NEW 2025 UPDATE

The POTA ANTENNA BOOK

A Complete Guide to Portable Antennas

by

Don Dickey
WV1W

Pictures Only Edition

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This book is dedicated to the operators who
I have shared many enjoyable QSOs with.

The author would also like to thank
the trusted friends who helped with
tips and suggestions to improve the
book during its creation and evolution.

Visit
wv1w.us/antennas
for info on stuff in the book!

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Introduction

I have been a licensed amateur radio aka “ham” operator since 1975. At that time, it was common for hams to build their own gear. Stations often had a separate receiver and transmitter, both nicely warmed by glowing vacuum tubes, plus a switch or relay to transfer the antenna back and forth between the units.

Fortunately, a company named Heathkit made construction possible, even enjoyable, providing all the components along with an excellent instruction manual. After you assembled and soldered everything together, you could even take the completed unit to one of Heathkit’s retail stores where a technician would put it on the bench, check it out, and tune it up for you, often N/C, and return it with a smile.

The practice of building one’s own gear naturally extended to amateur radio antennas. Simple wire dipoles and inverted-V types were very common, but some operators ventured into more complex yagi designs and multi-element systems.

I can’t remember buying a commercial antenna until I purchased a hamstick for POTA! That said, this book will differ from most other antenna books as it will cover both home-made designs and commercial ready-to-use products.

Antennas can be divided between two basic designs: those made primarily of wire, and those made of everything else, usually including aluminum and often with some plastics.

Finally, antennas can be further divided into two electrical types: resonant and non-resonant, and we will discuss how this affects both performance and utility.

Summarizing, this book covers wire and non-wire designs, resonant and non-resonant types, and both commercial and home-made products. We will leave few stones unturned!

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Basic Antenna Theory

Signals from your VHF or UHF handi-talkie (HT) usually go directly from your radio to another radio or repeater system. This is commonly referred to as ground wave propagation.

While HF signals can also travel via ground waves, they more commonly reach their destination after bouncing off the ionosphere, a layer of the earth's atmosphere that contains a high concentration of ions and free electrons. These charged components can allow the ionosphere to reflect radio waves, and often several subsequent bounces are possible. This is how a signal originating in the United States can be heard in Australia, on the opposite side of the Earth.

Several factors influence how successful sky wave propagation works at any particular time. Energy from the Sun plays a large role since that's where most of the charge in the atmosphere comes from. The Sun can also be the source of enormous amounts of noise which can mask weak HF signals.

Geometry also plays a part. Signals which go straight up bounce back straight down. This is called near vertical incident skywave (NVIS). While this can be useful for local communications, particularly EmComm, distances are usually limited to a few hundred miles.

Signals which go out at a low angle have the potential to reflect off the ionosphere at a similar angle and thereby reach much longer distances, often referred to as "DX" in ham-speak.

So you may ask why this information is relevant to choosing an antenna! The answer lies in the type of propagation each antenna design is likely to produce. Horizontal antennas like wire dipoles radiate much of their signals in all directions including straight up. Vertical antennas usually radiate at a lower angle closer to the horizon. This helps explain performance differences between antenna types in this book.

Another very important concept relevant to antenna design is resonance. Everything which has mass has a natural resonant frequency.

An example is the crystal wine glass which, when impacted by sound waves from a professional singer at its resonant frequency, sees the transfer of sufficient energy from her vocal chords to make the glass vibrate and literally shake itself to destruction. The same thing can happen when wind howls through a suspension bridge causing it to bend and twist until it falls apart into the water below.

If you ever felt the energy at a rock or organ concert, that was likely the result of low-frequency sound waves matching the resonant frequency of bones, muscles, or organs in your body.

When radio signals strike an antenna which has the same resonant frequency, there is significantly more energy transferred than when tuned to a different frequency.

Physical characteristics determine the resonant frequency of an antenna: material and size. Copper and aluminum have slightly different resonant frequencies for a given size, but length of the element is the most determining factor.

While we are interested in matching wavelengths, in the practical world we generally focus on half and quarter wavelengths when designing antennas due to size restraints.

Another concept to mention is capture area. This simply means that the bigger an antenna is, the more area it will have for propagating waves to strike and be captured for a receiver.

While non-resonant antennas, particularly long wires with lots of capture area, can and do work, I generally prefer to take advantage of the greatly increased efficiency which resonance provides, even if that entails extra effort in the tuning process.

Getting Started

Nothing in your POTA or EmComm kit will be more important than the antenna. Here, one size almost never fits all. In fact, I always pack more than one antenna. You can choose to focus on those sections in this book you are comfortable with whether that be ready-made or involve a construction project.

A basic theme of mine is to provide easy and affordable solutions to encourage you to give portable operation a try. You will have plenty of challenges in the field, so we will start with a simple and low-cost off-the-shelf antenna system that should offer excellent and reliable "bang for the buck" — **hamsticks**.

TIP: If you are more inclined to build your first antenna, you can jump ahead to the section on simple wire antennas.

Hamsticks are "loaded" quarter-wave vertical antennas. They usually have a 3/8-24 (UNF) threaded base permanently attached to a fiberglass shaft which is helically wound with a copper wire lower element and inductive loading coil close to the top of the section.

A female 3/8-24 socket at the top of the shaft accepts a similarly threaded stainless steel "stinger" of about the same length as the fiberglass section. The threaded ferrule has one or more set screws securing the whip which also allow for some length adjustment thereby tuning the antenna to resonance.

Full-size models are usually 8 feet long, and shorter models are also available, primarily for in-motion mobile use. I encourage you to focus your attention on full-length models as they are more efficient and offer better performance for similar cost.

You can purchase hamsticks from most of the usual ham gear shops. Mine were under $20 each. The models my friends bought costing twice as much don't seem to work any better. Sticks can also be found at flea markets, so keep an eye out!

Depending on band conditions, most POTA activity occurs on two primary bands: 20m and 40m. While you could buy a large set covering all the ham bands, your best bang will come from those two bands. For higher frequencies, you might be better off with a single telescoping whip which I will discuss later. If you could only afford one hamstick, it should be for 20m. If your initial budget is larger, add a 40m stick to your kit.

Performance will vary somewhat but is more dependent on ground conductivity and the rest of the antenna system than on the particular hamstick make and model you choose. By "rest of the system" I am referring to the counterpoise, usually a set of radials or whatever the hamstick is mounted to.

When people ask how well hamsticks work, I often mention that I completed a "Kilo" award (twice!) at Adirondack State Park (US-2001) with just a pair of hamsticks, often mounted to the stern rail of our sailboat dock-side on Lake George.

In a simple basic mobile setup, hamsticks can be attached to your vehicle using any of a wide variety of mounts. Vehicle mounting offers both speed and simplicity. Setup is virtually instantaneous, so you can be on the air moments after pulling off the road. Even if you later choose more extravagant portable antennas for full-day outings, you might use your trusty hamsticks for quick and easy operation during lunch breaks or when time in the field is limited by other constraints.

You might be tempted to save time and trouble with a magnetic mount on the roof of your car. While this works well on VHF and UHF frequencies, it can be significantly less efficient on HF bands, particularly 40m and lower.

You can improve the performance of a mag-mounted antenna by attaching some radials, but an elevated wire counterpoise usually needs to be tuned, and this can defeat the purpose of choosing a simple antenna.

Instead, I usually prefer a ground-mounted antenna. During the warmer months, I use a stake or pedestal mount (covered later). In the winter, when the ground is frozen, I often deploy a tripod mount which can even be used on top of snow.

When the weather is conducive, if I plan to operate outside of my vehicle, I often attach the hamstick to the picnic table, its bench seat, or sometimes to a nearby grill or fence.

During a POTA activation in Nickerson State Park on Cape Cod, I attached the mount to a cold water spigot in the park's yurt complex. I was pleasantly surprised when the counterpoise was so effective that my SWR was very low and I was able to make SSB contacts all over the U.S. and Europe without adding any radial wires as I usually do.

Hamstick on Tripod and Clamp Mounts
with push-on counterpoise wire connections

One downside of hamsticks is their relatively limited bandwidth. This is a function of all shortened antenna designs which present a high “Q factor.” One reason I prefer resonant antennas is because I can usually leave the tuner in the car. Nevertheless, the tuner can come in handy for widening the usable bandwidth of a high-Q antenna like a hamstick.

Hamsticks are usually tuned to resonance by adjusting the length of the stainless steel “stinger” whip. I often use my RigExpert Stick 230 antenna analyzer to adjust the antenna. Without an analyzer, you can use an external SWR bridge or the SWR metering function in your radio for checking and tuning the antenna.

Set your rig in the band and frequency area you plan on operating. Using low power for tuning is always a good idea.

TIP: With my Yaesu FT-891 portable rig I set the AM power output level for 5 watts. When I want to check SWR and tune up I simply switch the mode to AM. After tune-up, I switch back to the mode I will use for operating which will return the rig to its regular output power setting, usually 100 watts.

I recommend you make hamsticks easier to adjust in the field. The tiny hex socket set screws securing the stinger are really hard to find if dropped and they require a special tool. Start by replacing them, ideally with knurled head thumb screws, or at least with screws which have Phillips or regular slotted heads.

Next, adjust the tightness of the screws so the stinger can be just barely adjusted by hand. Screws should be tight enough to prevent slipping but loose enough so you can move the stinger up and down as required for tuning without tools.

My second trick is to keep one stinger long for CW and digital band segments. My CW stinger is 48” long overall. Trim the other for the SSB band segments, usually requiring removal of about 6 inches off the end. My SSB stinger is 42” long overall.

My third trick is to make single-band hamsticks work on two bands! I got a 20m hamstick to work nicely on 17m by using my 19-inch 2m quarter-wave antenna (with 3/8-24 threads) on top instead of the regular 4-foot stinger. Similarly, I was able to get a 15m hamstick to resonate nicely on 17m by using a piece of coat hanger wire to lengthen the stinger.

Taking this trick even further, switch out the fixed length stinger for a short telescopic whip. My favorite is the one that comes with SuperAntenna kits but it is available separately. What makes this one unique is that collapsed it is just under 6 inches long from shoulder to tip. Threads on the bottom are standard 3/8-24 so it fits the top ferrule of most hamsticks.

Short Telescopic Whip

When you use this whip full-length on a typical 20m hamstick, it performs the same as it would with a 44-inch stinger covering the SSB part of the band. When you use it fully collapsed, the 20m hamstick will resonate on the 15m band. If you extend it about 18 inches, it resonates on the 17m band. So, you get 3 bands with just one hamstick. You can tune it without tools by adjusting the length as required for low SWR.

I expect you could get a 15m hamstick to work on 12m and a 12m stick to work on 15m with the same tricks. Ditto for getting a 12m stick on 10m and 10m stick on 12m.

My last trick is to combine hamsticks. I found that by putting a 40m hamstick with it's stinger on top of a 20m hamstick bottom section that it was usable on both 6m and 2m. Surprise!

TIP: You could combine a hamstick with a coil to get even more band coverage.

Some people think the best way to deploy hamsticks is in pairs, as a dipole, using a duplex mount with one stick basically grounded or even an “octopus” hub to cover multiple bands.

I am NOT a fan of hamstick dipoles, and these are my reasons:

A) Using hamsticks in a dipole configuration defeats their purpose. I use hamsticks for quick & easy activations, especially in the winter when there’s snow on the ground and it’s cold out. I can set up a hamstick on a tripod in under a minute. It takes another couple minutes to lay out some radials.

Setting up a dipole takes considerably longer because you need to set up a mast, and then tuning takes even longer when you have two antennas. Tuning can even turn into a nightmare.

B) A dipole that low to the ground has a very high angle of radiation. On 40m it would be pure NVIS. The range probably would be limited to a couple hundred miles. That’s fine for EmComm but not ideal for POTA.

As a vertical, the angle of radiation is low and reaches out much better. I routinely get into the EU and UK on 20m and have even gotten into Greece on 40m.

C) Making a dipole requires two hamsticks per band plus a mast and special duplex mount. That more than doubles the cost which is another reason to use hamsticks: they’re cheap.

D) Unless you have an octopus hub of some sort, changing bands takes many times longer than a single vertical.

E) The dipole is directional. The vertical is omnidirectional and hears/reaches more hunters.

I think that about covers it. Stick to a vertical configuration and keep it as simple as possible for less trouble and more fun. Hamsticks definitely represent some of the best antenna values for portable operation and POTA.

Another HF antenna worth mentioning is the Hustler mast-plus-resonator system. These were originally marketed for mobile use as their folding masts allow the vehicle to be garaged. Hustler later added a 54-inch non-folding mast which is less expensive and ideal for POTA applications. To this mast you must add a "resonator" consisting of a loading coil with a short adjustable whip.

Hustler Resonator with Whip

Standard resonators are available for all HF bands from 80m up to 10m and handle up to 400 watts. Their more expensive "Super Resonators" can handle up to 1 kW PEP and have slightly more bandwidth than standard resonators.

TIP: You can use the tuner in your rig or a separate outboard tuner to extend the usable bandwidth of Hustler resonators.

While normally a mono-band system, Hustler also offers their VP-1 multi-band adapter kit which attaches to the top of their masts and includes hardware to mount up to three resonators thereby allowing virtually instant band changes.

So, what's the catch? Standard resonators cost from $26 to $45 to which you must add a mast costing between $35 and $46. Unless you find a bargain at a flea market, I think hamsticks offer a much better value and similar on-air performance.

Multi-Band Vertical Antennas

While a hamstick (or two) is probably the easiest way to get started in portable operation on a tight budget, antennas offering coverage on more than one band might be the better way to go for some operators. This is especially true if you want to pack small for air travel or lighter for mountain-top operation aka SOTA (Summits On The Air).

The easiest way to cover multiple bands with the least amount of gear is simple — **a telescopic whip**. You change bands by adjusting the length of the antenna element directly. A single telescoping whip that is 17 feet long fully extended will permit operation on any band from 20m up to 6m or on even higher frequencies depending on its overall collapsed length.

TIP: Once you have tuned it for each band, you should be able to re-tune quickly using a tape measure or a knotted piece of string as a reference guide.

Approximate starting lengths are easy to calculate. To find the length for a quarter-wave element, divide your operating frequency into 234 to get an approximate length in feet. There are also online calculators you can use. Just search the web for "vertical antenna calculator" to find one.

One advantage of the telescopic whip is its efficiency as a resonant antenna. Being a full-size quarter wavelength by design, it should out-perform all compromised coil-loaded antennas including the previously discussed hamsticks and Hustlers. Being able to cover many bands with a single radiator is the single best reason to consider getting one for your kit.

Telescopic whips aren't without a few issues, however. The first is cost. Good 17-foot whips can be $75 or more with shipping and taxes added. While this is about the same as a set of three or four hamsticks, you have the advantage of an added band or two for your money.

Perhaps the biggest disadvantage is durability and therefore reliability. It is not uncommon for portable antennas to fall over. This can be the result of a gust of wind or "operator error" during deployment and recovery. Unfortunately, telescopic whips are more prone to damage than other antenna types when this happens. It doesn't take much damage to prevent them from extending and collapsing smoothly.

Due to their weight and length, it is important to use a sturdy mount, especially when the whip is used full-length on 20m. While a simple lightweight camera tripod might be fine for an 8-foot hamstick, a 17-foot whip requires something more substantial, possibly with an added weight or tent stakes anchoring the tripod legs to the ground.

I recommend a heavy-duty tripod which has a hook from which you can hang something like a gallon jug full of water. See the Mounts section for more information and pictures.

For operation on the lower frequencies, a loading coil can be used to extend the coverage of a telescopic whip. Since the whip's length can be adjusted for tuning, this can be a simple fixed-impedance coil. One such example of this is the "Sporty Forty" from Wolf River Coils.

When used with their 213-inch whip, the Sporty Forty allows coverage of the complete 40m band including CW and data segments. Note that shorter 20m whips from other companies may not cover as much of the 40m band when the Sporty Forty is added. Buyer beware!

WRC Sporty Forty Coil

WRC Sporty Forty Deployed
extends range of telescopic whips

Chameleon Antenna also sells a 40m coil, but the cost is more than twice WRC's for similar CW & SSB power ratings. Michael, KB9VBR, offers a video on his YouTube channel showing how to make your own coil for 40m. If you are handy, this would be an economical solution for adding a very useful band to your telescopic whip.

TIP: To switch between 40m and other bands you don't need to remove the coil. Just bypass it with a short jumper!

Moving on, most other multi-band verticals use an adjustable coil where unused turns are either bypassed or shorted out. While significantly more complex than the fixed-inductance Sporty Forty, this approach has some advantages.

First, it can be simple to make small adjustment to achieve a low SWR. For example, the WRC *Take-It-Along* wiper ring can be rotated for fine tuning resonance. It is also possible to have several taps on the loading coil to make band changes faster and easier, an approach used by Buddypole.

Perhaps the best reason to use an adjustable coil design is the ability to ditch the fragile telescopic whip in favor of a more robust military-style sectional whip made of brass. Not only will this more likely survive fall-over events, brass is also somewhat more conductive than stainless steel, so it might be a little more efficient as the radiating element.

Sectional Military-style Brass Whip
AT-271/PRC clone with 3/8-24 (UNF) threaded base

Adjustable coils have their own issues. With moving parts, there are more things that can go wrong or simply wear out. They can also be challenging to tune in the field, especially if done manually with just an SWR meter.

I encourage operators using an antenna system with an adjustable coil to seriously consider adding an antenna analyzer to their kit, as the time and frustration saved will usually be worth the added expense.

There are several commercial multi-band vertical antennas suitable for POTA and EmComm activities. In the next few pages we will discuss some of the most commonly used models. We will start with resonant designs since they do not usually require a tuner.

One such model is the *Take It Along* kit by Wolf River Coils. While their kit comes with a telescopic whip, I chose to deploy my coil with the previously mentioned military-style sectional brass whip as shown on the next page.

Wolf River Coils Silver Bullet 1000

WRC Silver Bullet 1000 coil with military whip

This is the best of both worlds providing band coverage from 80m on up with greater durability and efficiency.

One problem of note with standard WRC designs is the possibility of QRO power levels coupled with high duty cycles of high-speed CW and/or digital modes causing damage to the coil. If you operate either fast CW or FT8 you should limit your power to QRP levels or consider upgrading to WRC's more expensive "Platinum" models which have been designed and constructed with better materials to handle more power.

If you are looking for an antenna that is compact enough for air travel, the kits from Super Antenna or Buddipole might be more appropriate and worthy of consideration.

While more expensive than the Wolf River Coil kits, these come in very tidy and lightweight packages.

Super Antenna models offer decent performance on 20m and higher bands and marginal performance on 40m. I would probably skip kits with their 80m coil and VHF "SuperPlexer."

Deluxe Super Antenna Kit

Deluxe Buddistick Kit

These kits include everything you need except the feedline:

- loading coil
- telescopic element
- tripod and/or clamp mount
- counterpoise wire
- carry bag

Yaesu offers a particularly interesting portable antenna system in their ATAS-25. I'm guessing it was originally designed to be used with their discontinued FT-817 / FT-818 QRP transceivers. Being so small (~ 7 feet tall), it might be a poor choice for QRP where antenna efficiency is paramount, but it could be a useful piece of kit for a POTA setup running QRO at 50 to 100 watts. The ATAS-25 covers 7, 14, 21, 28, 50, 144 and 430 MHz.

Yaesu ATAS-25
Portable Antenna Kit

What makes this antenna completely unique is how it was designed to be mounted on a standard camera tripod or any mount with 1/4-20 threads. Like other manual screwdriver designs, it has a movable coil for tuning it to resonance. This operation can be very tricky and time-consuming, so I would strongly recommend using an analyzer to speed up the process.

Yaesu ATAS-25 Deployed

New in 2023, the REZ Ranger 80 is somewhat like a "Cadillac" upgraded Wolf River TIA design with a more robust coil and military-style whip, plus a better radial system using banana plugs for quick attachment to a "puck" at the base.

REZ Ranger 80
heavy-duty coil with radial puck

For this top-of-the-line antenna, be prepared to part with $550 which includes a ground spike mount that's likely useless in winter when the ground is frozen solid. So, plan on adding a tripod and/or jaw clamp to your kit if you live up north where winter cramps our style for a few months.

Another relatively new commercial antenna is the Chelegance MC-750 shown below available direct or from select dealers.

Chelegance MC-750
with easily removable jumper for 20m

The Chelegance kit offers reasonable performance for around $250 and includes an adjustable coil and 17-foot telescopic whip. Unfortunately, they used metric threads so you can't mix and match Chelegance parts with existing 3/8-24 mounts and whips you may already have.

The company also offers a portable dipole kit, the Chelegance JPC-7. I would discourage you from considering this model as setup and tuning will be considerably more complex and troublesome than their vertical antenna. It is also more expensive and probably won't offer better performance.

In a departure from several mostly non-resonant antennas, Chameleon introduced their MCC (Multi Configuration Coil) along with multiple PRV (Portable Resonant Vertical) kits.

Build quality appears to be very good and antennas based on the MCC should perform well when coupled with a good radiating element and decent counterpoise system.

From the outset, the MCC looks like a larger and possibly heavier duty copy of the Super Antenna MP1. Power is limited to 500 watts for SSB, 300 watts for CW, and 200 watts for digital modes, almost identical to the Super Antenna model.

There are 2 big differences, however. While the Super Antenna MP1DXG kit with ground spike, counterpoise, and carry case can be found on Amazon for only $225, a Chameleon with similar capabilities costs a whopping $569 (with coax added but without a carry case).

The collapsed length of the MCC is also more than 2 inches longer (12.5" vs 10.3") and 5.5 ounces (158 g) heavier) than the Super Antenna MP1C coil making the latter better for back-packing and SOTA-type activations as well as air travel.

Chameleon MCC Multi Configuration Coil

Another big difference in the design is how Chameleon feeds the coil directly instead of through its base like most other antennas, Super Antenna included. This means their design makes it virtually impossible to center-load the antenna because the feedpoint will move up with the coil. It also means you can't use a standard mobile mount to feed their MCC. I see this as a major problem since I already have a good assortment of 3/8-24 threaded mounts as seen elsewhere in this book.

To improve the efficiency of many vertical antennas, one solution can be a longer radiator. There are a number of commercially available products that could be used. A longer element will also increase the usable bandwidth of the antenna so you won't have to re-tune as often while moving around the band, particularly on 40m or lower frequencies.

The least expensive option is a Hustler mast. Their 54-inch non-folding MO-3 (about $35) could be used with a 3/8-24 (UNF) coupler nut added to one end. Two of these masts might even be stacked to add 9 feet to your antenna's radiator.

A more compact and elegant solution is Chameleon's MIL EXT. Their current version 2.0 model is 28.1 inches long collapsed and 105.5 inches long when extended. Adding an AT-271/PRC type sectional military-style whip (previously shown) results in a radiating element just over 18 feet long.

One problem you may encounter with an antenna this long is stability, particularly on a windy day. The solution to this problem are guy lines. Chameleon offers a Universal Guying System, but I found a much less expensive alternative: Hustler's VP-1 multi-band adapter kit, about $12. Sandwich the plate between the upper and lower sections, and you can easily add a few paracord guys out to inexpensive tent stakes.

Hustler VP-1 Multi-band Adapter Plate

If you are inclined to make your own vertical antenna, I can offer some ideas to get you started. My own self-supporting vertical antenna uses a bunch of swaged aluminum tent poles. It offers reasonable performance when there aren't any trees to support a wire antenna.

This antenna can be ground mounted via a pipe driven into the earth, attached to a heavy duty camera tripod, or clamped to a picnic table. Examples follow on the next page.

My tent pole antenna has 3/8-24 threads at the bottom, which is a standard for many ham and CB antennas and mounts. A set of counterpoise wires (discussed later) completes the design.

Tent Pole Antenna Parts
with 40m coil and guy system for windy days

The perfect metal vertical for POTA would have a coil to resonate the antenna on 40m but also work on 20m as a full size quarter-wave without the inductance of the coil. By using fewer tent pole sections, this antenna actually covers all ham bands from 40m to 6m without needing a tuner.

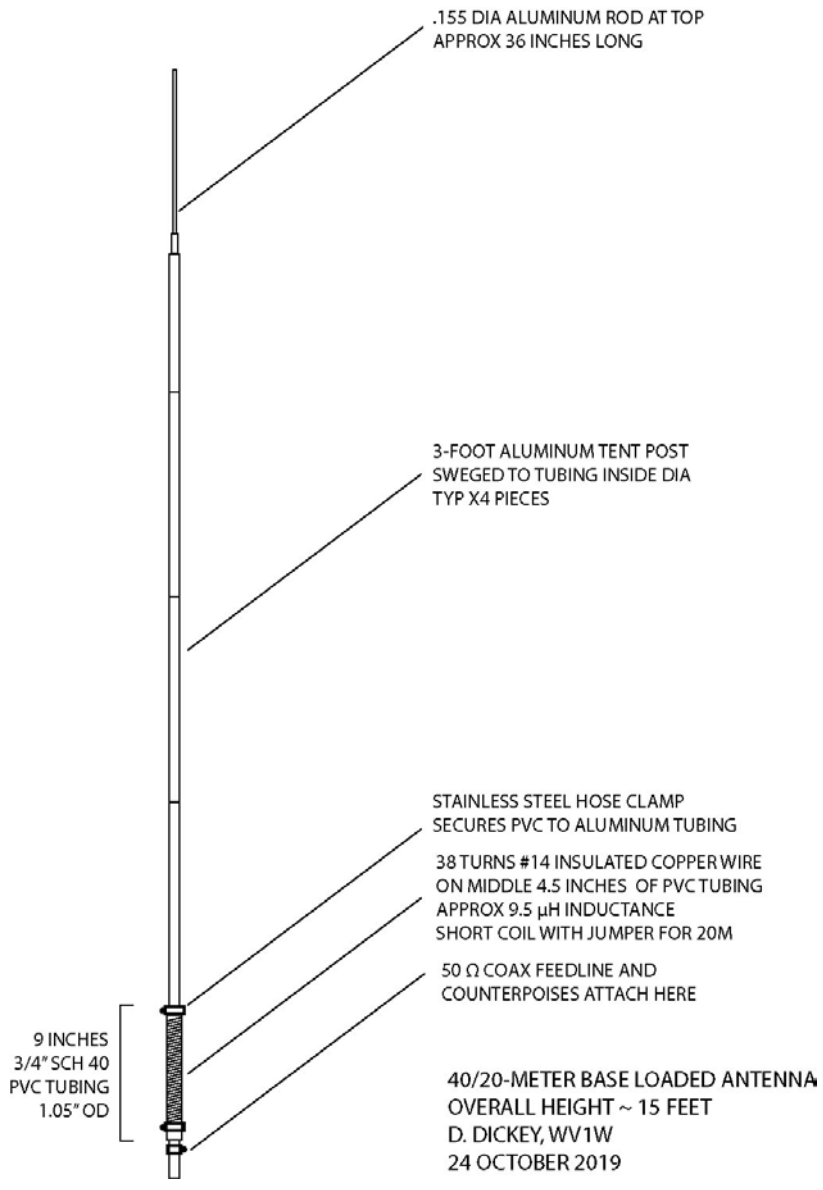
A jumper bypassing the coil is used to switch bands in seconds. I used right-angled push-on terminals for my jumper. I suggest using a bright colored wire so it's easy to see if you set it down on the ground to help prevent the jumper getting lost.

40m Loading Coil
with easily removable jumper for 20m

The top tent pole section has a through cut that can be squeezed together with a small stainless steel automotive hose clamp. This allows it to grip a tunable tip that can be extended up to 3 feet thereby allowing the antenna to cover the lower CW and digital frequencies (FT8, etc.).

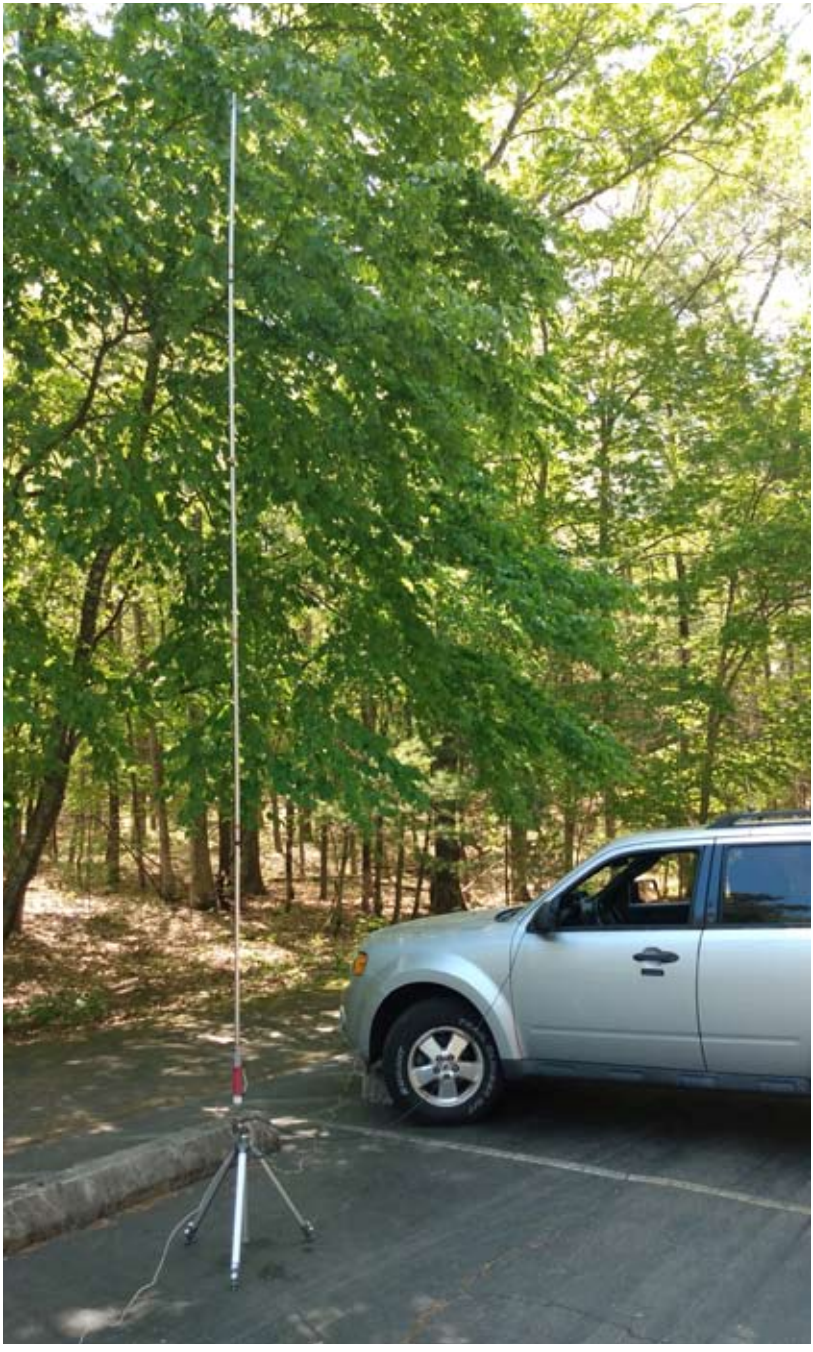
Tunable Tip
can be adjusted in/out for the lowest SWR

40m/20m Vertical Antenna Drawing



TIP: Don't buy anodized aluminum tent poles from Amazon or REI and expect them to work well as an antenna because they will not have electrical continuity end-to-end.

Tent Pole Vertical Antenna with Coil



Tent Pole Vertical on Tripod

Remote-Tunable “Screwdriver” Antennas

The last category of vertical antennas I want to cover includes remote-tunable models. These typically employ a coil of some sort with a motor-driven wiper or contact. They are often referred to as “screwdriver” antennas. Once tuned to resonance, they can be fairly efficient, though this depends mostly on the ground or counterpoise system.

One such system is the Tarheel family of products. Their HP or high-power models can handle full legal power. Their smaller Baby Tarheel and Little Tarheel are more appropriate for POTA and can handle 200 watts on SSB and 50 watts on CW and digital modes. Using a standard 3/8-24 threaded mount, installation is similar to many other mobile antennas, except you must also run control wiring to operate the screwdriver.

Rooftop-mounted Tarheel

Another remote-tuned antenna worth considering is Yaesu’s ATAS-120A. What makes this system unique is how it is automatically tuned by circuitry in several Yaesu transceivers including the highly recommended FT-891.

Yaesu ATAS-120A

The ATAS-120A covers HF (40m and higher), VHF, and even UHF bands. At just over 5 feet tall (extended) it won't be the most efficient antenna on 40 meters, but it does work well enough to make contacts with the simplicity of pushing a button on your radio.

Of course, every antenna has pluses and minuses. The big plus of remote-tunable antennas is their ease of use. You don't have to climb up on the top of your RV to adjust a coil or change a resonator. However, there are basically two serious downsides.

The first negative is cost. Without doubt, these are the most expensive mobile antennas you'll find. Yaesu's ATAS-120A is close to $400, and Tarheels start at close to $500. These prices don't include the extra-sturdy mount they also require.

The second negative is durability and reliability. There is simply more that can go wrong inside these antennas, and they are more likely to fail, especially during foul or cold weather.

Magnetic Loop Antennas

Magnetic loop antennas can be effective and efficient. They are extremely compact and deploy easily especially when compared to many other portable types. They work independently of a ground plane and earth. On the surface, they seem like a good match for portable operation and POTA.

CHA F-LOOP 3.0 Plus
two-section aluminum radiator — diameter < 3 feet

Given their size and other benefits, one would naturally question why mag loops aren't more popular. In fact, I have yet to see one in successful operation among my many personal friends and acquaintances doing POTA.

There are many reasons that magnetic loops haven't been more widely accepted. First off, they represent a major deviation from typical antenna concepts and designs. There is a bit of "black magic" at play as they are not well understood by most "old-school" operators.

Mag loops operates by capturing and resonating the magnetic field component of electromagnetic waves. This contrasts with traditional antennas that focus on the electric field component.

Secondly, they are expensive. Most good commercial models start at $400 and can easily exceed $650 after desired options are added. This puts them outside the budget of many operators, particularly those just getting started with POTA.

Many have severe power handling limitations. The model shown on the previous page handles only 25 watts SSB and 10 watts CW/digital, just about twice what's considered QRP.

Next up, they can suffer from reliability issues. While the mechanical construction of the loop itself is relatively simple, I am personally aware of the many problems a friend has experienced with his magnetic loop, mostly involving the required electronic control box.

Finally, they don't lend themselves to quick and easy band changes. A resonant dipole or full-size quarter wave vertical easily covers an entire band without tuning. By comparison, magnetic loops are extremely high-Q antennas, and frequency changes often require retuning at the control box.

In short, while mag loops do have their followers, I do not presently recommend them for POTA and EmComm.

If you are inclined to consider a magnetic loop, I encourage you to watch some of the videos posted by VE3TWM on his YouTube channel *Outdoors on the Air* where Tracy shares his experiences with a mag loop antenna.

Antennas for VHF & UHF

I must admit that my experience with portable operation on VHF and UHF has been somewhat limited to what is normally mounted to my vehicle and occasionally transferred to a portable tripod instead. This includes a 5/8 wave antenna for VHF and a home-brew antenna with quarter-wave elements for the VHF, UHF, and 800 MHz bands.

TIP: Most 5/8 wave 2m antennas also have a low SWR on 6m. Just be careful not to exceed the recommended power limit.

For any serious long-distance VHF or UHF work, a beam-type "yagi" would be recommended. You forfeit omnidirectional coverage for significantly more gain.

Unlike an HF yagi, you would not need to worry as much about the height above ground as even a speaker stand or painters' pole would provide a full wavelength or more distance from the earth. Some designs can even be hand-held.

For satellite work, a dual-band design would be preferred because the uplink and downlink are normally on different bands. Fortunately, a compact 3 or 4-element design should provide enough gain for many of the newer "birds" or even the International Space Station (ISS).

Since a base station VHF or UHF yagi would typically be mounted high up on the roof or a tower, a rotor is almost always required. For portable operation and POTA, however, you can easily point the antenna by-hand, thereby greatly simplifying the setup.

Unless you have experience constructing things from aluminum tubing, I recommend serious VHF and UHF operators invest in a commercial yagi from one of the reputable antenna companies.

For omnidirectional coverage a simple ground plane design might suffice. For more gain or the ability to operate on multiple bands, a collinear vertical is a better option. My choices would include Comet's GP1 (about $75) or GP3 (about $95). Diamond offers equivalent models in their X30 and X50.

Generally, I would avoid those models (from either company) which have multiple sections as the threaded joint between them can be prone to problems and failures down the road.

If you need wide-band coverage to support activities on both ham and public service or GMRS frequencies, you might want to consider a discone design. While discones basically have unity gain, they offer acceptable SWR over their entire frequency range, typically from 6m all the way to 1,200 MHz.

Wide-band Discone Antenna

Wire Antennas

Easily the least expensive way to get on the air is with a simple dipole made from wire you may have laying around. You really don't need a balun, and the coax can be connected directly to the elements for simplicity. I don't even own a balun!

Before you settle on an antenna, it's important to repeat that most POTA operations right now seem to happen on two primary bands: 20m and 40m. I suggest that you begin with a mono-bander cut for 20m. You can easily attach extra wire later on for 40m if desired.

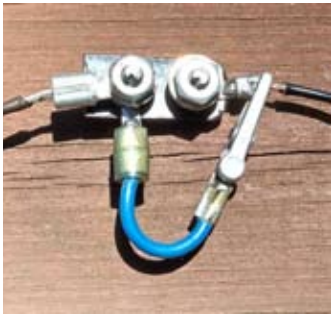
Park rangers might frown on using their trees for antenna supports. That said, it is possible to do so if done carefully. I recommend the inverted-V configuration because it usually requires only one tree. This design is also more omnidirectional than a "flat top" dipole.

Resonant wire lengths are listed in tables later in this book. Start with a pair of wires 16 feet long, one for each side. The final length after tuning will depend on the angle of your V and whether you operate using phone or CW/digital. The wire for my first POTA antenna was actually free, scavenged from a discarded vacuum cleaner a neighbor put out on trash night!

Set the antenna up in your yard or nearby park. Check the SWR and trim equal amounts (a couple inches at a time) off both sides to bring it into resonance.

A more ideal POTA antenna would be resonant on both 20m and 40m with as little effort as possible. The off-center-fed (OCF) dipole or inverted V seems perfect. The only drawback is the need for a very good 4:1 current balun. The better baluns are heavy, requiring a very sturdy/strong center support. The OCF dipole also needs a fair amount of room as the long leg is about 44 feet long.

A less expensive alternative is a linked dipole. This is a mono-band 20m wire antenna with an additional length on each side for 40m. You can bolt these extra sections on using ring terminals at the ends. I use alligator clips to link the sections, and it takes only a few minutes to lower the antenna and change bands.



40/20m Linked Dipole Kit with Coax
includes throw line with weight and lines for ends with stakes

A dipole for portable operation can be much simpler and lighter than you might want at your home QTH. It doesn't have to survive high winds or ice storms. It also won't have time to stretch as deployments will usually be for just a few hours at most. So, while 12 gage hard-drawn copper might be preferred for a permanent dipole antenna, stranded 18 gage lamp cord or speaker wire is perfectly fine for POTA.

SOTA operators might even sacrifice durability for even thinner wire to minimize weight in their kit. Just be careful to avoid CCA (copper-clad aluminum) when sourcing wire.

Dipole Wire Antenna Lengths

USA BAND	CW BOTTOM	CW TOP	CW MID	DIPOLE LEG-FT
160	1800	2000	1900	123.2
80	3525	3600	3563	65.7
60	5332	5405	5369	43.6
40	**7025**	**7125**	**7075**	**33.1**
30	10100	10150	10125	23.1
20	**14025**	**14150**	**14088**	**16.6**
17	18068	18110	18089	12.9
15	21025	21200	21113	11.1
12	24890	24930	24910	9.4
10	28000	28300	28150	8.3

USA BAND	SSB BOTTOM	SSB TOP	SSB MID	DIPOLE LEG-FT
160	1800	2000	1900	123.2
80	3800	4000	3900	60.0
40	**7175**	**7300**	**7238**	**32.3**
20	**14225**	**14350**	**14288**	**16.4**
17	18110	18168	18139	12.9
15	21275	21450	21363	11.0
12	24930	24990	24960	9.4
10	28300	29700	29000	8.1
10T	28300	28500	28400	8.2

General Class Frequencies in KHz
10T = Technician Class Frequencies
Bold = Primary POTA Bands
Leg Lengths in Feet
Overall Length = Leg x 2
Always Cut Long - Trim to Resonance

Dipole/Inverted-V Construction

As previously mentioned, antennas for POTA don't need to be made from the same wire gauge as at your base station. They don't need to follow the same construction methods either. By comparison, portable antennas can be extremely light-duty and still be durable enough to withstand being set up and taken down several times each week. This section will offer some concepts for quick and easy on-site dipole construction.

The feedpoint can be wires connected directly to a coax feedline, either with solder or using ring terminals with standard fasteners like nuts and bolts. A better design might be an off-the-shelf connector with binding posts.

BNC and UHF Binding Post Connectors

BNC-to-binding post connectors are readily available. The one on the right with a PL-259 UHF connector is harder to find.

To hoist the feedpoint, make a U-shaped bend in your coax and secure it with a cable tie. I use a Velcro-type tie for easy on/off. Then tie your throw line to the bend with a bowline knot. This will position the connector with binding posts pointing down.

The ends of your dipole can be standard ring terminals. Crimp and solder them if you are a "belt-and-suspenders" type person. Use thin nylon lines or micro paracord from these ring terminals to tent stakes. It doesn't get much simpler than that!

Easy Links

I often get questions on how to make links, so this page will present some examples to get you started when constructing a linked dipole or my linked vertical featured later in this book.

There are two kinds of links: temporary and permanent. An example of temporary links is when you build a 20m dipole but want the option of adding 40m only occasionally.

These links can be simple ring terminals. When you want to switch to 40m you just bolt an extra segment onto each side. Another solution is to have alligator clips on the ends of your dipole. To get on 40m you simply clip the add-on segments on.

Permanent links are built into the antenna so you always have the option of changing bands. That's like the link already shown. The following are a couple more options to consider.

Single Alligator Clip Link
wires secured to plastic tubing with knots

Dual Alligator Clip Link
wires secured with zip ties as shown or a square knot

TIP: Use a short link to lower the resonant frequency of an SSB antenna so it covers CW/digital band segments.

Locally Available Antenna Parts

If you are making your own wire antennas, there are a few components you don't have to order. One is paracord. Walmart carries black and high-visibility yellow or orange paracord at most stores. Where you find them in your local store can vary. Ozark Trail branded products will be in the camping area along with tent stakes for the ends of your inverted-V. Hyper Tough brands are found in the hardware area. Check their website to see what's in-stock near you.

High Visibility Reflective Orange 550 Paracord
reflective cord is ideal for late shift activations

Walmart also carries heavy-duty black 1100 paracord which I use at home for permanent installations.

You can use an inexpensive high-density polypropylene cutting board from the kitchen tools area to make a center support and insulators for the ends of your dipole. Their Mainstays brand 8.5 x 11 inch board is under $3. They have larger boards if needed for more parts or larger components.

Use a fine-tooth saw to cut the board into the desired shapes. I recommend drawing a template on paper for complicated shapes like a center support. Then, use your drill to make the holes for wire antenna elements and support ropes as needed.

Walmart also carries #36 twisted mason line (230-feet long) which could be used for a throw line in a pinch.

As an alternative to building a linked dipole, a commercial model of this design is available ready to deploy from SOTAbeams and their distributors for about $90.

SOTAbeams Band Hopper Linked Dipole
available for 80m, 40m, 30m, and 20m bands

The speaker wire dipole is a favorite of many successful SOTA operators. Theirs are usually made from thin 24 or 26 gage wire for minimum weight. Mine, designed for POTA, is made from 18 gage wire for more strength and durability. Look for stranded copper wire and, again, avoid CCA wire. If you can't find good speaker wire, Home Depot and Lowe's carry 18 gage lamp "zip" cord which would fill the bill nicely.

20m Speaker Wire Dipole Antenna
simple, inexpensive, & effective

As with any dipole, cut it longer than you think you'll need and trim it to resonance. Start with 17-foot legs for 20 meters and 33-foot legs for 40 meters. Tune for 20m first, then add 17 more feet and trim for 40m. Use alligator clips or connectors between sections for quick and easy band switching. There are plenty of dipole and inverted V antenna calculators on the web which you can use to figure out how much wire you need.

You can skip the PL-259 connector and use a simple banana plug for the rig's antenna jack and a push-on "F" terminal or alligator clip for the rig's ground terminal. You don't need a separate feedline as it is part of the antenna. You can carry add-on linked sections to resonate on lower frequencies.

There are a number of ways to support a dipole or inverted V antenna. A suitable tree limb can be used in some situations. To raise the dipole, you will need a throw line with weight attached. Fortunately, arborists have figured out how to do this, and their tools and gear are perfect for antenna work.

The throw weight is a small fabric or leather sack filled with lead shot. It is less likely to hurt you if it comes down on your head than a rock or piece of metal. Also important, it is more likely to drop freely through foliage than other weights. You can buy arborist equipment online and from the Home Depot.

You can buy the throw weight separately if you already have an appropriate line. A highly visible color is best so you can see where it went after launching. You can use this to pull up your antenna or use it to pull up another support line.

Arborist Throw Line and Launcher
with throw weight

I use an swinging underhand toss to loft my throw line over a branch and can reach limbs as far as 40 feet up. Sometimes it takes a few tries to get the right spot.

If you have limited dexterity, a “Big Shot” launcher may offer a viable solution. The launcher uses a slingshot type device to propel the weight in the direction you point the pole. The pole comes in two 4-foot sections to easily transport. Cost is about $150 without the trigger accessory which adds another $60.

Sometimes the limb you want to hang the antenna from is out of reach for an underhand toss of your arborist throw weight. Instead of purchasing an expensive dedicated launcher to tackle this problem, I take a simpler almost free approach.

My current POTA kit includes an 8-foot spinning rod and reel. The rod breaks down into a pair of 4-foot sections, so it fits easily in the car trunk. There are travel rods that break down into smaller sections if desired for even more portability.

The reel contains about a hundred yards of 20# monofilament line. You don't want really strong mono because you may have to break the line if it gets hung up in a tree. My guess is that many POTA operators already have a setup they can use.

2-Piece Spinning Rod
medium-duty, 8-feet long

To deploy this system, you will need a weight to cast over the desired tree limb. I use a half-inch bolt about 2 inches long with a nut attached. A better solution would be a 3 or 4-ounce "bank-type" lead sinker available on Amazon or at your local tackle shop. Get some spares as you will eventually need them.

Tie your mono line to the sinker. You can use a snap swivel if desired. Cast the weight over the desired branch. It should drop through the foliage. If not, try again.

Then, remove the sinker and attach your regular throw line to the mono. When you reel it in, you will replace the mono with the heavier line used to raise your antenna. Do not attempt to raise your antenna with the light-duty mono line.

Another popular wire antenna design that works well for POTA is end-fed. This can be either random-length (non-resonant) usually fed by a 9:1 transformer or a resonant half-wave fed with a 49:1 to 64:1 transformer. Sometimes these transformers are called an “unun” and sometimes they are an “auto-transformer.” In both, it is typically a wire-wound toroid, often in an enclosure, attached to a length of wire used as the radiator. Sometimes a ground and/or counterpoise is added.

The random-length version usually requires an antenna tuner and the one in your rig might work, but sometimes an external tuner with expanded range will be needed.

The resonant half-wave version usually does not require a tuner unless you try to operate at the opposite end of the band for which it was designed, on CW or FT8 for example.

MyAntennas End Fed Half Wave Antenna
resonant on 40/20/15/10m without tuner

You can wind your own transformer or use a kit, but many POTA operators choose to buy it with or without a radiator. Search the web for “end-fed antenna” and you’ll find sources such as Balun Designs, Chameleon, MyAntenna, and Nelson. Portable models often skip the enclosure and use shrink-wrap.

If you purchased or built an unun transformer you might want to test it before connecting it to your transmitter! Fortunately, this is easy to do if you have an antenna analyzer.

Head over to your workbench with:

- unun to test
- antenna analyzer
- double-male UHF connector
- carbon resistor (value below)

To test a 9:1 unun the resistor should be 9 x 50 = 450 ohms.

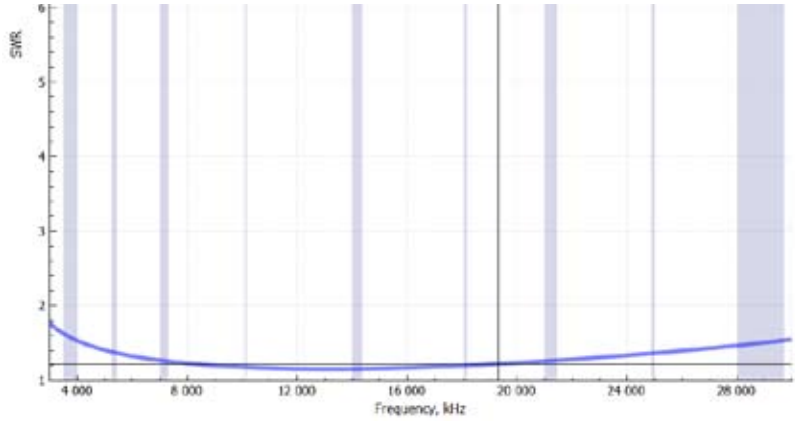
To test a 49:1 unun the resistor should be 49 x 50 = 2,450 ohms.

TIP: If you don't have a single resistor of the desired value you can connect multiple resistors in series and sum their combined values to get close.

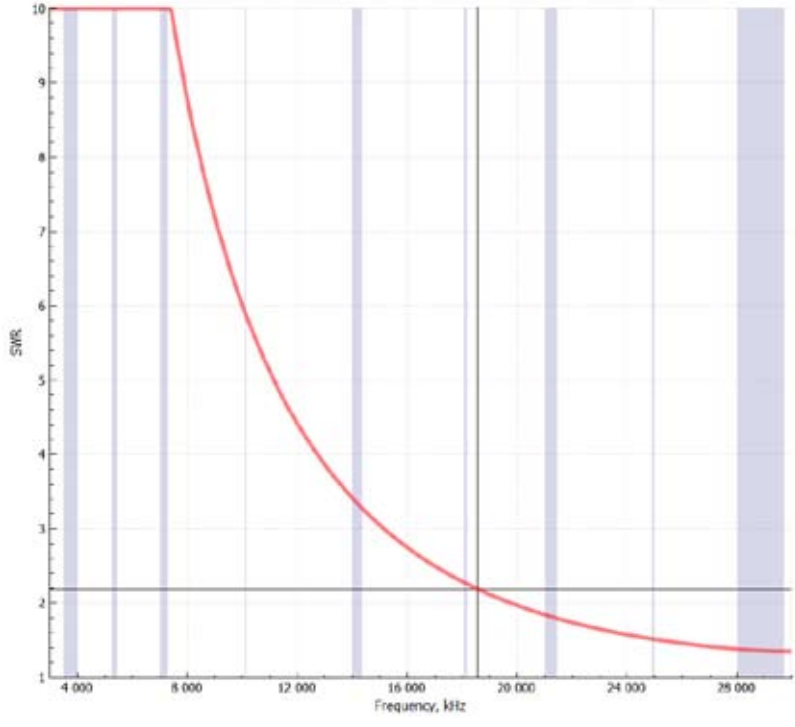
Attach the 50 ohm low impedance side of your unun to the analyzer with a double-male connector. Attach the resistor across the high impedance side of the unun.

Use your analyzer to sweep the frequency range you plan to use, typically from 3.5 to 30 MHz for HF operation. The plot should exhibit a low SWR across that entire range, normally under 1.5:1 and preferably much lower.

TIP: If possible, connect your analyzer to a computer via USB when running test plots. As an alternate in the field, you might connect it to your phone or tablet via Bluetooth. Many analyzers from Rig Experts have these useful features.



Good 9:1 UNUN Test Plot
acceptable SWR over entire range



Defective 49:1 UNUN Test Plot
high SWR over entire range

The defective unun plotted above was returned to the dealer.

I prefer resonant antennas because I can usually leave the tuner in the car. Nevertheless, sometimes the antenna which worked perfectly in my yard refuses to present a low SWR in the field. That's why I don't leave the tuner home. Every once in a while, for reasons out of my control, even a normally resonant antenna wants help from a tuner. It's best to be prepared.

There are some POTA operators who use non-resonant antennas and simply rely on a tuner all the time. Chameleon's *Hybrid-Mini* and *MPAS* kit are examples of good non-resonant antennas. This approach can indeed remove lots of frustration from the process. It's much easier to push a button and tune the antenna automatically than fuss with adjustable coils, telescopic whips, and linked dipole elements.

The primary reason I prefer resonant antennas is performance. When I compared a non-resonant wire with 9:1 unun to my resonant inverted-V the difference became apparent. Stations I could work using the resonant antenna couldn't even be heard with the non-resonant wire, and both had about the same capture area. Michael, KB9VBR, found the same to be true when comparing his resonant WRC SB1000 setup to a similarly sized non-resonant Chameleon MPAS with Mil whip.

So, while non-resonant antennas are almost universally less efficient than resonant ones, sometimes this is a small price to pay for the best use of your time and energy. This is one of the decisions you'll face, and the choice you make for one activation might change for another!

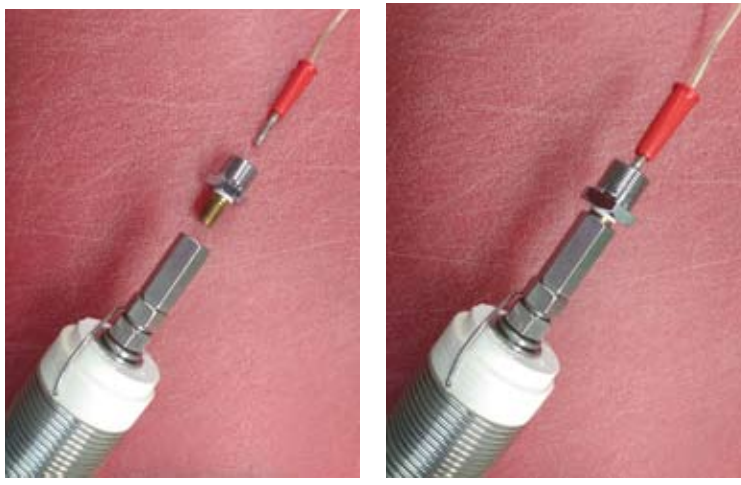
While I prefer to use my wire antennas because I think they work the best, I usually bring the tent pole antenna along to have an option when there's no way to hang a wire. Similarly, I also carry a long wire (~ 62') and tuner for situations where the supporting tree is not near where I want to operate. This is essentially an end-fed antenna, and it works quite well on all HF bands with SWR adjustments as required via the tuner.

Antennas for the Low Bands

While most POTA activity can be found on 40m and higher bands, some operators may want to get on 75/80m or maybe even 160m. Those with a full-size WRC Silver Bullet 1000 or REZ Ranger 80 coil can tune down to 3.5 MHz if they also have a 17-foot whip. Those who purchased a short whip might be out of luck, but there is an economical solution: use a wire!

The challenge is simple: attach a wire to the upper end of a coil. One easy way would be to add a 3/8-inch diameter ring terminal to your wire and simply fasten it with a short 3/8-24 (UNF) machine screw.

There's a better way! Use the core from a 3/8-24 stud mount to make your coil ready to accept a standard banana plug.

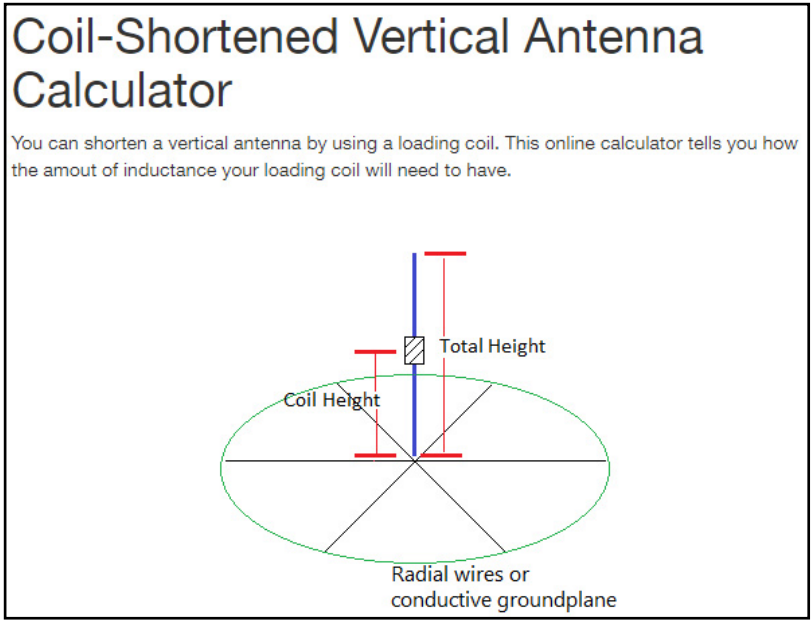


Stud Mount as Wire Adapter
between WRC coil and banana plug on wire element

Thread the stud into the top of your coil and plug in the wire. For 75/80m use a wire that is at least 10 feet long, suspended from a tree limb or portable mast. For 160m the wire needs to be at least 43 feet long. In either case, a longer wire will improve efficiency since it will require less inductance.

You might want to know how I came up with those numbers! This page will demonstrate where to find and how to use an online calculator to save lots of time in the field.

Start by visiting this site: **www.66pacific.com/calculators/**
On the left side, click **Coil-Shortened Vertical Antennas**



Coil-Shortened Vertical Antenna Calculator

- For Total height of antenna in feet, start with **40**
- Distance from antenna base to the center of the coil, enter **0**
- Diameter of the conductor, enter **0.064** for 14 gauge wire
- Operating frequency in MHz, enter **1.8** for 160m
- Click the **Calculate** button

Change the total height and recalculate until the inductance is 83 µH or slightly less (the inductance of WRC's Silver Bullet 1000 coil from their FAQ page). You should end up at about 43 feet using an inductance of 82.8 µH from the WRC coil.

Once while vacationing on Lake George I wanted to check into a net on 3.999 to connect with an old friend. I had packed light for the week with just a pair of hamsticks plus my 40/20m linked vertical wire antenna (in the next section). I started thinking about what I could put together to get on 75m.

Enjoying a cocktail on the dock with my wife, I realized that the empty blood mary mix bottle could be a simple coil form! It was very sturdy plastic compared to a 1-liter seltzer bottle.

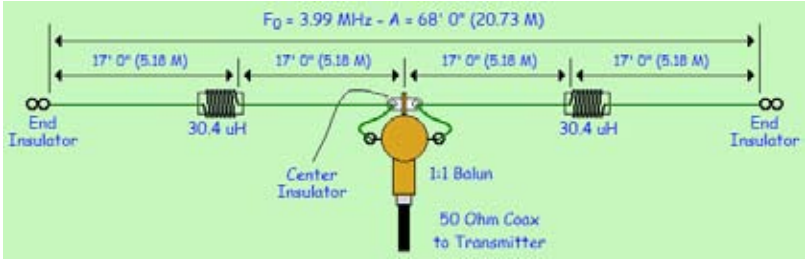
Bloody Mary Mix 75m Loading Coil

I had some spare 16-gauge wire in my kit which turned out to be just enough to wind the 20 µH loading coil I calculated would be required. A few zip ties held the wire in place. After some experimentation, when I added my 33-foot linked vertical wire to the top this coil I was able to tune up on 75m. Sometimes you need to be creative, and portable operation can provide surprise opportunities to do so.

If want to get on 75/80m but have limited space in your yard, my tri-band linked dipole might be for you. It uses a pair of loading coils in the middle of a pair of 40m elements.

With coils in the circuit it tunes up on 75m. With the coils bypassed with a shorting jumper it tunes up on 40m and possibly 15m as a harmonic. With open links (not shown) before the coils it tunes on 20m using just the inner segments. Cut your segments a little longer if making for CW/digital.

I used a pair of 2.5-inch diameter plastic vitamin bottles for coil forms and cut off the tops and bottoms to reduce weight. The coils had 23 turns of 16-gauge insulated stranded wire.



Shortened 80m Dipole

30 µH Vitamin Bottle Loading Coil

The wire components have ring terminals on both ends, and the whole assembly is literally bolted together with small machine screws and nuts. Overall length is about 68 feet.

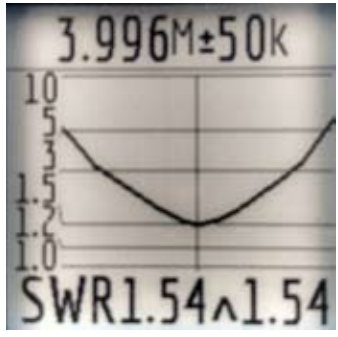
For operators looking for a simple and compact way to get on 75/80, Super Antenna offers the MC80 coil. This is designed to work with their MP1 and is added below that antenna's adjustable coil for 40-10m.

Don't expect miracles from a 7.5-foot high antenna on 75m! It is highly compromised, has very limited bandwidth, but you might still have fun making contacts with it. You could use a tuner to make frequency adjustments less sensitive.

Super Antenna MC80 Coil

The MC80 has 3/8-24 threads on both ends and is supplied with a brass 3/8-24 stud that allows it to be added to the MP1 or even another antenna like a WRC Sporty Forty.

If you already have a 40m hamstick you could add the MC80 above the fiberglass base and attach the stainless steel stinger to the top of the coil. I was able to get very acceptable SWR using this setup. **TIP**: Using a telescoping whip instead of the fixed length stinger would allow you to adjust the length for tuning the antenna to resonance across most of the band.



40m Hamstick with MC80 Coil

Antennas for the High Bands

This antenna is sometimes called a Tuned Transmission Line Trap or T2LT. It is essentially a vertical half-wave dipole.

The design includes two quarter wavelength (¼λ) sections except they are arranged one above the other and are end-fed at the bottom instead of side-by-side and fed in the middle like a horizontal or "V" dipole. The trap, usually a simple coil, separates the actual antenna components from the feedline.

This is a mono-band antenna. Refer to the *Dipole Antenna Wire Lengths* table for ¼λ dimensions on the desired band. Example: ¼λ = 8.2 feet for the middle of the 10m Technician phone band. This antenna + trap will be about 17 feet long.

The top section of my T2LT is a ¼λ piece of insulated wire connected to the center pin (only) of a PL-259 male plug. This plug is attached to a double-female "barrel" connector between the sections.

The bottom section of the T2LT dipole is a ¼λ length of coax (connected to the other side of the barrel) followed by a trap to isolate the antenna from the rest of the coax which serves as a feedline.

My T2LT antennas are made using inexpensive RG-58 coax with standard PL-259 plugs on both ends. RG-58 is lighter than RG-8X and bends nicely and closely around a 4-inch coil form.

TIP: You can make the T2LT out of 75-ohm CATV coax if that's what you have.

The trap is formed with 8 to 12 turns of coax secured on a suitable plastic form between 3 and 5 inches in diameter.

It should be as high off the ground as possible, ideally ¼λ for best performance.

TIP: an empty plastic peanut butter jar makes a strong and lightweight coil form.

Coax Choke aka Trap
sometimes called an “ugly balun”

Some experimentation is to be expected, adjusting section lengths and coil position up/down the coax for lowest SWR. Of course, an analyzer will make tuning easy and precise, but you can use the SWR meter in your rig if you don’t have one.

Advantages of the T2LT design include excellent on-air performance with a low radiation angle good for DX, no transformer (efficient), no radials (tiny footprint), and it is easy to build with commonly available inexpensive materials.

One disadvantage is the requirement for a support. I installed a ring terminal at the top for hoisting via an arborist throw line. While a suitable tree limb could easily work in many locations, some operators will need a mast to deploy this antenna. Overall height limits this design to 20m and higher bands.

TIP: Since this is a monoband antenna, you may want to make several for your favorite bands. I have had particularly good results with a T2LT built for 17m. The auto-tuner allows it to also work on 15m with acceptable performance.

Stacked Vertical

Chances are you never heard of this antenna design. It is really simple once you learn how it is designed. My stacked vertical covers 8 bands, and you can make it with wire you might have on-hand. When done, the antenna will fit in your pocket.

The design is basically a quarter-wave ground plane. It is similar to the linked vertical (covered later) but uses bolted joints instead of links for simple and easy construction.

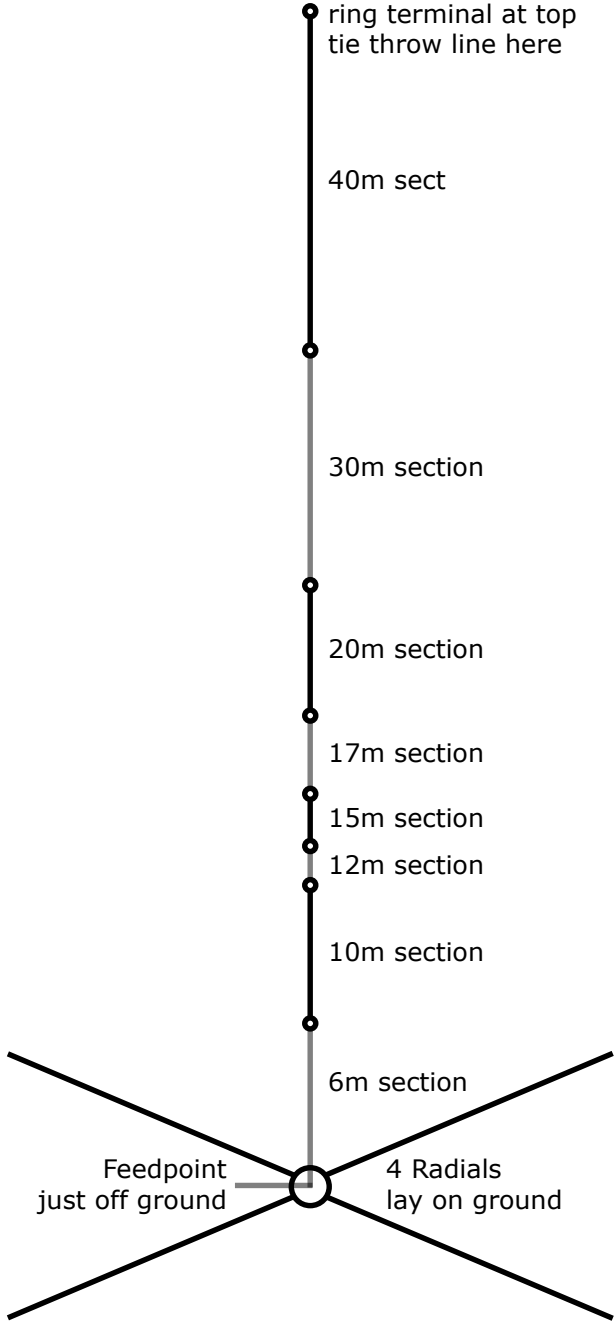
Typically, this antenna will be hung from a tree or non-conductive mast. The top of each section has a ring terminal for hoisting via an arborist throw line. The antenna has a banana plug at the bottom that fits into a standard double-female "barrel" connector for a coax run to your rig.

All segments bolted together create a quarter-wave 40m vertical. By unbolting segments and using what's left below you can change bands as desired. It doesn't take very long to lower the antenna and remove a section (or several). You can leave the 40m and 30m sections home if they aren't needed.

Like any ground plane, it also requires a counterpoise system, usually a set of untuned radials laying on the ground. I simply clip radials onto the outside of the coax plug.

The antenna should be approximately a quarter wavelength (¼λ) long for each band. Refer to the *Dipole Antenna Wire Lengths* table in this book for approximate dimensions. I tuned mine for the middle of the General class phone band segments except 10m for the Tech class phone segment and 30m for FT8. Make yours for CW frequencies if desired.

To build the 8-band stacked vertical antenna, you need about 33 feet of wire. Separated zip cord or speaker wire would be fine. I used 18-gage insulated stranded wire scavenged from a vacuum cleaner power cord found by the road on trash night.



8-Band Stacked Vertical

I alternated black and white wires in the "stack" to make sections easy to distinguish. Section lengths are approximate. Cut segments long and trim to resonance for lowest SWR starting with the bottom and working your way up the stack.

Crimp or solder ring terminals to section ends after trimming. Label sections with a fine point marker and a narrow piece of white first aid tape wrapped around the terminals.

6m	10m	12m	15m	17m	20m	30m	40m
53	45	14	19	23	42	81	111
white	black	white	black	white	black	white	black

SSB Stacked Vertical Wire Sections
dimensions in inches

You can modify the build for CW/digital frequencies or simply use a short add-on section to tweak the SWR when needed.

6m	10m	12m	15m	17m	20m	30m	40m
56	44	13	20	22	44	78	120

CW/Digital Stacked Vertical Wire Sections

8-Band Stacked Vertical
showing all sections bolted together

You might wonder why I included a 15m segment when this antenna will resonate on that band "for free" as the 3rd harmonic of 40m. Good question! The 15m segment allows this antenna to work without that long 40m wire, just in case you don't have a tall enough tree or long enough mast for it.

You could use bullet-type snap connectors to make connections completely tool-less, but I found these eventually become loose, and they're also hard to pull apart with cold fingers.

If you have an aversion to using regular nuts and bolts, another tool-less option might be to use fasteners with wings. Most home center and hardware stores stock these parts in the area with drawers of specialized fasteners.

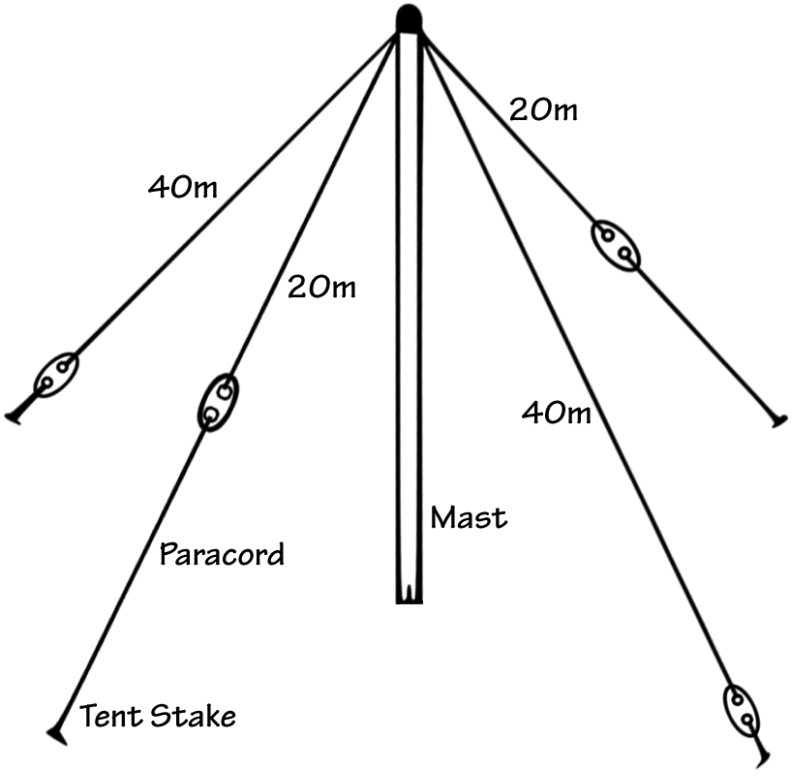
Wing Bolt & Wing Nut

Radials are discussed in more detail later in this book.

Clip-on Radials Are Part of this Antenna Kit

Crossed Fan Inverted V

While NVIS isn't normally a type of propagation most POTA operators specifically look for, this hybrid fan-dipole design can offer the best of both worlds. You can expect close-in NVIS contacts on 40m but also omnidirectional long distance contacts on 20m and with automatic band switching.



Crossed Fan Inverted V
40m NVIS with 20m and 15m skywave propagation

To set up this antenna, you need a center support which is strong enough to handle the feedpoint with coax connected. This could be either a tree limb or very sturdy portable mast.

The "hot" sides on both bands are connected to the coax center conductor, and the opposite sides are connected to the braid.

Inverted V Wire Antenna Lengths

USA BAND	CW BOTTOM	CW TOP	CW MID	INV-V LEG-FT
160	1800	2000	1900	117.0
80	3525	3600	3563	62.4
60	5332	5405	5369	41.4
40	**7025**	**7125**	**7075**	**31.4**
30	10100	10150	10125	22.0
20	**14025**	**14150**	**14088**	**15.8**
17	18068	18110	18089	12.3
15	21025	21200	21113	10.5
12	24890	24930	24910	8.9
10	28000	28300	28150	7.9

USA BAND	SSB BOTTOM	SSB TOP	SSB MID	INV-V LEG-FT
160	1800	2000	1900	117.0
80	3800	4000	3900	57.0
40	**7175**	**7300**	**7238**	**30.7**
20	**14225**	**14350**	**14288**	**15.6**
17	18110	18168	18139	12.3
15	21275	21450	21363	10.4
12	24930	24990	24960	8.9
10	28300	29700	29000	7.7
10T	28300	28500	28400	7.8

General Class Frequencies in KHz
10T = Technician Class Frequencies
Bold = Primary POTA Bands
Inverted V Angle = 45 Degrees
Leg Lengths in Feet
Overall Length = Leg x 2
Always Cut Long - Trim to Resonance

You don't need a balun, but you could use a 1:1 voltage balun if you have one and are so inclined. None of my antennas include a balun, and they work just fine.

Element lengths for SSB or CW/digital frequencies should be about the same as for an inverted-V listed in the table on the previous page. Expect some interaction between the two bands, and experimentation/trimming may be required.

Some readers may wonder just how a fan dipole works. The answer is simple. Those elements who's resonant frequency matches that being either received or transmitted absorb or transfer most of the energy. The non-resonant wires are basically ignored. This is yet another example of the magic of resonance and why it is so important to antenna design.
TIP: Consider a 20/10m crossed fan when space is tight.

So the next question is why this antenna exhibits short NVIS propagation on 40m but has the potential for great omnidirectional DX on 20m. The answer has to do with the proximity in wavelengths of the elements to ground.

With the 40m elements so close to the earth, most of the RF energy is sent straight up which hits the ionosphere and bounces right back down. The 20m elements are closer to a quarter wavelength above the earth so tend to radiate at a much lower angle thereby skipping out at a similar angle to greater distances. This design can work for both POTA and EmComm.

The supporting mast or tree limb should be 20-24 feet high and, ideally, all four elements should terminate with insulators and a length of paracord. The 40m elements need only a couple feet of cord, but the 20m elements will require about 18 feet (each) so the angle from the mast is 45 degrees or more.

A benefit from this design: the elements with their attached cords anchored by tent stakes also act as guy lines for the mast. This antenna, properly installed, can withstand a good breeze.

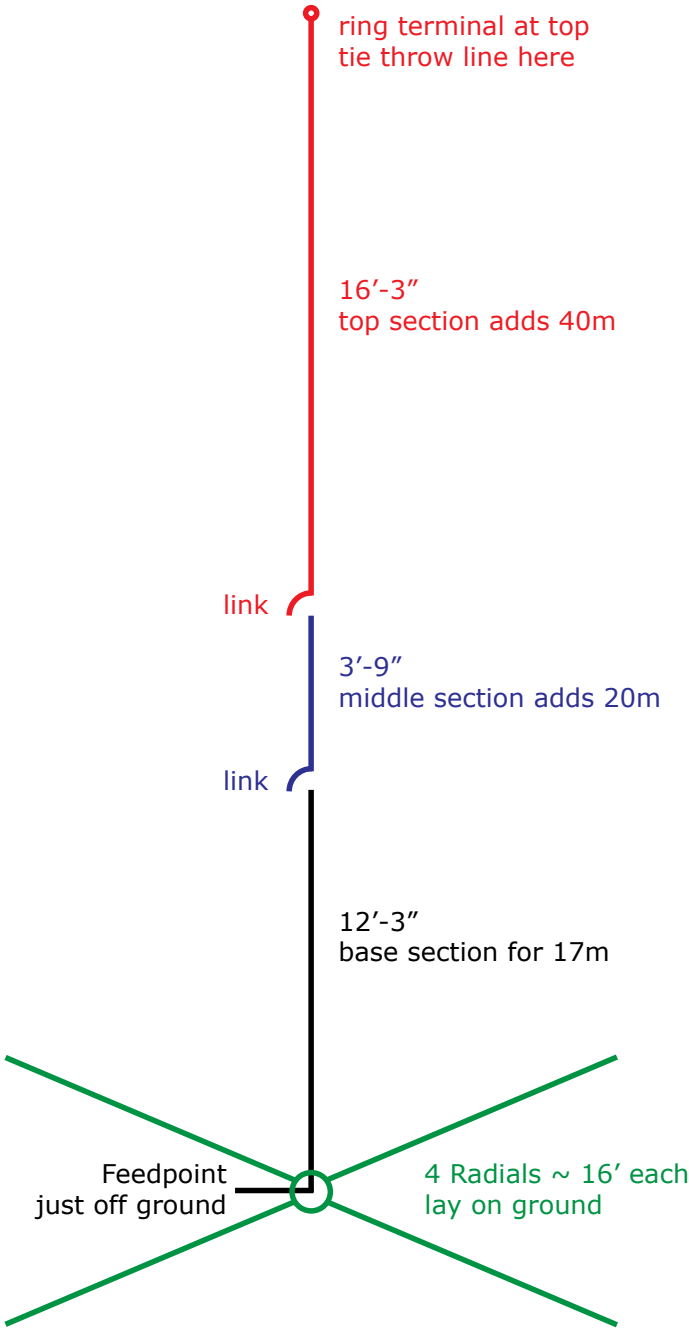
Original Linked Vertical

This truly original portable antenna is a full size quarter-wave linked vertical wire. The unique yet simple design takes the concept of a linked dipole, turns it 90 degrees, and uses a set of radial wires at the base for the counterpoise system.

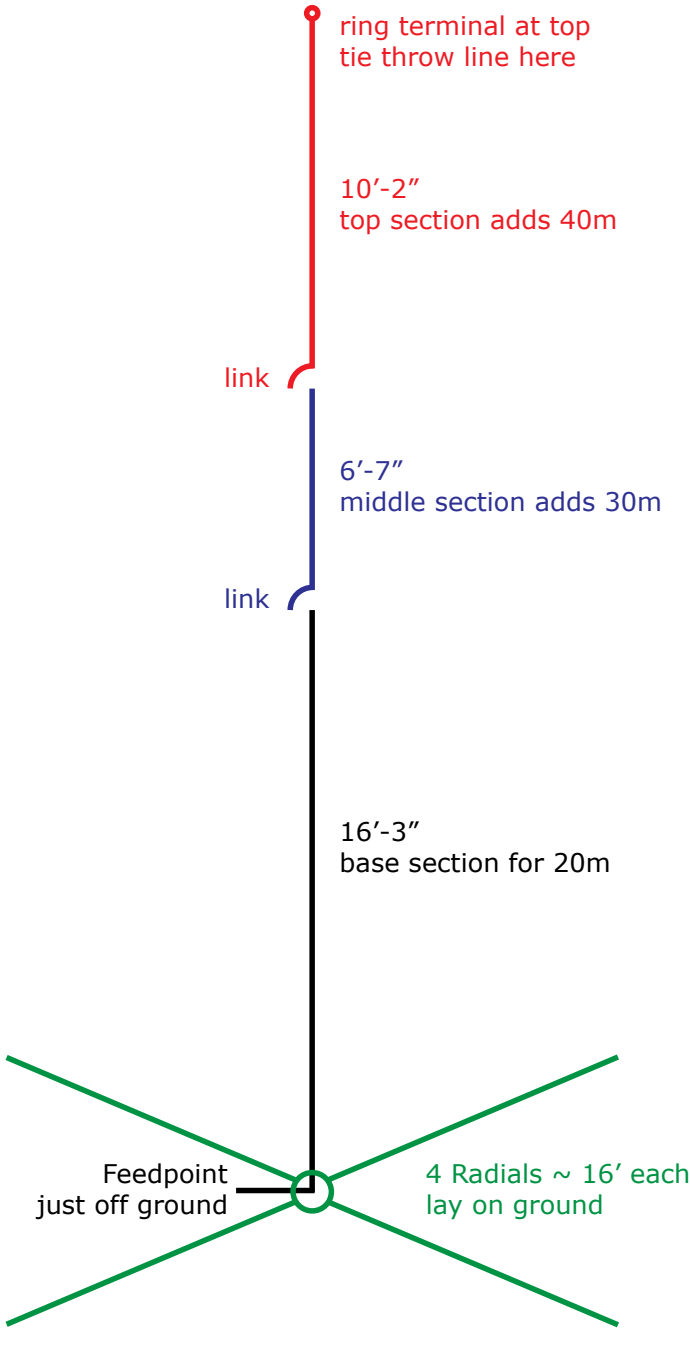
I initially created two designs, one for 40/20/17m SSB and another for 40/30/20m CW & digital modes. Since 21 MHz is the third harmonic of 7 MHz, with the links closed for 40m you can also tune up on 15m using either design. As a three quarter wave (3λ/4) antenna it works quite well. You could easily add more bands to yours using more links if desired.

The links can be like those shown previously for a linked dipole. The base is terminated with a banana plug to fit any standard female UHF connector. The top has a ring terminal where I tie a nylon line to hoist it from a tree limb. It's much quicker and easier to lower for band changes that a linked dipole, and radiation is omnidirectional at a low angle for DX.

Original Tri-Band Linked Vertical



40/20/17m SSB Linked Vertical



40/30/20m CW & Digital Linked Vertical

The wire radiator is usually connected to a RG-58 coaxial feedline using a standard double-female “barrel” connector.

Linked Vertical Feedpoint
with double-female connector

When coax is used, radial wires, usually four in sets of 2 x 16 feet long, are attached to the barrel connector or PL-259 plug using a copper alligator clip. If the SWR is higher than normal for some reason just clip on another set of radials.

This compact 40/20m version of my linked vertical antenna kit complete with two sets of radials fits in a plastic sandwich bag and weighs 13 oz or 370 g. The 18-gauge wire in this antenna easily handles 100 watts QRO power from my rig.

40/20m Linked Vertical Kit with Radials

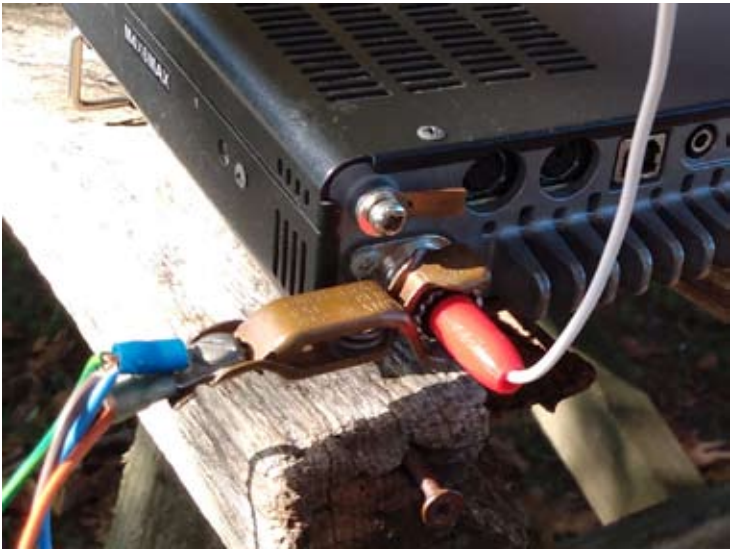
Sometimes, when I attempt to deploy this antenna over ground that has very low conductivity, I have trouble with high SWR. If I'm lucky, I can fix the problem by attaching another set of radial wires. That's easy enough since they just clip on.

There are places, however, where more radials don't help lower the SWR to an acceptable level, particularly if I am setting up over sandy soil. This is often the case on or near the beach, and living in New England, many parks are coastal.

With this antenna kit there is a "Plan-B" that can work when the ground under the antenna doesn't provide a suitable counterpoise: it converts into an inverted-V! By changing the feedpoint to an elevated position, the linked element and radial wire can be configured into a dipole.

The linked vertical's banana plug can also be plugged directly into an SO-239 antenna jack thereby eliminating the need for a feedline. This can make your kit even smaller and lighter.

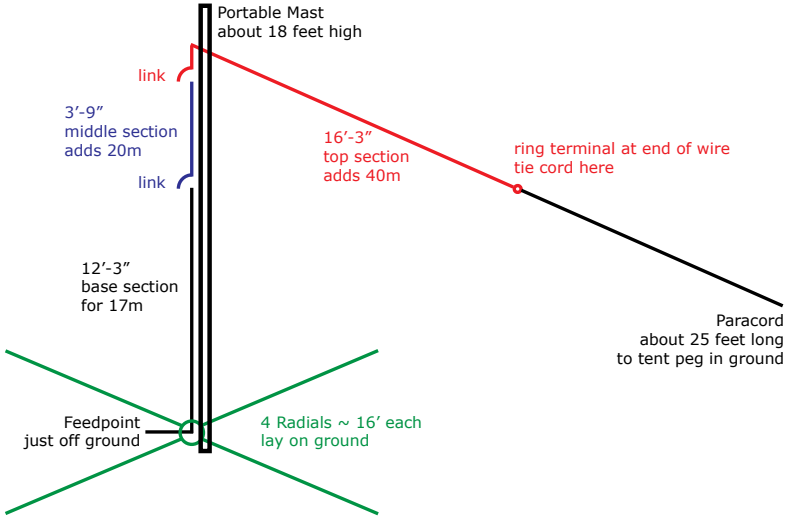
Linked Vertical Plugged into Yaesu FT-891



Radials Clipped To Outside of SO-239

If a tree or other suitable object is not available, the linked vertical may be supported using a portable mast (covered in another section). Do not use an aluminum or other conductive mast which would significantly de-tune the antenna.

If you want to deploy a 32-foot long version of the linked vertical covering 40m but don't have a high enough tree or tall enough mast, bend the top of the antenna over into a downward pointing sloper. This lets the full-size 40m antenna work using an 18-foot high portable mast sized appropriately to support a quarter-wave 20m antenna. Expect some NVIS propagation on 40m with this low-to-ground configuration.



40/20/17m SSB Linked Sloper

For a low-cost support mast solution, jump ahead to the Portable Masts section for one made from schedule 40 plastic pipe. Another economical option is a telescoping fishing pole sold for catching crappie or carp. Search Amazon for "Kamonda" to find some of these. Be gentle, as light-weight fishing poles aren't very strong or durable, but they're cheap enough to try, especially for a lightweight QRP setup with a linked vertical made from thin gauge wire.

My Favorite POTA Antenna

This antenna is the result of evolution, an example of what the Japanese call *Kaizen* representing continuous improvement. It combines the stacked vertical concept with the linked concept but substitutes single-pole single-throw (SPST) rocker switches for links.

You might ask why, and that would be a reasonable question. First off, you have the ability to operate on several more bands than the original linked vertical PLUS you can switch between your three favorite bands in seconds using the switches.

In my own build, the switches are used at the 17m and 20m link points. With switches closed, the antenna resonates on 40m, but it takes very little time and effort to drop the antenna and change to either 20m or 17m by opening a switch.

8-Band Stacked & Switched Vertical

I retained the banana plug feedpoint from previous designs. Like the 18-gauge wire, the rocker switches were scavenged from discarded vacuum cleaners found on trash night. This is basically a “free” high-performance vertical antenna that fits in your pocket! If you build this antenna it is important to use switches that have good isolation between the poles to prevent RF from bypassing when the switches are open.

Mounts

A CB-type mirror mount can be very useful. While obviously designed to clamp on a horizontal or vertical tube ("V" plate works both ways), using a standard "C" clamp you can also attach just the angle bracket to things like a sign post.

Stainless Steel Mirror Bracket with 3/8-24 Stud Mount

The mirror mount can be used for adding your hamstick to a balcony rail or fence. I use mine on the stern of our sailboat.

Ready for Maritime Mobile POTA
mirror mount on sailboat stern rail

A mirror mount attached to a piece of pipe or angle iron driven into the ground can get you on the air fast and within budget. Some operators use a 12-inch spike from the Home Depot or a 12.5-inch tent stake from the camping section at Walmart. I have such a setup for days when I feel like activating with as little effort as possible. You might want a mallet in your kit if you use a spike mount and encounter hard packed earth.

Note that this arrangement is not ideal in cold weather when the ground is frozen.

Spike Mount
with SO-239 connection and right angle adapter

TIP: If using a piece of pipe, put a large bolt in the top of it to take the brunt of being hammered into the ground.

My favorite ground mount is more expensive but easier to deploy because the spike is only 6 inches long. It uses a pedestal base often sold for supporting corner flags on a soccer field. The cost is about $15. It works very well, even with a full-size 20m vertical, because the disk helps prevent it from tipping over. Attach a mirror mount to the pedestal with longer bolts or a heavy-duty stainless steel hose clamp.

Pedestal Mount
with SO-239 connection and right angle adapter

Pedestal Mount in Ground

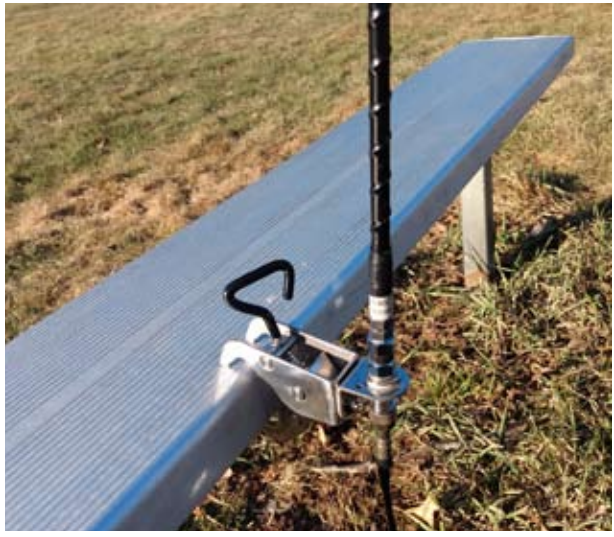
The Super Antenna UM2 is a clever gadget. It has tapped holes for both 1/4-20 and 3/8-16 tripod screws, a U-bolt for fastening to a pipe or railing, and it also comes with a large C-clamp which can fasten it to a picnic table or other fixed object.

Super Antenna UM2
universal mount for 3/8-24 antennas

Since the UM2 is frequently out of stock, the jaw clamp below is another excellent option which can often be found on Amazon. This can even clamp onto the ball if you have a trailer hitch. Like the UM2 above, the 3/8-24 stud mount can be rotated 90 degrees for horizontal or vertical configurations.

Workman QRCS3 with Firestik K-4A
jaw clamp with 3/8-24 mounting stud

Here are examples showing the versatile jaw clamp deployed with a hamstick. Radials can be attached to the mount using alligator clips if required. Sometimes the object clamped to provides a suitable counterpoise and radials aren't needed. "Even the blind squirrel finds a nut once in a while!"



Aluminum Bench

Guard Rail Cable

Tripods are very convenient. They work almost anywhere: on top of concrete, asphalt, wooden decks and also frozen ground.

Models from SuperAntenna and Wolf River Coils are perfect for hamsticks, Hustlers, and similar mobile antennas. They are lightweight, and legs are only about a foot long for good portability. Their 3/8-24 mounts include standard SO-213 coax connectors. The SuperAntenna hub also includes push-on lugs for fast and reliable radial connections.

Antenna Tripod Components

While these lightweight tripods can be blown over in a stiff breeze, you can use tent pegs or weights to hold the legs down.

SuperAntenna Tripod
shown with 20m hamstick attached

If you are deploying a 17-foot whip or plan to operate on 75m with a large coil, consider a heavy-duty field tripod instead. This type of tripod is my go-to solution in winter because it works on top of snow and frozen ground when the spike and pedestal mounts are unusable.

One downside of a tripod is that it can be toppled by a breeze. When buying a tripod for an antenna, choose a heavy duty model with a hook that you can hang a weight from, like a plastic jug filled with water or sand, to help keep it from tipping over. You can also bungee the hook to a corkscrew-type pet stake twisted into the ground.

Shadow Tech Field Tripod
low-profile with detachable hook for hanging a weight

Another useful feature is a low-profile configuration as shown above. The wider footing provides additional stability.

Less expensive sturdy tripods may be available. One example is the SLIK Pro 700 DX. Search Amazon or B & H Photo Video and similar professional photography equipment dealers. For POTA you don't need a pan head which is sometimes sold as an accessory for the tripod legs.

Wolf River Coils offers a camera tripod adapter plate with a 3/8-24 threaded stud mount. It has a 1/4-20 tapped hole that accepts the screw on most amateur camera tripods. It includes a bolt with wing nut for attaching radials.

WRC Tripod Adapter Plate

Another tripod-compatible 3/8-24 threaded mount is the Super Antenna UM3 that comes with their spike kit. It has a 3/8-16 tapped hole that fits the larger screw on heavy-duty professional camera tripods. The UM3 has a pair of quarter-inch tabs for radials with push-on F-type disconnect terminals.

Super Antenna UM3 Mount

I like to keep the base of the antenna as low as possible using a low-profile configuration. The reasons for this will become clear in the discussion of radials on the next section.

Radials

No discussion of antennas would be complete without talking about a counterpoise or radial system. The typical vertical antenna will not function very well without one, J-poles excepted. In particular, all popular commercial POTA antennas like the Wolf River Coils TIA, Buddystick, and Super Antenna require a good counterpoise to work well and include some kind of counterpoise with their kits.

If the antenna is ground-mounted or has a base less than 18 inches up, radials can lay directly on the ground and do NOT usually need to be tuned to resonance as they couple to the earth. Note that with low ground conductivity, like on sand at a beach, radials don't couple to the earth as well and can act as if they're elevated.

There is considerable discussion as to how long radials should be and how many need to be deployed. Here, views from knowledgeable sources vary widely. HyGain recommends a minimum of four 33-foot radials for their simple AV-18VS vertical antenna. Wolf River Coils includes three 33-foot radials with their antenna kits.

Many operators think that several times that number is required for good communications. My experience tells a somewhat different story. Most of the time, I've deployed just three or four 18-foot long wires laying directly on the ground for a counterpoise. When needed to lower my SWR at some parks, I actually prefer six 18-foot radials to three 33-footers. Over 61,000 documented QSOs and several dozen "Kilo" awards prove my system works well enough indeed.

To be sure, we have a high water table in my area, and stations in drought conditions may need a better counterpoise system.

Also, more radials might be desired at home, but for POTA (or EmComm) expediency is often more important than efficiency.

WRC puts large ring terminals on their supplied radials which go between their tripod legs and the mount. There are several problems with this arrangement. First, you must remember to attach the radials before you set up the antenna. Second, ring terminals have a limited lifespan, eventually break off, and will need to be replaced. Lastly, all their radials are black. They can disappear in low light situations and are a mess to untangle.

REZ and Chelegance have a quicker and easier attachment method using banana plugs, but their radials only work with their mounts and, again, their wires are all the same color. At least Chelegance picked a brighter color than black!

My crazy simple system attempts to solve all of the above issues. I attach radials using a copper alligator clip. This is actually faster than banana plugs because it can attach more than one at a time. Alligator clips work with ALL mounts, not just one brand. And, by using different color wires, they're much easier to untangle, even when the Sun is going down.

Sometimes I clip radials to the mount, but I also can clip them to the outside of a plug or connector. As seen previously in My Favorite Antenna, they can even attach to the outside of the SO-239 antenna jack right on the back of the radio or tuner.

Radials Clipped Onto Mount

I've even found a way to get radials literally for free!

Radial Adapter

With this adapter attached to your antenna mount, you can plug in as many off-the-shelf extension cords as desired. Need more? Use a cube tap! Need a longer counterpoise? Plug a couple extension cords together. Since it's a female socket, it is both safe and an economical partner for your vertical antenna.

Radial Kit

adapter, triple tap, and extension cords

Extension Cord Radial Kit Deployed
with hamstick antenna and tripod mount

Deployment:

- Set up antenna on tripod, post, clamp, etc.
- Connect coax from antenna to transceiver.
- Clip radial adapter to antenna mount or outside of coax.
- Plug in a regular UNMODIFIED extension cord.
- If you want a long radial, chain cords together.
- If you need more radials, use a cube tap.
- Then, plug in 3 UNMODIFIED extension cords.
- Stretch out extension cords on the ground.
- For 40m/80m use long cords (on a reel) for best results.
- Check SWR, adjust antenna and radials as required.

Portable Masts

There is another solution to not having a perfect tree for hanging your antenna: bring your own! Many POTA operators carry a portable mast to support their antenna. If sturdy enough, it can be used to hang a resonant dipole. To save weight, a thin flexible mast can support a simple resonant quarter-wave wire or an end-fed antenna element.

There are several sources for antenna masts. Some are designed just for this purpose. Examples include the 32-foot Travel Mast from SOTAbeams. It is made of telescoping fiberglass sections and under 27 inches long when collapsed.

SOTAbeam Travel Mast

Another option is a windsock pole. Jackite's 31-foot Thick Tip Fiberglass Windsock Pole is available for around $80.

Jackite Windsock Pole

TNØ7 Engineering's 31.5-foot long Lightweight Portable Antenna Mast is relatively new to the market arriving in 2023. It weights just over 4 pounds and collapses to 45 inches, so it is a bit longer but appears to be much more rigid than some of the light-weight models from other companies. The outside diameter is 2.06 inches at widest point.

TNØ7 Engineering Portable Antenna Mast

While commercial telescoping masts are nicely compact for transport and up to 32 feet long when deployed, they can be expensive and exceed the budget of some POTA activators.

Fortunately, there is a solution you could try: a home-brew antenna support made with off-the-shelf schedule 40 plastic pipe from your local Home Depot or plumbing supply shop.

Nom. Pipe Size (in)	O.D.	Average I.D.
1	1.315	1.029
1-1/4	1.660	1.360
1-1/2	1.900	1.590
2	2.375	2.047
3/4	1.050	0.804

Schedule 40 Plastic Pipe Dimensions

You can see in the table above that some sizes will just fit inside the next larger size. Those two sizes could be used to construct a 19-foot mast with a foot of overlap inside. Combining a 1-inch pipe with a 1.25-inch pipe you could have a 20m quarter-wave mast for about $20 at current prices.

1” Pipe Fits Nicely Inside 1-1/4” Pipe

For a shorter package (or an even longer mast) cut 10-foot lengths in half and alternate 5-foot sections of the two chosen sizes. Remember to include overlaps in your design, and purchase hardware or hose clamps to secure the joints.

While you could use an aluminum or steel telescoping painter's pole to support the feedpoint of a dipole, the metal would de-tune a vertical wire antenna running up the pole. Plastic or fiberglass are better solutions because they are non-conductive and gives you the option of using a simple straight or even helically wrapped wire antenna fed at the bottom.

For another example of a home-brew support mast, I used the telescoping fiberglass handle of a pole pruner (with saw removed) to make an antenna. The handle is helically wrapped with insulated wire. There is a short aluminum tube at the top with an adjustable tip for fine tuning the antenna to resonance.

Pole Pruner 20m Antenna
with 3 guy lines to tent stakes

There are 3 guy lines attached with mini-carabiners for support. One person can set up the antenna by following a simple procedure.

First, lay the pole on the ground and attach 2 guys running them out at 120-degree angles from the pole. Secure the ends with tent stakes. Stand the pole upright and move its position to remove the slack from the first 2 guys. Attach the 3rd guy line and keep tension on it while moving out from the pole and securing with another tent stake. The mast can now be extended to operational height. By moving the base to one side the pole can easily be lowered for adjustment and repositioned.

To support a portable mast I use what is called a sand spike for a surf fishing rod. Push the sharp angled end into the ground about six inches. Then, use a set of three guy lines out to tent stakes to steady it.

The portable mast simply drops into the flared opening on the top of the tube instead of a fishing rod. You could make a similar spike with a piece of PVC pipe. I used stainless wire lines from my parts bin, but highly visible yellow or orange heavy-duty paracord guys would be ideal.

Sand Spike Portable Mast Holder
shown with tent stakes and stainless steel anchor lines

Snap Links at Top of Spike
secured with hose clamp

3 Guy Lines
attached to tent stakes

There are several other ways to support a mast: secure it to something else like a heavy-duty tripod or speaker stand, or use a drive-on pedestal mount (available from SOTAbeams).

Drive-on Car Stand
from SOTABeam

Trailer Hitch Mount
from Max-Gain Systems

Speaker Tripod Stand
from Sweetwater

Portable speaker stands like the model shown above are commonly used by DJs and can be found where public address (PA) systems are sold. You might even be able to rent on just to try it out.

For even more options, search for lighting stands used in professional videography and photography at B & H Photo and similar outlets. Heavy duty models run up to 13 feet tall and collapse to about 4 feet.

Cables & Connectors

Most POTA antennas will require some kind of feedline, with the speaker wire dipole being one notable exception since the feedline is part of the antenna.

Unlike your shack at home, in a park the rig will usually be relatively close to the antenna. My POTA kit includes one coax 18 feet long and another 24 feet long. A pair of 25-footers with connectors would be a reasonable alternative and easier to find.

Because you won't be running a lot of power, 100 watts maximum, and the lengths are relatively short, 50 feet or less, you don't need full-size RG-8 or LMR-400. Indeed, RG-8X, sometimes known as mini-coax, might even be over-kill. Most of my cables are RG-58, and at HF frequencies the loss for 50 feet will be under 1 dB.

I also carry a double-female barrel connector so I can join two sections of coax together. If possible, get one that's knurled in the middle for a good grip when disconnecting the cables.

25-Foot RG-58 Coax Assembly
with knurled barrel connector to join sections

SOTAbeams uses RG-174 coax on their lightweight Band Hopper linked dipole antenna. While this is very light and works fine, I prefer the added durability of heavier RG-58. It is also easier to put standard connectors on RG-58.

It may be easier to find ready-made RG-58 cables with BNC connectors installed because these types have also been used for computer network wiring. It's OK to use most RG-58 network cables for HF communications at 100 watts, but you will probably need a BNC-to-PL-259 adapter at the radio end and a BNC-to-BNC barrel connector to join sections if desired.

BNC to PL-259 Adapter

BNC Barrel Connector

When I make homebrew antennas, I sometimes use a standard RCA phono jack at the feedpoint. At POTA power levels and frequencies, this is adequate and they are easy to work with.

RCA Feedpoint with Tabs for Counterpoise Wires

If you are packing a lightweight POTA kit for a hike or travel by air, look for RG-316 50 ohm coax on Amazon. I have a 20-foot length that fits in the palm of a hand. It has standard PL-259 plugs on both ends to mate with my Yaesu FT-891 and a compact Super Antenna MP1 kit.

RG-316 Coax with PL-259 Connectors

It is also available with BNC connectors to fit many QRP rigs.

RG-316 Coax with BNC Connectors

Useful Accessories

There are several useful accessories to consider when preparing your kit for POTA activations. A wide-range external antenna tuner immediately comes to mind. If your transceiver has an internal tuner, it most likely has a limited range, typically handling an SWR of up to 3:1. Portable antennas, particularly non-resonant ones, can often present a more significant mismatch, and an external tuner can often make such a situation tenable.

Furthermore, internal tuners only work with coax-fed antennas. You may want to deploy a long wire, and many external tuners can handle this because they have a built-in balun or unun.

I carry a Dentron Jr. Monitor (no longer manufactured, but probably available used at the usual ham sources) which has connections for coax, random wire, and parallel feedline.

Dentron Jr. Monitor

A similar tuner is currently available from MFJ for about $140.

MFJ Travel Tuner

Most modern rigs have a built-in SWR meter. If yours does, you can use that to tune the antenna. If not, you should choose a tuner that includes an SWR display.

Many operators prefer an automatic tuner or “coupler” to a manual model. Instead of fiddling with multiple knobs and adjustments, a single click on a button is all it takes!

There are really two kinds of auto-tuners. One is designed specifically to tune a random wire or element. This type would include Icom’s AH-4 and Yaesu’s FC-40. These tuners are installed right at the antenna element (wire or whip), not at the radio. They typically require a decent ground to work best.

Icom AH-4 Remote Antenna Tuner
controlled by circuitry in specific Icom radios

The other type of automatic tuner usually goes right next to your rig, connected with a short coaxial jumper, and is used to tune a coax-fed antenna. Because it tunes the coax and not the antenna, there can be considerable loss as some of the transmitted energy never reaches the antenna.

Because the Yaesu FT-891 is my POTA rig of choice, it seemed to make sense to get their matching FC-50 tuner for it.

Yaesu FC-50 Antenna Tuner
made specifically for the FT-891

Benefits of this choice include its control being well integrated with the rig. You can easily assign one of the "soft keys" on the front panel to turn the tuner on and off. Note that the tuner has to be attached before the rig is powered ON for it to be recognized. If you happen to attach it with the rig ON, no problem. Just power-cycle the FT-891 and all is well.

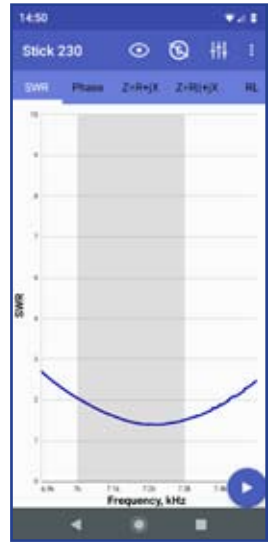
Yaesu FT-891 with FC-50
tuner fits conveniently under radio

Another very useful tool, especially if you are trying to make an antenna resonant without a tuner, is an antenna analyzer. This tool can show you the resonant frequency of your antenna. If it is too high, your antenna is too short, and if too low, your antenna needs to be trimmed.

An analyzer also makes it much easier to adjust the coil on a system like the Wolf River TIA or Buddystick. The time saved will make your experience a lot more productive and fun.

I chose the Stick-230 from RigExpert. There were several reasons I liked this model: it has a very long lasting battery and is extremely compact (fits in your hand). The small paper-white display can be supplemented by viewing high resolution plots on your smartphone via bluetooth (see example below) or on a PC via USB. The rechargeable battery is a standard 18650 lithium-ion type that is user-replaceable.

An antenna analyzer makes checking and adjusting an antenna much easier and faster. This translates directly into more fun.



RigExpert Stick-230
with sample plot of 40m antenna on a smartphone

Packing for POTA

In keeping with my theme of "success breeds enjoyment" it is very important to avoid simple mistakes that will detract from your fun at the park. The best way to do this: get organized.

Start by making a packing list, to include everything in your kit: rig, microphone/key, power cable, battery, antenna, and feedline. Don't forget your log, a water bottle, and I also pack a POTA sign so visitors and authorities alike know what I'm doing. See the sample POTA checklist in the reference section at the end of this book.

Next, assemble everything on your packing list. If something looks like it needs attention, like a weak crimp on a cable, fix it before you pack it! Leave as little to chance as possible.

Pack your kit in something that makes it easy to transport and deploy. I pack my radio in a padded nylon lunch tote bag I bought at a local supermarket. This protects the radio from scratches, and my bag has a separate zippered compartment for the antenna tuner with cables and hand microphone.

Lunch Bag with Radio, Tuner, and Mic

My favorite linked vertical antenna is packed in a separate hard plastic tote with its support rope and throw weight, a couple sets of 16-foot radials, and the feedline with a double-female barrel connector already installed.

Everything else goes into a heavy-duty nylon backpack: spare feedline, extra wire, adapters, analyzer, water bottle, etc.

Finally, have a test run in your backyard or nearby park. This way you can mitigate any major problems before you head off to your first activation. Practice makes perfect!

Complete Station Packed in a Briefcase
rig, tuner, battery, mic, and antenna

Your First Activation

Before you leave home, you can schedule your activation on the POTA website. This is optional but highly recommended for CW activations due to Reverse Beacon Network (RBN) integration. It also tells hunters how many parks will be activated that day and help them decide to tune in or pursue a non-ham activity instead.

Before I leave home, I also write down the park reference number for the park(s) I plan to visit. You will need this to get spotted, whether you do it yourself or ask someone else do it.

The last thing I do before leaving home is make sure the log on my portable computer is up to date with all recent contacts.

When I arrive at a park, particularly if it is a new one to me, I survey the situation and decide what antenna to use. If I can operate near an appropriate tree, I'll set up my favorite linked vertical. If there aren't any desirable trees, I'll deploy a self-supporting vertical along with some wire radials.

Setting Up at a Park

Take Time to Enjoy the View
a body of water can help boost your signal

When you arrive at a park and survey the layout, pick a spot for your setup that will have a minimal impact on other park patrons. For example: avoid trailheads, fishing spots, swimming holes, and being right next to the latrine, water fountain, or other high-use facility.

Be careful about using trees for antenna supports. Many parks prohibit attaching anything to trees, and you don't want to have a confrontation with a ranger. If you do, be courteous!

Don't place wires or guy lines where other patrons might trip on them. It is a good idea to use highly visible lines or flags so patrons don't cross them by accident while you are busy concentrating on making a contact.

Safety First

Don't do anything stupid, like POTA during a thunderstorm. Once I was setting up, and a woman asked if my antenna was some sort of lightning rod. I answered, "Only during a storm!"

If a storm is passing through, you can grab your rig and other expensive gear and wait it out in the car. The antenna should be fine, and it won't take long to set your station back up.

Be extra careful to stay away from power lines. If you're throwing a rope up to raise an antenna, it sometimes doesn't go exactly where you thought it would. We've all had this happen. If a bad throw or the wind carries it over a power line, any moisture in the rope may allow enough current to flow to electrocute you. The upper wires on most poles is 13,000 volts!

Ham Radio on the Rocks

Antennas for Digital POTA

Digital modes may seem like the perfect marriage with POTA… low power, weak signal capability, and more. But, it's not all that simple, and that is why there is a dedicated section in this book on it to help keep you out of the weeds.

Your antenna needs to be up to snuff. Before you even connect it you need to think about whether it can handle the power your rig will send to it. For example, the original Wolf River Silver Bullet 1000 coil is de-rated from 100 watts on SSB to only 20 watts when used for digital modes. If you plan to run digital, it might make sense to choose their upgraded Silver Bullet Platinum model which is rated for 100 watts digital. Sure, it costs more than twice as much as the original model, but it can handle the duty cycle of digital modes (and high-speed CW) significantly better.

Then, you also need to see if your antenna can even tune down to the digital part of the band. If you cut your hamstick for SSB, chances are it won't go low enough for digital modes which are at the bottom of the band. The solution is simple. When you get a pair of hamsticks, like one for 20m and another for 40m, cut one of the whips for SSB and leave the other full-size for CW and digital band segments.

That is what I did, and while I had to cut several inches off to resonate in the SSB band segments, almost magically, the full-size whip was perfect for FT8 without being trimmed at all.

I encourage you to try your portable station at home first. Set up in your backyard. Use your system to make a few digital contacts. If all goes well, you can plan your first digital activation in a park. But, if you discover any problems, you can take your time correcting the issue at home instead of potentially wasting a trip to a park.

Antennas for QRP POTA

I'm not a strong advocate for using low power or QRP for POTA if you are just getting started as a new operator. QRP is absolutely fine, just the wrong place to begin your POTA journey. That said, if you are inclined to try QRP, read on for my antenna tips.

Running low power, you can't afford to waste any of it with an inefficient antenna system. I would recommend something resonant. If you're looking for something light and portable, a simple half-wave dipole or linked dipole would work nicely. See the SOTAbeams Band Hopper described in the antenna section of this book. If you prefer an end-fed design for ease of deployment, check out the Par "Trail Friendly" EndFedz antennas from Vibroplex.

Par End Fedz QRP Antenna
K4SWL photo

New in 2023 from Chameleon is their CHA OCF40 introduced at $99. 25 feet of RG-316 coax can be added for $75, but you can probably find a similar product elsewhere for much less.

Chameleon CHA OCF40
shown with optional RG-316 coax

Michael (KB9VBR) activated US-9840 with this antenna using his Yaesu FT-817 QRP rig and it seemed to perform very well. You need a tree or mast 25 feet high to deploy as an inverted V.

The main advantage of its off-center fed design is the capability of operating on several bands without a tuner: 40, 20, 10, and 6m. Primary issues are its size: 66 feet long (44’ on one side, 22’ on the other) and power limits of the included 4:1 balun: 50 watts SSB, 25 watts CW/digital. If you have room and can live with those constraints it might be worth trying.

If you're like me and enjoy building antennas, there are several options. A speaker wire dipole made with 22-gauge OFC conductors (not CCA) is inexpensive and eliminates a separate feedline.

For a more traditional dipole or end-fed design, I recently discovered copper fishing wire sometimes called trolling line. It is available in 20#, 32#, and 45# test. Some are plated with tin/nickel alloy for corrosion resistance.

Copper Fishing Wire
32# test ~ .030" dia ~ 22 AWG

You can pack the wire in a chalk line reel available at the Home Depot or Lowe's. Pull out as much wire as you need. When you're done, just wind it back in.

TIP: If you will be winding the wire onto a chalk line reel, don't get fishing wire that's plastic-coated because that could turn the reel into an inductor.

Add an "unun" transformer to make an inexpensive end-fed antenna. Pick one that can handle the power levels you run for the modes you operate, noting that high-speed CW and digital modes have much higher duty cycles than SSB.

DeWalt Chalk Line Reel

TIP: You don't need 550 paracord for hoisting lightweight QRP wire antennas. Look for M90 or M125 microcord for your kit. It's lighter and takes up much less space, too.

Late Shift Activation Tips

Activating during the "late shift" offers several unique opportunities for POTA. As the day ends propagation often increases, sometimes dramatically. More operators are home from work and on the air than during the day. If you live in a hot climate, the evening is usually one of the more comfortable times of the day to be outdoors without air conditioning. Finally, with the UTC day ending at 8PM locally, you can actually squeeze in 2 days of activations in just a couple hours.

Challenges, however, are numerous but not insurmountable with some planning. I recommend arriving well before it gets dark so you can set up with the benefit of natural light. This is especially true if you will be deploying a wire antenna using a tree for support. It isn't quite as important if you will be using a mobile antenna like a hamstick. I park my car so I can use the headlights to see during teardown.

It helps if antenna ropes are bright colors or reflective so you don't get tripped by one in the dark. Fortunately, yellow and orange paracord is easy to find at your local Walmart. If you deploy radials it helps to see them if they are insulated with white or yellow instead of black. (Try my FREE extension cord radials!)

Antenna Tricks & Hacks

This section will share some of my secret tricks. Some of them may be familiar to experienced operators, but there might be a new one or two here for everyone to try!

Trick #1 is to use existing hardware in the park for mounting your antenna. I pack a mobile mount attached to an angle bracket and a strong C-clamp. I've used this, for example, to attach the mount to a galvanized guard rail, giving me a solid connection for a hamstick or WRC antenna system, plus a decent counterpoise, with little time and effort expended.

Trick #2 is to make friends with the rangers at parks you visit frequently. I was at a park so many times last year, the rangers and I are on a first-name basis. This can come in handy if someone sees you putting an antenna up in a tree.

Trick #3 is to build a long wire (end-fed) antenna from multiple sections. Mine is 62 feet long made from 4 sections: a pair that are about 15 feet long each and another pair that are about 16 feet long each. I can use as many sections as I need for a given installation, or I can use sections to make a dipole or inverted-V antenna. For example, I can use a section on each side for 20m, or two sections on each side for 40m. My sections have ring terminals crimped and soldered to the ends. I literally bolt them together with short 6-32 machine screws and hex nuts.

Trick #4 is to wrap your throw line using a figure-8 pattern around your hand or other object. This prevents you from putting a twist in it. Later, it will pay out much better. I use the figure-8 wrap for my end-fed long wire too.

Figure-8 Wrap
prevents tangles - pays out nice

Trick #5 is to make and pack a short jumper with good alligator clips on both ends. You can use this to ground your antenna mount to a sign post or short out turns in a coil.

Trick #6 is to wrap a half dozen turns in your coax to make a choke. This can be particularly useful with end-fed antennas to prevent the coax from radiating when that is a problem. You'll know when you get "bit" by RF at your rig or on your key!

I encourage you to give yourself options, so when you arrive at a park you will always have a good solution to the issues at hand. At one park there were lots of tall trees but too many branches and foliage for hanging my inverted V or long wire. The self-supporting vertical saved the day and also gave me the option to operate on 80m with a longer coil in my kit.

Videos to Watch

Start by watching the video guides at parksontheair.com in the Help/Getting Started section. There are useful tips for both activators and hunters.

There are several successful POTA activators who are also stars on YouTube! You can learn a lot about POTA including reviews of antennas, rigs, batteries, accessories, and logging applications by watching some of their shows. Videos are a great option when bad WX keeps you from activating!

One YouTuber with lots of relevant POTA content is Michael Martens (KB9VBR). He also makes and sells J-pole antennas, and his YouTube channel is *KB9VBR Antennas*. Michael offers interesting regular Ham Radio Q&A sessions on his channel. He is a professional videographer, and it shows in his work. Check out his video about my POTA book in March of 2022.

Another prolific YouTuber who stands out from the crowd with lots of good POTA material is Mike Dahlhofer (K8MRD). You can easily find his channel: *Ham Radio Tube* (formerly *K8MRD Radio Stuff*). Hardly a week goes by without a new video or two of some sort. Check out my January 2023 livestream with Mike in the *LIVE* section of his channel.

There are several other great YouTube channels to watch. While not specific to POTA, check out Julian White (OH8STN) an American ex-pat who now hails from Finland, and his channel is *Off-Grid Ham Radio OH8STN*. You can also find Julian on Facebook at *SurvivalTech Nord* and at his own blog/site: oh8stn.org

From France, check out Gil Gruson (F4WBY) also known as the *RadioPrepper*. He offers lots of reviews, including some home-brew antennas, baluns, and other interesting gear like his PRC-320 military man-pack radio. You can also find Gil on his website at RadioPreppers.com

From Canada, look for Tracy William McKim, (VE3TWM). His YouTube channel is *Outdoors On The Air*, and he has over 50 interesting videos to watch covering antennas, rigs, and operating outdoors.

Also from Canada: Dennis Rule (VE3BF) has some videos taken while operating at his campsite. While not strictly for POTA, they are nonetheless completely relevant to portable operations with a wide variety of interesting product reviews. To find his channel, simply search YouTube for VE3BF.

Finally, honorable mentions go out to a bunch of good ham radio YouTube channels to check out in your spare time:

- *Ham Radio Crash Course* by Josh Nass (KI6NAZ)
- *Ham Radio 2.0* by Jason Johnston (KC5HWB)
- *Ham Radio Concepts* by Eric Hofer (KJ4YZI)

POTA on Social Media

From my experience, the world would probably be much better off without Facebook than with it. I say this because people comment on FB without the filter they'd hopefully use in face-to-face conversations at a local ham club meeting with friends.

For example, when I posted my tip on how to use unmodified household extension cords for radials (as documented in this book) several members of the POTA FB group commented that it was a good way to get electrocuted! The adapter was a socket, not a plug, with no way to energize it from a 120 VAC outlet. These folks demonstrated how little they know about electricity and probably don't deserve an FCC license. Yet, they felt compelled to write off my "stupid idea" when others with more background saw it as "simply brilliant."

That said, if you're into Facebook, there's a POTA group you can join. If you post suggestions or tips, you can turn commenting off and save yourself a lot of grief. Nuff said.

I don't have any experience with Slack, so won't offer any comments regarding it except to say that it is the preferred channel to use if you have some gear to offer for sale.

If you want other operators to be able to contact you, join and log onto the QRZ website. Then, type your preferred address in the "Public Email" box on your "callsign data" page. The default is blank, and thus your email address is hidden from view. You can always wipe it out later if you start to get spam.

Useful Links

If you design and build your own antennas, there are several useful calculators available on the web. Because these change all the time, it is better to offer you suggestions for what to search for. Try the following in your favorite search engine:

- *dipole antenna calculator*
- *inverted vee antenna calculator*
- *shortened dipole antenna calculator*
- *shortened vertical antenna calculator*
- *coil inductance calculator*

Visit the Support Page
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for info on stuff in the book!

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wv1w.us/register

Meet the Author

Hello! I'm Don, WV1W, author of this book. I've been a ham since 1975, first as WN1VDD and then as WA1VDD.

In my first career, I was a mechanical design engineer and worked on "macro" projects including large printing presses for Harris Corp and later "micro" projects including a pager watch for Timex when I was awarded a patent for the antenna.

Later, I followed my passion for baking and cooking and became the culinary professor for a state community college. I taught exclusively low-income inner city kids professional kitchen skills so they could get jobs in the culinary field.

I currently live in CT and am married to N1GDW. We have one daughter who is a successful fashion designer in NYC.

WV1W POTA Station at US-0882

Sample POTA Checklist

Transceiver
Transceiver Power Cord with Powerpoles®
Transceiver Hand Mic
Antenna Tuner with data and RF cables
Antenna Analyzer, charged
Morse Key
Headphones
Laptop or Tablet with updated log
Clipboard with:
    FCC License
    Blank Log Sheets
    ARRL Band Chart
Pencils & Pen
POTA Sign with holder
12v Battery, charged, with Powerpoles® Pigtail
Battery Clips to Powerpoles® Pigtail
Stacked or Linked Vertical Wire Antenna
Arborist Throw Line with Weight
Fishing rod & reel with casting weights/sinkers
Tent Pole Antenna with Loading Coil & Jumper
40m & 20m Hamsticks with long and short stingers
Counterpoise Wire Sets x2
Tripod with Mount
Jaw Clamp Mount
Pedestal or Spike Ground Mount
25-foot Coax Cable x2 with Barrel Connector
Mallet
Leatherman Multi-Tool
Spares: antenna wire, crimp connectors, paracord
Electrical Tape
Folding Chair & Folding Table
Thermos (with hot coffee) & Cup
Water Bottle (with fresh water)
Hat & Sunscreen
Bug Repellent

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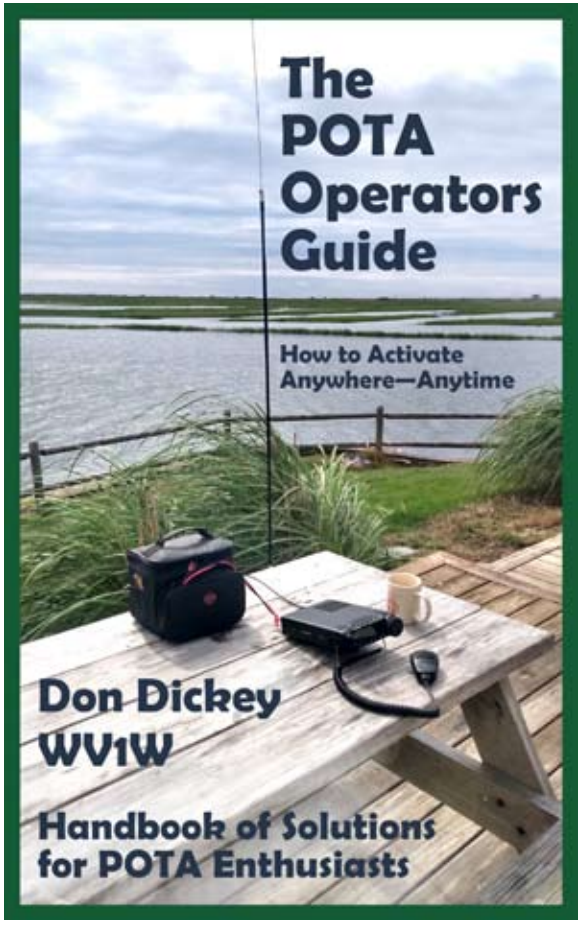

How to Activate Anywhere—Anytime!

- POTA on the Trails
- POTA in the Woods
- POTA at the Beach
- POTA on the Water
- POTA on Field Day
- POTA hunting DX
- Camping POTA:
- Mountaintop POTA
- Urban POTA
- Bicycle POTA
- Kayak POTA
- Roving POTA

During portable operation and POTA nothing is more important than your antenna. This book is a complete guide to the best and most affordable portable antennas covering both commercial and home-brew designs of all types to get you on the air.