About this Article

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A Super Duper Five Band Portable Antenna

Make camping and travel more fun with this easy to duplicate antenna.

Clarke Cooper, K8BP

One thing that makes Amateur Radio so wonderful is whether I am camping in the rugged Grand Canyon area or somewhere in the Great Northern Woods, I have the capability to work the world while operating low power (QRP).

As one who loves building and experimenting with antennas and operating QRP, it seems like every time I venture out into the backcountry I bring a new homebrew antenna to try out. Then in March 2006 while I was looking through an issue of *QST*, I noticed an MFJ advertisement for their 10 and 12 foot telescoping whip antennas. That's when my wheels started churning. After a few minutes of doing some calculations and sketches on paper, I came up with this rugged lightweight antenna.

After placing the order with MFJ for two of the MFJ-1954 10 foot whips, I ventured to my local Home Depot and purchased the rest of the parts. Surprisingly, this little project only took me about an hour to build. The fun really started several days later when I received the telescoping whips. The initial tune-ups with my MFJ antenna analyzer and Elecraft K2 indicated that this antenna loads up beautifully on 20, 17, 15, 12 and 10 meters without the need for a tuner. The best news is that it can be built for around $60.

Figure 1 — Details of PVC and copper pipe pieces for antenna center.

Travel Friendly

When broken down for transport, this antenna, minus the mast, consists of two short 2 foot 7 inch long elements and two lightweight MFJ whip sections retracted to a length of 2 feet.

To operate on the 20 and 17 meter bands, loading coils are used to resonate the system, with precise tuning available using the telescoping whips. In order to operate on the 15, 12 or 10 meter bands, the loading coil is bypassed and with a short jumper across the coil terminals the antenna operates as a full sized unloaded half-wave ($\lambda/2$) dipole.

How Does It Perform?

Three days after completing my new antenna, I drove north from my winter residence in Phoenix to Grand Canyon National Park for a couple of days of camping. With this antenna 10 feet in the air and my Elecraft K2 at 5 W output, I had no trouble making SSB and CW contacts to all parts of the US as well as some long haul DX contacts. The DX contacts on that trip included Asiatic Russia, Australia, Belize, Lithuania, Italy, Japan and Hawaii on 20, 17 and 15 meters. My location was surrounded by high mountains to the north, east and west. I was quite pleased with my latest antenna's performance. Even though I found no activity at all on the 12 and 10 meter bands I still feel very confident that when they open up, this antenna will be a winner on these bands as well. I just can't wait until I start using this antenna on Pactor to get my e-mail.

Making it Happen

The parts required are listed in Table 1. Cut the copper and PVC pipe per Table 1 and Figure 1. Remove burrs from all cut edges using emery cloth. Assemble all the parts on a clean surface. At a small sacrifice in weight, a ⅝ inch by 2 foot dowel can be inserted into the copper T to provide additional strength. This is recommended for extended use.

Push two of the copper bushings into the center T and insert the two CPVC couplings into the copper bushings as far as possible.

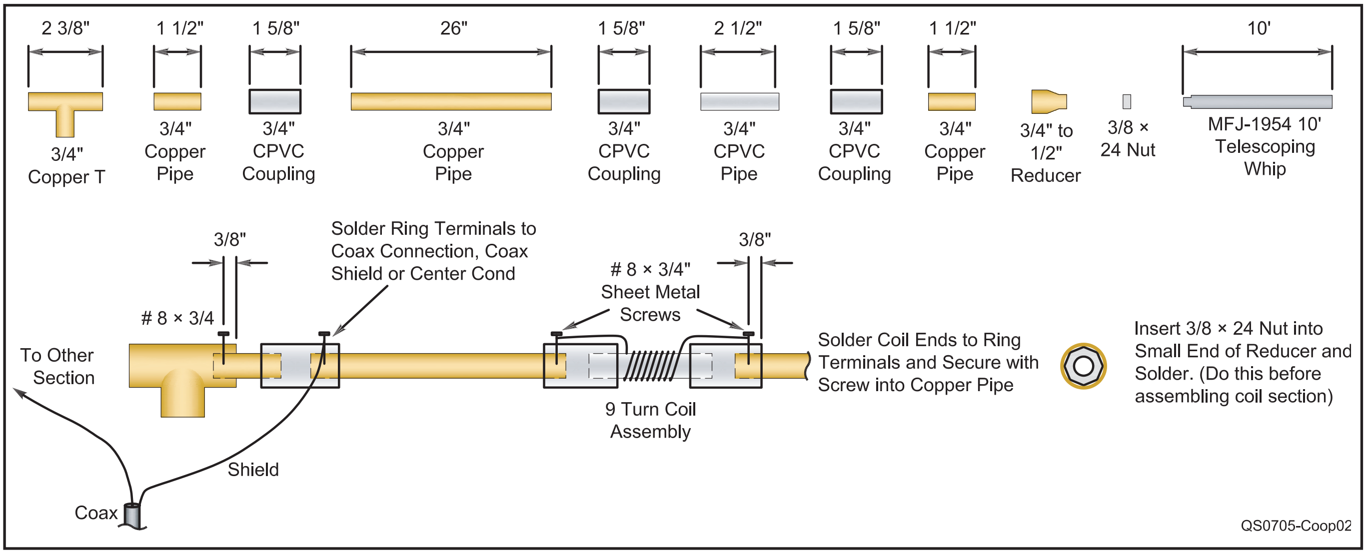

Figure 2 — Antenna assembly drawing.

Table 1
Parts Required to Assemble the Portable Dipole

Quantity one unless noted.

Alligator clips (4)
Copper pipe, ¾″ × 26 (2)
Copper pipe bushings (made from ¾″ pipe), ¾″ × 1½″ (4)
Copper pipe reducer, ¾″ × ½″ (2)
Copper T, ¾″
CPVC cement
CPVC gold pipe, ¾″ × 2½″
Fine thread stainless nuts, ⅜″ × 24 (2)
FSC hardwood dowel, ⅝″ × 4′
Insulated solid 20 gauge wire, 10′
MFJ -1954 (10 foot) telescoping whip (2)
Sheet metal screws, #8 × ¾ (package)
SXC CPVC couplings, ¾″
Ring terminals, 20 gauge size (6)

Table 2
Tools Required

Carpenter's saw	Hacksaw
Tubing cutter	Measuring tape
Electric drill and bits	Propane torch
Emery cloth	Soldering iron
Fine file	

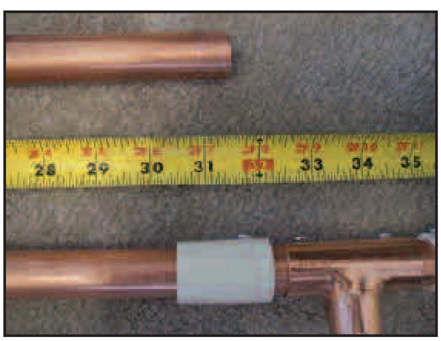

Figure 3 — Detailed view of inner element construction.

Drill four 3⁄32 inch holes on top of the center insulated T assembly and secure with four #8 × ¾ inch screws.

Next, insert both ¾ × 26 inch copper pipe elements into the CPVC couplings and drill four 3⁄32 inch holes. Then secure the four #8 × ¾ inch screws as shown in Figures 2 and 3.

Assemble the loading coil forms by lightly gluing two CPVC couplings to each end of a ¾ × 2½ inch CPVC pipe piece using CPVC cement. Make sure you apply glue only on the coupling half that will be used with the ¾ × 2½ inch CPVC pipe, as the other end of the couplings will be fastened later by #8 sheet metal screws. After assembly, wipe any excess glue from the outside of the form and from the inside of the free end of both of the coil CPVC couplings.

Drill two vertical holes in both coil assemblies, all the way through each end of the CPVC coil form assembly. Insert a length of 20 gauge wire all the way through both vertical holes of the coil form. On the short end, leave enough wire to connect to a ring terminal later. Carefully wind nine turns on the form and feed the remaining end through both holes. Adjust the coil windings by twisting the coil and pressing on the coils to remove any slack. When you are satisfied that the coil windings are tight, leave enough wire to connect to a ring terminal later. The completed coil assemblies are shown in Figure 4.

Insert the remaining ¾ × 1½ inch copper bushings into a ¾ × 1½ inch copper pipe reducer and carefully solder them together. Handle with extreme care until these items have cooled down.

Insert both ¾ × 24 nuts into the ½ inch ends of the pipe reducer until they are flush with the ends of the reducer. Carefully solder the nuts to the copper reducer. After they have cooled down, insert the ¾ inch ends of the reducers into the 20 meter coil form. Confirm that both coil windings run in the same direction. Then drill a hole in each outer section of the CPVC bushing, keeping both holes symmetrical.

Measure the coil wire tag ends and carefully strip off just enough insulation to make a loop that feeds into the terminals. Confirm that the center of the terminal is aligned with the mounting hole. Crimp and solder the wire connections.

Fasten each coil form to its respective pipe reducer and secure with a #8 × ¾ inch sheet metal screw. Slide the remaining end of each loading coil housing onto the end of each 2½ foot dipole element. Rotate the coil terminals so they are on top. Secure the coil assembly to each dipole element with a #8 × ¾ inch sheet metal screw. Attach the MFJ -1954 telescoping whips by screwing them into the end of each coil assembly as shown in Figure 6.

Attach a length of coax by separating the center conductor and outer shield and soldering a ring terminal on each. Secure each terminal to the outer side screws on the T assembly. Wind a 6-turn 7 inch diameter coil on the antenna end of the coax and secure with tape or wire straps. Connect the coax to the antenna by loosening up the side screws on each active element insulator. These screws are the ones on the outer edge of the CPVC coupler next to the element. Slide the coax terminals under each of these screws and retighten the screws. It doesn't matter which side the coax shield or center conductor is attached to. After these connections have been made, take an ohmmeter and hold one meter lead on the center T and with the other lead touch both elements. Both sides should indicate an open circuit.

If you wish, instead of the coiled coax

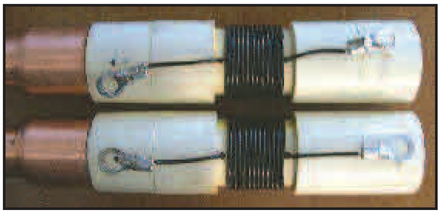

Figure 4 — Completed loading coil assemblies.

Table 3
Antenna Tuning Chart Settings and Resulting SWR

Band	Tune Frequency (MHz)	Max SWR	Coil	Whip Length
20 Meters	14.2	1.4:1	Yes	118″
17 Meters	18.11	1.0:1	Yes	78½″
15 Meters	21.15	1.1:1	No	99″
12 Meters	24.94	1.2:1	No	78″
10 Meters	28.8	1.2:1	No	64″

Figure 5 — One side of the antenna with retracted whip attached.

choke, you can use a 1:1 balun such as the one in Figure 6 that I made with a T200-2 toroid, a couple of feet of enameled wire and some odds and ends I had in my junk box.

Figure 6 — Dipole feed connection — toroid balun option shown.

Tuning it Up

Table 3 provides the data required to adjust the antenna for all five bands. You will likely want to adjust the length to whip at each noted frequency and record the length that provides a 1:1 SWR, since your construction might be different than mine. With the antenna adjusted to the frequency shown it should provide an acceptable SWR across each band, no greater than the *Max SWR* shown in the table.

If you were going to operate most of the time close to 14,000 kHz on CW and the band edge SWR of 1:4 is excessive for your radio, it can be corrected very easily by slightly lengthening the whip length to obtain a 1:1 SWR in the CW portion. On the other hand if you want to adjust for a 1:1 SWR at around 14,350 you can make the same type of a slight adjustment, this time by shortening the MFJ whips. By using this same technique on any band there is no need to bring along any bulky heavy antenna tuner on your camping adventure.

Hoisting it Up

There are many ways of installing such an antenna in a portable environment. There are tripod mounts, improvised railing supports and many types of telescoping support poles available from a number of manufacturers. I have had good results using a Model S216 telescoping fiberglass pole manufactured by Hastings. These are available at electrical supply houses. There are other similar types sold by a number of Amateur Radio dealers.

In my usual installation, I have secured a short piece of CPVC tubing on the top telescoping section. On the other end of this short piece, I insert it into a CPVC coupling that is part of the T section on my antenna. I have also used short pieces of aluminum tubing fastened together made from old antenna beam elements. Even short pieces of inexpensive CPVC pipe will do for a 4 to 5 foot mast.

For the base, I often use a folding portable flood light base I picked up at a yard sale. If packing in by foot, I leave the base at home and use available supports such as tree stumps to hold up the mast by securing with a piece of small rope. With this method, one can set up this antenna within 5 minutes.

One final bit of advice — please be careful when setting up your antennas wherever you are. Before erecting any type antenna, always make it a habit to look for any electrical wires above and 360° around you.

Clarke Cooper, K8BP, has been a ham since 1961 and holds an Amateur Extra class license. Clarke has a degree in electrical engineering and has spent most of his career designing manufacturing plants and automated control systems. He retired in 2001 as Project Manager for Federal Mogul.

He is a Life Member and a four term president of the Muskegon Area Amateur Radio Council in Muskegon, Michigan. He is also a member of the Thunderbird Amateur Radio Club in Phoenix, Arizona. He especially enjoys mentoring new hams and operating QRP on both CW and SSB.

Over the years, Clarke has had the pleasure of sending out over 30,000 QSL cards. He is a member of ARRL, QCWA, ARES, RACES, Fists and Adventure Radio Society. During the summer you can reach Clarke at 4202 E Pontaluna Rd, Fruitport, MI and in the winter at 17237 North 15th Pl, Phoenix, AZ 85022 or by e-mail at **k8bp@earthlink.net**.