

CO LINEAR ANTENNA DESIGN

While it is not possible to home-brew a commercial quality antenna, it is very feasible to build a collinear antenna for average use. This article describes a collinear antenna made from very inexpensive RG58/U coaxial cable and encased in PVC pipe. FYI -- This was (many years ago) for a science fair I entered. Didn't win but had a great antenna when I was finished. Kind of looks like the modern fiberglass antennas we all have seen around..

Before we start building you need to know characteristics of coaxial cable. Remember that there is something called the velocity factor for coaxial cable. For RG58/U coax it is typically .66. This means that when we calculate the length of $\frac{1}{2}$ wavelength in free space we need to adjust its size by multiplying it by the velocity factory. Simply put, RF is slowed down by the velocity factor when traveling through coaxial cable. Calculating the $\frac{1}{2}$ wavelength of RG58/U coaxial cable with a frequency of 444 MHz.: I chose 440 band because the lengths are small. Of course you can pick your own band by simply changing the frequency to say 145.47 MHz...

$$\frac{1}{2} \text{ wavelength of coax} = 300 / F / 2 * V$$

Where F = Frequency in Megahertz

V = Velocity factory of Coax

$$300 / 444 / 2 * .66 = .2229 \text{ meters or } 223 \text{ millimeters or } 8.78 \text{ in. (remember } 25.4 \text{ mm per inch..)}$$

Since most of us don't have mm tapes I will do this in inches..

To allow for cutting the ends of our coax, we will need to add .3 inches to each $\frac{1}{2}$ wave length for a total of 9.08 inches.

You will need 8 half wave lengths (9.08 inches) of RG58/U coaxial cable to be cut and connected in the manner shown in Figure 1. First cut back .16 inches of the outer jacket, braid and dielectric exposing the center conductor as in Figure 2. Now cut back the outer jacket another .16inches to expose the braid and push the braid back about a millimeter to prevent it from shorting with the center conductor. Now solder each half wavelength section as shown below. Add a few feet of RG58/U to the bottom.

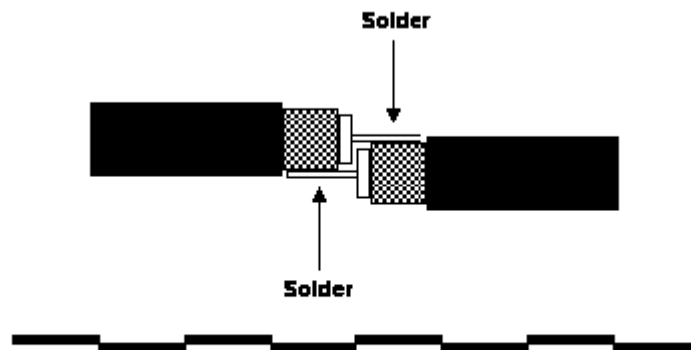


Figure 1

To add a $\frac{1}{4}$ wave element to the top of the antenna Use #16 solid wire or similar and solder it to the center conductor only. Or on the last element you make simply make it $\frac{1}{4}$ wavelength longer than the rest and then remove the shield. The length of the $\frac{1}{4}$ wave element is calculated as follows:

$$1/4 \text{ wavelength radiator} = 300 / F / 4$$

Where F = Frequency in Megahertz

$$300 / 444 / 4 = .1689 \text{ meters or } 169 \text{ millimeters or } 6.65 \text{ inches}$$

At the bottom of the array slide a 5/16 inch tube (or you can use braid from a piece of coax) over the feed point only. Solder the tube/braid to the shield of the bottom element. The length of the tube (or braid) is calculated as follows:

$$\frac{1}{4} \text{ wavelength of tubing} = 300 / F / 4 * V$$

Where F = Frequency in Megahertz

V = Velocity factory of Tubing. (Use .95 for 5/16" tubing)

$$300 / 444 / 4 * .95 = .1604 \text{ meters or } 160 \text{ millimeters or } 6.4 \text{ inches}$$

Because a collinear antenna is hot with RF along the shield of the coax, it is necessary to prevent the RF from coming back through the coax. Slide three FT50-43 or almost any similar sized toroids over the bottom end of the coax as shown in Figure 3. The toroids should be placed about $\frac{1}{2}$ wave length from the bottom of the array. Use the same formula for calculating a half wave length of coax. If you prefer, apply RF to the antenna at this point and slide the toroids up and down until minimum SWR is found. Tape the toroids to the proper point on the coax using electrical tape or similar means.

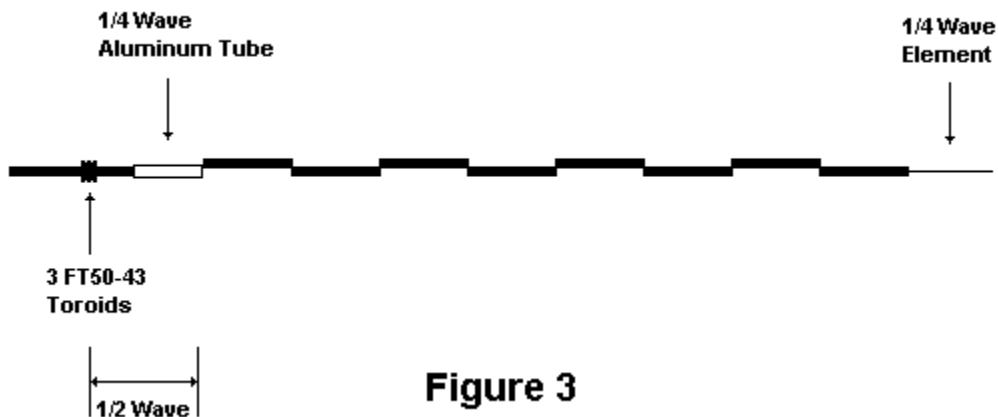


Figure 3

Carefully insert the coax assembly into a length 1/2" PVC pipe for final mounting. Place a cap on the top of the PVC after the antenna inserted. I taped a string to the top of the antenna (the bare $\frac{1}{4}$ wavelength) to allow me to pull the entire antenna into the PVC. On the bottom I used a cap with a hole drilled into it to mount a connector. I used a BNC connector which fits nicely into the $\frac{1}{2}$ inch PVC. You could also just extend the bottom coax through the hole and put a connector on the coax. Do not cement end caps until the SWR has been doubled checked. **Do not** use RG58/U for your complete feed line. Use a low loss coax such as LMNR 8 for the main feed line.

After completing the assembly of the collinear antenna, apply a small amount of RF with the antenna on the ground. Low SWR should be observed at this point. Remember tuning can be accomplished with the toroids. The SWR will be lower once the antenna is mounted in the air. If the SWR is greater than 2 to 1 across the entire band, a connection may separated or a short occurred. It will be necessary to correct the problem before proceeding. After good SWR is obtained, I used heat shrink around each joint and the put a tie rap on each point. The tie rap will make the antenna fit bitter in a $\frac{1}{2}$ PVC without moving around much.

If the eight $\frac{1}{2}$ wave coaxial elements result in an antenna too long for your liking (over seven feet), then it is okay to use four $\frac{1}{2}$ wave coaxial elements but the SWR may be slightly higher (Attach four $\frac{1}{4}$ wave vertical ground radials at the antenna feed point to help lower SWR.). **No radials are needed for the eight element version.** If 9 dB gain is still not enough for you then increase the number of coax elements from eight to sixteen. You will notice the antenna is getting kind of long if you do this!! Although only a 440 antenna was described in this article, the formulas can be easily calculated for any band.

If you go lower than 6 meters it is going to be very LONG..