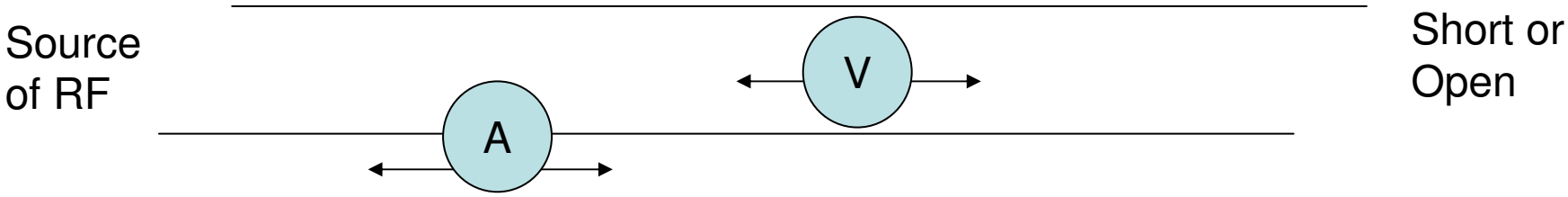
How to Build a Dual-Band Antenna for 2M/70cm

- Rubber duck nearly an isotropic source, but not as good
  - Victim's head absorbs some of the RF (maybe that explains a few things…)
  - Capacitance to body makes a "sortaground" that supplies half of the antenna plus a decent dummy load.
  - Directionality based on loss, not gain

- Alternatives commonly used
  - 5/8 antenna on cookie sheet
  - ¼ wave antenna on cookie sheet

- Dipole as a 2-m antenna
- Limitations
- Current distribution
- Voltage distribution
- Power distribution
- Ground plane as a squished dipole

- Transmission line theory
- Standing waves
- With low SWR voltage and current do not change much as you move along the line
- With high SWR voltage and current form nodes and loops along the line
- Old-time Zepp antenna was voltage fed



Lecher Wires (Open-Wire Transmission Line)

- An open or shorted quarter-wave stub inverts the impedance at the input end.
  - If the far end is shorted, there is a very high impedance looking into the stub
  - If the far end is open, there is a short looking into the stub.
  - If you start at the shorted end and move toward the input, you will notice that the impedance is zero at first (high current, very low voltage). As you move away from the short, you'll see the impedance rise (less current, more voltage) until you reach a voltage max at the input to the stub.
  - This gradual change in impedance can be used to match a feedline to the stub. The higher the impedance of the feedline, the farther from the short the feedpoint must be.

- A half-wave stub acts like two quarter-wave stubs.
  - If you put 2 quarter wave stubs together, you invert the impedance twice!
  - Since the impedance is inverted twice, looking into a half wave stub you see exactly the same impedance that exists at the far end.
- But a three-quarter wave stub acts precisely a quarter-wave stub (in a lossless line)

Impedances along J-Pole Matching Stub

"*Thunder is good, thunder is impressive, but it is lightning that does the work*." - Mark Twain

Operation of the J-pole depends on two different functions: matching and radiation

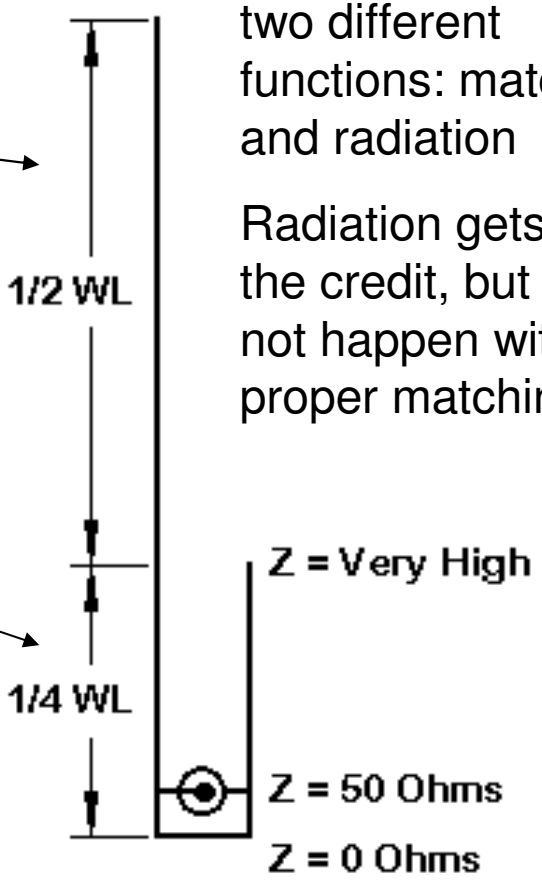
Radiation gets all the credit, but will not happen without proper matching.

Voltage-fed dipole

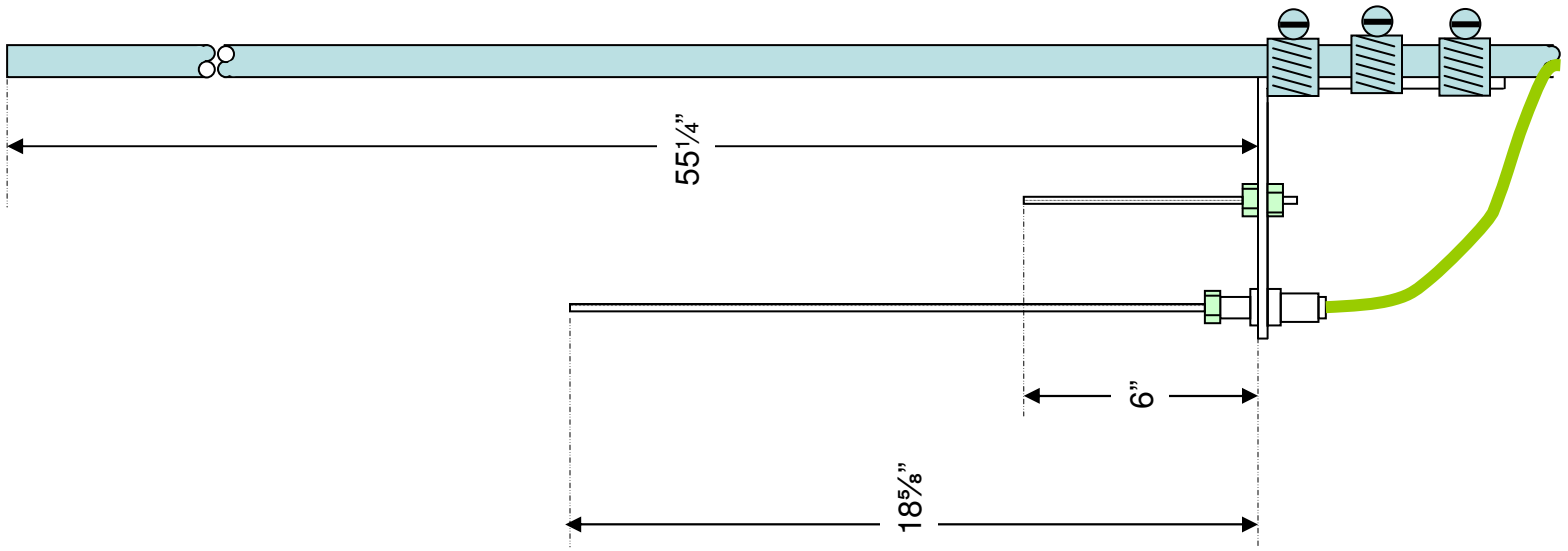
(This part does the work of radiating)

¼ wave stub

(This part does the work of matching the line to the dipole so that it can do its work.)



Dimensions of the Finished Antenna



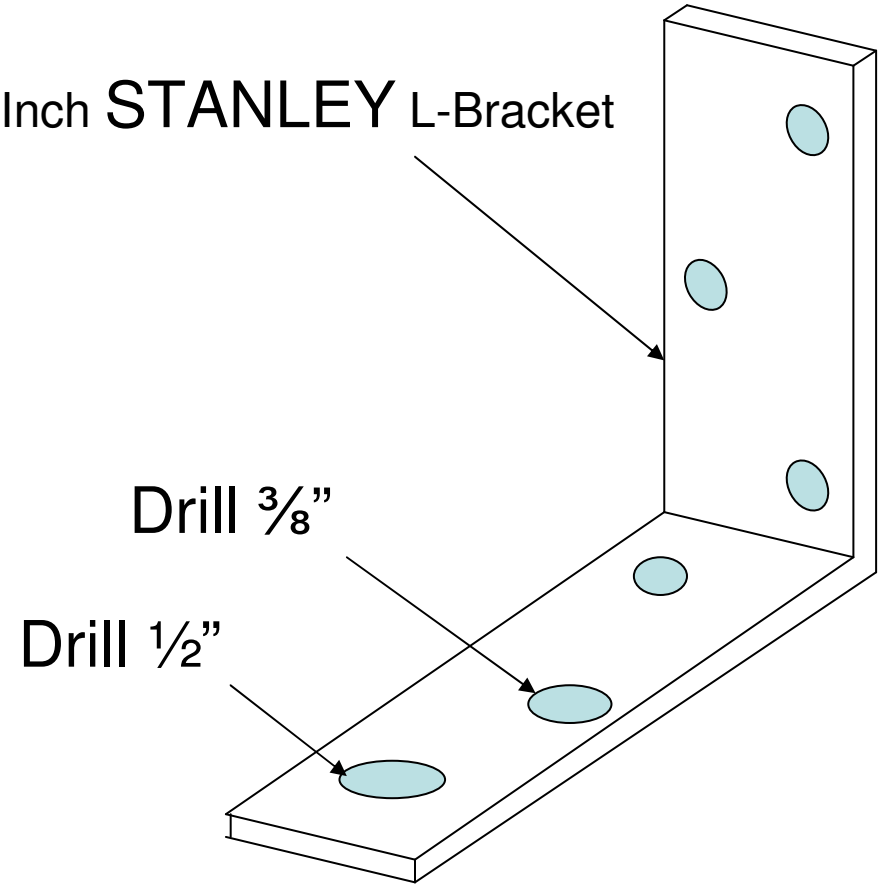
- Required Materials
  - ½” EMT conduit, 10’ section (Home Despot $2.89)
  - 3/8-24 x 36” all-thread rod (Elliot’s $2.59)
  - 3/8-24 locking nuts, 3 each (Elliot’s $0.20 each)
  - Number 12 hose clamps, 3 each (Elliot’s $0.59 ea)
  - 5” Stanley L-bracket (Despot $2.59)
  - UHF to 3/8” antenna mount (Texas Towers $4.89)
- Optional Materials
  - ¾” EMT conduit, 6” or 8” hose clamps, qty 3,

- Electric drill or drill press
- 1/2” Metal-cutting bit
- 3/8” Metal-cutting bit
  - Vise
  - Hacksaw
  - Screwdriver
  - SWR meter good at 146/450 MHz
  - Dual-PL259 coax patch cable
  - Feedline to your shack with PL-259 at antenna end

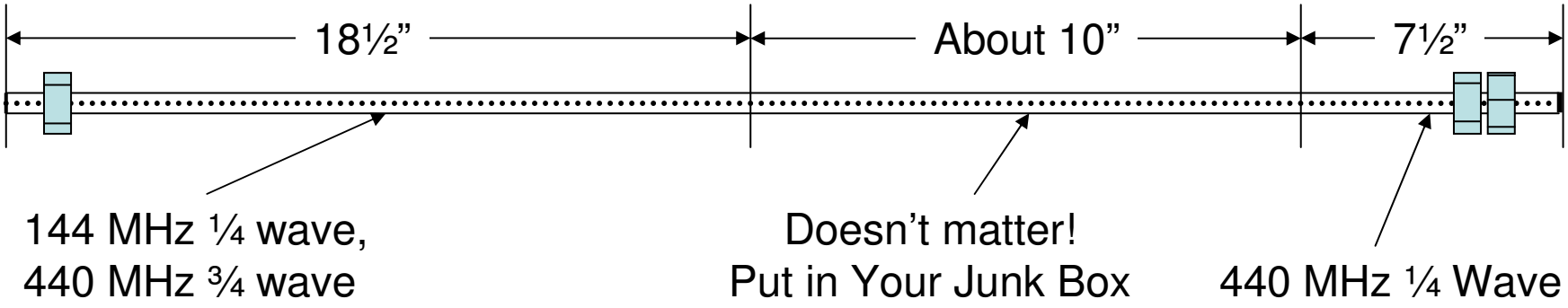
WARNING!

Metal shavings may fly into eyes, causing loss of vision. Wear eye protection while drilling bracket.

Rapidly rotating bracket may cause serious hand injury. Do not let this bracket get loose while you are drilling. Use clamps or drill vise to keep it securely held in place.

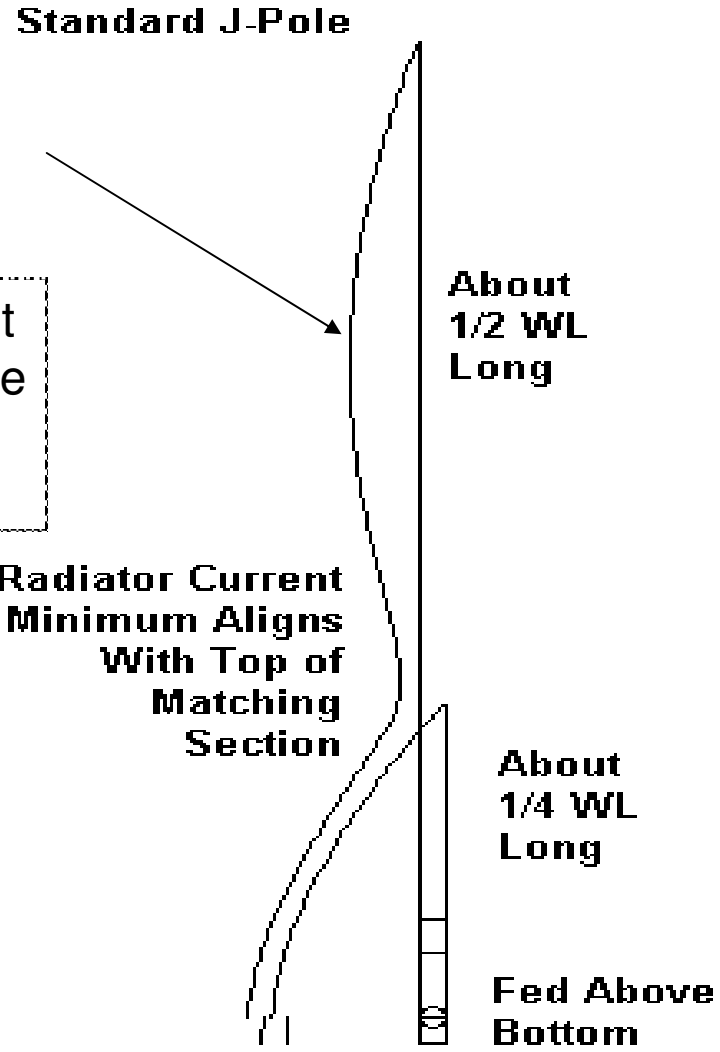


- "Measure twice, mark well, saw once…"
- Measure from original ends only because threads on ends are normally good.
- After measuring and before sawing, put 2 nuts on 7½ " end, one nut on 18½" end.
- Clamp the junk-box section in vise to saw rod.



1. Drill the bracket.
2. Measure and Saw the all-thread.
3. Mount antenna mount on bracket.
4. Mount bracket to conduit.
5. Install 18-inch all-thread.
6. Use SWR meter to adjust all-thread and position of bracket on conduit for lowest SWR at 146.5 MHz.
7. Install 6-inch all-thread and hand-tighten nuts.
8. Adjust 6-inch all-thread for lowest SWR on 446 MHz.
9. Then alternately adjust length of 18-inch all-thread and 6-inch for best SWR on 446.
10. Finally, adjust position of bracket on conduit for best 2M SWR.
11. Tighten and check all hardware
12. Weatherproof entire area above and between conduit and bracket with caulking compound or silicone sealer.
13. Ground with #12 or larger copper wire for lightning protection

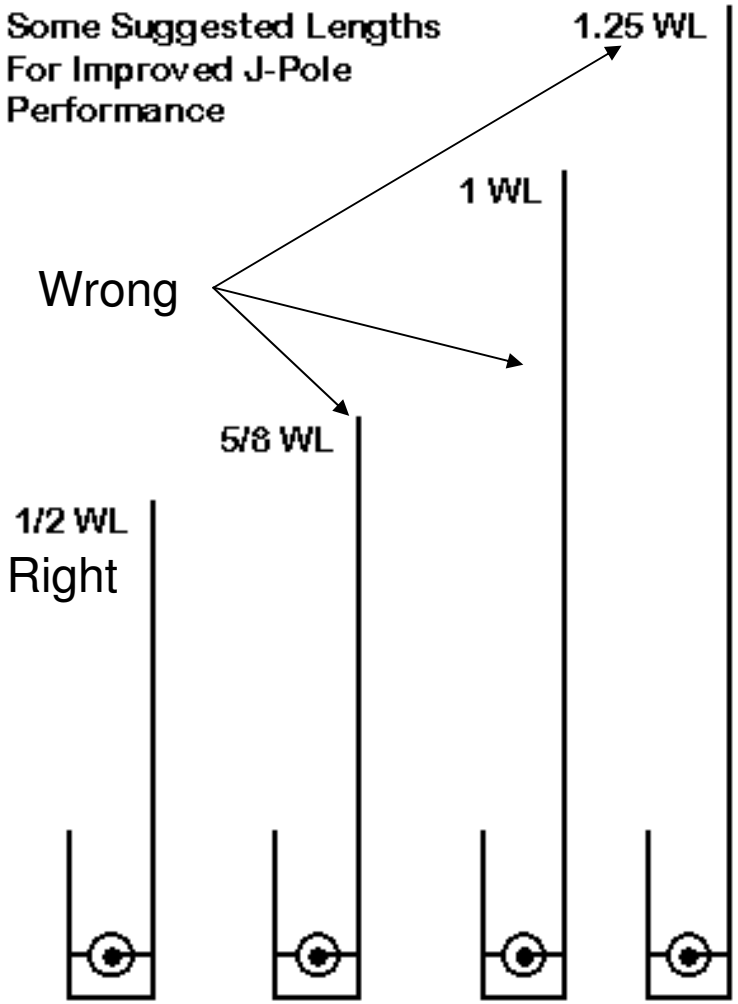
Current Distribution in the J-Pole



Current is Good! It's current that causes radiation, so the higher the current max, the better.

Thanks, W4RNL

If some is good, is more better?



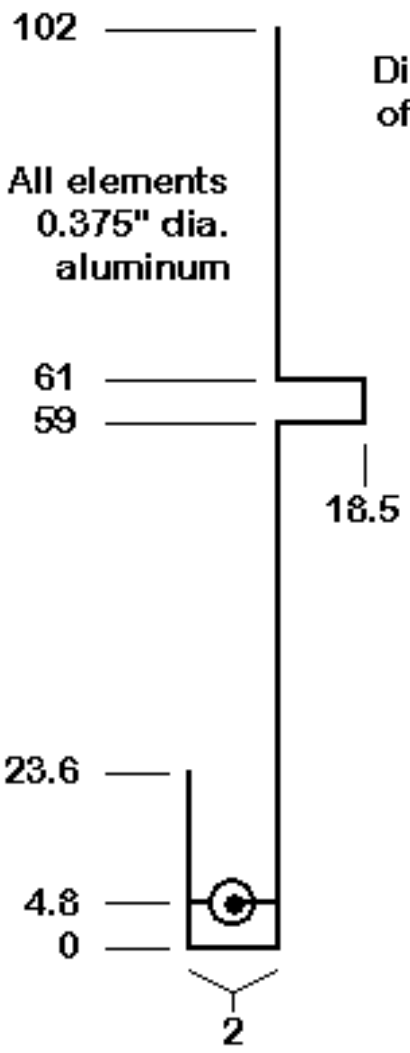
The standard J-pole extends ½ wave above the top of the matching stub, with maximum current in the middle of the ½ wave element.

Of all simple vertical antennas over ground, the 5/8 wave radiator has the lowest angle of radiation, however the base of the 5/8 antenna presents a relatively low impedance, not the high impedance offered by the ¼ wave stub. This suggestion is a flop.

The full-wave antenna is voltage fed, so it readily takes all the available power from the stub, however the phasing of the currents in the two half-waves actually moves the angle of maximum radiation UP and away from the horizon where we need it.

The 1 ¼ wave antenna has two strikes against it. First, it is an odd multiple of a quarter-wave radiator, so presents a low impedance at the bottom. It wants low voltage, high current – just the opposite of what the stub offers. Also it has the same sort of phasing problems as the full-wave radiator.

An Even Better J-Pole - Electrically



Modeled Dimensions of 146-MHz Collinear Standard J-Pole

Fig. 4

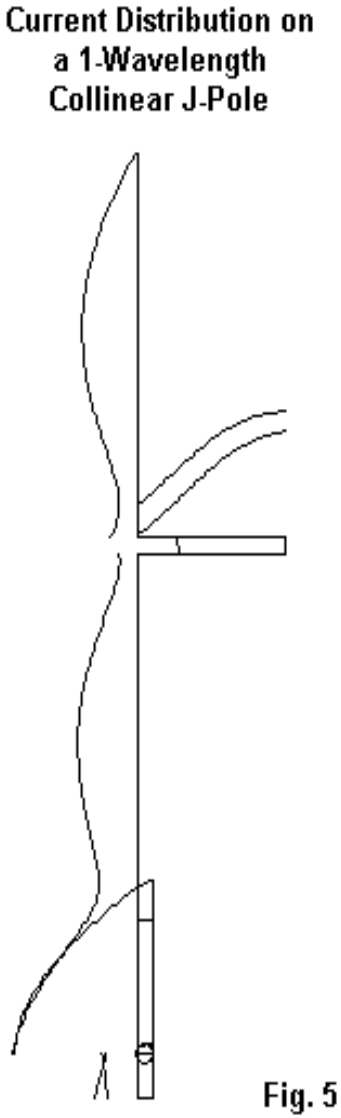


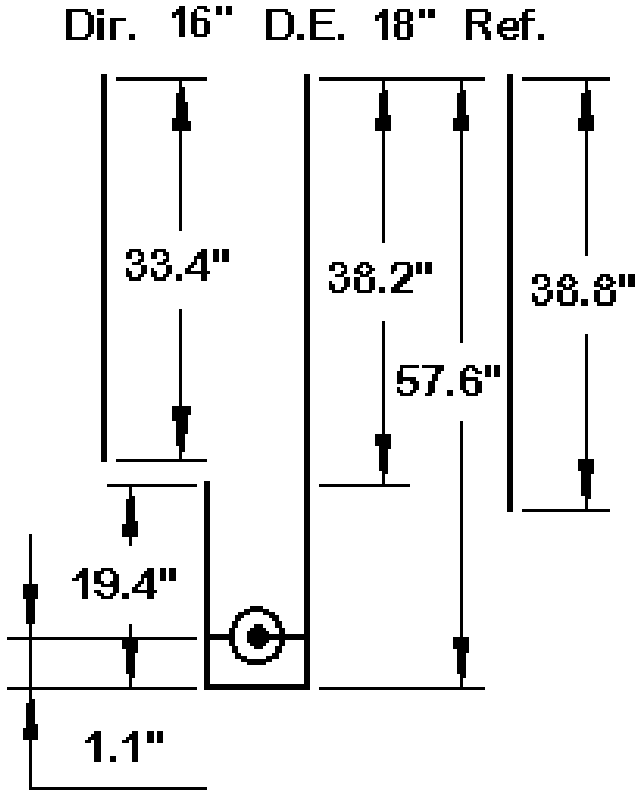
Fig. 5

The gain is about 7.4 dBi. This value is about 2.3-2.4 dB higher than the average gain of a single-radiator J-pole. Indeed, although many folks like to bandy the gain advantage of a collinear arrangement as 3 dB greater than a single section, we rarely obtain in real antennas more than about a 2.0-2.5 dB increase in gain.

Compared to many vertical antennas, the collinear J-pole shows a remarkable reduction in high-angle radiation. For any vertical collinear array, the only place from which to obtain energy for increased gain at lower elevation angles is from the high-angle energy of a single section.

Thanks, W4RNL

Crankin' up the Gain with a Jagi



Modeled Dimensions of a 3-Element Jagi (J-Pole Driven Yagi)

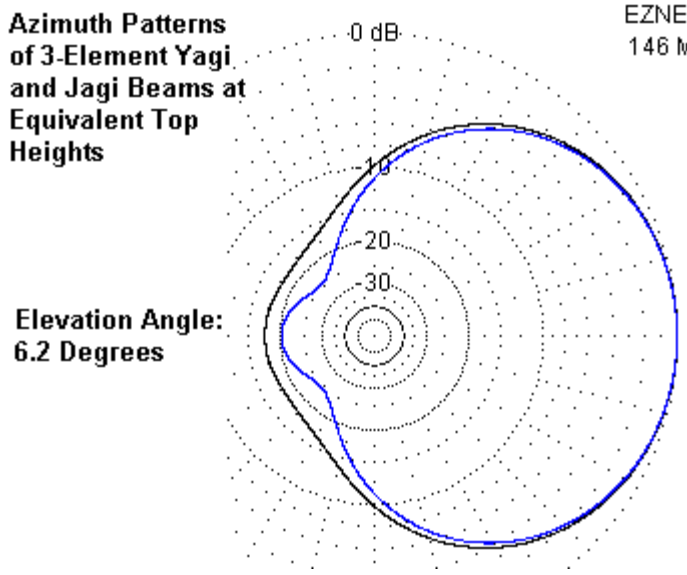
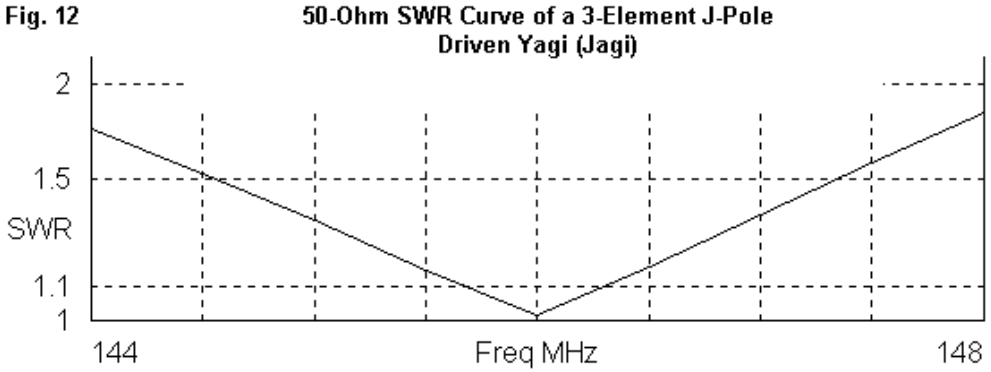


Fig. 12



Thanks, W4RNL

Your Assignment

1. **Use your J-Pole courteously!**

"…every face in the room visibly blanched at the sight of the dreaded Wouff Hong, that ancient instrument of torture used to enforce the rules of good operating and the Amateur's Code…"

2. **Go to W4RNL's website, http://www.cebik.com/, and browse the best antenna site on the Web. There's also great information on the history of ham radio and even some ham tales!**

- Make a jackleg antenna range to see how your favorite ducky or other portable antenna stacks up to your J-pole.