Antenna Workshop

A Low Cost Multi-band

Len Paget GM0ONX explores the W3DZZ and says that it's a trapped multi-band antenna that shouldn't be discounted.

And they said Amateur Radio was an indoor, sedentary hobby!

Whether it's due to space limitations or planning constraints by either by the local council or the XYL (or OM), few of us are able to erect an array of h.f. antennas for each of the bands we wish to operate and have to rely on a compromise multi-band antenna.

Designs of antenna seem to come into and fall out of fashion. Today's ubiquitous solution to the problem of multi-band operation seems to be one or other of the variants of a G5RV antenna. These antennas are available commercially and offer a 'quick fix' to the problem of working a number of h.f. bands with only one antenna.

However, this solution does require an antenna matching unit to get the best out of it with a modern rig. The typical modern rig has a transistorised p.a. stage and works best into a 50Ω load.

This 'unchangeable' impedance load is required by most modern rigs and when I tried a simple, but correct, G5RV at at my station, the combination gave a very mediocre performance. When I was first licenced in the early 1980s, the popular solution to this problem was to build a W3DZZ trap dipole.

The W3DZZ trap dipole, unlike the G5RV, does not require the use of an antenna matching unit on 3.5 and 7MHz. With its traps therefore, effectively with different electrical lengths at different frequencies, it has a typical in-band impedance of about 75Ω. The feed point impedances in other pre-WARC bands were also well within the limits 'tuneable' by the Pi network of the valve p.a. used by most rigs of the day.

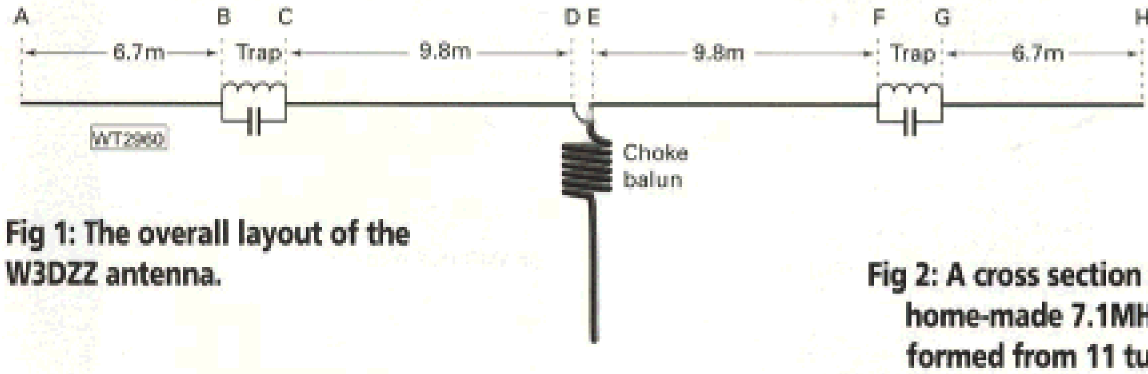

Fig 1: The overall layout of the W3DZZ antenna.

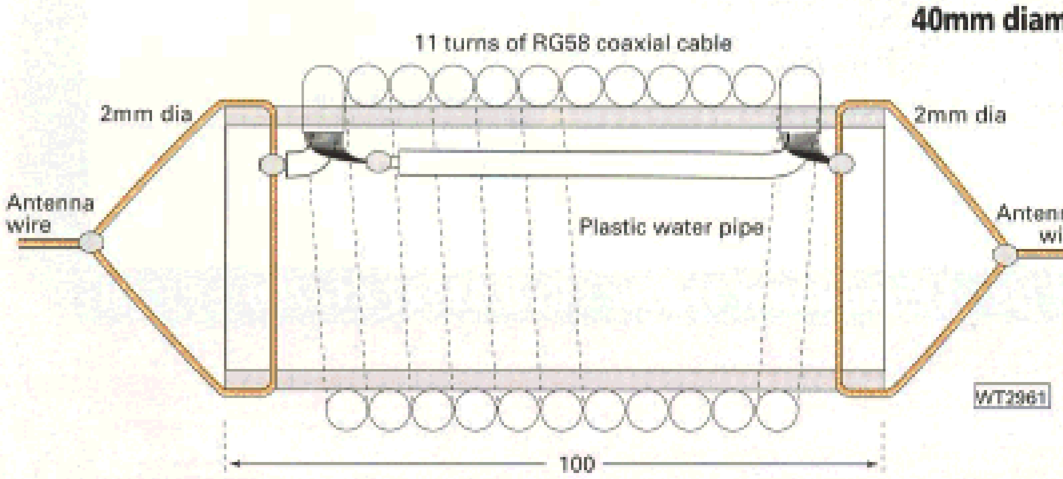

Fig 2: A cross section of the home-made 7.1MHz trap formed from 11 turns of coaxial cable wound on a 40mm diameter plastic water pipe.

Shorter Than Conventional

The W3DZZ antenna is shorter than a conventional 3.5MHz dipole making it ideal for restricted sites. The antenna is constructed using two 7.1MHz traps and 33m of wire. The antenna operates as an half-wave dipole on both 3.5 and 7MHz, as well as a full wavelength dipole on 14MHz. It also acts as a one and an half wavelength antenna on 21MHz and two full wavelengths on 28MHz, giving some gain over a simple dipole on these three higher frequencies.

The layout of the antenna is shown in **Fig. 1**, the version I constructed with **David Livingston MM3DHL** was constructed using one point five mm^2 pvc covered wire. You could use hard drawn copper or 'flexweave' cable instead as they both resist stretching. Both of these solutions can be expensive and difficult to obtain locally.

Back then, in the eighties, commercial traps for the W3DZZ were once readily

Trap Dipole

available from virtually any and every Amateur Radio emporium. But, unfortunately, they're no longer readily available and, no doubt, this has contributed to the decline in popularity of the antenna.

All, however, is not lost as it is very easy to construct your own traps. The 7.1MHz traps in this version of the W3DZZ are constructed from 11 turns of RG58 cable wound over a 100mm length of 40mm diameter pvc water pipe as shown in **Fig. 2** and the photograph of **Fig. 3**.

It's imperative that the ends of the coaxial cable are properly sealed as the braid of coaxial cable does a better than fair impression of a wick. Any water finding its way into the coaxial cable will ruin the trap. Any sealant must be of the non acetic acid type (i.e. doesn't smell like vinegar) as acetic acid types will corrode the copper connections through time. Unlike many commercial traps, these coaxial traps will happily run at up to 1kW power. So, with such a capability, the traps will loaf along at the UK's legal limit of 400W.

A topic that's generally overlooked by most builders of dipole antennas, is that dipoles are designed to be fed using a balanced feeder and, strictly speaking, should not be directly fed with unbalanced feeder such as coaxial cable. A simple balun can, effectively, overcome this problem and can be constructed from six turns of coaxial cable wound with a 50mm internal diameter as shown in **Fig. 4**.

The centre piece of the antenna is constructed from a scrap piece of Perspex or other good quality plastic board and is shown in Fig. 4. Perspex is rather brittle and a nylon chopping board would make a suitable substitute. If 'borrowing' one from the kitchen - check with the boss first!

Reduce The Strain

The wire elements are woven through the holes in the centre-piece to help reduce the strain on the terminals. The connections to the traps are made using the centres from 30A terminal block to allow trimming of the element lengths. After trimming the antenna these terminal blocks can be replaced with good quality soldered joints trimmed.

If possible, the antenna should be fed with 75Ω coaxial cable such as RG11 as the impedance of an half-wave dipole antenna is around 75Ω, but in practice an acceptable performance is still achieved with 50Ω coaxial cable. The coaxial cable and the balun are secured to the centre-piece using cable ties and then covered with waterproof tape such as 'Denso' tape, **Fig. 5**.

The dipole can be erected either as a conventional straight dipole or as an inverted V without any major loss in performance. The actual form will depend on the space and support structures available at the antenna location.

As with any antenna, it will need a degree of tuning to get the best out of it. Tuning this antenna is very simple, but must be carried out in the correct order. Start on the 7MHz band and trim the sections of wire between points C and D and between points E and F (Fig. 1) .

Trim no more than 50mm of wire from both sides of the antenna each time, before checking the matching. Try to get the the (voltage) standing wave ratio, (v.)s.w.r. as near 1:1 as possible on the desired section on the 7MHz band.

On no account attempt to trim any wire on any other part of the antenna until you are completely satisfied with results of the 40m band. An s.w.r. of 1.5:1 or less should be possible over the whole of the 40m band.

Once you are satisfied with the s.w.r. on the 7MHz band move to 3.5MHz and trim the sections between A and B, and G and H, again only 50mm at a time until you get the lowest s.w.r. on the 3.5MHz band. Unfortunately, it's unlikely that you'll be able to cover the whole 3.5MHz with an s.w.r. of 2:1 or less - but do the best you can!

Most Interest

A tip is to choose the area of the band that is of most interest to you. Then centre the lowest s.w.r. reading on that frequency. With careful tuning, you should be able to cover a 150kHz, or more, section of the band dependant on wire size used and the antenna's height above the ground.

The antenna, can be also, be used on 14, 21 and 28MHz using the internal tuner of most modern rigs and will usually give a easier match with this W3DZZ antenna than with a G5RV antenna. Although not officially on an harmonic of any other band, the version built by David Livingston MM3DHL and myself also gave reasonable performance on both 18 and 24MHz. Though this may only be a testament to the flexibility of the antenna matching unit of his Kenwood TS-570 rig.

The antenna, as described, should cost less that £10 to construct, excluding feeder cable. It may be constructed within a few hours. Many thanks go to David MM3DHL for testing the dipole and assisting with the photography for the article.

PW

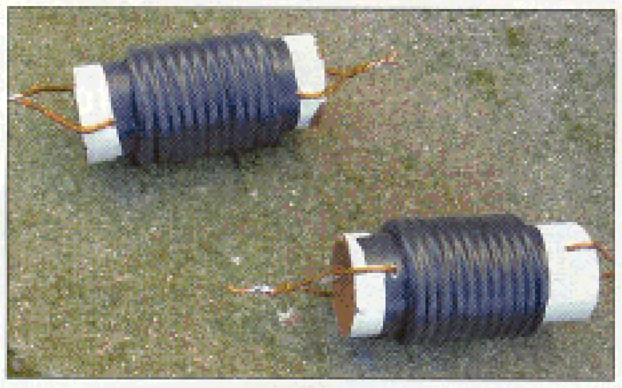

Fig. 3: And here are two I made earlier!

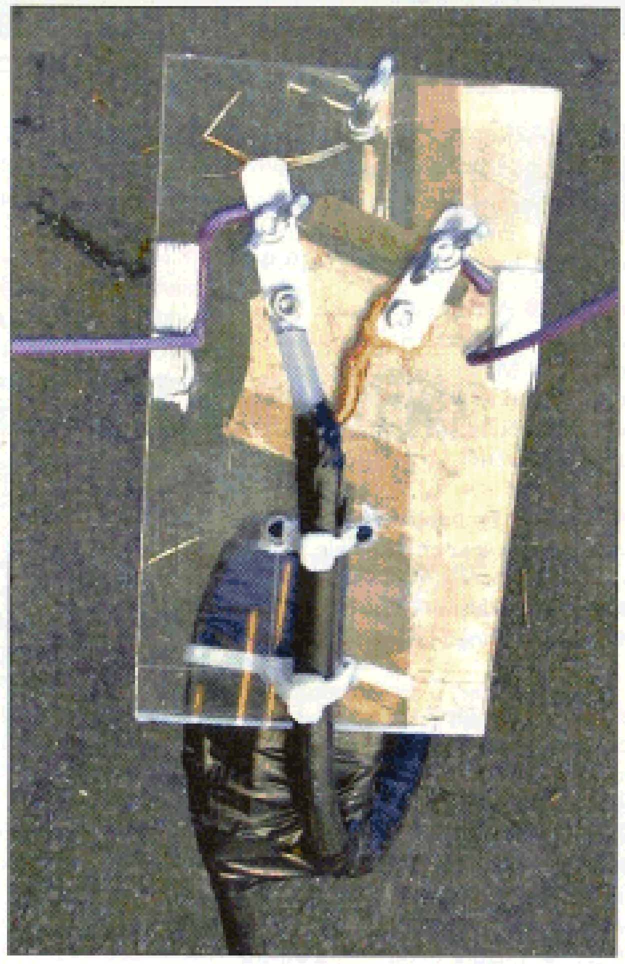

Fig. 4: The centre-point of the antenna was made from a scrap piece of Perspex, but a piece of chopping board would do the job as well. Note the choke wound balun slightly hidden by the centre-piece.

Fig. 5: Waterproofing the centre-piece with sticky Denso Tape keeps the weather out of the joints.