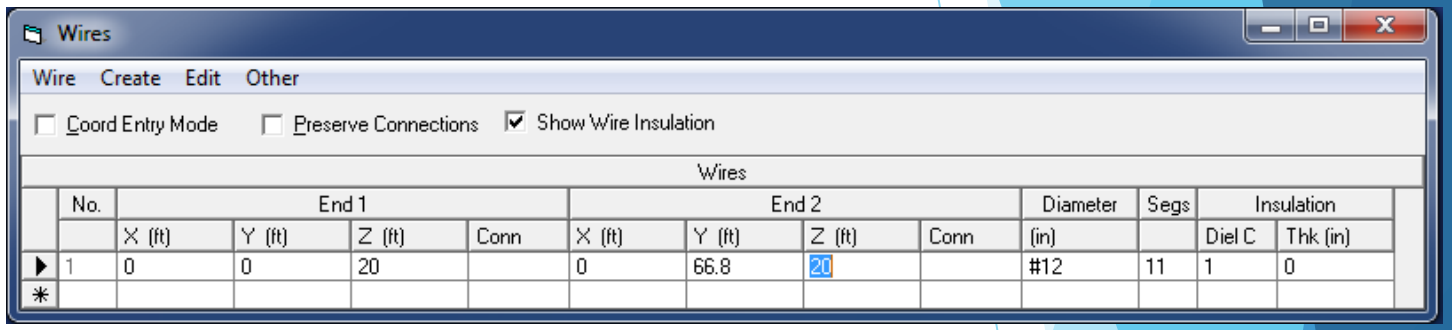
Use as a template: try out different positions and layouts for your antennas.

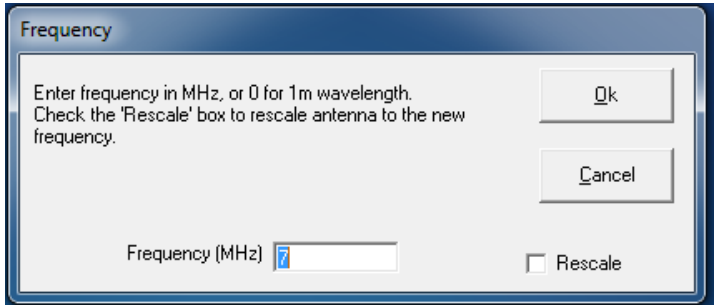


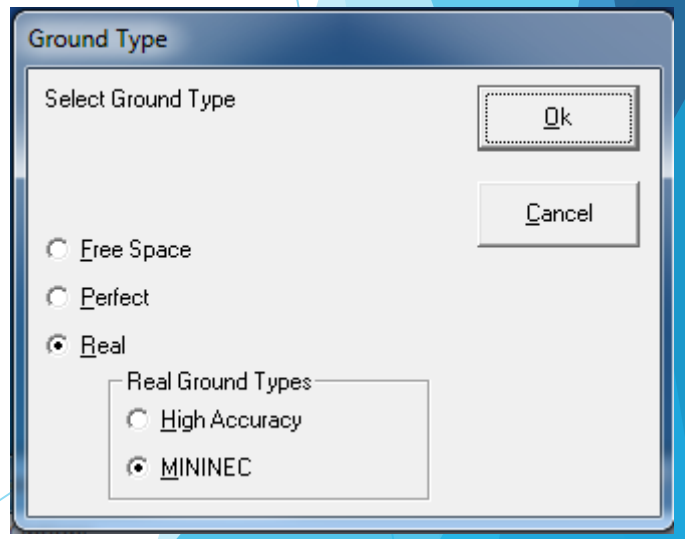
Antenna Modeling Overview

EZNEC 6.0 Demo: https://www.eznec.com/index.shtml









Use as a 'What If' Tool to try different antenna configurations

Antenna Modeling Overview

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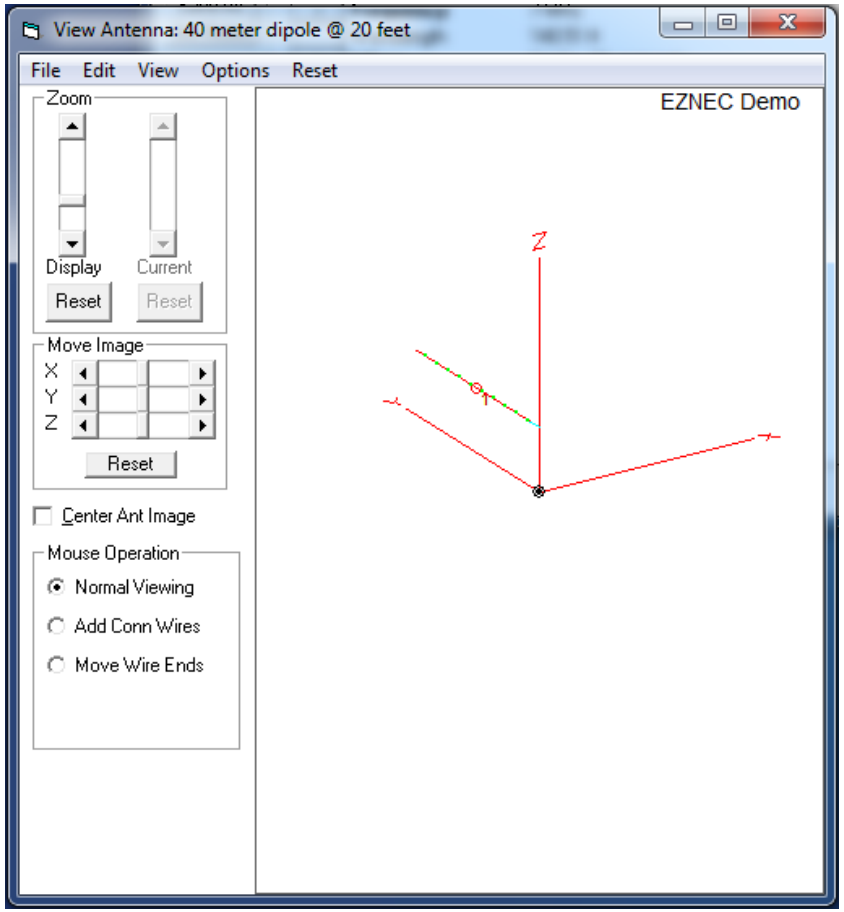

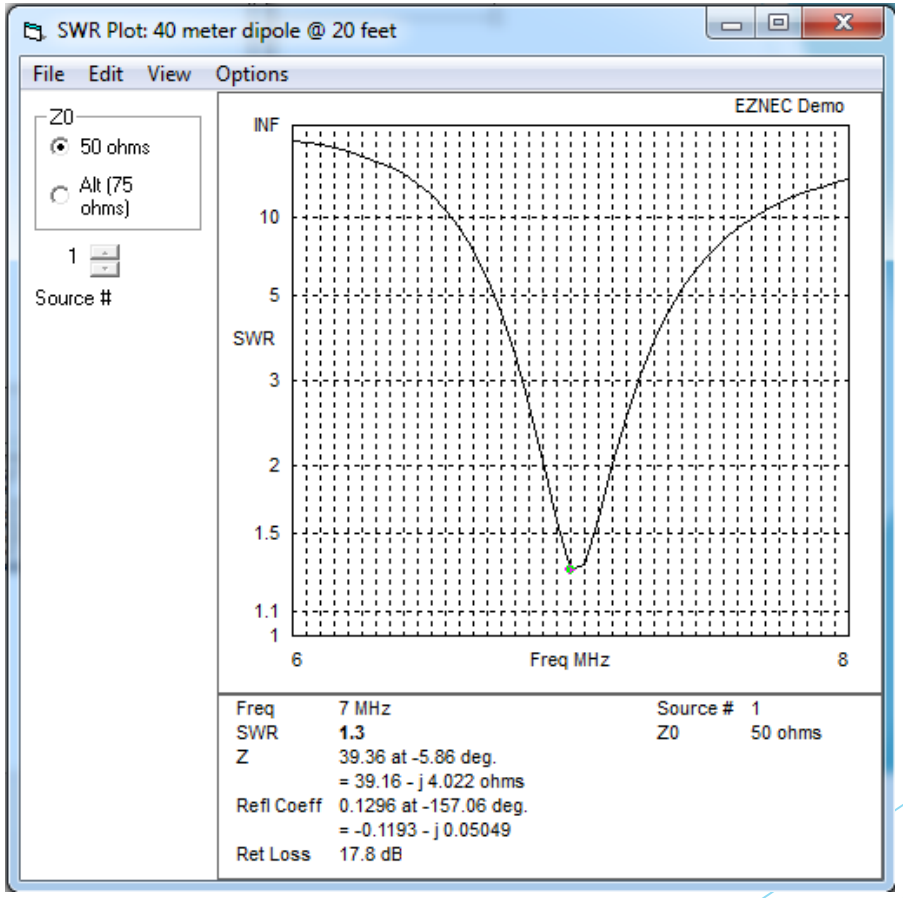

Use as a 'What If' Tool to try different antenna configurations

Antenna Modeling Overview

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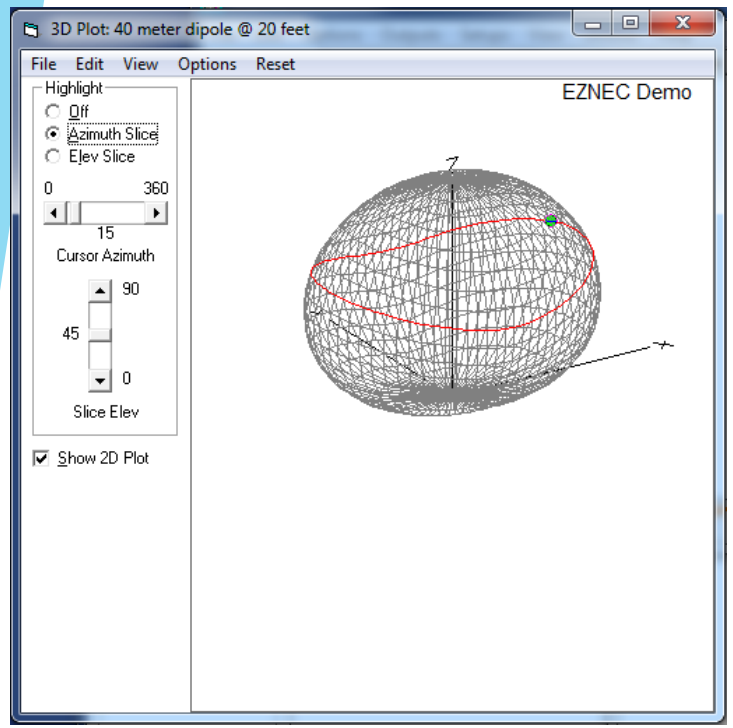
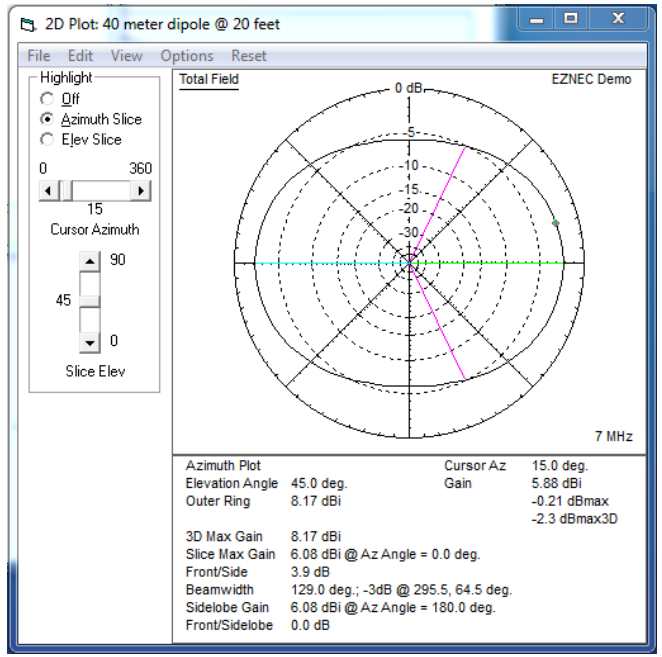
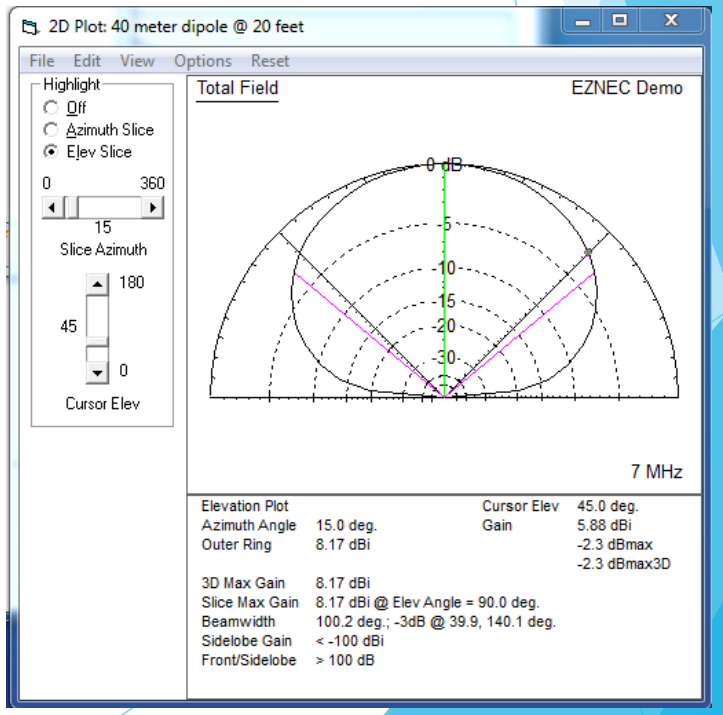


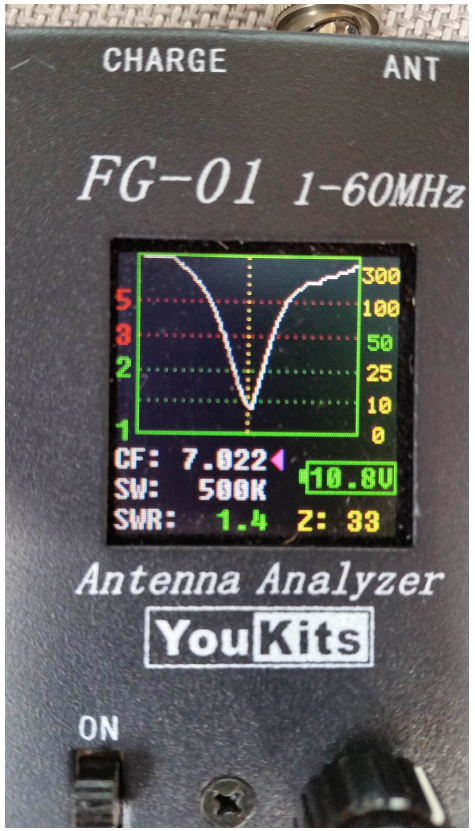




Use as a 'What If' Tool to try different antenna configurations

Antenna Analyzer Overview

Measure actual Antenna conditions



Used mainly during initial antenna setup & tuning

Review SWR

Glossary Term: VSWR

$$\mathrm{VSWR} = \frac{|V_{\max}|}{|V_{\min}|} = \frac{1+|\Gamma|}{1-|\Gamma|}.$$

$$\mathrm{SWR} = \frac{1+\sqrt{P_r/P_f}}{1-\sqrt{P_r/P_f}}$$

$$\mathrm{SWR} = \left(\frac{R_L}{Z_0}\right)^{\pm 1}$$

Definition

VSWR (Voltage Standing Wave Ratio), is a measure of how efficiently radio-frequency power is transmitted from a power source, through a transmission line, into a load (for example, from a power amplifier through a transmission line, to an antenna).
In an ideal system, 100% of the energy is transmitted. This requires an exact match between the source impedance, the characteristic impedance of the transmission line and all its connectors, and the load's impedance. The signal's AC voltage will be the same from end to end since it runs through without interference.

In real systems, mismatched impedances cause some of the power to be reflected back toward the source (like an echo). Reflections cause destructive interference, leading to peaks and valleys in the voltage at various times and distances along the line.

VSWR measures these voltage variances. It is the ratio of the highest voltage anywhere along the transmission line to the lowest. Since the voltage doesn't vary in an ideal system, its VSWR is 1.0 (or, as commonly expressed, 1:1). When reflections occur, the voltages vary and VSWR is higher -- 1.2 (or 1.2:1), for instance.

Mathematically:

VSWR is the voltage ratio of the signal on the transmission line:

VSWR = |V(max)| / |V(min)|

where V(max) is the maximum voltage of the signal along the line, and V(min) is the minimum voltage along the line.

It can also be derived from the impedances:

VSWR = (1+Γ)/(1-Γ)

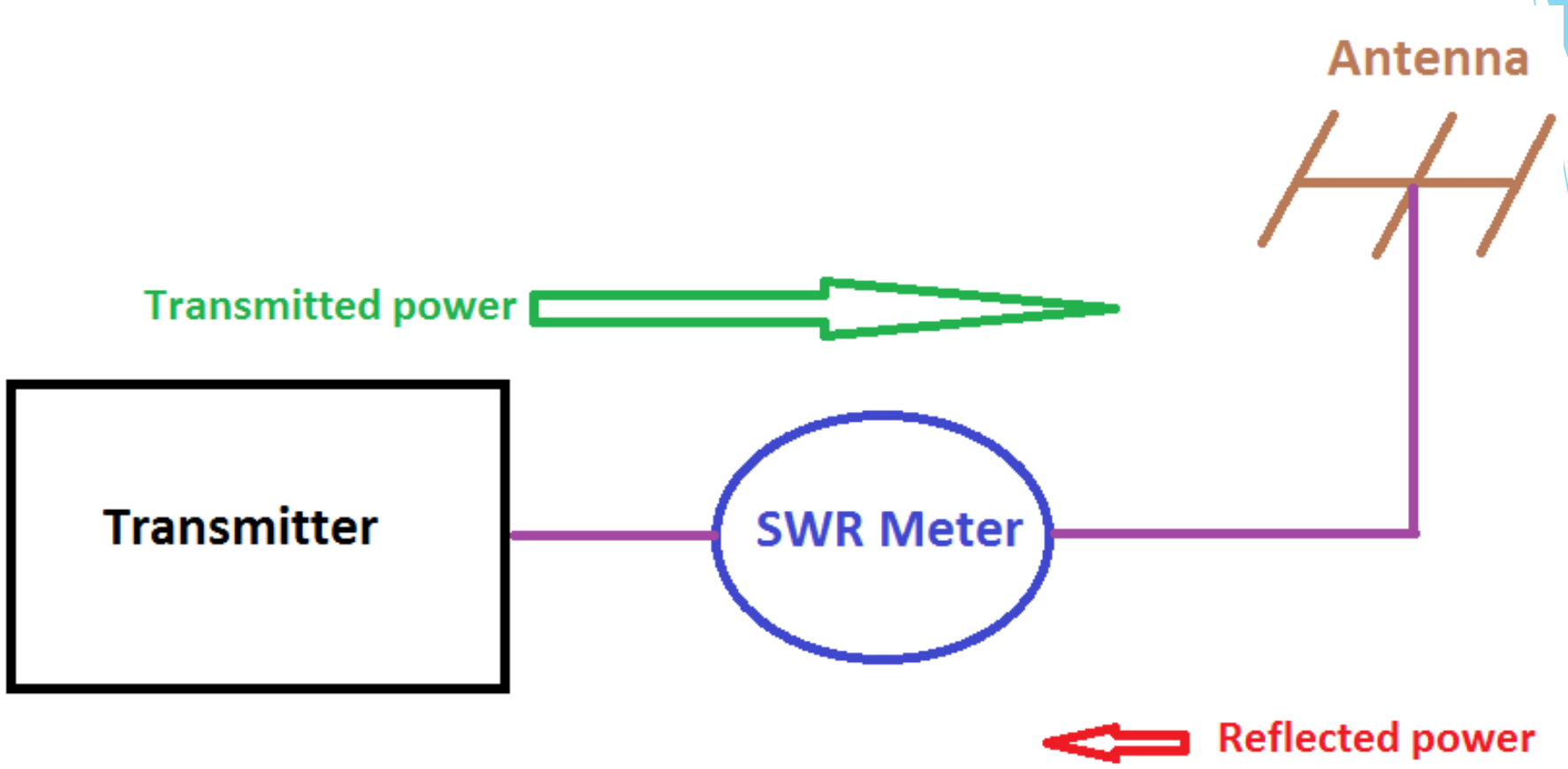
where Γ (gamma) is the voltage reflection coefficient near the load, derived from the load impeadance (ZL) and the source impedance (Zo):

Γ = (ZL-Zo)/(ZL+Zo)

If the load and transmission line are matched, Γ = 0, and VSWR = 1.0 (or 1:1).

What is SWR? What does it measure? Does it tell how an antenna performs?

Review SWR

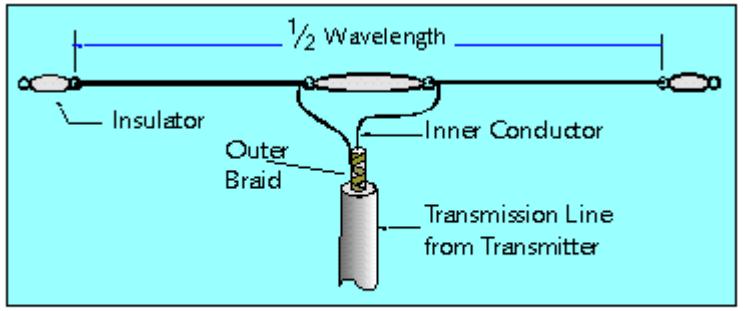


$$\mathrm{SWR} = \frac{1 + \sqrt{P_r/P_f}}{1 - \sqrt{P_r/P_f}}$$

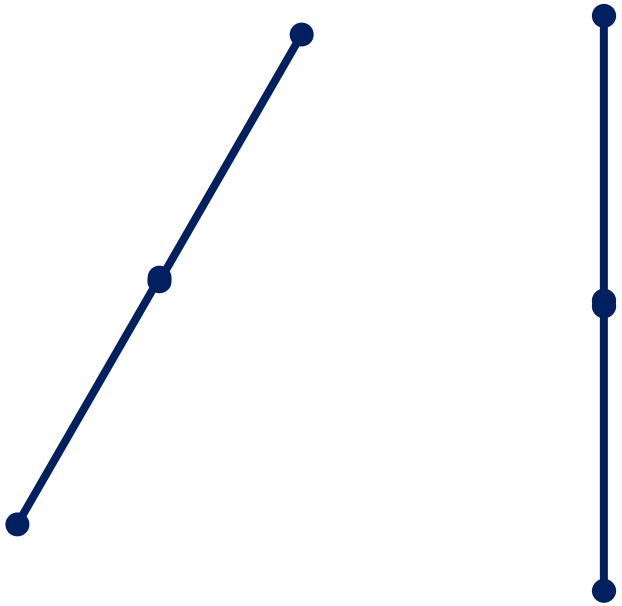
A low VSWR means the antenna is well-matched, but does not necessarily mean the power delivered is also radiated. **VSWR alone is not sufficient to determine an antenna is functioning properly.**

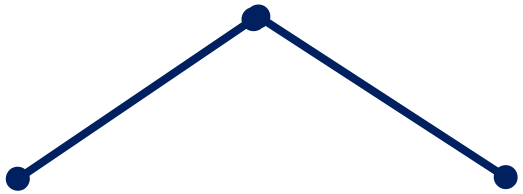
Horizontal Antennas

½ Wave Dipole: Simplest resonant antenna



dipole antenna



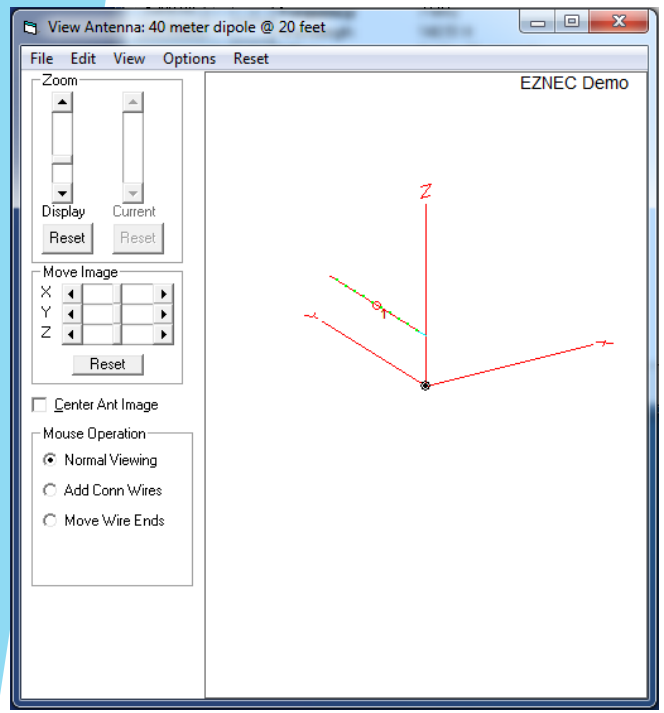


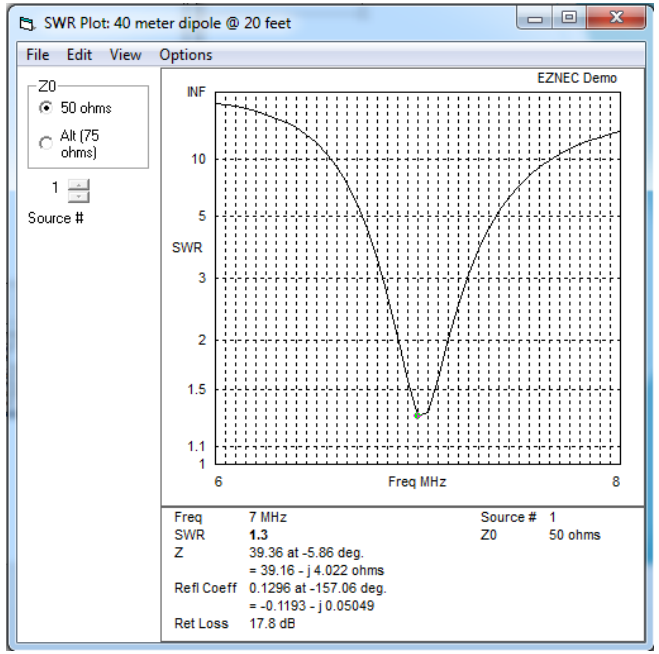
A dipole can be mounted: horizontally, sloping, vertical, or the ends can drop down to an Inverted Vee

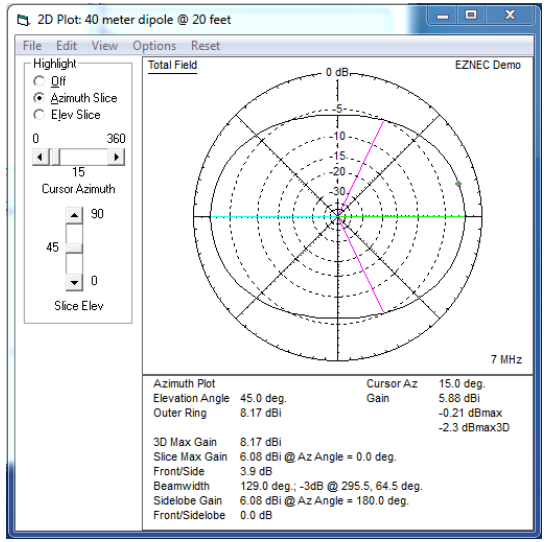
For HF wire antennas the formula is: 468/f (MHz) for the length of a ½ wave antenna

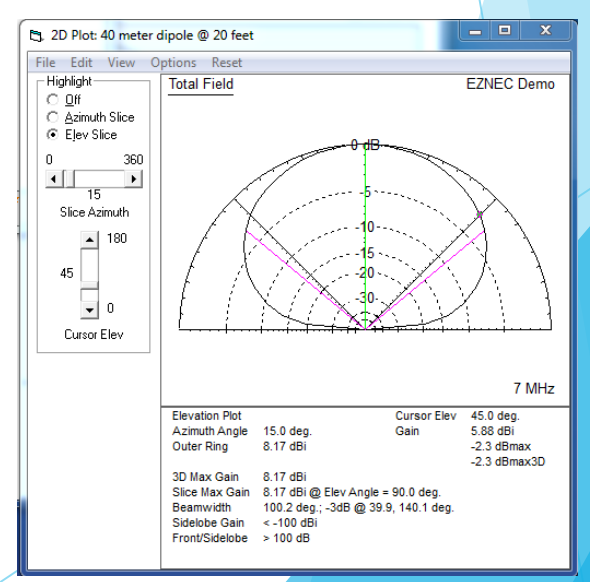
Horizontal Antennas

½ Wave 40 Meter Dipole: Predicted Patterns & SWR



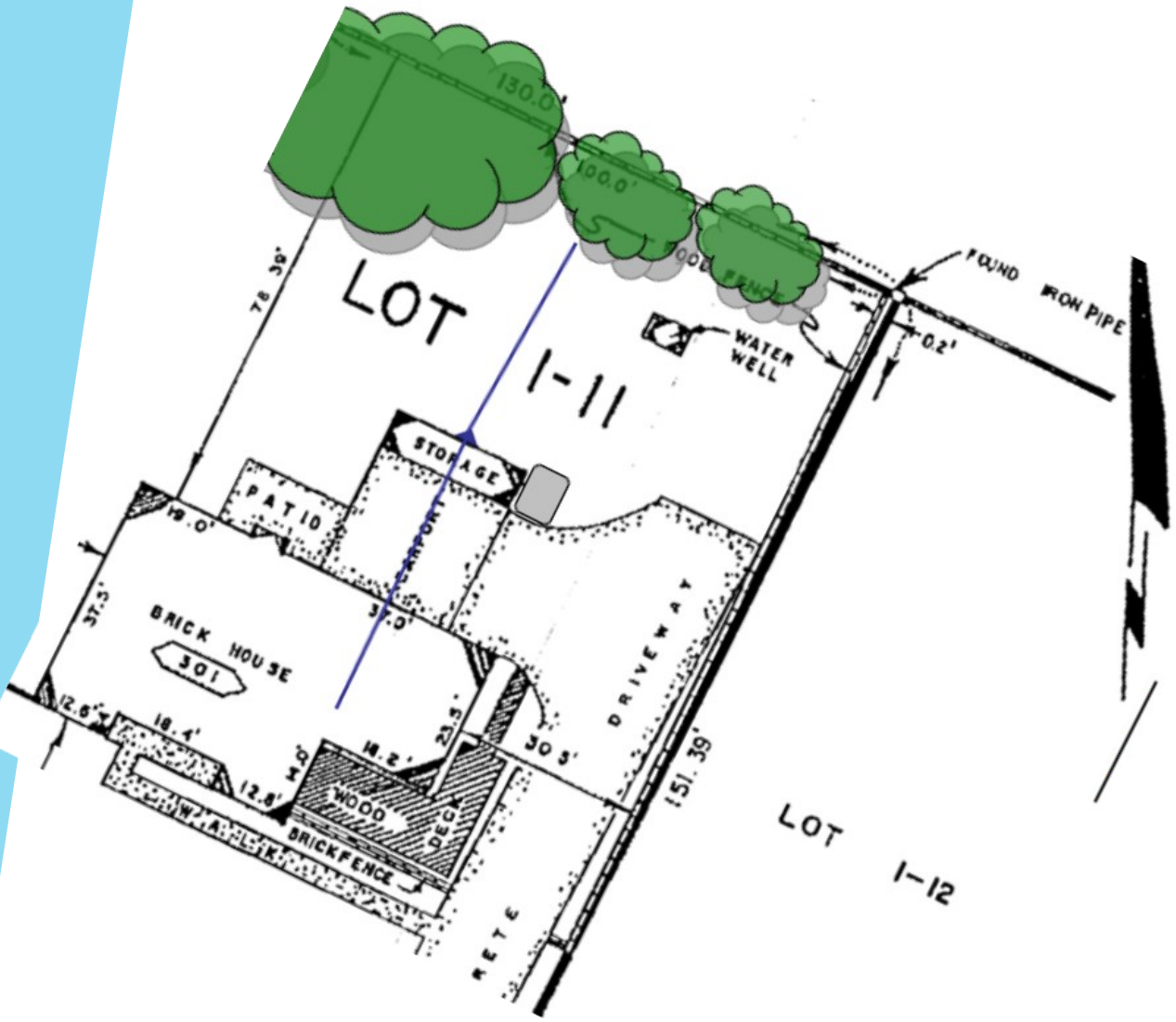


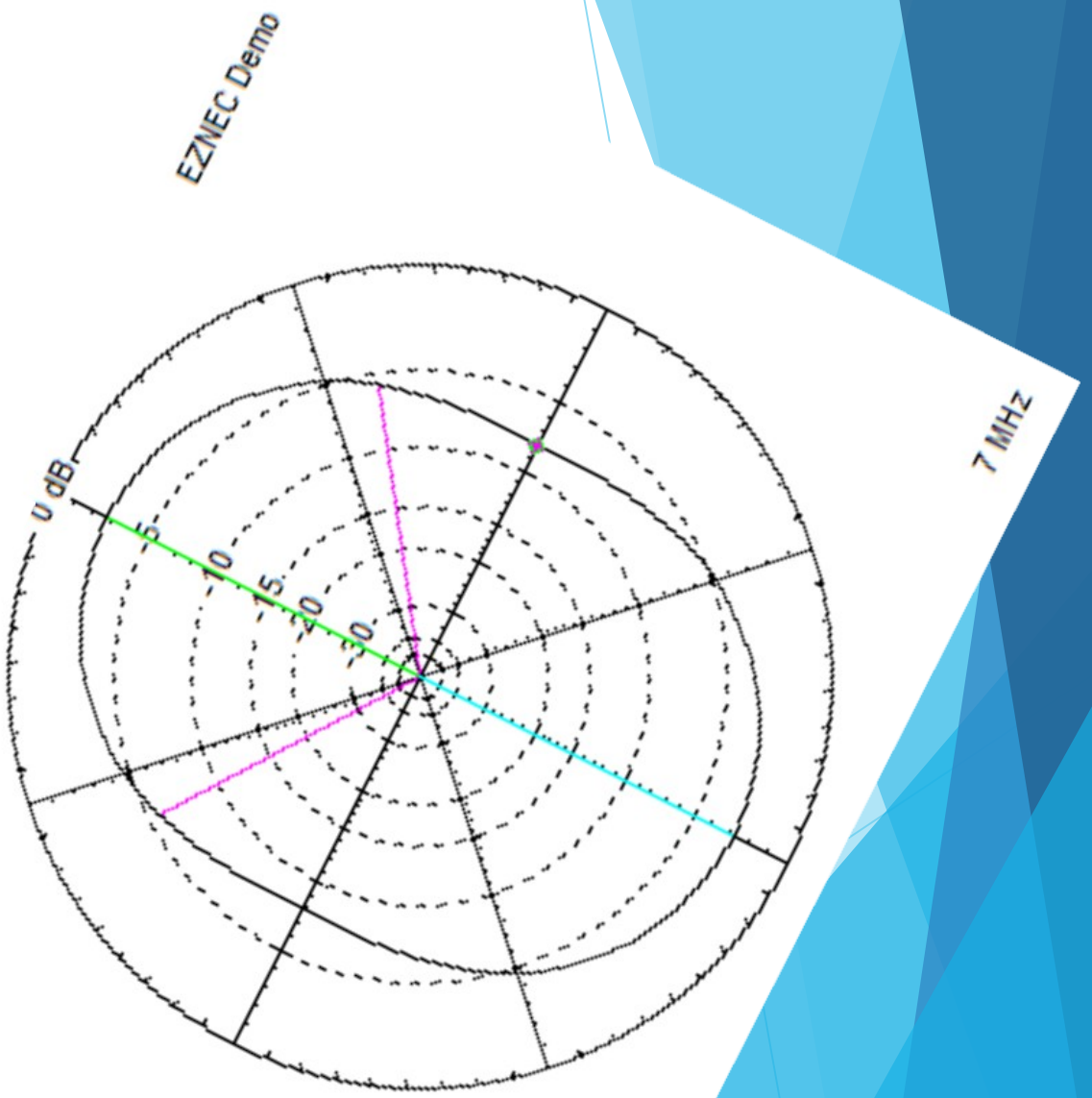




Horizontal Antennas

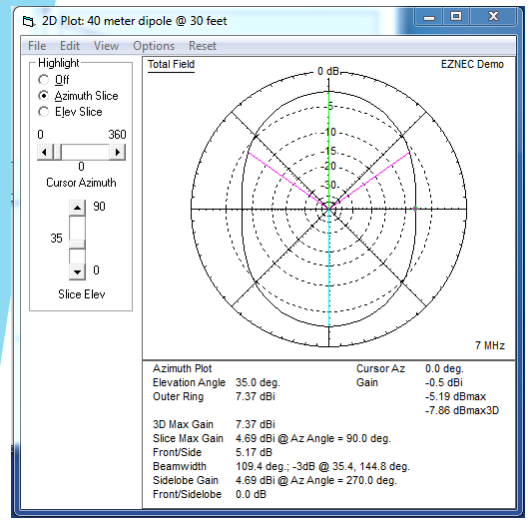
½ Wave 40 Meter Dipole: Layout & Predicted Pattern

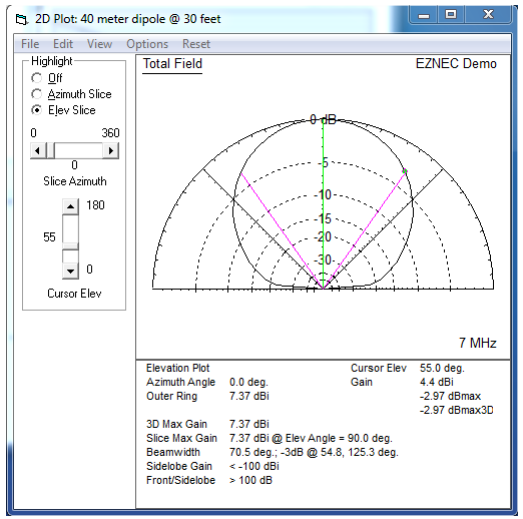


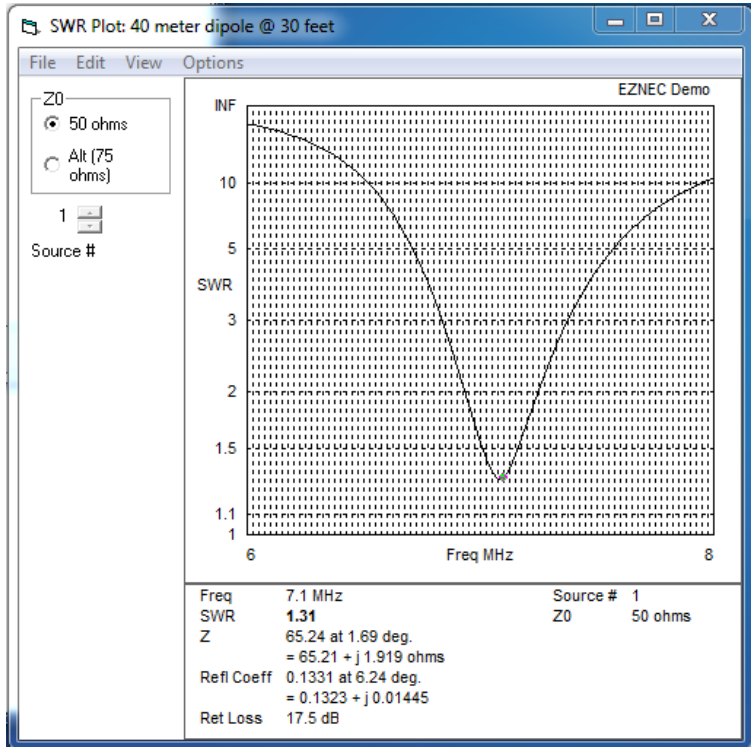


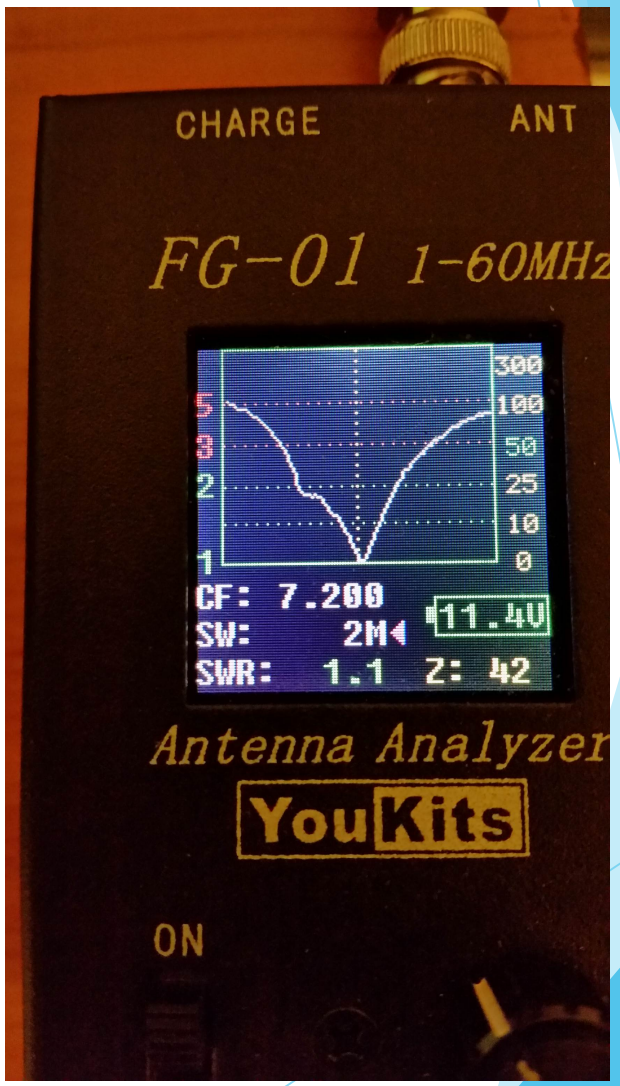
Horizontal Antennas

½ Wave 40 Meter Dipole: Predicted Pattern & SWR





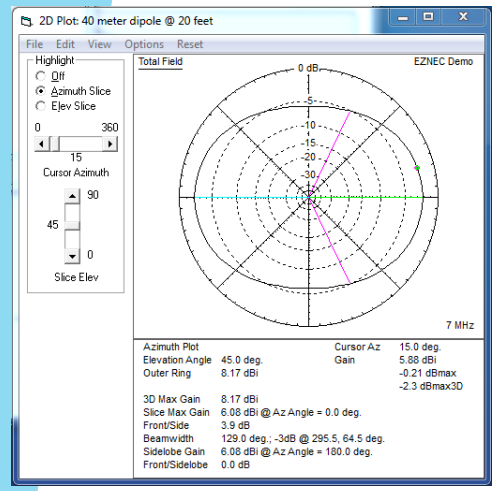


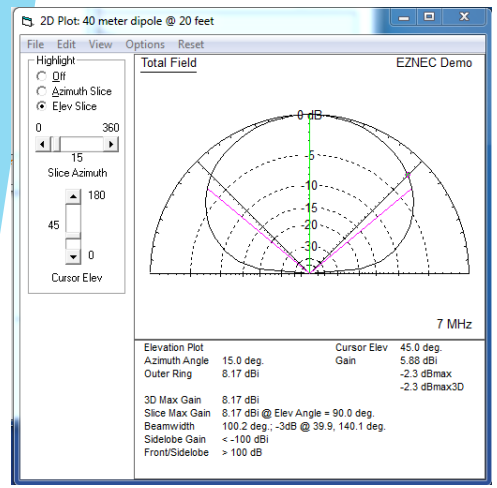


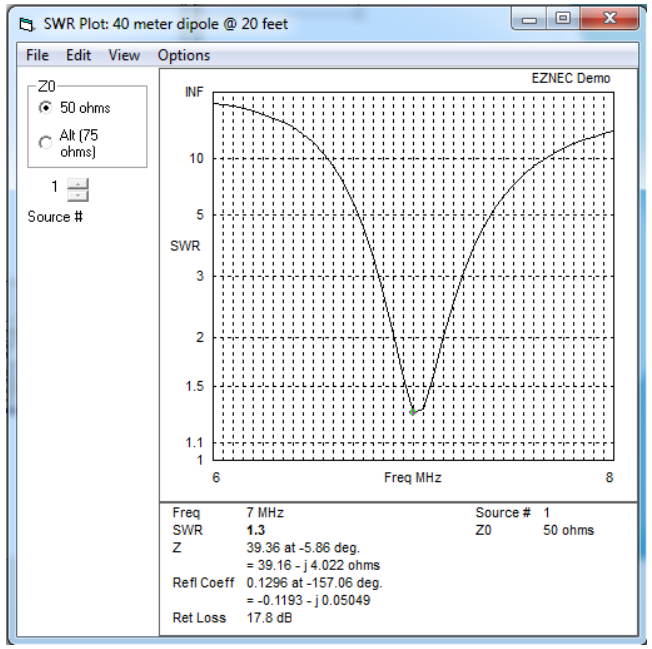
½ Wave 40 Meter Dipole: Actual SWR

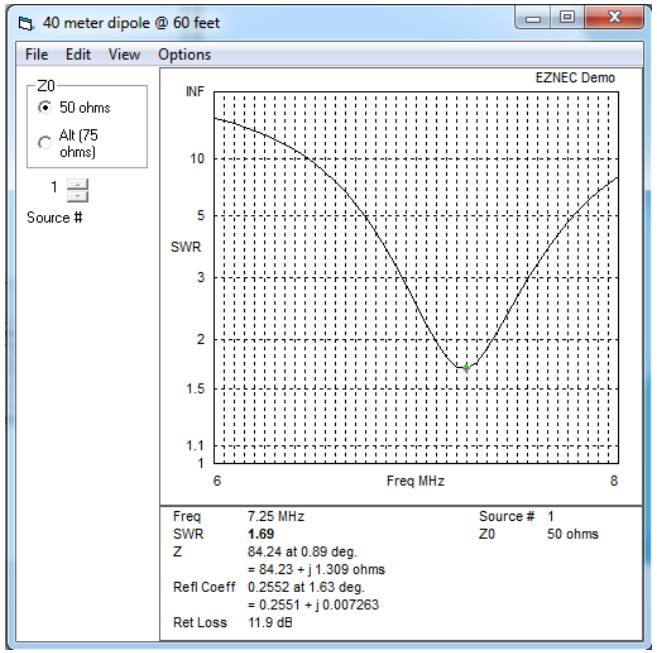
Horizontal Antennas

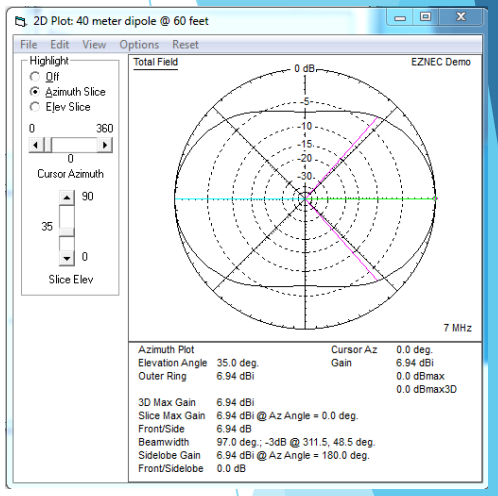
½ Wave 40 Meter Dipole: Predictions at different heights – 20 & 60 feet

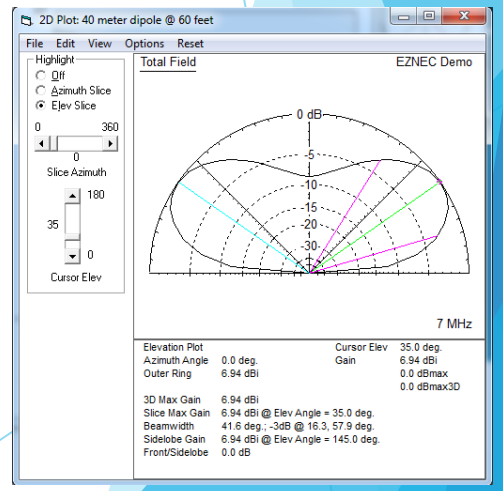






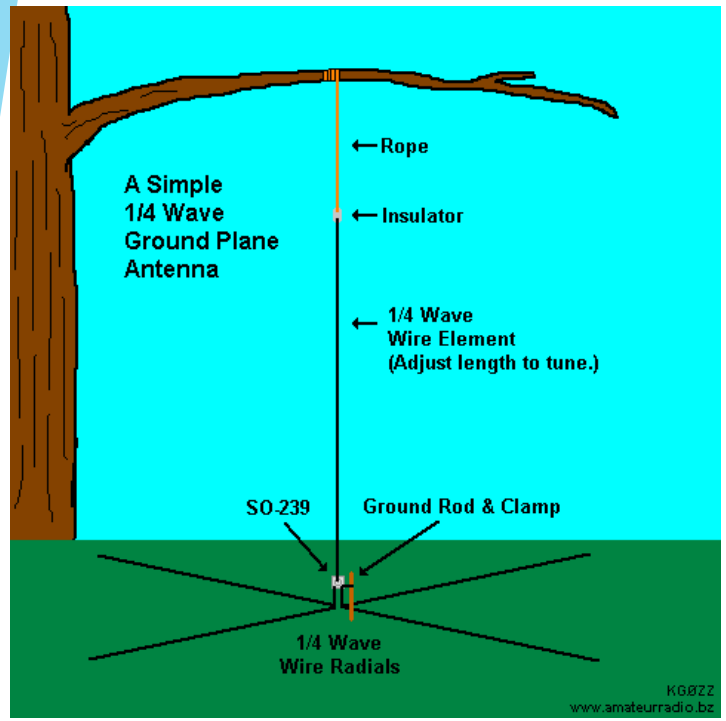


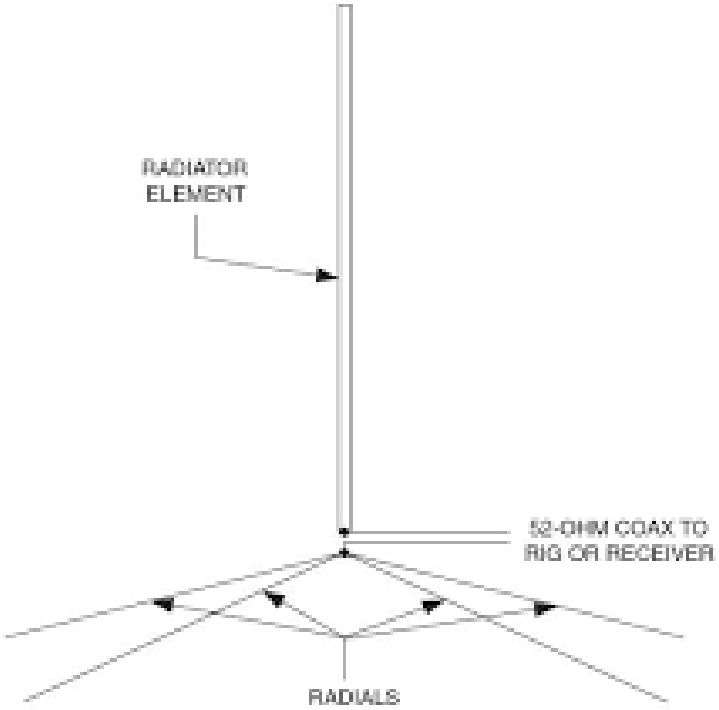




Vertical Antennas

1/4 Wave Vertical: Simplest resonant antenna



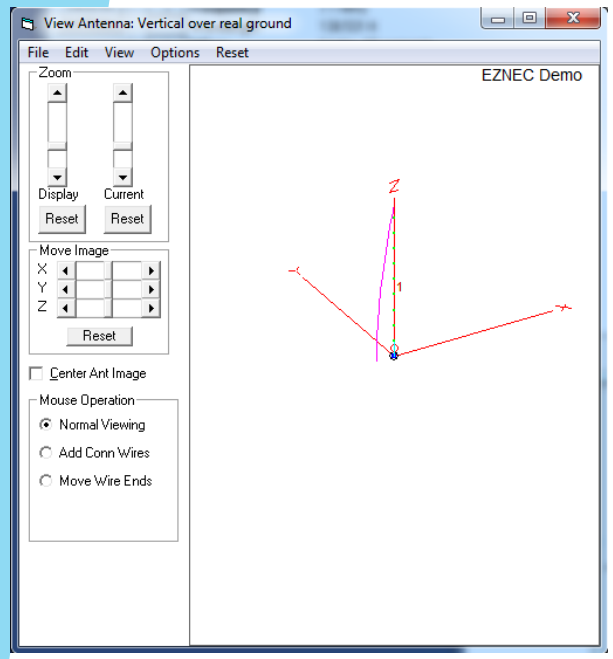


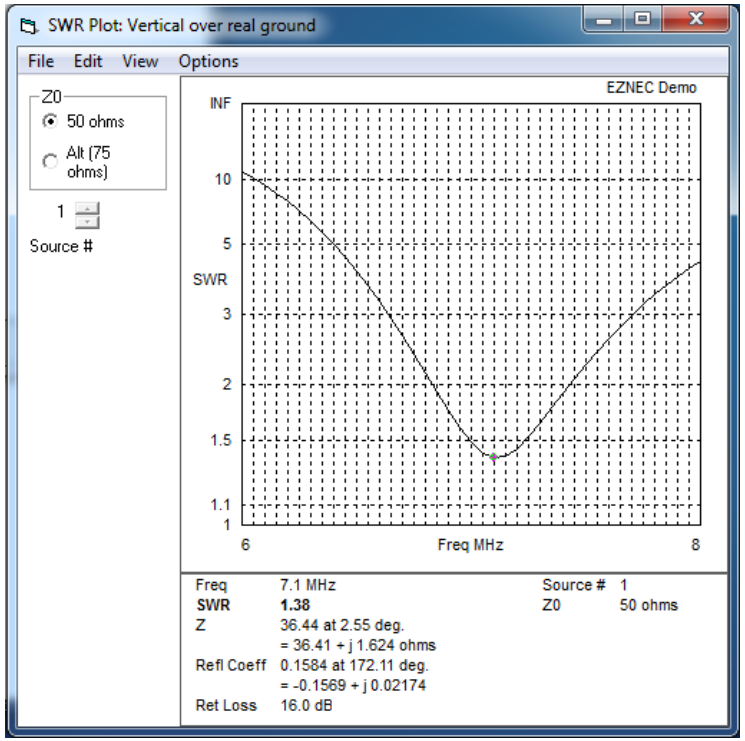
A vertical can be: supported or free standing

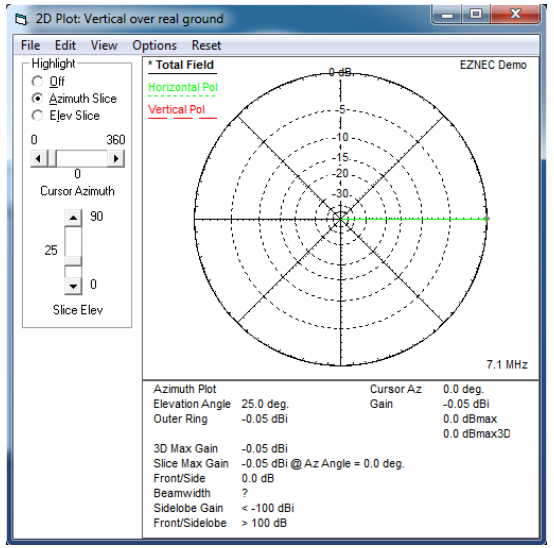
For HF wire antennas the formula is: 234/f (MHz) for the length of a 1/4 wave antenna

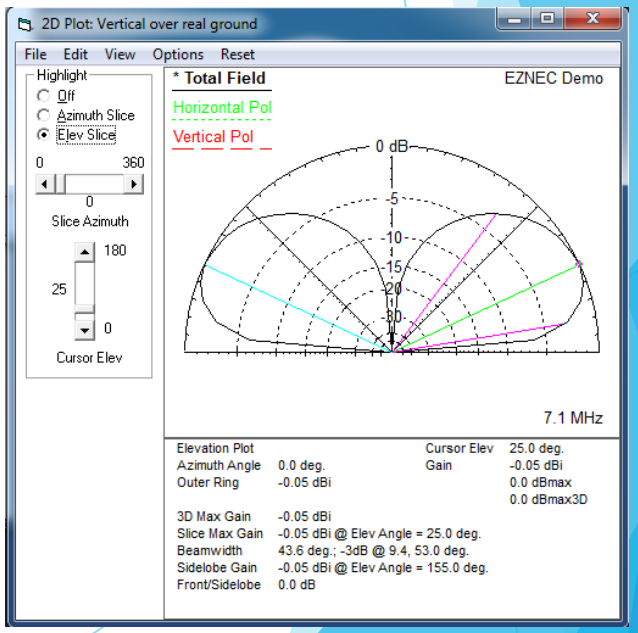
Vertical Antennas

1/4 Wave 40 Meter Vertical: Predicted Pattern & SWR



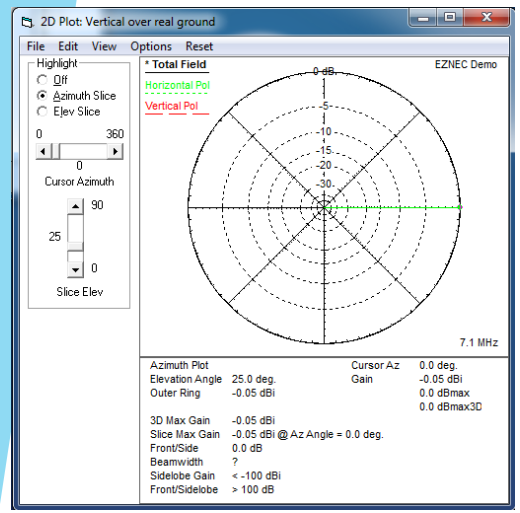


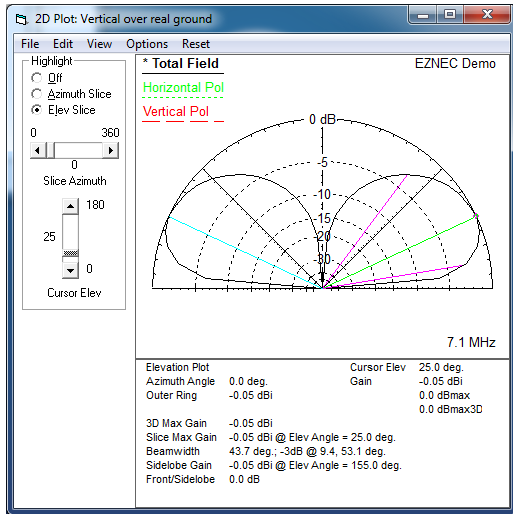


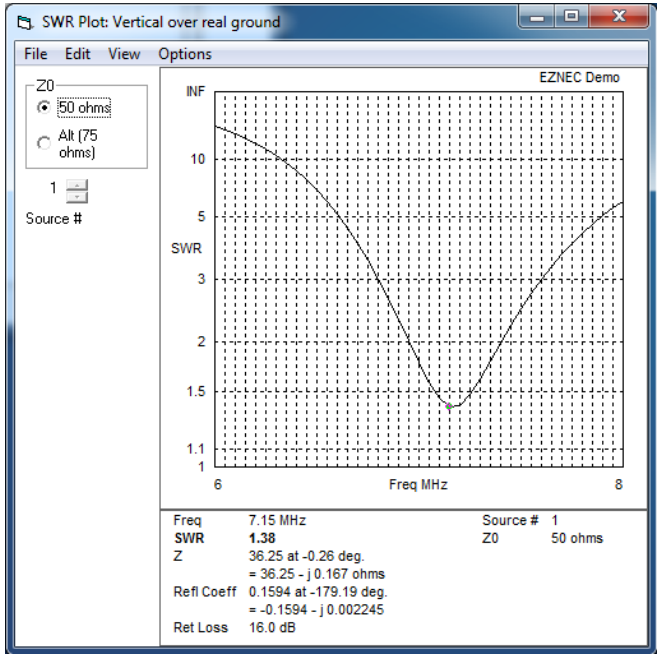


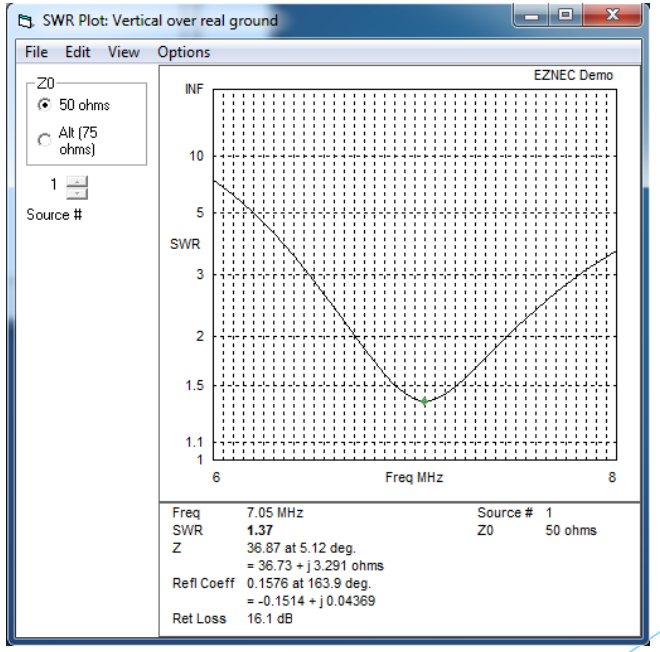
Vertical Antennas

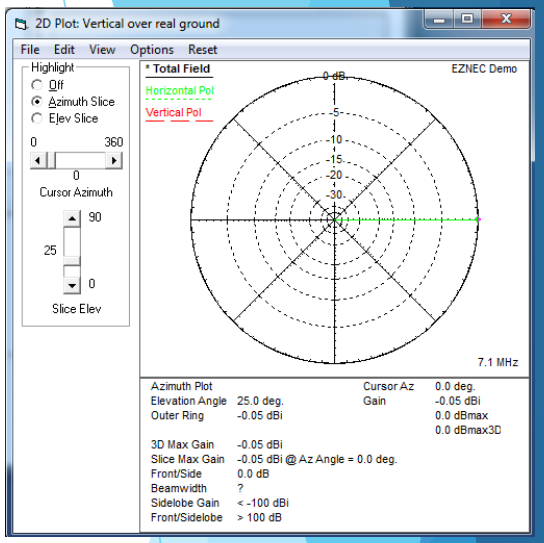
1/4 Wave 40 Meter Vertical: Predictions for different diameters – 16 ga & 2 inch

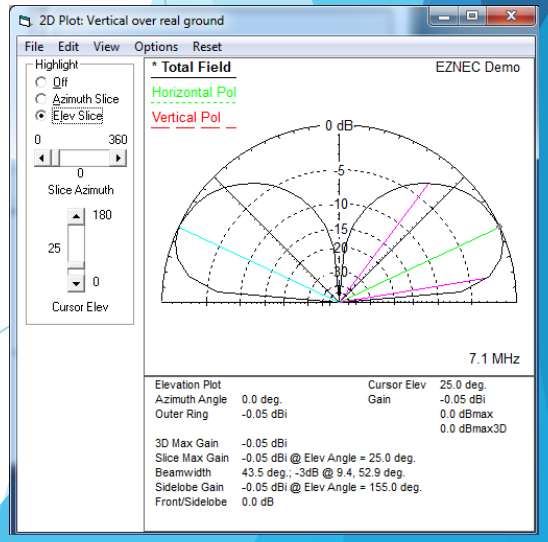






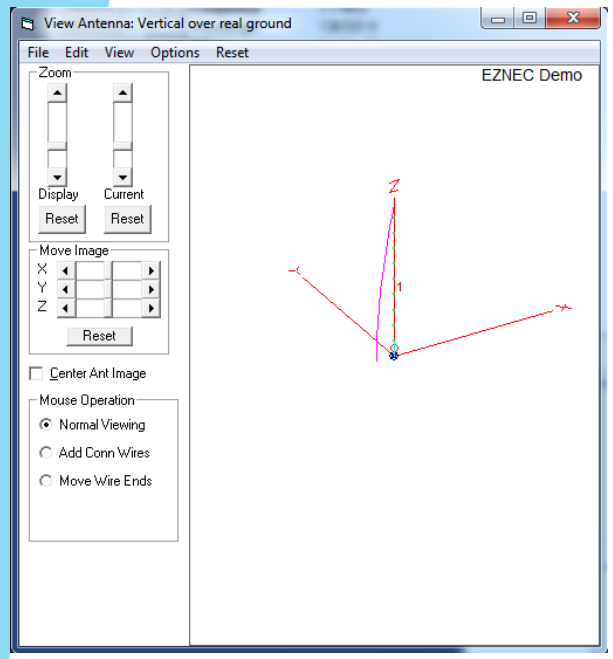


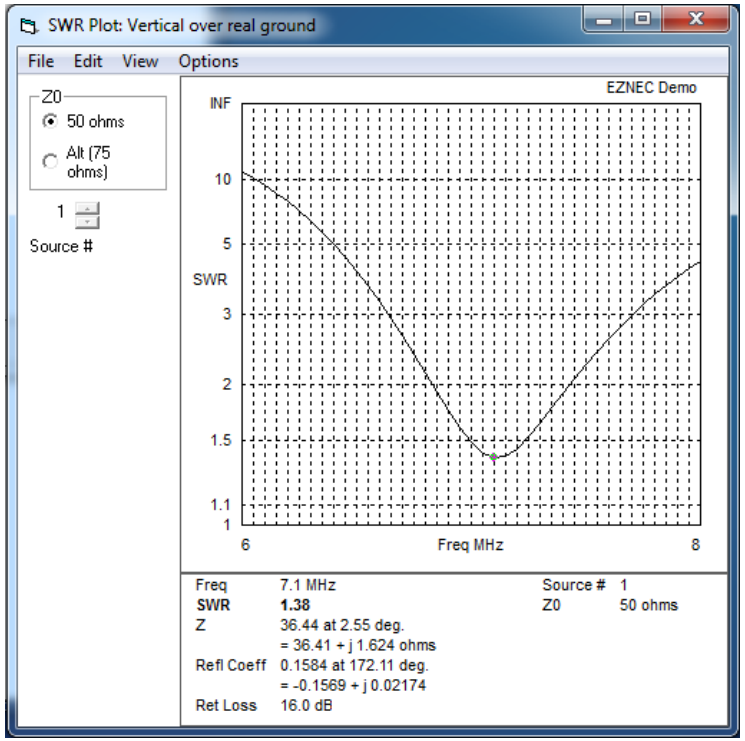


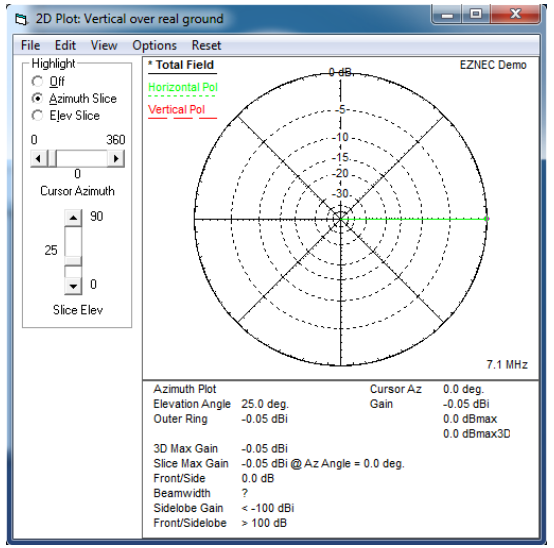


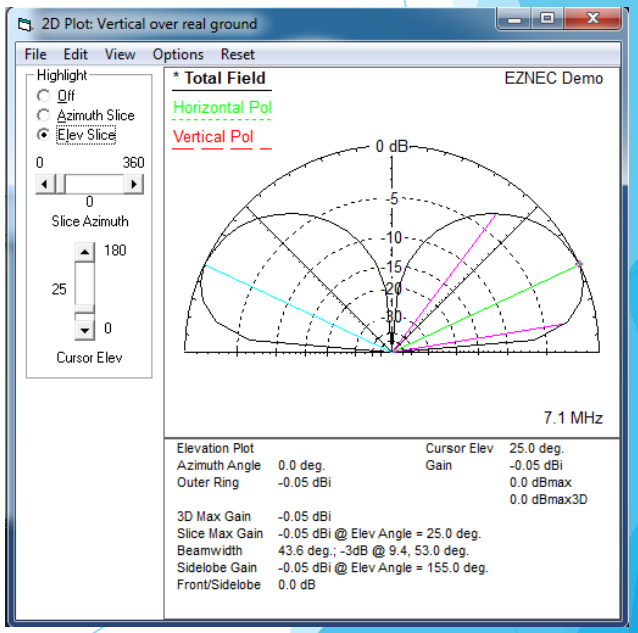
Vertical Antennas

1/4 Wave 40 Meter Vertical: Predicted Pattern & SWR



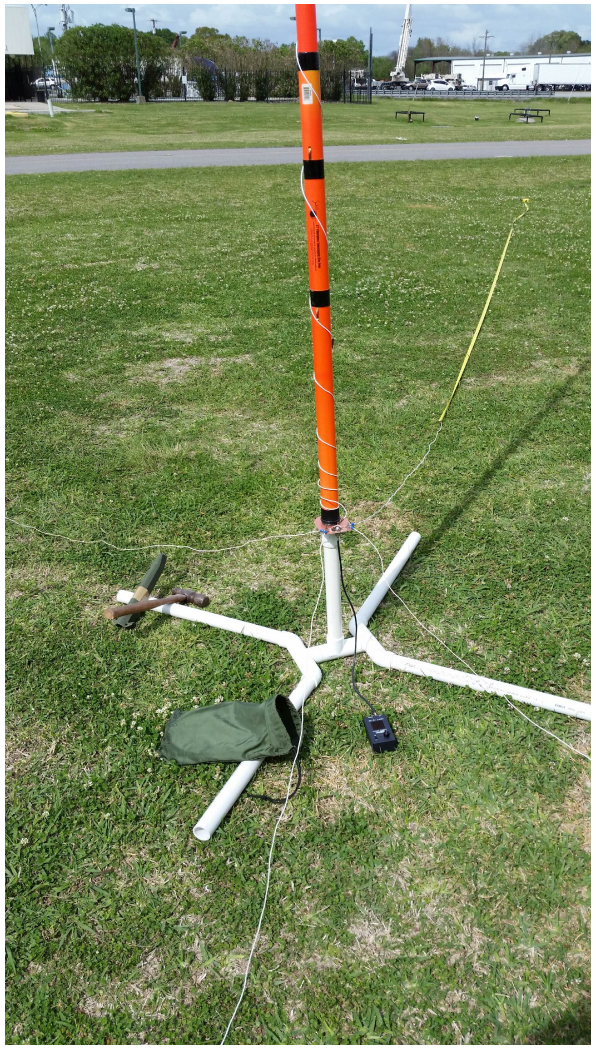






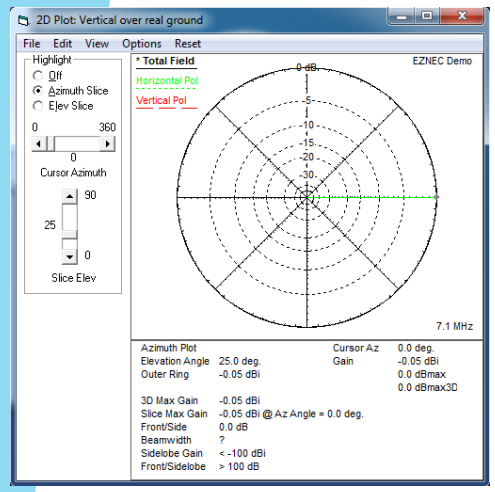
Vertical Antennas

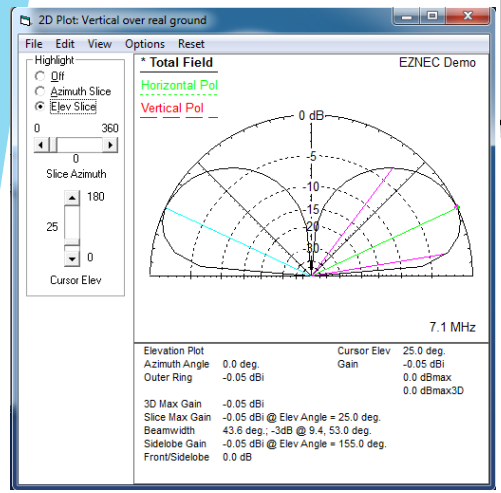
1/4 Wave 40 Meter Vertical: Predicted Pattern & SWR

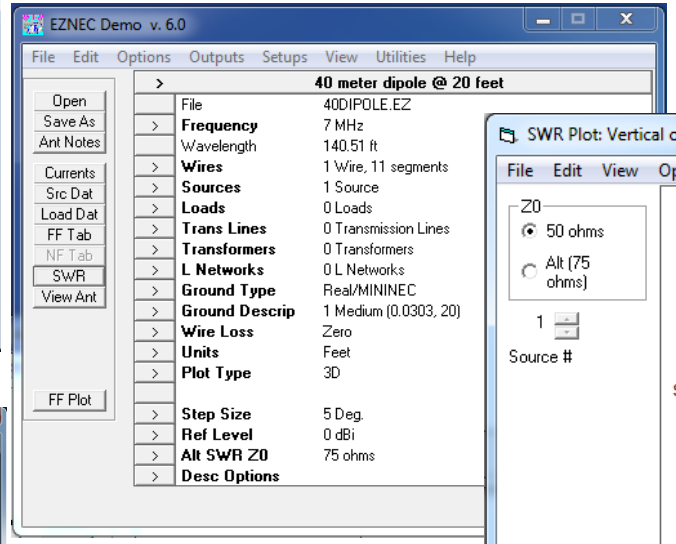


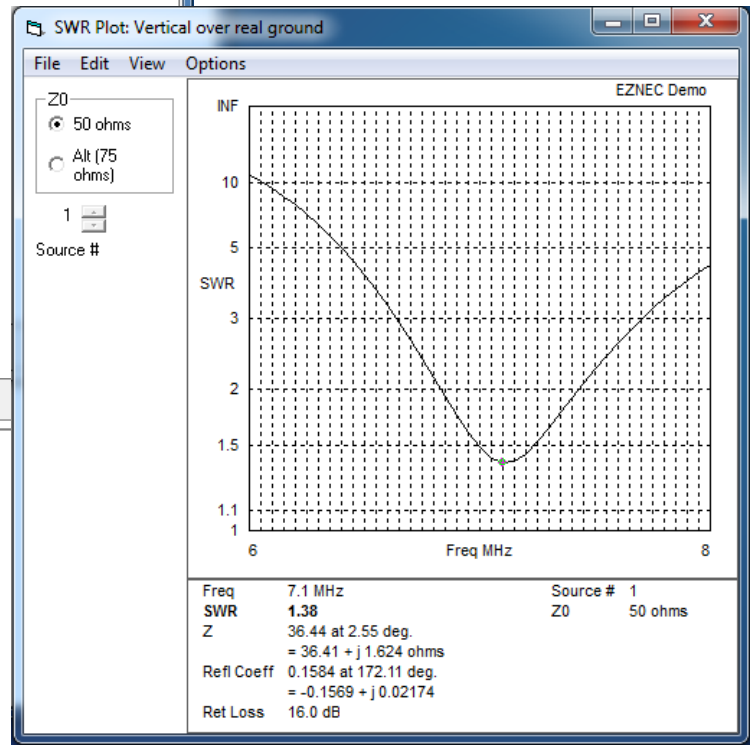
Vertical Antennas

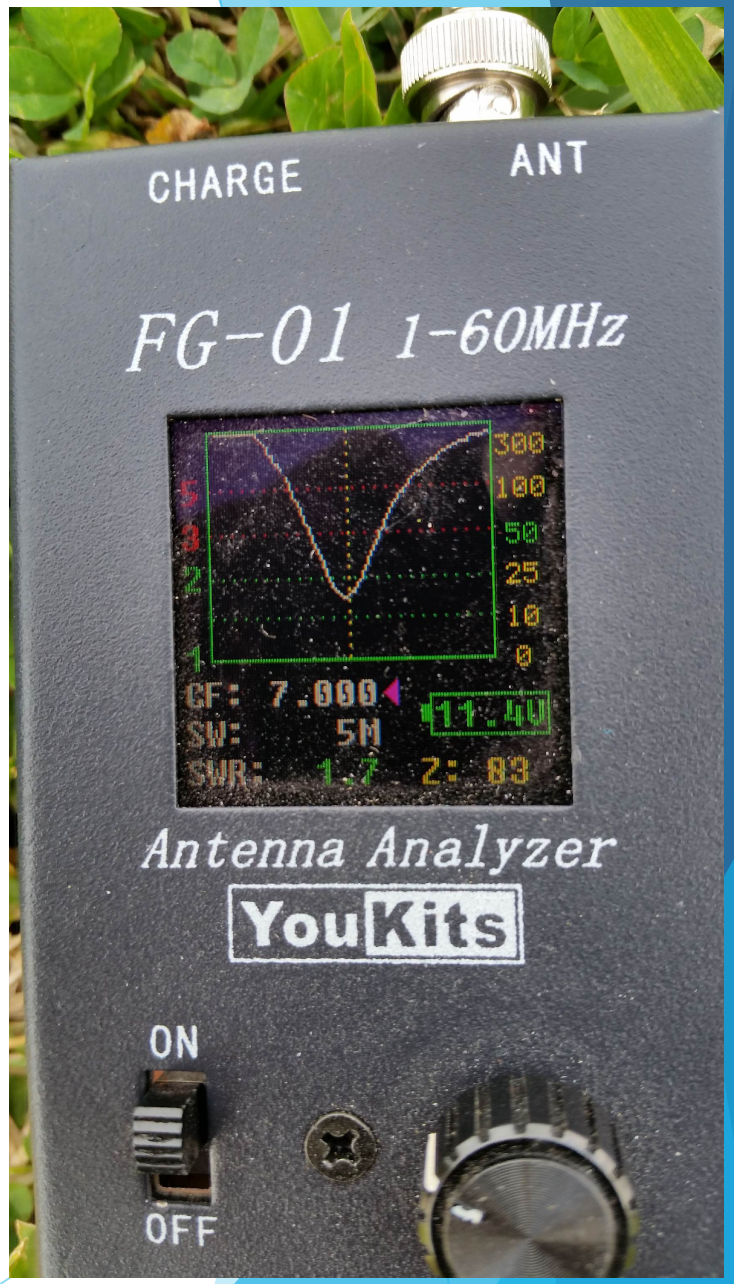
1/4 Wave 40 Meter Vertical: Predicted Pattern & SWR











1/4 Wave 40 Meter vertical: Actual SWR

Backyard Antennas

Safety First!

Do Not Place Antennas over, under, or near Power Lines!

Antenna Modeling Software Links

http://www.w5ddl.org/files/ComputerModelingSimple6.pdf

http://www.arrl.org/files/file/Antenna%20Modeling%20for%20Beginners%20Supplemental%20Files/Antenna%20Modeling%20-%20Getting%20Started.pdf

http://www.arrl.org/files/file/Antenna%20Modeling%20for%20Beginners%20Supplemental%20Files/Antennas%20101%20-%202013%20-%20The%20Basics.pdf

http://www.arrl.org/files/file/Antenna%20Modeling%20for%20Beginners%20Supplemental%20Files/EZNEC%20Modeling%20Tutorial%20by%20W8WWV.pdf

http://hamwaves.com/antennas/modelling.html

Backyard Antenna Links

http://www.qsl.net/v73ns/backyardwireantennaes.pdf

http://www.donkeith.com/n4kc/article.php?p=22

http://www.amateurradio.bz/40_80_meter_antenna.html

https://www.w0hc.com/ocf-dipole/

http://www.bvarc.org/pdf/HF_Antennas_by_KD5FX.pdf

http://w5sdc.net/delta_loop_for_hf.htm

80 & 40 Meter Horizontal Antenna Links

http://www.amateurradio.bz/40m_v.html

http://www.chem.hawaii.edu/uham/nvi40.html

https://www.arrl.org/files/file/Technology/tis/info/pdf/9106023.pdf

http://rsgb.org/main/get-started-in-amateur-radio/antennas/your-first-antenna-the-half-wave-dipole/

http://www.hamradio.me/antennas/wideband-80m-dipole-antenna.html

http://www.seed-solutions.com/gregordy/Amateur%20Radio/Experimentation/IVee80.htm

http://wireless-girl.com/Projects/Antennas/Broadband80mDipole.html

https://s3.amazonaws.com/files.qrz.com/k/aa6lk/w1hbq_80Wire.pdf

80 & 40 Meter Vertical Antenna Links

http://www.dj0ip.de/vertical-antennas/80-40m-on-18m-pole/

http://www.iw5edi.com/ham-radio/?80m-vertical-antenna-with-capacitance-hat,132

https://sites.google.com/site/trapantenna/about-the-antenna

http://www.hamuniverse.com/kl7jrmultibandvert4010.html

http://www.hamuniverse.com/hc4w4bwsgroundplane.html

http://www.saunalahti.fi/hohtola/ham/measuring-tape-antenna/Measuring-Tape-Vertical-Antenna-OH7SV.html

http://webzoom.freewebs.com/g8jnj/FatMax%20Antenna.pdf

http://www.ruskcountyarc.com/2013/12/creative-solution-for-portable-radials.html

Multiband Antenna Links

https://www.w5ddl.org/files/Zs6bkw_vs_G5rv_20100221b.pdf

http://www.nc4fb.org/wordpress/zs6bkw-multi-band-antenna/

http://www.qsl.net/wb1gfh/antenna.html

http://www.n4lcd.com/wireantennas/57-Five-Bands_no_tuner_Antenna.jpg

http://www.nc4fb.org/wordpress/w3edp-multi-band-antenna/

http://www.nc4fb.org/wordpress/optimizing-the-w3edp-antenna/

Q & A

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