Build A 9 dB, 70cm, Collinear Antenna From Coax
By N1HFX

Recently the RASON technical committee was hard at work at the repeater site repairing our 2 meter repeater antenna. One of the members commented to me that I should write an article about collinear arrays so that we could all build our own. While it is not always feasible to home-brew a commercial quality antenna designed to take hurricane force winds, it is very feasible to built 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.

Before we start building we need to cover some ground about the characteristics of coaxial cable. First 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 ½ wavelength in free space we need to adjust its size by multiplying it by the velocity factory. Simply put, RF slows down by the velocity factor when traveling through coaxial cable. All that aside now, lets calculate the ½ wavelength of RG58/U coaxial cable with a frequency of 444 Megahertz:

½ wavelength of coax = 300 / F / 2 * V

Where F = Frequency in Megahertz

V = Velocity factory of Coax

300 / 444 / 2 * .66 = .2229 meters or 223 millimeters

To allow for cutting the ends of our coax, we will need to add 8 millimeters to each ½ wave length for a total of 231 millimeters.

To get started, we will need 8 half wave lengths (231 millimeters) of RG58/U coaxial cable to be cut and connected in the manner shown in Figure 1. First cut back 4 millimeters of the outer jacket, braid and dielectric exposing the center conductor as in Figure 2. Now cut back the outer jacket another 4 millimeters to expose the braid and push the braid back about a millimeter to prevent it from shorting with the center conductor. It is best to lightly tin the braid with solder at this point. Now solder each half wavelength as shown in Figure 1. Attach a few feet of RG58/U to the bottom of the array as in Figure 1 for feeding the antenna.

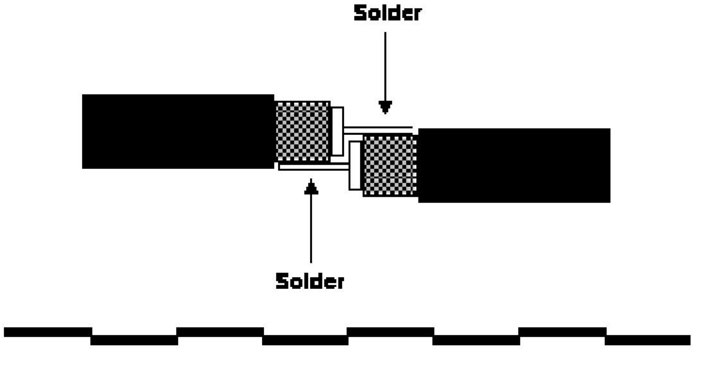

Figure 1

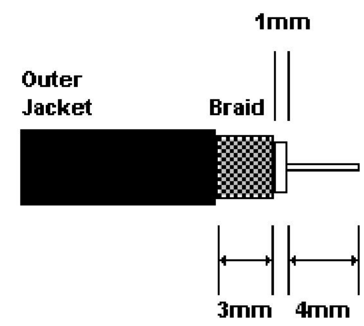

Figure 2

Now its time to add the additional elements to the top and bottom of the collinear array. First add a ¼ wave element to the top of the antenna as shown in Figure 3. Use #16 solid wire or similar and solder it to the center conductor only. The length of the ¼ wave element is calculated as follows:

1/4 wavelength radiator = 300 / F / 4

Where F = Frequency in Megahertz

300 / 444 / 4 = .1689 meters or 169 millimeters

At the bottom of the array we will slide a 5/16 inch aluminum tube over the coax and crimp it to the braid of the antenna feed point only. If copper is used, it is okay to solder. The length of the tube is calculated as follows:

¼ 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 meters or 160 millimeters

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 ½ 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.

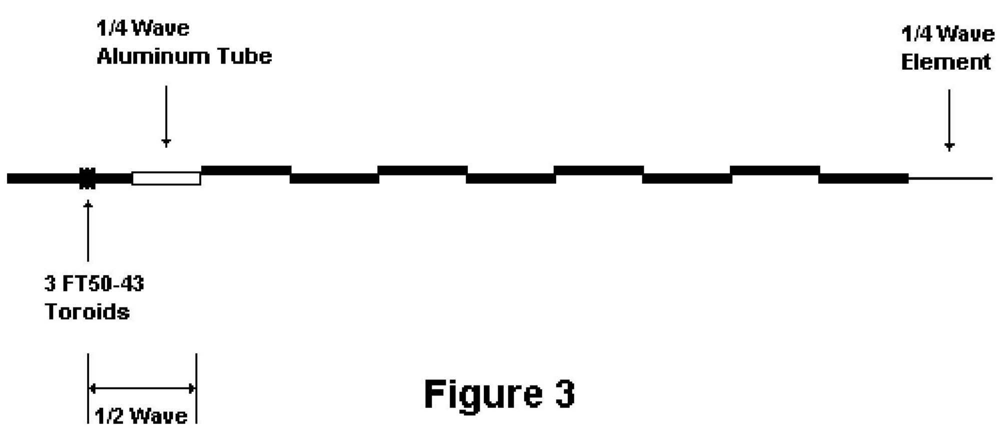

Figure 3

After completing the basic assembly of the collinear antenna, apply a small amount of RF with the antenna on the floor or ground. Relatively low SWR should be observed at this point. The SWR will be much 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, place heat shrink tubing along all connections or wrap tightly with electrical tape.

For final mounting, attach the antenna to a ¼" wooden dowel using tie wraps about every 3 inches. It may not be possible to obtain a wooden dowel for the complete length so attach two dowels together by using a 1 inch sleeve of 5/16" tubing and crimping the tubing at each end. Check SWR again to insure that no connections have separated or shorted. Carefully insert the coax and dowel assembly into several feet of ¾" PVC pipe for final mounting. Because of the tie wraps, it is not necessary to use spacers but may be necessary if larger size piping is used. Drill a hole for the coax at the bottom end cap and place an end cap on the top of the PVC. Do not cement end caps until the SWR has been doubled checked. Cement end caps and water proof coax opening on the bottom. Use whatever type of coaxial connector is desired on the bottom of the coax end but do not use RG58/U for your complete feed line. Use a low loss coax such as RG8/U for the main feed line to the transceiver. Don't forget to water proof all coax connectors.

If the eight ½ wave coaxial elements result in an antenna too long for your liking (over seven feet), then it is okay to use four ½ wave coaxial elements but the SWR may be slightly higher (Attach four ¼ wave vertical ground radials at the antenna feed point to help lower SWR.). If 9 dB gain is still not enough for you then increase the number of coax elements from eight to sixteen. You will probably need to attach guy lines to the antenna. Although only a 70 CM antenna was described in this article, the formulas can be easily calculated for the 6 meter, 2 meter or 1¼ meter bands. Millimeters were used for many of the measurements but can be converted to inches by dividing millimeters by 25.4 for those who are not familiar with the metric system. After installing one of these antennas, be prepared to hear stations and repeaters that you never heard before.

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