Omni-Gain Vertical Collinear for VHF and UHF

Coax comes alive II, the next generation

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This rugged antenna, an omnidirectional collinear, is capable of surviving harsh environments. It's a good choice for repeater installations and can be top, or side mounted to the tower. You can obtain approximately 3 - 10 dB of gain over a dipole, depending on the number of elements you use. The higher the gain the narrower the elevation pattern. Bandwidth is normally 10 Mhz. on the 70 cm. band and 25 Mhz. on 23 cm, making the antenna an excellent candidate for ATV repeater use. Many improvements have been made since my original article, "Omni-Gain Collinear for 70 cm and 23 cm," was first published in the May 1982 issue of 73 magazine.

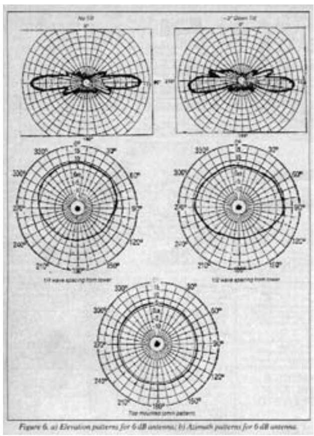
Concept of construction.

The main elements are constructed from ½ wavelength sections of rigid coaxial cable that you build. You can calculate the element length using the formula 5904 divided by the desired resonant frequency of the antenna, times the velocity factor of the coaxial cable. Originally I used RG-213 with a velocity factor of .66 or 66%, I now use RG-11 or CAC-11 (a solid conductor aluminum shield cable) for high power antennas and RG-6 for low power. Construction is facilitated by the removal of the jacket and shield from the coax and sliding the dielectric and center conductor into the hobby brass tubing to create the rigid hardline element. Select the diameter of the brass tube to just fit snugly over the dielectric and center conductor of the coax. The brass tube provides a more rigid support for each element and makes it easier to solder them together. Use the above formula to calculate the lengths of the brass tubes. Cut the coax segment 7/8" longer than the brass tube. This will allow 1/16" of dielectric and 3/8" of the center conductor to extend out each end of the tube for element spacing and soldering. Make as many ½ wave elements as needed for the gain you desire. 4 elements = approximately 3.5 dBd, 8 elements = 6 dBd, 18 elements = 9 dBd, and 21 elements = 10 dBd. In addition to the ½ wave elements, you need a ¼ wave element and a ¼ wave whip for the top of the antenna. The whip is cut to a true ¼ wavelength (no velocity factor correction) and is made out of number 12 wire or 1/8" brass rod. Vertical beam downtilt can also be applied into the calculation and construction of the antenna.

Constructing the collinear.

Step 1. Determine the length of the ½ wave elements using the formula: 5904 divided by the Frequency in Mhz. multiplied by the Velocity Factor of the of the dielectric. (5904/F x VF) Use the manufacturer's stated velocity factor for the cable you plan to use. Solid polyethylene usually has a velocity factor of .66 or 66% while foam cable ranges from .79 to .83.

Step 2. If you desire vertical beam downtilt, cut the elements 2% shorter, than the length calculated in step 1, for 3° of downtilt.



Step 3. Cut lengths of coax approximately 7/8" longer than the brass element tube.

Step 4. Remove the outer jacket and shield from the coax and slide the dielectric and center conductor into the brass tube. Center the coax element in the brass tube.

Step 5. Using a knife, being careful not to nick the center conductor, cut the dielectric so that a 1/16" sticks out past the end of the tube. This should leave about 3/8" of center conductor exposed on each end for soldering.

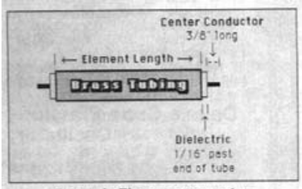


Figure 1. Element preparation.

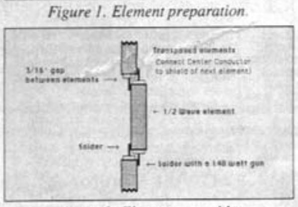


Figure 2. Element assembly.

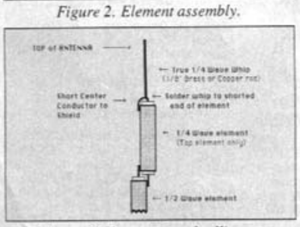


Figure 3. Top section of collinear.

Step 6. Being careful to keep the whole antenna as straight as possible, solder the prepared elements together by soldering the center conductor of each element to the outer conductor of the next element. You will end up with transposed connected elements.

Step 7. The last element is ¼ long, exactly ½ of the measured length of the ½ wave length element. Short out the top of this section by bending over the center conductor and soldering it to the brass tube. A ¼ wave whip is connected to the top of the shorted out ¼ wave coax element. The whip is a true ¼ wave long (no velocity factor correction) and can be constructed out of small diameter brass rod. Make certain that the full ¼ wave extends above the point where the coax section is shorted out by cutting the rod a bit longer and soldering this excess to the brass tube.

Step 8. The 50 ohm feedline can be any length. I use RG-213 or RG-214 coax with an "N" connector attached . Strip off at least a half wavelength of shield on the other end of the feedline. Leave about an inch of shield sticking out of the vinyl jacket for soldering to the brass tube. Cut the dielectric and center conductor to expose about 3/8" of the center conductor. Slide the half wave length or longer brass tube over the end of the exposed feedline so that the 1" of braid can be soldered over the bottom of the brass tube.

Step 9. Make a true ¼ wave long (no velocity factor correction) decoupling sleeve out of a piece of ¾" brass tubing. Using some excess shield material, or some other acceptable manner, solder the decoupling sleeve to the feedline outer conductor at a point exactly ¼ wavelength down from where the feedline attaches to the first ½ wave element.

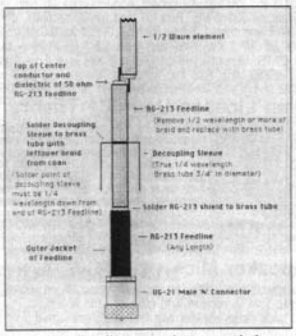


Figure 4. Feedline attachment and decoupling sleeve.

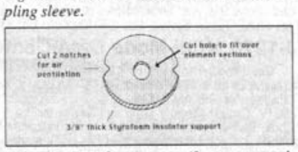


Figure 5. Styrofoam spacer (3 or more needed).

Step 10. Attach the exposed end of the feedline to the bottom of the collinear by connecting the center conductor of the feedline to the outer conductor of the antenna and vice versa.

Step 11. Make some styrofoam spacers to slip over some of the antenna elements. Cut the spacers for a diameter slightly less than the inside diameter of the radome pipe. Space them out to evenly support the antenna when you place it in the fiberglass or PVC radome cover. The spacers should be attached to the midpoint of the element with a small amount of epoxy or hot glue.

Step 12. Cut a piece of fiberglass or PVC pipe so that 18 inches or more extend past the top of the whip and also below the decoupling sleeve. Slide the antenna carefully into the pipe and cap off the top. Drill two holes near the bottom of the radome pipe and pass a piece of insulated wire through and around the feedline below the decoupling sleeve to support the weight of the antenna. Twist the wire until it holds the feedline tightly against the radome cover. Place another styrofoam spacer on the very end of the pipe and glue it in place. Make sure to poke a few small holes or notches in the spacer to allow the end of the antenna to breathe. You are ready to fire up the your collinear!

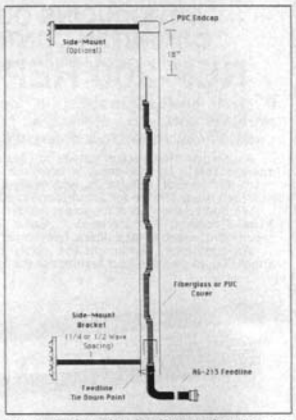


Figure 7. Completed collinear (four ½-wave elements).

Tune up and Operation.

Find a clear area, free of obstructions. Mount the antenna to a pole making sure to clamp the antenna to the mast at a point below the decoupling sleeve area. Attach a wattmeter or SWR bridge to the antenna. If the SWR is over 1.5:1 you can adjust the decoupling sleeve slightly up or down for the best reading. If you have designed the antenna for downtilt you can check it by observing the signal strength of a nearby repeater. Tilt the angle of the antenna until the signal peaks, then measure the angle with a protractor. If the angle checks ok you are ready to mount the antenna to your tower! Mounting your collinear on top of your tower will give you an omni-directional pattern. If you desire a Cardoid pattern, or if your only option is side mounting, you can mount the antenna to the side of the tower with one or two brackets. Make sure the bottom support is attached to the antenna below the decoupling sleeve, and that the top support is mounted 18" or more above the top of the whip. Mounting the collinear ¼ wavelength away from the side of the tower will give you about a 2 dB increase in the frontal lobe of the pattern. A spacing of a ½ wavelength will increase the signal 2 dB at 90° angles from the frontal lobe. Both patterns give a null in the direction of the tower.

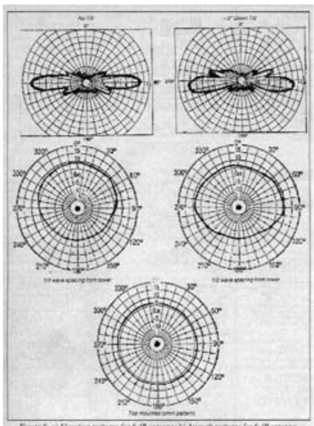


Figure 6. a) Elevation patterns for 6 dB antenna; b) Azimuth patterns for 6 dB antenna.

This antenna should handle the worst Mother Nature can through at it. It has performed admirably at the ATV repeater site on 5670' Santiago Peak for many seasons. Mounted on the tower it blends right in with the commercial commercial antenna installations.