

# POTA PERformer (Portable, Elevated, Resonant) Antenna by KJ6ER

## Introduction

The POTA PERformer (Portable, Elevated, Resonant) is a resonant elevated quarterwave vertical antenna for 40M-6M sitting on a PVC ground spike or tripod with the feedpoint about five feet off the ground and two elevated tuned linked radials. This is a fantastic portable antenna – easy to pack, fast to deploy, very effective and highly efficient. And it is very simple to build and deploy in the field!

I have computer modeled the antenna extensively in 4NEC2 and derived optimal whip and elevated tuned radial lengths. You will have to experiment in your own surroundings to finetune these, but I typically get <1.10 SWR on all bands. I have found through modeling, testing and extensive experience in the field, this elevated vertical is much more efficient than any ground-mounted version I have ever used!



## Elevated Tuned Linked Radials

The two elevated tuned radials are 90 degrees apart to provide some directionality within the 90-degree span (about 4-8 dB *front-to-back ratio*). If an omnidirectional radiation pattern is preferred, simply place the two elevated radials 180 degrees apart.

Having elevated tuned radials dramatically reduces near-field ground losses and increases directional gain versus a purely ground-mounted vertical with ground-coupled radials. I regularly get comments like "*you're the loudest signal on the band*" from POTA hunters.

The 20M-6M bands are all available using the telescoping whip. For 40M, I install a coil (such as the [Wolf River Coils™ Sport Forty](#)) at the base of the whip – but elevating two 33' radials is a bit cumbersome in the field. Instead, I clip the two 20M 16.5' radials end-to-end with the two fiberglass stakes (one in the center, one at the end) to have *one* elevated 33' 40M radial.

## Table 1. Antenna System Parts List with Prices and Links (as of August 2024)

Here are the components I *recommend* for the POTA PERformer (substitute as you wish):

- Chameleon™ 17' telescoping whip (\$70) – [chameleonantenna.com/shop-here/ols/products/cha-ss17](https://chameleonantenna.com/shop-here/ols/products/cha-ss17)
- Furniture grade PVC (tripod *alternative*) – [amazon.com/gp/product/B0876M7C2B](https://amazon.com/gp/product/B0876M7C2B)  
Chameleon™ CHA spike mount for PVC (\$65) – [chameleonantenna.com/shop-here/ols/products/cha-spike-mount](https://chameleonantenna.com/shop-here/ols/products/cha-spike-mount)
- Polarduck™ 78" tripod (\$56) – [amazon.com/dp/B0CNYK89TX](https://amazon.com/dp/B0CNYK89TX)
- Palomar Engineers™ RF Feedline Choke (\$35) – [palomar-engineers.com/tech-support/tech-topics/ferrite-tutorials/Coax-Jumper-Choke-RG-8 X-RFI-Range-1-8-65-MHz-30-dB-Noise-Reduction-1-5KW-PEP-3-FT-Tail-p408707295](https://palomar-engineers.com/tech-support/tech-topics/ferrite-tutorials/Coax-Jumper-Choke-RG-8-X-RFI-Range-1-8-65-MHz-30-dB-Noise-Reduction-1-5KW-PEP-3-FT-Tail-p408707295)
- Mirror mount with 3/8x24 to SO-239 stud – [amazon.com/dp/B01G2QSNDG](https://amazon.com/dp/B01G2QSNDG)
- Bright orange 18 AWG radials (\$18 spool) – [amazon.com/dp/B01MPZJOYN](https://amazon.com/dp/B01MPZJOYN)
- Mueller™ clips on each end of the radials – [amazon.com/dp/B00LPP8Q00](https://amazon.com/dp/B00LPP8Q00)
- Fiberglass 4' stakes to elevate radials – [amazon.com/dp/B08Q346VIN](https://amazon.com/dp/B08Q346VIN)

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**Table 2. Theoretical Calculations (234/f) vs. 4NEC2 Model Computations**

Below are the traditional quarterwave calculations vs. model computations for the 40M-6M band whip and radials. The Chameleon™ telescoping whip only extends to 205" or 17'1" max. However, if a coil is inserted at the base of the whip, 40M or 30M operation is possible to compensate for the shorter whip length (providing an equivalent electrical length). For relevance, note the computed "Whip Length" and "Radial Length" columns in **blue**.

| Band | Model Freq | Calc Whip Length | Model Whip Length | Whip Length (ft) | Radial Length (in) | Radial Length (ft) | SWR  | Ref Coeff |
|------|------------|------------------|-------------------|------------------|--------------------|--------------------|------|-----------|
| 40M  | 7.250      | 387.31           | 399               | 33.3             | 396                | 33.0               | 1.00 | -48.3     |
| 30M  | 10.125     | 277.33           | 287               | 23.9             | 282                | 23.5               | 1.00 | -54.2     |
| 20M  | 14.250     | 197.05           | 205               | 17.1             | 198                | 16.5               | 1.00 | -70.3     |
| 17M  | 18.140     | 154.80           | 165               | 13.8             | 150                | 12.5               | 1.01 | -42.7     |
| 15M  | 21.325     | 131.68           | 143               | 11.9             | 122                | 10.2               | 1.01 | -46.5     |
| 12M  | 24.960     | 112.50           | 128               | 10.7             | 96                 | 8.0                | 1.01 | -50.0     |
| 10M  | 28.500     | 98.53            | 117               | 9.8              | 77                 | 6.4                | 1.01 | -45.8     |
| 6M   | 51.000     | 55.06            | 56                | 4.7              | 43                 | 3.6                | 1.00 | -52.7     |

## Finetuning the Antenna in the Field

While the computed radial length for each band remains fixed (as in the table above), the antenna system resonance can easily and quickly be finetuned with use of an antenna analyzer (or the transceiver's SWR meter) by slightly adjusting the length of the whip once the radials have been attached.

Since every portable deployment will have different surroundings and SWR impact, I recommend remembering or documenting generally where to extend the telescoping whip *initially* for a particular band and then make finetuning adjustments from there.

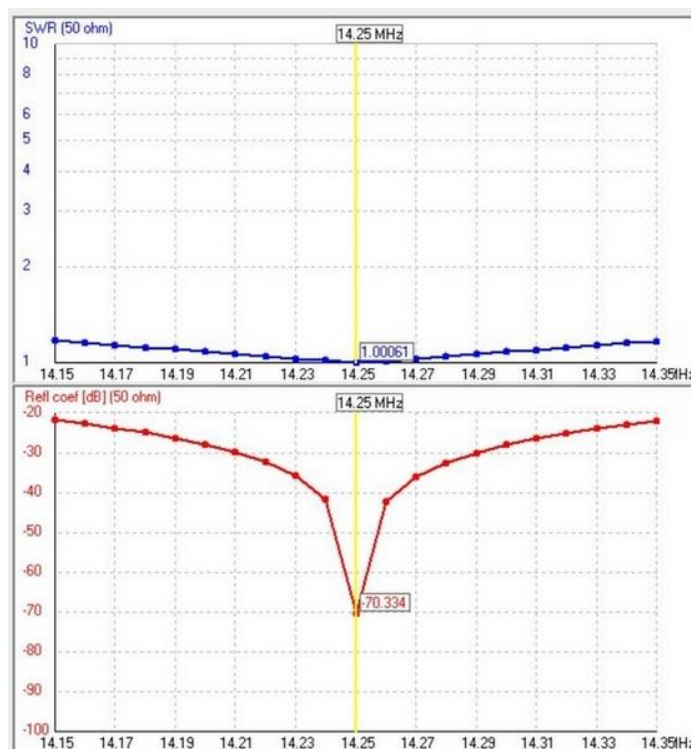
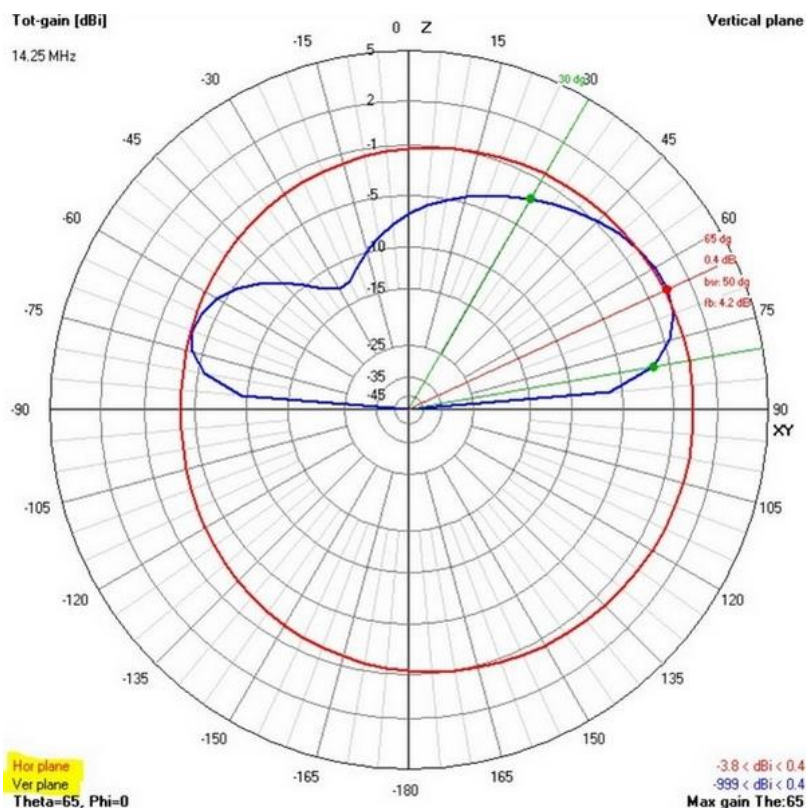
For example, I have found that 10M typically requires a little more than the top 4 sections of the Chameleon™ whip extended (above the bottom fixed section). On the other hand, 20M requires almost all the sections extended close to the full 17.1' length. The precise whip length will vary at each deployment depending on the immediate surroundings.

**Important:** It is imperative that a good quality RF choke be inserted directly at the feedpoint so that the coax feedline *does not* become part of the antenna system. If excluded, common mode currents (CMC) and radio frequency interference (RFI) will likely disrupt optimal antenna operation and cause issues with inconsistent SWR measurements.

Because of the tuned resonant characteristics of this antenna, an external antenna tuner is *not* typically required at the rig or antenna base potentially reducing any losses caused by these components and saving on packing.

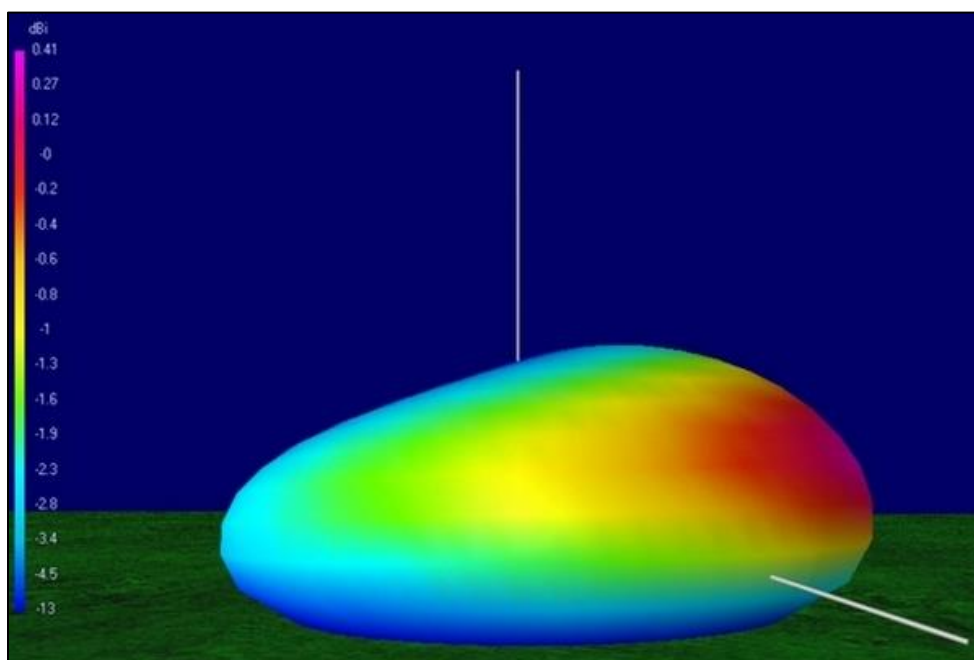
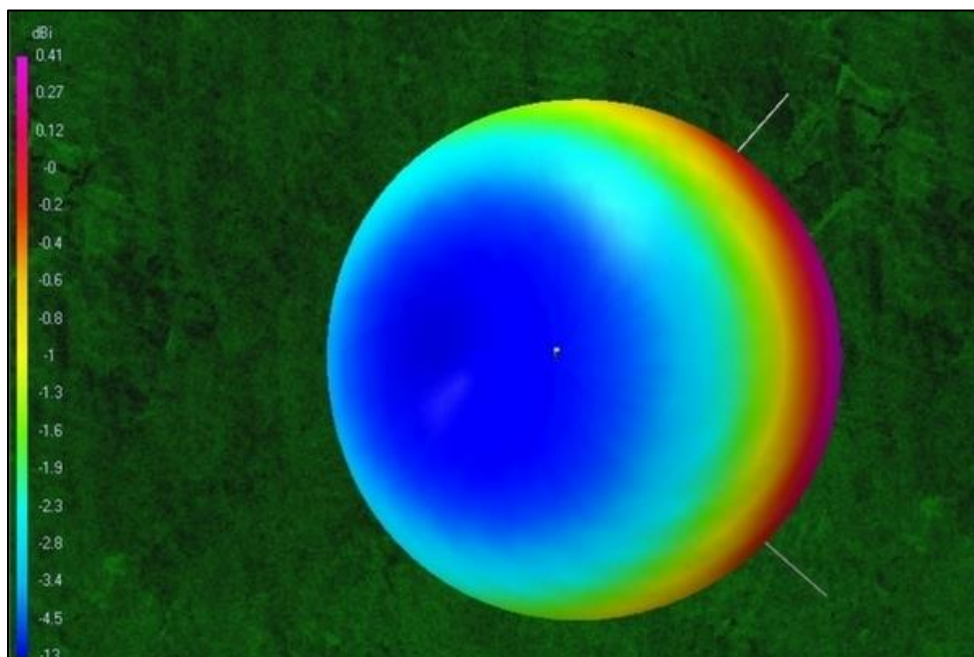
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4NEC2 Computer Model Graphics Showing the Far-Field Radiation Pattern (**vertical**, **horizontal** planes) and Reflection Coefficient (RC) for 20M (14.250 MHz). Note the directionality evident in the **vertical** plane. The maximum gain of +0.40 dB occurs at 25 degrees off the horizon. The reflection coefficient is a significant -70 dB at resonance.



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4NEC2 Computer Model Graphics Showing the Colorful 3D Radiation Patterns as seen from Above and the Side. The **purple** and **red** edges of the radiation pattern highlight the strongest directional characteristics of the antenna. Note the directionality off the elevated radials is evident in both views (white lines 90 degrees apart).



The following two pages provide photos of the **POTA PERformer** in my backyard '*antenna proving ground*' to demonstrate how the tripod configuration elevates the feedpoint up off the ground (depending on the leg spread chosen) and how the *non-conductive* fiberglass stakes elevate the ends of the two radials 90 degrees apart.

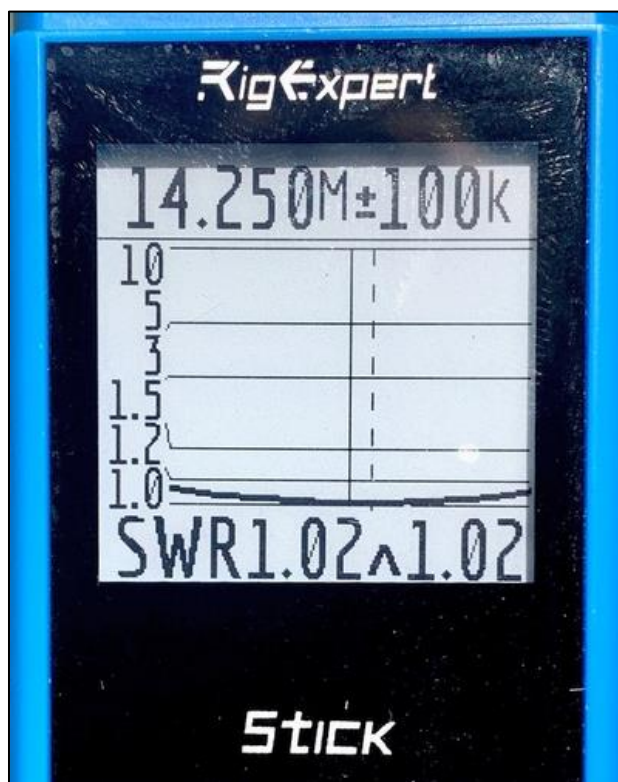
## POTA PERformer (Portable, Elevated, Resonant) Antenna by KJ6ER

**Antenna Deployment Showing Tripod Configuration and Radial Clips.** Mueller™ clips are fantastic antenna building components. They clip on and off easily for fast deployment and take-down. And the silicon-coated wire alleviates annoying tangles in the field.



## POTA PERformer (Portable, Elevated, Resonant) Antenna by KJ6ER

**Elevated Radial Deployment with Radial Clip and 20M SWR Measurement.** A reliable trick to ensure tension on the radials is to insert the *non-conductive* stake into the ground at a *60-degree angle* with the clip about *halfway up* the stake. Once attached, *slide the clip* up to the top of the rod until the radial is taut. With this antenna, I consistently measure excellent broadband SWR characteristics on all bands. No external tuner should typically be required.



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## PVC Tube with Spike Mount Deployment

Most of the time I deploy my PERformer antenna using a PVC spike mount instead of a tripod, leveraging a [40" furniture grade PVC tube](#) and the [Chameleon™ spike mount](#).

I like the 40" tube length because it is not too tall for me to reach the telescoping whip to adjust it for the band of operation, and still keeps the feedpoint elevated. The non-metallic PVC tube is also optimal because, unlike tripod legs, it does not interact with the shorter antenna radials, especially on the upper bands (10M-6M).

I prefer using furniture grade PVC because the walls are slightly thicker than the traditional irrigation type which provides more support for the antenna, especially when the whip is fully extended in the wind.

In the top [end cap](#), I drilled a 3/8" hole for a 3/8-24 fine thread bolt and a 1-1/2" x 3/8-24 nut on the outside. I use split lock and fender washers for a rigid, tight fit. The bolt connects to a mirror mount with a [Fire Stik™ stud and SO-239 connector](#) on a short base-threaded aluminum rod. At the SO-239 feedpoint, I use a [Palomar Engineers™ RF choke](#) to alleviate common mode currents and prevent the feedline from becoming part of the antenna. Do not operate the antenna without this feedline choke, it is imperative for optimal performance. The [Chameleon™ 17' telescoping whip](#) screws into the stud and the length is easily adjusted for band resonance in the field using an antenna analyzer.

In the bottom [end cap](#), I drilled a 3/8" hole for a 1-1/2" x 3/8-24 bolt to connect with the [Chameleon™ spike mount](#). I typically try to insert the spike about halfway into the ground for a stable base. In moist California soil, I can push the spike in the ground with my hand. If I am in a location with harder-packed soil, I use a rubber-head mallet to tap it in.



## PVC Top Cap with Mirror Mount / Stud and Bottom Cap for Spike Mount



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## Elevated Tuned Linked Radial System Using Spade Connectors

The performance advantages of the PERformer are the elevated feedpoint and the two elevated tuned radials placed 90 degrees apart providing good directional gain within the span of the radials. Make sure span compass points are selected in the direction desired for extra gain. On the west coast, I place them north and east for great results.

When I initially modeled the antenna in 4NEC2, I input many different radial spans from 10 degrees to 120 degrees apart to determine how the span impacted gain and directionality. Ultimately, the optimal span was computed to be at 90 degrees. As mentioned previously, placing the radials 180 degrees apart provides a more balanced omnidirectional pattern.

I also modeled different numbers of elevated radials to determine what quantity provided the best performance. I concluded that any incremental number of elevated radials beyond two provided very little benefit and just added to the components to carry with the antenna. Furthermore, two elevated radials provide more gain and improved SWR over just one radial.

When I constructed my early antenna prototype five years ago, I cut an individual pair of radials for each of the six bands (20M-6M) for model evaluation and optimizing purposes. Once I was satisfied with the results, I replaced the six pairs of radials with just one pair that included embedded spade connectors for each incremental band segment. This dramatically reduced the amount of wire I had to carry with the antenna.

### Original Six Pairs of Radials (left) Replaced by One Pair (center) with Connectors

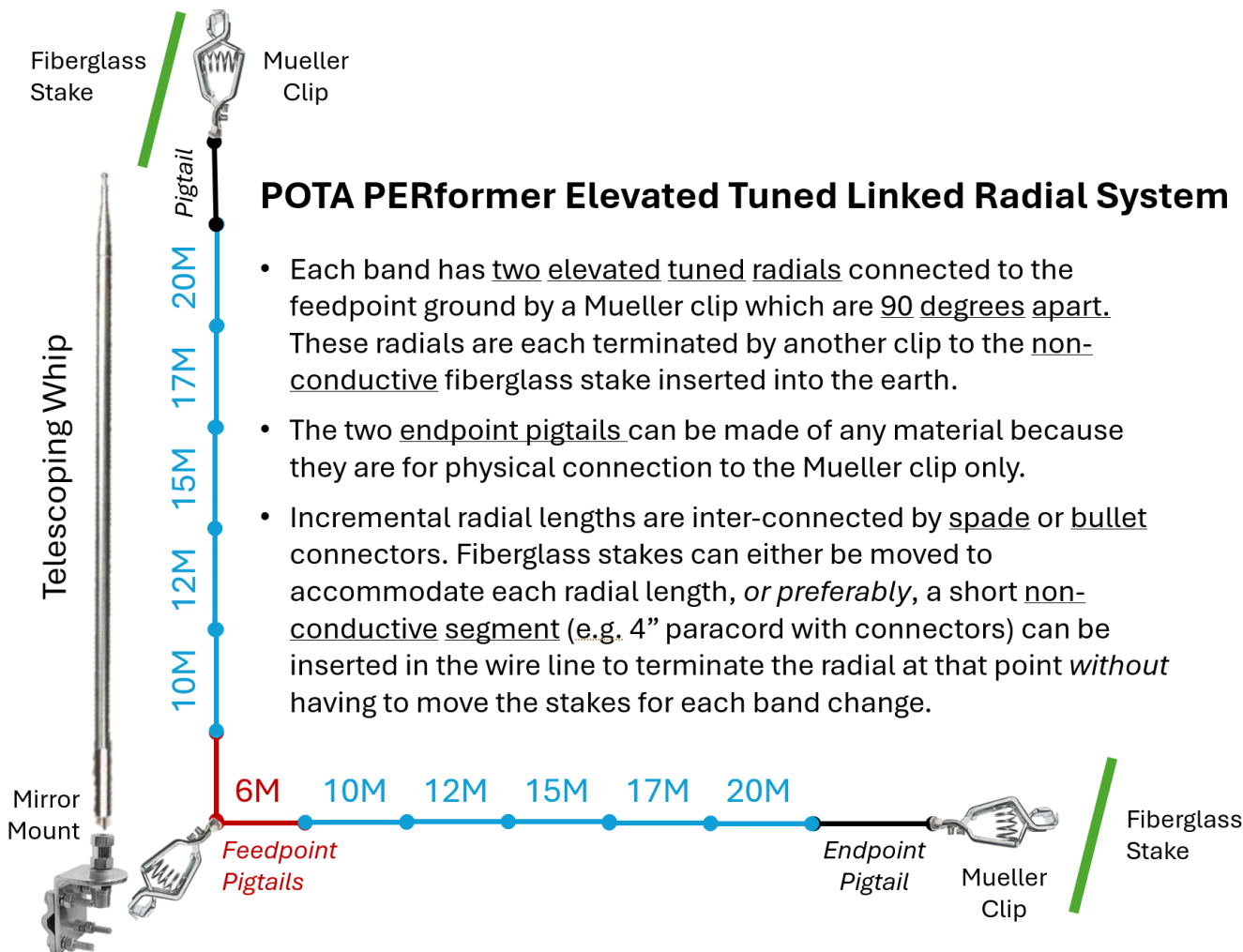


I pack the single pair of radials with a Wolf River Coils™ Sporty Forty (for 40M band operation) in a [zippered clear plastic travel bag](#) (right) commonly used for travel toiletries. These bags are fantastic to carry any POTA essentials. They are made of thick clear plastic and are water resistant. I have several of them to neatly organize all kinds of components.

On the following two pages, more detail on the lengths and construction of the linked radial system is provided. For this radial pair, I use one Mueller™ clip to combine and connect the two elevated radials at one end to the telescoping whip base, and a Mueller™ clip at the ends of *each* elevated radial to attach to the fiberglass stakes.

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## Antenna Configuration and Elevated Tuned Linked Radial System



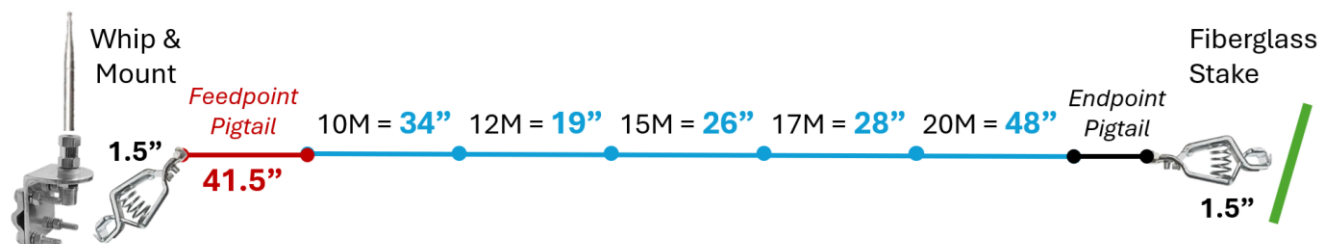
## Elevated Tuned Linked Radial Implementation

- When a short non-conductive paracord segment is inserted within each radial line at the appropriate point for the desired band of operation, the total length of each elevated radial is:

| Band / Length     | Description of Total Radial Length                     |
|-------------------|--------------------------------------------------------|
| <b>6M = 43"</b>   | 1.5" feedpoint clip + <b>41.5"</b> feedpoint pigtail   |
| <b>10M = 77"</b>  | 43" 6M radial length + <b>34"</b> 10M radial segment   |
| <b>12M = 96"</b>  | 77" 10M radial length + <b>19"</b> 12M radial segment  |
| <b>15M = 122"</b> | 96" 12M radial length + <b>26"</b> 15M radial segment  |
| <b>17M = 150"</b> | 122" 15M radial length + <b>28"</b> 17M radial segment |
| <b>20M = 198"</b> | 150" 17M radial length + <b>48"</b> 20M radial segment |

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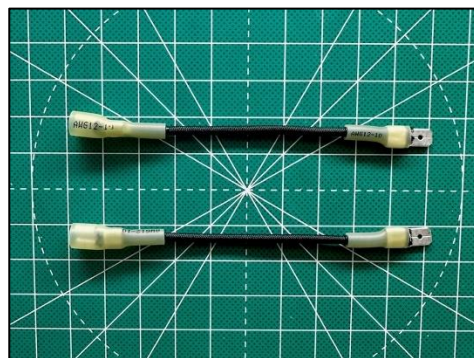
## Incremental Wire Segment Lengths for Each Band in the Radial Pair



To construct the linked radial system, cut a 6M pair with **41.5"** of wire (considering the 1.5" Mueller™ clip = **43"** total) and attach the Wirefy™ connectors. Next, cut pairs of *incremental* wire segments for each of the other five bands and attach connectors. I prefer these connectors because you *tightly crimp* the wire within the heat shrink tubing. Once heated, the tubing shrinks, and it also includes *internal glue* for a very secure fit.

Once all the *incremental* sections are cut, connect all the six band segments together in a single string to make a **198"** 20M radial. Add a short *endpoint pigtail* (made of *any* material) with a Mueller™ clip at the end. Make sure the band segments are all connected in *correct order*: 6M, 10M, 12M, 15M, 17M and 20M. Of course, it is important to label each band segment. I use a Brother™ label folded over itself on each wire segment.

## Wirefy™ Connectors/Tool, Linked Radial Pair, Non-Conductive Inserts



To change bands in the field, both the length of the telescoping whip and the two elevated radials must be adjusted. To adjust the radial lengths, there are two options:

1. Add or remove a radial wire segment(s) for the desired band and relocate the fiberglass stakes to ensure the elevated radials remain taut. This requires the stakes to be pulled and moved to new positions for each band change (not ideal, but it works fine).
2. A faster and simpler way is to insert a non-conductive segment between the band wire segments terminating the radial at that point for the desired band. I created this by cutting two **4"** lengths of **paracord** that were thin enough to fit the Wirefy™ connectors. By doing so, the fiberglass stakes do not need to be relocated for each band change. When the antenna is initially deployed, extend the two elevated radials fully taut with all band wire segments. Once extended with the stakes, insert the two non-conductive segments *after* the band segment desired. For example, if you want 15M, insert the non-conductive segments between the 15M and 17M wire segments. For 20M, insert the non-conductive segments between the 20M wire segments and the endpoint pigtails.

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## Final Comments

The POTA PERformer is my primary quarter-wave vertical antenna, and I strongly encourage you to try your own implementation in the field.

My elevated tuned linked radial system has performed extremely well for me. I am able to change bands by easily inserting the short non-conductive segment between the appropriate band wire segments and then adjusting the whip to resonance. Band changes take less than a minute.

It is imperative that an **RF choke** is installed at the antenna feedpoint to prevent the coax feedline from becoming part of the antenna system. An RF choke will also alleviate common mode currents (CMC) and radio frequency interference (RFI). Not only will this provide more optimal performance, but the measurable SWR will be reduced.



For my POTA activations, I typically use the **PVC tube with spike mount** rather than the tripod. But there are some POTA parks that do not permit spikes in the ground (or the ground is too rocky) so that deployment is best suited for the tripod, especially if it is windy and more stability is required. Alternatively, if the conditions are more calm, I use the smaller [Wolf Rivers Coils™ Mega Pod tripod](#) at the base of the PVC tube.

As with my **POTA Dominator halfwave vertical antenna**, this antenna deploys very fast. I can get the PERformer up and running with the elevated radials in a couple minutes. And when it is time to leave, the antenna is fast and easy to pack up. For me, a key feature of a portable antenna is not only its performance, but the *elegance* of its deployment.

The **POTA PERformer** could also be used at your **home QTH**. Keep in mind, you will have to adjust the telescoping whip length and the set of tuned radials for the band you want to operate on. While that is easy for POTA use, it may be inconvenient for you at home. Of course, if you only want to primarily run on a single band or two (e.g., 20M and 15M), that would be very easy to manage at your home QTH.

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One of my favorite parts of HAM radio is experimentation – especially with portable antennas. Give it a try and have some fun!

Please let me know if you have any questions, I'd be happy to help, 73! 😊

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