The "Plumber's Delight" Antenna

A new look for the J-pole!

by Eric R. Johnson KB6EPO

There have been many articles published over the years on J-pole antennas. Each design seems to be somewhat different from the next. I have always been interested in J-poles for their simplicity, their gain, and their ability to work independent of a ground plane. I have constructed nearly every design I have seen, with the exception of the few dual-band versions which have been published. I have always shied away from those because of the relative complexity of the homemade matching capacitors and other matching schemes described. I prefer things to be simple. Yet the dual-band idea was intriguing, and I thought that if two bands were possible, why not three?

I set out on a design (or more properly, tinkering) adventure to build a triband J-pole which met these requirements:

1. It must be built from cheap parts which are easily obtainable in virtually any town.
2. It must not require any special tools or test equipment to build.
3. It must be so simple in design that even the laziest of home-brewers (like me) will not hesitate to build one and get it on the air.

A Quest Fulfilled

It looks like an organ pipe cactus is growing on the roof of my shack, but I don't care because the performance-to-cost ratio is most gratifying. It exhibits a built-in triplexer effect, in that I can do any conceivable combination of simultaneous transmitting and receiving on my three rigs without having any rig interfere with the normal operation of another one. There is no transmitter power bleed-over from one feedline to any of the others.

For example, transmitting 30 watts on 440 MHz will not open the squelch on my 2 meter rig, nor interfere with the simultaneous reception of the local 2 meter repeater. While I have no real scientific means of measuring gain, I can tell you that from my QTH in Baja California, I am able to get into the repeaters on Mt. Palomar Q5 with only 100 mW of transmitter power on all three bands. These repeaters are about 90 miles from my QTH. Using a quarter-wave ground plane antenna and 1 watt transmitted power into the same group of repeaters, I received a Q3 signal report on 2 meters and was unable to access the 1.25 meter and 70cm machines.

Let's Build It

A trip to your local hardware store will provide everything you need for this project. The antenna is built from 1/2″ copper water pipe and fittings. You'll need about 8 feet of pipe, so a 10-foot length will do nicely. You'll also need three "T" fittings, three male-to-female 90 degree elbow fittings, and one reducing fitting.

The reducing fitting is the means by which I mounted my antenna. More on that topic later. Right now, let's play plumber! Figure 1 shows the overall view of the complete antenna. The top stub is for the 70cm band, the center one for the 1.25 meter band, and the bottom one for the 2 meter band. The 70cm section should be made first.

Cut the pipe so that when the pieces are assembled, as in Figure 2, the overall dimensions will be true. For the 70cm section only, it will be necessary to cut a small amount off of both the "T" and the male end of the elbow in order to obtain the small 0.375″ gap required.

Lay the assembly down on a flat surface and align the pieces, then dimple at the places marked "X" in Figure 2. I used a 16 penny nail and a large rock for this task. You may want to use a small ball peen hammer if you have one handy. Now use a propane torch to solder everything together. Be careful not to use too much solder or else you'll have the same problem I did the first time. The excess solder will get into the as-yet-unused end of the "T," and you'll have a devil of a time getting it cleaned out!

In the same manner cut, fit, dimple and solder the pipe for the 1.25 meter stub. This stub will be 180 degrees away from the 70cm stub. Now do the 2 meter section. This stub will be 180 degrees away from the 1.25 meter stub, and directly below the 70cm stub. Finally, take any pipe you have left and solder it into the unused end of the 2 meter "T." This is where you will attach the antenna to its mount.

Putting It in the Sky

I soldered a reducing fitting to the bottom of my antenna to provide a means of mounting it. The copper fitting has a 3/4″ female pipe thread on one end, and a 1/2″ female slip-fit on the other end. This fitting is depicted in Figure 1. Since 3/4″ galvanized thin-walled electrical conduit is cheaper than copper, I used a 10-foot section of that for a mounting pole.

A male-threaded fitting is available for the conduit, which allows it to screw into the bottom of my copper antenna. The conduit is clamped to the side of my shack near the roof peak. The whole conduit/copper antenna assembly stands by itself unguyed, and is quite sturdy. You may think of a different way to mount the antenna at your location, and so may not need the reducing fitting. Automotive hose clamps, to hold the antenna to the top of an existing mast, is one possibility that comes to mind.

There is no need for a ground plane or even a grounding wire. The antenna will work the same with or without them. From a safety standpoint, however, it is a good idea to ground the antenna.

To ensure a wobble-free 2 meter stub, I used a scrap of 1/4″ thick Plexiglas™ roughly 2″ square, close to the top of the stub, as a brace. I drilled holes through the Plexiglas and pipe, and used two 6-32 screws on the stub and two more on the central mast to hold the brace in place. This probably wasn't necessary, but I had the material lying around, so what the heck! The other two stubs are most definitely sturdy enough on their own.

Connecting The Feedlines

The antenna has three feedlines, one for each band. The feedlines should be a small diameter 50 ohm coaxial cable, such as RG-58, RG-223, or mini RG-8. I used RG-223, which is a double-shielded cable. Connect the feedlines to their respective elements as shown in Figure 2. Note that all shields connect to the mast, and all center conductors connect to the stubs. The distance above the bottom of the "J" to connect the coax is given by dimension "F" in the table.

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	2m	1.25m	70cm
R (in) = 8370/F (MHz)	57.375	37.375	18.875
S (in) = 2787/F (MHz)	19.125	12.500	6.250
G (in) = 165/F (MHz)	1.250	.750	.375
F (in) = 345/F (MHz)	2.500	1.500	.750

R = radiator; S = stub; G = gap; F = feedpoint.

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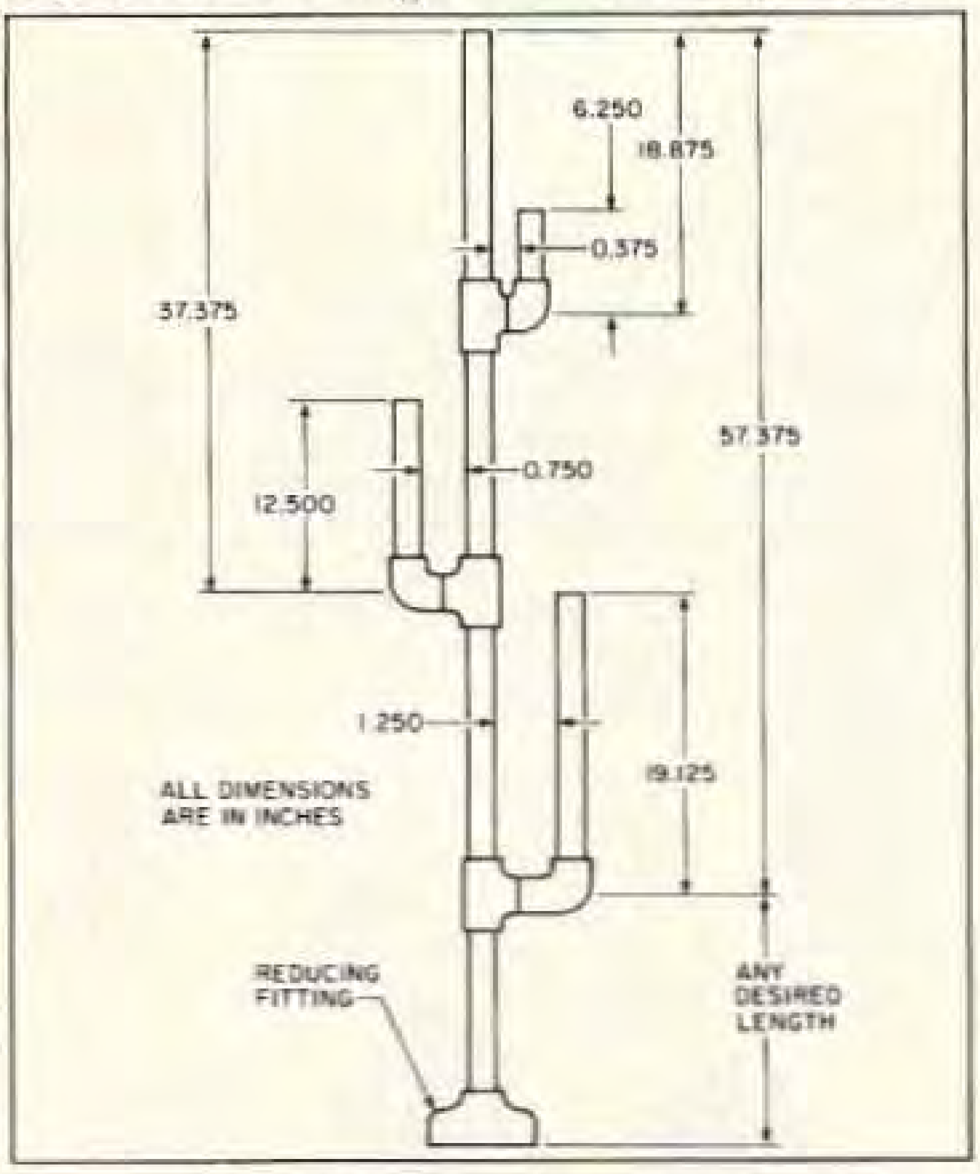

Figure 1. Tri-band J-pole antenna construction.

My finished antenna conformed very closely to the dimensions shown in Figure 1, and when I connected the feedlines I had 1.5:1 SWR or better on all three bands. The center frequencies chosen for this antenna are 146, 223, and 445 MHz. I had the antenna leaning up against a wood wall, and used a 12-foot scrap of coax to fine-tune the feedpoint. The stripped and tinned end of the cable was attached to each antenna section temporarily with Scotch tape.

I then transmitted into the antenna via a VHF/UHF SWR meter and moved the temporary connections up and down a little at a time until a 1.1:1 SWR was found. These points were marked on the pipe, and then small pilot holes were drilled. Small crimp-on eyelet terminals were first crimped, then soldered, onto the permanent feedlines.

Then I used self-tapping screws and lockwashers to attach the coax to the antenna. I cleaned everything up with a small brush and alcohol, to remove flux and dirt. Then non-corrosive RTV sealant was used to protect the connections against the weather. Non-corrosive RTV is that type which does not contain acetic acid. You can test for this by smelling of it; the proper type will NOT smell like vinegar. Route the feedlines from the two upper antennas down one side of the mast, 90 degrees from the plane of the stubs, in such a manner that the cables do not enter the space of the gaps below. You can use nylon zip ties to hold the cables in place.

I found that there was no change in SWR after I got the antenna away from the wood wall and up in the air with its permanent feedlines connected. SWR was 1.5:1 or better over the entire 2 meter and 1.25 meter bands, and over the entire 440 to 450 MHz section of the 70cm band.

No need to worry if you do not have access to a suitable SWR meter. Just connect your coax to the points indicated, and you'll have some very livable SWR values. On the other hand, if your finished antenna is not, physically, exactly the same as the measurements in Figure 1, you can use an SWR meter to adjust the feedpoints and still obtain close to 1.1:1 SWR. I found this out while helping my elmer (who is not a very good plumber) get his duplication of my model working. Formulas are provided in the table for those of you who would like to try this idea out on different center frequencies or bands.

Taking It Further

I built a version of this antenna for the 6, 2, and 1.25 meter bands out of 1.5" heavy duty steel TV antenna mast. It required two 10-foot sections of mast. The stubs were made from 3/4" galvanized pipe, and 1/5" angle iron was used to stand the stubs off from the mast. I used a MIG welder to put the thing together. Nylon guys were used.

This worked very well. Then I bought one of those Create Designs log periodic antennas that covers 50 to 1300 MHz, and started to look for a place to put it. The only place I could figure was on top of that 6 meter J-pole. So I stuck it up there along with a cheap Radio Shack TV antenna rotor.

I mounted the rotor to the top of the J-pole and used only a 1-foot section of mast above the rotor to mount the log periodic. This really messed up my SWR for those three J-poles! But by moving the feedpoints up or down a little and testing the SWR, I was able to get all three of them back to 1.1:1 SWR again.

Now I had omnidirectional vertical gain antennas for three bands plus a horizontal directional gain antenna for six bands all on one mast! Hmmmm... maybe I'll get ambitious enough one day to take the beast back down and weld on a stub for 70cm. I wonder if that would work, too?

Yes, I'm J-pole loco, and you might catch the disease too if you start playing with them. This is the perfect thing for the new rank of Technicians just starting out, to get on the air with three bands and very little cash outlay. 73

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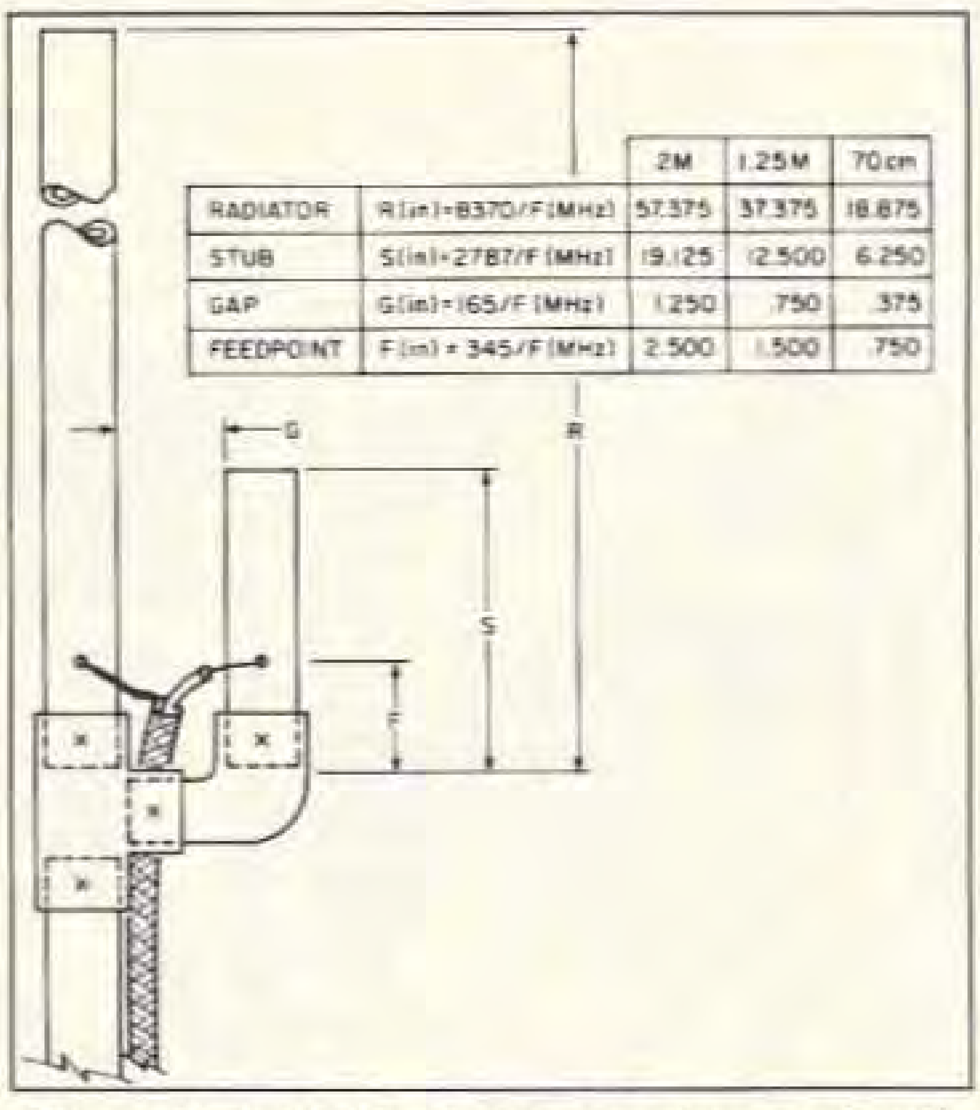

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Figure 2. Individual antenna element detail.