Lightweight, Collapsible Quad for 2 Meters

Excellent performance in a small package.

by Chester S. Bowles AA1EX

New England is blessed with numerous mountains and hiking trails. While our mountains aren't large by Western standards, they are interlaced with roads and trails that make them very accessible—a perfect opportunity for VHF/UHF mountaintopping trips.

I have been a licensed ham since 1967. However, when I purchased my first HT just a few years ago I discovered the pleasure of combining amateur radio with my occasional hikes through the woods. Of course, the elevation makes long-distance contacts easy. As an example, one of my most pleasant contacts occurred during a hike along the Wapack Trail, which has a trailhead just behind my house in Sharon, New Hampshire. Using the Mt. Greylock repeater in western Massachusetts, I had a long conversation with another hiker who was on the Appalachian Trail in Vermont. As we both huffed and puffed along our respective trails, we marveled at the technology that allowed us to communicate so easily across so many miles.

But using HTs on mountaintops presents some technical difficulties. Even using low power and a rubber duck antenna, keying the mike often opened up multiple repeaters. Hearing all those IDs come back was fun, but having any sort of contact was impossible. In addition, I was disrupting communications in multiple locations. The need for a directional antenna was obvious.

I began to think about various portable antenna options. However, my experience with directional antennas is very limited, so I invested $20 in the latest edition of the *ARRL Antenna Handbook*. It was a wise investment. The book is filled with technical information, along with numerous construction ideas. After reading the appropriate sections of the book and talking with some ham friends, my design began to take shape. Construction and tuning, however, turned out to be more difficult than I expected.

I chose to build a quad because of its inherent light weight and because (I thought) no matching would be required. Also, in theory, a two-element quad has more gain than a three-element yagi, making the boom length shorter and therefore more portable. My basic design was good. Construction was simple, the antenna collapsed as expected, and the weight was acceptably low. I quickly discovered, however, that at VHF frequencies the ratio between wire diameter and element length is crucial. Therefore, the formula for determining the length of a quad's driven element (1005/fMHz) did not work. Countless experiments with various gauge wires and element lengths left me no closer to success. I could not get the SWR below 2.8.

As it turned out, the solution was a simple stub-matching network using a trimmer capacitor. With that addition, the antenna matched perfectly, with SWR readings of less than 1.2 across the entire 2 meter band.

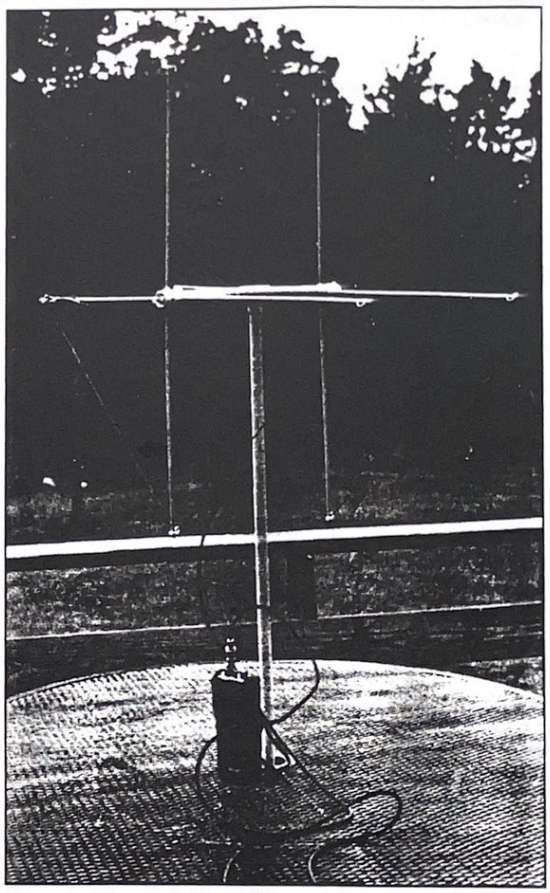

Photo A. The quad shown fully erected. Additional pieces of PVC piping can be added to the mast if more height is needed.

Construction

Construction of the quad is simple and takes very little time. Also, the materials are easy to find and inexpensive.

Start the construction by assembling the boom. The distance between the wire elements is not crucial; any length between 15" and 16" will work just fine. The boom consists of five pieces, as shown in Figure 1. The best approach is to cut two pieces of PVC piping, each about 7" long. Then assemble the boom and measure the distance between the spreader holes. Adjust the length of the boom by cutting off short sections of PVC piping until the total length is correct. Do not glue any of the connections or the antenna will not be collapsible. The parts will stay together by friction.

Next, drill 1/4" holes completely through the boom elements as shown in Figure 1. Note that one set of holes is in the coupling while the other set is in the 3/4" piping itself. This allows the spreaders to be rotated when collapsing the antenna. Drilling holes in PVC is perhaps the most difficult part of the construction. Use a nail or other sharp object to make an appropriate starting point on the PVC. Then, drill carefully, making sure the holes are straight and perpendicular to the PVC. Otherwise, the spreaders will be crooked.

Insert the 1/4" dowels through the holes. I used nylon ties to hold the dowels in place. Do not cut the dowels yet. That will be the last construction detail.

Select one set of wooden spreaders to be used as the reflector element and, using the nylon ties, loosely secure one plastic ring to each of the four spreader ends. Then, loosely secure one plastic ring to three of the spreader ends that will be used as the driven element. The plastic ring is not required on the fourth driven element spreader because

Photo B. The quad shown fully collapsed and ready to be carried to your favorite mountaintop. Note the HT for size comparison.

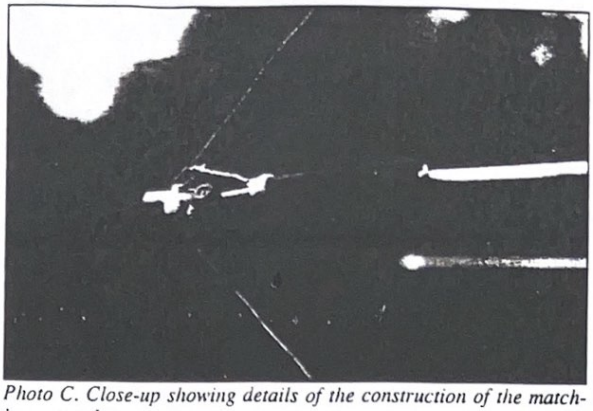

Photo C. Close-up showing details of the construction of the matching network.

the coax feed and the matching network will be installed on that spreader.

Cut the wires for the driven and reflector elements using the 18-gauge hookup wire. The driven element should be 82.5" (209.6 cm). The reflector should be 86.6" (220.0 cm).

Feed the reflector wire through the plastic rings on the reflector spreaders. Then strip about 1/4" of insulation from each end of the wire and solder the two ends together, making a complete loop. Position the plastic loops along the spreaders until you form a tight, perfect square (it helps to measure the distance along each spreader). Finally, tighten the nylon ties securely and cut the tails.

Construction of the driven element is more complex because of the matching network. First, feed the driven element wire through the three plastic rings on the driven element spreaders. Then, using a nylon tie, secure the driven element wires to the fourth spreader, as shown in Figure 2. Assembly and construction details of the matching network are also shown in Figure 2. Use caution when soldering to insure a good connection and to avoid overheating the components. Position the wire into a perfect square and tighten all the nylon ties, cutting the tails. Finally, secure the matching network and coax to the spreader using additional nylon ties.

A 30" piece of PVC piping serves as a short mast. Additional connectors and lengths of piping may be added to extend the mast if desired.

The only remaining construction detail is to trim the wooden spreader elements. Pruning shears work very well, but leave about 1/2" of extra dowel in case future adjustments are necessary.

Adjustments

Signals generated by a quad antenna are polarized. If you want *vertical* polarization, the antenna feed point must be on one of the horizontal spreaders. Conversely, if you want *horizontal* polarization, the antenna feedpoint must be on either the top or bottom spreader. The design of this quad allows the polarization to be changed easily—just twist the spreader elements 90 degrees.

Antenna matching is accomplished using an SWR bridge and tuning the trimmer capacitor to achieve the best reading.

To collapse the antenna, pull the PVC piping out of the "T" connector. Then, while holding the wooden spreader elements, twist the PVC piping and connector 90 degrees. The spreader elements will then line up in a package about 30 inches long. Of course, the wire elements will hang loosely at this point, but they will stretch back into shape when the antenna is reassembled.

I tested the antenna on several recent hikes. One hike took me up Mt. Monadnock in southern New Hampshire, and the second up Mt. Aziscoos in northwest Maine. Performance was as good as expected. The antenna fit easily into a long, narrow bag that I could wear like a backpack. Assembly was easy and quick, taking less than two minutes. And, best of all, the signal reports were outstanding. Using less than 1/2 watt, I was easily able to work repeaters 60-70 miles away with full quieting. Using 3 watts yielded similar signal reports on repeaters more than 100 miles away. Simplex was fun, too. The gain and directivity allowed me to block side signals quite well and to work selected stations with ease.

A note of caution: This antenna was designed to be very lightweight and portable. As a result, it is fragile. The 1/4" dowels can easily be broken, so use care when handling the antenna. Also, the antenna was designed to be used in fair weather. The capacitor and the wooden spreaders should not be exposed to rain or moisture. A light coat of spray lacquer or silicone sealant would afford some protection. Finally, the capacitor can be bumped easily, causing the setting to change. A drop or two of clear fingernail polish will "cement" the capacitor at the proper setting.

Those cautions aside, the antenna performs extremely well and is easily carried on hikes or climbs. I'm sure it will afford much pleasure on your mountaintopping expeditions. 73

PARTS LIST

1	3/4" PVC pipe, 10 ft. long
2	Couplers for 3/4" PVC pipe
1	"T" connector for 3/4" PVC
4	1/4" x 36" wooden dowels (for the spreaders)
1	Package nylon ties
7	1/2" plastic rings (available at craft stores)
20'	18-gauge hookup wire
6"	300 ohm TV twin lead
1	Trimmer capacitor 6-50 pF (Radio Shack # 272-1340)
Coax and connectors	

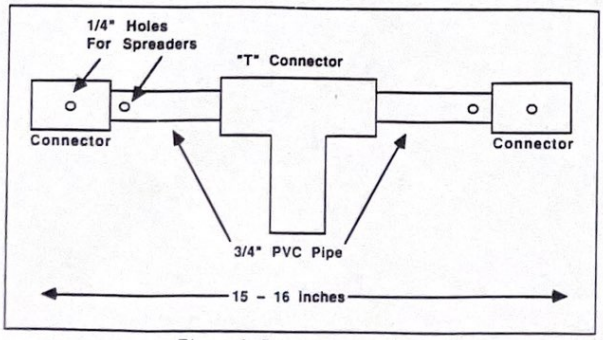

Figure 1. Boom construction.

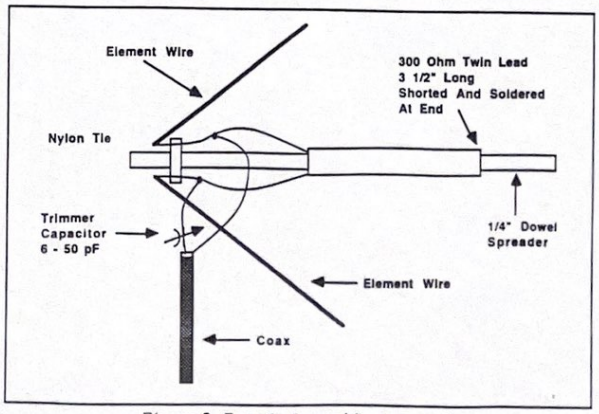

Figure 2. Detail of matching network.