To Trap or Not to Trap

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The trap antenna, whether a doublet or a one-sided vertical, was invented mostly to permit the operator to use coaxial cable as a feedline. It was not invented for maximum efficiency. As with all antennas, trap antenna adherents claim they get good results--and indeed they do. Whether they get better results than they would with other types of antennas of comparable size is a question few are positioned to answer. The answer would require that the trap antenna and the alternative be placed in nearly the same position at the same height, and few of us can afford the space, time, or money for such side-by-side comparisons.

There are two types of trap antennas, with examples illustrated in Figure 1. The most common are those with traps, or parallel tuned circuits, that are resonant at or just below the edge of the higher frequency band to be covered, with extensions to make up the length of the lower band. These antennas will be shorter than a full-size dipole at the lower frequency, since the trap acts like an inductor at the lower frequency, much like a mid-element loading coil. However, the inductive reactance is not a product of the coil alone, but of the tuned circuit making up the trap.

The second type of trap antenna is one with a parallel tuned circuit with the components and position selected to permit the antenna to show a low SWR on several of the ham bands. W8NX, who has done a great deal of work on these types of antennas, published an 80/40/17/10 meter antenna with only one trap each side of center, and it was tuned to 5.16 MHz (QST, July, 1996).

Let's look at the more conventional trap antenna first and simplify it to just 2 bands, like 80/40 or 20/10. A full size #14 copper wire resonant dipole will have a gain of about 2.1 dBi in free space, but it has this gain only in one ham band. We may use the gain figure as a standard against which to measure trap antennas for two bands. The first thing we note is that performance of a two band trap antenna of conventional design is dependent very heavily on the Q of the trap. There are many trap designs, but here is a table of one pretty good design with coils of various Qs. The gain is for free space. Comparisons between dipoles and doublets at the same height above real ground will show the same differentials.

Q	High-Band Gain (dBi)	Low-Band Gain (dBi)
50	0.7	1.7
100	1.4	1.8
200	1.8	1.9
400	2.1	2.0
800	2.2	2.0

Avoid low-Q trap coil designs. It is fairly easy to homebrew airwound coils with a Q of 200, and common coil stock usually meets this figure. Even the best series-wound coaxial trap coils will not have Qs higher than about 400, and most coils with Qs claimed to be higher than 400 will not retain that Q under the influence of the our chemistry-lab atmosphere. Nonetheless, a dipole with a gain of 1.8 or so will not yield results noticeably worse than a full size dipole, since a half dB of lost gain translates into less than a tenth of an S-unit. (Where these small losses mount up is in multiband beams with traps in every element, since the losses of each trap tend to be cumulative. They also add up in antennas with many traps for many bands.)

The sample conventional 80/40-meter trap dipole in Figure 1 uses traps tuned to 6.75 MHz. With a Q of 200, the traps equalize performance on the two bands at just above 1.85 dBi in free space. This is only about 0.35 dB down from a full size dipole for each band.

Well, that's not too bad. What about the other type of antenna, like the W8NX improved trap antenna? Since the trap is not resonant at any ham band, the antenna is functional over its entire length at all advertised frequencies. On the three upper bands, the trap mostly adjusts the reactance that appears at the feedpoint so that coax can handle the feed task. On 80 meters, as Al Buxton notes, the trap does exhibit significant losses--about 0.6 dB relative to the gain of the wire of the same length (83.6') without the trap. (The 80 meter performance is down by a bit over 1 dB from a full-size dipole for 80 meters.) Since most of the impedances are close to 100 ohms, replacing the

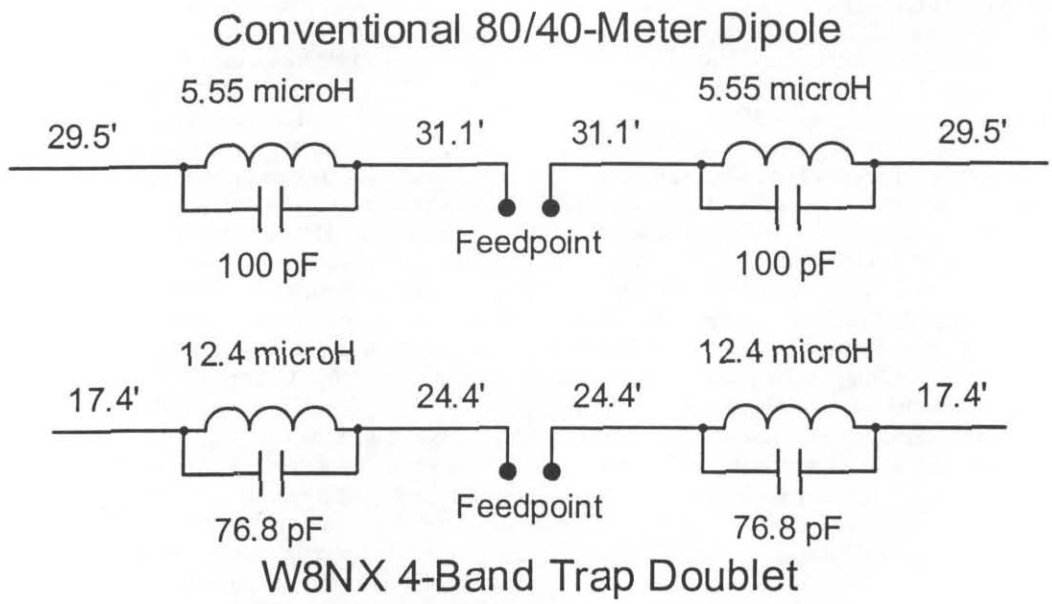

Figure 1

recommended 1:1 balun with a 4:1 balun will likely create no problems.

Since the W8NX antenna is operative along its entire length, its patterns are not true dipole patterns on all but 80 and 40. On the upper bands, they are multi-lobe patterns typical of a wire of the same length fed with a parallel transmission line and an antenna tuner--and at the same lobe strengths. So unlike the conventional trap antenna, the special trap design acts like a simple doublet.

Now we have an additional selection criterion for our decision-making machine. If we just have to have coax, then a trap design is desirable, especially if we do not have space for a yard full of standard dipoles. If we have to have standard dipole figure-8 or (at low heights) oval patterns, then the conventional trap design is indicated. If we have to have the coax, but are willing to accept patterns that are a function of the antenna length, then the special trap design may be useful.

But--what if we do not really have to have coax. What if we could use parallel feedline and an antenna tuner. And--what if the dipole pattern were not too important to us. Should we still opt for a trap antenna? Probably not.

First, traps are always a maintenance problem. More than their losses, their inability to withstand weather without periodical disassembly and cleaning is a disadvantage to most users. Open traps are an invitation to big bug nests and closed traps invite little insects that get into weep holes and eventually clog them.

Second, a doublet with an ATU allows one to put a signal on all the ham bands. The W8NX antenna, without the traps, is about the right length for an EDZ on 20 meters, but the high reactance requires parallel feedline to avoid losses. With the traps and a coaxial feedline, the band is not accessible without significant power losses in the line.

Third, in the short run, a trap antenna may be cheaper than an ATU, but since ATUs are not out in the weather, they tend to last a lifetime. Hence, you can prorate their costs over many years more than a trap antenna.

So if you need the exact things a trap antenna offers, then opt for either the conventional or the special design types. On the other hand, if you prefer general operating on all bands, then simply put up a doublet and feed it with parallel feedline and an ATU. The 121' of the conventional trap antenna would translate into a good doublet at 80 meters and up. Even the 83' length of the W8NX antenna--which is short by G5RV standards--when used as a doublet without traps, will still give performance every bit as good as any trap antenna and on more bands. The length of a doublet is not critical, but a. try to make it at least close to 3/8 wavelengths long on the lowest frequency needed and b. be ready to change parallel feedline lengths in case you run into the occasional impedance condition your tuner cannot handle well.

Remember that there is no magic to any kind of trap or doublet antenna. For the band in use, the elevation angle of maximum radiation will be the same as a dipole at the same height above ground. Therefore, more height is always a key to improved performance of any trap or doublet antenna.

My object is not to downgrade traps: use them where your system's specifications demand them. But do not neglect the multiband doublet, which can be just as good and occasionally better for many installations. Hopefully, setting the two side-by-side here will let you make a more reasoned decision for your installation.

For further information on trap antennas and other antenna topics, you are invited to check out the W4RNL web site at:

http://funnelweb.utcc.edu/~cebik/radio.html