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DOUG'S DESK

CONSTRUCTION PROJECTS, TECHNIQUES, AND THEORY

A Minimum-Space Wire Vertical for 75/160 Meters

The February 1996 column focused on mini antennas that urban dwellers could build for use on 160 meters. That article has generated some letters and phone calls, which brought to my attention an oversight on my part when I wrote the piece. Therefore, I will address that matter at the start of this article, since the principle in question applies to this antenna as well.

Several readers duplicated the half-size, inductively loaded 160 meter dipole described in the earlier article. When they erected it and checked the SWR, they had readings as high as 6:1. I failed to mention in the article that any inductively loaded antenna, including a mobile antenna, is affected by surrounding conductive objects such as power lines, phone lines, houses with metal siding, and such. Furthermore, the antenna height and configuration (straight dipole, inverted V or sloper) affects the impedance and resonance of the system. Trimming for resonance is always necessary after the antenna is erected. This is true also for many full-size dipoles without loading coils. In other words, we can't simply wind the coils, cut the wire sections to the prescribed length, and then assume the SWR will be 1:1.

Normally, the outer wires above or beyond the loading coils must be adjusted for antenna resonance at the preferred operating frequency. There will be situations where the number of coil turns may require adjustment. Resonance is indicated when the antenna feed point is entirely resistive. This coincides with the lowest SWR obtainable, even though it may not be 1:1. A dip meter is useful for trimming a loaded antenna for resonance. The feed line is attached to the feed point, and the station end of the coaxial cable is terminated with a small two- or three-turn link. The dipper probe is inserted in the link, and the instrument is adjusted for a pronounced dip in meter reading. This indicates the resonant frequency of the system. If the frequency is too low, remove wire from the outer ends of the antenna. If it is too high, add wire to the outer conductors.

A Short Wire Vertical

Some readers reported insufficient space for the reduced-size antennas described in my February column. I have always maintained "If you can't go out with your antenna, go up." Vertical antennas have been a practical option for some "cliff dwellers" since the beginnings of radio. Vertical antennas are the salvation of a vast number of amateurs today.

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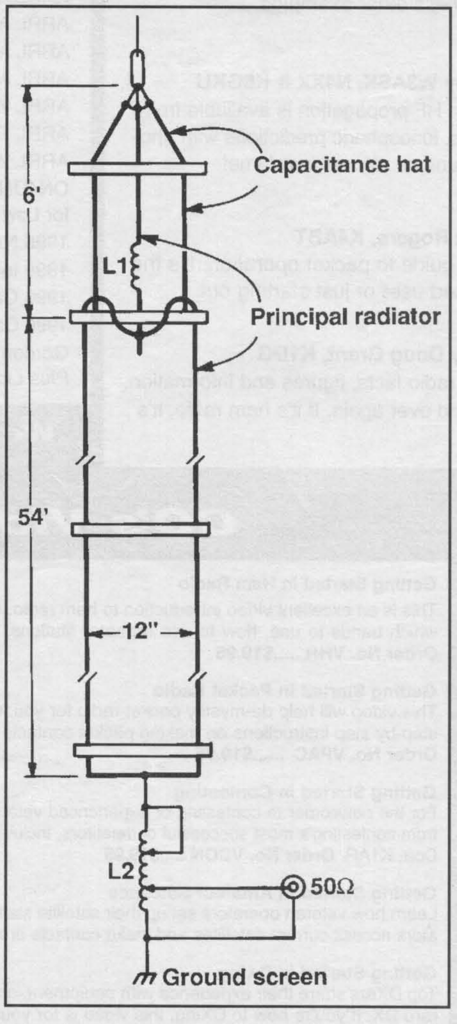


Fig. 1– Conceptual illustration of a half-size, inductively loaded wire vertical for 160 meters.

A quality, rugged, commercial vertical antenna can be expensive. However, a homemade vertical that uses wire can be inexpensive and effective. This month I will describe such a radiator.

Fig. 1 shows a basic design for a half-size, 60 foot, two-wire vertical antenna for 1.8 MHz. It can be sloped from a tree, tower, or mast. The second wire increases the bandwidth of the antenna. A top-loading inductor, L1, is used to provide system resonance. L2, at the antenna feed point, is used for fine adjustment of resonance, while providing an impedance match to 50 or 75 ohm coaxial cable. The taps on L2 are chosen experimentally to obtain resonance at the desired operating frequency and to provide an SWR of 1:1. The top section of wire, which is insulated from the principal lower conductors, functions as a capacitance hat to minimize the amount of inductance required for L1. This increases the antenna efficiency.

As is the situation with any quarter-wave antenna, a ground screen is needed to minimize losses. A group of 60 foot on-ground or buried radial wires (16 to 32 of them) will provide acceptable performance for DXing and local communications.[1] Longer and more numerous radials will improve the performance somewhat. Those who lack the space for radials can use a 120 foot counterpoise wire for the ground system. However, the antenna may not perform as well as when radials are used. It is important to recognize that one or more copper rods driven into the earth at the feed point will not work like a true ground screen. At best, ground rods serve only as a DC ground while providing a reference point of sorts for the grounded conductor of the feed line, L2 and L3 of fig. 2. Antenna efficiency will be extremely poor if only ground rods are used.

A Practical, Two-Band Wire Vertical

If you like to operate on 75 and 160 meters but have limited antenna space, you may wish to construct the system in fig. 2. L1 and L2 provide resonance and impedance matching on 160 meters. L3 performs that function on 75 or 80 meters. A top-loading coil is not required for 75 meter use. An extra set of wires has been added to the fig. 1 example for use on 75 meters. The overall length of these wires is less than 1/4 wavelength in order to establish resonance by means of L3.

Remote band switching is accomplished by K1. This relay and coils L2 and L3 are contained in a weatherproof box at the antenna feed point. Manual band changing can be done with a ceramic rotary switch that will accommodate the RF current and voltage present at the antenna feed point.

K1 is "floated" at RF by mounting it on

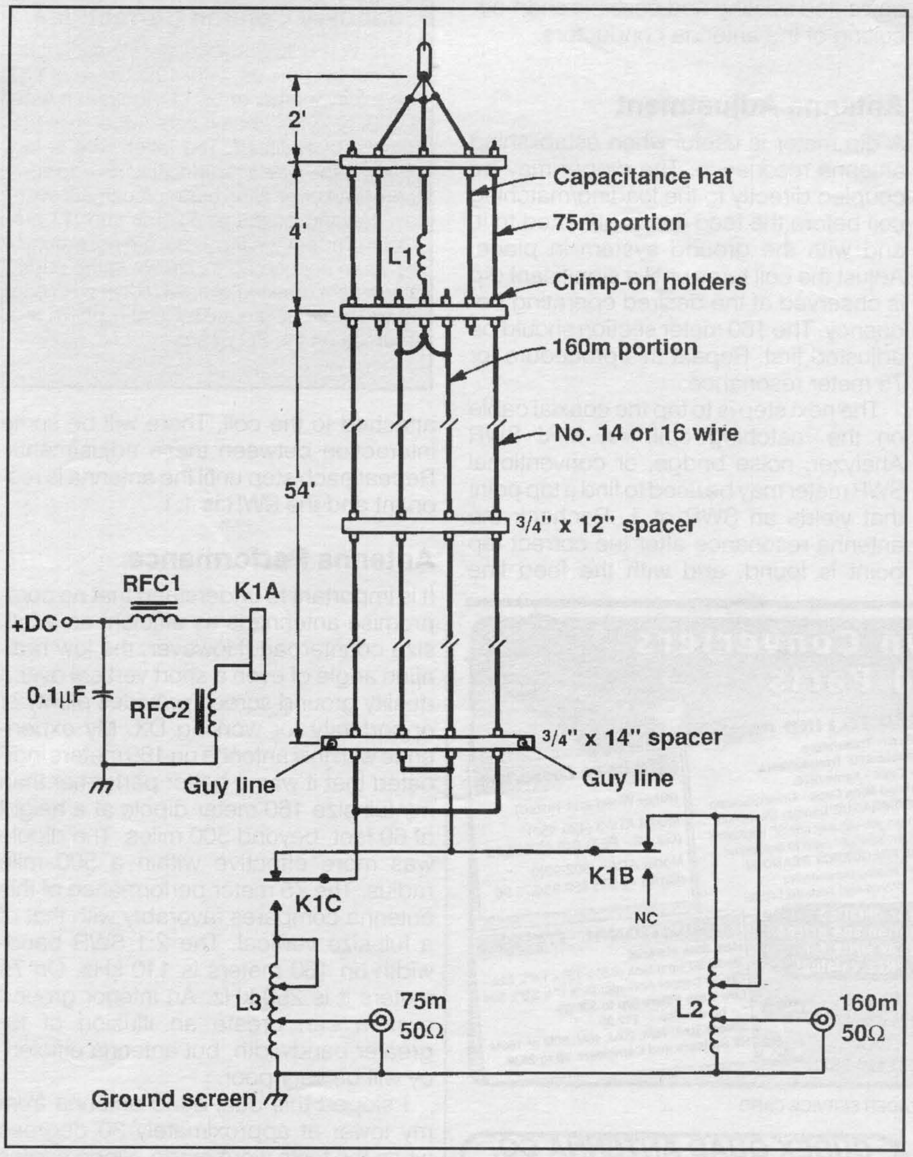


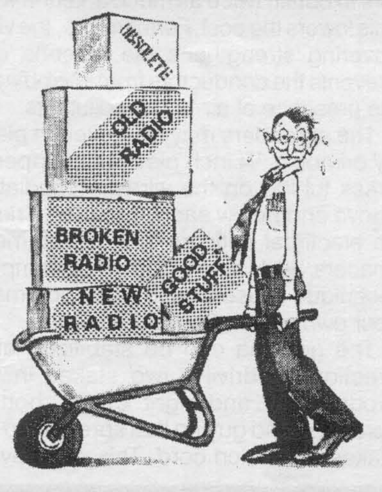
Fig. 2– Diagram of a two-band wire vertical for use on 75 and 160 meters. L1 is an 80 μH inductor with 4 inches of close-wound No. 14 enamel wire on a 2 inch OD form such as high-impact polystyrene tubing (see footnote 2). $Q_u = 110$. *L2 is a 36 μH inductor. Use 42 close-wound turns of No. 14 enamel wire on a 2 inch OD coil form (same material as L1). Tap at approximately 8 turns above the grounded end (see text). L3 has 20 turns of No. 14 enamel wire on a 2 inch OD form. Tap at approximately 3 turns above ground. K1 is a two-pole, double-throw, 12 or 24 VDC relay with 4 ampere or greater contacts. RFC1 and RFC2 have 16 turns of No. 26 enamel wire on Amidon Assoc. FT-37-43 ferrite toroid cores.*

insulating material, such as Plexiglass. The K1 field coil is RF-isolated from the control wires to help keep the entire relay above RF ground. These measures prevent arcing between the relay and ground. The RF chokes and bypass capacitor prevent unwanted RF energy from entering the station via the control wires. If a rotary switch is used for band changing, it should also be kept above RF ground.

Construction Tips

If you are interested in minimizing the cost of your wire vertical, you can use bamboo for the spreaders. The bamboo sections should be treated with two coatings of marine spar varnish or exterior polyurethane varnish to prevent undue weathering and moisture absorption. An excellent lightweight spreader material is 3/4 inch OD high-impact polystyrene tubing. I have purchased this material from an Ohio plastics dealer.[2] PVC tubing may be used at the expense of creating a relatively heavy antenna. Wooden dowel rod, boiled in canning wax, is another option to consider.

Stranded No. 14 copperweld antenna wire will ensure the longevity of the anten-



na, but ordinary No. 14 stranded copper wire is less costly. I have used vinyl-covered, stranded No. 18 speaker wire. It is a simple task to separate the twin conductors to obtain twice as much antenna wire. This lowers the cost. Furthermore, the vinyl covering strengthens the antenna and prevents the conductors from corroding in the presence of air-borne pollutants.

The spreaders may be locked in place by crimping $^{1}/_{4}$ inch pieces of copper or brass tubing on the wires, immediately above and below each spreader. Crimp-on electrical splicers or thin-wall metal spacers work nicely, too. This crimping technique is useful also when you make your own open-wire feeders.

The antenna can be stabilized after erection by driving two stakes in the ground, left and right of the bottom spreader, and guying that spreader to the stakes with nylon cord. This will prevent unwanted twisting and possible short-circuiting of the antenna conductors.

Antenna Adjustment

A dip meter is useful when establishing antenna resonance. The dipper may be coupled directly to the loading/matching coil before the feed line is attached to it, and with the ground system in place. Adjust the coil turns until a significant dip is observed at the desired operating frequency. The 160 meter section should be adjusted first. Repeat this procedure for 75 meter resonance.

The next step is to tap the coaxial cable on the matching coil. An MFJ SWR Analyzer, noise bridge, or conventional SWR meter may be used to find a tap point that yields an SWR of 1. Recheck the antenna resonance after the correct tap point is found, and with the feed line attached to the coil. There will be some interaction between these adjustments. Repeat each step until the antenna is resonant and the SWR is 1:1.

January Column Corrections

The W1FB 25 watt solid-state linear amplifier article in the January 1996 issue of *CQ* has a part number error. T1 requires an Amidon BLN-202-43 balun core rather than the BLN-2402-43 listed. The latter core is too small for the wire size specified. In addition, there is an error in the parts-placement overlay drawing on page 61. R2 and R3 are shown correctly in fig. 1, but are not grounded when connected as shown in the parts-placement drawing of fig. 4. R2 and R3 can routed to circuit ground by rotating them 180 degrees on the PC board.

Antenna Performance

It is important to understand that no compromise antenna is as efficient as a full-size counterpart. However, the low radiation angle of even a short vertical over a quality ground screen provides plenty of opportunity for working DX. My experience with this antenna on 160 meters indicated that it was a better performer than my full-size 160 meter dipole at a height of 60 feet, beyond 500 miles. The dipole was more effective within a 500 mile radius. The 75 meter performance of this antenna compares favorably with that of a full-size vertical. The 2:1 SWR bandwidth on 160 meters is 110 kHz. On 75 meters it is 250 kHz. An inferior ground system can create an illusion of far greater bandwidth, but antenna efficiency will be very poor.

I sloped this dual-band antenna from my tower at approximately 30 degrees when the tests were made. Slope angles up to 45 degrees are satisfactory. Maximum directivity occurs in the direction of the slope if a metal structure is used to support the antenna. Radiation off the back side of the tower was down by roughly 3 dB when I made my field-strength measurements.

This antenna concept can be applied for multiband operation from 7 MHz and higher when space is limited. An additional wire may be added to the antenna in fig. 2 to permit 40 meter operation. This modification would complicate the band-switching circuit, however. A second relay would be required for three-band operation.

Footnotes

1. Brown, Lewis, and Epstein, "Ground Systems as a Factor in Antenna Efficiency," *IRE Proceedings*, Vol. 25, No. 6, June 1937.

2. United States Plastic Corp., 1390 Neubrecht Rd., Lima, OH 45801 (419-228-2242).