

Lightweight Portable Antennas: Options & Tradeoffs

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**THEY SAID I COULD BE
ANYTHING**

SO I BECAME A RADIO STATION



Purpose & scope

Overview of antenna options & tradeoffs for lightweight portable ops

- SOTA, POTA*, back-country camping, etc.
- where weight/bulk or other issues limit or preclude other options that would be OK for vehicle-accessible locations or home shack, and
- power requirements are low (<50W) and generally provided by LiPo/LifePo battery
- Main focus on HF (many more types become viable at VHF & up)

* “park/picnic table” style POTA allows all these plus some bulkier /heavier options

Main differences from other contexts

- Exposure to wx – especially wind!
- Transport by LPC (leather personnel carrier)
- Operating in rugged/obstructed/non-level areas



General criteria & tradeoffs

1. Weight
2. Bulk / shape factor
3. Ease of deployment
4. Operating footprint
5. Robustness
6. Reliability
7. Difficulty of construction or repair
8. Cost
9. Band / mode & power requirements
10. “Fashion” / interests

A word about bands

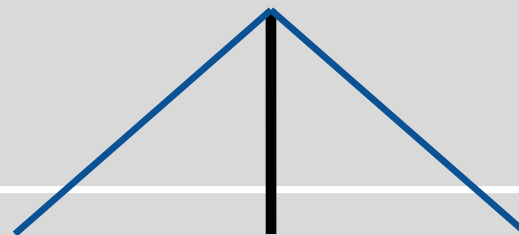
- Many lightweight designs available with some multi – band capability & this can be handy,
- but beware of trading weight/bulk/shape/cost, etc. for multi, multi band capability
 - Most remote portable ops take place in daylight – poor time for bands longer than 40m
 - Where are the listeners? Most SOTA chasers in last 6 years have been on 40m, 30m (CW), 20m, 17m. (With sunspot cycle 25, better 15m - 10m coming).
 - ‘Loiter time’ is limited in wilderness wx – can you actually work > 2 or 3 bands? (Typical SOTA trip: drive 2 hours, hike 2 hours, setup 10 mins, operate 30 mins.)

Types to be discussed

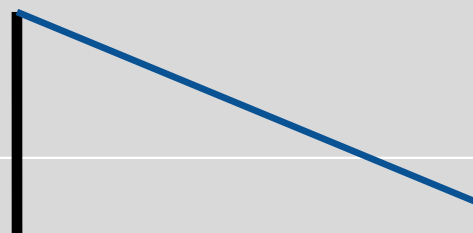
- Inverted – V dipoles
- End-fed half-waves (EFHW)
- End-fed long wires / random wires
- Verticals
- Loops
- Commercially manufactured vs. homebrew
- VHF/UHF expanded possibilities

Types to be discussed

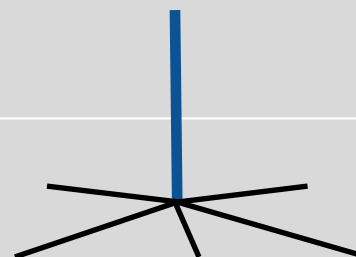
Inverted - V dipoles



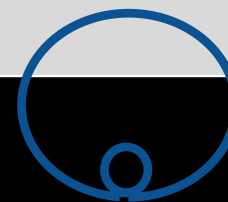
End-fed half-waves (EFHW) or
End-Fed Long / Random Wires



Verticals



Loops



Inverted – V dipoles



Inverted – V dipoles: homebrew



Inverted – V dipoles: storebought



Linked dipole on wire winders with carry bag & tent pegs

Inverted – V dipoles: the good news

- Light, small, back-packable. (Use a nylon or mesh bag)
- Easy to make or fix, deploys easily on wire winders.
- Can make multi-banded using clips or plug links.
- If cut to approx. resonance in each section, no tuner needed. Balun is optional.
- Mix of horizontal & vertical polarization - low noise, decent takeoff, generally good tx/rx.
- Relatively insensitive to orientation at HF frequencies.
- Lower losses than many other options; usually get good signal reports even at low power.

Inverted – V dipoles: kits / design tools

Trapped kit: <http://www.qrpkits.com/dualbanddipole.html>

Simple linked type homebrew: www.sotamaps.org/extras

Create SOTA CSV Linked antenna designer Other option Rectangular Sloop

HF Linked Dipole Antenna Designer

No. of bands: 2 Set by band...

Highest frequency: 18168 kHz

Middle frequency #1: kHz

Middle frequency #2: kHz

Middle frequency #3: kHz

Lowest frequency: 14112 kHz

Length units: meters

Center support height: 6.2 m

End support height: 0 m

Rope extender: 4.9 m

My favourites... Clear all Calculate

Results for: wire, un-insulated (standard)

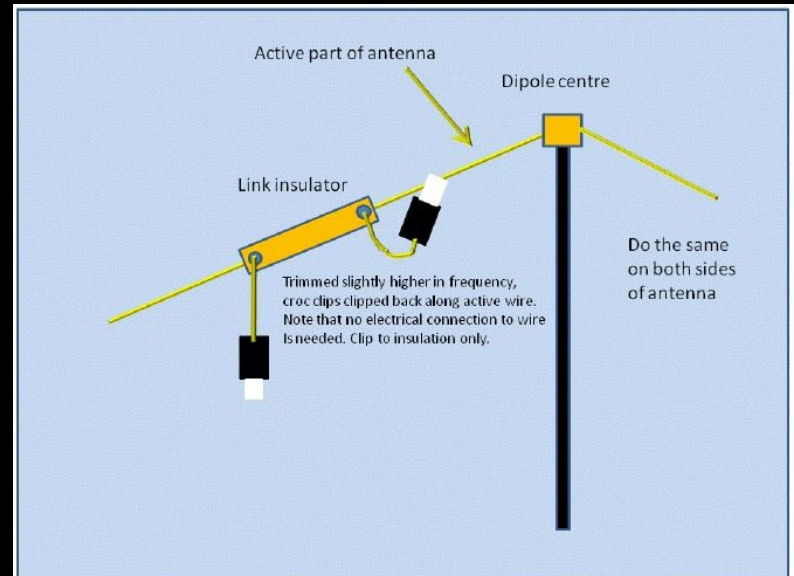
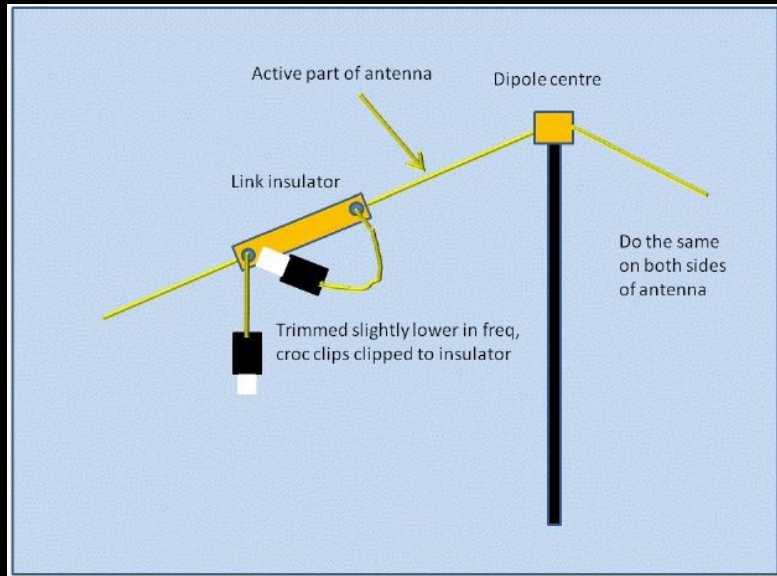
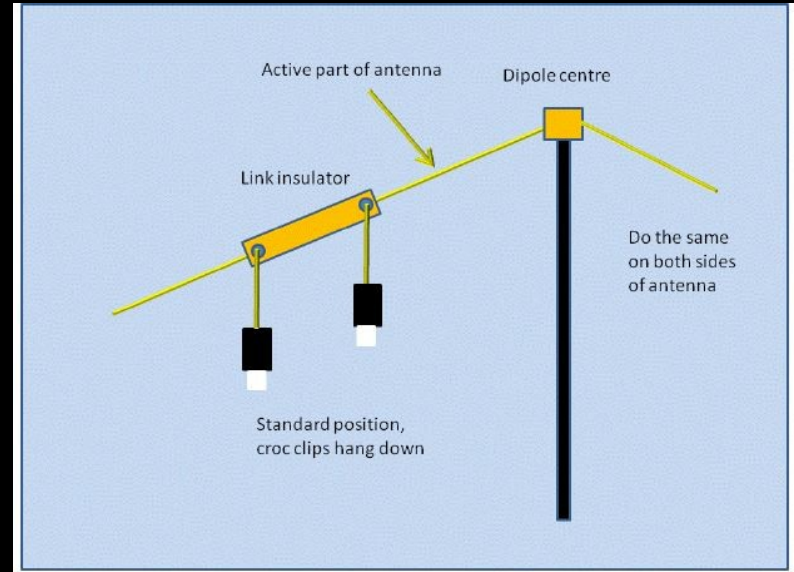
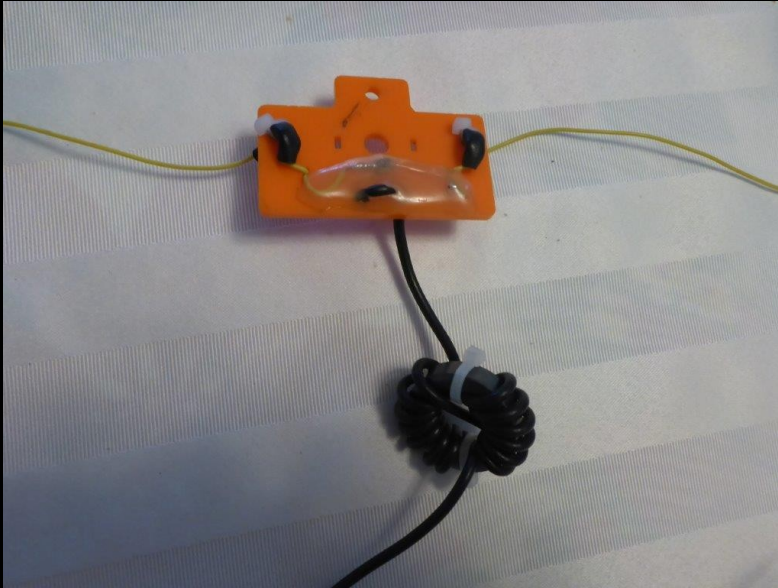
	Inner section	Middle sections			Outer section
		#1	#2	#3	
f (kHz)	18168	-	-	-	14112
Length	3.75m	-	-	-	1.08m

Length one side: 4.83m Apex angle: 50.4°

Info... Settings... Save Export...

CS : 6.20m
Foot : 7.50m
www.sotamaps.org
Snapshot

Inverted – V dipoles: centers & links



V - dipoles – now for the bad news

Needs fairly high center, typically requires an extension pole, supported by guying cords, fence post or (isolated) tree.



Poles

Guying is easy in good wx, low wind & with a helper in wind, single-handed, etc. it's good to make use of trees, fenceposts, etc. - if available!



Guying Kit



V dipoles – the bad news, cont'd

- Takes longer to set up than end-feds; tendency for the 2 legs of wire to get tangled while deploying.
- Longer wire needed than with end-feds –harder to deploy in cramped/bushy areas or around obstacles & is less practical than end-feds for bands $> 30\text{m}$, especially in windy conditions.
- Needs longer feedline than end-feds, with some associated loss.
- Care needed to ensure appropriate 'inclusion angle' at peak ($90 < x < 120^\circ$).
- Must lower to open or close links if band change desired. Traps can avoid this but they add weight/bulk.

End-fed half-waves (EFHW)



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End-fed half-waves (EFHW): pros

- Shorter wire than dipole, more practical for bands $\geq 20\text{m}$, especially in cramped areas.
- Several options for configuration – sloper, inverted L, inverted V, even flat along a series of tree branches.
- Good option for wind – string directly toward or away.
- Easier & faster to deploy than dipoles, can use a pole at one end or just throw a weight across a tree branch.



Arborist throw weight



Cabela's multi-tool: doubles as repair device

End-fed half-waves (EFHW): pros, cont'd

- Feed point at low end greatly reduces length of feedline. (Can use hiking pole as a support for transformer at low end, & run feedline down to radio – feedline acts as a ground.)
- Works well low to ground (acts more as NVIS antenna)
- Possible to get some multi-band combinations without having a tuner, by building transformer & links



End-fed half-waves (EFHW): cons

- Depending on design, may need tuner that can handle fairly high SWR, or (preferred) need to build in a custom transformer to make resonant at desired f range, which is a bit trickier to home-brew.
- Involve some power loss vs. a resonant dipole (depending on design).
- Can get hung up when deployed into trees. (especially evergreens). Be prepared to replace the odd wire ...



Despite the above, these designs are the “weapon of choice” for most hard-core SOTA activators.

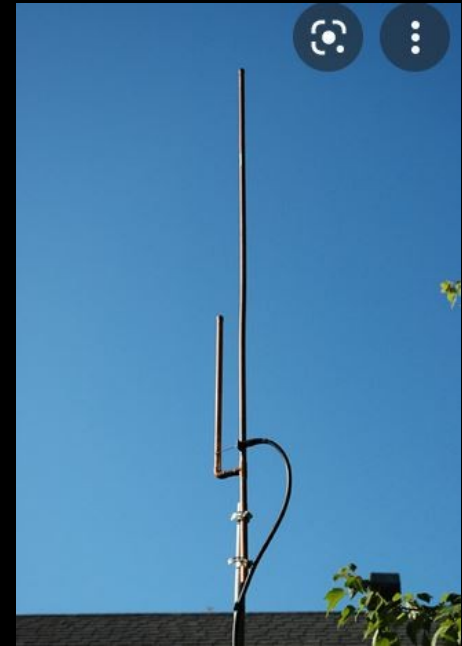
End-fed half-waves (EFHW): homebrew

- <http://gnarc.org/wp-content/uploads/The-End-Fed-Half-Wave-Antenna.pdf>
- <https://vk1nam.wordpress.com/2014/08/08/link-end-fed-half-wave-antenna-and-tuner-for-sota/>
- And for fun.
- <https://www.youtube.com/watch?v=s- LyhdGapM>

End-Fed Long-Wire/Random Wire

- Similar considerations as for EFHW
- May use longer or shorter wire than EFHW, although generally no practical advantage / disadvantage in needed setup area.
- No need to cut to resonant length but **always** requires a tuner (often external) that can handle large SWR excursions. Need to accept inevitable power loss.

Verticals



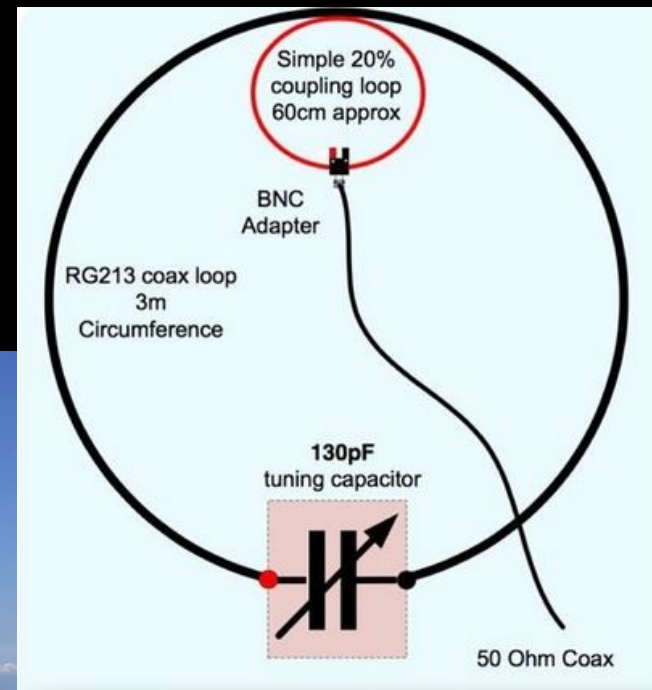
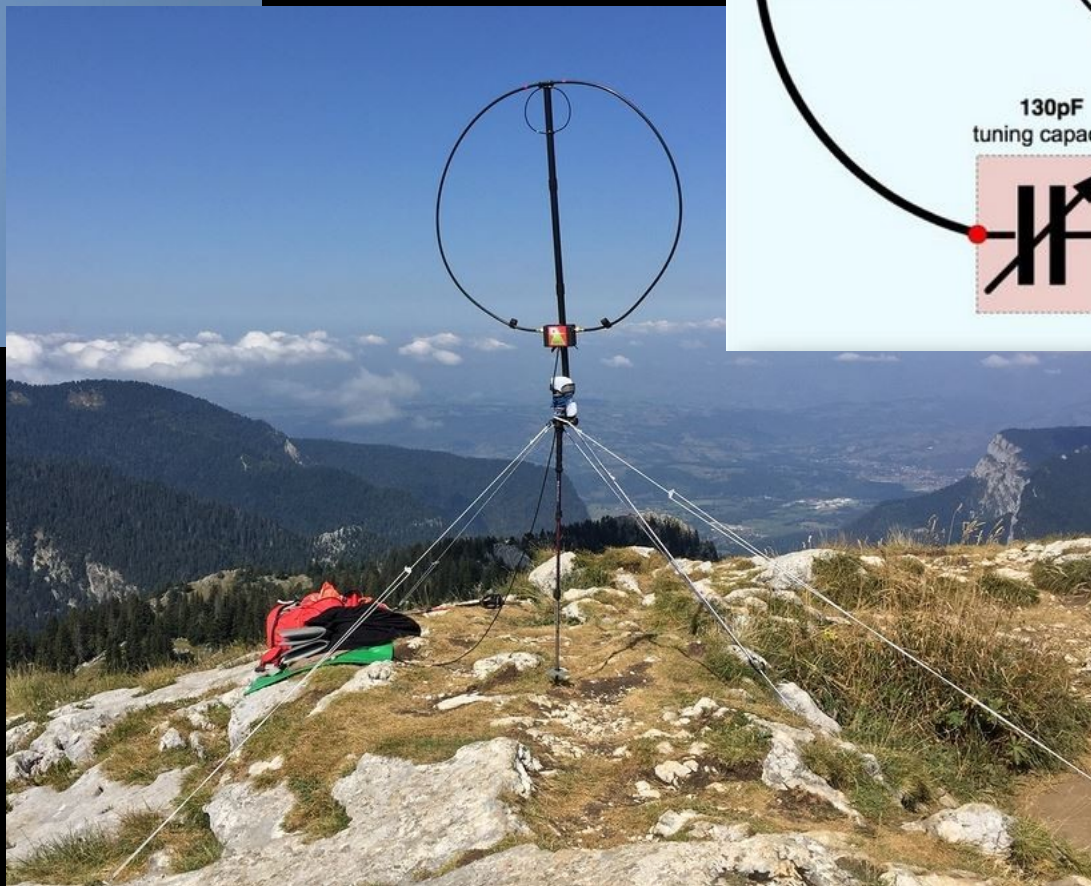
Verticals - pros

- Many are fairly easy & fast to deploy, on own stand, or using a pole, tree or tripod, sometimes without need for a guying system.
- Inherently omni-directional.
- Nice low takeoff angle.
- Very small footprint, useful in tight or obstructed operating areas.
- Many are collapsible or otherwise pack down to a fairly small volume; cylindrical shape factor of pole portion facilitates attaching to a backpack.

Verticals - cons

- Needs counterpoise or radial system to perform well -- can be difficult to deploy in cramped or obstacle-strewn areas. If dogs & kids are present, forget it!
- Much more prone to fall over in wind.
- Access to lower bands brings associated need for more height, or coils /traps that add weight & bulk.
- Vertical polarization somewhat more sensitive to manmade noise. Better for FM than SSB.
- Usually requires tuner or fussy adjustments to length of a collapsible antenna to make it resonant. (SOTA experience with J-poles is quite poor.)

Loops



Loops - upside

- Like verticals, can cope with a small setup area
- Low noise (mag field not e-field)
- Directional & can null out a specific QRM source or peak a weak signal.
- Fairly easy to homebrew - e.g. using coax – but many commercial options also available.
- Can reorient polarization fairly easily.

Loops -- downside

- Bulky, not easy to pack down, odd shape factor for packing & trickier to mount – usually on a tripod.
- Prone to upset in wind unless strong mounting system or weighted down.
- Narrow-banded & very fussy to tune, (with built-in capacitor, can't use an ATU).
- Less efficient than most wire antennas, and size constraints for backpacking mean they are even more inefficient below 20m band.

Commercial vs. homebrew



Commercial (vs. homebrew) - pros

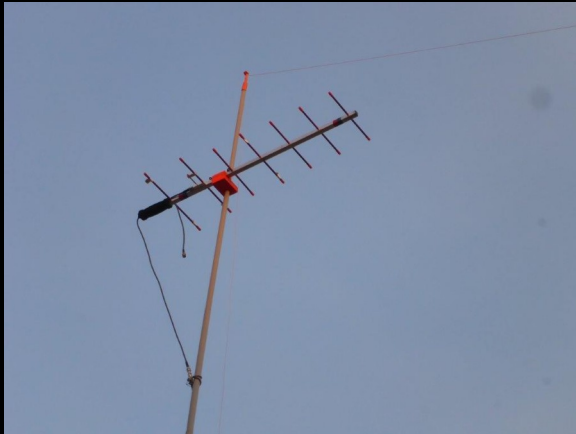
- Typically offer multi, multi-band capability
(Reminder: you don't have that much "loiter time" on a SOTA hill to work more than 2 bands!)
- Can handle higher much power levels than the typical SOTA 5 – 40 Watts.
- Often provide options for several different configurations – inverted V or L, sloper, vertical.
- Many are made of strong, durable materials (good for wind) and come with their own high-fashion field packs & accessories.

Commercial (vs. homebrew) - cons

- **Expensive!** (*MPAS Chameleon: \$600USD*)
- Often more complex & therefore harder to trouble-shoot quickly in the field or repair at home.
- **Typically heavier & bulkier** (sometimes a lot) than many of the above options when done as homebrews for lower power levels.
- Usually use coils, traps, chokes, etc. – at the cost of more weight, bulk and some power loss.

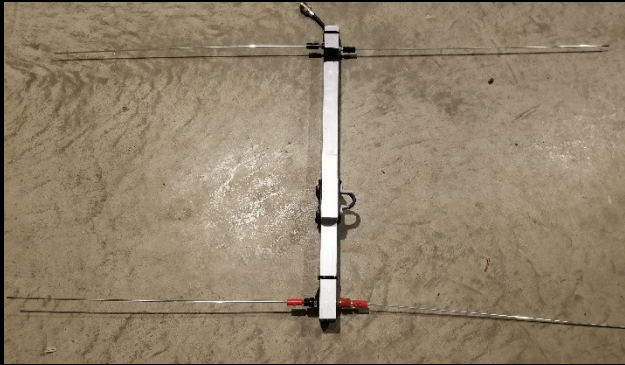
Beyond HF – options open up

- Shorter wavelengths - VHF & up – make many other design types more viable for lightweight ops – Yagi, Moxon, quad, log periodic, double zepp, patch, slot, helical, etc. – but getting line-of-sight can be a challenge ...



Beyond HF – options open up

- Shorter wavelengths - VHF & up – easy to homebrew.



A word about feedlines

- At HF frequencies, feedline loss is a lesser issue than weight & bulk of coax – can use RG 174, RG58, RG8U, etc. and run lengths up to 25' just fine.
- Can get more expensive “exotic” types of coax but it's not really necessary given low noise floor outdoors.
- Ladder line is generally too sensitive to damage / twisting/shorts when running around in the woods; we tend to use it just for short matching stubs.
- At VHF/UHF & especially microwave, the picture changes – go for shortest length possible of something beefy – like LMR 400 ultra-flex for microwave – and pray your backpack doesn't break

Lightweight portable has its rewards – why not try it?

