The Dual-Band "J" Antenna

A superior performance mobile or base station antenna for 146 and 220 MHz.

by Robert E. Bloom W6YUY

We have several excellent dual-band transceivers. We need good dual-band antennas to complement them. The dual-band "J" described here is a natural for mobile operation, or for base station communications as well.

I designed this antenna to conserve space on the roof of the Los Angeles ARES communication command center mobile van, which is presently being developed with the cooperation of both the Los Angeles City Fire and Police Departments.

Background on the "J" Antenna

Why the "J" antenna? Because it is one of the most suitable for nondirectional communications. To this we can add: superior low angle of radiation, increased gain over a dipole or ground plane, larger signal capture area, and possibly the only design with an inherent full current circulating system. The dual "J" antenna design covers the two most widely used mobile frequencies: the 144 and 220 MHz (2 meter and 1⅓ meter) bands.

The basic "J" antenna, a design which dates back to the mid-1930s, retains characteristics that some present-day antennas are still reaching for: a takeoff of the Zep or Zeppelin of that same period. Its quarter-wave matching section provides the intrinsic feedline current return circuit. The return circuit can be compared to the radials of the ground plane and even more closely to the ladder feed of the Zep. Only the Zep feedline design left the drawing board prematurely.

The ground plane antenna is often installed as though the ground radials are not really important. The length and the number of ground radials not only make up the return circuit but also determine the 37-ohm feedline impedance of the device. Fortunately, many metal automobile rooftops are large enough to accommodate the higher frequencies' units. My thoughts on gutter-mount types of commercial antennas can be expressed as: "Shame on the manufacturer of the device." And, pray tell, where is the current return circuit of the quarter-wave dipole design?

The "J" antenna has an inherent low angle of radiation, unrestricted by the influence of the return circuit of ground or the ground radials. This low angle of radiation produces an extended ground-wave range. In addition, with proper atmospheric conditions, it will allow extended long-range DX communications by allowing the signal to arrive at the ionization layer at an angle that will reflect the signal back to Earth rather than being captured and absorbed by the layer. The ¾ wavelength of the "J" provides a signal capture area three times that of the ground plane and increases its gain by about 1.2 dB. That's almost 3 dB over the so-called reference dipole.

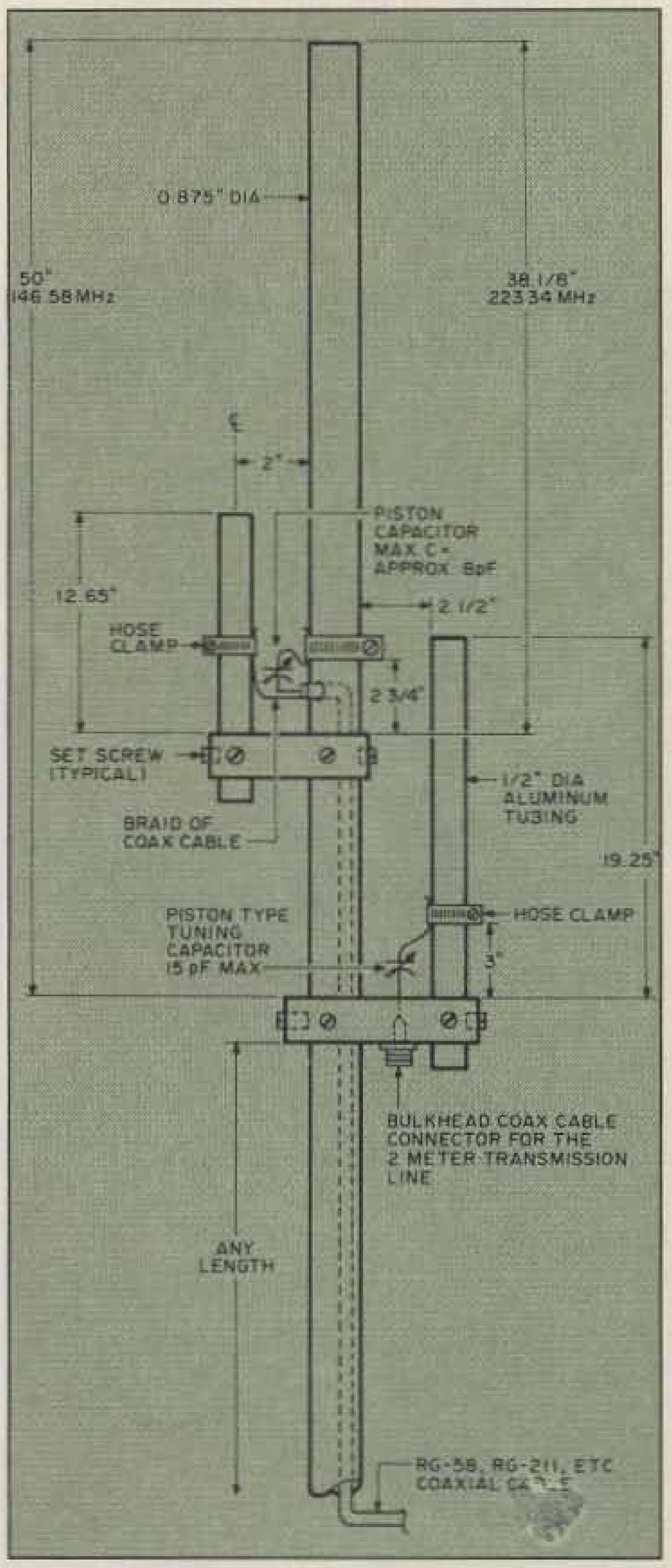


Figure 1. The dual-band "J" antenna.

The Specs

See Figure 1. The radiating sections of the antenna are ¾ wavelength long. The large diameter tubing causes a significant (K) constant factor as related to the wavelength-to-diameter ratio, thus reducing the dimensions a bit. The most significant length reduction is caused by the loading effect of the top antenna acting upon the lower frequency unit. The additions of both C & L are determined by the material's bulk dimensions. The basic formulas remain the same but variations in material sizes make determining "K" somewhat involved. I will work around this in the tuning procedure.

The coaxial feedline for the 220 MHz antenna section is fed up through the inside of a ⅞" diameter main tubing section. An approximately ⅜" diameter hole is drilled into the tubing where the coax exits to connect to the feed point of its matching section.

The lower frequency 2 meter cable is run externally. Any tubing extending below the 2 meter section is not a part of the radiating section but becomes the mast post. This can be of any convenient length consistent with your height and mounting requirements.

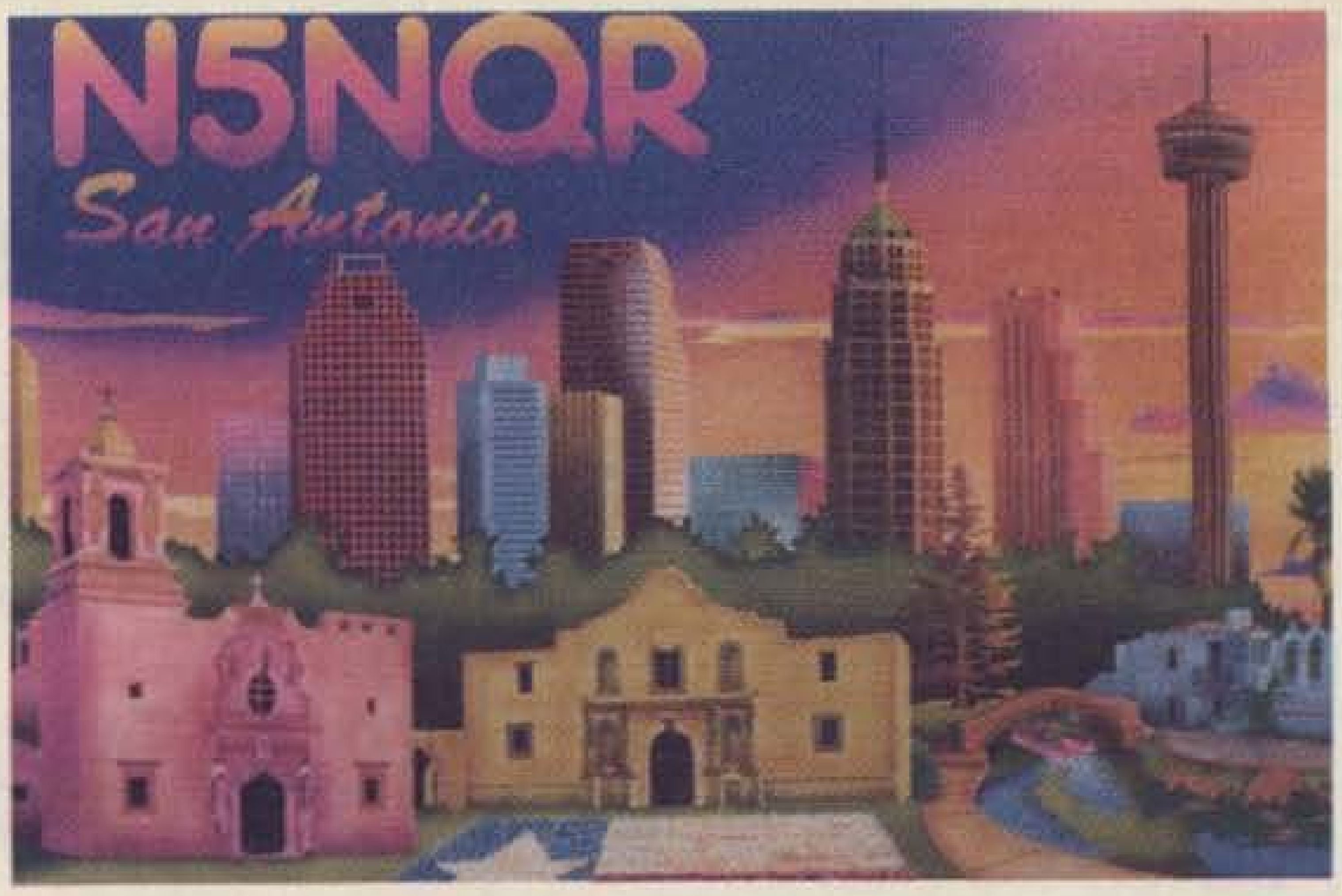
The quarter-wave matching sections are of ½" aluminum tubing. These lengths can be determined by a conventional formula, with the applied shortening "K" constant of wavelength to diameter ratio. This article will furnish all dimensions for the basic output frequencies of 146.58 MHz and 223.34 MHz, which are the dominant frequencies used in our ARES communication van. For any selection of frequencies which differ from these, apply the simple formula:

$$\text{New length dimensions} = \frac{\text{Original dimensions} \times \text{Original frequency}}{\text{New frequency}}$$

The change in length will be quite small.

The bar stock used to support the quarter-wave sections is approximately 1½" wide x ¾" thick. This can be almost anything you choose, consistent with rigidity. The holes in the flat portion for mounting the elements and bulkhead coax connector were drilled using ⅞" and ½" end mills or spot face tools. I used 6/32" screws as set screws to hold the elements in place and allow for adjustment. I recommend either two or three screws, whatever is convenient for each slide element. The 8 pF and 15 pF capacity values for the 220 MHz and 146 MHz frequencies respectively are maximum values and will require adjusting for minimum standing wave ratio.

Although a unity SWR can be achieved, it is not an absolute. For mobile operation the transmission line length will have a very low attenuation and virtually all the signal will be radiated. *Continued on p. 84*



QSL OF THE MONTH

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much fun you're having. Show 'em how easy it is once you get started.

Heck, when I got started with NBFM I had to build my own gear. I still have a couple of my old RTTY panels around. They're monsters compared to today's stuff. 19" x 24" panels packed with tubes. I even had to make my own tuned chokes for the filters.

Other than kits, yes it's very difficult to build ham gear these days. It's the parts. Now that virtually no parts are made in America and most of the parts houses have blown away, unless you go to a hamfest flea market you aren't going to find parts. So buy kits. Let entrepreneurs find the parts and bundle them for you.

By the way, I'll be at Dayton again this year, and I'll be out for the Minneapolis convention. I want to hear some adventure stories from you—of business, hamming, getting newcomers. I also want to hear that you've stopped smoking, given up beer and have slimmed down. With so few new hams to subscribe to *73*, I need all you old timers to live long, healthy lives. Now, where'd I put those darned ski boots?

Y'all write . . . y'hear? 73

Dual-Band

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Tuning Procedure

For tuning you'll need a low level signal source of approximately five watts, such as a Bird wattmeter with an appropriate full-scale plug-in element or other SWR indicating instrument. Set up the antenna to the dimensions given. If your material is of the same diameter, the only adjustments would be for the capacity settings.

First, mount the antenna in place because there will be capacities from the vehicle itself. If you don't mount it, then clamp it to a wooden ladder located at least 10 feet from any surrounding structures. Start with the higher frequency element (the upper unit). With the SWR bridge in place, feed the appropriate signal. Note the incident or forward power level. Reverse the wattmeter element or switch position for a reflected power indication; adjust the capacitor for a minimum reflected energy indication.

Move yourself out of the RF field and note the reading. Touch up for minimum reflected indication. If not near unity, move the support bar in either direction to reduce the readings. Move the quarter-wavelength section in either direction to further reduce the indication. Conclude the adjustment by tuning the capacitor. Repeat the above procedure on the lower frequency unit. If you tune the lower frequency first it won't be necessary to repeat the procedure on the higher frequency.

I used glass piston capacitors to tune out any inductive reactance. After the unit had been tuned, I sealed the ends with plumber's white silicone sealant. An alternative to this is to measure the resultant capacity of the tuning capacitor and substitute fixed value capacitors.

I would be most interested in hearing from you if you put together this duo-bander. I respond to all letters that include an SASE. 73

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