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By Phil Salas, AD5X

A Simple and Portable HF Vertical Travel Antenna

How to build a portable, efficient antenna without bursting your budget.

With all the small HF rigs available today, the ability to take an HF station on business trips, vacations, family visits, camping and other activities is becoming very easy. Often, the limiting factor is an effective portable antenna to go with the radio. As I'm sure most of you know, the bigger the antenna the better the performance. I usually prefer a full-size dipole. Depending on your location, a dipole may be inconvenient because it needs some form of support. I decided to look into building an inexpensive, portable, vertical antenna for use when a dipole is not practical.

My goal for this antenna was for it to be as long as possible so as to maximize its radiation resistance and hence, efficiency; yet it must also be easily packed in a small suitcase. In addition, it needed to be multiband, covering 40 through 10 meters. The parts needed had to be readily available and, of course, it shouldn't break the bank! Finally, I wanted the antenna to provide low (nearly 1:1) SWR so no antenna tuner was needed.

The resulting antenna described here breaks down into three 2-foot mast sections, a small center-loading coil (air-wound for efficiency), a short telescoping whip and a small base support. When the antenna is put together (a matter of minutes), it has a total height of about 12 feet.

Read through all the directions first to become familiar with the project, but don't be intimidated by all the assembly directions. This antenna is easier to build than it is to explain how to build it. No more than about two hours should be necessary for its construction.

Gathering the Parts

Except for the loading coil, all parts are available from either your local hardware store or RadioShack. I obtained the loading coil from Surplus Sales of Nebraska (www.surplussales.com). The coil (Miniductor 4027) is 2 inches in diameter by 10 inches long, with 10 turns per inch of 16-gauge wire. The cost is $15 for one of these coils. As this price, it is not worth trying to build your own coil, and you'll have enough of the coil left over for other projects (maybe a second antenna for a friend?). The complete parts list is shown in Table 1.

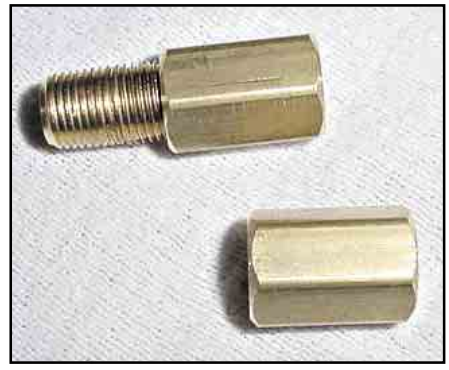

Figure 1—Nipple (top) and coupling (bottom).

Riser Preparation and Assembly

First, screw each of the three 0.7-inch 1/8-NPT nipples into three separate 1/8-NPT couplings. Screw these in as tight as you can. I used pliers to screw the coupling on

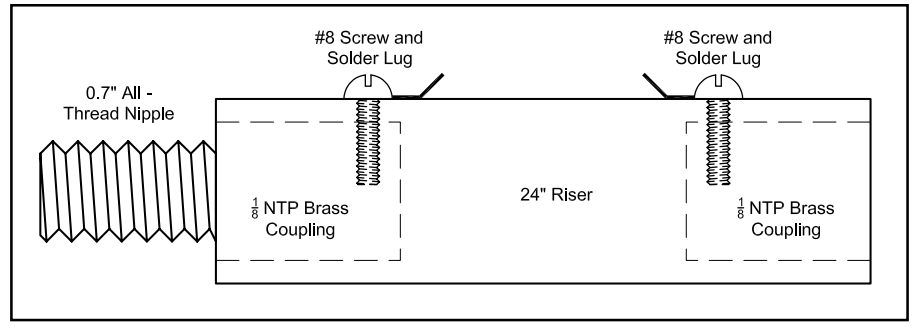

Figure 2—Middle section assembly.

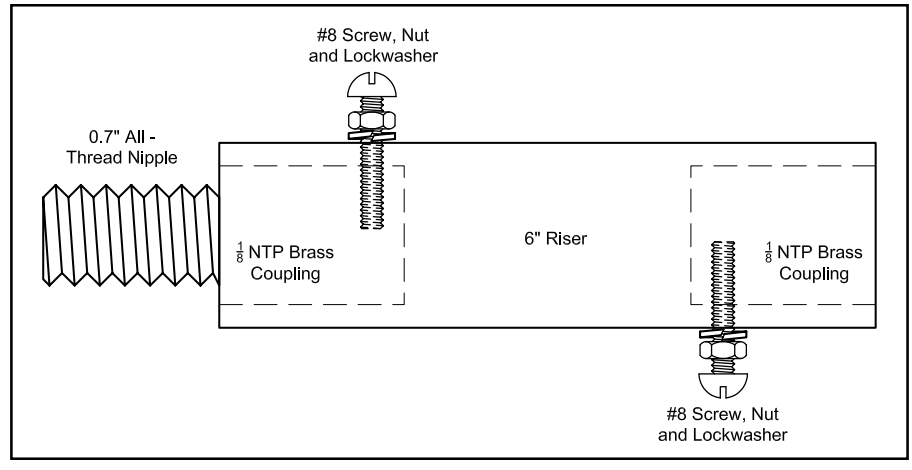

Figure 3—Coil section assembly.

Table 1
Parts List

Qty	*Description*
1	Coil, Miniductor 4027, Surplus Sales of Nebraska
3	24-inch sprinkler system risers[1]
1	6-inch sprinkler system riser
1	¾-inch PVC-T
1	¾-inch to ½-inch PVC adapter
2	¾-inch PVC threaded plugs
7	1/8-NPT brass couplings
3	1/8-NPT 0.7-inch all-thread nipple "NIPPLE 1/8-inch × CLOSE"
1	1/8-NPT 1-inch nipple
2	#8 × 1¼-inch brass screws
6	#8 × ½-inch brass screws
2	#8 brass nuts
8	#8 copper-plated steel split lock washers
8	#8 brass flat washers
1	3/8 × 12-inch threaded brass rod
2	3/8-inch brass nuts
2	3/8-inch brass flat washers
2	3/8-inch copper-plated steel split lock washer
6	#6 stainless steel 3/8-inch sheet metal screws
1	72-inch telescoping antenna (RS 270-1408)
1	Chassis-mount SO-239 connector (RS 278-201)
3	Banana jacks, 2 red and 1 black (RS 274-661)
10[1]	#14 solid copper house wire, insulation removed
10	¼-inch solder lugs

Note: RS is RadioShack.

[1]The adjustable center-loading coil will be a little over 6 feet above the ground. If this is too high, you may wish to change one or more of the 24-inch risers to 18-inch risers, or place the coil assembly between the second and third riser.

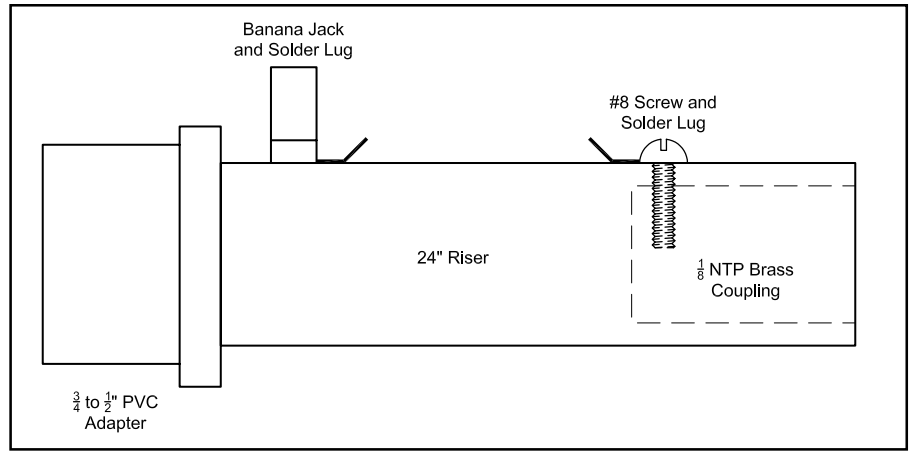

Figure 4—Bottom section assembly.

each end of a nipple as tight as I could. Then I unscrewed the couplings. One end will break loose right away, and the other will stay tight in the remaining coupling. Next, heat up each nipple/coupling assembly with a large soldering iron and carefully run a bead of solder around the nipple/coupling interface. See Figure 1.

Now insert the couplings *without* the nipples into one end of each of the four sprinkler system risers (one 6-inch and three 24-inch risers). I found this to be a very tight fit on some risers, so you may need to gently tap these in place so they are flush with the ends of the risers.

Next insert the remaining three 1/8-NPT couplings (with nipples) into the opposite ends of two of the 24-inch risers, and the 6-inch riser. See Figures 2 and 3. Remember, one of the 24-inch risers does not have a nipple/coupling installed. Again, these nipple/coupling assemblies may need to be tapped into place. To do this without damaging the nipple, insert the coupling-end of the nipple/coupling assembly into the riser as best you can. Then place the nipple-end on a piece of wood, and gently tap the opposite side of the riser with a hammer until the coupling is fully seated in the riser. Make sure that the nipples extend out of the risers.

Next drill and tap a #8 threaded hole through each end of the risers into the inserted 1/8-NPT brass couplings. Each of the inserted 1/8-NPT couplings is 0.7-inches long. Measure back from the end of each riser 0.5-inch and drill a hole (#29 drill, 0.135-inch diameter) through the riser and one side of the brass coupling. The holes should be positioned on the same side of the long (24-inch) risers, and on opposite sides of the short (6-inch) riser. Tap the holes with a #8 tap. Insert the ½-inch long brass screws with lock washers and flat washers into the tapped holes in the 24-inch risers.

Now, insert each of the two #8 1¼-inch brass screws through a #8 nut, lock washer and flat washer. Screw them into the tapped holes on the 6-inch riser. Leave most of the screw protruding out from the riser. Tighten the nut to secure everything in place. These screws will be used for the coil support.

Remember that one of the 24-inch risers did not have a nipple/coupling assembly installed. This riser is the bottom antenna section. To prepare this section, drill a 1/8-inch hole in the riser just above the open threaded end of the riser. Into this hole, mount a red banana jack with its associated solder lug mounted on the outside of the riser. After you get everything tightened, you might want to drip a little epoxy on the mounting screw inside the riser to keep the banana jack from coming loose. Next, screw this end of the riser tightly into the ¾ × ½-inch PVC bushing. See Figure 4.

It is finally time to install the antenna wires. Strip the insulation off of three 30-inch pieces of #14 solid copper house wire. Solder one end of each of the three wires to a #8 solder lug. Attach each of these solder lugs to the brass screw on one end of each of the 24-inch risers. Now wrap two turns of the wire around each of the 24-inch PVC risers and determine where the wire should be cut and another solder lug attached to connect the wire under the far-end brass screw on each riser. The bot-

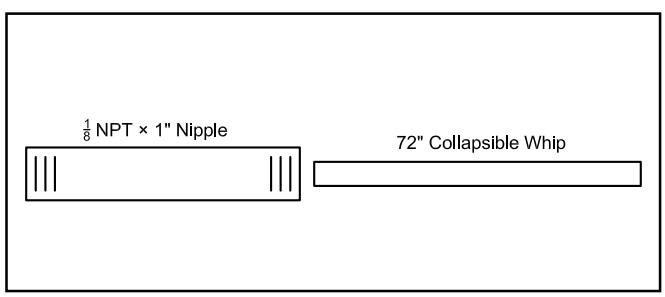

Figure 5—Collapsible whip assembly.

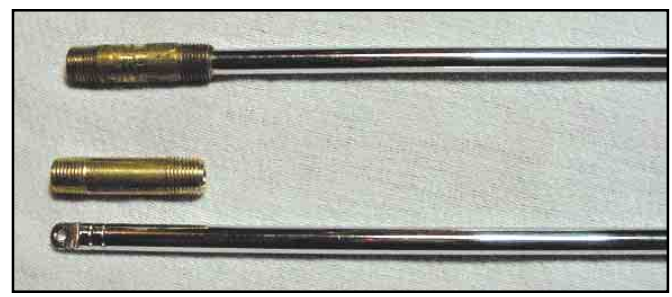

Figure 6—Whip and coupling.

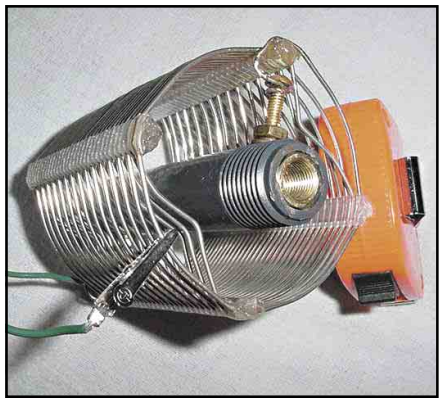

Figure 7—Coil assembly.

tom section riser should already have a solder lug attached under the banana jack.

Collapsible Whip Preparation

File the plating off the small mounting stub at the base of the RadioShack 72-inch collapsible whip antenna. Once the bare brass is exposed, tin this with solder. Now insert the whip antenna base into the 1/8-NPT × 1-inch brass nipple such that the antenna base is just below the lip of the nibble. Temporarily hold these pieces together with some masking tape. Now heat the nipple with a soldering iron and solder the brass antenna base to the inside of the nipple. See Figures 5 and 6. Incidentally, I did find that some brass nipples were a little small on the inside to pass the collapsible whip. Nipples I purchased at True Value Hardware cleared the whip, and nipples purchased at Home Depot did not. If you can't find a nipple with a 0.275-inch ID, you can easily drill it out with a 9/32-inch drill bit.

Loading Coil Assembly

Cut off a 5-inch length of the Minductor 4027 coil. Unfold about half a turn from each end of the coil. On one end of the coil, solder a 6-inch piece of insulated wire terminated with an alligator clip. Using a screwdriver, indent every other turn of the coil. Finally, solder the coil leads to the brass screw heads on the 6-inch riser (adjust the brass screw lengths as necessary). The coil end, with the clip lead soldered to it, should be on the end of the riser that has the brass nipple showing. See Figure 7.

Base Assembly

The base can be built easily just by referring to Figures 8 and 9. First, drill a 3/8-inch diameter hole into each of the ¾-inch PVC threaded plugs (one plug will be used for the ground support 3/8-inch threaded rod, the second plug will be used for the SO-239). Note that the plugs are threaded and the T is smooth. I used threaded plugs since they slip easily into the T. They will be held in place with #6 sheet metal screws. I also cut off about half of the threaded part of these plugs so as to leave more room inside the PVC T for the wiring. Place the SO-239 temporarily over the 3/8-inch hole just drilled in one of the ¾-inch threaded plugs and mark the location for two #6 stainless steel machine screws which will hold it in place. Also mark four points on the T as shown for the #6 stainless steel screws that will hold the two ¾-inch threaded plugs in place. Before finally connecting the SO-239 to the base, solder wires to the center conductor and to the ground for connecting to the internal connections as shown. You will probably need to file out a little more of the hole in this threaded plug so as to easily pass the ground wire. I used a short piece of copper braid from a piece of RG-58 cable from the SO-239 ground to the black ground banana jack, and soldered the end directly to the 3/8 × 16 brass nut. Drill 1/16-inch diameter holes for the six stainless steel sheet metal screws and complete the assembly of the base. I rounded the end of the 3/8 × 16-inch brass rod with a file to make pushing the base into the ground a little easier. I didn't sharpen the end, since this could cause a problem if you are trying to carry this through airline security!

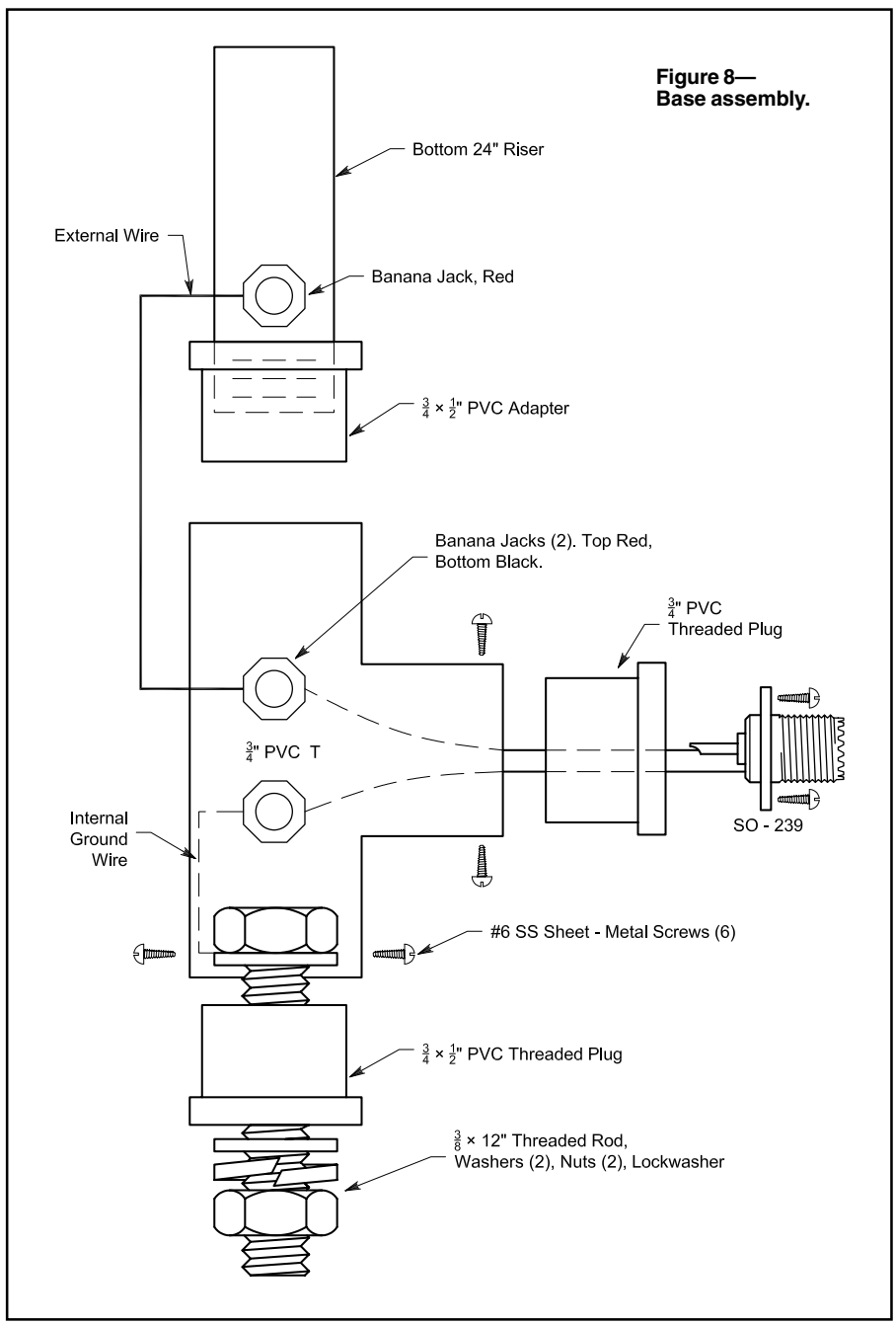

Figure 8—Base assembly.

Figure 9—Base, prior to final assembly.

Figure 10—All of the antenna components.

Finally, attach ¼-inch spade lugs to each end of a 2½-inch long piece of bare #14 copper house wire. This will be the piece of wire that is used for attaching the base assembly to the bottom section of the antenna.

Ground Radial Network

To minimize your ground losses, you really need some form of ground radials. These radials should be at least as long as the antenna is high. Therefore, I made six 12-foot radials using #22 insulated wire. Almost any gauge wire, insulated or not, can be used here. In my case, I attached all the wires together and to a ¼-inch spade lug on one end. This lug will attach to the lower black banana jack on the base assembly. You may wish to have six separate ground wires with their own spade lugs as unraveling the six folded-up radials takes longer than putting the rest of the antenna together. On each outer end of the radials, I soldered a 1-inch long piece of brass $^1/_8$-inch rod. These ends are then pushed into the ground to help hold the radials in place.

The entire antenna, broken down into individual pieces, can be seen in Figure 10.

Antenna Assembly

To assemble the antenna, first press the bottom antenna section (24-inch riser with banana jack) into the top of the base assembly and attach the 2½-inch length of interconnecting wire between these two red banana jacks. Then screw one of the remaining 24-inch risers into the top of the bottom antenna section (finger tight). Push this base/riser assembly firmly into the ground, keeping it as vertical as possible.

Now, assemble the remaining 24-inch riser with the loading coil assembly and the collapsible whip. Again, finger tight is all that is necessary for all brass fitting interconnections. Extend the whip, and screw this entire assembly into the open end of the 24-inch riser that is available on the assembly pushed into the ground.

Finally, extend the six radials, and attach the common end to the bottom black banana jack on the base assembly. See Figure 11.

Initial Antenna Setup

The idea here is to find permanent adjustment points on the coil for each band. So, starting with 40 meters, use an antenna analyzer to find the coil tap that gives the best SWR. See Figure 12. Mark this tap point. Move to 30 meters and repeat. Repeat again for 20 and 17 meters.

For 15, 12 and 10 meters, the entire coil will be shorted out and the top whip will be adjusted for resonance in these bands. I marked the top whip with a permanent black marker at the points necessary for these bands.

Now pull the loading coil/collapsible whip top assembly off, and solder short pieces of wire to the tap points determined for the 40 through 17 meter bands. From this point forward, you can just go back to these tap points, or adjust the top collapsible whip, and not have to worry about making SWR measurements. You'll find that in all cases, the SWR is under 1.5:1.

Conclusions

I've described an inexpensive, yet efficient, portable vertical antenna for your operating excursions away from home. It assembles in minutes. While it is easily packed in a small travel bag or suitcase, you'll be amazed at the performance of this antenna. And, you'll have the pride associated with knowing that you built it yourself!

Photos by the author.

Phil Salas, AD5X, has been a ham for 38 years and is an ARRL Life Member. He holds a BSEE from Virginia Tech and an MSEE from Southern Methodist University. He is currently Director of Hardware Engineering at Celion Networks in Richardson, Texas. At home he shares his station with his wife Debbie, N5UPT, and daughter Stephanie, AC5NF. You can contact Phil at 1517 Creekside Dr, Richardson, TX 75081-2913; **ad5x@arrl.net**.

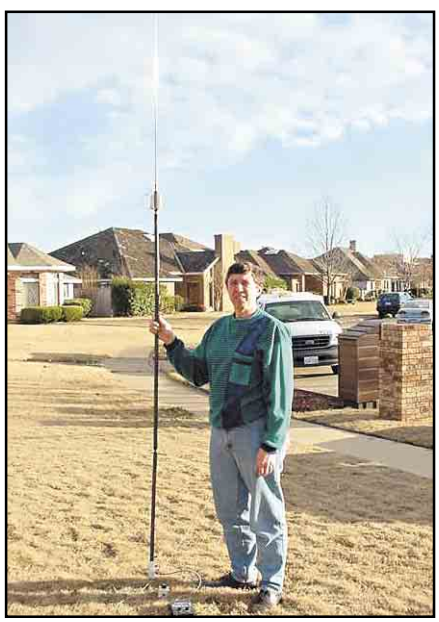

Figure 11—Phil, AD5X, and the finished antenna.

Figure 12—Finding the permanent adjustment points on the coil for each band.