Building the 160m Inverted-L

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We debunked some myths of the monoband inverted-L and laid out "ten commandments" for its construction in the March 2018 issue of *ZeroBeat*. In this edition, we'll be building one for 160m at my place in Westfield. My constraints were fairly minimal, as the lot contained an area with space for almost 100 foot long radials in every direction and tall pines to hold the vertical element. Although I did model the antenna, 4nec2 and EZnec do not do an accurate job of modeling our New England ground and, in the case of the inverted-L, the ground is half of the antenna.

I did conclude that I would need at least sixty radials on the ground, or eight radials ten feet in the air. Elevated radials are more sensitive to symmetry and length (see: N6LF's papers). They also tend to interfere with goings-on in the yard, not to mention decreasing the height of the vertical section by ten feet. On the other hand, ground mounted radials would require *thousands* of feet of wire and each would need to be stapled to allow for mowing -- but this is the design prefered by the broadcast industry when given the space. After weighing the options, I decided to lay many radials on the ground.

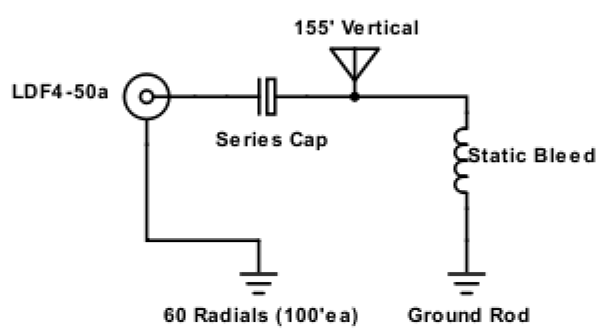
At around this time, we decided to remove a filled-in swimming pool on the property and regrade the entire back yard. This process left me with two open acres of virgin dirt, upon which I laid over 40,000 square feet of galvanized hardware cloth as a groundscreen. You can find this at your local farm supply near the chicken wire; it is relatively inexpensive in bulk.

I also had to build a matching system for the antenna. Since I designed the vertical element to be greater than a quarter wavelength (155 feet), it would present inductance at the base. I procured a variety of fixed doorknob-style high-voltage capacitors to bring the load to near 50 ohms. *Why longer than a quarter wavelength?* As we discussed in the March edition, we want to bring the current maximum higher up in the vertical section of the antenna, instead of leaving it right at the base. The easiest way to do this is to lengthen the antenna slightly. This is not an antenna you can evaluate simply by checking SWR, as **SWR is a poor design metric**.

Finally, I had to construct a choke. I could have purchased a commercially available model, and I have used the DX Engineering feedline "isolators" in the past. However, as there was construction going on in the yard delaying my antenna build, I had the time to design a choke myself. I settled on K9YC's design, which calls for seven loose turns of RG-8 thru five 2.4" o.d. #31 toroidal cores, obtained from Fair Rite. The materials cost was about half of the cost of the DX Engineering option and the labor was free! I placed the choke at the feedpoint and buried LDF4-50a hardline to the shack. I also tested an air core “ugly choke” for posterity, but I remain unconvinced these actually function at all.

We laid the first radials on an insufferably hot July day. Nothing can prepare you for such a job: it’s hot, you’re bent over much of the time, and you’re likely trudging through tick-laden wilderness. Nevertheless, we managed to lay sixty radials, the majority of them over 100 feet long in most directions. Next, the antenna wire itself went up; nearly 100 feet vertical and the remaining 55 feet horizontal. I’m lucky to have tall trees here, but I was shopping for them, of course. The rope had been in the tree since May, when K1YO visited with his air cannon.

In certain directions, the radial met a fence or other boundary; my methodology was to end the radial there and staple it. Some will tell you to bend the radial to preserve its length. Others will tell you that current doesn’t like bends. There’s even an anecdotal story of a broadcast engineer with constrained space laying his radials in a spiral pattern! My obstacles were all at least 70 feet from the feedpoint, and knowing that the majority of the ground loss happens close to the feedpoint, I decided the length that far out wasn’t terribly critical. I paid far more attention to the spacing between each radial, especially near the base of the antenna, to ensure a symmetrical and efficient return path for the current. The underlying giant groundscreen certainly didn’t hurt in that regard.



The radials were welded at the base to a circular bus of copper refrigerator tubing. This provided a neat way to attach radials without spending $70 on the DX Engineering option. I used a Harbor Freight torch to perform the brazing. The bus is then connected to the coax shield, while the pin connects directly to the vertical element via a high voltage series capacitor.

There is a shunt coil between the vertical and ground intended for static bleed. This is simply an 8”-long 1.5” o.d. PVC pipe wrapped with 16 gauge wire. It is invisible to RF, and measures about +j 850 ohms at 1.8 MHz. Array Solutions offers a nearly identical product if you don’t want to roll your own.

This feedpoint arrangement is both cheap and ugly. You could get fancy with a weatherproof box and bring things up to broadcast industry standards. I deemed this unnecessary and I anticipated the ongoing need to rearrange things for testing; all components are accordingly attached with terminal lugs for easing swapping.

I’ve tested the antenna with a variety of ground configurations. There is no real-world difference between using the groundscreen as sole counterpoise, using the groundscreen connected to the radials, and “floating” the radials (disconnected) atop the groundscreen. I attribute this to the symmetry of my radial field; if I had less space for radials, the groundscreen would probably be much better than the radials. I do not have sophisticated test equipment to perform effective measurement of eddy currents on the groundscreen in any scenario, but the granularity of an RBN test is enough for me: not even a dB difference in any configuration on any given night. I’ll be continuing these tests throughout the winter.

Transmitting is only half the equation on topband. You have to hear them to work them! While the ears on a vertical or inverted-L might be good enough for day-to-day domestic FT8 or WSPR, serious DX work calls for serious RX antennas. I’ll address low-cost RX antennas and explain how you might improve your hearing from a small lot in a future article.

This has been a condensed treatment on an extensive project. I am happy to provide more in-depth information (models, test spreadsheets, and more) to those interested. I am also available to help other “locals” get on 160.

CU on topband,
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