A Fan Dipole for 80 through 6 Meters

The parallel or fan dipole can be effective if you keep a few facts in mind.

Richard P. Clem, WØIS

While variations on the design have appeared many times in *QST* over the years, many newer hams (and more than a few old timers) are unaware of the simple antenna design shown in Figure 1, variously referred to as fan, fanned or parallel dipoles.[1] This antenna requires neither tuner nor switching for operation on multiple bands, and requires only a single coaxial feed line.

The mechanical details of this antenna are not critical. It can be adapted to a variety of configurations to take advantage of existing support structures, or to operate on different bands. The configuration shown in Figure 1 has been in use at WØIS for a number of years, and provides good results on 80, 40, 20, 15, 10 and 6 meters, and a sufficiently acceptable SWR on 30 and 17 meters to allow for occasional ventures onto those bands.

Antenna Concept

This antenna consists of four dipoles, all sharing the same coaxial feed line. These dipoles are cut for the approximate centers of 80, 40, 20 and 10 meters. Essentially, the signal from the transmitter "sees" only the antenna that is resonant, since the antennas for the other bands present a high impedance.[2] The 40 meter element is 3⁄2 wavelengths on 15 meters, and 7⁄2 wavelengths on 6 meters, so the antenna is also resonant on those bands. I have the antenna installed in inverted V fashion, with the center supported by a mast made of schedule 80 PVC pipe secured to the house and extending a few feet above the top support. The eight half dipole legs run to convenient points on the house and trees.

Most of the previous *QST* references to similar antennas show the elements running parallel to one another and in close proximity. For example, ON4UF shows construction with 300 Ω ribbon cable, and W9DOS shows the use of four conductor rotator cable. One comment I've heard from users of similar antennas is that if the elements are tightly coupled, while the completed antenna uses less real estate, there is a great deal of interaction between adjacent elements. Such an antenna requires a great deal of careful trimming to achieve resonance on all bands.

[1]Notes appear on page 42.

Table 1

Final Element (Half Dipole) Lengths for Each Band

Band (Meters)	*Length (Feet)*
80	66
40	32.5
20	16.5
10	8.25

The WØIS Version

At WØIS, the eight wires are run in all directions, each spaced approximately 45° from the next element. This provides a certain amount of mechanical stability to the PVC mast. More importantly, this has greatly reduced interaction between the various elements.[3] Each side of each dipole was simply cut according to the familiar formula

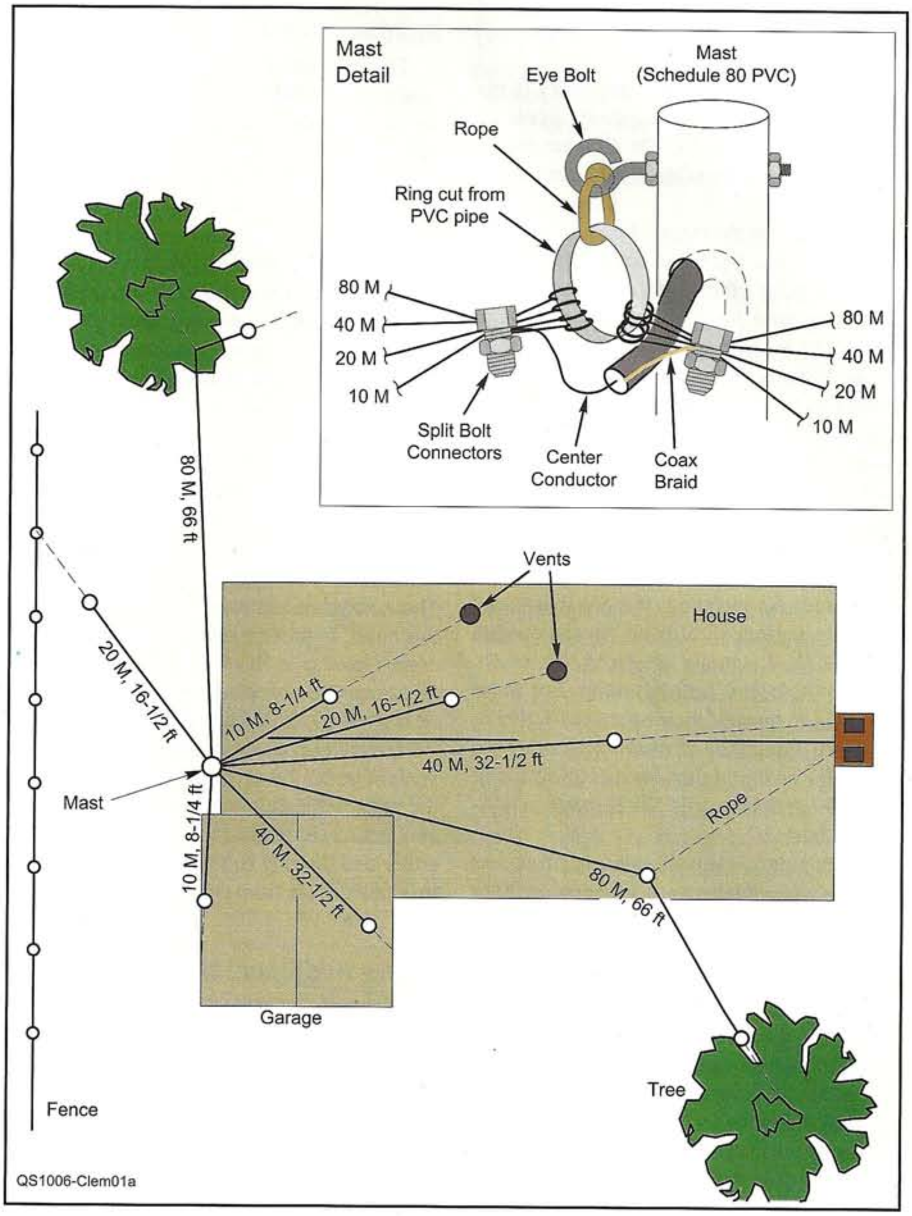

Figure 1 — Aerial view of WØIS fan dipole. The inset shows detail of center connections.

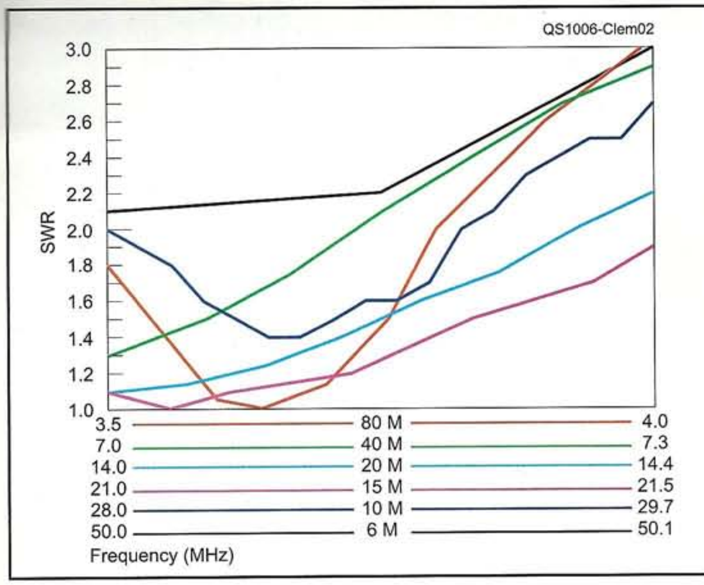

Figure 2 — Measured SWR vs Frequency (see text).

L=234/f, where L is the length in feet, and f is the frequency in MHz.

The only tuning that was necessary in my case was lengthening the 80 meter dipole by about 4 feet on each side. On all other bands, there was an acceptable SWR across the entire band.

I believe that the reason I had to lengthen the 80 meter elements had nothing to do with the fact that the other elements were present. As can be seen from Figure 1, I needed to zigzag the 80 meter dipole somewhat, and this probably accounted for the fact that they needed to be longer than the value derived from the formula. The final lengths for each element (that is, the length of one half of each dipole) are shown in Table 1.

The final SWR curves are shown in Figure 2. My intention was to tune the antenna for optimum SWR in the middle of each band. As installed, the SWR actually favors the bottom of the band. Since I operate mostly CW, I actually preferred this result, and didn't do any further tuning. For those who will do most of their operating higher in the band, it might be advisable to shorten the elements for the higher bands for optimum SWR. Note that my old SWR meter is optimistic above 2:1.

Surprisingly, even though no effort was made to make this antenna function on 30 or 17 meters, the SWR on those bands is also marginally acceptable (approximately 3:1). I suspect this is because those frequencies are close enough to being an odd multiple of 3.5 MHz. In my antenna, the SWR is unacceptably high on 12 meters.

The same design could be used on different bands simply by removing elements or adding elements of different length. This is a very versatile design, and is the ultimate in operating convenience — to change bands, absolutely no tuning or switching is required.

Building Your Own

The construction details are not critical. I used some available #18 AWG stranded copper wire. While a balun could be used, and is generally recommended, I did not use one. Instead, I cut a small piece of PVC pipe to use as the center insulator. All of the elements are secured to this center insulator merely by twisting a loop around the insulator. The coax is connected to the elements with a split bolt connector a few inches away from the center insulator.[4] The center conductor of the coax is connected to the four elements running in one direction, and the shield of the coax is connected to the four elements running in the other direction. [It is a good idea to put sealer on the exposed braid. — *Ed.*] The split bolt connector compresses the five wires together. This connection is not soldered, and has continued to work well for several years. The coax should run initially upward from this point, to prevent water from entering the coax. I used type RG-8X coax; however, any 50 Ω coax can be used with type depending on tolerable loss and power level.

The various elements are secured to convenient points on or near the house, such as the gutters, the chimney, vent pipes, a fence, and trees. The ends are secured with rope, either tied directly to the antenna wire, or to insulators made from rings formed by cutting PVC pipe.

A Few Additional Notes

Many of the early *QST* references to an antenna of this type contain an editor's note pointing out that such an antenna has absolutely no harmonic suppression capabilities. If a 7 MHz signal is generating a harmonic on 14 MHz, then the 14 MHz signal will have an efficient radiator at its disposal. One should be aware of this possibility; however, if a modern rig complies with FCC spectral purity requirements, it shouldn't be necessary to rely on the antenna for additional attenuation.

An antenna of this type is infinitely adaptable. For example, the design could be adapted by those needing a "stealth" antenna by hiding the coax and using materials such as thin gauge wire and monofilament line. I frequently use a similar antenna for low power operation while camping. I use a piece of coax terminated with a PL-259 UHF plug on one end and two alligator clips on the other end. To erect an antenna, I merely measure sections of wire for the bands I'm interested in (often using an 8 foot picnic table as a convenient measuring stick), and then erect them in trees or whatever other supports are available, using string, or simply draping them over branches.[5] In the center, I attach one alligator clip to one set of wires, and the other alligator clip to the other set of wires. The result is a dipole that can be erected in minutes.

This type of antenna is one of the simplest ways to construct a multiband antenna. It does requires a fair amount of wire in the air. However, the fact that the placement of the elements is not critical makes it very adaptable to most real estate.

Notes

[1]For example: H. Berg, W3KPO, "Multiband Operation with Paralleled Dipoles," *QST*, Jul 1956, pp 42-43; J. Grebenkemper, KA3BLO, "Multiband Trap and Parallel HF Dipoles—A Comparison," *QST*, May 1985, pp 26-31; S. Wysocki, W9DOS, "Using Four-Conductor Rotator Cable in Paralleled Dipole Antennas (Hints and Kinks)," *QST*, Sep 1958, p 50; L. Richard, ON4UF, "Parallel Dipoles of 300-Ohm Ribbon," *QST*, Mar 1957, p 14.

[2]See discussion in H. Berg, W3KPO, "Multiband Operation with Paralleled Dipoles," *QST*, Jul 1956, pp 42-43.

[3]Grebenkemper (Note 1) does show some interaction between elements at a 45° angle, but less than for parallel radiators. In my experience, this lesser interaction is not so severe as to require adjustment of the element lengths.

[4]Halex Company part number 32403B or equivalent.

[5]Having insulated antenna wire actually touch the trees is acceptable at low power levels. At higher power levels, however, care should be taken, since it might be possible for such an arrangement to actually set fire to the tree.

ARRL member Richard Clem, WØIS, was originally licensed in 1974 as WNØMEB, and later as WBØMEB. He holds an Amateur Extra class license and has held his current call sign since 1977. He is an attorney and ARRL Volunteer Counsel. The antenna described in this article was recently used to win ARRL Triple Play award #215, which included working all states on PSK-31 with 5 W. You can reach Richard at 1616 N Victoria St, St Paul, MN 55117 or at **w0is@arrl.net**. QST