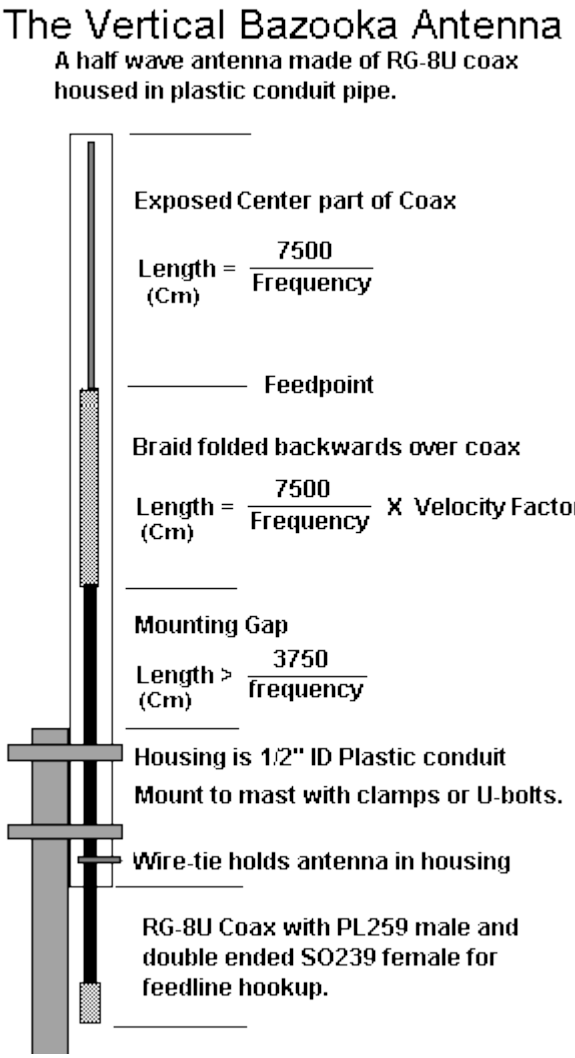
Vertical Bazooka Antenna

Build your own dipole from coax

VE3VDC - L D BLAKE

Every radio amateur should build at least one antenna to prove to themselves they can improvise in an emergency. One of the easiest and quickest antennas to build is the Vertical Bazooka, which is made entirely from RG-8U coaxial cable.



The plan for a Vertical Bazooka is in the drawing above. Copy the image to your own hard disk and you are all set. The design and image are public domain so feel free to copy them and give them out as you wish.

Beyond being extremely easy to build, these antennas have several nice features to recommend them:

- **Total cost under $10.00cdn**

- **No coils needed.**
- **No ground radials.**
- **SWR under 2:1 across several megahertz**
- **They are surprisingly rugged antennas.**
- **Can be built as part of your feedline**
- **Can be coiled up and put in your car trunk.**
- **Performance like regular half wave antennas.**

The antenna itself is an off-center fed vertical dipole made by flipping a quarter wavelength of braid back over the outside of the coax. The center lead of the coax forms one half of the dipole and the braid forms the other. The resulting antenna has a low radiation pattern and an impedance of 55 - 60 ohms.

One of the more interesting features is the braid itself. By folding an electrical quarter wavelength of braid back over the insulated coax we are forming both a dipole and a "bazooka" (sleeve) balun, a coaxial 1:1 balun that greatly reduces feedline radiation. This makes the Vertical Bazooka a good choice for use on apartment balconies.

The braid side of the dipole ends up considerably shorter than the top element because of the interaction between the braid and the coax. The outer braid couples with the inner braid to form the balun and is thus affected by the velocity factor of the coax. Note on the plans that I've compensated for the length difference. Also note the formulas given will start you off long so you have to trim for the best SWR.

You can use the formulae in the diagram above to create Vertical Bazooka dipoles for any frequency. However; practical considerations of mounting and support tend to limit it to the span from 10meters (28mhz) to 70cm (440mhz). Below about 25mhz the housing tube becomes very long and can be difficult to support. Above about 450mhz you are pushing the frequency limits of the coax which are affected by the lower braid section of the dipole.

Power handling with good quality coax should be 100+ watts. However; if you plan to run more than 50 watts on a regular basis, as a precautionary measure, you should add a couple of layers of electrical tape or heat shrinkable tubing between the braid and the outer insulation of the coax.

The Vertical Bazooka is a fun and easy antenna that can be built in an afternoon.

Building The Antenna

My weekend project was to build a Vertical Bazooka for 2 metres. I was easily able to build the antenna and get it set up on my balcony in a day, including several coffee breaks as I went. I had more trouble getting some weight for the base I used than I did building the antenna.

One preliminary step I would strongly recommend if you are working from an enclosed location such as an attic or a balcony, is to spend some time with a handy talkie and find out where you are going to get the best results. Position the finished Vertical Bazooka in your personal "hot spot". On my balcony this was just a bit West of center.

On the left you see all the parts needed to build a Vertical Bazooka antenna. The larger circle of cable is RG-8U coax which will become the antenna. The inner coil is my feedline made of 4 wavelengths of RG-8X coax. At the back of the picture you see the grey plastic tube, a piece of electrical conduit that will hold the finished antenna.

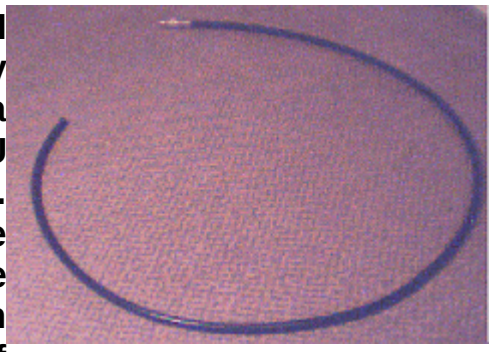
NOTE: IN THIS PROTOTYPE, GRAY PVC WAS USED. IT IS HIGHLY RECOMMENDED THAT YOU USE WHITE PVC. GRAY HAS MUCH MORE ATTENUATION TO RF THAN WHITE!

The first step is to decide how you want to mount the antenna. It is important to have enough of a gap between the bottom of the coax shield and the mounting structure. If this distance isn't at least 1/8 of a wavelength it is very likely the SWR will be affected when you mount the antenna.

If it's going on top of a tower, you can simply make the plastic housing tube as long as you want, leaving plenty of extra for the mounting gap. If you are doing a balcony mount a little figuring will have to be done to ensure the antenna will fit between your balcony and the one above it, with some clearance above.

For my balcony mount I decided on 160cm. Mounting this on a 75cm piece of pipe on a round base gives me lots of mounting gap (certainly more than the minimum) but doesn't make the antenna

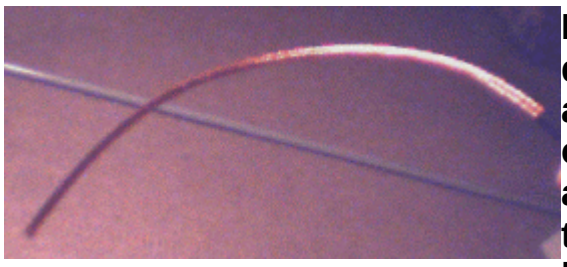
so tall that it would not work between my balcony and the one above. I actually worked it out so the bottom of the braid would be a couple of centimetres above the steel top rail of the balcony, which seems to have been a workable plan.



Having decided the lengths of things I then cut the tube and temporarily assembled it to the base. Next I put a PL259 connector on the the RG8-U coax and cut it to fit in the tube. Obviously you want the antenna to be the full length of your tube so be sure to allow a couple of extra inches when cutting. At this point I had a piece of RG-8U, the right length, with one connector installed, as you can see in the picture. This will become my antenna.

The next step was to measure down 1/4 wavelength from the open end of the antenna so I could cut away the outer insulation and expose the braid.
This distance is determined by the formula:
7500 / frequency = Length (in centimetres)
I wanted to cut for center band, so, on 2 metres this is 146.000mhz.
Substituting into the formula:

7500 / 146 = 51.37 cm. (20.22 inches)

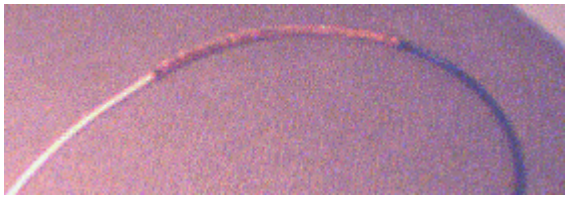


Being extremely careful not to damage the braid, I made a cut around the outer insulation of the coax at this distance and cut along it's length. This allowed me to remove the outer insulation, leaving me with the braid exposed as shown in the picture to the left.

Now comes the fun part. Without unraveling it, I had to push the braid back over the still-insulated part of the coax, reversing it on the cable. In other words the braid came up inside the outer insulation and then went back down on the outside.

Fortunately this isn't all that hard to do. The braid on coax works like "Chinese Handcuffs" in that when you push back on it it will expand in diameter. I worked from the open end back, getting it all loose and a little bit expanded, then I just grabbed it at the bottom

(where the insulation ends) and rolled it back over itself. This took about 10 seconds, once I got the hang of it.



The larger picture to the left shows the antenna with the braid flipped back. At the right is a close-up of the feedpoint (where the center and braid go opposite directions) showing how the braid is flipped back over the outer insulation.

Now I hit a little snag. When you loosen the braid as I did it gets springy and very difficult to keep in place. I finally ended up wrapping tape around the bottom to hold it in place while I trimmed. I then found I could could trim it very easily with cutter pliers.

For your first cut on the braid use the formula

(7500 / frequency) X velocity factor = length (in centimetres)

It is very important that you know the velocity factor of the RG-8U coax you are using for the antenna. If you have the .80 type, cutting for .66 will make it too short. If you have the .66 cutting for .80 could cost you a lot of hours trimming it down. So, be sure first.

My coax was the .66 velocity factor type so substituting into our formula we get:

(7500/146) X .66 = 33.91 cm (13.35 inches)

This should get the length of the braid very close to the correct length and very little trimming should be needed.

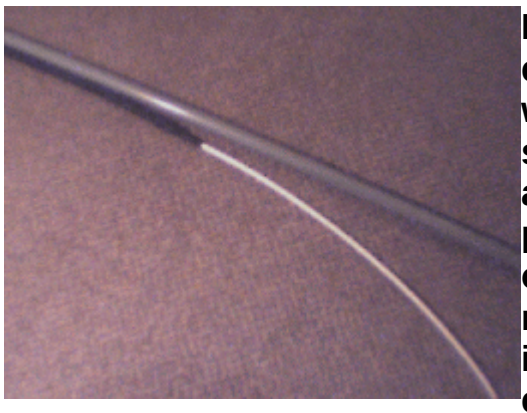
On the right is a picture of the antenna taped to the side of it's housing just before I took it outside for tuning. Note the tape at the bottom of the braid, to keep it from springing back.

Trimming the top section for best SWR is easy. The final length of the upper section (center lead) will vary according to the dielectric effect of the rather thick insulation on it. So I cut very slowly taking no more than a centimetre, often just a couple of millimetres at a time.

After each cut I would check the SWR at 144.000mhz and 148.000mhz. Getting them equal means the antenna is the right length. If the low frequency is better the antenna is too long. If the high frequency is better the antenna is too short. So you know when to stop cutting!

Trimming the braided shield is a bit tricky. Each cut has a large effect and tends to affect the SWR equally all across the band. If you find you can't get the SWR under 1.5 to 1, you can try a small cut on the braid, no more than a couple of millimetres, and see what happens. If the SWR improves try it again... if not, stop where you are.

You should note that you won't likely get a 1:1 SWR out of this antenna. It's feedpoint impedance is closer to 60 ohms, so anything under 1.5:1 is good.



I discovered through experimentation that I actually wanted the antenna just a tiny bit short. Inserting it into it's tube had an effect like lengthening it slightly, probably due to the dielectric effect of the plastic. So the first cut you make that's too short, stop and test it in the tube... it's likely to be the exact length you need.

To the left is a shot of the antenna all ready to be assembled and put to work. Note that I have put heat shrinkable tubing over the braid part of the antenna. This is to prevent it from moving after assembly, vinyl tape should work as well. If the braid moves inside the housing, the SWR will be affected.

There were now only a couple of minor details left:

The first task was keeping the antenna from sliding out of the plastic tube that was to be it's home. This was easily solved by making a small hole in the tube and using a wire tie to clamp the antenna into place.

The last detail was some waterproofing which I handled by putting a chair leg cap over the top of the tube. You can get these at most hardware stores in packs of 4. The nylon ones are really tough and work well.

And finally once it was all together I put it on an old fan base I had sitting around and added a little weight to keep it all in place. It would have been better to clamp it to the railing, but at the time I didn't have my landlord's permission. The final assembly, sitting on my balcony is shown on the left.

The antenna is almost invisible from the ground. It looks like a mop handle or broomstick, and not at all like an antenna.

The SWR is under 1.5 across the entire 2 meter band. It measured 1.3 at each end and 1.1 in the middle during my tests; not perfect but totally usable.

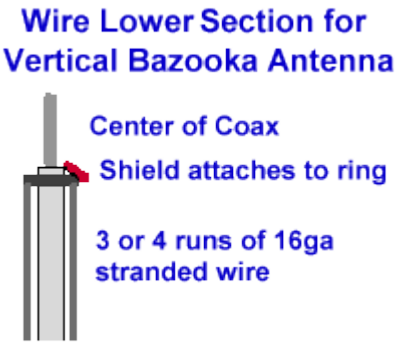
Some Suggested Modifications

Since originally posting this article I've received a few emails with suggestions for improving the design. Here are a couple of the better ones...

USE WHITE PVC INSTEAD OF GRAY. MUCH LESS RF ATTENUATION

Use copper tube for the lower section.

Instead of using the braid itself, a section of copper tubing could be used to make the lower section. In this case cut the braid leaving only a short stub that would be soldered to the copper tube. The length is the same as for the braid version, but the tube is more dimensionally stable. You would trim it with a pipe cutter. (I've not tested this version, so additional feedback would be appreciated)



Use several pieces of wire to replace the lower section.

> **In this modification you replace the shield section with 3 or 4 runs of insulated 16ga lamp wire. To do this cut the braid and twist it to form a short stub for soldering. Make a ring of wire to fit around the coax, attach the wires to the ring and solder to the shield braid. The wires are then secured to the sides of the coax with heat shrink tubing. To adjust this new bottom section, clip bits off the ends of the wires. This modification has the advantage that you can still roll the antenna up, if used for an emergency antenna.**
>
> **More mods and improvements will be posted as they come in. To offer a suggestion click the "Feedback" link at the bottom of this page.**
>
> **Putting It To Work**
>
> **In checking with a number of people around my area, up to 30 miles away, signal reports have been fair, not braggable. Most reports are about the same as I would expect for a quarter wave, all were far better than for my handy talkie. The performance is adequate, so the overall project is what I'd call a success.**

Reports from a couple of other Amateurs who have put Vertical Bazookas on mast pipes are better than those from my balcony. This I think is to be expected since the operating environment on my balcony, surrounded by sheet metal, is far from ideal.

Making an emergency version of this antenna is simple. Just don't put it in the tube. You can then coil it up and put it in your emergency communications kit. Add a little coax and some nylon cord on the top end and you can string it over a tree branch or hang it from a clothesline while you need it.