

Antennas part II

Popular Wire antennas for HF



technet #12 11/4/24

Jim Thomas AI5EG
somewhere near Harwood, TX

* Antennas part I 12/6/23 Chris Faas W5CUY



Hams *LOVE* antennas

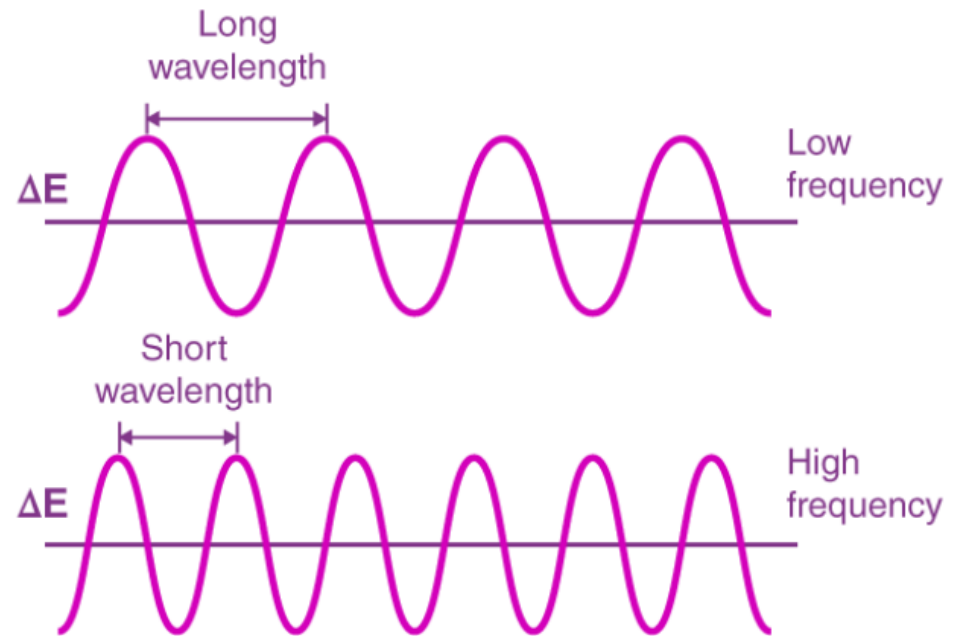
NOW is a great time to get on the air on HF bands

Popular Wire Antennas

- Dipole / Inverted V
- Multiband dipoles
- End Fed Halfwave
- Stealth/HOA restricted ideas
- Many others

Some Terms (jargon)

Frequency, Wavelength



Impedance = resistance + reactance

Velocity Factor:

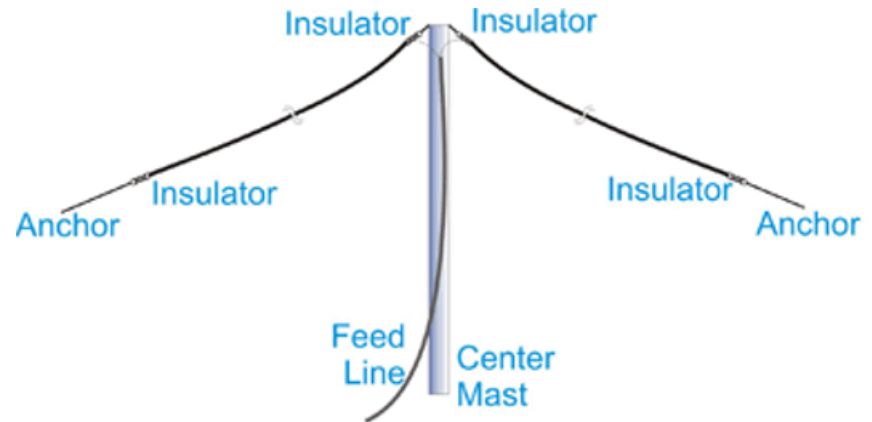
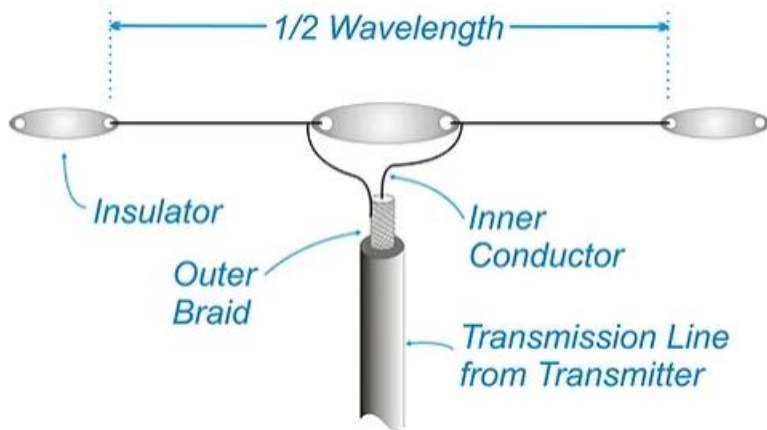
In 'free space' radio waves travel the speed of light but a bit slower along wire & coax makes the actual length shorter than wavelength in "free space"

About .95 for bare copper wire

Coax can vary ~ .7 to .85

Conversions https://www.onlineconversion.com/frequency_wavelength.htm

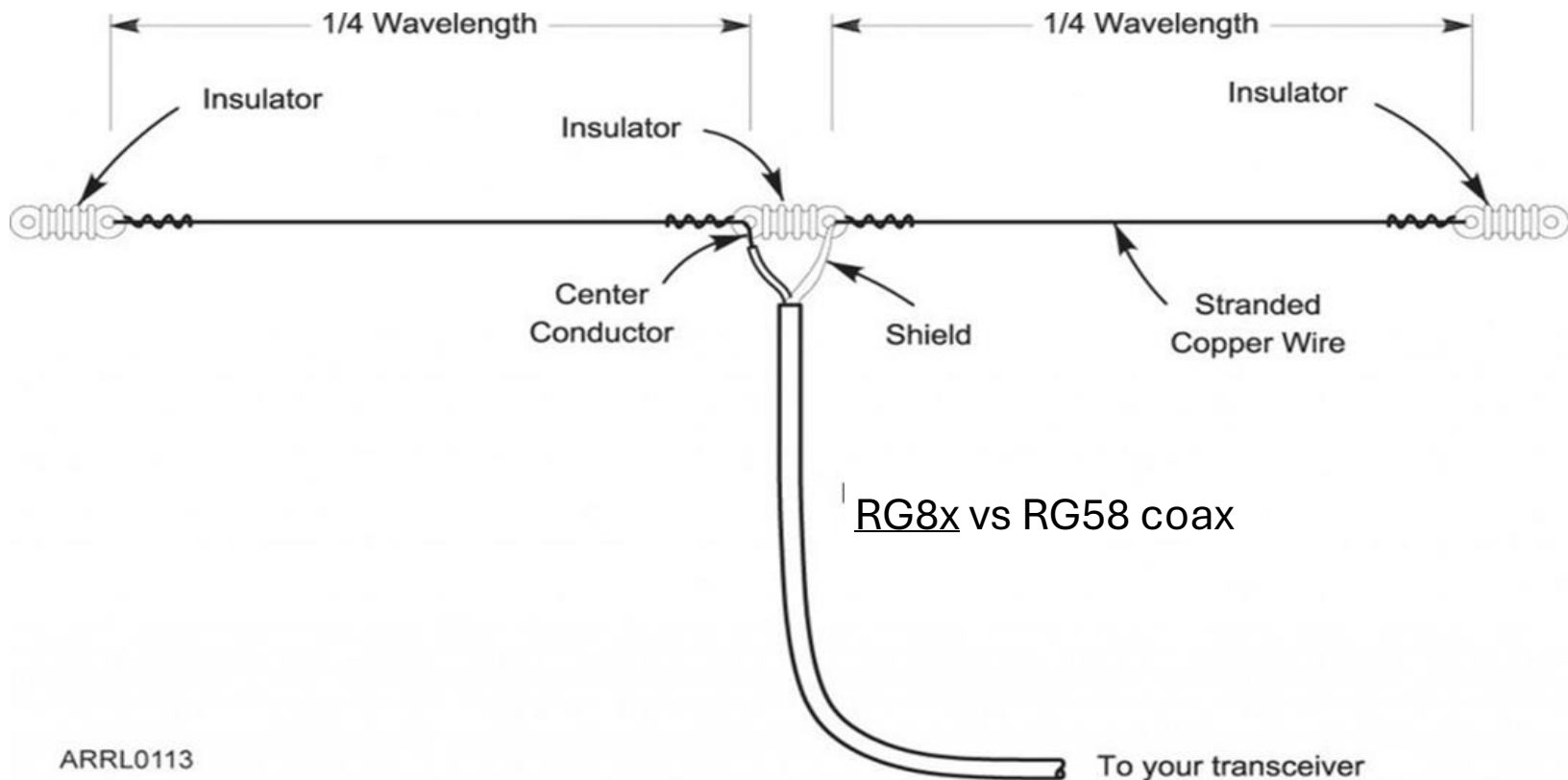
Half Wave Dipole vs Inverted V Antennas



- Simple –popular “My first antenna” for most hams
- Widely used, efficient, Easy to make and cheap
- Directional: broadside (perpendicular) to the wires
- Dipole vs Inverted V
 - Dipole slightly more gain broadside
 - Inverted V slightly less directional
better match for 50ohm feedline,
Single high support mast

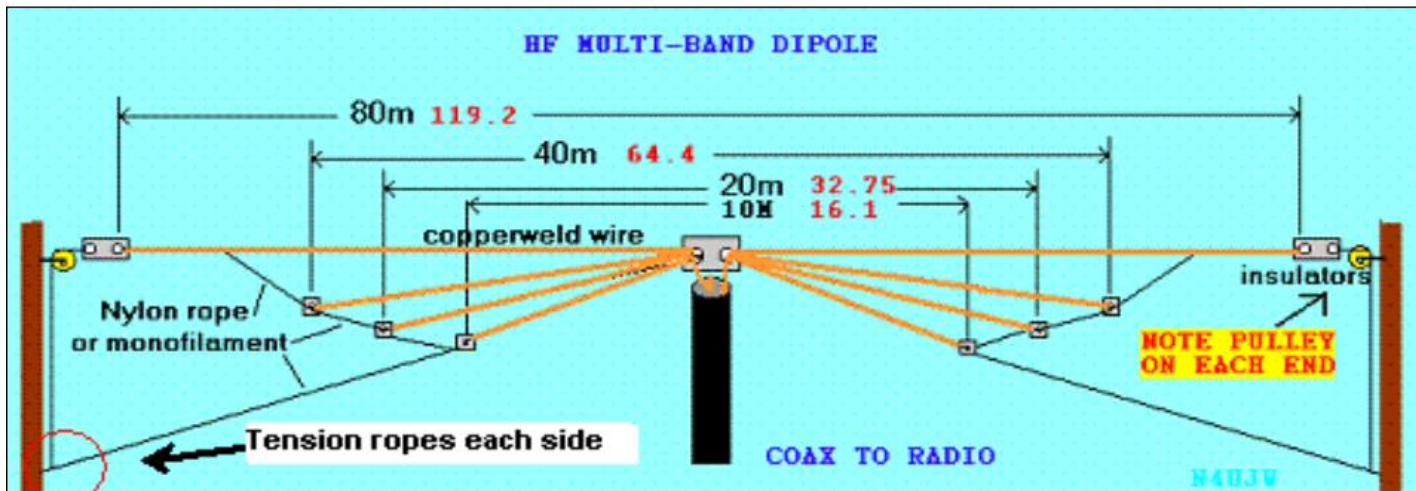
Half Wave Dipole / Inverted V construction

- Wire length formula (will get you close)
 - **Overall feet halfwave = $468 / \text{freq Mhz}$** , each side $234 / \text{freq Mhz}$
 - Example: for 40M phone band ... 7.2Mhz $\rightarrow 468 / 7.2 \text{ Mhz} = 65\text{ft}$
- Cut it few feet longer and fold the excess ends
- Check SWR, adjust lengths if needed

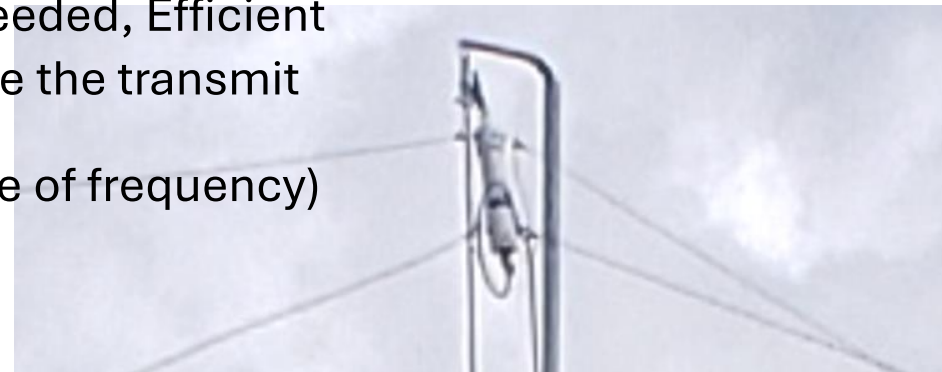


Multiband Wire Antennas

Fan dipole



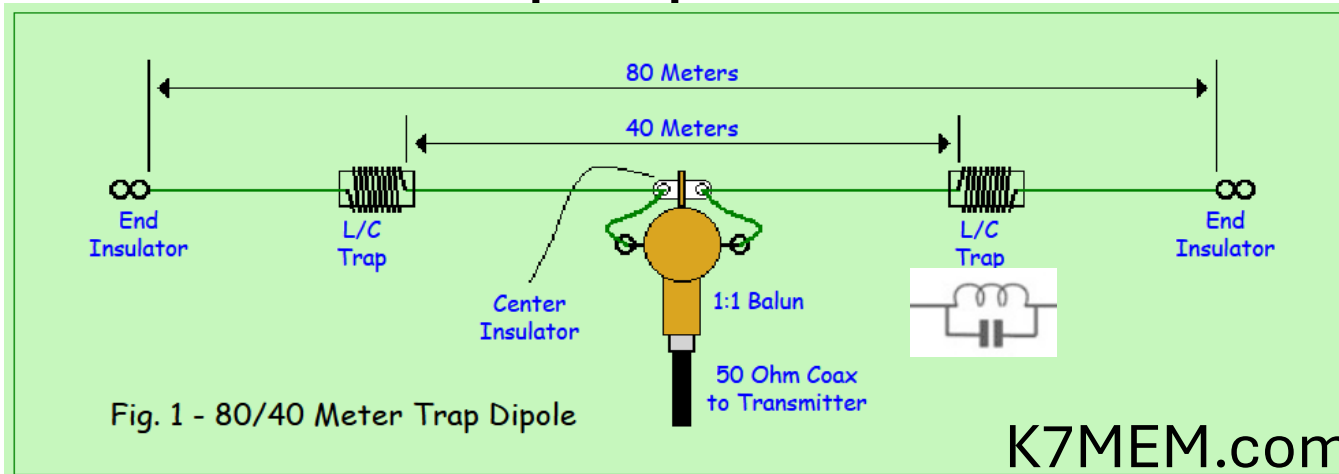
- Simply multiple dipoles hooked to the one feed line coax.
 - Many ways to spread wires outward... be creative!
- No tuner or No antenna band switch needed, Efficient
- The resonant antenna will naturally take the transmit power = Point of minimum impedance.
- 40m wire will work at 15m (odd multiple of frequency)
- Tip: Separate antennas at feed-point Reduces interactions, easier tuning



<https://www.hamuniverse.com/kl3jmsrifandipole.html>

<https://www.hamuniverse.com/multidipole.html>

Multi Band Trap Dipole



$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

- Trap is a parallel LC (inductor/capacitor) circuit. At the trap's *resonant frequency*, it blocks the RF on the wire from going further.. But **ONLY** at the resonant frequency.
- Good match on all bands, no tuner needed.
- Coils in the trap(s) will shorten the length needed to get resonance on the lower bands. In the example above 80M about 4-5 ft shorter.
- There is some loss associated with the traps on the lower bands
- 10m/12m and 15m/17m not possible due to closeness of the bands frequencies
- odd harmonic 15m working on 40m wire “trick” doesn't work

End Fed Halfwave

A “cult phenomena”.....

- Fed from the end rather than the middle
- requires a 49:1 transformer (unun) to match to 50 ohm coax

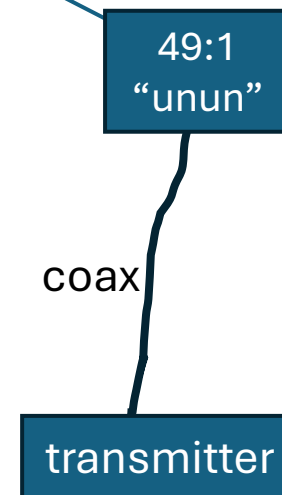


Brenda KJ5ADO

1/2 wave-length radiating wire



Built by my daughter, Avery WE5GAL



- Light weight, Portable:
- POTA, SOTA, ARES/RACES go kit
- Easy to deploy
- Stealth
- Backup antenna
- Easy to build, inexpensive to buy
- Should be in every ham's bag of tricks
- <2:1 SWR possible 40, 20, 15, 10
- But.....

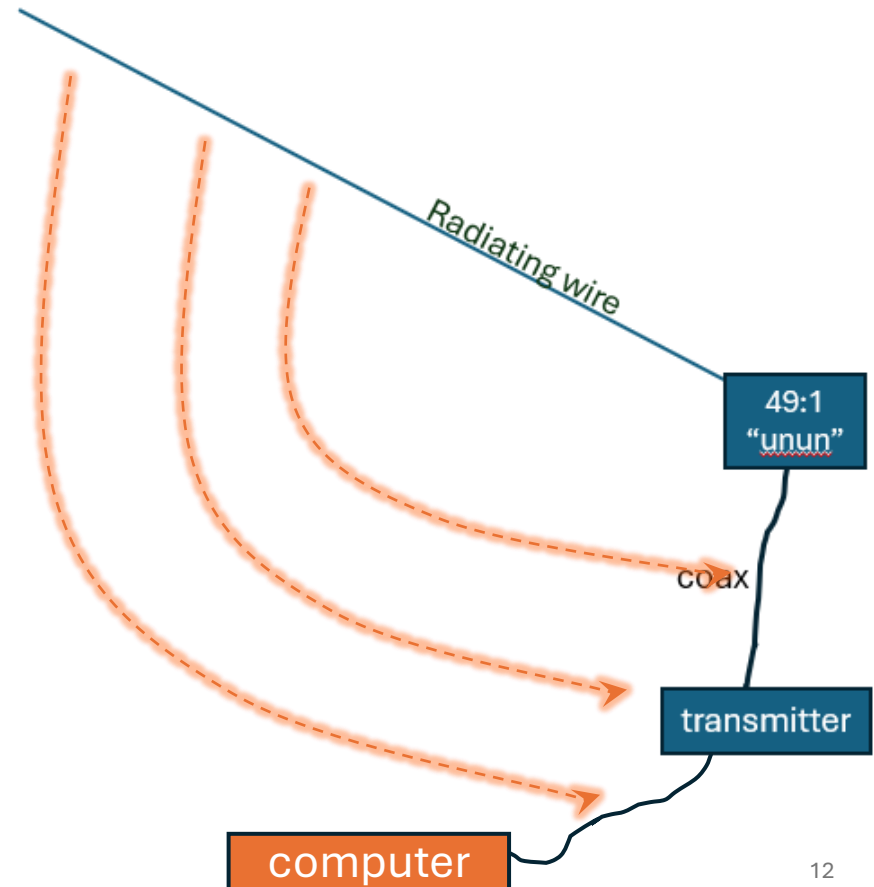
End-fed halfwave - myth

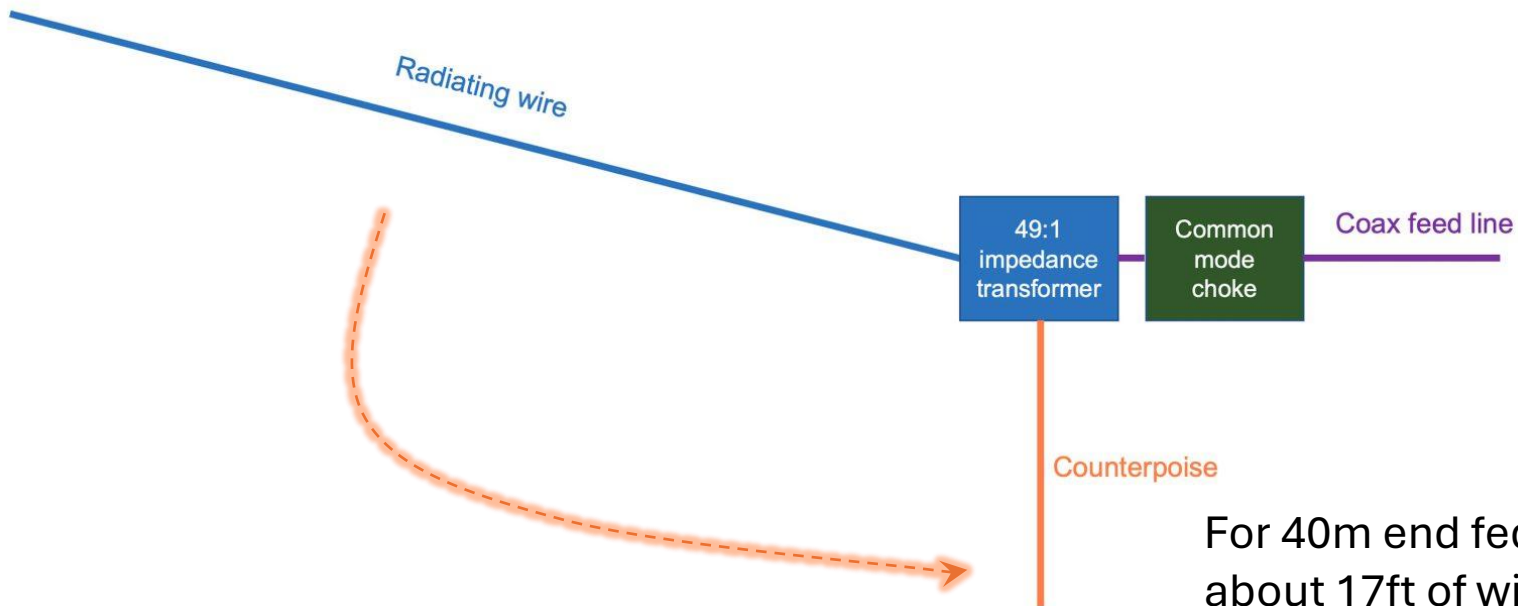
One “theory” is that a *counterpoise* is not required.

FACT: All antennas *require* a return path for radiated RF currents. If not provided, the RF will find a path.

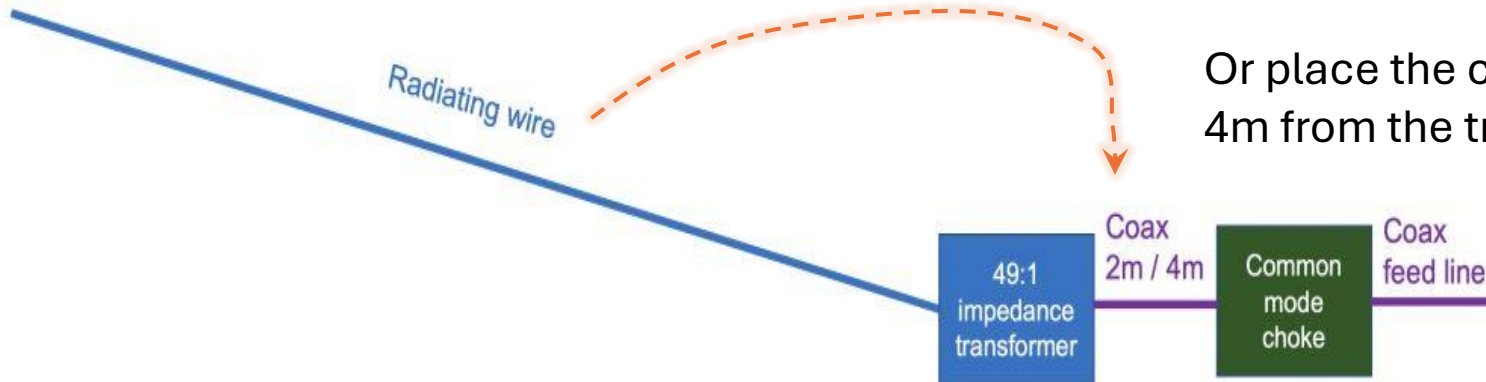
Without a counterpoise, the feedline, your radio & its cables will be the return path

- RF interference when transmitting and RF noise receiving
- Affects SWR, tuning and efficiency
- **low power, in the field or QRP this may not be a concern, the coax feedline will be fine.**
- **With high power, dangerous RF voltages & fields could be present in the shack**





For 40m end fed, connect about 17ft of wire to the ground terminal at the transformer coax connection

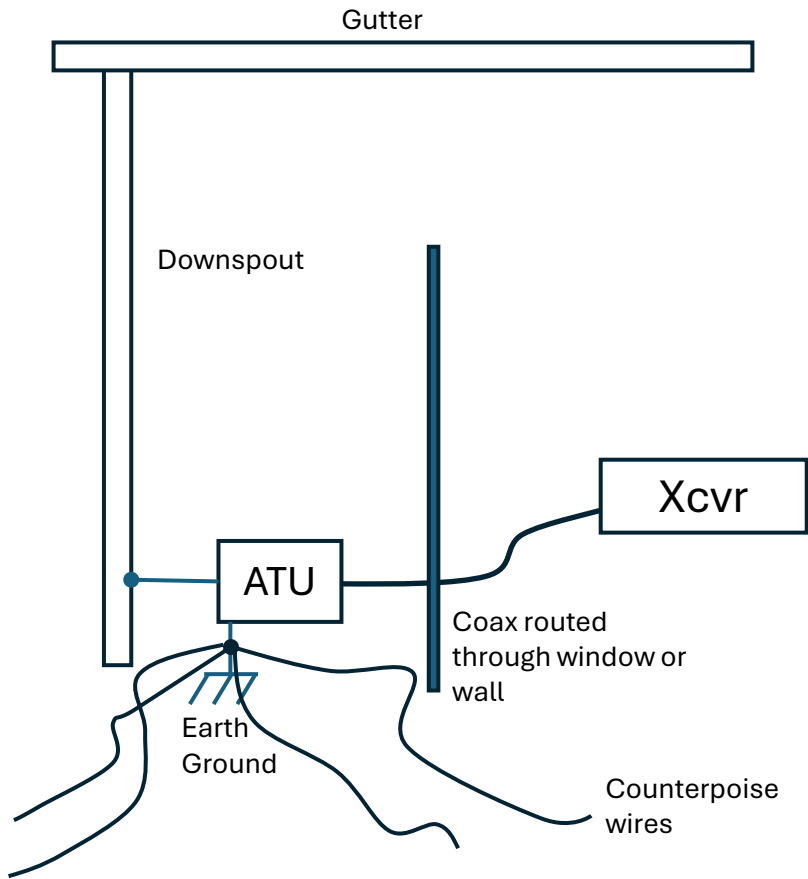


Or place the choke 2m or 4m from the transformer

Stealth / HOA restricted

“any antenna is better than no antenna”

Rain Gutter Antenna

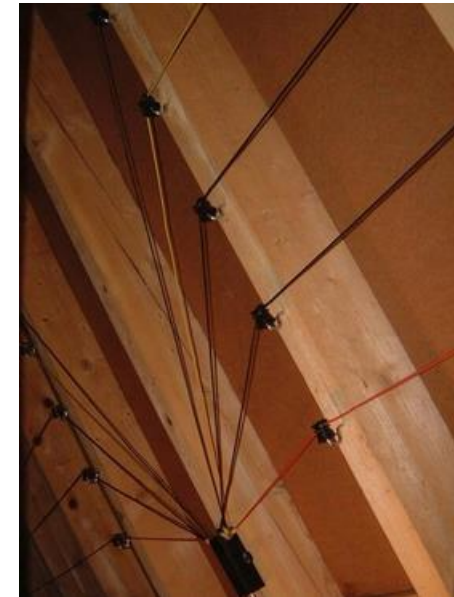
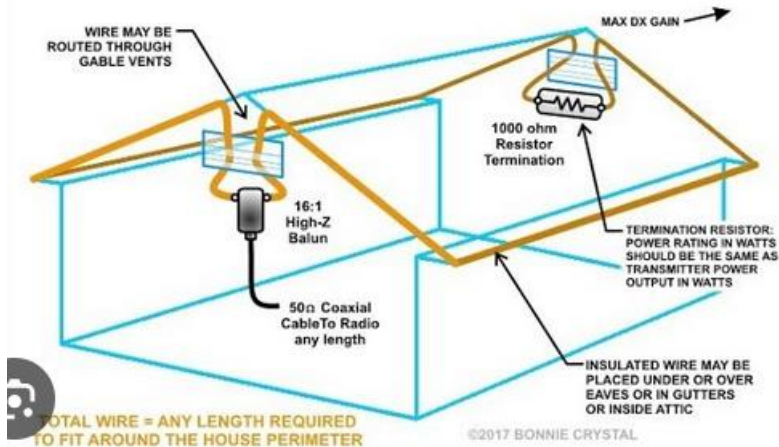


<https://fullduplextech.com/ham/gutter-antenna-hf/>

Stealth / HOA restricted – Dipole ideas



**Broadband Butterfly
Terminated Dipole Antenna (BBTD)**
House Roof Version
1.8 MHz to 54 MHz SWR <2:1



https://youtu.be/Y473hOmif-E?si=bLliTBF9mgZNx5K_\

Other Popular Wire Antennas

Discussion

More resources in the Appendix

Check out a great web source. Martin E Meserve, K7MEM in-depth information and has built in calculators for diy of many antenna designs

<https://k7mem.com/index.html>

Appendix

Everything affects Everything

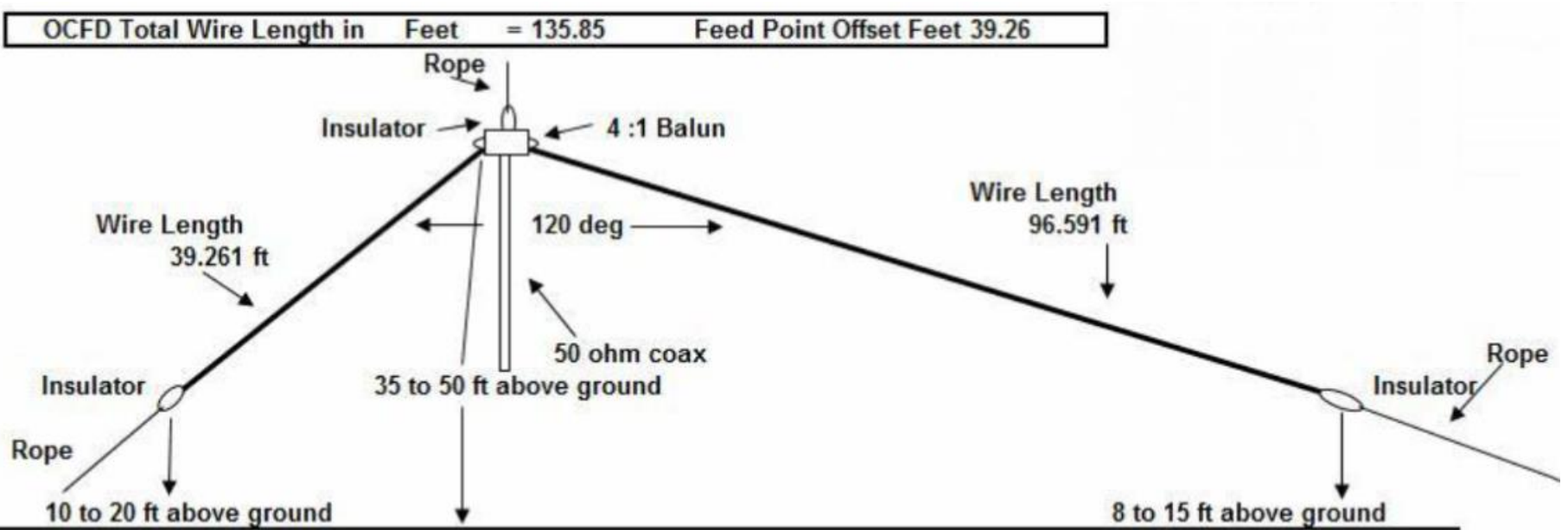
.... but don't stress

- Identical antennas behave differently at different locations
- Reciprocity: Characteristics of an antenna are the same whether it's used for transmitting or receiving
- Total transmit power = power radiated + power losses in coax, wire, etc.
- Aim your power: directional gain

The 80m conundrum

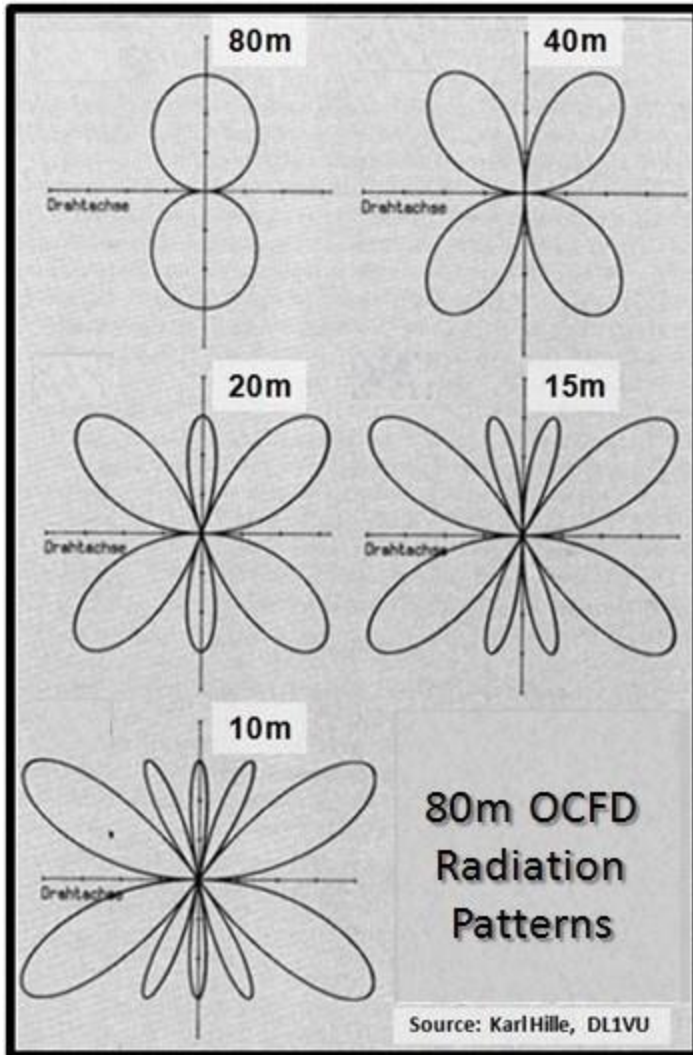
- 80-75m, 3.5-4.0Mhz ham band is too wide for a dipole to work at CW/FT8 end and SSB end.
- Two solutions that worked for me....
 - Cut antenna length for CW end (longer) and use a tuner for SSB end
 - Cut antenna length for SSB end (shorter) and add connectable extensions to work in CW/FT8 end.
No tuner needed, but the ends need to be accessible.

Off Center Fed Dipole



- Low cost single wire antenna, low radiation angle
- Favors even harmonics
- As shown covers 80,40,20 and 10. 15 & WARC will require a tuner
- Impedance at the feed point is around 200 ohms requiring a quality 4:1 choke balun
- When tuning, be sure to adjust each wire proportionally

OCFD radiation patterns



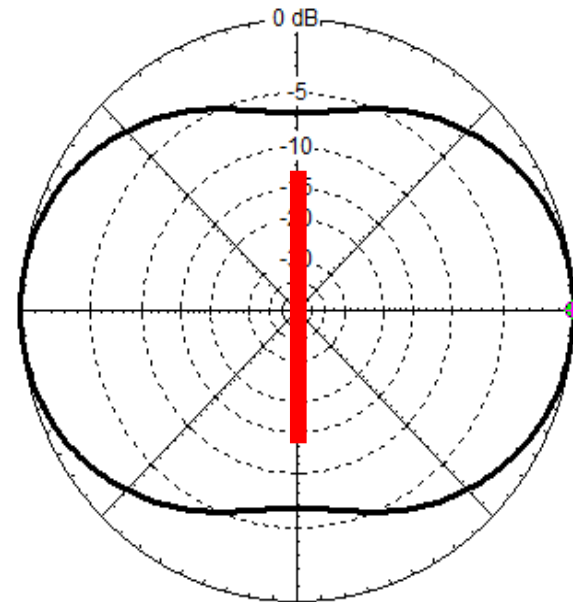
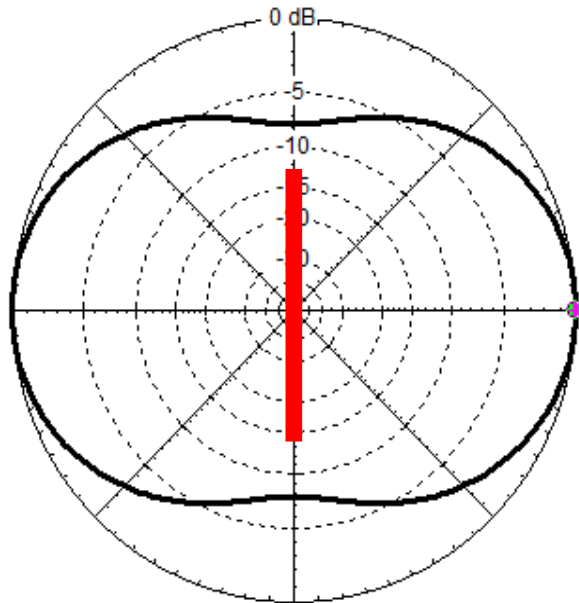
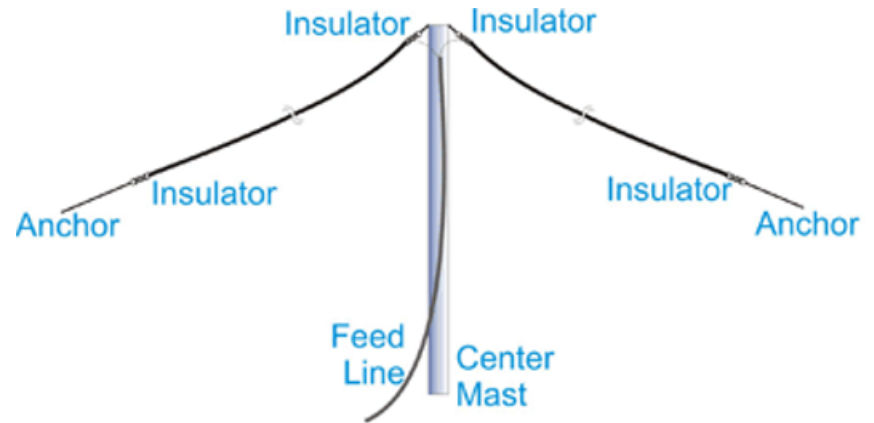
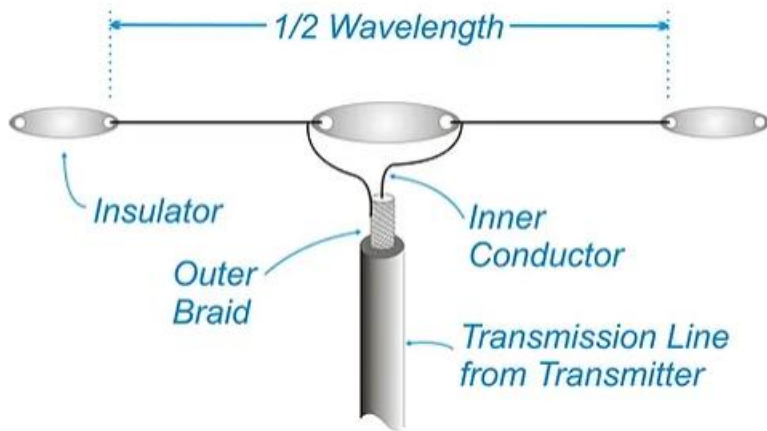
- Has pronounced nulls in the radiation pattern
- Spreadsheets for calculating different base frequencies i.e. 160m or 40m
 - <https://www.balundesigns.com/support-downloads/>

<https://www.onallbands.com/off-center-fed-ocf-antenna-multitalented-or-misunderstood%EF%BB%BF/>

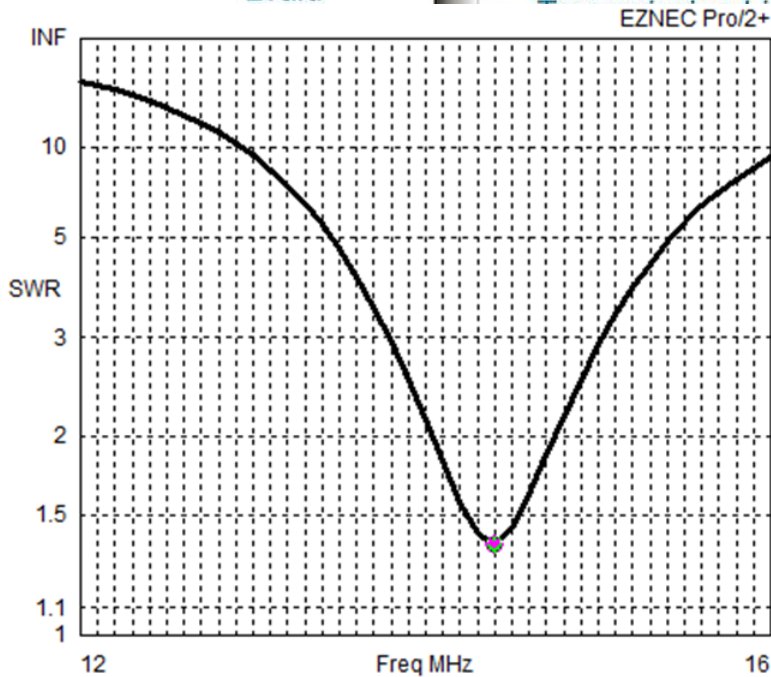
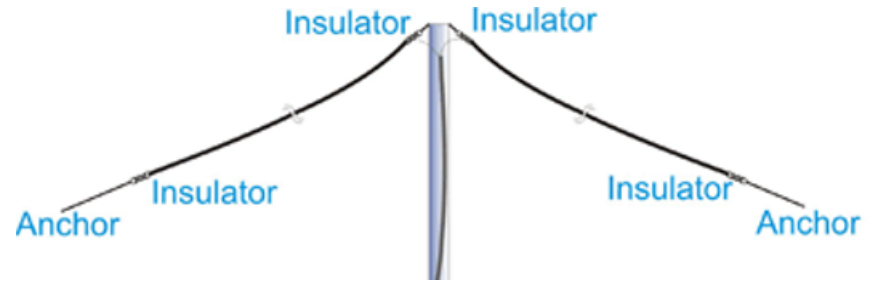
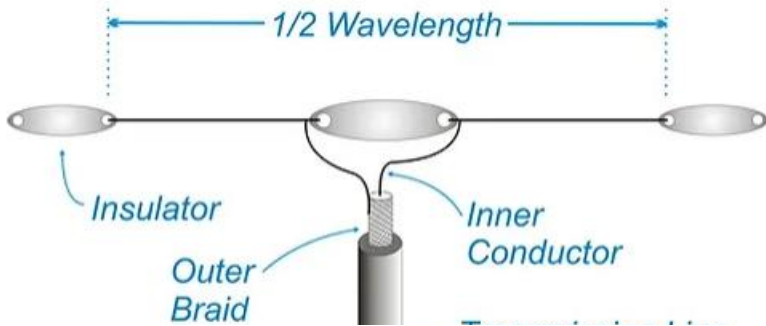
20m Half Wave Dipole vs Inverted V (45°)

same antenna wires center @35ft

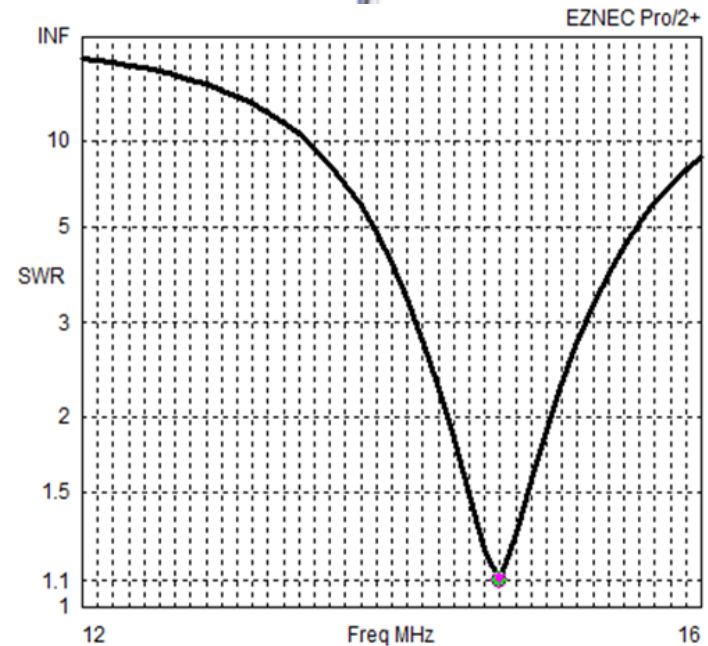
(Modeled in EZNEC Pro2+ over typical ground)



20m Half Wave Dipole vs Inverted V (45°) same antenna wire lengths, center @35ft



Freq	14.4 MHz	Source #	1
SWR	1.36	Z0	50 ohms
Z	67.98 at 0.02 deg.		
	= 67.98 + j 0.02883 ohms		
Refl Coeff	0.1524 at 0.08 deg.		
	= 0.1524 + j 0.0002071		
Ret Loss	16.3 dB		



Freq	14.7 MHz	Source #	1
SWR	1.1	Z0	50 ohms
Z	45.84 at 2.35 deg.		
	= 45.8 + j 1.879 ohms		
Refl Coeff	0.04805 at 154.79 deg.		
	= -0.04347 + j 0.02046		
Ret Loss	26.4 dB		

For Hams:

a 40m (7 Mhz) dipole can work at 15m (21 Mhz}

Dipole will have resonance at odd multiples of the base frequency
RF current (blue) must be zero at the ends for resonance
(i.e. the wire literally ends, so no current can flow there)

Fundamental: 7Mhz 40m



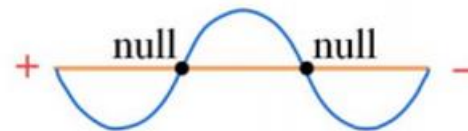
a single half-wavelength

14Mhz 20m not possible



two half-wavelength

3rd harmonic: 21Mhz 15m



three half-wavelength

Sources & Info

- K7MEM.com Check out the best web source I've found --- has built in calculators for diy of many antenna designs
 - <https://k7mem.com/index.html>
- Fan dipole
 - <https://www.hamuniverse.com/kl3jmsrifandipole.html>
 - Note: read updated construction tips for center insulator in this one
 - <https://www.hamuniverse.com/multidipole.html>
- Endfed Halfwave
 - <https://www.pa9x.com/how-to-prevent-rfi-caused-by-endfed-vertical-and-dipole-antennas/>
- Trap dipole
 - https://k7mem.com/Ant_Trap_Antenna.html
 - <http://www.arrl.org/hf-trap-antennas>
 - <http://degood.org/coaxtrap/> ATTIC TRAP DIPOLE – HOA
- HOA Antennas
 - <https://fullduplextech.com/ham/gutter-antenna-hf/>
 - <https://wb3gck.com/2016/12/18/the-wb3gck-downspout-antenna-revisited/>
 - https://youtu.be/Y473hOmif-E?si=kZJ_B4C6hJdySzo9
- OCFD
 - <https://www.balundesigns.com/content/OCF%20Dipole%20V2.pdf>
- More resources
 - <https://hamradioprep.com/courseid-6/25/>
 - <https://www.balundesigns.com/support-downloads/>