By Jim Valdes, WA1GPO

The FARApole

A portable HF antenna for 6 through 20 meters that's ideal for toting.

The Falmouth Amateur Radio Association (FARA) is one of the largest and most active Amateur Radio groups on Cape Cod, Massachusetts. The group has a number of amateurs who enjoy the construction phase of our hobby—they are affectionately known as "hackers." Several of FARA's projects have been published and are available on the Web.[1] FARA's latest project is a low cost portable HF antenna, the FARApole—it's ideal for low power, multiband transceivers, like the Yaesu FT-817.

There are a number of commercially available HF portable antennas. Most, however, are relatively costly and they are frequency limited, factors that might discourage "casual" operating. One of our goals was to have an antenna as versatile as the FT-817 transceiver itself, and the pictures illustrate the flexibility of that design.

The antenna is compact; it will easily fit in a suitcase along with a UHF-style magnet mount for weekend getaways. Although primarily intended for low power operation, power levels up to the 100 W level can be tolerated when it is operated as a dipole or in a mobile configuration, provided the radio is located a satisfactory distance from the transmitter. This is necessary for safety and to minimize RF feedback at the

[1]Notes appear on page 54.

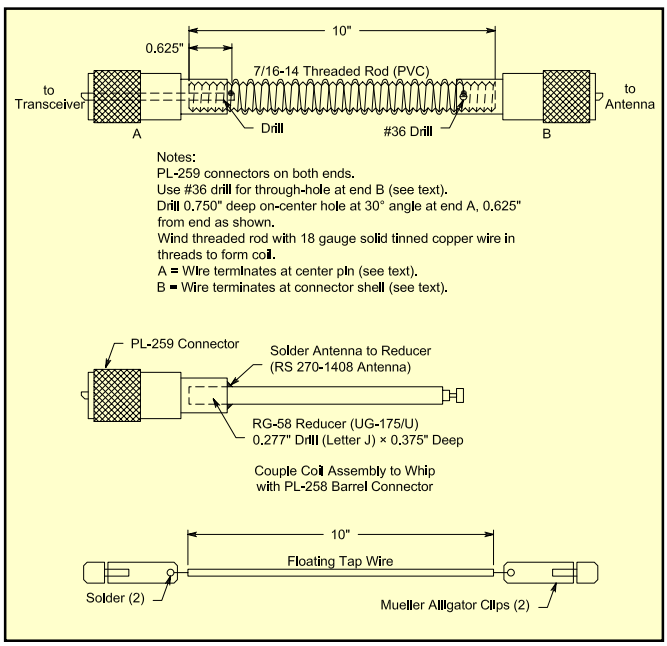


Figure 1—Construction details of the FARApole antenna. Note that the coil connects to the PL-259 center pin on one end, but to the connector shell at the other end. Construction of a dipole requires two "B" terminations for one element (see text).

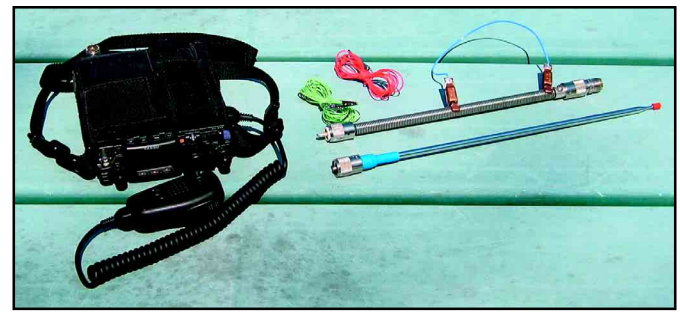


Figure 2—The completed FARApole antenna, dismantled, but ready for installation. The wire bundles are counterpoise radials that will be attached to the transceiver's ground terminal. Note the right-angle UHF connector at the rear of the transceiver. This will ensure that the vertical antenna is, indeed, vertical.

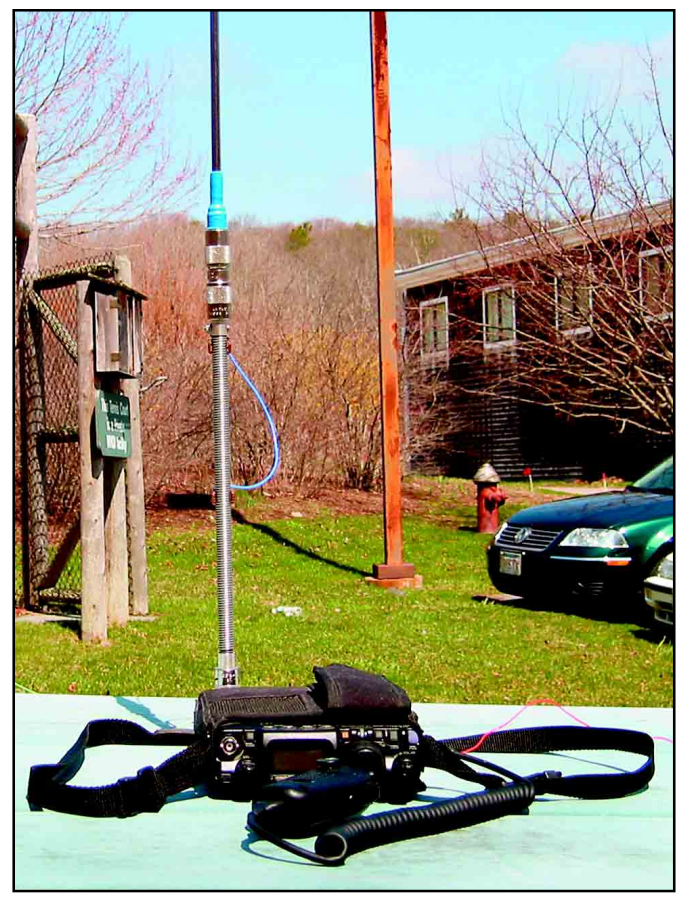


Figure 3—The antenna assembled and mounted on the transceiver. The counterpoise radials can be seen running to the left and right of the transceiver.

100 W power level. The operator is cautioned to observe recommended safe RF exposure limits. [This is always prudent when operating close to an antenna at moderate power levels. An excellent ARRL reference text, *RF Exposure and You*, contains effective safe guidelines for operation at various power levels with respect to frequency and distance.[2]—*Ed.*]

This is a portable antenna design utilizing readily available components and it is easy to construct—only simple hand tools are needed for fabrication. The antenna is base loaded with a telescoping whip and a "wandering" lead to tap a loading coil for various bands. The overall length is approximately 7 feet. With all parts on hand, it can be constructed in less than 15 minutes.

Assembly Hints

The construction of the antenna is detailed in Figure 1. Table 1 is the parts list and the completed antenna (dismantled) is shown in Figure 2, next to an FT-817 transceiver.

The loading/matching coil is wound with 18 gauge tinned solid copper wire. Stretch and straighten the wire by pulling it over the round end of a rake handle or other similar tool to remove any kinks. Temporarily install the PL-259 connectors and drill the holes in the $^{7}/_{16}$ inch threaded PVC rod prior to starting the final assembly. Remove the connector near the 30° hole—bend one end of the wire into a "J" shape and work it through the 30° hole and out the end of the rod. Straighten the wire and reinstall the PL-259 connector.

Install the 4-40 hardware in the through-hole on the other PL-259 connector—do not tighten at this time. Carefully wind the wire onto the threaded rod using the threads as a coil form. Wind the coil as tightly as possible; this will take about 5 minutes.

At the far end of the windings, loop the wire over the 4-40 screw, pull it tight and secure the hardware. Refer to Figure 1 during the assembly. Trim the wire and solder the center pin of the first PL-259. You're almost done!

Place the RG-58 reducer in a vise and carefully enlarge the hole to accommodate the base of the telescoping element.[3] Drill very slowly as the brass fitting tends to seize and grab the drill bit. Use a 0.277 inch (letter size J) drill bit, as shown (Figure 1). Access to a small lathe is desirable, but is not essential. *Caution*—keep your fingers away!

Use a little emery paper to buff the lower end of the whip prior to assembly. A little rosen flux (don't use acid flux) will improve the solderability of the whip. Again, clamp the modified reducer in a vise, insert the whip (extend the upper sections so as not to overheat), and sweat-solder the whip with a butane torch. Install the reducer into the remaining PL-259 and secure the threads with some Loctite 242 thread-locking compound. A little shrink tubing over the assembly will enhance its appearance.

Lastly, solder the Mueller clips to the ends of the 10 inch piece of tap wire. This serves as a wandering lead to tap the coil for selecting the necessary loading in order to bring the antenna into resonance on various bands. That's it—you're done!

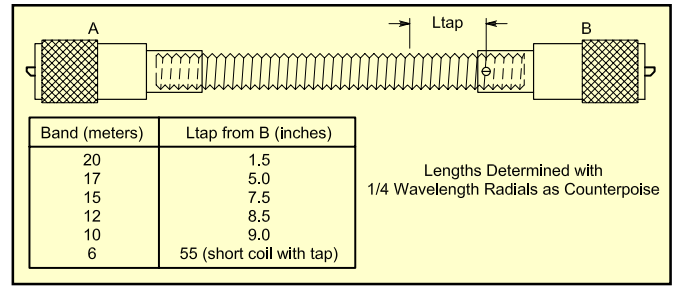
Operation

All loaded antennas represent some compromise—in this case it's the ease of construction. A center loaded antenna with an air-core inductor would likely be more efficient, but much more difficult (and expensive) to build. In effect, this antenna functions as a base loaded $^{1}/_{4}$ wavelength vertical. As such, it *requires* some form of counterpoise (in this case, radials) to complete the "other half" of the dipole.

Figure 3 (a loaded $^{1}/_{4}$ wave vertical with wire radials) and Figure 4 (a modified $^{1}/_{2}$ wave dipole) illustrate two examples of the antenna, ready for use. The system SWR is as sensitive to the counterpoise as it is to the loading coil tap. Quarter wavelength radials using color-coded 22 gauge jacketed wire are a simple and cost effective solution to the counterpoise problem. In any case, the exact position of the coil tap must be determined experimentally, as it depends on the counterpoise placement (the position of the radials) or the use of a second element to form a dipole. Radials that are suspended on a deck or table will not have the same coil tap position as those that are placed directly on the ground.

Tune-up is simple. Place the FT-817 (or any other transceiver) in a low power mode and set the meter to the SWR position (or use an in-line SWR indicator). In FM or CW (you will need a steady carrier) alternately adjust the tap and key the transmitter until you obtain an acceptable SWR. Do not

Figure 4—A dipole version of the antenna can be constructed (see text). The portable mast is made of PVC pipe, joined by a PVC coupling. The elements are mated using a UHF T connector, supported by a PVC T section that is cut in half and joined with electrical tape. One of the elements requires two "B" terminations, as outlined in the text and shown in Figure 1.



Band (meters)	Ltap from B (inches)
20	1.5
17	5.0
15	7.5
12	8.5
10	9.0
6	55 (short coil with tap)

Lengths Determined with 1/4 Wavelength Radials as Counterpoise

Figure 5—The approximate tap positions for the loading coil. For 6 meter operation, the coil is shorted with the tap wire and the overall antenna length (including the tap wire) is adjusted to 55 inches.

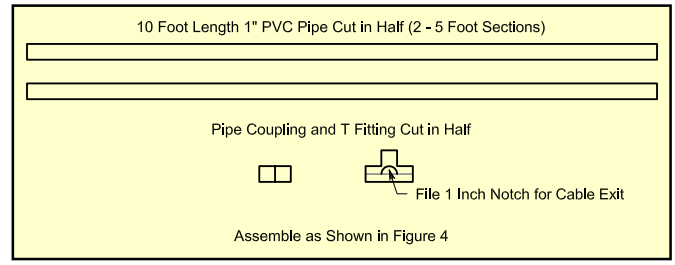


Figure 6—Details of the portable mast fabrication. The mast consists of two 5 foot PVC sections, joined with a coupling. A PVC T, cut in half, is used to support (with the help of electrical tape) the dipole version of the antenna. A notch filed in the T serves as an exit hole for the cable.

Table 1
Parts List for the FARApole Antenna
CI=Craftech Industries, **www.craftechind.com;** RS=RadioShack, **www.radioshack.com;** M=Mouser Electronics, **www.mouser.com**.

Description	*Quantity*	*Part Number*	*Source*	*Details*
7/16-14 PVC rod	1	D200-21-27	CI	10 inch (PVC threaded rod)
4-40 pan head × 5/8	1			Standard hardware item
4-40 flat washer	1			Standard hardware item
4-40 nylock nut	1			Standard hardware item
18 gauge bus wire	1	602-296-100	M	15 feet (tinned solid copper)
PL-259 connector	3	523-83-1SP	M	UHF coaxial connector
PL-258 coupler	1	523-83-1J	M	UHF coaxial female-female coupler
UG-175/U adapter	1	523-83-175	M	RG-58 reducer for PL-259
Telescoping antenna	1	270-1408	RS	72 inch
Shrink sleeve	1			1/2 × 2 inch
Mueller-type clips	2	13AC511	M	Large jaw type
Miscellaneous wire				10 inch wandering tap lead and radials

Figure 7—The FARApole used as a stationary mobile antenna with a magnet mount.

touch the antenna or wire lead assembly when transmitting. Figure 5 shows suggested tap positions. Short the coil with the clip assembly and adjust the overall length to approximately 55 inches for 6 meter operation.

There are two types of coil terminations, see Figure 1—A and B. In the dipole configuration (Figure 4) the second element is constructed with two "B" terminations (one at each end of the loading coil). Both elements of the dipole are joined with a UHF-type T connector.

You can mix and match— use the type B-B coil in series with the A-B coil for expanded (lower) frequency coverage. Use care, as the "B" terminations are RF "hot" on the connector shell and a longer coil assembly will place more strain on the coaxial connector. The "A" termination *always* connects to the radio or coaxial cable—as, here, the coil goes to the PL-259 center pin.

A Portable Mast

When the antenna is used in a dipole configuration a portable mast is handy; this can be seen in Figure 4. The mast is constructed from 1 inch PVC pipe and fittings; Figure 6 details the mast assembly. The T fitting is cut in half. A pipe coupling is attached to one of the mast pieces and the modified T to the other. Use a UHF-type coaxial T for the center of the dipole element, as outlined earlier, and electrical tape to hold it in position on the mast. You may wish to file a notch in the pipe T fitting for the cable to exit.

A Few Comments

In fussing with various types of portable antennas, I've noticed, on occasion, some RF feedback (RF output indicated on the meter when I wasn't talking). Winding the coax (I use 30 feet of RG-174/U cable) into a 5 or 6 turn, 4 inch diameter loop as a common mode choke at the radio's antenna connector was helpful. Small clip-on RF chokes also worked. I found Yaesu's tone-encoded microphone (MH-36) to be much more susceptible to RF feedback than the standard microphone (MH-31) supplied with the transceiver.

The orientation of the Yaesu FT-817 rear panel coax connector would not permit the antenna to be in a true vertical position when mounting the antenna to a right angle (UG-646/U) connector on the back of the radio. This was due to the index locking tabs on the mating connectors. I solved this problem by grinding the tabs off on the 90° connector with a Dremel tool.[4] The antenna looks better when it is truly vertical.

Fixed mobile operation (not in motion) with a magnet mount (Figure 7) was satisfactory on the higher frequency bands, but it required a "ground clip" to the car body on the 20 meter band for an effective counterpoise.

The antenna has only seen limited use outdoors, as it was winter on Cape Cod when it was completed. A number of successful coast-to-coast contacts were made and several contacts were made on 20 meters throughout the US and South America. It's lots of fun to use—even if it is cold outside!

The Falmouth Amateur Radio Association's Web site (**www.falara.org**) maintains some FAQ files on our TekTalk forum pages. Please check the Web site for any recent developments or modifications to the FARApole antenna. Thanks to our Webmaster, K1BI, for his support.

Notes
[1]FARA projects can be seen at the FARA Web site: **www.falara.org**.
[2]Available from the ARRL Bookstore. Order no. 6621. Telephone toll-free in the US 888-277-5289, or 860-594-0355, fax 860-594-0303; **www.arrl.org/shop/**; **pubsales@arrl.org**.
[3]Be careful when clamping the reducer in a vise. Do not clamp the threads. Too much pressure will distort the cylinder and it will then be difficult to thread into the PL-259 connector.—*Ed.*
[4]A 90° UHF male-female connector with a smooth interior shoulder with no locking tabs at the male end is available commercially, although it may be difficult to find.—*Ed.*

Photos by the author

Licensed since 1962, Jim Valdes, WA1GPO, holds an Amateur Extra class license. He is active on all of the amateur bands from 160 meters through 70 cm. Jim has a BS degree in electrical engineering and has worked for the Woods Hole Oceanographic Institution for almost 30 years. You can contact him at 63 Alderberry Ln, East Falmouth, MA 02536 or at **wa1gpo@arrl.net**.