

A 146- and 445-MHz J-Pole Antenna

Getting on 146 and 445-MHz with a single J-pole antenna can be done inexpensively. I did it by building the dual-band J pole shown in Figure 1. The total materials cost about \$21, and only commonly available hand tools are required for assembly. Interested?

Some Background

A vertical J-pole or dipole designed for use at 146 MHz will resonate at 440 MHz because it's about $\frac{3}{2}\lambda$ long at that frequency. However, according to *EZNEC*,¹ most of the 445-MHz radiation is at an elevation angle of about 45° instead of a lower angle desired for repeater and ground-wave communication. Also, the antenna's input impedance at 445 MHz is about two and a half times that of the 146-MHz value. For dual-band operation, both of these hurdles can be overcome by simply placing two 445-MHz elements close to the feedpoint of the 146-MHz $\frac{1}{2}\lambda$ element. The vertical radiation pattern of the resulting antenna at 445 MHz is shown in Figure 2. The 445-MHz elements have little effect on 2-meter operation. Once the antenna is adjusted for 2-meter operation, the 445-MHz antenna input impedance can be adjusted to equal the 2-meter impedance by adjusting the spacing of the 445-MHz elements from the main element. Increasing the spacing between the elements increases the impedance at 445 MHz and vice versa. The length of the 445-MHz elements primarily affects the resonant frequency and to some extent, also affects the input impedance. The length of each 445-MHz element is less than $\frac{1}{2}\lambda$ at 445 MHz. At a true $\frac{1}{2}\lambda$, the impedance and resonant frequency appear to be insensitive to spacing and length adjustments.

At 146 MHz, this antenna's input impedance is about 65 Ω , delivering an SWR of about 1.3:1 at resonance. Placing a $\frac{1}{4}\lambda$ Q section in the feed line at the feedpoint

Pipe your signals to 146 and 445 MHz with one antenna!

Table 1

Materials Required

- 10 feet of copper water pipe (type L or M; see text)
- 5 inches of $\frac{1}{2}$ inch PVC pipe
- 1— $\frac{1}{2}$ inch copper T
- 1— $\frac{1}{2}$ inch copper L
- 2— $\frac{1}{2}$ inch copper pipe caps
- 15 inches of $\frac{3}{8}$ -inch OD copper tubing (0.331-inch ID)
- 2—Pieces of $1\frac{1}{4}$ in \times $6\frac{1}{8}$ in \times $\frac{1}{4}$ -inch-thick Plexiglas
- 5 ft of RadioShack RG-8 coax (RS 278-1312)
- 1—Teflon-silver PL-259 connector.

can lower the SWR between 144 and 148 MHz. The Q-section impedance is about 59 Ω . Because the Q-section length is about $\frac{3}{4}\lambda$ at 445 MHz, it also works at this frequency.

How It Works

The antenna's main vertical element (see Figure 1 and the title page photo) is about $\frac{1}{2}\lambda$ long at 146 MHz and employs a $\frac{1}{4}\lambda$ stub at the bottom to decouple the main element from the mast and feed line. The antenna is similar to a standard J-pole antenna^{2,3} except that it's fed at the center of the main element instead of tapping the feed line partway up the stub. The coaxial-cable feed line passes through the main element. Two elements, almost $\frac{1}{2}\lambda$ long at 445 MHz, are placed near the antenna's feedpoint and parallel to the main element. These elements are parasitic and don't need a separate feed line; they are excited by the main vertical element. The antenna is quite efficient because no lossy matching networks or coils are used. The gain on both

bands is about the same as a vertical dipole or single-band J pole.

As described later, the Q-section is made by replacing $13\frac{5}{8}$ inches of the coaxial-cable feed line shield braid with $13\frac{5}{8}$ inches of $\frac{3}{8}$ -inch copper tubing.

Construction

The antenna elements are made of $\frac{1}{2}$ -inch copper water pipe and soldered fittings. The center insulator (see Figure 3) is made from $\frac{1}{2}$ -inch PVC pipe and the standoff insulators (see Figure 4) for the 445-MHz elements are made of $\frac{1}{4}$ -inch-thick Plexiglas. You can purchase the $\frac{1}{2}$ -inch copper pipe, copper fittings and $\frac{1}{2}$ -inch PVC pipe from a building supply outlet. (If you're going to build two antennas, you can purchase the copper pipe much cheaper in 20-foot lengths at a plumbing supply.) The Teflon-silver PL-259 connector and RG-8 coax are available from RadioShack. (You can find good buys on such connectors at hamfests.) Short lengths of $\frac{3}{8}$ -inch-diameter tubing can be pur-



¹Notes appear on page 53.

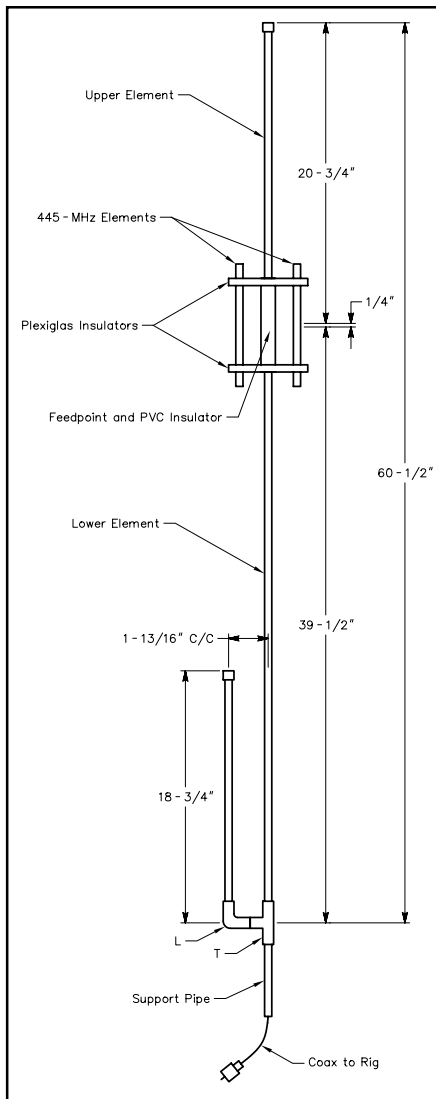


Figure 1—General dimensions of the two-band J-pole antenna. The copper-plumbing L and T at the bottom of the antenna fix the spacing between the stub and lower portion of the main element.

chased at a hardware store. Small pieces of 1/4-inch-thick Plexiglas can usually be found as scrap at a glass shop. Broken golf-cart windshields are another source of Plexiglas.

In any 445-MHz antenna construction project, it's important to adhere to the given dimensions. A dimension deviation of even 1/16 inch is considerable at 445 MHz, especially at the feedpoint. It's practically impossible to construct a feedpoint connection at 445 MHz without introducing some transformation of the antenna impedance. Therefore, you should closely follow the dimensions and feedpoint detail described. I built a second antenna using the plans provided here and it performs exactly like the prototype. If you intend to mount the antenna on a mast, use type L copper pipe for the elements. Use type M pipe (it's lighter

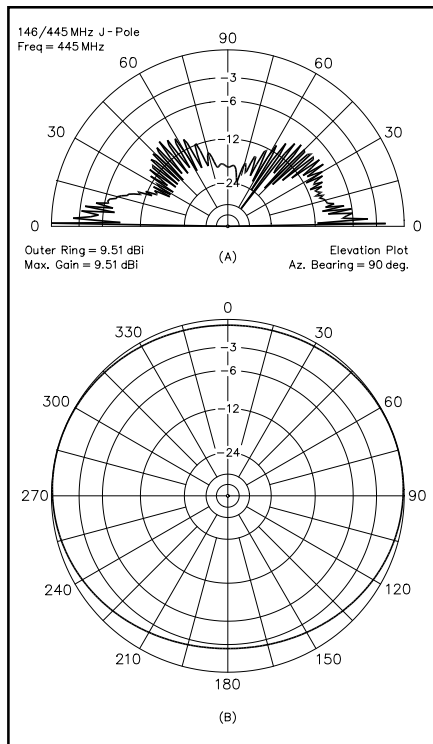


Figure 2—EZNEC plot of the antenna's vertical (A) and azimuthal (B) radiation patterns at 445 MHz.

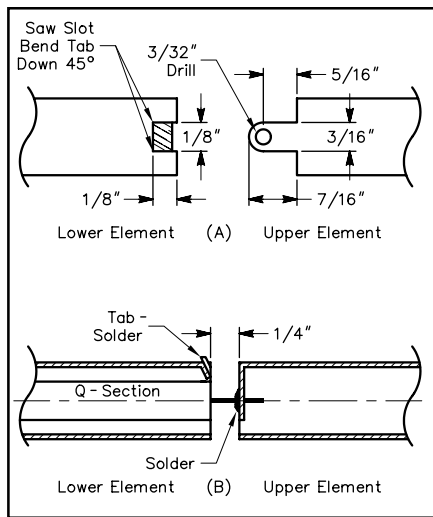


Figure 3—Feedpoint detail. The tab on the upper portion of the main element accepts the center conductor of the coax of the Q section. See Figure 9.

than type L) if you intend to suspend the antenna from a support.

Before soldering, polish all mating pipe pieces with #0000 steel wool. I recommend using a propane torch for soldering the joints. The trick in soldering copper pipe and fittings is to get the copper hot enough to melt the solder *before* applying solder. The solder then flows into the joint without leaving drips that require cleanup.

First, cut two pieces of copper pipe to

make the stub and the 39 1/2 inch lower element. Cut these pieces to their final lengths after soldering each piece to the respective L and T at what will be the bottom ends of the stub and lower element. Measure the length of these pieces from the center of the T and L connection. Cut the stub pipe to a length of 18 11/16 inches allowing about 1/16 inch for placement of a cap at the top of the stub. Use a 1-inch length of pipe to join the T and L. The T and L butt together to fix the 1 13/16 inch center-to-center spacing between the stub and the lower element. The mounting/support section below the lower element can be any length, but should be at least 12 inches to allow clamping to a mast.

Make two hacksaw slots in the top of the lower element as shown at the left in Figure 3A. Bend the tab between the slots about 45° toward the center of the pipe.

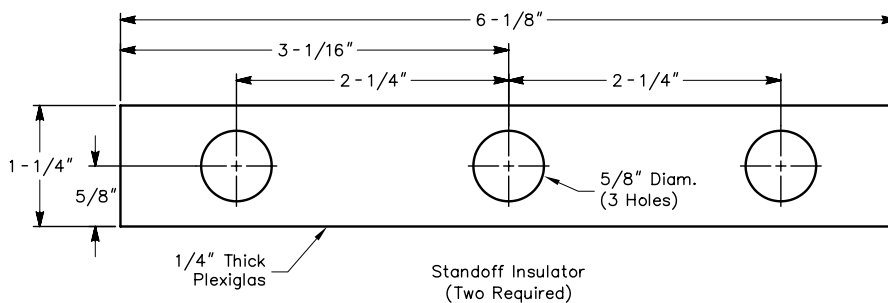
Before cutting the upper element to length, some work must be done. At what will be the bottom of the upper element, cut a tab as shown at the right in Figure 3A. Drill a 3/32-inch diameter hole through the end of the tab. (It is at this tab where the center conductor of the feed-line coax will later be attached.) Dress the tab with a file and tin the tab using a propane torch or high-power soldering iron. Bend the tab 90° toward the pipe center as in Figure 3B. Once the tab is bent, cut the upper element to a length of 20 3/4 inches allowing about 1/16 inch for placement of a cap on the upper-element top.

You can fabricate the standoff insulators shown in Figure 4 from 1/4-inch-thick Plexiglas or 1/2-inch PVC pipe. Plexiglas is easier to use because the 5/8-inch-diameter holes can be made using a hand-held drill and a common wood spade bit. Drill at a low speed to prevent melting the Plexiglas. If you use PVC pipe for the standoffs, use a drill press to keep the holes properly aligned. Cut the two 445-MHz elements to a length of 11 1/16 inches (see Figure 5). Make the center insulator from a 5-inch length of 1/2-inch PVC pipe (see Figure 6). Cut a longitudinal slit the entire length of the pipe; I used a hacksaw to do this.

The coaxial-cable feed line extending from the antenna's feedpoint to just below the support section can be any convenient length, but use RadioShack RG-8 (RS 278-1312)⁴ to get the proper velocity factor and impedance for the Q section. The Q-section details are shown in Figure 7. The Q-section consists of a 13 5/8-inch length of 3/8-inch copper tubing (Figure 7A) slid over the center insulation of the top end of the feed line (Figure 7B).

On the Q section, fashion a tab on the end of the tubing similar to that at the bottom of the upper element (see Figure 7A). Following Figure 7B, cut the end of the feed

Figure 4—Two standoff insulators made of 1/4-inch-thick Plexiglas sheet or 1/2-inch PVC pipe are required to hold the 445-MHz elements adjacent to the main element.



line with a sharp knife to expose $\frac{7}{16}$ inch of the center conductor. (Figure 8 shows the finished feedpoint end of the Q section.) Remove $13\frac{1}{4}$ inches of the coaxial-cable feed line's outer cover and the shield to expose the dielectric. Then remove an additional $\frac{5}{8}$ inch of the coaxial cable's outer

covering exposing the shield braid. Clean and tin the tab and the opposite end of the Q-section tubing. Slide the tubing over the coax and under the shield so that the end of the tubing with the tab is even with the end of the center dielectric (Figure 7B). Using a high-power soldering iron or low torch

flame, solder the shield to the tubing, allowing the solder flow through the braid. Dress the joint so that it passes through the lower element.

Assembly

Clamp the lower element and stub assembly horizontally in a vise about 14 inches from the top of the lower element. Slide the Q section and feed line into and through the support section until the Q section is exactly even with the top of the lower element. While keeping the Q section in the center of the lower element (Figure 3B), bend the tab on the Q section over the tab on the lower element. Solder the tabs together. Snip off the excess tab length of the Q-section and file the joint flush with the surface of the lower element.

Slide one standoff onto the lower element until it is about 10 inches from the feedpoint. Open the slit in the center insulator and hold open the slit by inserting two pennies (or something similar) side by side at four points within the slit. Slide the center insulator over the lower element until it touches the standoff. Bring the upper element into place passing the center conductor of the coax into the hole in the tab according to Figure 3B. To hold the feedpoint in place, clamp the lower and upper elements to a strip of wood using hose clamps. Solder the coax center conductor to the upper-element tab by heating the upper element near the base of the tab and letting the heat flow down the tab.

Remove the hose clamps and wood strip around the feedpoint. Slide the center insulator up until it is centered over the feedpoint and remove the pennies. The center insulator will clamp tightly around the feedpoint. As shown in Figure 5, assemble

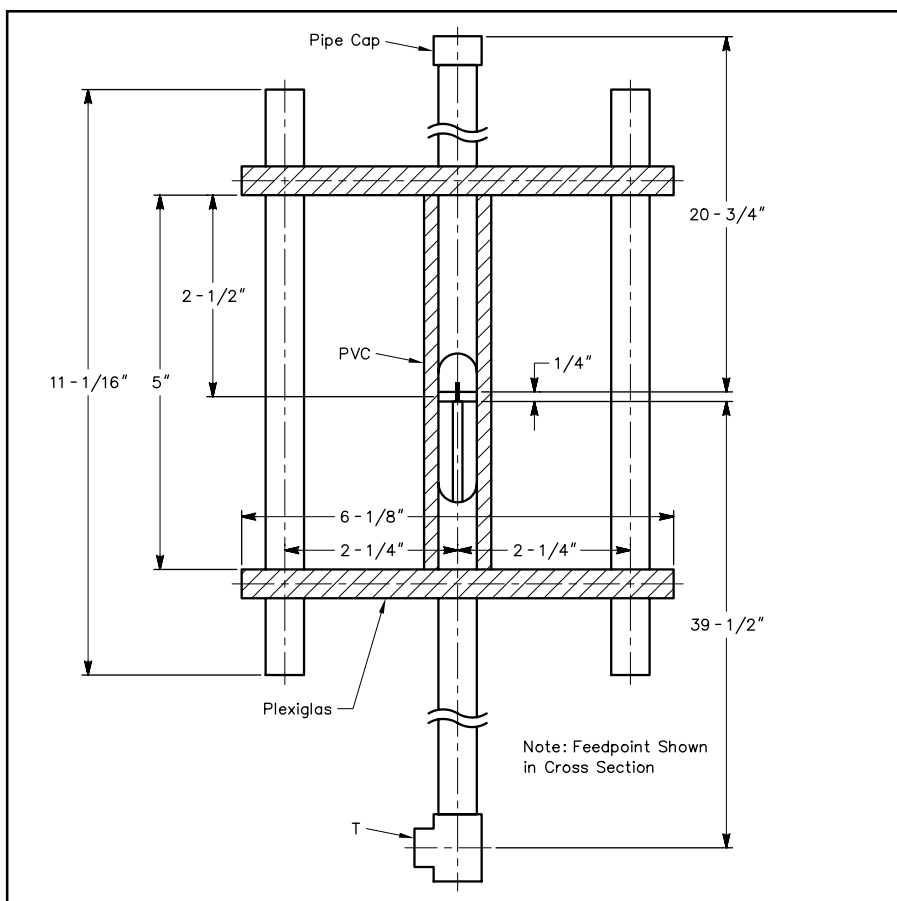
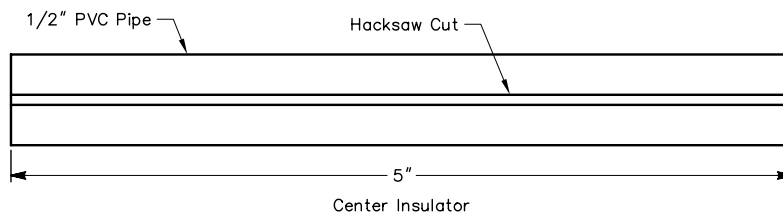


Figure 5—A cross-sectional view of the two-band J-pole's feedpoint.

Figure 6—Center insulator dimensions.



NEW PRODUCTS

KENWOOD TS-940 IF-10B/IF-232C UNIT FROM PIEXX

◊ If you own a Kenwood TS-940 transceiver and have wanted to run it under computer control, you have probably encountered the frustration of trying to locate the internal computer interface board—the IF-10B—that was once available as an optional accessory.

PIEXX has designed a product that not only takes the place of the discontinued Kenwood IF-10B, but also incorporates the functionality of Kenwood's IF-232C level converter, making it a complete system for interfacing the TS-940 to your computer.


The price of the IFB/C system is \$89 plus \$6 shipping (US). For additional information contact PIEXX Inc, 13 Main St, Hillsboro, NH 03244; tel 603-464-5625; fax 603-464-5411 piexx@conknet.com; <http://www.piexx.com>.

GOLIST QSL MANAGER SEARCH PROGRAM

◊ The Golist has introduced a new Windows program—GoSearch—designed to search the Golist Online Database for the QSL routes of DX stations.


GoSearch appears as a small window on your screen when active and rests on your task bar when idle. Enter a DX call sign into the search box and the program will automatically launch your Internet browser, search the Golist Online Database and display the results. The software will work with Windows 3.1, 95/98 or NT.

A demo version of GoSearch—that allows a limited number of lookups on the online database—is available free of charge. Registered versions include a one-year subscription to the online database with an unlimited number of lookups. GoSearch can be downloaded from the Golist Web site or provided via e-mail.

Price: \$24. For more information contact The Golist, PO Box 3071, Paris, TN 38242; tel/fax 901-641-0109; golist@golist.net; <http://www.golist.net>. 

FEEDBACK

◊ In the September 2000 QST, page 64, the Web address of Electronic Design Specialists is shown incorrectly. It should be <http://www.eds-inc.com>.

◊ Please refer to the article by Rick Littlefield, K1BQT, "A Wide-Range RF-Survey Meter," QST, Aug 2000, p 43. In the sidebar, second column, first paragraph, last line, the RadioShack part number for the ferrite core should be RS 273-105.—*tnx Carl Soltesz, W8PFT* 

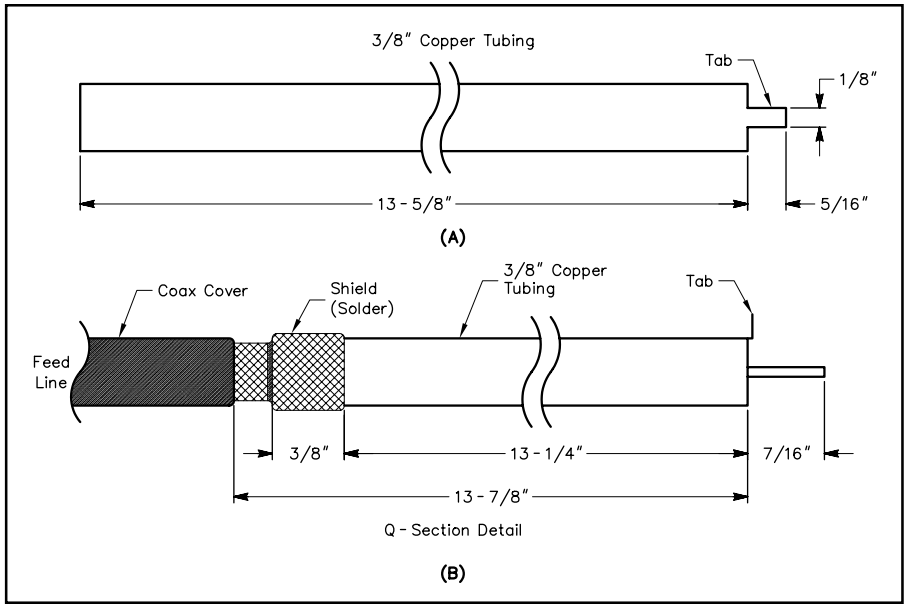


Figure 7—Q-section detail. A length of copper tubing is slid over the coaxial cable's dielectric and soldered to the shield braid at one end; see text.



Figure 8—Feedpoint end of the Q section prior to final assembly.



Figure 9—This cutaway view shows the tabs of the Q section and lower element soldered together.

the 445-MHz elements and upper standoff. Use silicone cement or caulking to hold the 445-MHz elements in place. Seal the top, bottom and slit of the center insulator with silicone cement or caulking. Install the cap on the top of the upper element.

If you intend to suspend the antenna by its top in a tree, install a top insulator made from PVC pipe and provide a support for the feed line at the bottom of the support section.

Evaluation

I found that the SWR and frequency range of the antenna are about the same when the antenna is mounted on a 20-foot mast as when it's suspended by its top at 40 feet. With 50 feet of CQ-4XL cable⁵ ("poor man's Hardline"), the SWR measured 1.3:1 or less from 144 MHz to 148 MHz and 1.5:1 or less from 438 MHz to 450 MHz. Because I don't have a tower, I suspended the antenna in a tall pine tree. With the top at about 40 feet, I got the expected signal reports on 2 meters from repeaters within a 40-mile radius. The only repeater available to me in the 440-MHz band is about 30 miles away and at an eleva-

tion of only 100 feet, with its antenna on the side of the tower opposite my location. Six of seven bars on my LCD S meter lit up and I received good reports from stations that I worked. I've concluded that the radiation patterns and gain predicted by EZNEC are close to those realized on the air.

Notes

¹EZNEC antenna software is available from Roy Lewallen, W7EL, PO Box 6658, Beaverton, OR 97007; tel 503-646-2885; fax 503-671-9046; w7el@teleport.com. Price: \$89 postpaid; add \$3 outside the US and Canada. Visa and MasterCard charge cards accepted.

²John Post, KE7AX, "The Copper Cactus J-Pole," *73 Amateur Radio Today*, Feb 1992, pp 9, 10 and 27.

³The ARRL Handbook, 1998 Ed, pp 20.56-20.57.

⁴RadioShack RG-8 cable has the following characteristics: a solid dielectric of 0.280-inch OD, a 13-gauge center conductor (7x21) and a velocity factor of 0.66.

⁵The Wireman, 261 Pittman Rd, Landrum, SC 29356-9544; tel 800-727-9473 (orders only), technical assistance 864-895-4195; fax 803-895-5811; e-mail cqwire@juno.com, n8ug@juno.com; <http://thewireman.com>.

You can contact Andrew at 203 Lord Granville Dr, Rt 2, Morehead City NC 28557; w4uld@mail.clis.com.

Photos by the author

