An efficient portable dipole from Mobile Whips

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Using back-to-back loaded ¼ wave HF mobile whips for an efficient portable dipole is not new to the Ham community. Why this configuration is much better than a single whip mounted on a vehicle is not well known. Also elusive is how to "correctly" implement the configuration.

The basic structure

I chose two Iron Horse IHF 20 fiberglass whips for a 20M portable antenna. Iron Horse also sells a well-made mount to form a dipole from two whips, the IHDAK-AD. You can do the same with virtually any mobile whips that are not too heavy for the center mount, and also on other bands.

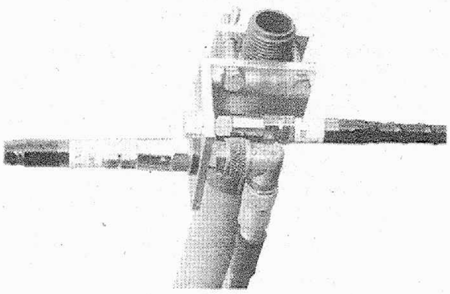

Figure One: Mount on mast with all part and assembled feedline.

One of the whips is insulated from the mount, and fed by the center conductor of the coax, through the PL-239 right-angle adapter, figure one. The other whip connects to the shield of the coax through the mount. For a predictable radiation pattern, I use a balun in the feedline. I want to talk to the world, not the trees. I prefer the popular W2DU ferrite choke balun, figure two. Other balun types work well too, but should be the 1:1 variety with coax connectors at both ends.

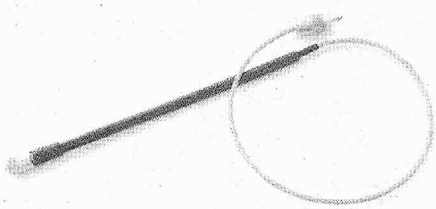

Figure Two: W2DU ferrite choke 1:1 balun

Also, the mast should also be isolated from the antenna. Figure three shows my solution — two short threaded ¾ in. PVC, schedule 80, plastic pipe nipples and a threaded coupler. Insert this into the inverted end of a 5-ft. Radio Shack steel TV mast. When I travel in my RV, I telescope three 5-ft. TV mast sections with the antenna on top and drop the whole structure into a stake pocket of my pickup (figure four).

Tuning and matching

Step one, putting the dipole on frequency is straightforward. I use my rig (on low power) through a common SWR

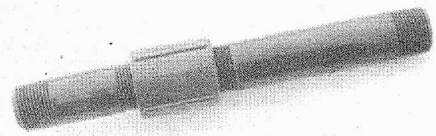

Figure Three: Mast top insulator. Slips in to end of metal TV mast

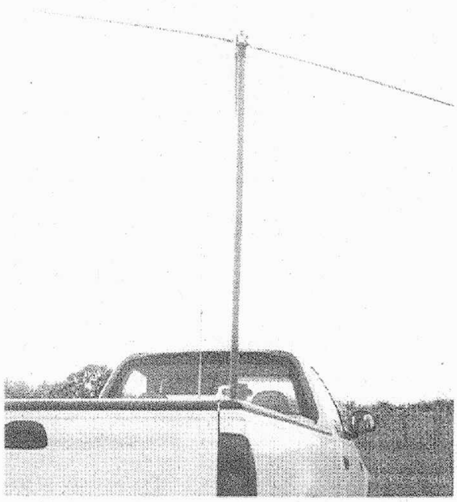

Figure Four: Antenna on one mast section in pickup stake pocket. Normally I use three.

bridge. Remember, though, that you now have two top sections to adjust, not just one. Keep both at equal length for now. Adjust for lowest SWR. You will not be able to achieve 1:1 SWR at this stage. I reached only 2:1.

Step two, getting the match, is achieved by now moving the top whips off center — one in, one out, by the same amount, keeping the total antenna length the same. This will hold the tuning you achieved in step one. The SWR can now be reduced to nearly 1:1. One inch at a time worked for me on 20M. One of the top sections of my 20M Iron Horse dipole is now roughly six inches longer than the other.

Feedpoint impedance

Why does this work? Let's think about it. What is the impedance of a thin dipole in free space? Yes, roughly 72 ohms. But is this the impedance of our back-to-back whips? NO! If you physically shorten an antenna with loading coils, its impedance drops.

My 20M Iron Horse dipole is physically only roughly half as long as a full-sized dipole. Feedpoint impedance changes with the square of the length. This predicts that my half-sized dipole has a center-point feed impedance of roughly ¼ of 72 ohms, or 18 ohms. So what do we do? So how do we make the match?

If we offset the feed-point from the center, the impedance will rise. So at a short distance off center there is a 50-ohm point that will match the impedance of the coax. It is this second adjustment that provides the correct impedance match. The first step tuned the dipole for frequency.

Ground losses

Some may question how back-to-back ¼-wave whips can be much better than a single ¼-wave whip on a vehicle. The answer is found in basic mobile HF antenna theory. A ¼-wave whip on a vehicle must have a "counterpoise." To work, the "virtual image" or counterpoise acts like the missing half of a fully ½-wave dipole. To visualize this, picture a ¼-wave whip mounted on a metallic mirror. You would see what looks like the other half of a dipole as a reflection in the mirror. This "virtual" other half makes the ¼-wave whip behave like a ½-wave dipole.

On a very large conductive surface or ground plane a ¼-wave antenna radiates efficiently. But if most of the ground plane is high resistance soil, as is the case for most mobile HF installations, antenna efficiency is terrible. Soil resistance as a rule of thumb is very roughly on the order of 35 ohms. It eats up most of your transmitter's power in a mobile setup. Very little gets radiated.

The only kind of resistance an antenna wants to see is what we call radiation resistance. It is not an actual physical resistance, but is actually the loading of space on an antenna. It readily accepts the transmitter's power forming a radio wave. So ideally, all we want in an antenna is radiation resistance. In a mobile installation however, soil resistance is also unfortunately always present. Remember it is part of the ground plane. So now both kinds of resistance, good and bad, share the transmitter's power.

To give you a concrete example, one of my ¼-wave Iron Horse whips in a conventional mobile situation would have a radiation resistance of roughly 4.5 ohms (1/16 x 72 ohms — only 11% of the total. Remember, it is only ¼ as long as a full-sized dipole. So now 89% of the transmitter's power is only "heats up worms."

A back-to-back pair of ¼-wave mobile whips, however, does not needs a ground plane image to work. The other whip provides the return path for the antenna's field, replacing the virtual image in the high loss soil ground plane. Now virtually all of the transmitter's power can go to radiation resistance. Ground loss is the number one reason why back-to-back whips are superior to a single vehicle-mounted ¼-wave whip.

Try the configuration; you will like it. I like it especially for PSK-31. It is also quite suitable for Amateur Radio operators who must live with indoor antennas.

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