A case for the

Multi-band Wire Antenna

The Issues:

- Small yards
- Powerlines and obstructions
- Neighbors and HOA's
- Municipal / County restrictive ordinances
- RF Noise levels
- Expense and complexity

This is NOT the answer

K0EU >

Observations:

- Fixed antennas with high gain in all directions across all bands do not exist – all are compromises
- Verticals are much better than no antenna at all
- Elevated OCF ½ w verticals (i.e. Hy-Gain AV640) work better than ground mounted 1/4w trap verticals
- Horizontal wires at moderate heights outperform and are quieter than verticals
- Loops work well, but a horizontal wire as high as the top of a loop will outperform the loop

Observations, cont.

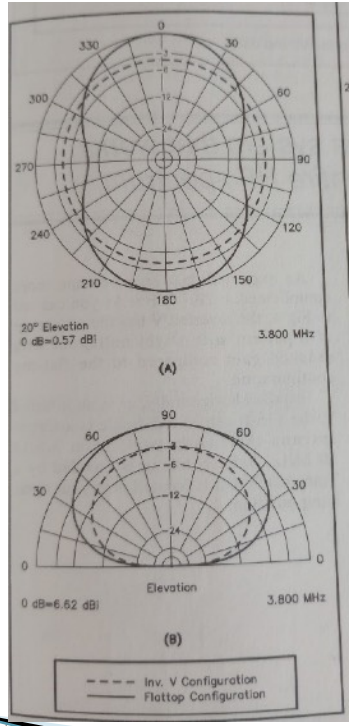
- Higher and larger is always better
- Single wire antennas can be made quite stealthy
- Flat top is better than an inverted V as long as it's > ½ the height of the top of the inverted V
- Flat top is an effective contest antenna in the new "limited antenna" category
- Antenna modeling is an "estimate" – real world signal peaks and valleys aren't as dramatic as in the model – there's lots of "fill"
- Your antenna will deliver some "surprises" –

  usually pleasant…

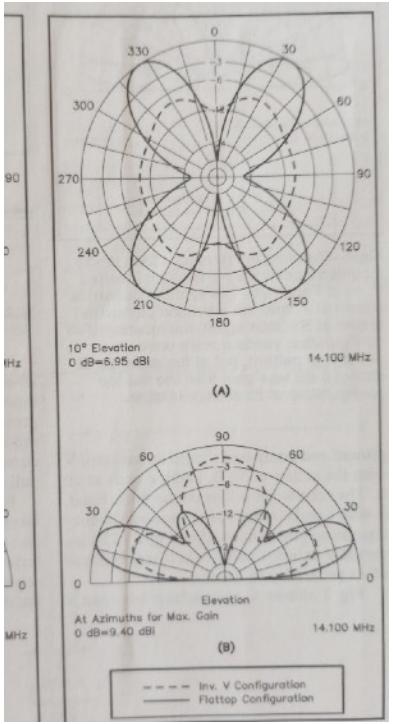
Antenna Performance Ladder

135’ Flat Top @ 50’ vs Inverted V

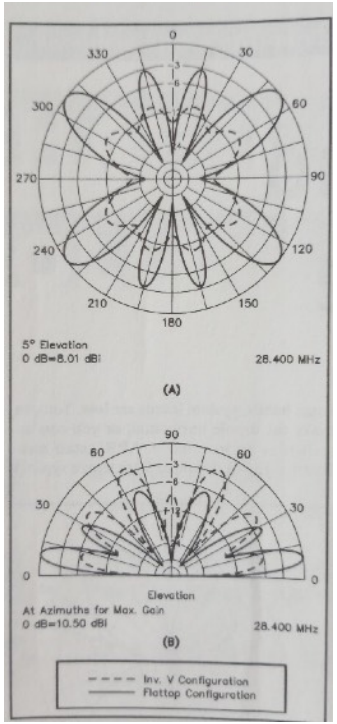
80m + 4 dB



20m + 7 dB

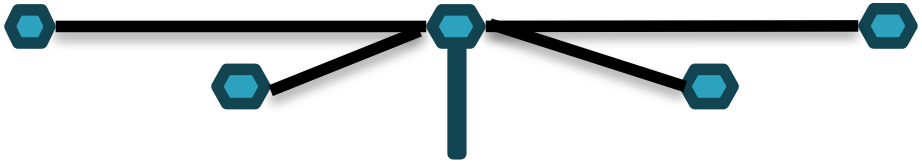


10m + 8 dB

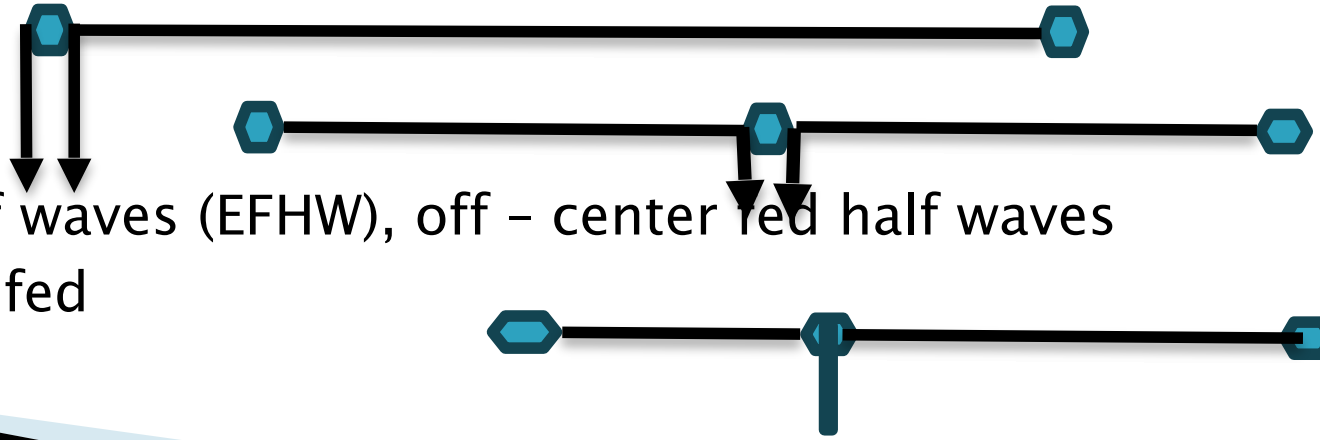


Common Multiband Wire Antennas

Dipoles



Zepps (end fed), Double Zepps, Doublets, G5RV, balanced feed



End – fed half waves (EFHW), off – center fed half waves (OCFD), coax fed

Dipoles:

- Several bands, can be < ½ wave. Limited bandwidth.
- Parallel, loading coil, or traps
- Bi-directional broadside pattern on all bands. Best when coverage is desired in 1 or 2 certain directions
- No gain except over a vertical. With traps, more bands = more trap loss
- Usually fed with coax, internal tuners help
- Good for vertical and sloper orientation

Zepp / Doublet / Double Zepp / G5RV…

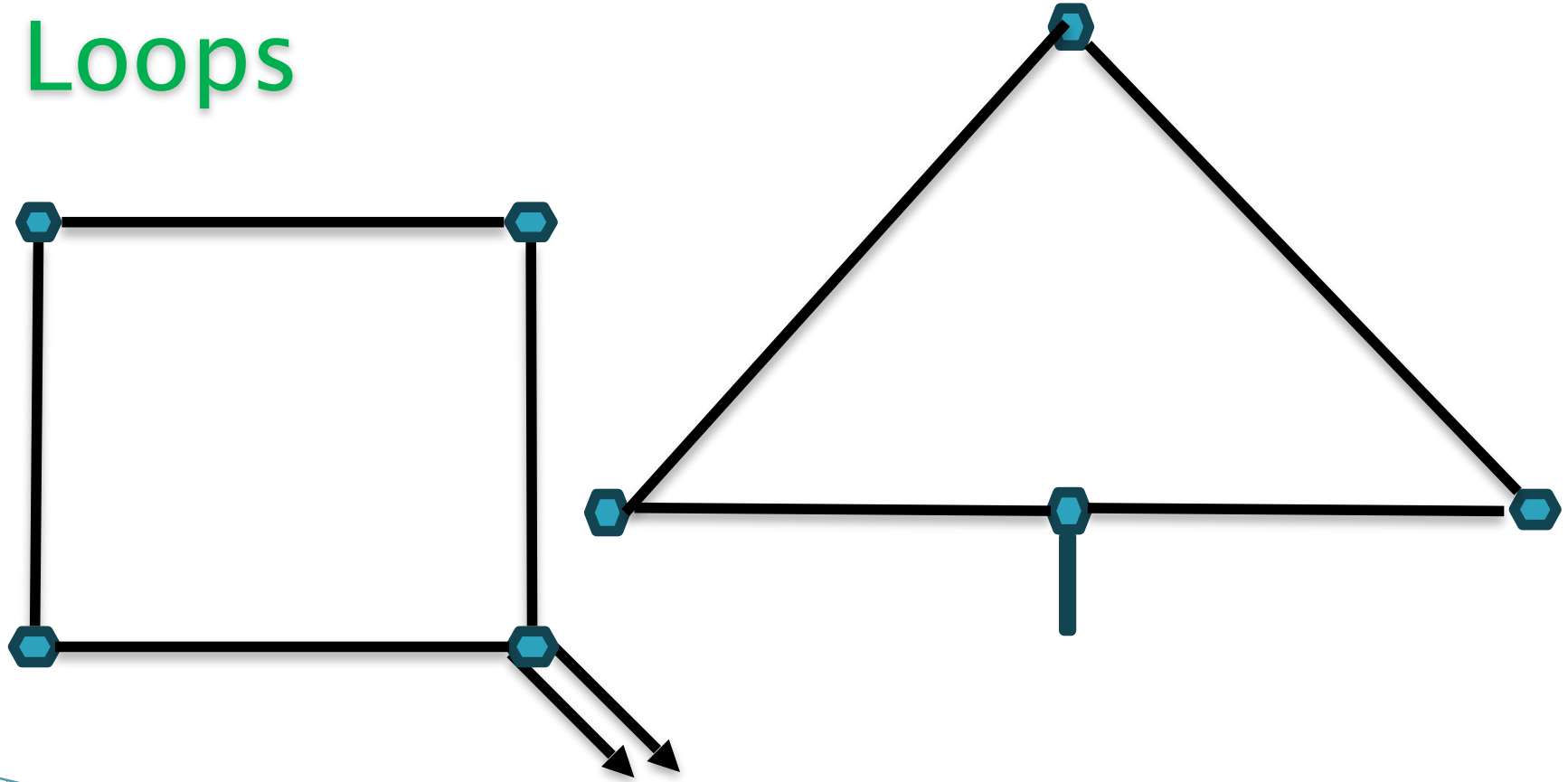
- Cover ALL bands and modes

- Uses ALL of the wire on all bands at > 1/4 wavelength
- Bi-directional broadside pattern on lower bands, more complex and omni-directional pattern with gain (to 4 dB or so) on higher bands.
- Balanced feed – open wire / 450 ladder line / 300 twinlead, center fed (preferred), offset, or end fed
- Good for general all – directional coverage
- Requires a tuner, has better harmonic suppression
- Can get wonky with stray currents at higher power

EFHW, OCFD, Windom Antennas:

- Good compromise for several bands, but WARC band limitations. Bandwidth limited without tuner. Won't work well below ½ wave long.
- Uses ALL of the wire on all bands.
- Bi-directional broadside pattern on lower bands, more complex and omni-directional pattern with some gain (2 dB or so) on higher bands.
- Coax feed + tuner – often internal tuner is OK. Still some feedline loss on higher bands
- Good for general all – directional coverage
- Good option when balanced feed isn't feasible

Loops



Full Wave Loops:

- Mostly used for just a few bands – a compromise to cover other bands.
- Uses ALL of the wire on all bands.
- Bi-directional broadside pattern on lower bands, more complex pattern with negligible gain on higher bands.
- Quiet
- Needs balanced feed and a wide range tuner for multiband use
- OR best, a remote tuner at the feedpoint fed with coax
- Some high radiation lobes on some higher bands
- Better option when only 1 high support is available

Why Mess with Balanced Feed and Tuner?

- A wide range of antenna impedances to 2K+ ohms across bands
- High SWR on coax attenuates forward AND reflected power
- 3 – 600 ohm balanced line + tuner doesn't attenuate reflected power. More closely matches antenna system impedance- reduces SWR and losses, improves efficiency
- Example: Antenna with 1000 ohm feedpoint impedance:
  - With 50 ohm coax feed – 1000/50 = 20:1 SWR
  - With 450 ohm balanced feed – 1000/450 = 2.2 SWR
- Tuner adds appropriate (C or L) reactance to match antenna and feedline to 50 ohms, also suppresses harmonics

Balanced Feedline Considerations

- Center feed much preferred – balanced feedline current all bands, lower feedline SWR, no feed radiation, easier to tune
- Use STRANDED wire, even in 450 ladder line
- Avoid feedline resonance, radiation and coupling issues with specific feed lengths (chart)
- Feed + Length/2 = ¼ wave or multiple thereof @ lowest band
- Feedline perpendicular to wire for at least ¼ wave
- Distance ladder line > 3’ from conductive materials
- Use a high-quality external balun, short coax run into house

Non – resonant Feedline Length Chart

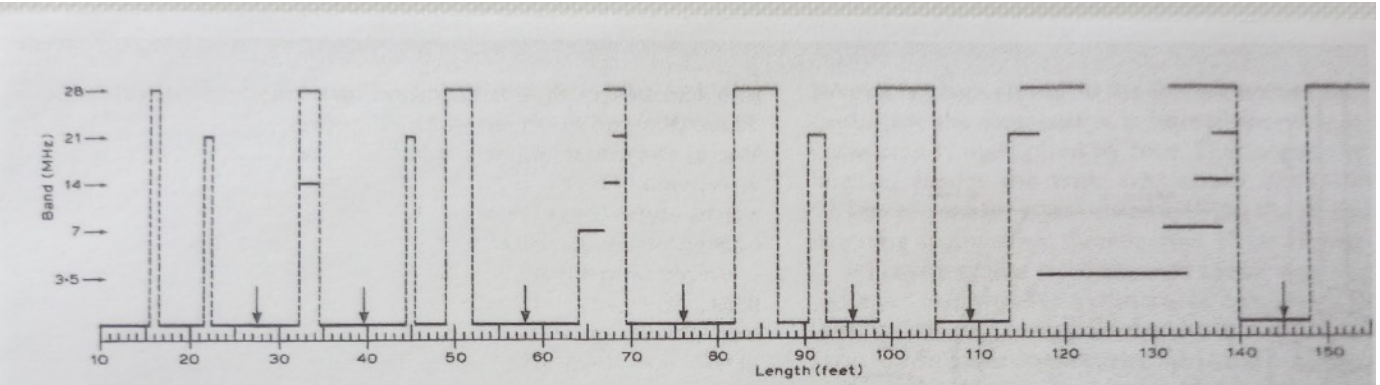


Fig 4.37. Lengths shown by solid lines along the horizontal axis avoid exact resonance in the 3.5, 7, 14, 21 or 28MHz am systems where the coupling apparatus is isolated from ground. Best operating lengths corresponding to *l* in Fig 4.36(a) are of the wider ranges as shown by the arrows. To include 10, 18 and 24MHz while avoiding undue proximity to band edges it wil to make some provision for alteration of *l* when the waveband is changed. The diagram needs some modification for the l if not all bands are required, since not every resonance is shown; eg if 28MHz is not needed 85ft could be used but, owing t at 14MHz, not 100ft *(ARRL Antenna Book)*

These lengths ( ) avoid resonant feedlines that will radiate and be difficult to tune

Antenna Considerations

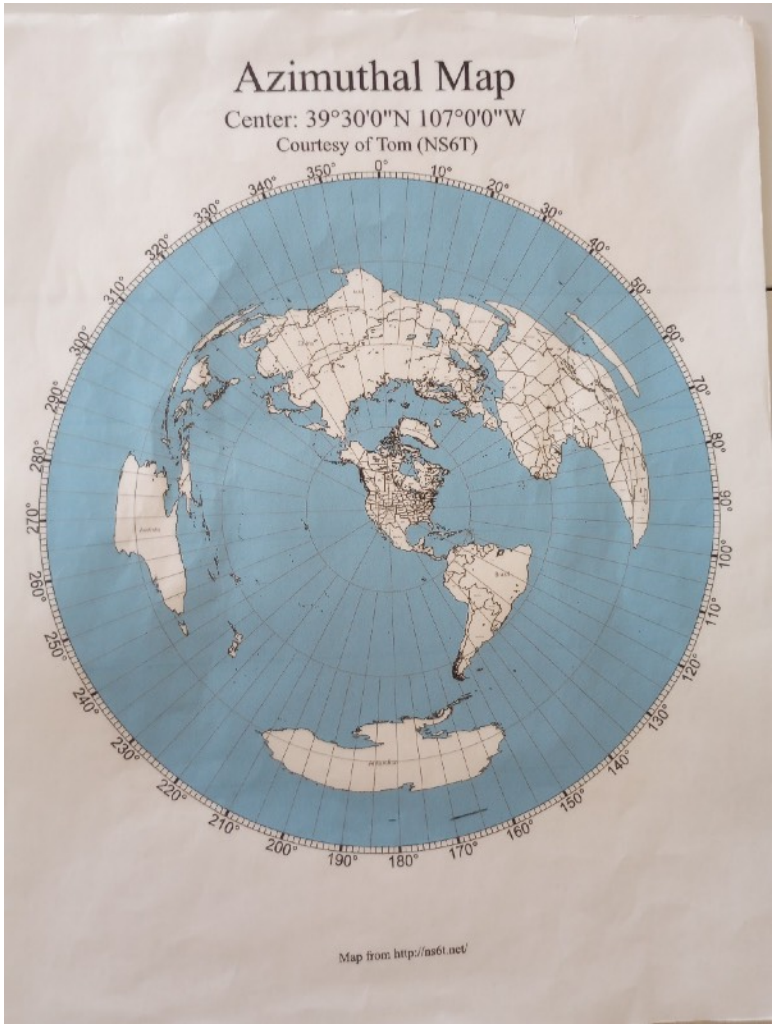
- Max length? How high? What bands?
- 1 vs 2 (or more) supports?
- Balanced line + wide range tuner feasible?
- Directional focus – Stateside? DX?
- Possible directional orientation(s)?
- How much output power?
- Nearby topography

Where is the DX?

Vast majority of DX is from Northwest through North to Northeast

VK, So. Pacific Is. and So. Africa are West and East

So. America off in the Southeast



The Simplest Answer:

"Put up the longest wire you can as high as you can, and feed it in the center with balanced line"

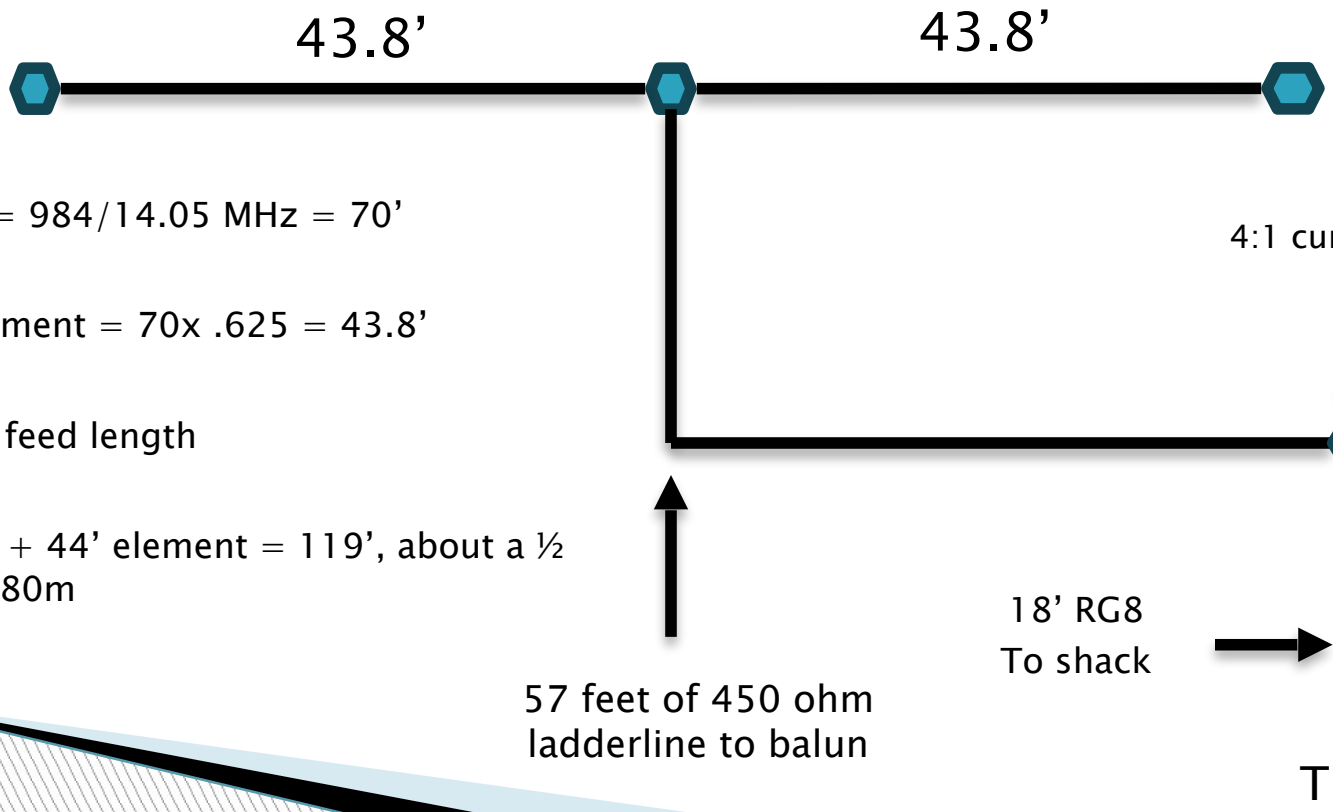
- Lew McCoy W1ICP (sk)

My Solution – a Doublet

- I do CW DX on all bands 80 – 10m + WARC @ 100W
- Built as an 87’ stealth doublet broadside N – S along roof line
- Also a dipole on 60m, Extended Double Zepp (EDZ) on 20m.
- Low end supports, so a semi – flat top configuration
- Useful gain 20 – 6m. 3 dB N/S on 20, 4 dB on 6
- 450 ohm ladder line through attic to a 4:1 balun, coax into shack
- Some high takeoff angles OK – QTH in the canyon, higher terrain in most directions, especially W and NE
- Also have a 51’ Inverted V doublet off one end in attic

for E & W

Doublet Design for 80m and up. Also an EDZ (Two 5/8w in phase) on 20m



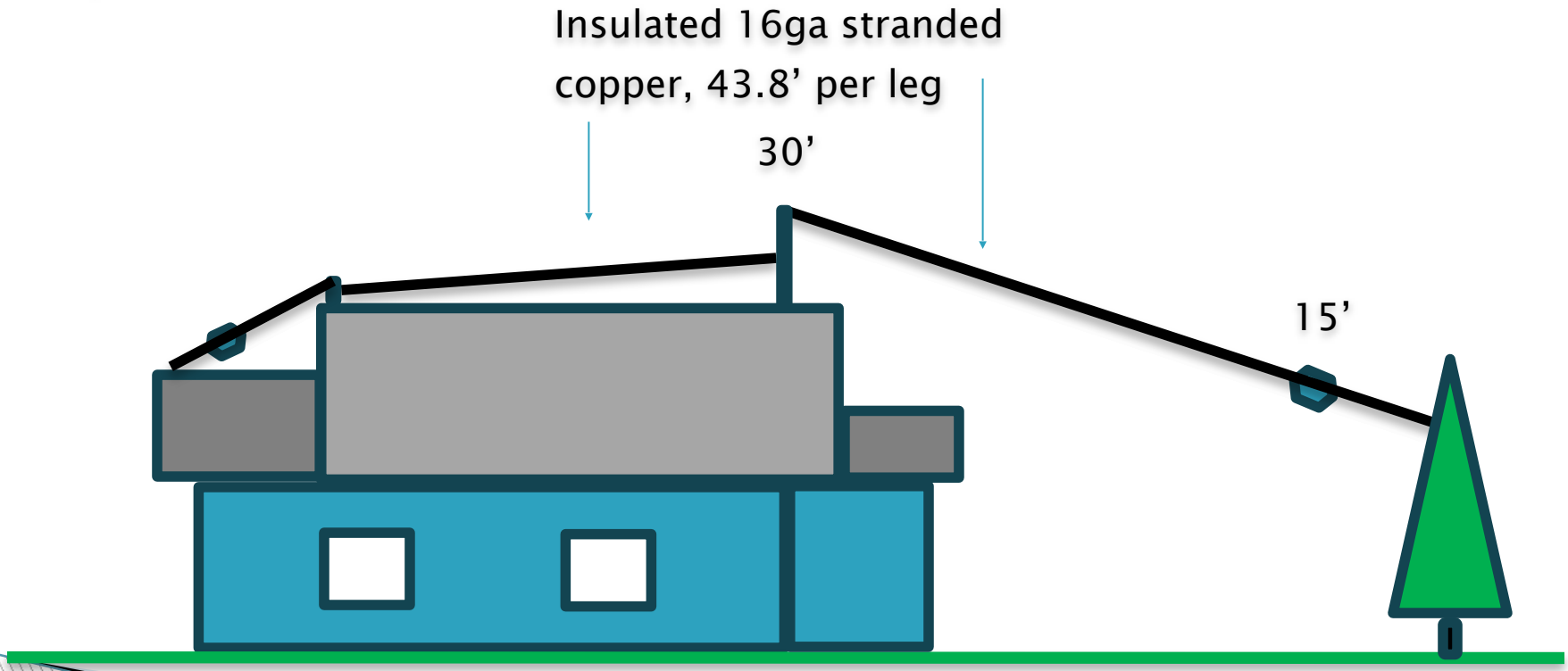
1 wave = 984/14.05 MHz = 70’

5/8w element = 70x .625 = 43.8’

75’ total feed length

75’ Feed + 44’ element = 119’, about a ½ wave on 80m

My Doublet



North elevation

Can you see it?

EZ-NEC (Numerical Electromagnetics Code) Modeling by Roy Lewallen W7EL

(does not include the house under one leg…)

77K+ lines of code

free, no longer supported

GIGO – be precise

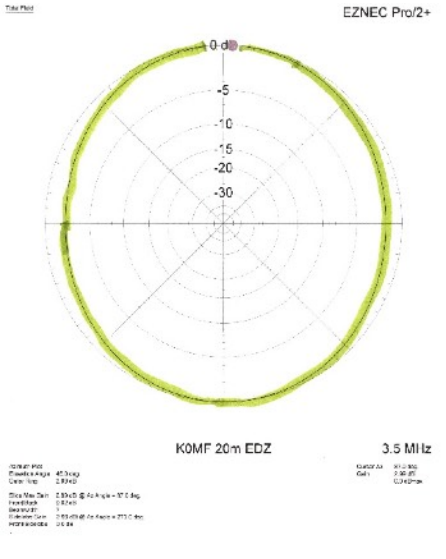
EZ-NEC app, manual download – EZNEC.com

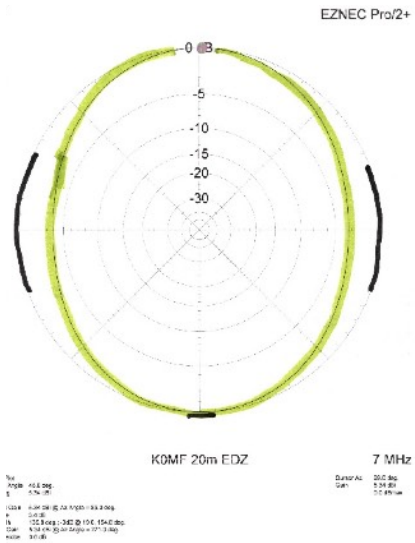
U-tube instructional video – G-QRP Club 12/4/21

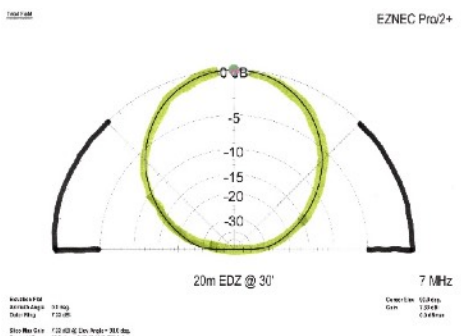
EZ-NEC Modeling

- File – open or add description
- Use / modify saved descriptions
- Set options / parameters (gnd type, units, etc)
- Build elements. Odd # of wire segments (7 – 21) on X/Y/Z axes. Build V's horizontal first
- Make first element equidistant across center
- Verify build in "View Ant"
- Define source – i.e. 50% from end of wire #1
- Generate plots – print, scan, save as jpeg

Semi – Flat Top Doublet, 80/60/40/30m

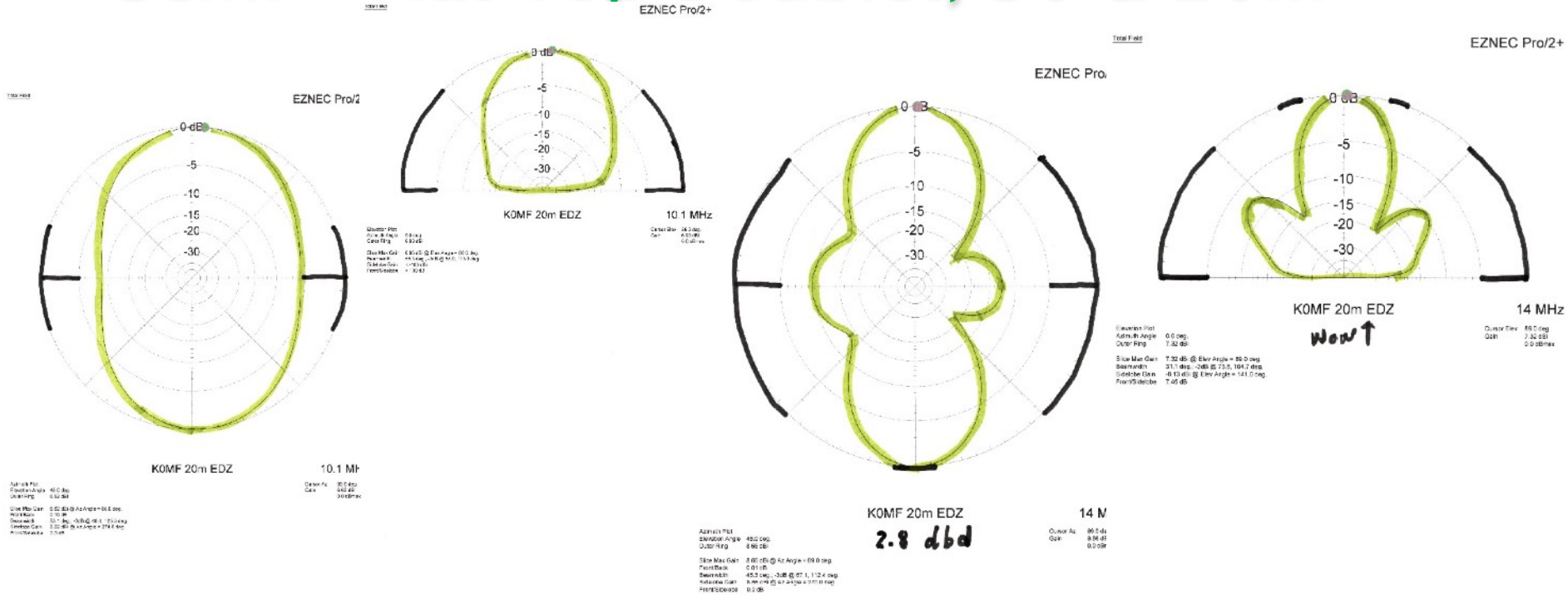






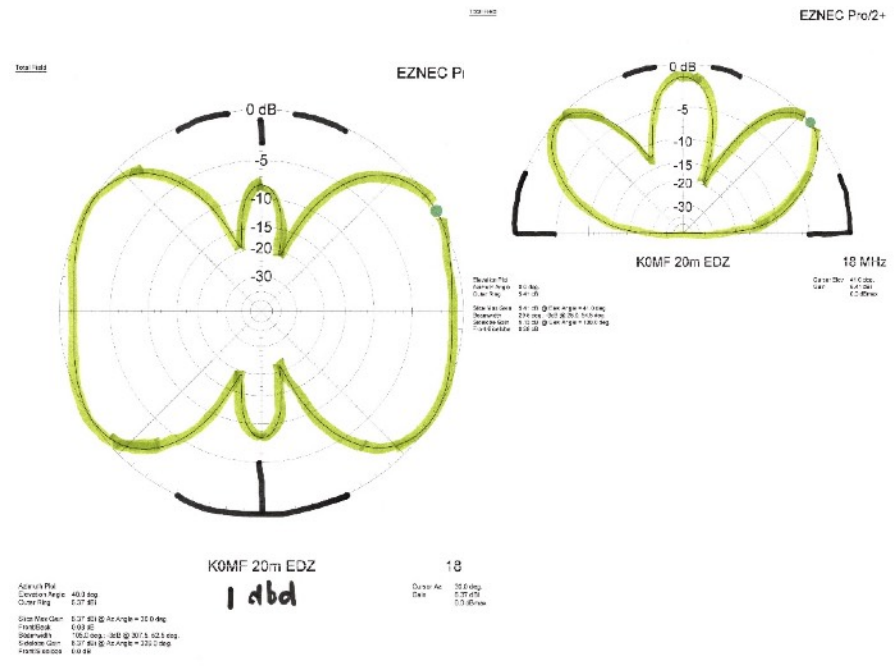
A low dipole, high takeoff angle

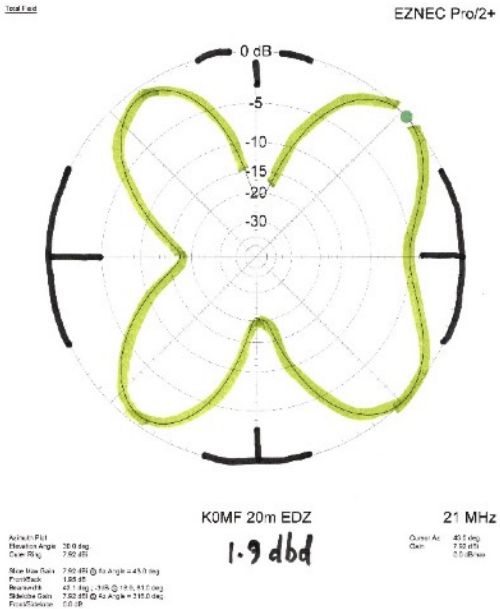
Semi – Flat Top Doublet, 30 & 20m

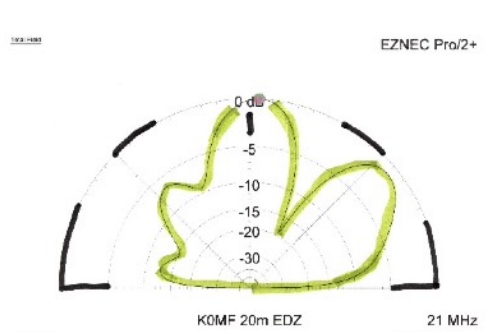


Dipole on 30, high angle gain on 20

Semi – Flat Top Doublet, 17 & 15m

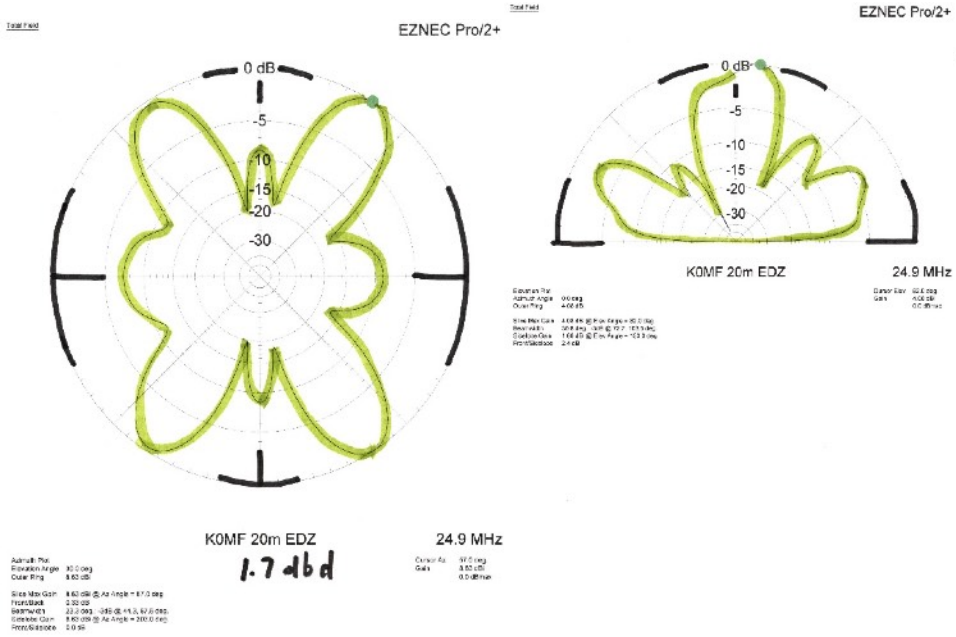


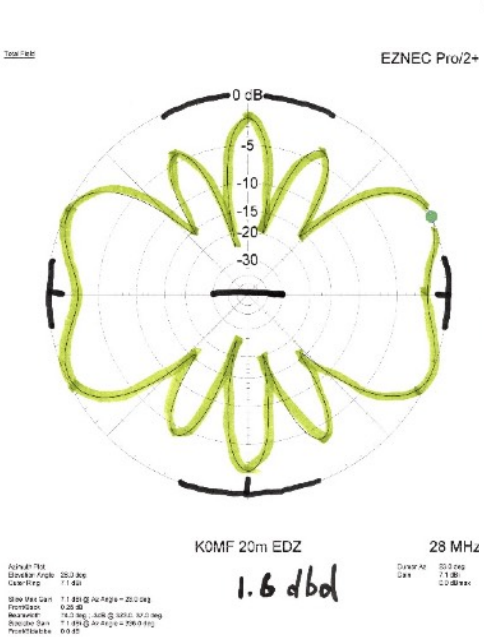


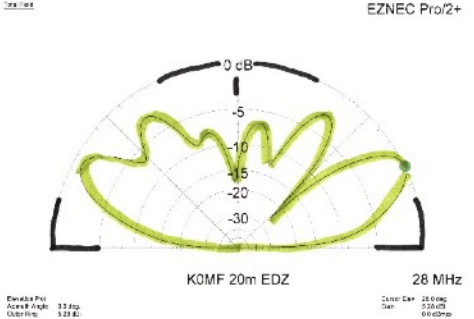


Starts to look better above 20m

Semi – Flat Top Doublet, 12 & 10m



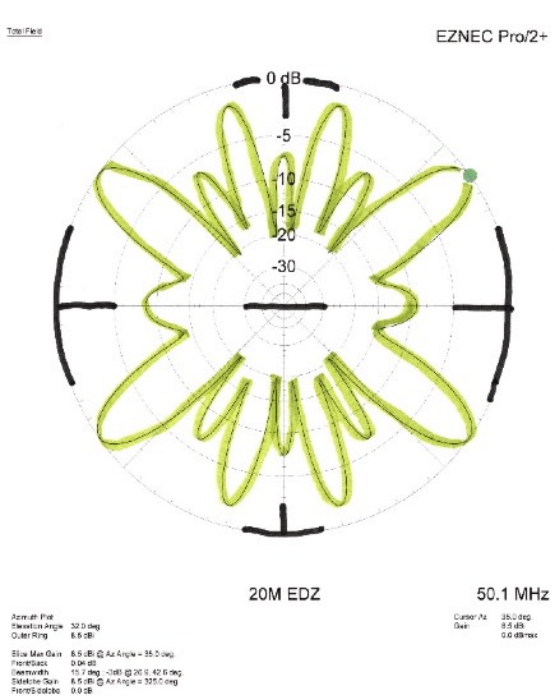


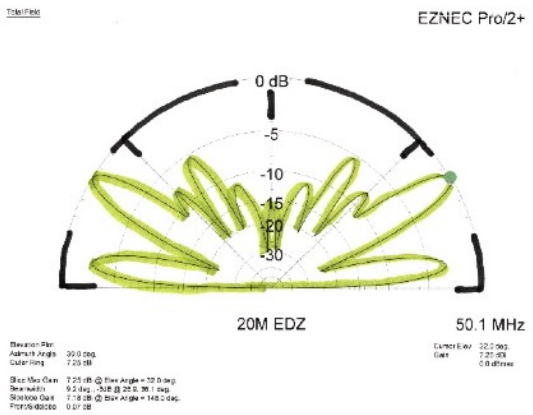


Much nicer, especially on 10

Nice patterns on 6M!

- Bonus band
- My tuners don't cover 6, but…
- 2.5:1 SWR straight in – internal tuner handles that





Tuners / Baluns

- Use high efficiency (minimal loss), especially for high bands. See ARRL comparative tests – best tuners have loss < 5%
- High power units regardless
- Bypass the internal balun, often lossy, use good external balun and coax feed into shack
- Separate tuners / setting charts for each antenna is nice

Does it work?

Better than hoped. So far, worked all 50 states, all 84 ARRL sections, 38 of 40 WAZ zones. All CW, no FT8

DXCC countries:

80m – 37(!)	40m – 102	30m – 20	20m – 128
17m – 35	15m – 105	12m – 10	10m – 114

Total = 209

Surprises

- Overall performance – > plots suggest and I expected
- 80M! VE6 – sure, but 37 countries with so little focus?
- Good 30/17/12 coverage – just haven't focused there
- Decent (limited antenna category) for SS /10m contests
- 6M – I'll have to try it, but worried about RFI
- Easy to tune

- High elevation angles, especially on 20m – tough going over the poles
- RFI in house w/100w – chirping smoke alarms, killed CAT rig – PC connection. Fixed with inline ferrite chokes

Next Steps:

Reach out to me or other Club members for advice, modeling, and assistance

Be creative – surprising what will work

Try it and have faith!

WARNING – Past performance is no guarantee of future success – your results may vary!

Mike Ferguson K0MF
k0mf@arrl.net

TNX and GL!