The "No-Excuses" 160M Antenna

This antenna is designed for stations having a difficult time putting a decent signal on 160M from small or CC&R'd lots.

It is a 27 ft. vertical antenna, made from three 10 ft. PVC sections bolted together, and $\frac{1}{2}$ wavelength of antenna wire helically wound around the PVC sections. A capacitance hat is on top, and the antenna is fed with a 50-ohm feedline.

Total cost for all parts is less than $90 and assembly is pretty simple. Construction time is about 6-7 hours.

**Parts List**

**Home Depot**
- one 10' length, 2" diameter schedule 40 PVC
- one 10' length, 1-1/2" diameter schedule 40 PVC
- one 10' length, 1" diameter schedule 40 PVC
- one 1" diameter PVC end cap
- one 2" diameter PVC end cap
- one 1/4" x 3 1/4" threaded bolt
- one 1/4" x 2 3/4" threaded bolt
- one 1/4" x 1 ft. threaded aluminum rod
- two 3 ft. length brass rods
- 4 1/4" diameter nuts (Home Depot)
- 4 1/4" diameter washers (Home Depot)
- one can Rust-Oleum Spray Paint (dark green)

**Radio Shack**
- 2 packets, multipurpose posts (RS 274-661)
- 1 packet, crimp-on spade tongues (RS 64-408)
- 1 packet, alligator clips (Radio Shack has them)
Misc
- one 500 ft. roll insulated stranded wire (you can use 14, 16, or 18 gauge)
- one roll of your favorite ground wire for radials (insulated or un-insulated)
- one roll duct tape (2" wide)
- one SO-239 chassis mount coax socket + mounting screws/nuts

Tools Needed
Soldering iron, solder, glue/glue gun, hacksaw, drill, 1/8" drill bit, 1/4" drill bit, felt marker pen

Construction

PVC Painting
Using a can of Rust-OLEum Paint For Plastic, the first step was to make the PVC pipe environmentally friendly by spray painting all 3 pieces green. This was easily done by suspending each 10 ft. section from 2 pieces of nylon rope between 2 branches of a convenient backyard tree.
**Bottom Section Antenna and Ground Connections**

Prepare the bottom of the 2" PVC section for ground and coax connections. First, place the 2" PVC cap on the bottom of the section to make sure it won’t interfere with the coax connector and internal wiring. Use a felt marker to mark the border between the bottom cap and the PVC section. Remove cap.

Drill holes for the SO-239 center section and attachment screws. I centered my connector 2-1/4" from the bottom edge of the section.

Drill 1/8" holes for the binding posts and ground-to-SO-239 hole. I made one antenna post hole and 2 ground post holes. (Note: In retrospect, 3 ground post holes would be better, placed 120 deg. apart). Antenna post is placed 2" from the bottom edge and ground posts 1-1/2" from the bottom edge to prevent shorting. I placed the antenna post about 45 degrees from the coax connector. 1 ground post was placed immediately beneath the coax connector and one other was placed on the side of the PVC opposite the coax connector. Stated another way, place the 3 binding posts equidistant from each other around the PVC section, antenna post 2" from the bottom, and ground posts 1-1/4" from the bottom. Write "A" next to the antenna post hole and "G" next to the ground post holes.
Coax Connector/Antenna Binding Post Preparation
Solder a 4" piece of #14 insulated wire to the center connector of an SO-239. Push the wire into the prepared SO-239 hole in the 2" PVC tube and attach the SO-239 to the PVC using 3 of the 4 mounting holes. Attach the other end of the insulated wire to the inner section of the antenna post using a spade tongue. Secure with the binding post nut, and solder.

Coax Connector/Ground Binding Post Preparation
Cut a 6" section of #14 insulated wire and solder (or crimp) spade lugs on both ends. Connect one end outside the PVC to the remaining SO-239 screw, and secure the final SO-239 screw. Connect the other end of #14 wire to the closest ground binding post on the outside of the PVC. Inside the PVC, attach another piece of #14 between the 2 ground binding posts-- essentially connecting both ground binding posts and the base of the coax connector together. Secure with nuts, and solder. Take care not to short the antenna and ground braids.

Glue each binding post to the PVC, inside and outside. Place a red binding post cap on the antenna post, and black binding post caps on the ground posts. You’ll be glad you did when it's 1:00 a.m. and you have to work on the antenna.
**PVC Mast Preparation**

Cut 2' 6" from the 10' length of 1" diameter PVC. Next, prepare the 1" and 1-1/2" 10' PVC for assembly using duct tape.

Step 1. Wrap duct tape around the bottom 2" of the 1" and 1-1/2" PVC pipes.

Step 2. With the 1-1/2" pipe, wrap another section of the PVC with duct tape between 22" and 24" from the bottom of the pipe.

Step 3. With the 1" PVC section, wrap a second section of the PVC with duct tape between 9-1/2" and 11-1/2" from the bottom.

**Note:** Use enough duct tape to ensure a good telescoping fit is created between PVC sections when assembled.

Telescope the PVC sections together. Stop when the top edge of the upper duct tape wrap of the 1-1/2" and 1" PVC lengths are level with the top edge of the lower PVC section. The 1 1/2" PVC section will extend 2' into the 2" bottom PVC section, and the 1" PVC section will extend 11-1/2" into the 1 1/2" PVC section.

With the lower joint (2" and 1-1/2" sections), drill a 1/4" hole through both sections 1' down from the top of the 2" section. With the upper joint (1-1/2" and 1" sections), drill a 1/4" hole through both sections 6" down from the top of the 1-1/2" section. With a 3-1/4" bolt, nut, and washer, fasten the 2" and 1-1/4" sections together. With a 2-3/4" bolt, nut, and washer, fasten the 1" and 1-1/2" sections together.
Drill a 1/8" hole 1" from the top of the 1" PVC section and attach a red-capped binding post to it, using a nut and glue to secure it. This will be the antenna-to-capacitance hat attachment point.

**Wire Winding**

Prepare a 1/2-wavelength length of wire for your desired center frequency. I chose 1.825 MHz. Using the formula $\frac{468}{1.825} = 256'\ 5''$ of wire. Using our kitchen table, which measured 5 ft long and a large coffee can with 2 large screws protruding from sides at the top and bottom 180 deg apart (to keep the wire from falling off the can as it was being wound), my XYL "unwound" the wire from the spool, while I wound it onto the coffee can. 50x across the kitchen table = 250' + an additional 6' 5" did it. Cut the wire, adding a few extra inches for experimentation, but keep the 256' 5" point marked: that length worked for me.
If you use insulated wire, remove the insulation for several feet from the attachment point; it'll make future adjustment easier. Attach the wire to an antenna binding post at the bottom of the 2" PVC section and start winding your 1/2-wavelength section of wire to the mast. Ideally, make the spacing as large as possible. I "eyeballed" my winding, and found a 1/2" pitch to work best. Use duct tape wraps every few feet on the PVC to secure the windings. As you near the end of each PVC section, take care to avoid the bolts with the wire. As you wind the 1-1/2" section you'll know if you need to increase or decrease the winding pitch. When you've reached the end of the wire, solder a spade tongue to it and attach the wire to the antenna binding post with the red cap at the top of the 1" PVC section.

Note: For a permanent installation you can skip this step. At both PVC joints, cut the antenna wire, strip insulation from the ends and solder an alligator clip to each end. Clip the wires back together. This will allow you to easily take apart and reassemble the antenna as needed.
**Capacitance Hat Construction**

Drill four 1/8" holes 90 degrees apart in the 1" PVC cap, 1" from the bottom of the cap. Drill another 1/8" hole beside one of these holes. Insert the brass rods into the cap, forming an "X." Take a 6" piece of #14 insulated wire, put it through the 1/8" hole not used by the brass rods, and wrap it around the junction of the two brass rods inside the PVC cap. Solder the rod-and-wire connection. Connect the ends of the brass rods together with bare solid wire, as well as another "square" of wire connecting the brass rods midway between the rod ends and the PVC cap. I used #14 gauge copper wire.

Attach the PVC cap to the top of the 1" PVC section. Secure the wire outside the PVC cap to the top antenna binding post using a spade lug. It's important to have a good electrical connection between the antenna wire and capacitance hat. **Note:** For a permanent installation there's no reason not to attach and solder the top of the antenna wire directly to the center of the capacitance hat.
**Bottom Cap Preparation**
With a hacksaw, cut a 1’ section of 1/4" threaded aluminum rod. Drill a 1/4" hole in the bottom of the 2" PVC cap and also through the center of a piece of scrap plywood (about 1 ft. square). Run the threaded rod through the 1/4" hole in the cap, and then through the plywood. Attach a pair of nuts and washers on the threaded rod inside the cap and on the other side of the plywood. When tightened, leave 2" of rod inside the cap, taking care that it won’t touch the base section antenna and ground wiring when attached to the mast. Leave 10" of threaded rod sticking out from the bottom of the plywood. The plywood base serves as a stabilizing platform to ease final installation of the vertical. By gently standing on it and pushing, you can easily drive the 10" of threaded rod into the ground.

![Bottom Cap Mounted on Plywood](image1)
![Bottom Cap Showing Threaded Rod](image2)

**Guying And Bracing**
In my case, I attach the mast to my back fence at the 6' point. I keep a section of nylon rope attached at 12', wrapped around a tree limb, and secure the rope tightly at ground level. Your guying/bracing will depend upon where you place the antenna.
**Erecting The Antenna**
After bolting the PVC sections together, attach the capacitance hat (don't forget the wire-to-antenna binding post connection). Place the bottom 2" PVC cap/plywood base in the ground where you want the antenna to stand. Raise the 27 ft. antenna, bracing the bottom against the ground. Carry the antenna to the plywood base and set it into the PVC cap. One person can carry/mount the antenna but two people makes it easier. Guy or brace according to your needs.

![Image: Antenna Against Fence To The Left of the Pine Tree]

**Radial Wires**
Of course, use as many ground radial wires as possible, ideally cut for 160m. One 160m 1/4-wavelength ground, together with 1/4-wavelength wires for other bands, is better than nothing at all, but the more, the merrier. I used #16 stranded insulated wire soldered to spade lugs, and then attached to the ground posts.
**Performance**
Attach your 50-Ohm coax. I used a borrowed MFJ 249B antenna analyzer to check for resonance. I hope you're as lucky as I was with resonance at 1.830 MHz, and a 50 KHz bandwidth, with <2:1 SWR. If the antenna isn’t resonant, adjust the antenna wire length from the bottom of the antenna.

Overall, this antenna works pretty well on 160M. It’s a solid performer from KH6/KL7 to the Mississippi and decent performance to the W/VE East Coast. For DX, the Pacific, Caribbean, and Central America are strongest. Europe is weakest.

**Update**
Changes made since building Version 1.0:
- Re-wound the antenna wire using 4-conductor #18 stranded wire
- Hot-glued the antenna wire to the PVC pipe for extra stability
- Improved the ground system with more radials

Version 2.0 of the Antenna -- Using 4 Conductor Wire
Summary

This is not "the" perfect antenna for 160M, but for a small lot, or where CC&R's are strictly enforced, this little vertical is a good alternative to an inverted-L or dipole. Making it "stealth green" helps too.

Good luck with your 160M efforts. Let me know if I can help.

73,
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Reference:

2. Personal communication with Jon Sims, (N7ON)