2m Roll-up J-Pole

Dallas N4DDM

GARS Workshop - November 16, 2021

M0UKD’s Slim Jim and J-Pole Calculator

2m Roll-up J-Pole

What I'll touch on for this Workshop

- Before we start building I would like to teach a few things about Transmission Lines
- Transmission lines; balanced (twin lead, window line, ladder line), unbalanced (coax)
- Impedance matching using a ¼ wave matching stub
- Impedance matching using non-50-ohm ½ wave transmission line
    - When life gives you lemons, you make lemonade
- Velocity Factor, what it is and how it affects the math
- Websites that do the math so you don't need your slide ruler, calculator, or aspirin
- Dallas' twist to the Roll-up J-Pole that I don't see anywhere

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Roll-up J-Poles can be made for other bands

- 70cm 420-450 **435MHz**
- 1.25m 219-225 **222MHz**
- **2m 144-148 146MHz** ***What we will be building***
- 6m 50-54 **52MHz**
- 10m 28-29.7 **28.85MHz** or just the Tech SSB 28.3-28.5 **28.4MHz**
- 12m 15m 17m 20m?
- Air Band Frequencies, 118-137MHz, **127.5MHz**
- VHF Marine Band, Ch16 **156.800MHz**
- NOAA Weather 7 channels, Ch 3 **162.475MHz** ***My demo from scrap Window Line***
- FRS/GRMS 22 channels, **465.1315MHz**

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Websites used for most of our heavy math skills

M0UKD’s Slim Jim and J Pole Calculator

- https://m0ukd.com/calculators/slim-jim-and-j-pole-calculator/

Google; convert cm to inches

- https://www.google.com/search?q=convert+cm+to+inches

Times Microwave - Coax Cable Loss Calculator

- https://www.timesmicrowave.com/Calculator?

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Times Microwave Systems - Coaxial Cable Attenuation Calculator

On the next slide I'll use the Times Microwave Calculator to show losses based on coax

- Set the cable type; RG-6, RG-59, RG-58, RG-8x
- Set the frequency to 146 MHz...
- Plug in the cable length in feet, 20 feet for this antenna
- Calculate and compare the results with other cables
- Know your losses before you part with your time and money

Every gain on an antenna system is a ***two-fer***

- Less loss on transmit AND Less loss on receive

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50-ohm vs 75-ohm cable

Times Microwave Systems - Coaxial Cable Attenuation & Power Handling Calculator

RG-58 **50-ohm** 20 feet at 146MHz

- Cable Vg 66.0%
- Cable loss 5.5dB/100ft - Max Cable Assembly Insertion Loss 1.2dB
- https://www.timesmicrowave.com/Calculator?Product=RG-58&RunLength=20&Frequency=146

RG-59 **75-ohm** 20 feet at 146MHz

- Cable Vg 66.0%
- Cable loss 4.1dB/100ft - Max Cable Assembly Insertion Loss 0.9dB
- https://www.timesmicrowave.com/Calculator?Product=RG-59&RunLength=20&Frequency=146

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50-ohm vs 75-ohm cable

Times Microwave Systems - Coaxial Cable Attenuation & Power Handling Calculator

RG-8X **50-ohm** 20 feet at 146MHz

- Cable Vg 66.0%
- Cable loss 4.5dB/100ft - Max Cable Assembly Insertion Loss 1.0dB
- https://www.timesmicrowave.com/Calculator?Product=RG-59&RunLength=20&Frequency=146

RG-6 **75-ohm** 20 feet at 146MHz

- Cable Vg 66.0%
- Cable loss 3.3dB/100ft - Max Cable Assembly Insertion Loss 0.7dB
- https://www.timesmicrowave.com/Calculator?Product=RG-6&RunLength=20&Frequency=146

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WHAT!!! 75-ohm cable has less loss than 50-ohm

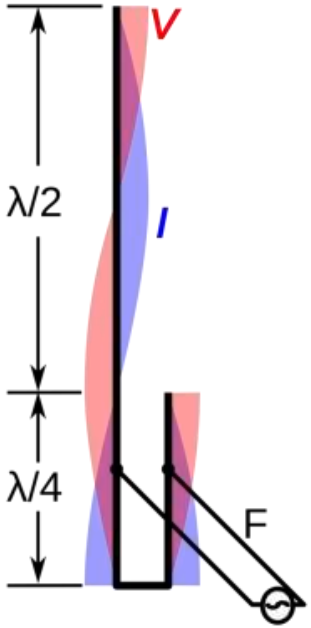
The story I heard was the Navy wanted the best coax…

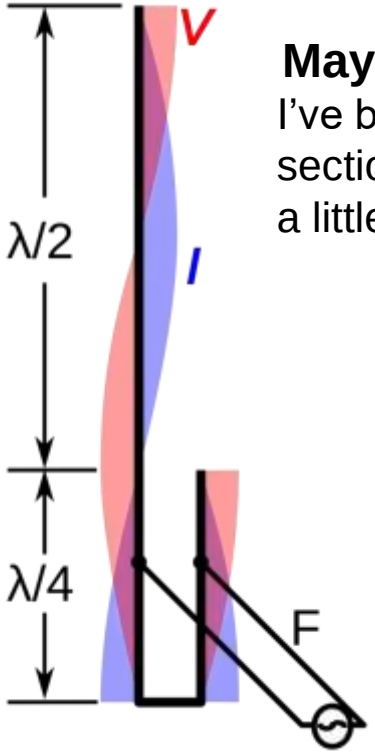
- Coax is a compromise, you can get low loss OR high power, not BOTH…
- 35-ohm cable can handle more power but doesn't like high SWR...
- 75-ohm cable has less loss, that's why the cable TV industry uses it...
- 50-ohm is somewhere in the middle…

The Quarter Wave Stub

Magical Properties

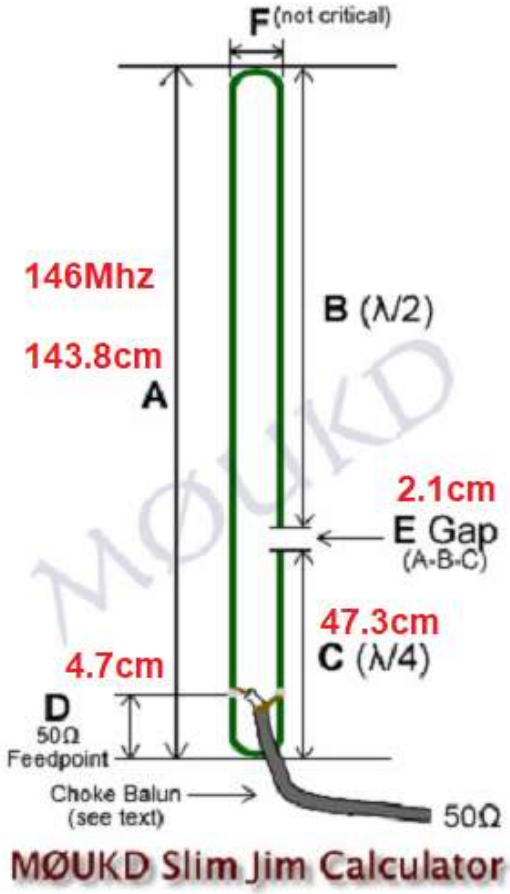
- The short at the bottom reflects as an open at the top
- Easy to visualize as we can see the short and the open
- What's hard to visualize is that at some point between the open and short there is a 50-ohm impedance point
- The J-Pole calculator does the math to find that 50-ohm impedance point
- In this case it is used to match the coax impedance to the open end of the ½ wave antenna
- This is just like using a balun to match 50-ohm cable to the end of a EFHW HF antenna





Maybe a future Workshop

I've been told that the top section can be a 5/8s wave for a little more gain



https://en.wikipedia.org/wiki/J-pole_antenna

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The Half Wave Stub - We only need this if we are going to use 75-ohm cable

Different Magical Properties

- Becomes a 1:1 impedance transformer
- Meaning it matches the input impedance to the output impedance
- So your 50-ohm radio sees the 50-ohm antenna

(Wavelength / 2) x Velocity Factor

- We will use the J-Pole calculator but we will use the Vg factor for RG-59 which is 66%
- Belden 8241 RG-59/U Velocity Factor 66%
- https://catalog.belden.com/techdata/EN/8241_techdata.pdf
- 67.8cm = 26.69291 inches x 9 = 240.23619 inches = 20.0196825 feet
- Use an Antenna Analyzer or Vector Network Analyzer to trim your 20+ foot cable

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Coax Balun

What is a Coax Balun and why do we want/need one

- When you transition from unbalanced to balanced transmission line, current can run down the outer skin of the coax and radiate distorting the radiation pattern of your antenna
- Think of a nice beam pattern with great front to back ratio distorted by a vertical run of coax
- It can also put unwanted RF in your shack causing RF burns
- At 146MHz, 3-4 turns for coax should fix this
- It also lets you secure the coax to the base of the antenna so no stress is on the soldered connection.

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To facilitate building the antennas I have construction tips

On the demo antenna:

- **See how to make the top and bottom shorts adjustable.**
- **This lets you tune the 50-ohm point by moving the bottom short**
- **Moving the top short adjust the antenna length**

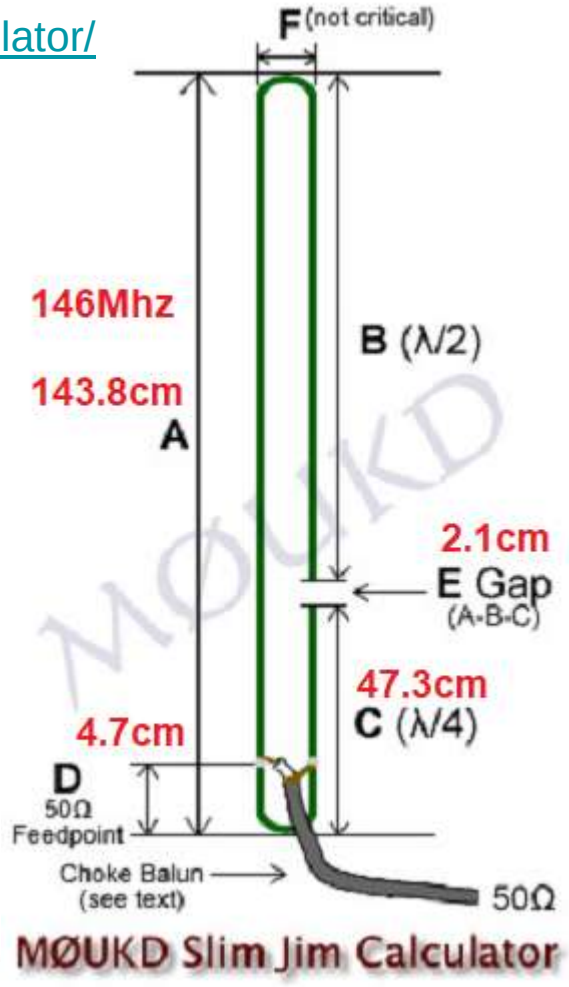
On the 2x4 note the dimensions show where to mark your Window Line:

- Top and bottom shorts **(Try to center them on a solid section of the Window Line)**
- 50-ohm impedance point **(Try to center this on an open section of the Window Line)**
- Gap **(Try to center this on a solid section of the Window Line OR on a small window)**
- **Leave room at the top and bottom to hang the antenna and mount the 3-turn coax balun**

https://m0ukd.com/calculators/slim-jim-and-j-pole-calculator/

Slim Jim and J Pole calculator

Slim Jim / J Pole antenna calculator.		
Frequency	146.0 MHz	
Velocity Factor (see text*)	0.92 vf	
Calculate my Slim Jim / J Pole!		
Actual wavelength	2.05 metres	
Wavelength considering velocity factor	1.89 metres	
A. Overall length (λ*0.75)*vf (plus gap for Slim Jim)	141.8 cm (J Pole)	
	143.8 cm (Slim Jim)	= 56.61 ins
B. Half wave radiator section (λ/2)*vf	94.5 cm	
C. Quarter wave matching section (λ/4)*vf	47.3 cm	= 18.62 ins
D. 50Ω feed point. Adjust for 1:1 SWR. (λ/40)*vf	4.7 cm	= 1.85 ins
E. Gap (λ/100)	2.1 cm	= .83 ins
F. Spacing – not critical	4.5 cm	
Clear Form		



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All About Circuits - College level info on ¼ and ½ wave transmission lines

- Impedance Transformation - Chapter 14 - Transmission lines
- https://www.allaboutcircuits.com/textbook/alternating-current/chpt-14/impedance-transformation/
- https://www.allaboutcircuits.com/textbook/alternating-current/chpt-14/standing-waves-and-resonance/

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What I'll hope you took away from this Workshop

When you see a J-Pole antenna you will see and know the parts that make it work

- ½ wave radiating element
- ¼ matching network
- The 50-ohm impedance point
- Balun

Transmission lines can do more than get your signal from your radio to your antenna

- Matching networks
- Filters

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How to make your next J-Pole antenna better?

How about making the top section ⅝ wave for more gain?

How about making it out of copper pipe? (also known as a Copper Cactus)

How to add 3dB of, low cost, bi-directional amplification using passive components?

- That’s 3dB gain on transmit and 3dB gain on receive
- Your 5 watt HT would have 10 watts of punch
- Your 50 watt radio would have 100 watts of punch
- How many of y’all would like to build a J-Pole out of copper pipe?
- How many would like to build a *collinear* J-Pole with 3dB more gain?