A Backpack Portable 20-Meter Zepp

This simple and inexpensive antenna offers light weight, ease of setup, and great performance, making it an excellent choice for SOTA use.

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As both a hiking and ham radio enthusiast I have a lot of fun combining the two activities. The gear I use isn't elaborate or expensive. The antenna, of course, is a critical element of the needed equipment. There are numerous options to select from. In this article I describe an implementation that has worked very well for me.

In order to support envisioned SOTA and backpacking activities, my antenna requirements were: single band 20-meter QRP operation; minimal setup effort; light weight; and good radiation efficiency. These requirements were specifically geared to complement my QCX-mini, which is a kit-built, miniaturized, single HF band, CW-only QRP transceiver.

The option I chose, a Zepp, is a good combination of low cost, light weight, ease of setup, and performance that has served me well in numerous SOTA activations (refer to Figure 1). It is effectively an end-fed half-wave antenna with a transmission line transformer for impedance matching. I used 300 ohm TV antenna cable for the transmission line base on its light weight and flexibility. The performance turned out to be as good as I hoped for, with a measured SWR under 1.2:1 over the 20-meter CW frequencies.

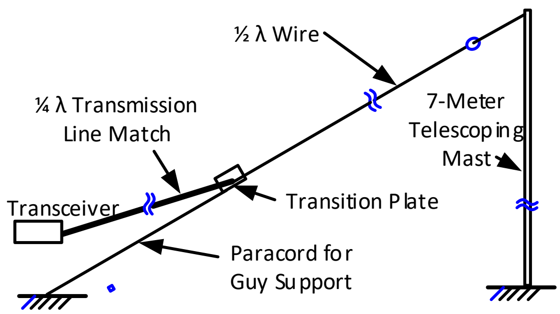

Figure 1. Simplified System Pictorial Diagram. This antenna is light weight, easy to set up, and performs well.

The Venerable Zepp

The Zepp antenna was invented by Hans Beggerow in 1909 for use in Zeppelin airships (see Figure *2*). It trailed behind the airship and consisted of a single one half wavelength long wire radiator, in series with a quarter-wave parallel transmission line impedance matching stub.

The term "Zepp" is now applied to any resonant antenna fed at the end with a two-wire transmission line, and sometime loosely to any horizontal antenna, no matter how it is fed. When implemented in a vertical configuration for

VHF/UHF bands it becomes what we know as a J-Pole.

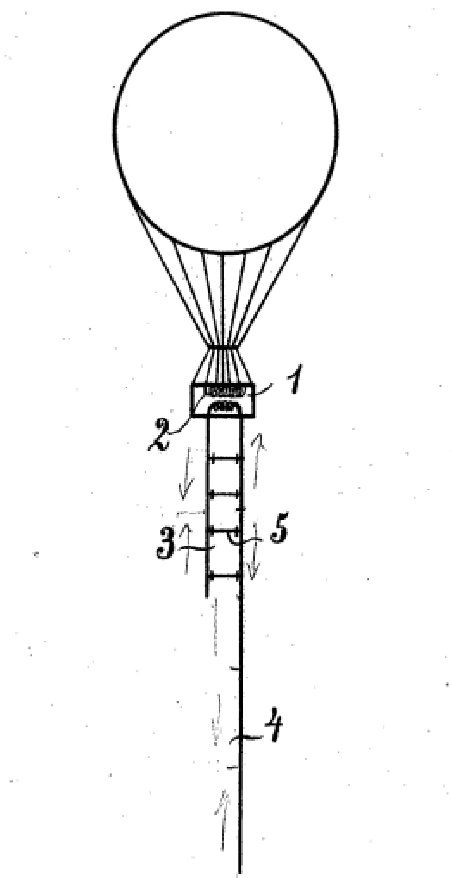

Figure 2. Zepp Original Wiring Diagram Excerpt from German Patent no 225204, 1909. It consists of 2 wires of unequal length dangling from an airship.

Principle of Operation Overview

The operation of the Zepp can be somewhat of a struggle to conceptualize due to the fact that one of the two transmission line wires is left open. However, when circuit dimensions are comparable with the electromagnetic wavelength, a complete electrical loop is not necessary, and energy is in fact transferred to the single wire and effectively radiated. For a more complete explanation of this, I suggest referring to the ARRL Antenna Book and/or the Instruction Manual for the EZNEC2 antennal modelling program.

With this in mind, there are a couple of ways to visualize the Zepp operation.

It can be seen as a full wave wire antenna with the feed point being ¼ λ from one end, as illustrated in Figure *3*. The ¼ λ wire is then folded to become the second wire in a transmission line.

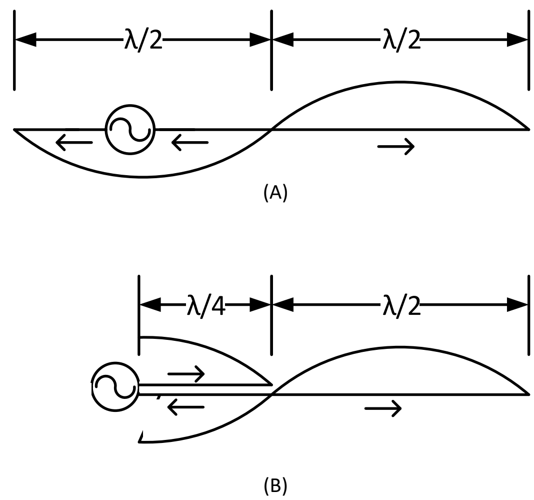

Figure 3. Folded Antenna Analogy for an End Fed Antenna

The mechanization of the Zepp described herein relies on a quarter wave 300-ohm transmission line impedance matching transformer to match the nominal 50-ohm transceiver impedance to that of the relatively high (circa 2,000 ohm) half wavelength long wire. For this case where the length of the transmission line is one quarter wavelength long (see Figure 4), or an odd multiple of a quarter wavelength long, the input impedance becomes:

$$Z_{in} = \frac{Z_0^2}{Z_L}$$

From this, the impedance ratio is:

$$R = \frac{Z_L}{Z_{in}} = \frac{Z_0^2}{Z_{in}^2}$$

For the above values of Z_0 (300 ohms) and Z_{in} (50 ohms) R is equal to 36. The value of Z_L is therefore 1800 ohms, which is in the ballpark of what can be expected for a ½ wave wire antenna of this type (note that the actual measured Z_{in} was 45 ohms, making Z_L 2,000 ohms). For comparison, toroid type matching transformers commonly used for this purpose typically have a ratio of 49:1. The performance of the transmission line match proves to be entirely adequate for this application.

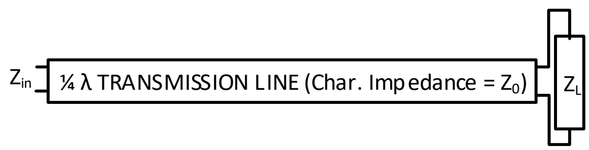

Figure 4. ¼ λ Transmission Line Transformer Diagram.

Construction

This design is very simple to construct. Materials are shown in the table below.

Item	Description
Antenna Wire	Any antenna wire with flexibility for winding would be acceptable. I used #18 gage silicon-insulated stranded copper.
Transmission Line Match	300Ω Twin-Lead TV cable
Transition Plate	Plastic from a standard electrical box.
RF connector	PL-259 or BNC connector
Mast	Spiderbeam (www.spiderbeam.com) Telescopic Fiberglass Pole, 7 meter (23 ft.), or equivalent

The exact antenna wire and transmission line dimensions after accounting for velocity factor and trimming to tune were:

- ½ λ wire: 30’ 10’’
- ¼ λ 300Ω matching line: 14’ 2”

If you have an antenna analyzer, start with a 10% or so longer length and trim to the lowest SWR.

The transition plate is cut and drilled to support the connection of the antenna wire and 300Ω line, as shown in Figure 5. They are soldered together and secured to the transition plate using cable ties as shown. Cord is tied to transition plate to provide an attachment point for securing to a stake or other tie point. This relieves stress on the 300Ω line and allows the antenna wire to serve as one of the guy lines.

Figure 5. Transition Plate. This plastic plate provides mechanical support for the junction of the antenna wire and the 300Ω transmission line.

The transceiver end of the 300Ω line is soldered to a short (3-4 inch or so) coax cable stub that is connected to the RF connector, and shrink-wrap is used for insulation.

Performance

Performance was measured with a RigExpert AA-600 Antenna Analyzer. As shown in Figure 6 and Figure 7 the performance is excellent, and no additional tuning network is necessary for a 50 ohm transceiver impedance.

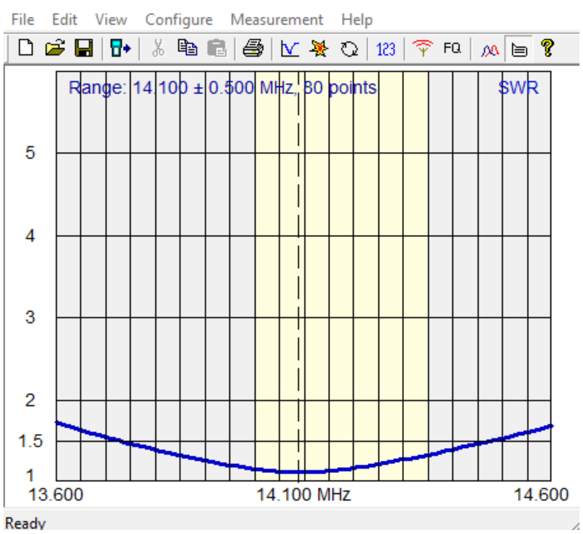

Figure 6. Measured SWR. The SWR was better than 1.2:1 for the 20-meter CW frequencies.

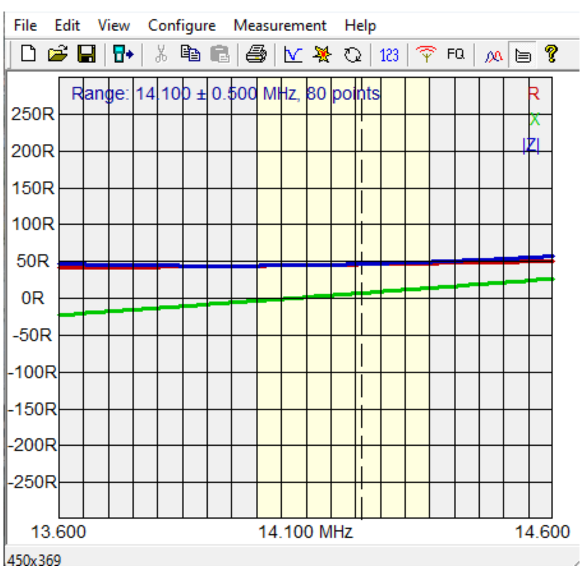

Figure 7. Measured Impedance. The impedance at resonance is 45 ohms.

I modeled this antenna with EZNEC2 (http://eznec.com) which is available as a free download. As expected, the radiation pattern is essentially the same as that of a half wave dipole.

I use this antenna connected directly to my transceiver. If additional distance to the transceiver is desired, then a balun may be connected instead, and coax of any length can be used.

Setup and Operation

The antenna and associated hardware are shown in Figure 8. Setup at the site is as follows:

First I extend the mast. I use the pipe clamps (available from SpiderBeam) at the mast section joints to ensure that the mast does not inadvertently collapse. As an alternate, electrical tape can be used.

I establish a good location that provides as comfortable sitting position as possible. I then secure the transition plate cord (which is approximately the same length as the matching line) to something close to this location. This allows me to connect the transceiver without putting any strain on the 300Ω line.

I tie the cord that is attached to the antenna insulator to the top of the mast. Backstays are tied to the mast about chest-high, spaced close to 120 degrees from the antenna wire direction and secured to tent stakes, rocks, bushes, or anything else available. Occasionally there is a pipe or some other support that enables me to tie the mast directly to it making the back stays unnecessary. The mast is then erected and secured with the antenna wire taut. The mast flexibility prevents excessive stress on the antenna wire.

Figure 9 shows a typical SOTA setup.

Figure 8. Complete Antenna Ready for Setup.

Operating Success

To date, I have successfully activated ten summits using this antenna in conjunction with my QRP QCX-Mini, making solid contacts from the SOTA sites (all in Southern California) to stations across the continent, and with DX contacts that include Japan and Europe. I have been very pleased with the performance, and look forward to many more activations. This is a great way to enjoy ham radio and the great outdoors at the same time.

Figure 9. Typical Setup. This is on SOTA peak W6/ SC-285 (Ladyface) near Agoura, CA.

Biographical Note:

Charlie Richards has been a ham since age 12, and currently holds an Amateur Advanced-class license. He worked as a Systems Engineer in the aerospace industry for over 40 years, and has recently retired. Originally from Mississippi, he resides in Southern California and is a member of the Conejo Valley Amateur Radio Club in Thousand Oaks, CA. Charlie can be reached at ccrich5280@outlook.com.

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