

## Stealthy Roof-top 2m Base-station Antenna

This 2m roof-topper slips over a vent-pipe. It is only 12 inches tall, yet has the gain of a J-pole. Your neighbors will never notice it.

by John Portune W6NBC

The secret of stealth, whether for magic shows or ham radio antennas, is “hide it in plain view.” To neighbors, ham antennas are “eyesores.” CC&R covenants often forbid them. Yet vent pipes, fireplace flues, and air conditioning ducts – just as visible as antennas – are somehow invisible to wandering eyes. When’s the last time you noticed your neighbor’s roof vents? If a ham radio antenna can be made to look like a normal roof-top dweller, no one will ever see it.



Here’s just the ticket, a tiny 12 in. high 2m staggered slot roof-topper that looks like a vent pipe. Though small, it has the gain of a J-pole. Compare size and gain in Figures 1 and 7. Which one will your neighbors notice?

### Design and Construction

This small wonder is made from a short length of common 4 in. DWV ABS plastic pipe and heavy-duty 2 in. aluminum duct tape, Figure 2. Besides what’s needed for the antenna (12 in.), you may want to add additional length at the bottom for mounting or for an angle to match your roof.

*Figure 1: My home-brew J-pole next to the vent-pipe roof-topper.*

The completed vent antenna is then painted matt black or covered with matt self-adhesive vinyl. Mine simply sits over an existing vent pipe (not a hot one).

The aluminum tape is 3.6 mil Scotch 3311 aluminum duct tape. It and other brands are readily available on the internet in small rolls. Thinner tape, or household aluminum foil and glue may be used but are somewhat more difficult to apply.

## Construction



Figure 2: Vent antenna before painting. Note highlighted shorting tapes.

Begin by applying a temporary wrap of masking tape with the top edge 12 in. down from the top of the pipe. Next, attach the 8.875 in. long vertical tape segments. Figure 3 shows the layout. Note that the vertical segments alternate, one up, one down, and that they overlap the horizontal segments. This permits good RF connection by capacitive coupling. This way, the adhesive on the tape is not a problem.

In flat view, the staggered slot that forms the antenna is easy to see. The most important feature is that this antenna is vertically polarized. It's what we need for a 2m base station antenna. I used the printed markings on the ABS pipe to get the first vertical tape segment straight. Note that the last vertical segment is wider than the

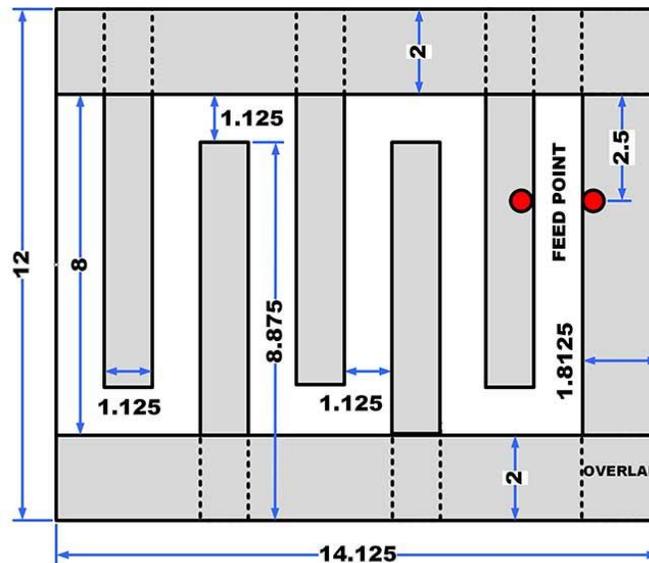


Figure 3: Flat view showing aluminum tape segments and locations. Note the tape overlap and the feed point. Shorting tapes for tuning and matching are not shown

others and is 12 in long. Complete the tape application by adding the two horizontal segments. Both of these are full wraps with an end overlap.

A 3 in. Version

## A 3 in. Version

If you prefer, the same concept can be implemented in smaller diameter ABS pipe. Figure 4 gives dimensional details for a 3 in. pipe version. This smaller pipe size may be more available in your local hardware store. The bandwidth is a little less. The gain and radiation pattern remain the same, however. The only difference in construction, is that the vertical aluminum tapes and the slot are narrowed to  $7/8$  in. Also, the feed point is moved. One small downside is that attaching the coax to the internal feed point is more difficult with the smaller pipe.

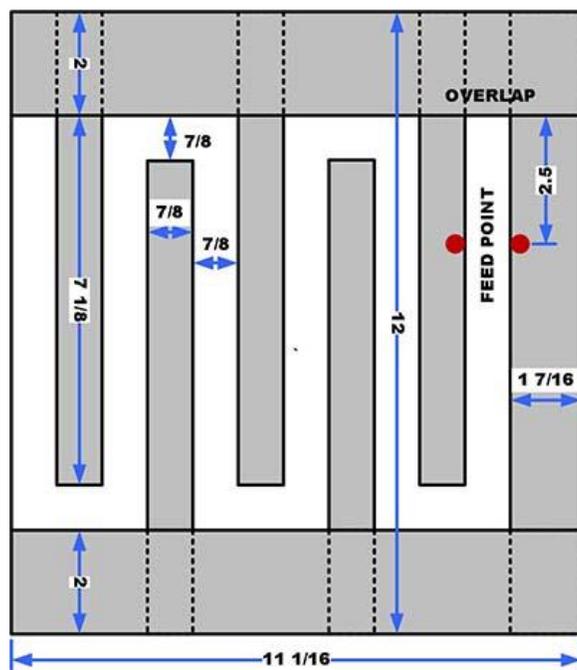


Figure 4: dimensions of 3 in. version of antenna.

## Feed Point and Balun

Make up a coax pigtail; RG-58 or Mini-8 are satisfactory. Separate the braid and the center conductor and add ring terminals for 6-32 screws. Also apply weather proofing. Drill two  $9/64$  in. holes near the edge of the slot as shown in Figure 2, for attaching the pigtail from the inside of the pipe. Use brass or stainless hardware. Run the coax out the bottom.

If you are using RG58 or Mini-8, allow roughly 2 ft. extra for a four turn coax balun, 1 in. in diameter, inside the pipe. See Figure 5. If this antenna will be used over an existing roof-top vent pipe, make the balun 3 in. in diameter and two turns to slip over the vent pipe. Mix 61 ferrite beads are also very suitable. Alternately, you may cover the antenna with an ABS test cap.



*Figure 5: Internal feed point and coax balun*

### Tuning and Matching

First measure the initial resonant frequency (the tune) and also the SWR (the match), with an antenna analyzer. The frequency will initially be low and the SWR high. The slot is longer than needed to allow for tuning and matching. To adjust the frequency, short circuit the non-feed end of the slot with a small length of aluminum duct tape. In like matter, short the feed end to adjust the SWR. Note the highlighted shorting tapes in Figure 2. Completely cover any unused slot with the shorting tapes. The tapes will vary in length and position as shown, depending on you situation. However, by proceeding in small increments, a good tune and match can always be achieved. Go slowly; the adjustments interact.

### Bandwidth and Efficiency

Figure 6 shows the bandwidth measured with an antenna analyzer, a Comet CAA-500 MKII (similar to an MFG-259B). As seen, the 3dB bandwidth is roughly 5.5 MHz – very satisfactory for a 2m antenna. If one compares this actual bandwidth to the theoretical bandwidth of 2.2

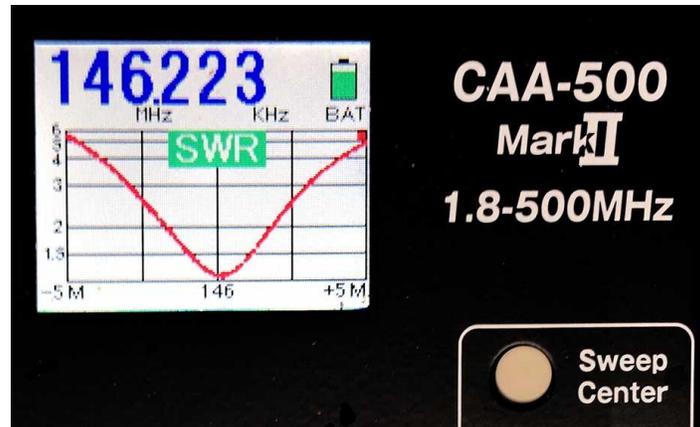


Figure 6: SWR and Bandwidth on a Comet CAA-500 MKII Antenna Analyzer

MHz as predicted by EZNEC, an estimate of radiation efficiency can be inferred. Antenna engineers generally accept that radiation efficiency is roughly the inverse of the bandwidth ratio, and that 30-50% efficiency is very acceptable for a practical bandwidth. In this case, a 2 to 1 actual to theoretical bandwidth ratio indicates a radiation efficiency of roughly 50%.

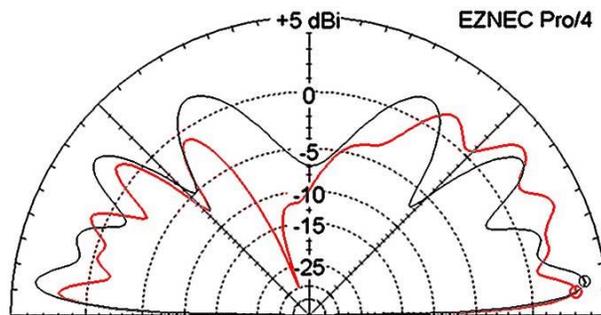


Figure 7: Comparative elevation radiation patterns and gains, Vent Antenna (black), J-pole (red)

## Final Considerations

To complete the disguise, paint the completed antenna with a plastic-base paint, such as Krylon Fusion. Alternately it may be covered with matt black self-adhesive vinyl from a local craft store or sign shop. As mentioned above, you may wish to cut the bottom of the pipe for your roof angle, or for a mounting clamp. Happy vent-pipe stealth.

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