COLLAPSIBLE QUAD FOR 10-METER HILLTOPPING

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Ten meter activity is at a peak and the availability of small rigs like the HTX-100, the President, and the Ranger make wilderness portable operation more interesting than ever. Of course the weak link in the system is almost always the antenna. Mobile antennas are inefficient. Beams are too large for easy transport, even when they're broken down. Dipoles have to be hung. This usually means mounting them low to the ground, unless someone is willing to climb a tree.

The collapsible one-element quad described here provides most of the features hilltoppers want in an antenna:

- The quad loop shows high efficiency and, as a bonus, relative immunity from the effects of surrounding objects.
- Even at a 10-foot elevation, the quad shows a good bidirectional pattern.
- The antenna width is less than 9 feet and ideal for erecting in tight spaces (like between two cars).
- The antenna goes from storage to use (and back again) in less than 10 minutes — including rig tune-up.
- The quad collapses without disassembly into a package about 8″ × 6″ × 5-1/2 ′ for easy transport.
- Except for a female coax connector (SO-239) and a scrap of plastic, all parts for the antenna are available from the hardware store.

Electrically, there's nothing new in the collapsible quad. It's cut to the textbook formula that defines the quad's length in feet as 1005 divided by the frequency in megahertz. With a target frequency of 28.5 MHz, the overall loop is about 35-1/4′ long or about 8′9″ on a side. A quad loop at least a half wavelength above ground has a feedpoint impedance of about 120 ohms, a factor I'll discuss later.

Building the collapsible quad

The traditional way to build a quad is to use an X support with a single piece of wire around the perimeter. The hilltopper uses a different mechanical scheme. As **Figure 1** shows, the antenna uses a PVC center support, aluminum L-stock horizontal elements, and wire vertical elements. The PVC pipe mounts over standard TV masts.

The PVC center support consists of two 5′ pieces of rigid PVC plumbling pipe. The top piece is 1″ diameter; the bottom piece is 1-1/4″ diameter. This gives you an outside diameter of 1-5/16″ for the top piece and an inside diameter of 1-3/8″ for the bottom piece. They nest easily and loosely.

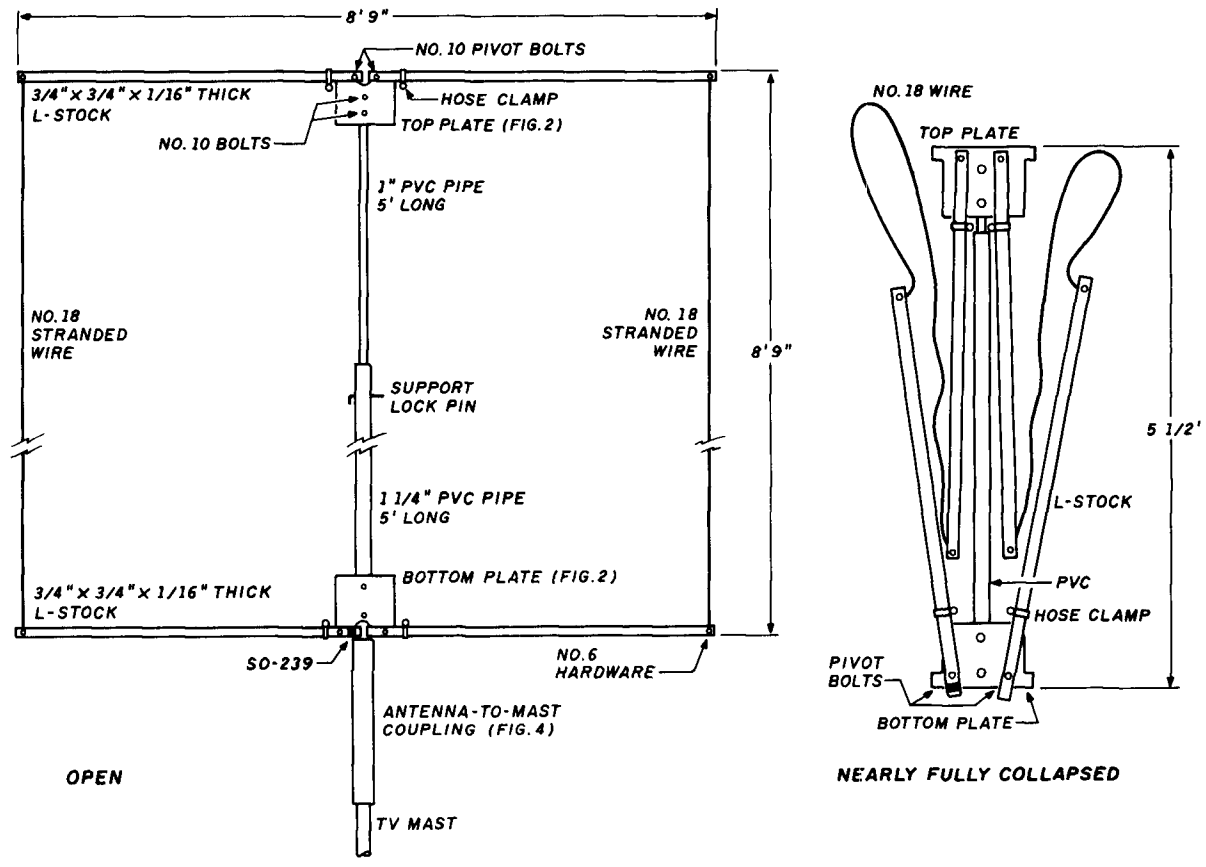
Mount an acrylic plate cut to the dimensions shown in **Figure 2** on each PVC section. A pair of no. 10 bolts and nuts per plate provide more than enough strength to hold the plates securely. I cut my plates from 3/16″ scrap taken from a protector designed to go under an office chair. Use care when cutting the 1″ × 3/4″ wings to prevent stress cracks. Drill a small (1/8″ to 3/16″) hole at the inside corner and then cut to the corner. If you use a sabre saw, work slowly to prevent the hot plastic chips from binding the cut closed.

Drill the plate-to-PVC holes about 1-1/2″ from the top and bottom of the plate. Drill holes for no. 10 hardware which will form the pivot points for collapsing the antenna elements in line with the wings. One-inch hose clamps slip over the L stock elements and onto the plastic wings to lock the horizontal elements in place. Squeeze the clamps to partially shape them to the odd element configuration.

Because each horizontal element is 4′ 4-1/2″ long, use 4 pieces of 3/4″ × 3/4″ × 1/16″ thick aluminum L stock. I used 8′ sections (Ease, Inc. no. 2207) and have enough left over for a 6-meter quad loop. Mount each element to the plate with no. 10 hardware, leaving a 1/8″ gap between them. Make a bridge piece for the top section from no. 18 wire, ring connectors, and no. 6 hardware. Note the orientation of the L stock. The flat side of the L should face toward the center of the antenna, not outward. This provides good strength in the direction of tension from the side wires.

At the center of the bottom element, use a chassis punch

FIGURE 1



Overall view of the quad loop, open and collapsed.

to cut a 5/8" diameter hole in one of the pieces for a modified SO-239. Be sure to leave enough room between the SO-239 threads and the L stock wall for the screw-on sleeve of the male connector. Cut off two opposing mounting hole corners from the female coax connector and file the cut edges smooth. Using the two remaining mounting holes, mount the connector to one side of the bottom horizontal element. On the prototype the connector is outside the no. 10 pivot hardware. If you widen the pivot points on the bottom section plate, there may be room to mount it close to the center gap between the two element pieces. Drill the other L stock section at the gap for no. 6 hardware. Make a no. 18 wire bridge and put a ring connector on one end. Solder the other end to the coax center pin.

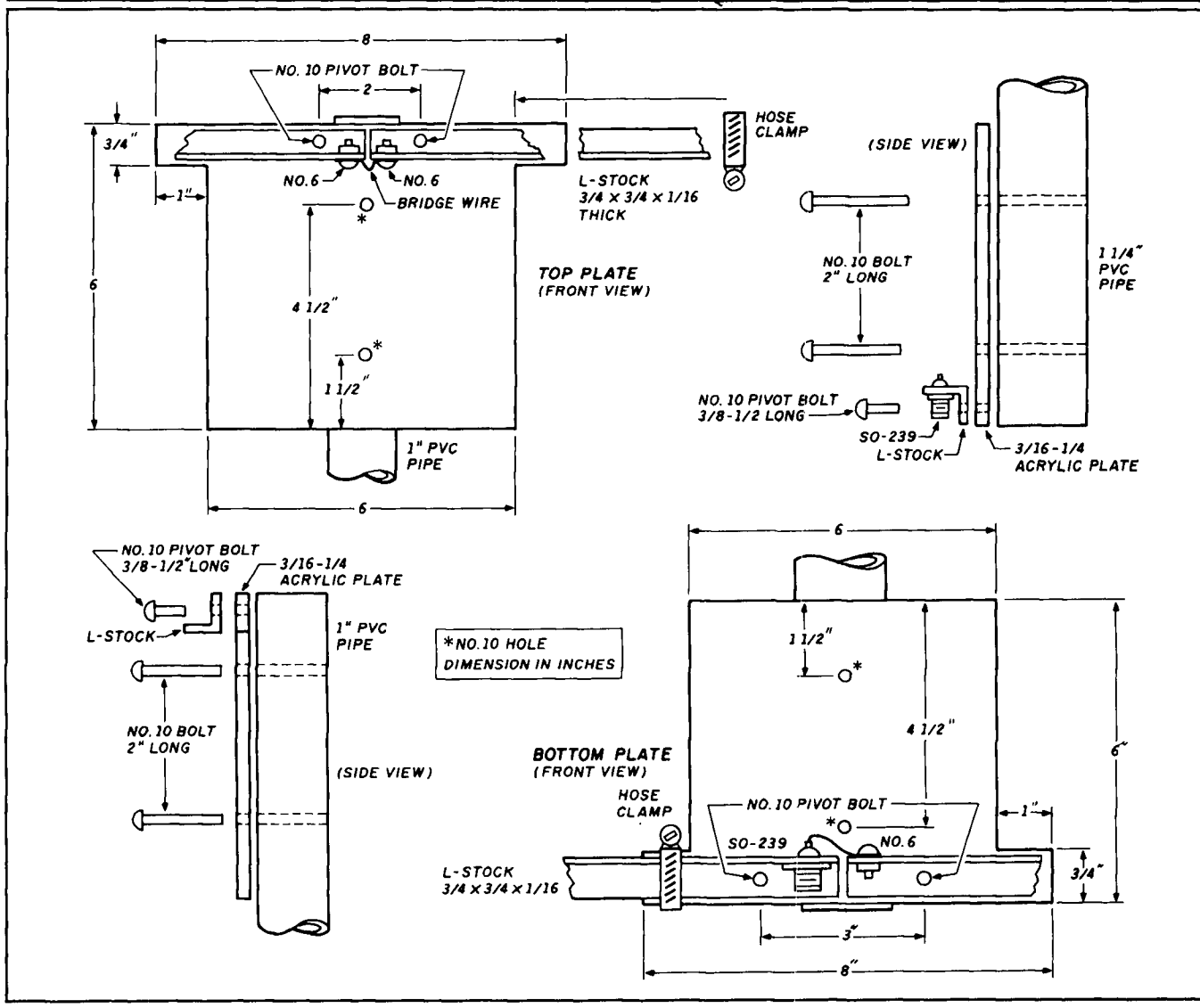
Cut two pieces of wire (no. 18 insulated stranded wire works well), each 8'9" long. Solder ring connectors to each end. Drill the vertical side of the L stock at each corner for no. 6 hardware. Be sure the hose clamps are attached to the four pieces of L stock. Slide the top PVC section inside the bottom section, then connect the vertical wires to each side.

To complete the basic antenna, drill a hole through the two PVC sections at the center. Lay the antenna on a flat surface like a driveway or a basement floor. Extend the horizontal elements and lock them by tightening the hose clamps over the wings and securing the pivot hardware.

PARTS LIST

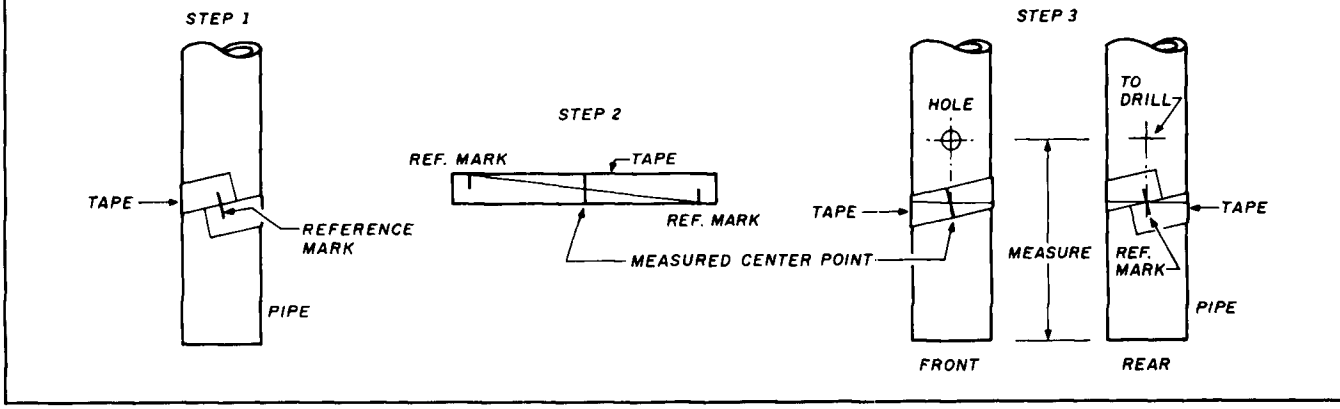
Number Rquired	Item	Source
4	3/4" × 3/4" × 1/16" thick aluminum L stock (angle stock), each piece at least 5' long	hardware store
4	stainless steel hose clamps, 1" diameter	hardware store
2	acrylic plates, 3/16" (or more) thick, 6" × 6", with 3/4" × 1" wings	scrap
18'	no. 18 stranded copper wire, insulated	Radio Shack
1	5 feet of 1" PVC-1120 rigid pipe	hardware store
1	5 feet of 1-1/4" PVC-1120 rigid pipe (Note: small additional lengths are needed for the antenna-to-mast coupling described in the text.)	hardware store
5	no. 10 bolts, at least 2" long, with nuts	hardware store
4	no. 10 bolts, 3/8" long, with nuts (pivots)	hardware store
7	no. 6 machine screws, 3/8" long, with nuts	hardware store
2	no. 4 machine screws and nuts for coax connector	hardware store
7	ring connectors	Radio Shack
1	SO-239 female coax connector (modified)	Radio Shack
2	5 foot TV masts	Radio Shack
1	1-¼" inside diameter crutch tip	hardware store
45'	1/8" to 3/16" diameter rope	hardware store

FIGURE 2



Top and bottom acrylic plate detail.

FIGURE 3



A simple method for drilling PVC pipe.

Extend the PVC sections until there's light tension on the L stock as the wire side elements reach their limit. Mark the inner pipe at this point. Make a vertical alignment mark on both pieces so the final product will be a flat plane.

Drill a hole through both pipes to fit a bolt or other pin. I use an old L-shaped Allen wrench a bit over 1/8" in diameter. Using a drill press will assure that you'll have well-centered holes. For free-hand holes, drill through one side of each PVC pipe only, preferably at the alignment mark. Using the larger pipe, wrap a piece of masking tape around the pipe at a slight angle so that the left edge of one end meets the right edge of the other, as shown in **Figure 3, Step 1**. Make a mark across the two edges. Remove the tape and spread it on a plate. Measure the exact center between the two marks, as shown in **Step 2**. Now follow **Step 3** and replace the tape, aligning the center mark with the first hole you drilled. The drill line is where the other marks meet on the other side of the pipe. Measure the distance from the pipe end of the first hole and mark an equal distance on the reverse side. The cross hairs mark the point to drill. Use a very short bolt to hold the first inner and outer holes together and drill through the second outer hole to complete the passage for the pin.

Opening and closing the completed antenna

Place the completed antenna on the floor to practice opening and closing. To open the antenna for use, bring each L stock element to the horizontal. Slide the hose clamps over the plastic plate wings and tighten. Tighten the no. 10 pivot hardware. Make sure the no. 6 hardware is secure at the wire ends and bridge connections. Extend the nested PVC pipe section until the center holes are aligned and plug in the pin. All that remains is to connect the coax and put the antenna on a mast.

Reverse the process to collapse the antenna for transport and storage. Assume that you have removed the coax and dismounted the antenna from its mast. Loosen the hose clamps and slide them off the wings. Loosen the no. 10 pivot hardware and swing the horizontal elements to align with the PVC pipe. Remove the pin through the pipes and nest the sections together as far as they will go (to the plate bottoms). Use the side wires, tie wraps, or other binders to wrap each end of the collapsed assembly. The antenna is now ready for transport.

Mounting the antenna

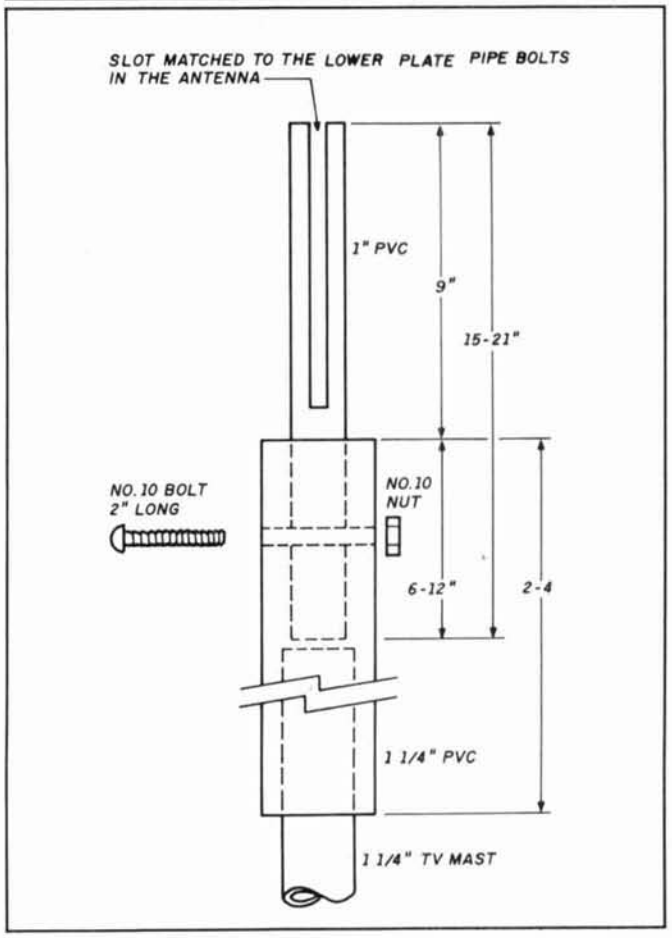
Mounting the antenna to a mast requires a bit of thought and preparation. There are undoubtedly many schemes that will work. For hilltopping, I use two 5′ sections of TV mast to elevate the bottom of the antenna 10 feet off the ground. I keep the swaged end of the masts down and have installed a crutch tip to the end that touches the ground to keep dirt out of the mast. I can use up to two more sections with simple rope guying.

The mast-to-antenna support section shown in **Figure 4** serves two purposes. The slotted upper section of 1" PVC fits over the bolts that hold the plate to the bottom section of antenna PVC. The 9" slot holds well for hilltop operations, but wouldn't be suitable for taller masts subject to higher winds.

The 3′ length of 1-1/4" PVC slips over the top of the TV mast. It's long enough to provide a secure mount and to allow redirection of the antenna by the "armstrong" method. Because the antenna shows a bidirectional pattern, even when close to the ground, it's important to be able to turn the antenna 90 degrees. You can add a rubber grip or handle to the bottom end of the PVC for easier turning.

Guying is simple with just 10 feet of mast. I loop three 15 foot 1/8" ropes over the top of the bottom plate. This anchors the antenna to the mast in light breezes. If the antenna is mounted between cars, I make loops to hold bungee cords hooked to fender wells or door handles. On open ground I tie the guy ropes to metal tent pegs. My YL, N4TZP, and I can assemble and erect the entire system in 10 minutes as nothing weighs more than about 5 pounds. Higher installations require more elaborate systems using guy rings and secure fastenings.

FIGURE 4



Mast-to-antenna support section.

My simple mounting and guying system has survived 15 mile-per-hour breezes without difficulty. Anything above that level would kill my urge to operate on a hilltop, anyway.

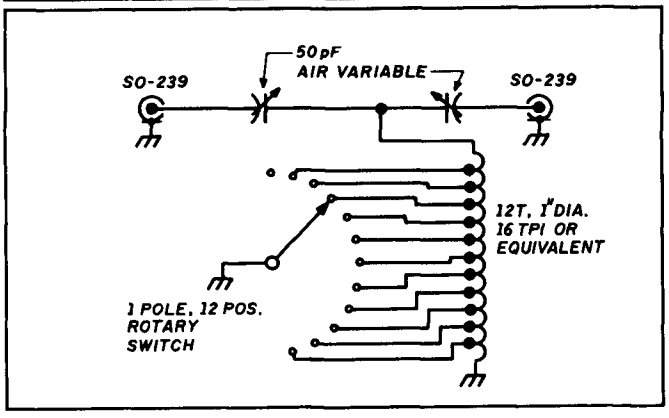
Tuning the antenna

A quad can't resist the offset of its normal feedpoint impedance close to the ground. At heights above a half

wavelength, the quad norm of 100 to 120 ohms permits the use of a simple matching section with 50-ohm output transmitters. A 5'7" length of RG-59 will perform the transformation. At lower heights, however, the section becomes useless.

Because the coax (RG-58) is only about 20 feet long its losses with a low power rig are small, even with SWRs above 3:1. This is why I use the simple homebrew T-circuit matching unit shown in **Figure 5**. The capacitors are 50-pF MAPC types with shafts. The coil is 12 turns of 1" diameter, 16 turns-per-inch miniductor type stock. A 12-position switch taps the coil at each turn. The tuner is in a 4" × 5" × 6" aluminum case salvaged from another project, but a smaller case would work. I keep an old SWR meter attached to the

FIGURE 5



Simple T-match circuit for the collapsible quad.

tuner with a double male connector. Tune-up is a quick process because my HTX-100 has a 5-watt output position, and there's a high safety margin if the initial settings are way off base. I have the quad settings marked on the case. Changes of location require only the smallest tweaking of the capacitors to eliminate reverse voltage readings.

The proof of the system is in the operation. A recent trip to Signal Mountain, Tennessee, to participate in the Chattanooga Choo Choo Net, produced excellent results. The W4RNL/N4TZP station (with the assistance of WA4TKN) received excellent signal reports. We could work almost everything the big beams on the mountain could. By pointing northeast-southwest toward Knoxville (120 miles away) we heard WA4TJW check out due to local thunderstorms. Turning more east-west brought a number of W5's to workable levels. The station went from car to on-the-air in 10 minutes (including setting up a small table with folding legs). After the session it took us 10 minutes to load the antenna back into the car.

Experiences like these have confirmed the soundness of developing a hilltop antenna which is more efficient than the usual mobile whip, and more free-standing then the usual dipole. The collapsible quad loop inexpensively fills a gap in the range of antennas available for portable 10-meter operations. hr