10.4.1 FULL-SIZE VERTICAL ANTENNAS

A vertical antenna should not be longer than about ¾ λ at the highest frequency to be used, however, if low-angle radiation is wanted. You can see why from reviewing the radiation patterns for dipoles in the chapter **Dipoles and Monopoles**. As the antenna lengthens, the pattern breaks up into lobes that are at high elevation angles for a vertical antenna. Nevertheless, an antenna that is λ/4 on the lower frequency of operation can still be useful over a 3:1 frequency range or even more if the high-angle radiation can be tolerated. For example, an 80 meter λ/4 vertical around 66 feet high is useful through the 30 meter band and a 25-foot vertical would be useful from about 10 MHz through the 28 MHz band.

In recent years, the 43-foot ground-mounted vertical antenna with an automatic antenna tuner mounted at the base of the antenna has become very popular as an all-band HF vertical, including 160 meters with the appropriate tuner. See **Figure 10.36**. While the elevation angle of maximum radiation begins to increase significantly above the 20 meter band, the combination of simplicity and clean appearance make up for the compromise. (A variation on this idea is the "flagpole" antenna discussed in the **Stealth and Limited Space Antennas** chapter.) If the lower bands are not required, a 22-foot vertical is quite effective at and above 40 meters. The antennas can be constructed from aluminum tubing or as a fiberglass mast with wires inside or taped along the outside of the mast.

In lieu of using an automatic antenna tuner at the base of the vertical, several *QST* articles listed in the Bibliography serve as examples of how a single vertical antenna can be put to work on several bands. The referenced articles by Phil Salas, AD5X discuss matching the antenna's impedance on 160 and 80 meters.

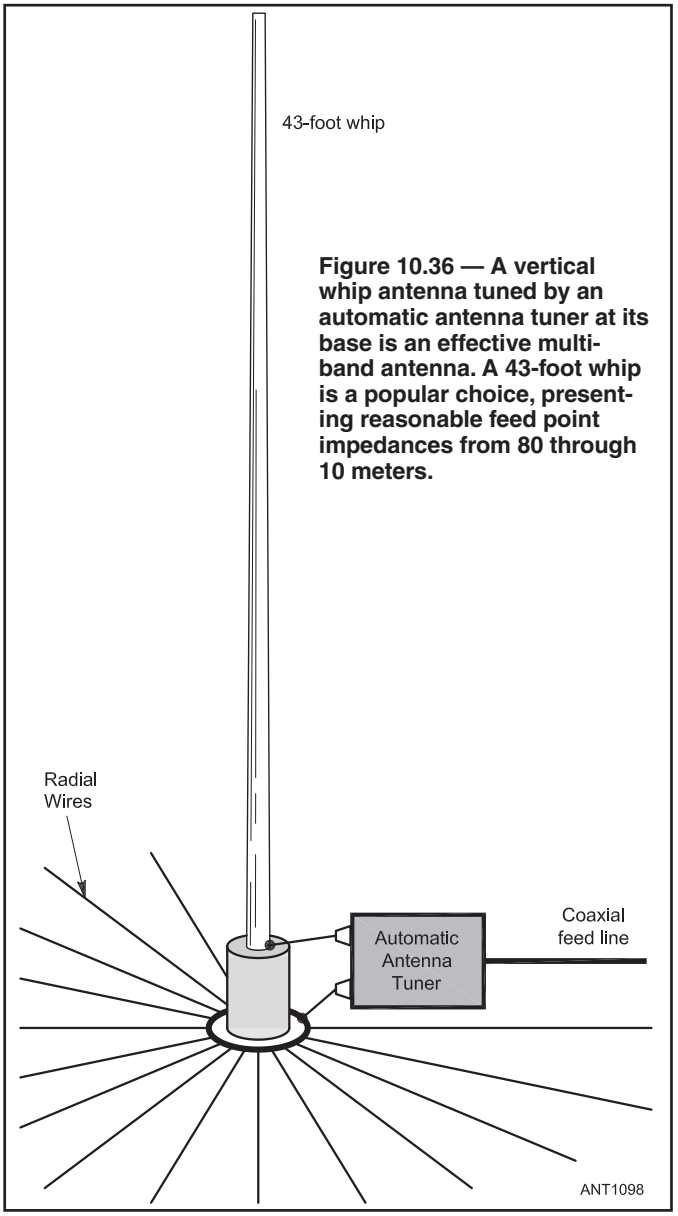

Figure 10.36 — A vertical whip antenna tuned by an automatic antenna tuner at its base is an effective multi-band antenna. A 43-foot whip is a popular choice, presenting reasonable feed point impedances from 80 through 10 meters.

10.4.2 SHORT VERTICAL ANTENNAS

A short vertical antenna (one less than λ/4 at the operating frequency) can be operated on several bands by loading it at the base, the general arrangement being similar to Figures 10.1 and 10.2. That is, for multiband operation the vertical can be handled by the same methods that are used for random-length wires.

Another method of feeding is shown in **Figure 10.37**. L1 is a loading coil, tapped to resonate the antenna on the desired band. A second tap permits using the coil as a transformer for matching a coax line to the transmitter. C1 is not strictly necessary, but may be helpful on the lower frequencies, 3.5 and 7 MHz, if the antenna is quite short. In that case C1 makes it possible to tune the system to resonance with a coil of

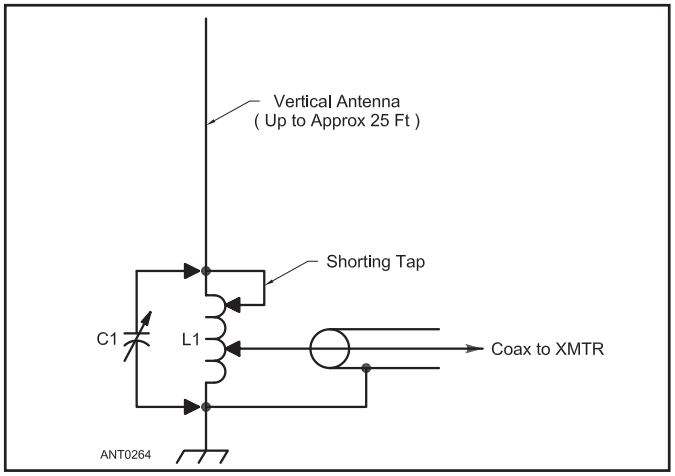

Figure 10.37 — Multiband vertical antenna system using base loading for resonating on 3.5 to 28 MHz. L1 should be wound with bare wire so it can be tapped at every turn, using #12 AWG wire. A convenient size is 2½ inches in diameter, 6 turns per inch (such as B&W 3029). Number of turns required depends on antenna and ground lead length, more turns being required as the antenna and ground lead are made shorter. For a 25-foot antenna and a ground lead of the order of 5 feet, L1 should have about 30 turns. The use of C1 is explained in the text. The smallest capacitance that will permit matching the coax cable should be used; a maximum capacitance of 100 to 150 pF will be sufficient in any case.