Propagation
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Another Simple 160-Meter Antenna

The March/April 2011 issue of the ARRL's National Contest Journal had a great article on a simple 160-Meter antenna. The article was titled "The Easy Inverted L for 160", and was authored by Steve Carr, NEØU. The simple antenna was a single-radial Inverted L. The purpose of this column is to compare the single-radial Inverted L to another simple 160-Meter antenna – the Inverted V. It may do much better than you expect if it is oriented properly.

Using GNEC Version 1.6 (www.nittany-scientific.com) running the NEC4 core, I modeled a single-radial Inverted L over average ground (relative dielectric constant = 13, conductivity = .005 S/m). The vertical portion starts at 1 foot, goes up 60 feet, and then slants down to 15 feet (slanting it down gives a convenient tie-off point to a tree or structure). The single radial is 129 feet long and is 1 foot high. Figure 1 gives pertinent information for this single-radial Inverted L.

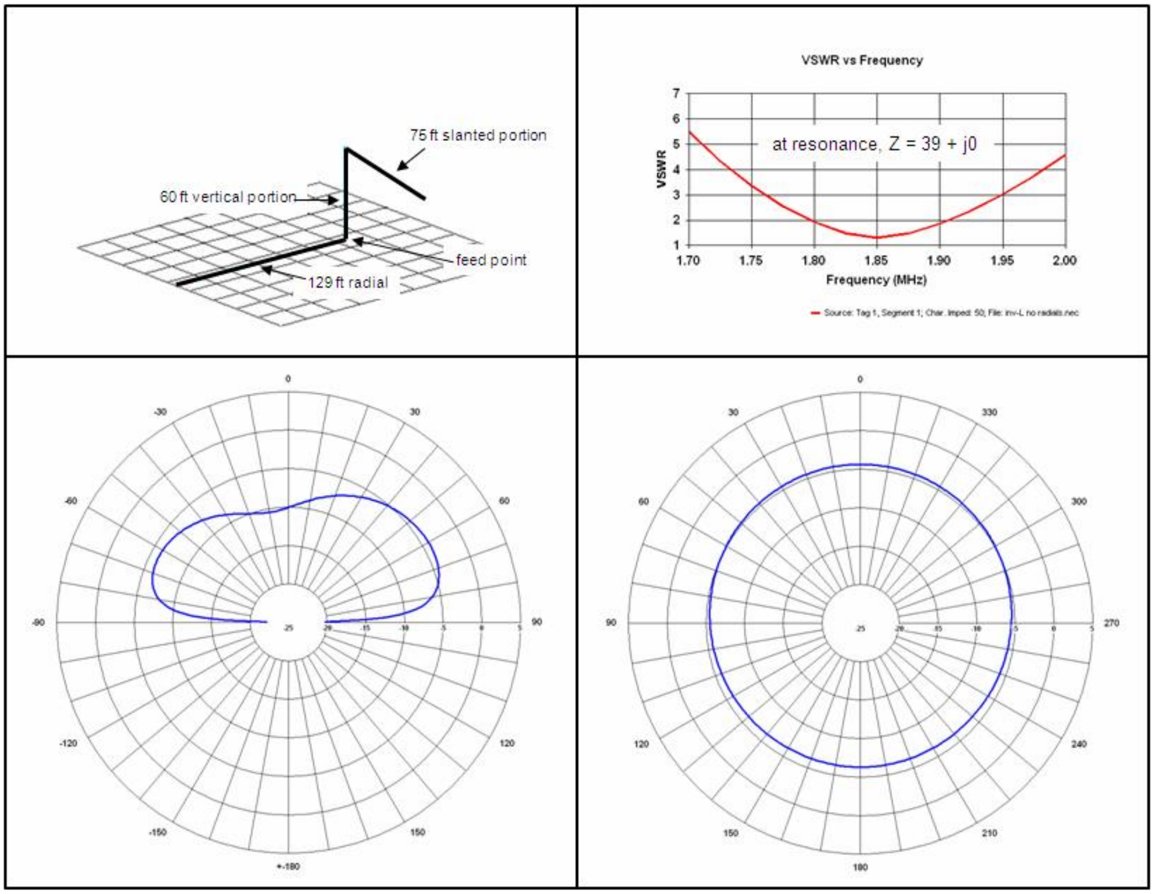

Figure 1 – A Single-Radial Inverted L

Note that the slanted portion of wire runs in the opposite direction of the single radial. I did this because this is how a single-radial Inverted L would be implemented at my QTH. The vertical portion would be supported by a tree at our property line, the long single radial would run off into the woods, and the slanted portion would run back to the house.

The upper left image in Figure 1 is the physical configuration of this antenna. The upper right image is the SWR. The lower images are elevation (left) and azimuth (right) patterns.

The SWR at resonance is 1.3:1 (50 ohms divided by 39 ohms), and the 2:1 SWR bandwidth is about 100 KHz. Most modern rigs (and amplifiers) will be happy with a 2:1 SWR without any additional matching. From the elevation pattern, the gain maximizes at around 25 degrees elevation at about -4 dBi. Both patterns show slight asymmetry (directivity). With most of the radiation vertically polarized (due to the 60 foot vertical portion), this antenna should work well for most of us in North America (see the Polarization sidebar).

One caveat is in order. The resistance at resonance at the feed point of the single-radial Inverted L will vary based on your configuration. See the Inverted L Impedance Trends sidebar for more information.

Now let's look at an Inverted V. Figure 2 gives pertinent information for a 160-Meter Inverted V with its apex at 60 feet and the ends 30 feet high.

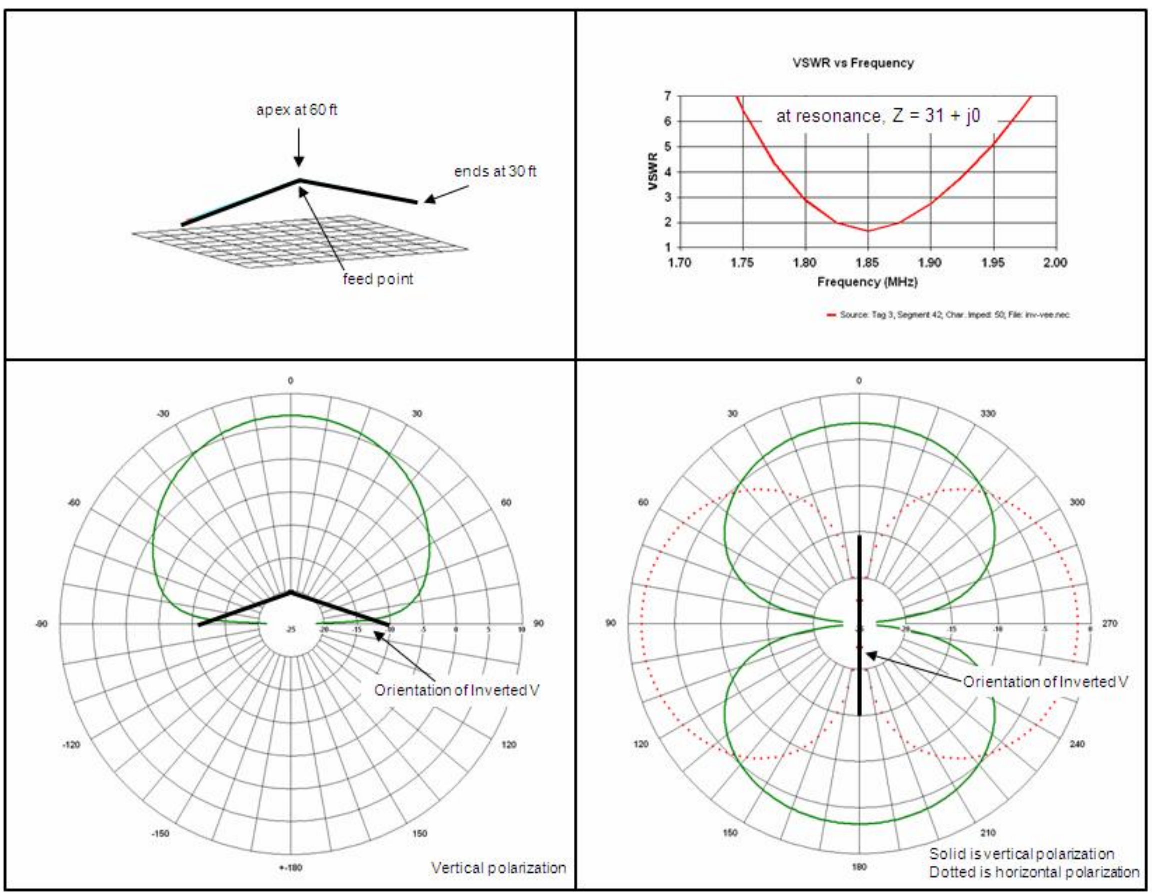

Figure 2 – An Inverted V

The SWR at resonance is 1.6:1 (50 ohms divided by 31 ohms), but the 2:1 SWR bandwidth has decreased to about 50 KHz. From the elevation pattern, the gain maximizes at about +7 dBi – but it maximizes straight up (since it is at a relatively low height in terms of wavelengths). The azimuth pattern shows the classical figure 8 pattern for both the horizontal and vertical components of polarization. Note that vertical polarization, what most of us should generally use in North America, is off the ends of the Inverted V.

Let's take a more detailed look at the gain of these two antennas. Figure 3 gives this data in terms of vertical polarization for elevations angles from 5 degrees to 50 degrees.

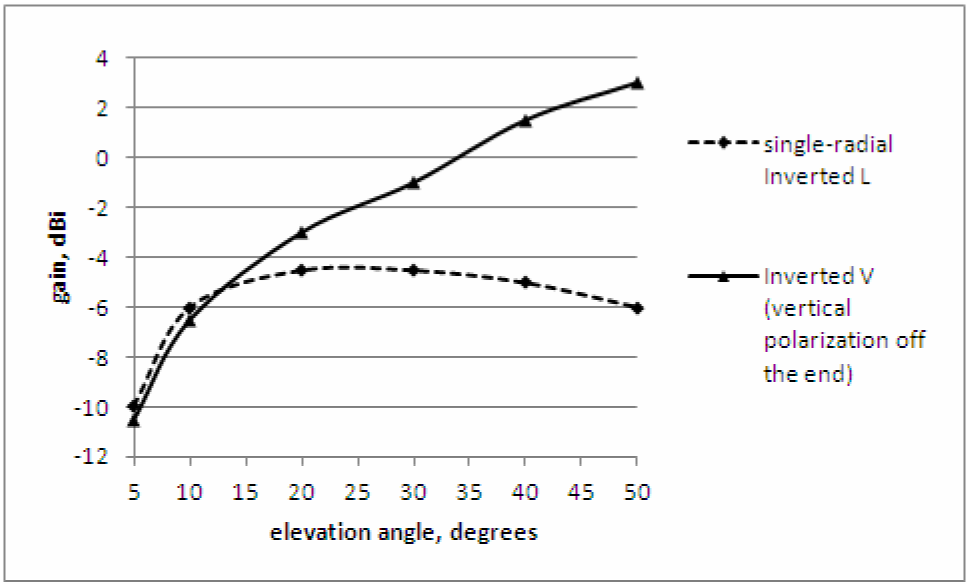

Figure 3 – Comparative Gains

At extremely low elevation angles the single-radial Inverted L has a slight advantage. But the Inverted V exceeds the single radial Inverted L at elevation angles greater than about 15 degrees. So the Inverted V, properly oriented so that the wire is in the direction of the target locations (off the ends of the antenna), can be another simple antenna that puts out a very workable signal.

I've had on-the-air experience with both of these antennas (although not a single-radial Inverted L). When my six-radial Inverted L for 80-Meters and 160-Meters (three elevated 120-foot radials on 160-Meters and three elevated 60-foot radials on 80-Meters) came down in high winds several years ago, I put up a temporary Inverted V (apex at 60 feet as in the model) with one wire heading south-southwest and the other wire heading west-northwest (that's what fit on my property). I believe I've not given up much when working stations in the directions of the wires. By the way, this temporary Inverted V is still up because it is simple and performs well in contests. To achieve the last dB for DXing, though, I would definitely re-install the multiple-radial Inverted L.

With the March/April 2011 issue of NCJ and with this issue, you have two choices for simple but effective 160-Meter antennas. You won't be king of the hill with these antennas, but you'll certainly work your share of domestic and DX stations.

Polarization sidebar

Because the ionosphere is immersed in the Earth's magnetic field, there is more order to polarization than generally acknowledged. At HF (3-30 MHz), circular polarization is the norm. But at 1.8 MHz, polarization tends towards highly elliptical (i.e., near linear). Additionally, the extraordinary wave (one of two characteristic waves that propagate through the ionosphere) is heavily attenuated around 1.8 MHz (because 1.8 MHz is close to the electron gyro-frequency), leaving the ordinary wave as the only useful characteristic wave on 160-Meters.

For most of us in North America (and generally those in the northern hemisphere worldwide), vertical polarization provides the best coupling to the ordinary wave. Thus vertical polarization is generally the best way to go. Be aware that at times, due to short-term variations of the ionosphere, horizontal polarization will be best. Thus the old adage "you can't have enough 160-Meter antennas" applies.

Inverted L Impedance Trends sidebar

The feed point resistance at resonance of your single-radial Inverted L will depend on your ground conditions, how much of a vertical portion you have, how much you slant down the "horizontal" portion, and the direction of the radial with respect to the direction of the horizontal portion.

Of the four variables given above, the two biggest players are how much of a vertical portion you have and if you slant down the horizontal portion.

As you shorten the vertical portion and use more of a horizontal portion to achieve resonance, the feed point resistance decreases. As you slant the horizontal portion down more and more, the feed point resistance also decreases. These effects are seen in Figure 1 – if the vertical portion was around 90 feet (instead of 60 feet) and if the horizontal portion was truly horizontal (instead of slanting down), the feed point resistance at resonance would be right around 50 ohms (instead of 39 ohms).