A Simple Multiband HF Vertical Antenna

Low profile, high performance, inexpensive vertical.

by Allen C. Ward KA5N

Sunspots are back, we have the WARC bands, and multiband vertical antennas are monsters of complexity. All true statements? I thought so until until I stole several different designs (called research) and put them together to get a simple, cheap, and best of all, great working multiband vertical antenna.

Why a vertical? Vertical antennas have a very small footprint, a very important consideration for the city dweller. Vertical antennas also squirt a lot of signal at low radiation angles, and that means good DX! Most multiband vertical antennas use traps and have the advantage of working on several bands with a single coax feed. Unfortunately, all traps have some loss, no matter how well designed. And manufactured multiband trap vertical antennas tend to be expensive as well as complicated.

Open Wire, Tuners, and Radials

A vertical should be at least a quarter-wave at the lowest frequency. Without going heavily into theory, the gain of vertical antennas generally increases with length. A half-wave antenna has higher gain than a quarter-wave antenna. Vertical antennas, no matter how complicated, are basically just lengths of aluminum tubing stuck together. Therefore, if we can manage to get RF into it, a quarter-wave of tubing at 10 MHz should provide operation from 10 MHz to 30 MHz, with the gain increasing as the frequency increases.

There are many examples of horizontal, multiband antennas (G5RV, for example) fed with a matching device such as a transmatch or antenna tuner. Most of these designs require balanced open wire feeders for proper operation. Open wire feedlines have to be supported or carefully placed to avoid proximity to conductive objects, and they may perform poorly in rainy or icy conditions.

In the March 1987 *QST* (Hints and Kinks) "A Simple, Multiband Vertical Antenna," by James G. Coote WB6AAM, the author gave a few examples of vertical antennas, successful on several bands, that used open wire and an antenna tuner. In "This Antenna Is Too Good To Be True," by J.W. Spencer W4HDX in the February 1984 issue of *73*, the author described a multiband horizontal antenna which used paralleled coax as tuned feeders. This type of feedline is immune to effects from nearby conductors and can go right into the shack without special precautions. How would this type of feed work with a vertical?

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Connections should be soldered and protected from the weather with tape or silastic compound.

It works great!

The antenna I came up with requires radials and should be elevated above ground (height not critical). The length of the vertical element and the radials should be the same. The radials should be insulated from actual ground or other conductors. The configuration is a groundplane vertical at the quarter-wave frequency. The exact length of the elements is not critical. 16.5 feet gives excellent 20 through 10 meter operation, whereas 21.5 feet gives good results down to 30 meters. Often the radials of groundplane antennas are allowed to droop to raise the feedpoint impedance. Since this antenna uses a tuner, you don't need to do this. However, if you do allow the radials to droop, it should not cause a problem.

Selecting the Tubing

Tubing with 0.047" to 0.055" wall thickness is available in six and eight foot lengths at many hardware stores. Tubing with outside diameters differing by ⅛" telescope together nicely if the larger diameter tube is split with a hacksaw for two or three inches and the smaller tube is telescoped into the larger for four or five inches with the joint secured by a stainless steel hose clamp.

It is a good idea to use some anti-oxidation compound on the tubing. This type of tubing currently sells for $5–$10, depending on the diameter and length. A little scrounging will help in the cost department. I found some ⅝" diameter tubing almost seven feet long, sold as poles to hold up sagging clotheslines, for less than $2 each.

The aluminum poles used to hold up shower curtains, 1" in diameter and 6 feet long, sell for about $3.50 (not the anodized decorative ones, please!). Tubing (usually 12-foot lengths) is also available from wholesale supply houses. The problem is finding a supply house which will sell in small quantities. Your employer may allow you to make purchases through his purchasing department. Discarded CB base antennas and wind-damaged ham antennas are also good sources of

tubing. You may also find aluminum tubing at scrap metal dealers or recycling centers.

Three six-foot lengths of tubing with overlap will do for a 16.5 foot antenna. A 21.5 foot antenna will require one eight-foot length and two six-foot lengths. The diameter of the lowest section should be at least ¾", with each subsequent section ⅛" smaller in diameter.

Constructing the Radials

The radials are made of wire (of course, they could also be made of aluminum tubing). The exact type is not particularly important. I used plastic insulated 20 AWG stranded copper wire because I happen to have a 1000-foot roll of it.

The radials should be connected at the feedpoint, and since they're hot with RF, they should have insulators at the ends farthest from the feedpoint. The radials should be equally spaced, if possible. Four radials are plenty, and you may be able to get away with using only two or three. Just be sure they are all the same length as the vertical element. This is a balanced antenna, so you don't need radials of different lengths for each band.

There are many ways of supporting the vertical element. I chose to use screw-in fence insulators (bought at the hardware store) mounted about a foot apart on a vertical 2 x 4 attached to my patio cover. The tubing is secured to the insulators with galvanized guy wire.

The base of the antenna is 8 feet above ground (quarter-wave at 10 meters). The radials should be at least high enough not to garrote passersby.

Choose the Right Coax

The paralleled coax feed is the unique part of this antenna. The type of coax is important; it should be solid, dielectric coax. DO NOT USE FOAM DIELECTRIC COAX. The voltage rating is not high enough, and it may break down under high SWR conditions. RG-58, RG-59, and RG-8 or their equivalents are all suitable if they can withstand the power level you're using. The feedline is constructed by paralleling two identical lengths of coax. The shields are connected together at each end and grounded at the transmatch, but left unconnected and insulated at the antenna end.

This makes a feedline of either 100 or 150 ohms impedance (depending on the type of coax). One inner conductor is connected to the vertical element and the other is connected to the radials. Most open wire feedline (also called ladderline) is usually 450 or 600 ohms. The impedance difference doesn't cause any problems. One major difference is that open wire feedline is lossless and therefore the SWR on it can be extremely high without any degradation of radiation effectiveness. Paralleled coax will have some loss and should be as short as possible. Loss introduced by a run of thirty feet or so should not be excessive—probably less than that of 3 or 4 traps.

Of course, you can use open wire lead if you insist!

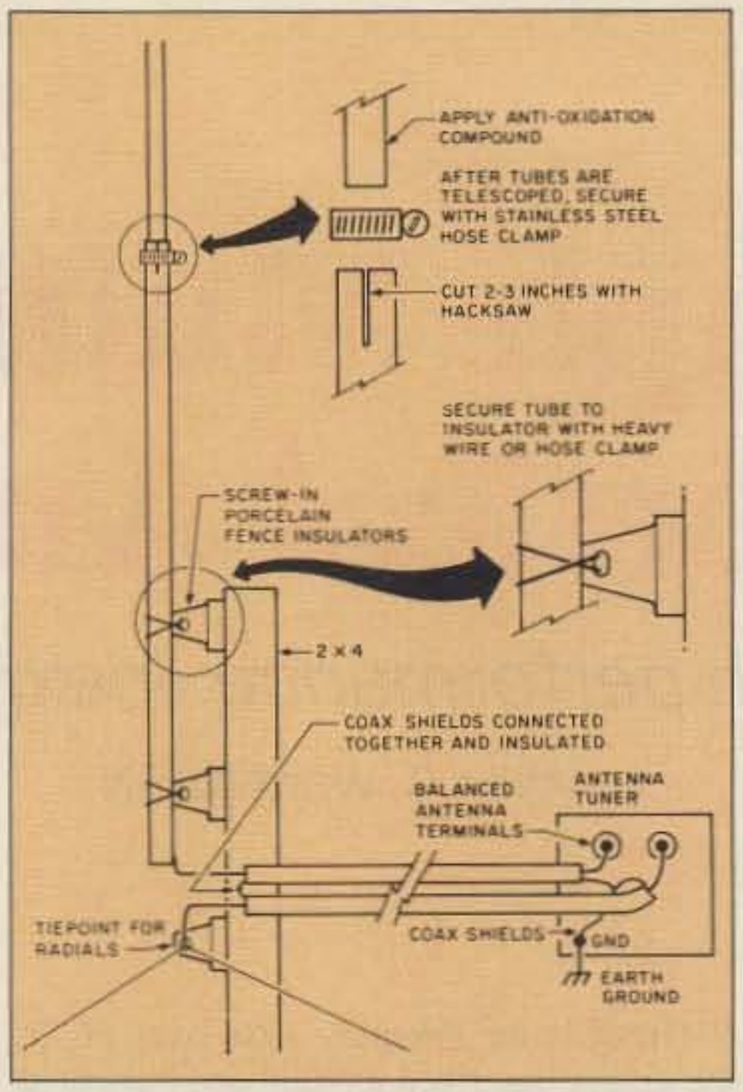

Figure 1. Construction details of the multiband HF vertical. Note placement of the antenna tuner.

Operation with the Antenna Tuner

An antenna tuner (transmatch) MUST be used with this antenna. If you can find an E.F. Johnson Viking Matchbox, either the 275 watt or the 1 kilowatt unit, buy it! Works great with this antenna. These units are conservatively rated and they don't use or require a ferrite balun. Don't be concerned that they do not have bandswitch settings for the WARC bands.

Try tuning on the nearest band settings, both higher and lower than the desired band, and select the settings which give the best match.

Of course, other antenna tuners will also work. Simply select the terminals and settings for balanced feedline. I also recommend the new cross needle SWR meters, as they make tune-up quick and painless.

Having a no-tune transceiver, a multiband antenna, and a matching device, may seem a step backwards. The tuning is fairly broad, so you can make reasonable QSYs without retuning. The benefits are worth the trouble. Solid state rigs will not put out maximum power into a mismatch. The tuner attenuates harmonic radiation and should lessen TVI problems.

You will also note a great improvement in received signal level when the antenna is matched. Too, the tuner is inside the shack so there won't be any trips into the cold or dark to adjust for low SWR.

"... for a cash outlay (with a bit of scrounging) of about $25 for a multiband antenna, this one can't be beat!"

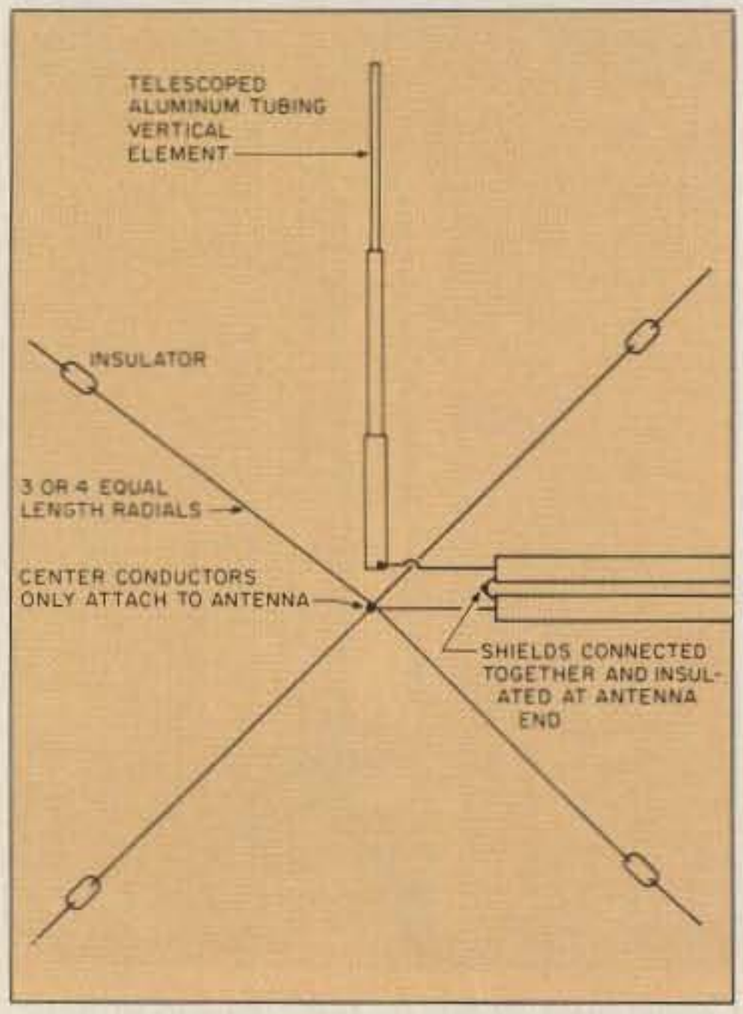

Figure 2. You need only four radials to create a good grounding system.

As Good as the Expensive, Manufactured Verticals

If I had a choice, I would prefer stacked monoband yagis at 125 feet for each band, but for a cash outlay (with a bit of scrounging) of about $25 for a multiband antenna, this one can't be beat! It's easy to tune to a very low SWR on all bands—30, 20, 17, 15, 12, and 10 meters.

You can drape the feedline here and there without unwanted effects, and bring it into the shack through a window.

It is omnidirectional, which can be either good or bad, depending on circumstances. It is my opinion that it works about as well as the most expensive manufactured vertical multiband antenna, and gives the satisfaction of doing-it-yourself and saving money at the same time.

A slim vertical rod has a minimum visual impact. It stands wind very well and rain or ice makes little difference in its performance. Give it a try! 73

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Parts List

Quantity	Item	Price
18–24 feet (depending on scrounging ability and tubing diameter)	aluminum tubing	$0–$25
3	fence insulators	$4.50
70–100 feet	coax	$15–$35
100 feet	wire (radials)	$0–$10
3	hose clamps	$3
1	anti-oxidation compound	$1.50
	Total Cost	$0–$80