Multi-Purpose 6 Meter Dipole Antenna

by Gordon Gibby KX4Z
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Introduction

Our Alachua County emergency communications group has been working toward better and better communications across our 969-square mile county, with less dependence on 2 meter FM repeaters. A couple of factors have arisen suggesting we more strongly consider 6 meter SSB. First, more and more of us have easy access to this band and mode because of commercially available transceivers such as the Yaesu FT-991A and the Icom 7300, which include 6 meter SSB. Secondly, local VHF weak-signal experts (including Mike Hasselbeck WB2FKO) pointed out to us the multi-dB advantage of 2.8kHz SSB over wideband FM for voice communications.

Recent actual simplex communications tests have confirmed that 6 meter SSB may be a great fit for providing county-wide communications that aren't so dependent on the state of the D-layer absorption, or of the F-layer ionization. And newer amateurs with the Technician license can easily participate in 6 meter communications. Finally, we support hams in all life situations and locations, some of whom live in limited apartment situations, and both indoor and outdoor antennas are easily possible with 6 meters.

All of those reasons prompted me to come up with inexpensive and versatile 6 meter antenna solutions. This is the first such solution, a "semi-inverted-V" 6 meter dipole.

Figure: 6 meter PVC-supported semi-inverted vee antenna, only slightly wider than a traditional living room couch.

When constructed with one side merely *slip-connected* with a securing screw, this antenna can be **easily broken down** for easy transport, as shown in the figure to the side. For indoors, it can be easily hung from attic rafters, or on a wall like a painting. For outdoors, multiple mounting techniques are possible. The total cost of the components should be below $15. This is a very low-cost, versatile antenna!

Construction

The "semi-inverted-V" was chosen to allow hanging the antenna from a single center support if necessary. This allows it to be easily hoisted up a line over a tree limb. It also decreases the horizontal footprint for those using the antenna inside. Because the included angle is 135°, the antenna loses little for horizontally polarized signals (the customary VHF weak signal polarization) but has some responsiveness to vertically polarized signals. It may have slightly less "notch" to end-on signals than a horizontal dipole, but elsewhere there will be compensating lower performances compared to a dipole (there is no "free lunch"; see: https://www.md0mdi.im/the-underrated-inverted-v-antenna/). To emphasize local simplex low-angle signals, you prefer to get this antenna well above 1/2 wavelength above ground, but

that isn't hard when 1/2 wavelength is only 9 feet! Using an attic, a 2nd floor wall or high on a first-floor exterior wall suffices. The coaxial cable can be RG8X or any suitable cable, brought down symmetrically for 6 feet or so to minimize unbalanced induced currents. If desired, a suitable common mode choke can be used, even as simple as several 6" turns of coax.

The combination of semi-inverted V construction, insulated wire, and further PVC pipe encircling results in the actual wire being approximately 7% shorter than expected from the usual $468/F_{MHz}$ equation for bare wire dipoles.

To avoid issues of RF radiation, at 100-watts of SSB, one should stay more than 3 feet from the antenna. (See: http://arrl.org/rf-exposure-calculator)

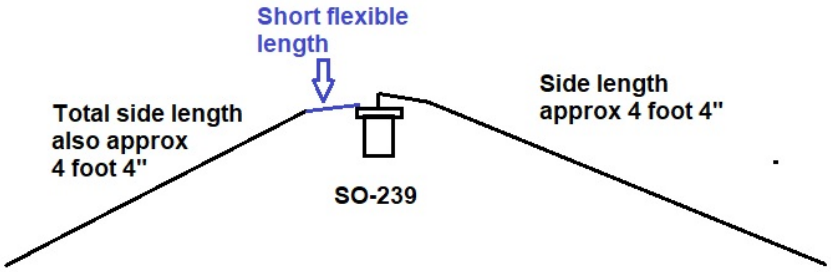

Figure: Drawing of dimensions

The parts list includes:

Item	Description	Possible Source
1	SO-239 coaxial connector	If you can solder the body connection quickly without overheating the insulation, the phenolic-insulated SO239's from this assortment can be used, which are inexpensive: https://www.amazon.com/Inovat-UHF-Female-Mount-Connector/dp/B06XB9CV3P The Teflon insulated versions withstand overheating much better: https://www.amazon.com/wlaniot-SO-239-Chassis-Connector-Bulkhead/dp/B089ZZZZDS
2	6" length of stranded wire to allow bending when disassembled, #16 suggested	
3	#14 solid house wire (THHN) to a total length on each side of approximately 4 ft 4 inches (adjust as needed for best SWR at desired frequency)	The size of the wire is not critical. The insulation causes a slightly shorter length to be resonant. The color of the wire is immaterial. One possible source: https://www.homedepot.com/pep/Cerrowire-25-ft-14-Gauge-Black-Stranded-Copper-THHN-Wire-112-3401A/202564770
4	1/2" schedule 40 PVC pipe Each side cut to 3 ft 10 inches	Cut from a 10-foot length, typically available for less than $5. Use hacksaw, wood saw, or circular saw to cut. https://www.homedepot.com/p/IPEX-1-2-in-x-10-ft-White-PVC-SCH-40-Potable-Pressure-Water-Pipe-30-05010HD/319692959
5	Center 45 degree elbow PVC fitting	https://www.homedepot.com/p/Charlotte-Pipe-1-2-in-PVC-Schedule-40-45-Degree-S-x-S-Elbow-Fitting-PVC023090600HD
7	1/2" PVC slip-cap end fitting x 2, with small hole drilled to allow wire to protrude	https://www.homedepot.com/p/NIBCO-1-2-in-CPVC-CTS-Slip-Cap-Fitting-C471712/100015035
8	Small length of paracord to provide	

	support loop; thread through drilled holes a few inches from center on both sides, through center elbow; tie with square knot	
9	PVC cement to secure (a) end caps to PVC pipe after wires are passed, and (b) ONE PVC pipe to center elbow (leave other side free to be removed, secured only with small screw)	
10	#6 x 1/2" sheet metal screws	Use 2-4 screws as desired to secure the SO-239 connector; use one screw to secure the removable side pipe of the inverted vee

Assembly

- Drill a pilot hole for the SO-239 in the side of the elbow connector, approximately 3/16". You cannot drill the required 5/8" hole using a normal drill bit because it will grab and fracture the PVC. I used two different types of abrasive drill bits as shown in the illustration below:

Figure: Tools to create 5/8" hole for SO-239

- Cut the PVC pipes to the 3 foot 10 inch lengths, deburring as necessary. At the ends that will be toward the center, drill suitable holes for a support loop, suggested 1/4" holes about 4" from each center end; bevel so that they won't cut through cordage.

- Solder one 4 foot 4 inch solid wire to the center conductor of the SO-239, insulate the connection with electrical tape.

- Carefully solder one end of 6 inch stranded wire to one of the mounting holes of the SO-239, avoiding over heating to damage the phenolic insulation. A 25-50watt iron can accomplish this job with low-temperature 60/40 traditional lead-based solder. If this will be difficult, connect with a stainless steel 6-32 machine screw/nut/lockwasher and use some dielectric grease against corrosion.

- Solder solid wire to the free end of the stranded wire, such that the total length of that side is also approximately 4 feet 4 inches.

- Pass the wires through the PVC pipes (solid wire does this easily) and out the end-caps.

- Pass the paracord loop rope through the drilled holes in the PVC pipes, internally across the 45° elbow and tie them on the outside with a square knot.

- Mount the SO-239 connector to the elbow using small pilot holes and #6 sheet metal screws as desired. You may optionally fill the gaps between the SO-239 and the rounded surface of the elbow connector with some form of glue of caulk if the assembly is to be maintained outdoors. This will limit rainwater ingress and access by flying insects.

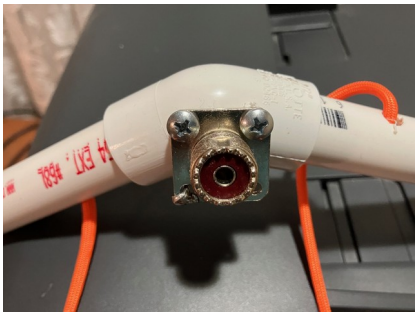

Figure: Mounting SO-239 connector

- If the antenna is planned to allow disassembly, glue the elbow to the PVC pipe that has the center (solid) wire, and after passing wires through drilled holes in the end-caps, glue the end caps. Drill pilot hole to allow the remaining PVC pipe to be pinned to the remaining side of the 45° elbow, small enough to allow good purchase by #6 sheet metal screw.

Figure: Detail showing screw to pin removable section.

- If the antenna is to be maintained outdoors, be certain the drilled holes in the end caps will allow entrained rainwater to exit, but not allow flying insects to enter.

- Tune as necessary with an antenna analyzer. You can expect a 2:1 SWR bandwidth of 3MHz or greater.