DUAL-BAND ANTENNA FOR 146/446 MHZ

This nifty project by Wayde Bartholomew, K3MF (ex-WA3WMG), first appeared in *The ARRL Antenna Compendium, Volume 5*. This mobile whip antenna won't take long to build, works well and only requires one feed line for the two-band coverage.

Wayde used a commercial NMO-style base and magnetic mount. For the radiator and decoupling stub, He used brazing rod, which he coated with a rust inhibitor after all the tuning was done. You can start with a 2-m radiator that's 20.5 inches long. This is an inch longer than normal so that it may be pruned for best SWR.

Next tack on the 70-cm decoupling stub, which is 6.5 inches long. Trim the length of the 2-m radiator for best SWR at 146 MHz and then tune the 70-cm stub on 446 MHz, moving it up and down for best SWR. There should be no significant interaction between the adjustments for either frequency.

Final dimensions are shown in **Fig 22.98**. The SWR in the repeater portions of both bands is less than 2:1.

ADAPTING WA3WMG'S MOBILE ANTENNA FOR FIXED-STATION USE

You can use the WA3WMG dual-band mobile whip as the radiating element for the groundplane antenna in Fig 22.96. Don't change the 2-m radials. Instead, add two 70-cm radials at right angles to the 2-m set. See **Fig 22.99**. The antenna is no longer two dimensional, but you do have two bands with one feed line *and* automatic band switching.

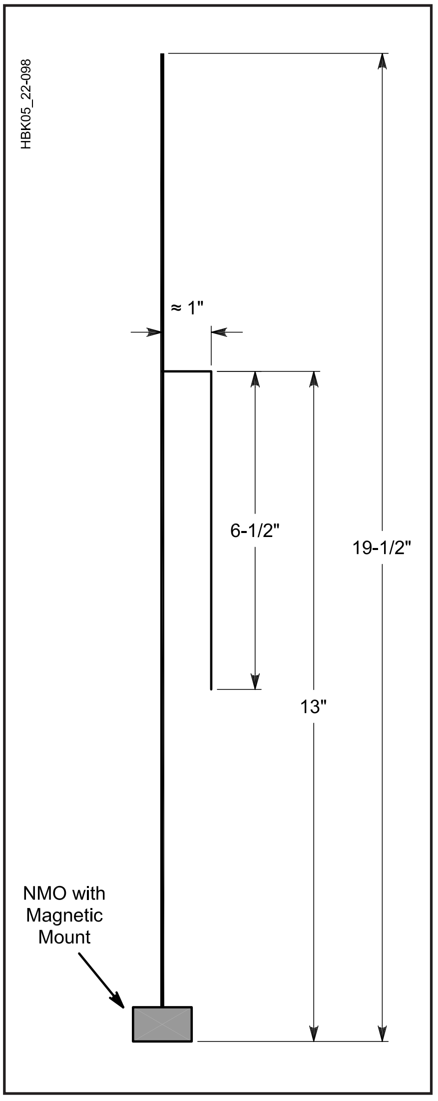

Fig 22.98 — Diagram of WA3WMG's dual-band 146/446-MHz mobile whip. Brazing rod is used for the 2-m radiator and for the 70-cm decoupling stub.

Fig 22.99 — WA3WMG's whip can be used to make a dual-band groundplane antenna. Separate radials for 2-m and 70-cm simplifies tuning. [Photo by K8CH]

A QUICK ANTENNA FOR 223 MHZ

William Bruce Cameron, WA4UZM, built the antenna for 223 MHz shown in **Fig 22.100**. It took less than an hour to build. To make one, you'll need 9 feet of #10 copper wire, 6 inches of small-diameter copper tubing, and a 10-foot length of PVC pipe or some other physical support.

Bend the antenna from one piece of wire. Slide the copper tubing over the top end of the antenna, and adjust how far it extends beyond the wire to get the lowest SWR. (Don't handle the antenna while transmitting—make adjustments only while receiving.) For more precision, you can move the coaxial feed line taps on the antenna's matching stub (the 12-inch section at the bottom) about an eighth of an inch at a time. The antenna shows an SWR of 1.2 at 223 MHz.

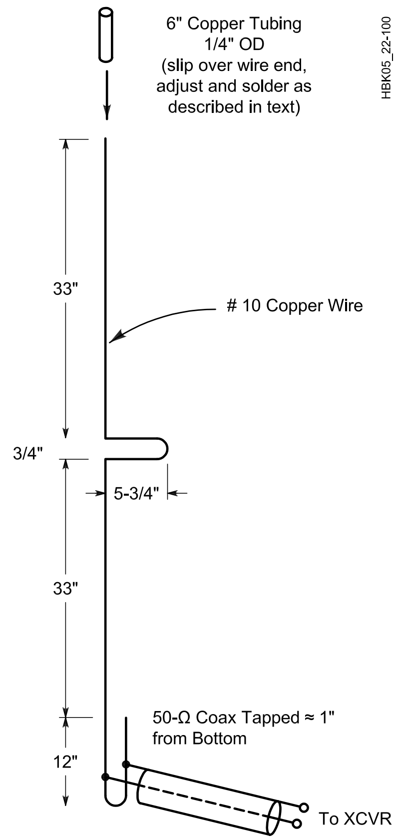

Fig 22.100 — WA4UZM's quick 223-MHz antenna gets you going on 1 1/4 meters in a hurry. The text explains how to adjust it for minimum SWR. To support the antenna, lash it to a piece of PVC pipe with UV-resistant nylon cable ties.

AN ALL-COPPER 2-M J-POLE

Rigid copper tubing, fittings and assorted hardware can be used to make a really rugged J-pole antenna for 2 m. When copper tubing is used, the entire assembly can be soldered together, ensuring electrical integrity, and making the whole antenna weatherproof. This material came from an article by Michael Hood, KD8JB, in *The ARRL Antenna Compendium, Vol. 4*.

No special hardware or machined parts are used in this antenna, nor are insulating materials needed, since the antenna is always at dc ground. Best of all, even if the parts aren't on sale, the antenna can be built for less than $15. If you only build one antenna, you'll have enough tubing left over to make most of a second antenna.

CONSTRUCTION

Copper and brass is used exclusively in this antenna. These metals get along together, so dissimilar metal corrosion is eliminated. Both metals solder well, too. See **Fig 22.101**. Cut the copper tubing to the lengths indicated. Item 9 is a 1 1/4-inch nipple cut from the 20-inch length of 1/2-inch tubing. This leaves 18 3/4 inches for the λ/4-matching stub. Item 10 is a 3 1/4-inch long nipple cut from the 60-inch length of 3/4-inch tubing. The 3/4-wave element should measure 56 3/4 inches long. Remove burrs from the ends of the tubing after cutting, and clean the mating surfaces with sandpaper, steel wool, or emery cloth.

After cleaning, apply a very thin coat of flux to the mating elements and assemble the tubing, elbow, tee, endcaps and stubs. Solder the assembled parts with a propane torch and rosin-core solder. Wipe off excess solder with a damp cloth, being careful not to burn yourself. The copper tubing will hold heat for a long time after you've finished soldering. After soldering, set the assembly aside to cool.

Flatten one each of the 1/2-inch and 3/4-inch pipe clamps. Drill a hole in the flattened clamp as shown in Fig 22.101B. Assemble the clamps and cut off the excess metal from the flattened clamp using the unmodified clamp as a template. Disassemble the clamps.

Assemble the 1/2-inch clamp around the 1/4-wave element and secure with two of the screws, washers, and nuts as shown in Fig 22.101B. Do the same with the 3/4-inch clamp around the 3/4-wave element. Set the clamps initially to a spot about 4 inches above the bottom of the *J* on their respective elements. Tighten the clamps only finger tight, since you'll need to move them when tuning.

TUNING

The J-Pole can be fed directly from 50 Ω coax through a choke balun (3 turns of the feed coax rolled into a coil about 8 inches in diameter and held together with electrical tape). Before tuning, mount the antenna vertically, about 5 to 10 ft above the ground. A short TV mast on a tripod works well for this purpose. When tuning VHF antennas, keep in mind that they are sensitive to nearby objects—such as your body. Attach the feed line to the clamps on the antenna, and make sure all the nuts and screws are at least finger tight. It really doesn't matter to which element (3/4-wave element or stub) you attach the coaxial center lead. Tune the antenna by moving the two feed-point clamps equal distances a small amount each time until the SWR is minimum at the desired frequency. The SWR will be close to 1:1.

FINAL ASSEMBLY

The final assembly of the antenna will determine its long-term survivability. Perform the following steps with care. After adjusting the clamps for minimum SWR, mark the clamp positions with a pencil and then remove the feed line and clamps. Apply a very thin coating of flux to the inside of the clamp and the corresponding surface of the antenna element where the clamp attaches. Install the clamps and tighten the clamp screws.

Solder the feed line clamps where they are attached to the antenna elements. Now, apply a small amount of solder around the screw heads and nuts where they contact the clamps. Don't get solder on the screw

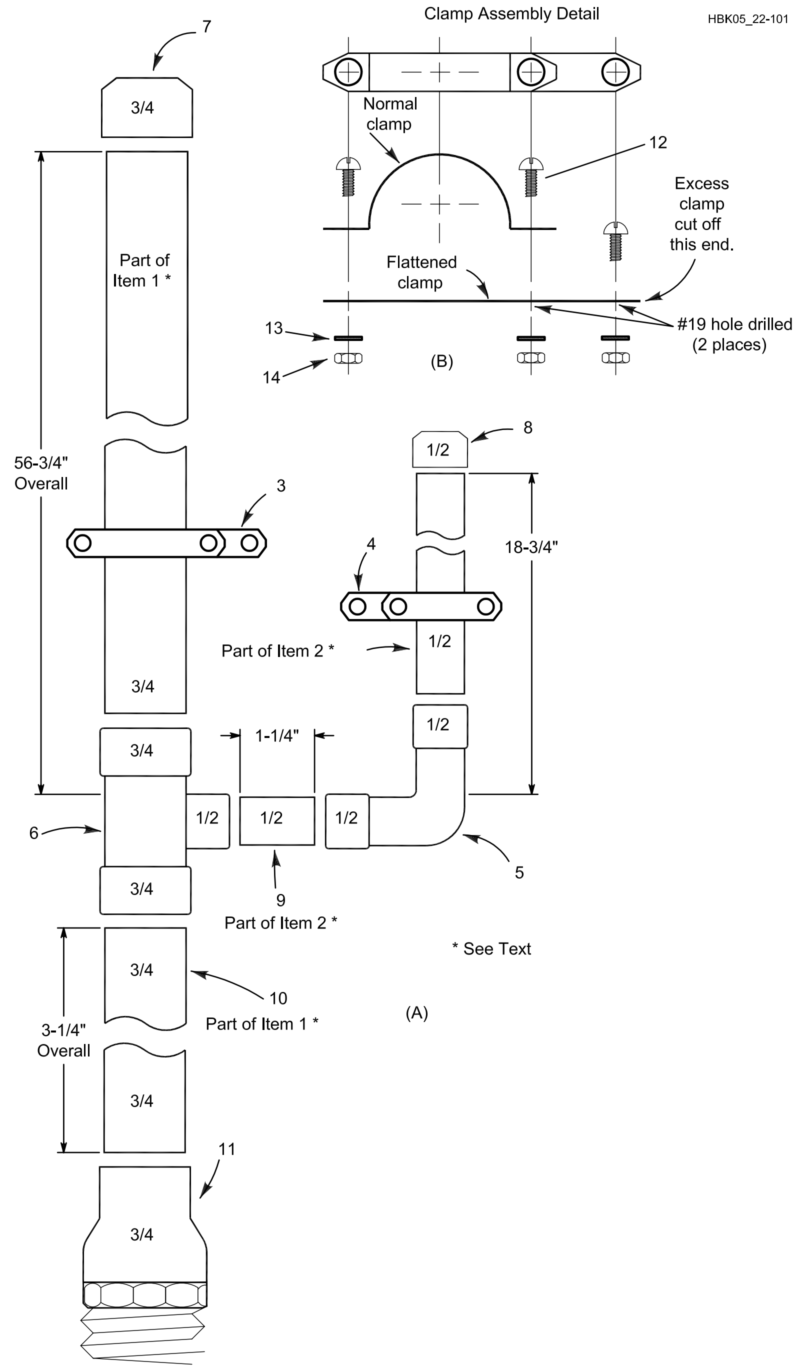

Fig 22.101 — At A, exploded assembly diagram of all-copper J-Pole antenna. At B, detail of clamp assemblies. Both clamp assemblies are the same.

Item	*Qty*	*Part or Material Name*
1	1	3/4 inch × 10 ft length of rigid copper tubing (enough for 2 antennas, 60 inches per antenna)
2	1	1/2 inch × 10 ft length of rigid copper tubing (enough for 6 antennas, 20 inches per antenna)
3	2	3/4 inch copper pipe clamps
4	2	1/2 inch copper pipe clamps
5	1	1/2 inch copper elbow
6	1	3/4 × 1/2 inch copper tee
7	1	3/4 inch copper end cap
8	1	1/2 inch copper end cap
9	1	1/2 × 1 1/4 inch copper nipple (Make from item 2. See text)
10	1	3/4 × 3 1/4 inch copper nipple (Make from item 1. See text)
11	1	Your choice of coupling to mast fitting (3/4 × 1 inch NPT used at KD8JB)
12	6	# 8-32 × 1/2 inch brass machine screws (round, pan, or binder head)
13	6	# 8 brass flat washers
14	6	# 8-32 brass hex nuts

threads! Clean away excess flux with a non-corrosive solvent.

After final assembly and erecting/mounting the antenna in the desired location, attach the feed line and secure with the remaining washer and nut. Weather-seal this joint with RTV. Otherwise, you may find yourself repairing the feed line after a couple years.

ON-AIR PERFORMANCE

The author had no problem working various repeaters around town with a $^1/_4$-wave antenna, but simplex operation left a lot to be desired. The J-Pole performs just as well as a Ringo Ranger, and significantly better than the $^1/_4$-wave ground-plane vertical.

VHF/UHF Yagis

Without doubt, the Yagi is king of home-station antennas these days. Today's best designs are computer optimized. For years amateurs as well as professionals designed Yagi arrays experimentally. Now we have powerful (and inexpensive) personal computers and sophisticated software for antenna modeling. These have brought us antennas with improved performance, with little or no element pruning required.

A more complete discussion of Yagi design can be found earlier in this chapter. For more coverage on this topic and on stacking Yagis, see the most recent edition of *The ARRL Antenna Book*.

3 AND 5-ELEMENT YAGIS FOR 6 M

Boom length often proves to be the deciding factor when one selects a Yagi design. ARRL Senior Assistant Technical Editor Dean Straw, N6BV, created the designs shown in **Table 22.24**. Straw generated the designs in the table for convenient boom lengths (6 and 12 ft). The 3-element design has about 8 dBi gain, and the 5-element version has about 10 dBi gain. Both antennas exhibit better than 22 dB front-to-rear ratio, and both cover 50 to 51 MHz with better than 1.6:1 SWR.

Element lengths and spacings are given in the table. Elements can be mounted to the boom as shown in **Fig 22.102**. Two muffler clamps hold each aluminum plate to the boom, and two U bolts fasten each element to the plate, which is 0.25 inches thick and 4·4 inches square. Stainless steel is the best choice for hardware, however, galvanized hardware can be substituted. Automotive muffler clamps do not work well in this application, because they are not galvanized and quickly rust once exposed to the weather.

The driven element is mounted to the boom on a Bakelite plate of similar dimension to the other mounting plates. A 12-inch piece of Plexiglas rod is inserted into the driven element halves. The Plexiglas allows the use of a single clamp on each side of the element and also seals the center of the elements against moisture. Self-tapping screws are used for electrical connection to the driven element.

Refer to **Fig 22.103** for driven element and Hairpin match details. A bracket made from a piece of aluminum is used to mount the three SO-239 connectors to the driven element plate. A 4:1 transmission-line balun connects the two element halves, transforming the 200-Ω resistance at the Hairpin match to 50 Ω at the center connector. Note that the electrical length of the balun is λ/2, but the physical length

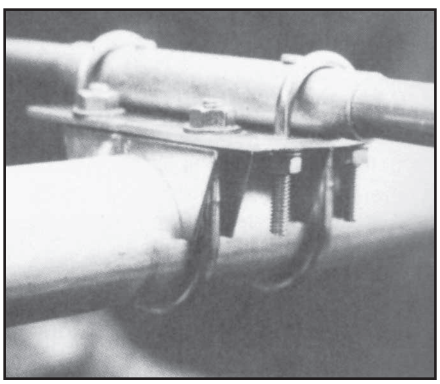

Fig 22.102 — The element-to-boom clamp. Galvanized U bolts are used to hold the element to the plate, and 2-inch galvanized muffler clamps hold the plates to the boom.

Table 22.24
Optimized 6-m Yagi Designs

	Spacing From Reflector (in.)	*Seg 1 Length (in.)*	*Seg 2 Length (in.)*	*Midband Gain F/R*
306-06				
Refl	0	36	22.500	8.1 dBi
DE	24	36	16.000	28.3 dB
Dir 1	66	36	15.500	
506-12				
OD		0.750	0.625	
Refl	0	36	23.625	10.0 dBi
DE	24	36	17.125	26.8 dB
Dir 1	36	36	19.375	
Dir 2	80	36	18.250	
Dir 3	138	36	15.375	

Note: For all antennas, telescoping tube diameters (in inches) are: Seg1=0.750, Seg2=0.625. See figure 22.66 for element details.