Multi-Band Antenna

Colyn Baillie-Searle GD4EIP shows you his design for a three-band antenna that needs little or nothing extra in the way of test equipment to set up.

I was looking for an easy antenna that I could use for the WARC bands of 10, 18 and 24MHz preferably without having to use an antenna tuner. At that time, I was using a G5RV antenna, but was not very satisfied with the results I was obtaining on the 10MHz band, the one that I was using most of the time. So, I decided to look into constructing a simple antenna that would work on all three WARC bands with an acceptable matching to the transceiver between the three bands.

The first possibility I thought of, was to use a trap dipole consisting of two traps in each leg of the dipole. I could have used coaxial traps and there is a lot of information on constructing these, which can be found on the Internet at: **www.seed-solutions.com/gregordy**

When you have the webpage displayed, find and click on 'Amateur Radio' and then 'Antenna and other experimentation'. Then towards the bottom of the page that's presented, you will find 'Building Coaxial Cable traps'. This is an excellent site which explains how to construct coaxial traps.

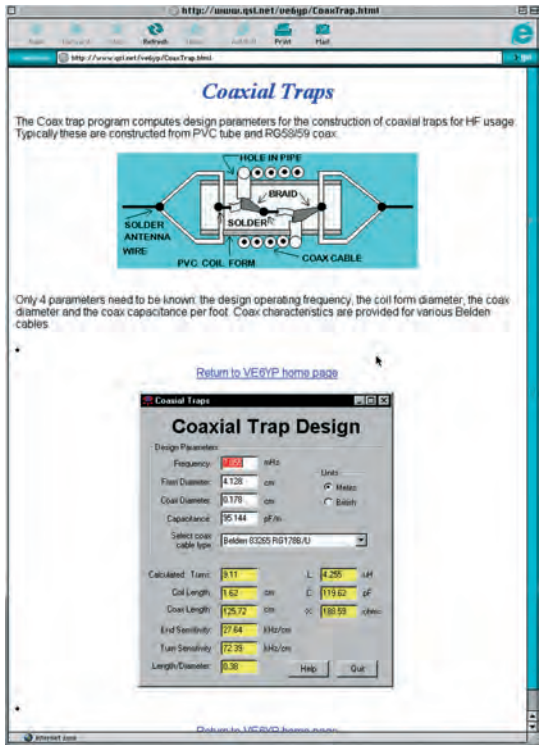
Then from Greg's site, you can go and download a free piece of software *Coaxial Trap Design* from the webpages of **Tony Field VE6YP**. This PC software, is a handy calculator program that provides all dimensions and information on constructing a coaxial trap. You input your frequency and former dimensions and the program will give you the length of coaxial cable required to make the desired trap. To get directly to the site, look at the website: **www.qsl.net/ve6yp** with a screen-grab of the program in operation to be found at: **www.qsl.net/ve6yp/CoaxTrap.html** as shown in **Fig. 1**.

Tony's site gives you the same software program for obtaining the length of coaxial cable without any explanation, but it does show a picture of how to construct the actual trap. Although these traps are easy to construct you require some form of test equipment to see if they operate at the required designed frequency.

For testing, you'll need instruments such as a dip meter, antenna analyser or signal generator together with a probe. I had worked out that I would need two matched traps, set to operate at 24.9MHz and a further two traps, set to work at 18MHz .

Problems With Traps

Well, the problem using traps is the losses that they introduce, **Fig. 2** shows a basic trap dipole showing how the sections



● **Fig. 1: This free to use, BM PC program is to be found on the website of Tony Field VE6YP.**

operate at the respective frequencies. This type of antenna is easy to construct once one has the respective traps. There have been several designs in *PW* in the last year or two, so I won't elaborate on it any more. And, of course, you will need with the aid of an one or more pieces of test equipment to tune the respective lengths of the antenna elements so that the antenna will resonant on the three bands.

So, in spite of looking up how to make traps, you may ask, why I didn't use them? Initially, I looked into making the traps and weather proofing them, then after a short time decided it was far too much trouble and I need to look at an easier alternative. One alternative, would have been three separate dipoles, one for each band, but that would require separate feeders and space to erect them.

Not wanting to use three separate feeders and in any case, my garden is not large enough to accommodate them, why could I not join the three dipoles together in the centre and just use one feeder to all three? This option would certainly seem, not only to be a better idea and easier to construct, but would have the extra option of low-cost! Not to mention needing little in the way of test equipment.

Equal Lengths

The first step to making the dipole is cutting the respective lengths. A dipole antenna is made of two equal lengths of wire with the overall length adding up to a half wavelength at the desired frequency. Finding the overall end-to-end length in metres of the dipole, is obtained by dividing 150 by the frequency required. (You will often see the formula 468/f when working in imperial measurements).

Although the two calculations, for metric and imperial dimensions give slightly differing physical answers, I've found that, in many cases, some trimming of lengths is needed anyway to give spot-on matching. So, calculating the starting lengths, for

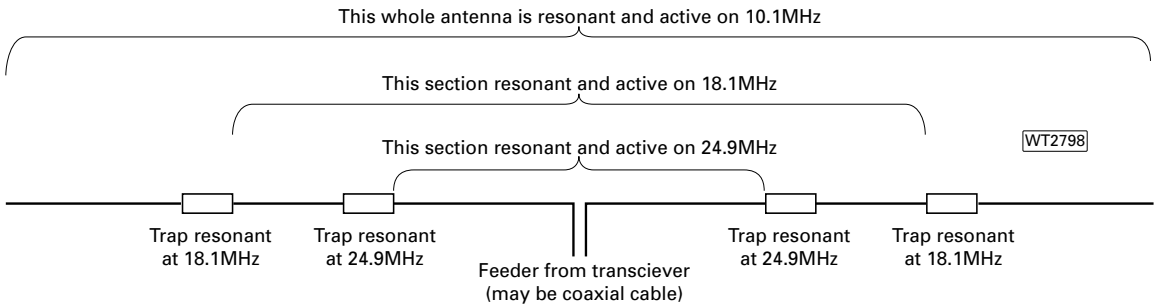


Fig. 2: I decided that, although a trapped dipole as shown here can be effective, it was be more work than I wanted to undertake. (See text for more detail.)

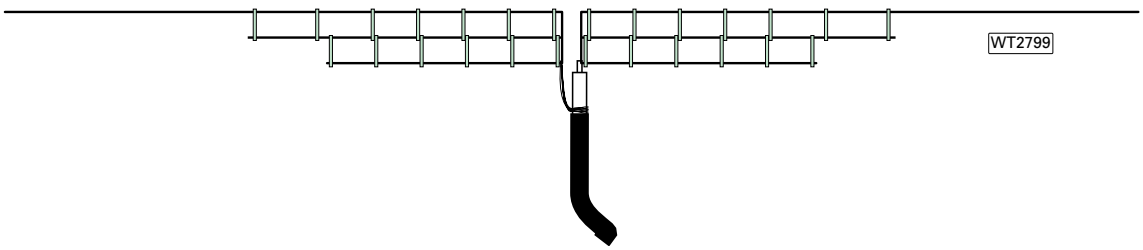


Fig. 3: A skeletal overview of the antenna that I ended up building. Although there is some interaction, each pair of elements is resonant on only one band.

the three WARC bands give start point lengths of:

10.1MHz	14.85m	46.3ft
18.68MHz	8.03m	25ft
24.89MHz	6.03m	19.45ft

These are the overall lengths and to make the dipoles each length need to be cut into half again. It is advisable to make each length a little longer than the above to allow trimming to resonance once assembled. And of course each leg for one particular band is half of the overall length of the dipole itself. A simple T-piece is used to join all the parts together at the centre of the antenna.

The inner of the coaxial cable, together with one set of three legs of the separate dipoles are all connected to one side of the T-piece. While the screen and the other three legs are connected to the other side of the T-piece. The 10MHz dipole is the longest and this one will eventually support the remaining two. Insulators must be attached to the end of this dipole in order at it can be fastened to some support once the whole assembly has been completed.

Next, fix spacers about 300mm apart along the dipole in order to attach the 18MHz dipole to it. Thus the 18MHz dipole will be approximately 4 inches below the 10MHz one. This is to be done on both sides. Next attach spacers to the 18MHz dipole in order to attach the 24MHz dipole in a similar manner as for the 18MHz dipole. On completion you should have a ladder looking dipole assembly on each side of the centre rather like **Fig. 3**.

Final Stage

The final stage is testing the assembly for resonance on each of the bands. First start with the 10MHz band and using either an antenna analyser or your transmitter with low output power, measure the s.w.r of the antenna at the band's centre (or point of interest).

Adjustment, is by trimming small lengths off each end of the dipole until the s.w.r is 1:1 or thereabouts. Next repeat the exercise for the other two dipoles. This will complete the dipole assembly and will be ready for use on all three bands without the need for an antenna tuning unit.

The centre T-piece is a standard dipole centre, which can be obtained from suppliers, such as **Westlake Electronics** or **Waters and Stanton**. If you feel particularly adventurous, you can make one out of insulating material as shown in **Fig. 4**.

The element spacers were obtained from Waters and Stanton Plc. (Ladder line spacers WS-2580) and are easy to attach to the wires as they are just pushed onto the wire and do not require any form of attachment to keep them in their place. Also they do not seem to move in high winds. You can easily make spacers but often you'll find that they are not as easy to attach as these ones are.

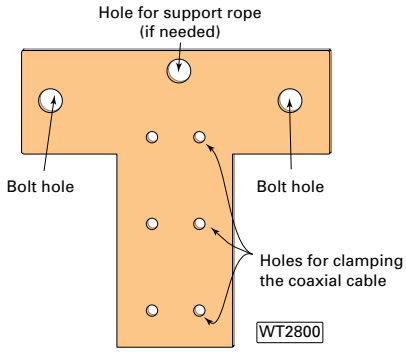


Fig. 4: A simply made dipole centre-piece can be made from a T-shaped section of a strong insulating material. The holes to secure the coaxial cable are spaced just wide enough apart to allow the locking ties to grip the cable firmly to minimise the strain on the wires.

Although this assembly has been designed for the WARC bands the principle can easily be adopted for any other two, three or more bands. My experiments on the 14, 21 and 28MHz bands were as follows. All the lengths are start points and should be trimmed as described above.

14MHz	14.85m	34.6ft
21MHz	7.15m	23.4ft
28MHz	5.3m	17ft

The antenna described is much cheaper to construct than a trap dipole and does not require any test equipment other than ones transmitter glet the antenna working. With traps one will require some form of test equipment to check them for resonance.

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