

Inverted-L Myths and Realities

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The venerable Inverted-L is the most popular antenna for the low bands, due in large part to its simplicity. It has enabled many hams to get on 80, 160, or even lower from their city lots. Unfortunately, its ease-of-use has allowed substantial misunderstandings as to design theory.

This article will address several of the most oft-repeated myths regarding Inverted-L's for the low bands. In a future follow-up article, I will detail the construction of a 160m Inverted-L at my new QTH using the "Ten Commandments" provided below.

Myths and Realities:

- **"I feed my Inverted-L directly and my SWR is great."**

If you feed your inverted-L without any type of matching network but you have low SWR, your antenna is probably very poor. The low SWR is due to tremendous ground losses near the feedpoint. As you improve your radial system, SWR will actually rise and will likely require additional capacitance at the feedpoint. SWR is a poor design metric.

- **"Radials reflect your signal."**

Your radial field provides a return path for RF (similar to the shield side of a dipole), but does not "reflect" your signal. The actual reflection happens several wavelengths away from the antenna and is due to something called the *pseudo-Brewster Angle*.

- **"This is a great limited-space antenna. Four radials should be fine!"**

How many radials do I need? Bad news: you need a bunch. For our poor soil conductivity, you're going to need at least thirty and they should be $\frac{1}{4}$ -wave long. I've found the length to be less important than the density near the feedpoint; for this reason, try to keep them evenly spaced, even if they are shorter in some directions. If you are extremely space limited, you can add a galvanized ground screen around the feedpoint (in addition to as many radials as possible, as long as possible). Good news: 30 radials appears to be the point of diminishing returns per tests by N6LF and others, so you will have achieved reasonable maximum performance with this setup.

- **"My vertical hears just fine."**

Verticals are noisy receive antennas. Often, my very short beverages-on-ground have been 6 or 7 S-units quieter than the Inverted-L on 160 and allowed me to make QSOs that simply wouldn't have been possible otherwise.

- **"The vertical should be a quarter-wave long."**

Your Inverted-L should actually be longer than a $\frac{1}{4}$ -wavelength. Making the antenna slightly longer will raise the current maximum in the vertical section well above the feedpoint (this is good). The trick, of course, is keeping the maximum beneath the horizontal portion; if the antenna

becomes too long, the horizontal portion will act as a radiator instead of a capacitance hat (this is bad). If you've done this properly, of course, you will still need to provide some capacitance at the feedpoint. Based on modeling at my specific QTH over the years, I've found 135' to 150' lengths to be the sweet spot for 160. Again, SWR is a poor design metric -- a small L-network at the base will easily solve the problem.

- **“I don't need a feedline choke.”**

Unless your ground is outstanding (think radials over saltwater), the shield of your feedline is being used as a radial. This can cause all sorts of ugly RFI in your home and, worse, your neighbors' homes. Consider using a commercially available choke (occasionally called an “isolator”) or construct your own. K9YC's popular design calls for seven turns of RG-8 through five 2.4" o.d. #31 toroidal cores.

- **“The wire is just thrown over a branch. It works fine.”**

Verticals are easily coupled with anything nearby, including trees. While trees aren't as bad as metallic structures, it is still best to have your vertical out in the open away from the greenery. A catenary support rope can help. Additionally, there will be substantial voltage at the end of the antenna when running high power, so be sure there is sufficient space and insulation between the endpoint and any vegetation.

- **“Feedline losses are so low on 160 that the coax doesn't matter.”**

It's true that loss decreases with frequency, however most coax is inherently leaky. This means that while feedline loss isn't the primary concern on 160, intermod and mechanical considerations might be. Consider using a high quality coax like LMR-400 or hardline. This rule holds true for any antenna on any band, and especially so if you intend to operate radios on other bands at the same time. True hardline has the added benefit of direct burial and is widely available on eBay and government surplus websites.

Ten Commandments for your Inverted-L

By way of summary, here are my basic design requirements for a good Inverted-L. Many of us, myself included, can't have all of them, but we should attempt *most* of them. After all, who among us is without sin?

1. Don't use SWR as a design metric
2. Make the vertical section as tall as possible
3. Use as many evenly-spaced radials as possible
4. Use a decent choke at the feedpoint
5. Avoid lossy bottom-loading
6. Place the vertical element in the open, away from trees and buildings if possible
7. Use high quality coax or hardline to feed the antenna
8. Match at the feedpoint, only use a tuner in the shack as a last resort

9. Use empirical performance tests; avoid “I snagged 3Y0 so it works fine” -statements
10. Don't use SWR as a design metric (again)

My final point is that we should never make *perfect* the enemy of *good enough*. Many of our constraints will dictate how well we can build this or any other antenna. The true test of our mettle is what we do within those constraints to maximize performance.

C U on Topband!

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