The 7OGN 8-for-6
A DX Antenna For 50MHz

Dennis Arnold G7OGN enlists the aid of Duncan Cadd G0UTY to 'stretch' the G2BCX antenna design to work on 50MHz.

The antenna I'm about to describe started off as a 'I wonder if...' style of idea after I looked at the G2BCX antenna design presented in *More Out Of Thin Air* (and originally in *Out Of Thin Air* too. **Editor**.).

The antenna is based rather loosely on an original design by the late **Fred Judd G2BCX**, It's a design using two driven phased folded dipole elements in combination with other parasitic elements to create a small, but effective beam antenna for the 144MHz band. But would the redesigned antenna work on 50MHz? Read on and find out.

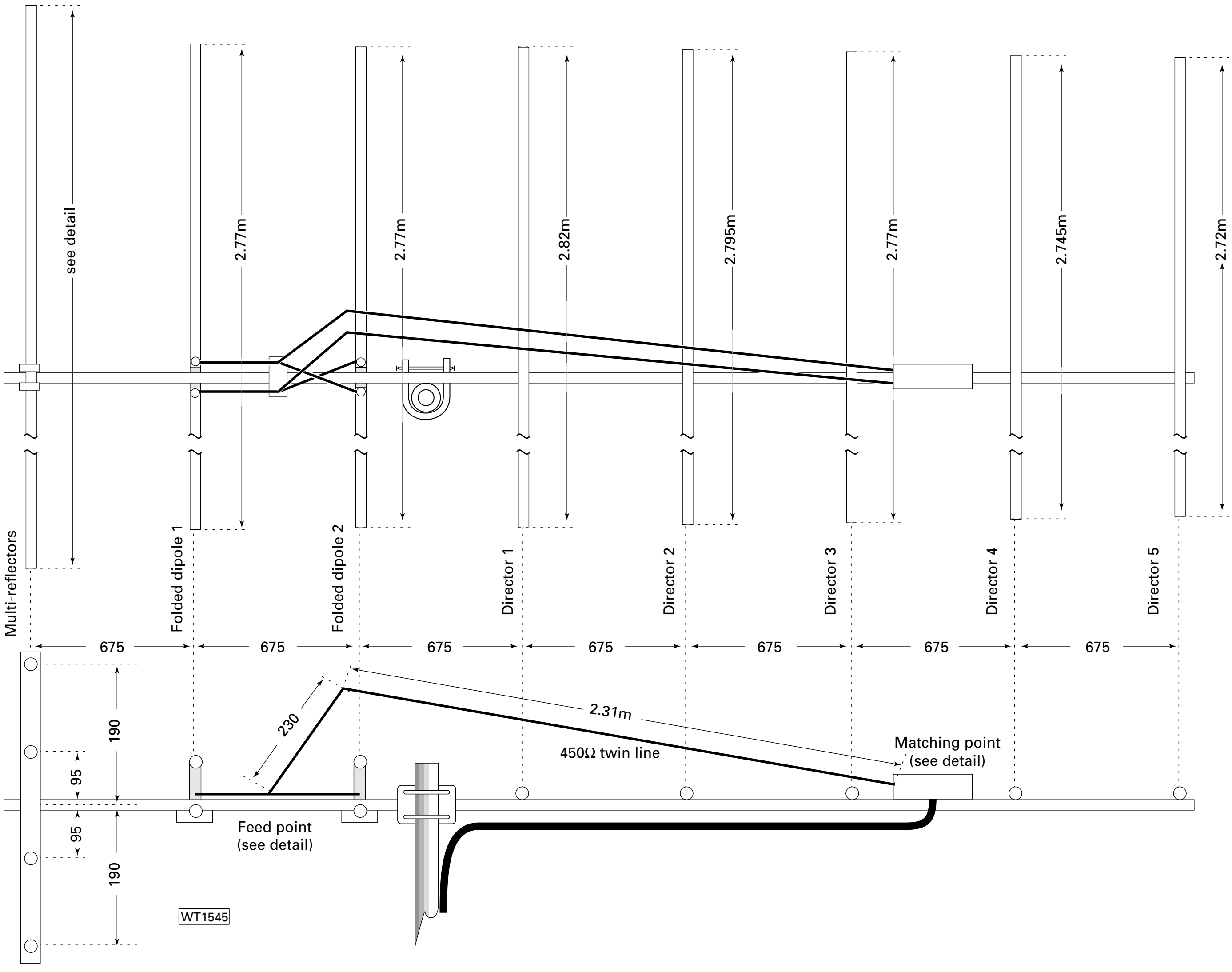
I make few claims of originality for the basic design, but tweaking the new antenna for a decent match on the 50MHz has proved interesting. These tweaks involved the removal of a few elements and a change of element thickness (relative to wavelength). And it's made a difference to the feed-point impedance as you would expect.

In the light of experience, a few practical modifications have been needed. In my new design, all the elements are spaced 675mm apart. Using the computer programs *NEC2* suggested that the input impedance is purely resistive, at around 30-35Ω, with little reactive components.

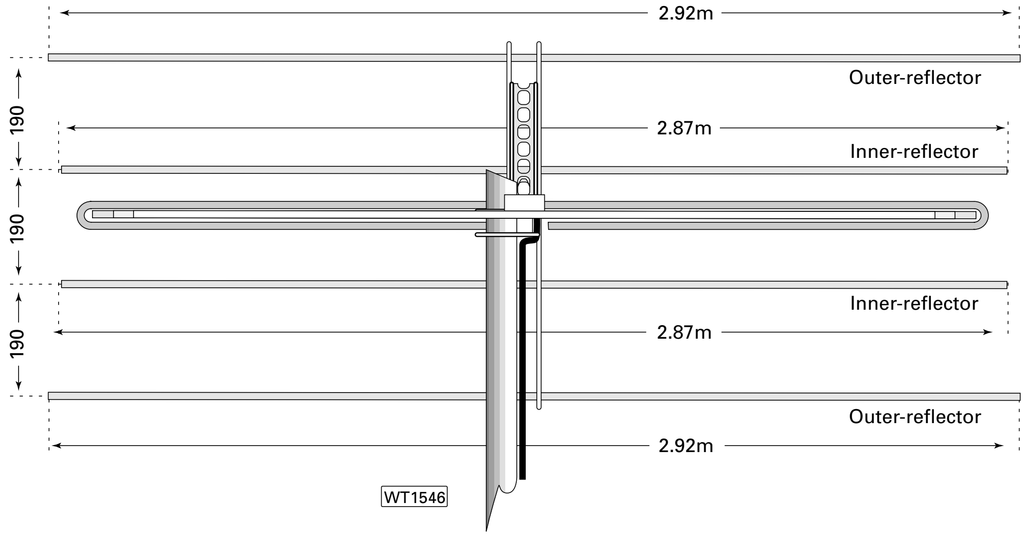
Impedance Transformed

The antenna input impedance is transformed, using a matching stub transformer, to the more 'usual' 50Ω needed to match into the coaxial cable. The 450Ω 'phasing' line is bought forward from the the crossed-over feed points between the driven elements to a waterproof box towards the front-end of the boom. This box also contains the 'shorting' bar matching system.

As the 450Ω phasing and λ/2 transformer line is longer than the distance between the two mounting points. So, it has to be kept away from both elements and the boom by non-metallic supports if it is not to cause losses and mismatch. The feeding coaxial cable, then runs from the

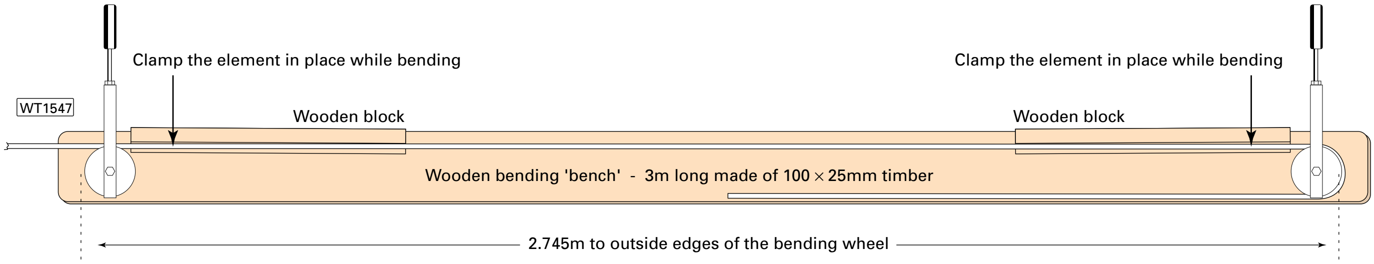


■ Fig. 1: The antenna that Dennis G7OGN built - seen from above and the side. All dimensions are in millimetres unless stated.



■ Fig. 2: Looking from the 'sharp-end' into the antenna shows the four reflector elements are longer on the top and bottom elements.

■ Fig. 3: The bending 'bench' and jig that was produced to make production of the folded elements easier and more consistent.



adjustable feed-point in the box, under the boom back towards the mast, and then down to the transceiver.

Antenna Layout

Let's have a look at the general construction and layout of the '7OGN' antenna, which can be seen in **Fig. 1** and **Fig. 2**. The two driven elements are folded half-wave dipoles, with five directors and a multi-element reflector. In the final design I've used 'half-inch' aluminium tube throughout.

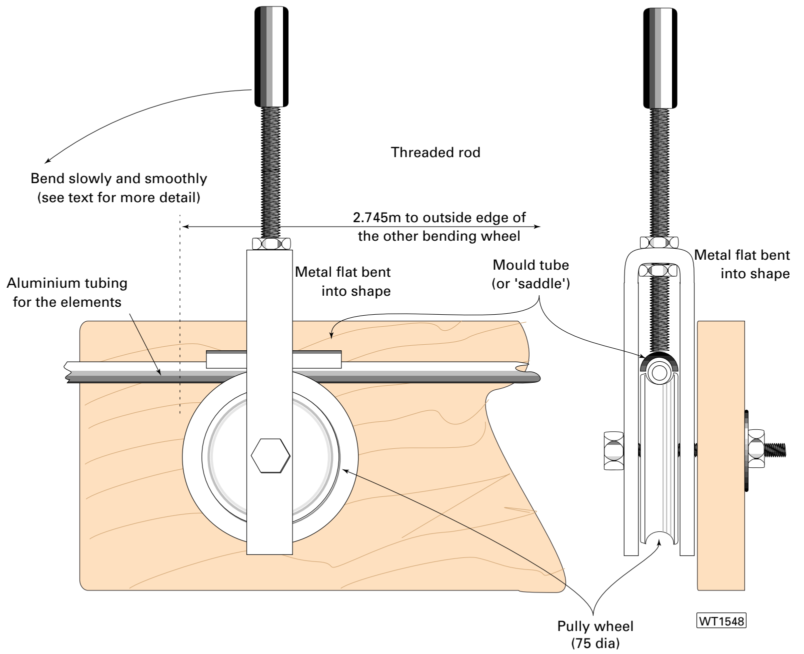
The reflectors are mounted on a small 'sub-boom' with the two outer ones rather longer than the two nearer the main boom. All element spacing is constant at 675mm between element centres. The phasing line should be held in the shape shown with a non-conducting support under the high point.

The Construction

Now it's time to turn to the construction of the antenna, which is quite straight forward. The only tricky bits being the forming of the folded dipole elements. Each element needed to be bent from a single length of aluminium tube for rigidity, but the slightest miscalculation could be costly in tubing.

So, as a compromise on the initial prototype antenna, each element was made up of five pieces of tubing: a 'top piece of 2.67m long, two lower parts - each 1.32m long and two 'U' bends of 9/10mm ($^3/_8$in) for the end pieces. Now the two ends are 'trombone' sliding fit pieces, and could be used to give a slight change in matching to give the best s.w.r. reading.

When the best dimensions for the folded elements had been determined (2.77m 'tip-to-tip'), each of the folded dipole elements was made from a single 8m length of 12.7mm ($^1/_2$in) diameter aluminium tubing. To ensure repeatability, we made a wooden bending jig shown in the diagram of **Figs. 3** and **4**. A bending 'bench' such as the one shown is extremely useful.



■ Fig. 4: The tube forming 'end' in more detail. (See the text for more information).

Bending Wheels

The bending wheels were two 75mm diameter pulley wheels that held the tubing with a snug fit inside the rim. The mould tube, or saddle is a short section of steel tube that had an internal diameter the same as the tubing used for the elements. The 'inside' of this saddle should be as smooth as possible.

The bending bench, or jig, was made from one three metre length of 100×25mm timber with two 75mm diameter aluminium pulley wheels, mounted so, that when the aluminium tube was in place, and bent around the

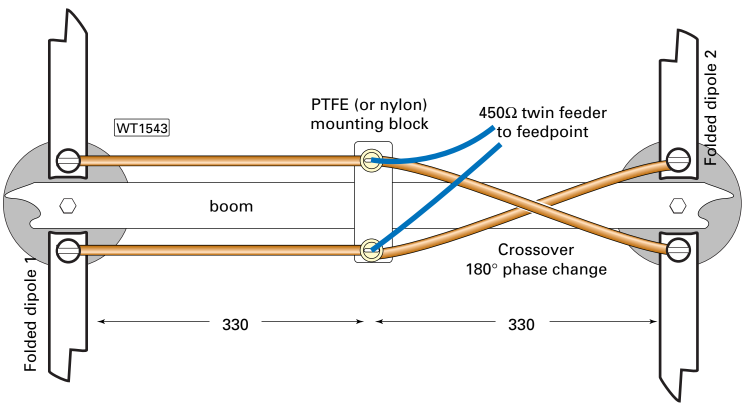


Fig. 5: The cross-over phasing lines can be made from heavyweight insulated copper wire, but should be isolated from each other and the boom. The elements are held onto the boom by commercial dipole mounting kits available from Deecom. (See text for more detail).

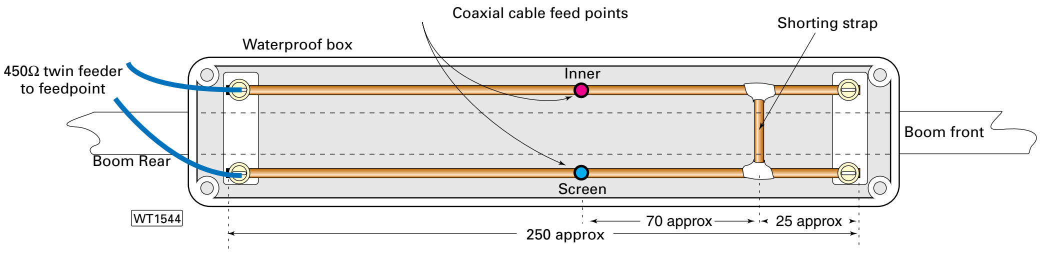


Fig. 6: The shorting bar matching system employed in the antenna. As the impedance can change quite quickly only small

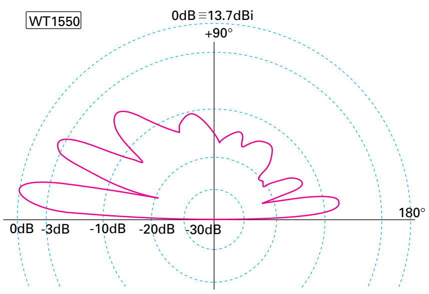


Fig. 7: The theoretical radiation pattern of the antenna in the vertical plane (redrawn from a computer printout).

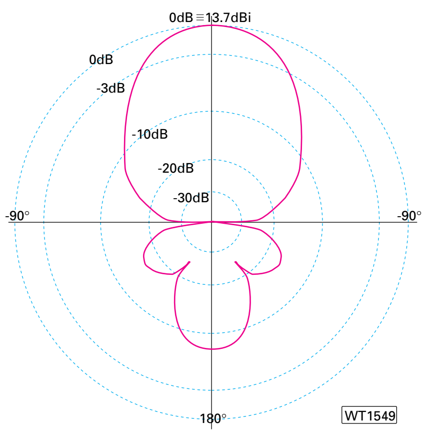


Fig. 8: The theoretical radiation pattern of the antenna in the horizontal plane (redrawn from a computer printout), the forward gain is around 11dBd (13.7dBi).

wheel, the outsides of the curved elements measured 2.77m apart. For initial measurements, only short sections of tube were placed on the pulley wheels.

If you don't want to go to the lengths of making your own jig, then tube formers, to aid bending the tubing accurately, should be available from all good plumbing suppliers ('half-inch' Pipe Benders). However, I can recommend making your own jig, if you have a good mechanical workshop available.

Bending Technique

There is a technique for using pipe-bending formers that gives a good smooth bend without flattened tubing. The technique is to have a bending set-up where all the parts fit neatly and closely together. When making the bend, try and carry out the action in a single smooth movement as evenly as possible.

When bending the tube, especially with aluminium, it's no good try to 'take a run' at it, or snatching the thing. This method often leaves kinks in the tubing or changes of direction at the bend. So, with that in mind and having completed the bending of the element, they should lay flat on the ground.

I used two dipole boom-mounting adapters (originally from **Deecom**) as mounting supports for the driven elements. These were mounted upside-down **underneath** the boom and the folded element was mounted above the boom, the mounting bolts also holding the feeding lines from the common point on the upper side of the boom. The cross-over feeding lines are basically as shown in **Fig. 5**.

Matching & Adjusting

Now a few words about how the matching is checked and adjusted. The dimensions shown in The feed-point-box of **Fig. 6**, make a good starting point.The box itself should be made of some weatherproof insulating material, and the items should be isolated from the boom.

Movements of the shorting strap make large changes to the matching and these should be limited to about one millimetre at a time. Changes to the feed-point position cause less of a change in matching and so, may be used to 'fine-tune' the matching. Take care to seal the case before putting the antenna into operation

Radiation Patterns

The radiation patterns, were originally printed out using *xnecview* that runs under the *Linux* operating system rather than the more usual *Windows95/98*. The patterns, **Figs. 7** and **8**, show that the lobes are broad in the horizontal plane (reducing the antenna 'aiming' problems) but quite narrow in the vertical plane. The patterns themselves have been plotted using the standard ARRL plotting conventions, which will readily enable comparisons with other published designs.

For the purposes of modelling, the antenna was assumed to be 10m above a 'Sommerfeld' ground model for 'average' earth. (This computer model assumes a dielectric constant of 13 and a conductivity of 10^{-5} so, it approximates 'the real world' well).

Since there is some cost involved with making this antenna, both in terms of techniques and cash, it would seem to be an ideal club project. The costs being 'shared' among the members. This is my next task to get our radio club (**Northampton Radio Club G8LED** and **G3GWB**) active on 50MHz.

At my own location, where the original antenna is used, I've noted wind speeds in excess of 75knots (around 135k.p.h.) sustained over several days. The antenna has, in spite of the long unsupported elements, survived it all with honours and allowed me to work into '5B4', '9A', 'SV9', 'ZS6', 'ZB2' and most areas of Europe.

This project would have been far more difficult to complete without a lot of help from **Duncan Cadd G0UTY**, who stepped in to help with the mathematics and computer plots for the antenna,when my own knowledge was 'flagging'. Thanks Duncan!

PW