Attic Antenna

Alternatives Considered and Results

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Attic Antenna

What Do I Want?

- HF Multiband Capability
- 1.5 KW PEP Capability
- 100% Inside Attic
- Optimized for Voice on HF Bands
- Radiation Max in E-W directions

Attic Antenna

Limitations of Attic Design

- Running Feedline to Basement Shack
- Risk of “Foot through Ceiling”
- Size of Attic—impacts length of antenna
- Height above ground of Attic—impacts impedance and radiation pattern
- RFI - Can’t upset neighbors or XYL
  - Minimize Common Mode Currents (CMC) on the outside of the coax shield
  - Radiation effect on appliances, fire alarms, GFI’s, etc
  - Staying within max radiation exposure guidelines

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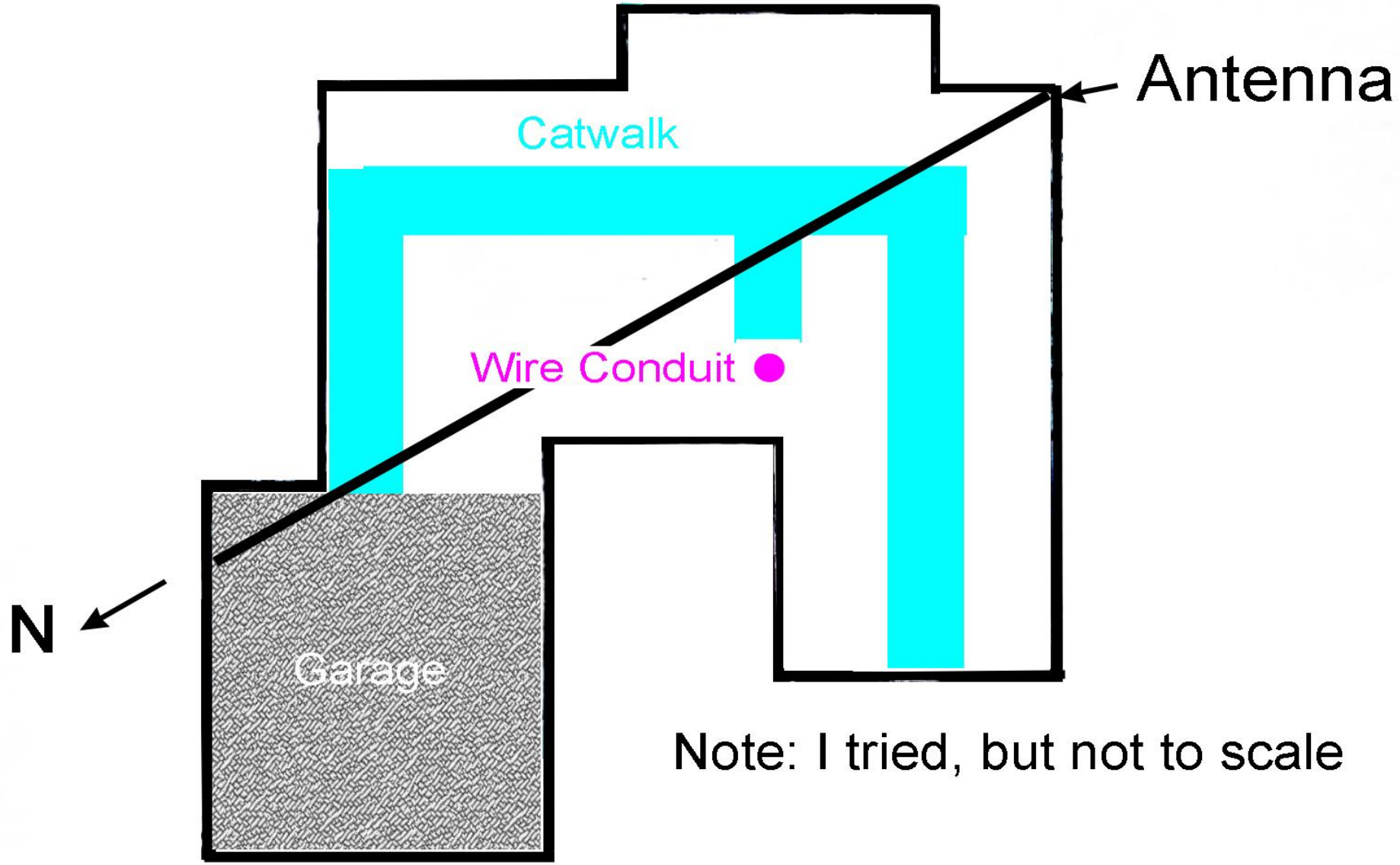
Preparation Work

- Catwalk to prevent fall through and/or disturbing insulation
- PVC pipe (2”)”feedline conduit” through 1st floor wall to basement shack
- Lighting of attic and routing Romex out of the way
- EZNEC Analysis of alternatives (EZNEC is a computer model-based simulation tool for antenna design).
  - Fan Dipole
  - End Fed Half Wave (EFHW)
  - Off Center Fed Dipole – Center Loaded (OCFD-CL)

Attic Antenna



Note: I tried, but not to scale

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- Pictures of Catwalk (right)
- Picture of feedline conduit to the basement with insulation removed (below)

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Effect of Lowering a 67.5 foot OCF Dipole

	40 meters				10 meters			
Height	F_{res}	Z	El_{pk}	El_{-3db}	F_{res}	Z	El_{pk}	El_{-3db}
50 ft	7.04	375	68*	38*	28.19	135	31*	25*
25 ft	6.82	225	89*	56*	28.18	136	25*	15*
15 ft	6.84	144	89*	57*	28.16	152	35*	22*

- Resonant frequency tends to lower as antenna is lowered
- Antenna feed impedance is lowered significantly for fundamental
- At fundamental, **radiation patterns tend to shift skyward**
- End Effect causes 10m (4^{th} harmonic) to be above 4x – more so at low heights

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Decision Considerations

- Dimensions of Attic preclude 80 meters without loading which limits bandwidth (25 - 30 khz) & reduces radiation efficiency
- 60 meters & 30 meters have limited power & bandwidth-no pursuit
- Definitely interested in 17 and 12 meters, possibly 6 meters
- **Will look at End Fed Half Wave (EFHW), Off Center Fed Dipole-Center Loaded (OCFD-CL), & Fan Dipole to cover 40, 20, 15, & 10 m bands**
- Because of low height, none of these antennas will be great for dx; each will be more of a NVIS (Near vertical incidence skywave) antenna, but I'm on the air. (Recent experience)

Attic Antenna
EFHW

Pros

- Fed from end is advantage in many applications but not here
- Multiband capability for 40, 20, 15 and 10 meters
- Single wire antenna for multiple bands
- Tuning flexibility with center loading and loading inductors

Cons

- Some reduction in efficiency vs other two alts
- Requires impedance matching UN-UN and counterpoise
- More prone to core saturation at high power and therefore RFI
- More prone to CMC’s than other 2 alternatives (Choke bigger)
- End Effect Requires special tuning considerations for higher bands

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Fan Dipole

Pros

- In attic, lots of wood rafters to locate wires (outdoors this is a con)
- Center fed helps to minimize CMC's, but some choke still required

Cons

- 15 meters presents tuning challenge—requires loading inductors
- Uses lots of wire which must be kept apart within roof constraints
- For me, feedline must run parallel to antenna wires –CMC's/detuning
- Interaction between wires makes tuning challenging

Attic Antenna
OCFD-CL

Pros

- Feedline at 16.3% provides 40, 20, 15, 10 meters
- Single wire antenna for multiple bands
- Tuning flexibility with center loading and loading inductors

Cons

- Reduction in efficiency vs fan dipole
- Requires impedance matching UN-UN & large choke vs. Fan dipole
- Some core saturation issues, but not as much as EFHW
- Smaller choke required vs. EFHW
- End Effect impact requires special tuning considerations for higher bands

Attic Antenna

Choice

- Although any of these will work, I chose the OCFD-CL
  - By happenstance, feedline location was nearest my basement conduit allowing perpendicular departure from antenna wire
  - Article by DJ0IP convinced me I'd enjoy the tuning challenge.
  - In the future, I expect to design a 17m, 12m, and possibly 6m fan dipole to complete desired band "portfolio".
- Construction issues
  - Environmental- attic hot in summer but free from precipitation
  - Finding "straight line" for 66 feet of wire difficult
  - Matching network and Center load mounting can fit anywhere
  - Catwalk can't go everywhere so still some care required

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Single wire multiband antenna dilemma: End Effect

- When using a single wire for multiband, harmonically related bands do not resonate at perfect multiples of the fundamental band. They resonate at higher frequencies due to “end effect”.
- The ends of the wire act as capacitors resulting in shorter wires for a longer electrical length.
- This impacts the fundamental frequency (with one current node) more than harmonically related frequency with more current nodes
- End Effect is approximated as 3% of wavelength, but this varies depending on height and other factors such as ground conductivity.

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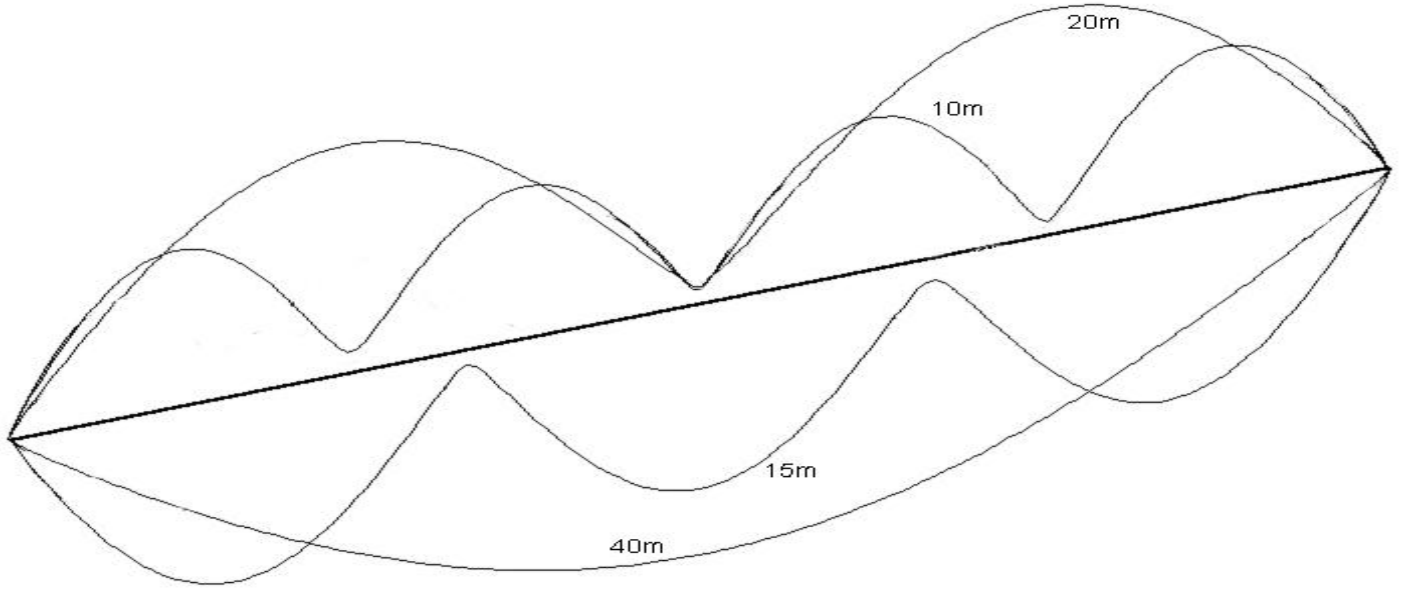
Single wire multiband antenna dilemma: End Effect

- Below, current nodes are shown resonant on a wire antenna for 10-40m
- For dipole, 468/f is cut length; however, true electrical length is 492/f
- 5% difference is due to wire velocity factor (2%), and end effect (3%).

$\lambda/2=c/f$ L = 468/f(Mhz)
L = 492/f(Mhz)

λ - wavelength
c - speed of light (free space)
f - frequency
L - half wave dipole length



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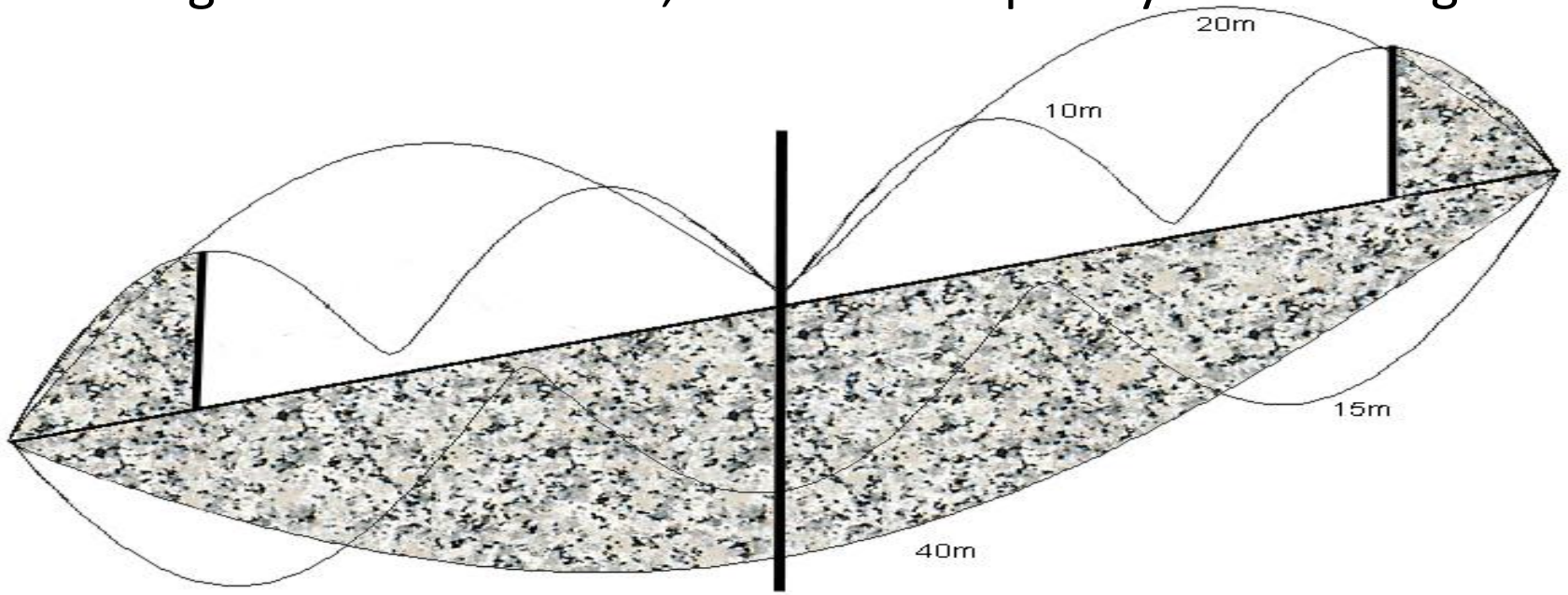
Single wire multiband antenna dilemma: End Effect

Example: 10m has 4 current nodes with 8 minima but only 2 ends; 40m has 1 current node with 2 minima & 2 ends. For 40m, wire is cut with 3% reduction of the entire half wavelength

At 10m, end effect “shortening” is less as it applies to outside quarter wave nodes only; therefore, wavelength at 10m must be shorter to fit on wire cut for 40m. If wavelength must be shorter, resonant frequency must be higher than 4x



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Standing Wave Ratio (SWR)

- An objective in designing antennas is to minimize SWR. SWR is a metric of how well an antenna, feedline & the radio are matched (typically 50 ohms).
- When the antenna system is perfectly matched, the maximum amount of energy is transferred from transmitter to antenna, and conversely, from antenna to receiver when listening.
- If the antenna system has SWR > 1:1, you can use a tuner to match the antenna/feedline to your radio…this protects the radio.
- However, you still have losses in the tuner, the feedline & the antenna… energy loss that creates heat rather than radio waves.
- The best antennas are resonant & have low swr, & do not need tuners. However, using a tuner-based antenna system is better than no antenna!!!
- The next slide will discuss how to tune the OCFD-CL antenna to minimize the need for a tuner.

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OCFD, CQ May 2021 by BOB GLORIOSO (W1IS) AND BOB ROSE (KC1DSQ)

- Tuning levers for OCFD-CL
  - Length of wire
  - Feedpoint location –impacts swr tradeoff between 20 and 15 meters
  - Center loading **value** impacts base band tuning and, by shifting center load **location**, SWR minimum frequency on 20 m (small effect)
- Tuning Approach
  - Setup antenna length based on 20 meters, 15 meters and 10 meters
  - Modify feedpoint to optimize swr tradeoff between 20 and 15 meters
  - Establish centerload capacitance to move swr response of 40 meters
  - Tweek center load % to fine tune band locations (requires EZNEC)

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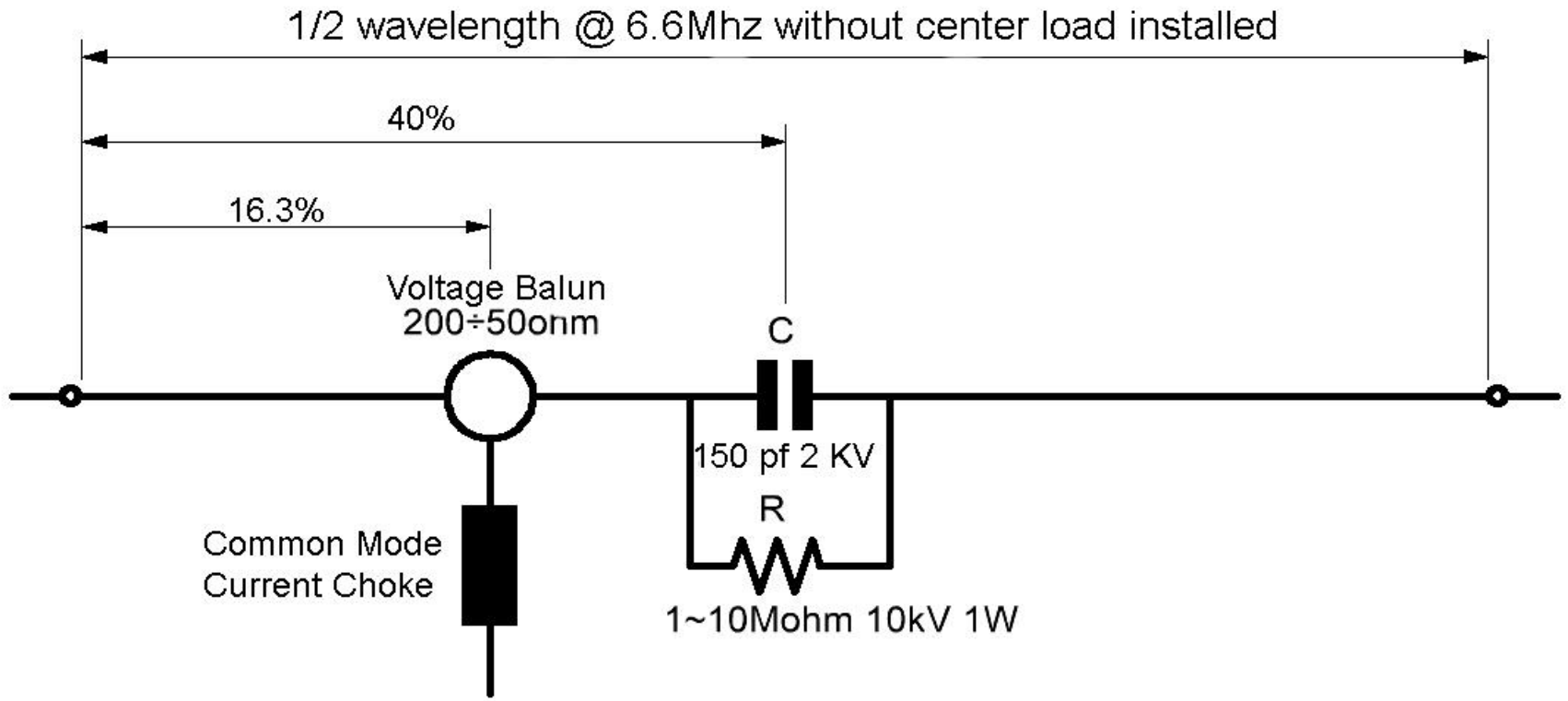
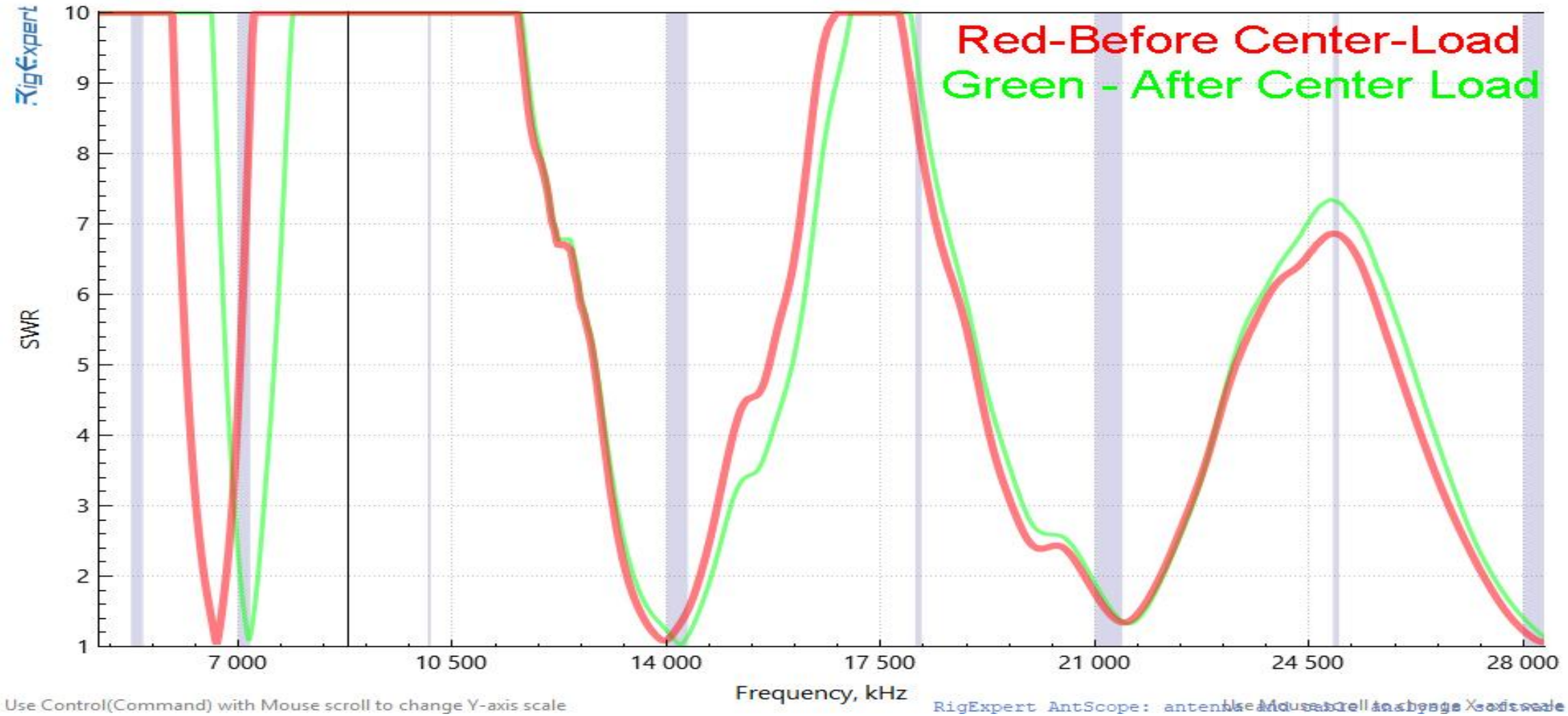
Off Center Fed – Center Loaded Dipole

Below are the results of my design—application specific:

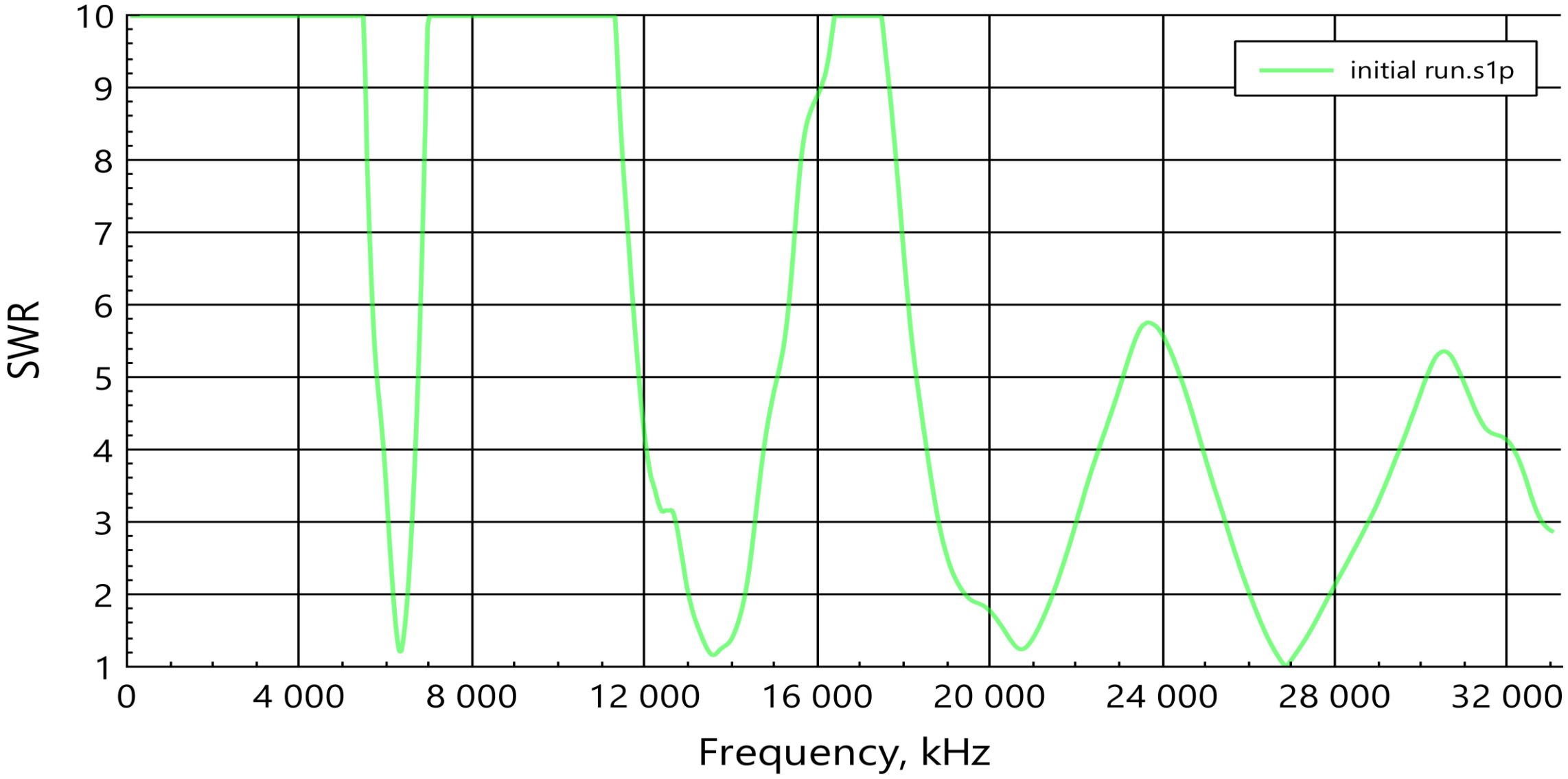


Attic Antenna

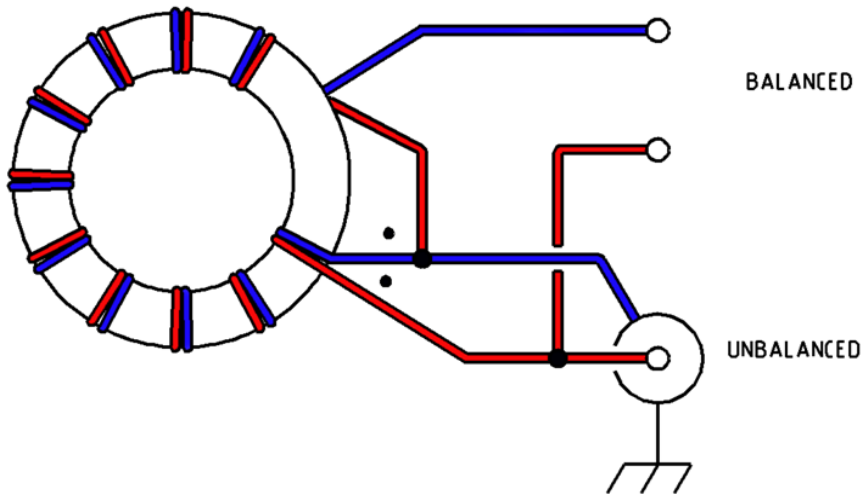
Results

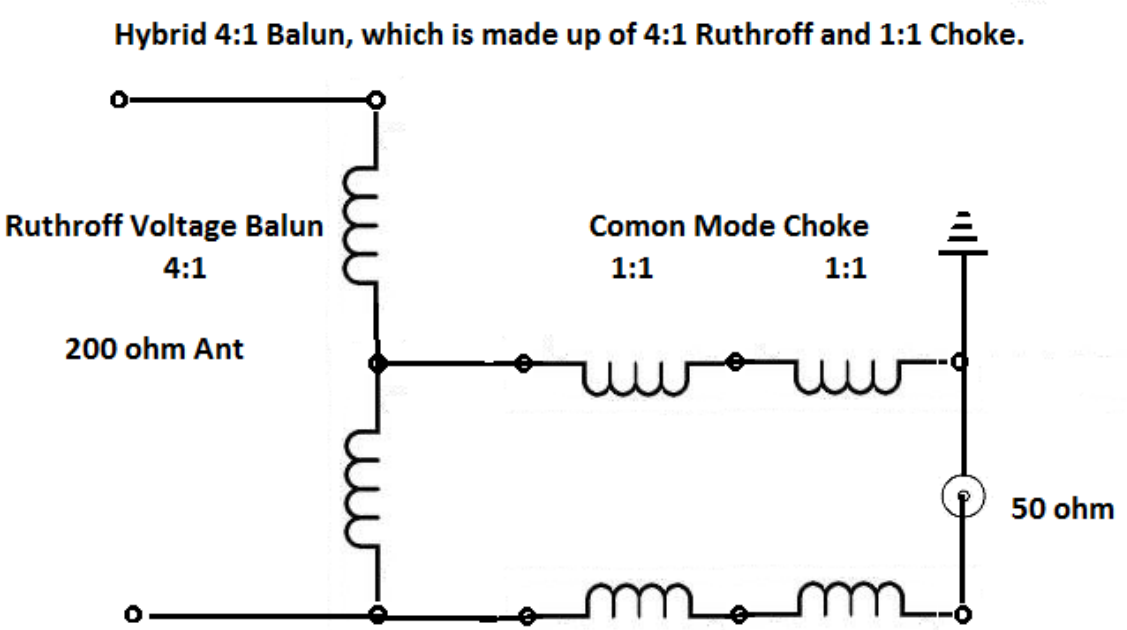


Initial Attempt B4 Center load



Appendix





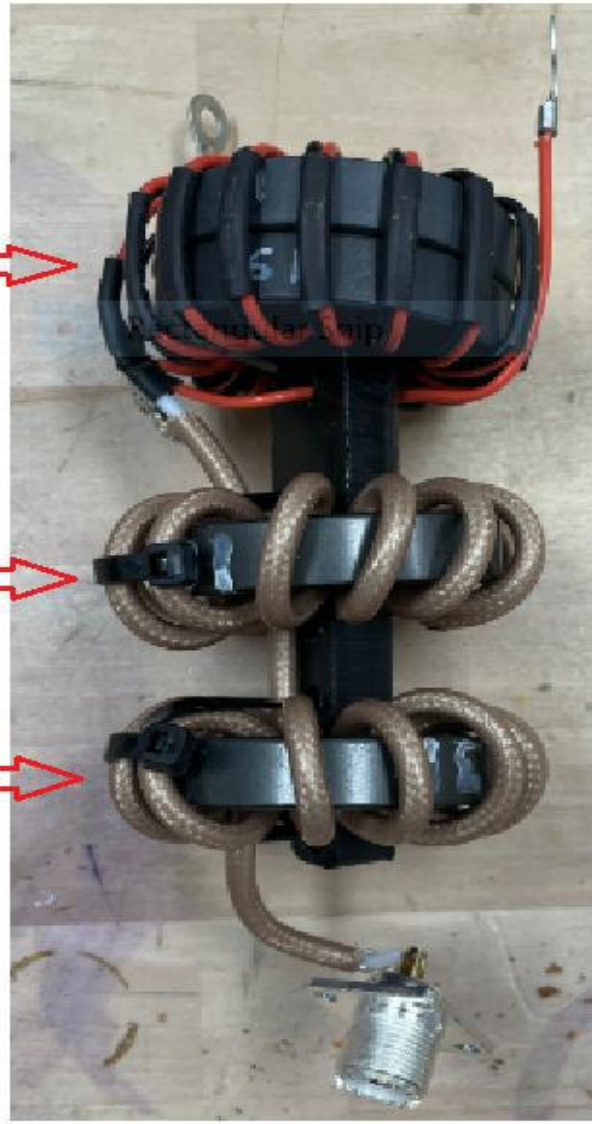
From: Mother of all Baluns - Everett Sharp N4CY
everettsharp@aol.com 10/17/2021

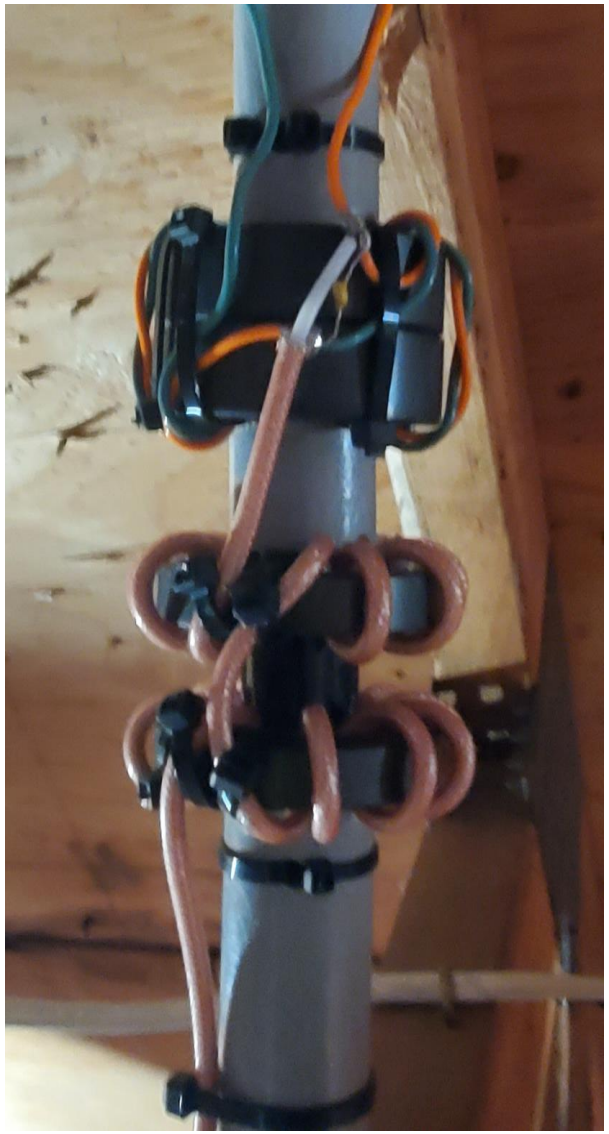
4:1 Hybrid Balun (Mother of All Baluns)

2 Stacked FT240-61 Toroids with 14 Bifilar turns of #14 High Build Magnet wire with a Teflon Sleeve.

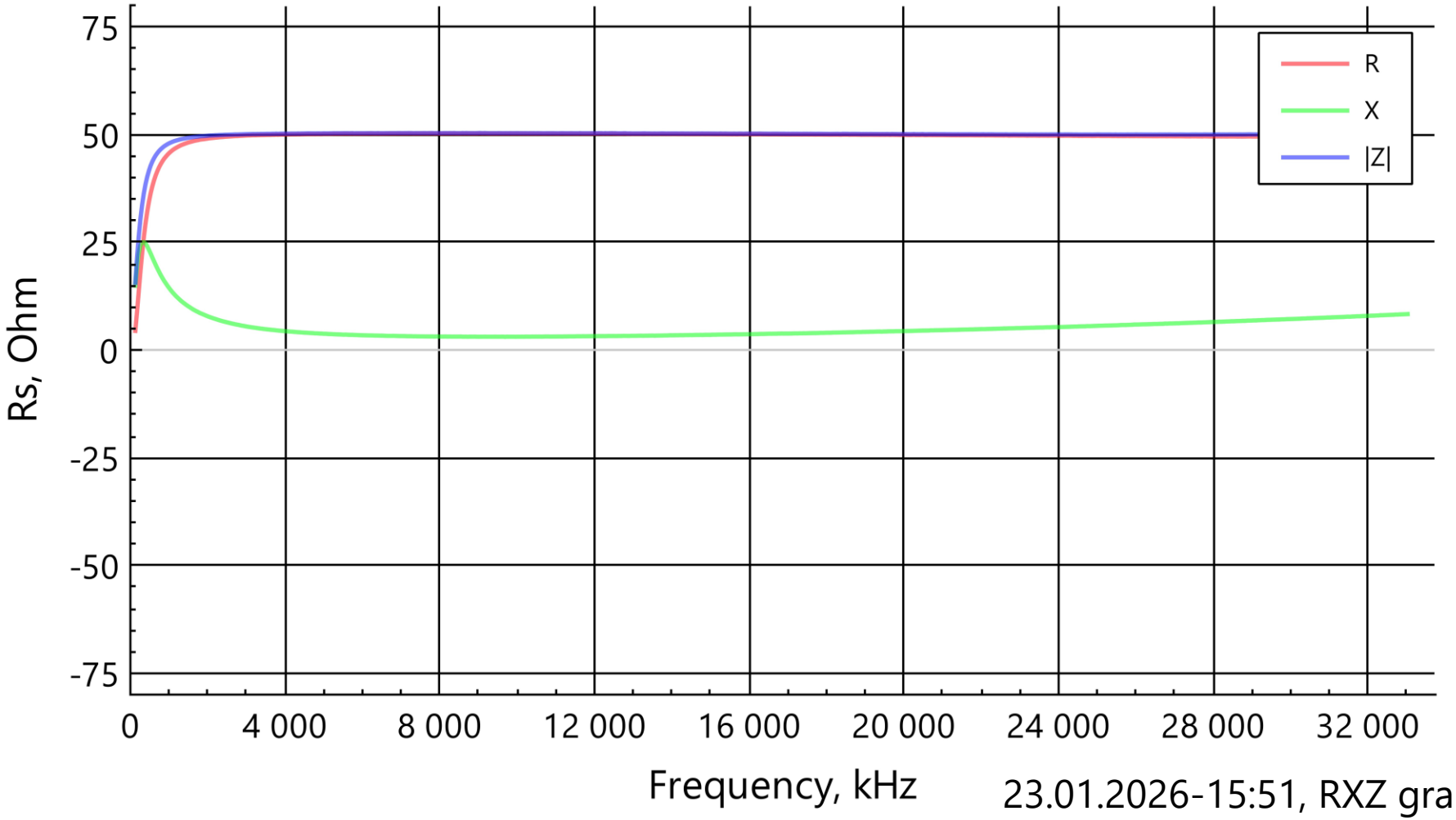
FT240-31 Toroid with 14 turns of RG400 coax

FT240-31 Toroid with 14 turns of RG400 coax





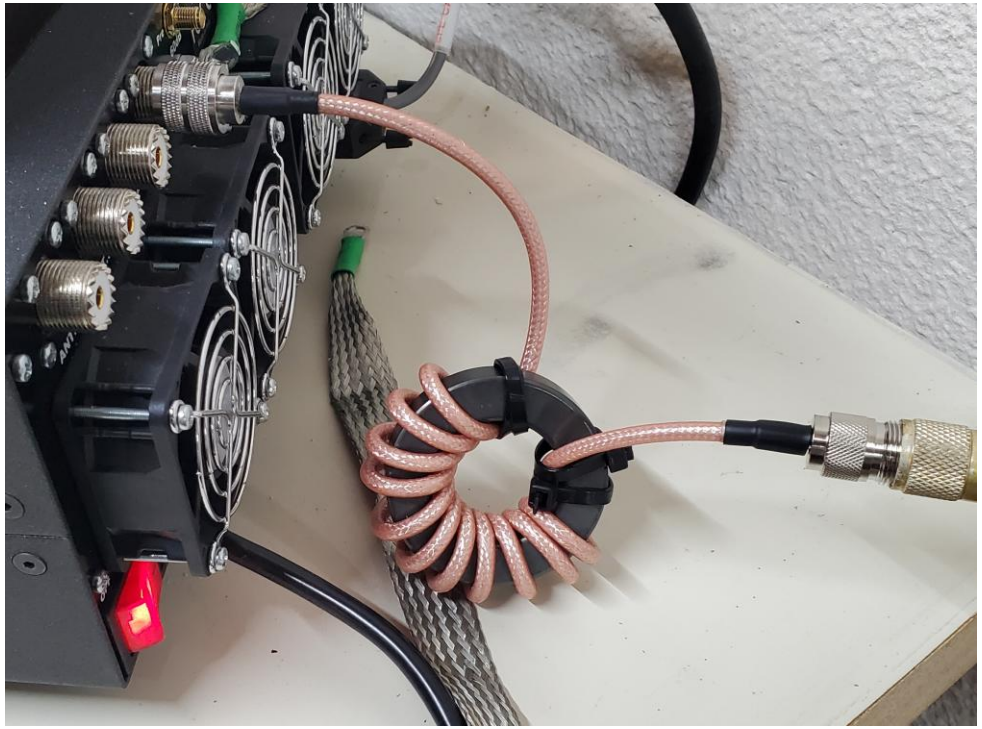
Balun output with 200 ohm resistor as antenna



23.01.2026-15:51, RXZ graph

Choke in shack

Placed at Linear to minimize CMC's at radio...specifically, reduce noise current pickup while routing through home (Runs near internet modem and switch, and LED lighting).



Center Load

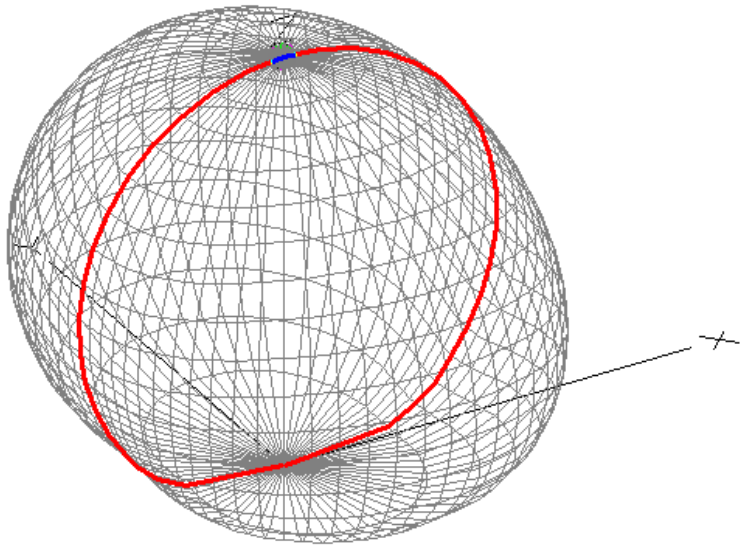
Two "doorknob capacitors" (Hi current, Hi voltage) & variable air capacitor shunted by a 2 megohm resistor to prevent static build up.

Suggested Readings for OCFD-CL

- **Multiband HF Center-Loaded Off-Center-Fed Dipoles** by Serge Stroobandt (ON4AA) - *https://hamwaves.com/cl-ocfd/en/index.html*
- **OCFD-CL -** 2 Part Youtube presentation by Richard (Rick) Westerman (DJ0IP) - *https://www.dj0ip.com/hhg2-ocfd*
- **A New Design of a 40-6-Meter Off-Center-Fed Dipole** *BY BOB GLORIOSO (W1IS) & BOB ROSE,(KC1DSQ)* **CQ May 2021 -** *https://batteryeliminatorstore.com/blogs/ocf-masters-articles/a-new-design-of-a-40-6-meter-off-center-fed-dipole*
- **Mother of All Baluns** by Everett Sharp (N4CY) **-** *https://www.dj0ip.com/super-ocfd-balun*

OCF-CL Radiation Patterns-40m

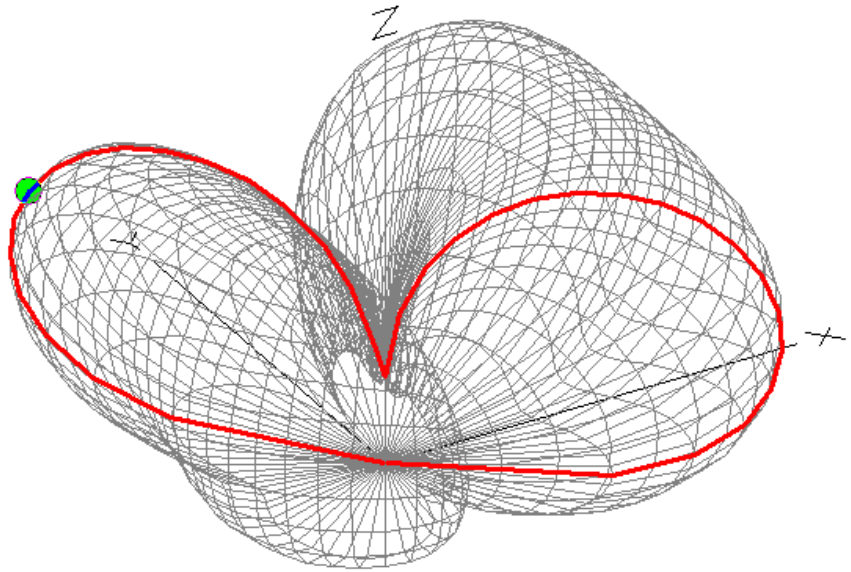
EZNEC Pro/2+



7.18 MHz

OCF-CL Radiation Patterns-20m

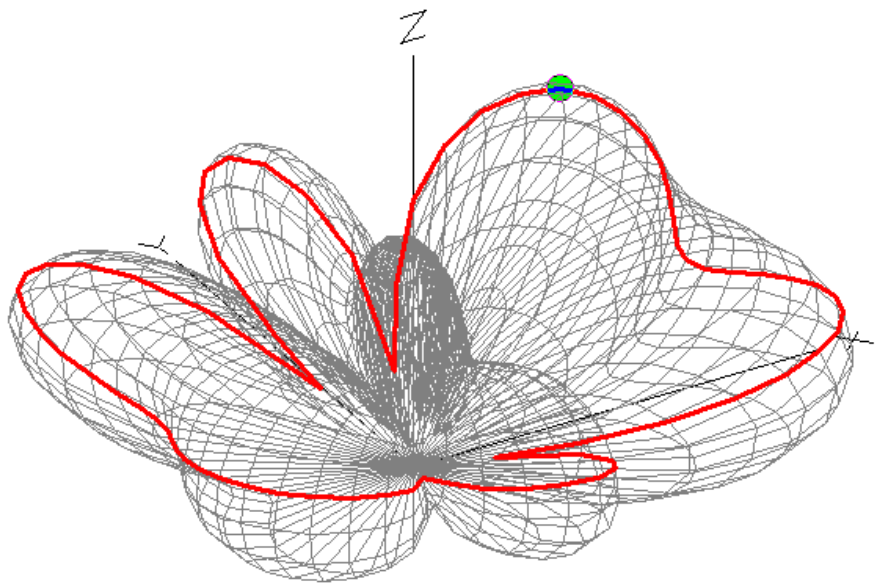
EZNEC Pro/2+



14.19 MHz

OCF-CL Radiation Patterns-15m

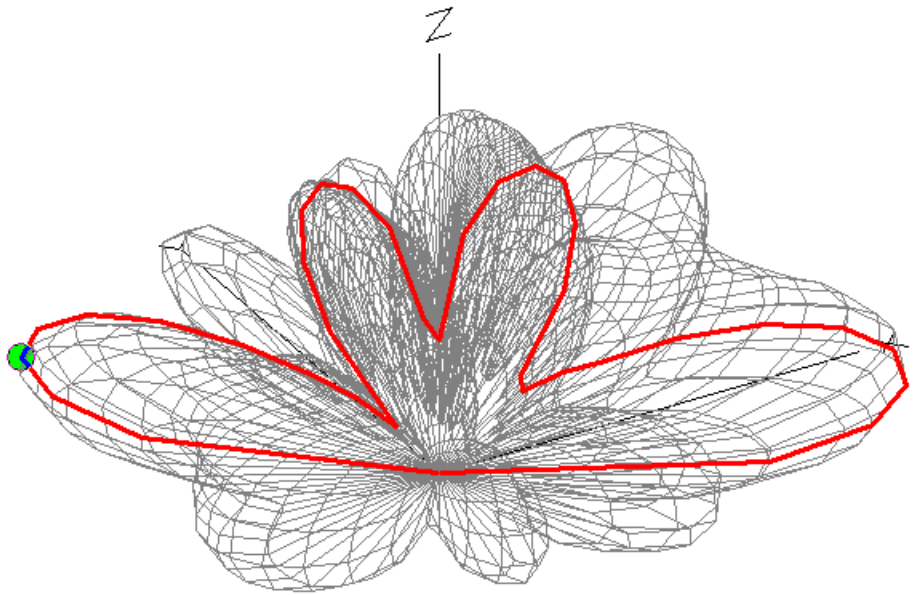
EZNEC Pro/2+



21.3 MHz

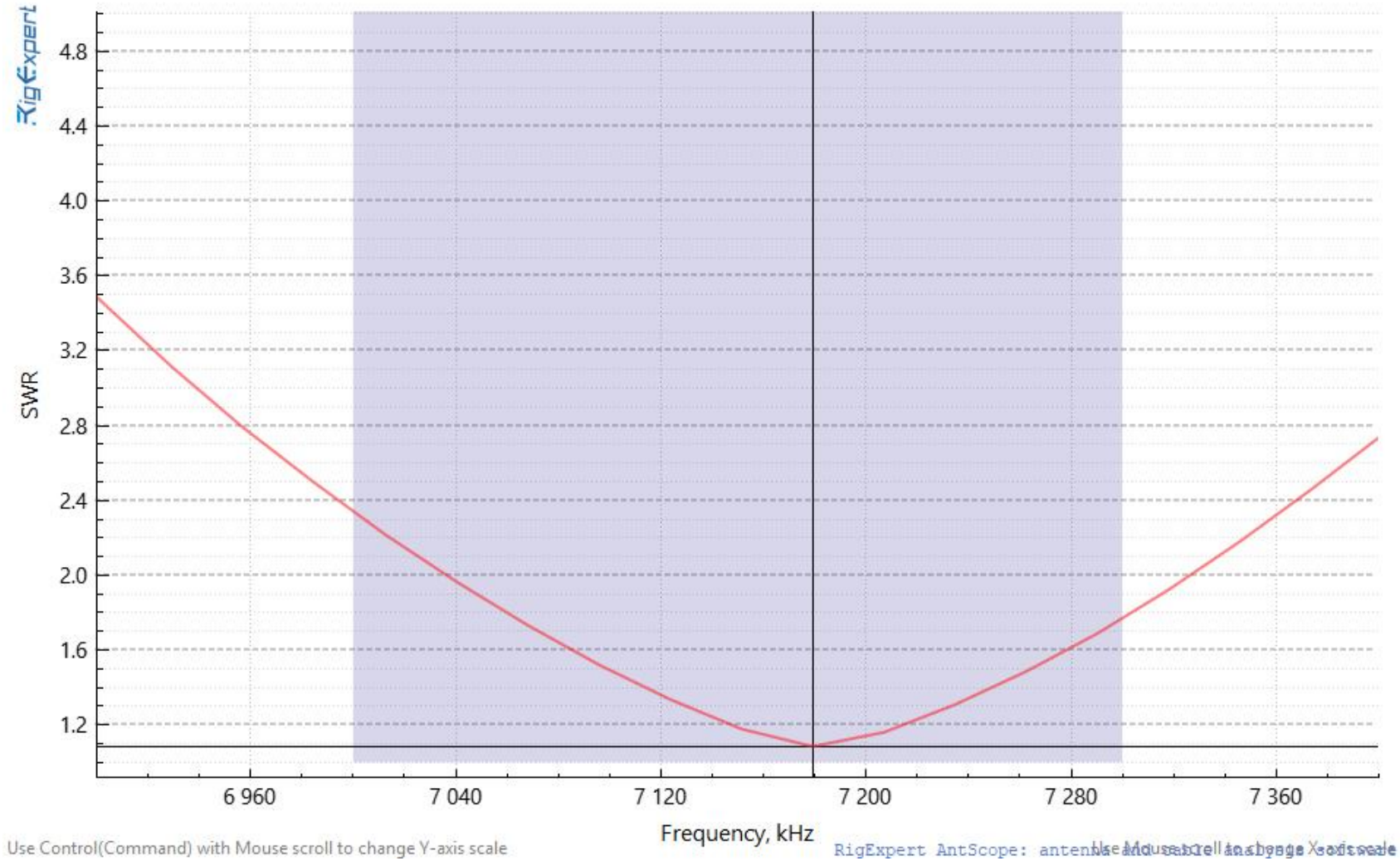
OCF-CL Radiation Patterns-10m

EZNEC Pro/2+

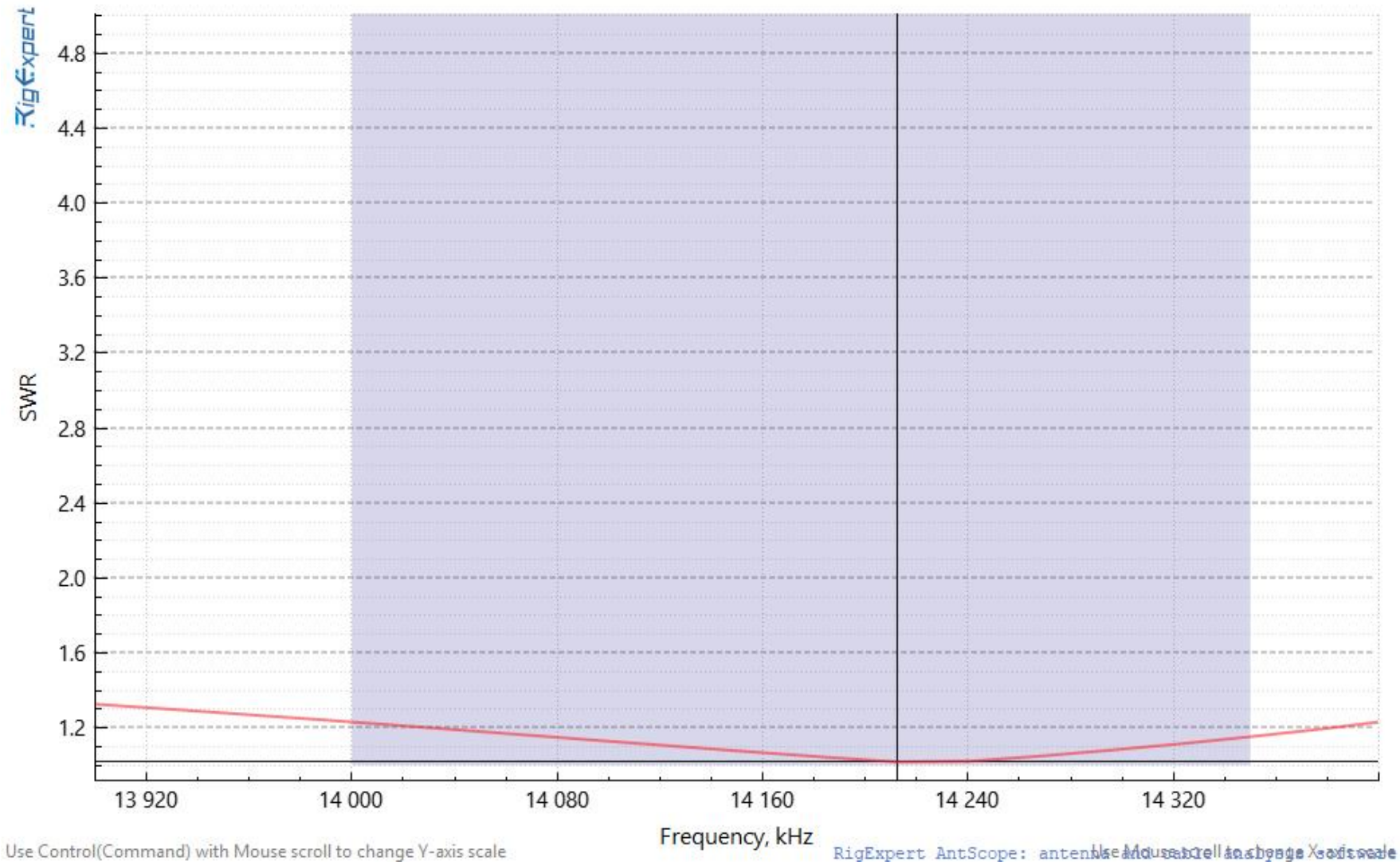


28.43 MHz

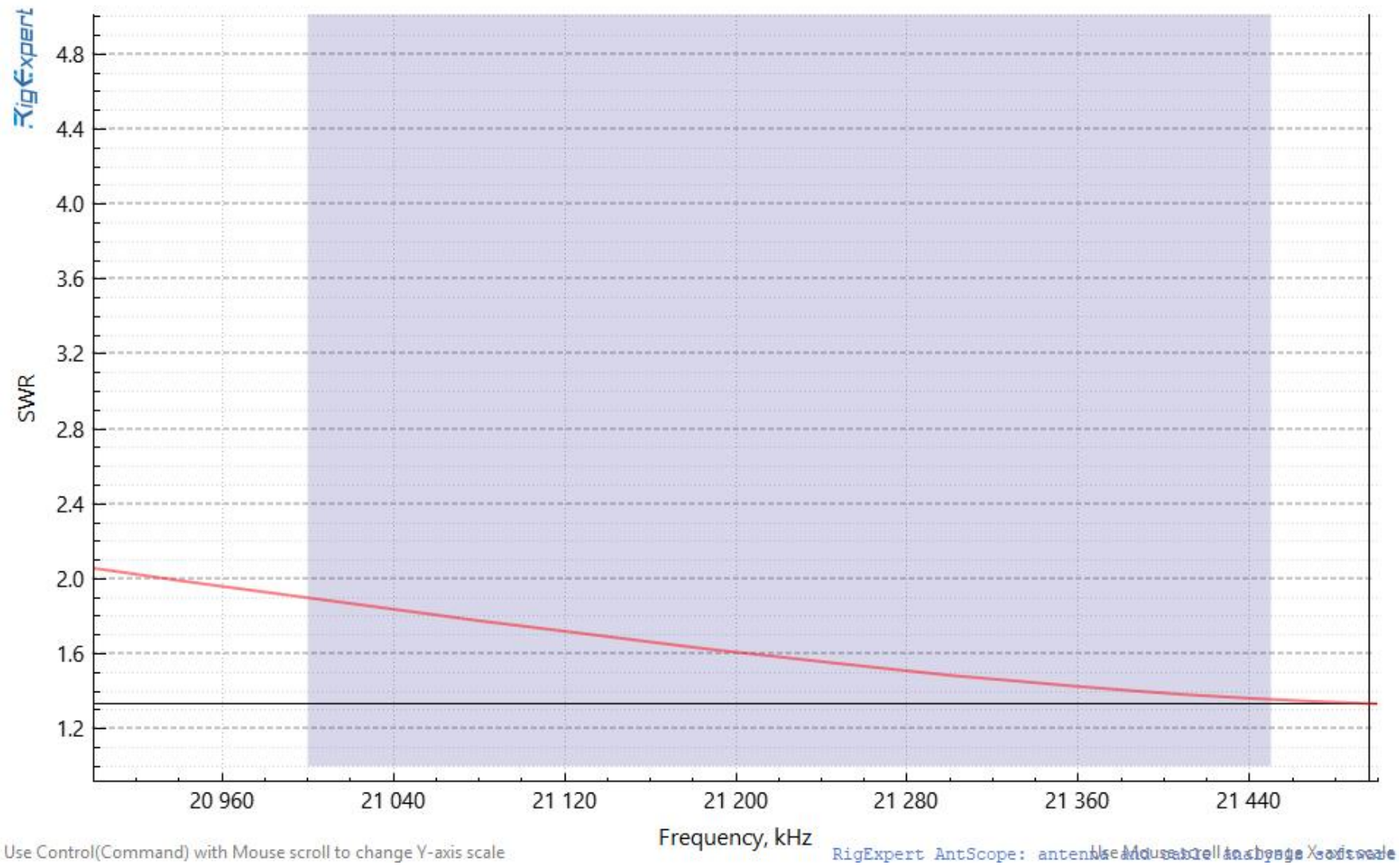
40 meter final



20 meter Final



15 meter Final



10 meter Final