437 Mhz Cross Yagi Project

Firstly I would to thank the following people for help with this project:-

KC4UMO Buddy McLawhorn:- For taking the time to answer some questions.
G4YCA Chris:- For his webiste article on the construction of the Power Divider/Splitter.
VK4ZZ Gavin:- For the use of the analysers.

I have built a few J-poles, verticals etc, but this was first stab at building a Yagi, various lessons have been learned, and as usual the second one is easier than the first. Well here goes:-

I developed an interest in working the birds, so I started to look for crossed yagi's on the internet. After a few days I decided to build my own. I used a java based website to get my element dimensions and spacing.

Specs

Ref. 337mm
DE. 322mm
D1. 298MM
D2. 294MM
D3. 290MM
D4.286MM
D5. 283MM
D6. 280MM
D7. 277MM

Spacing (Cumulative)

Ref. Zero
DE. 137MM
D1. 188MM
D2. 311MM
D3. 458MM
D4. 629MM
D5. 821MM
D6. 1027MM
D7. 1242MM

I included an extra 40mm each side of the boom for waterproofing purposes. The vertical side of the array was placed ¼ wavelength in front of the first, so an extra 171mm was added to the total. (171mm, ¼ wavelength at design frequency of 437.800 Mhz).

When measuring for the holes in the boom I found that two elements intersected each other, no drama, a shift of a few mm both ways fixed this. I modeled the array in EZNEC, and the change was not even noticeable.

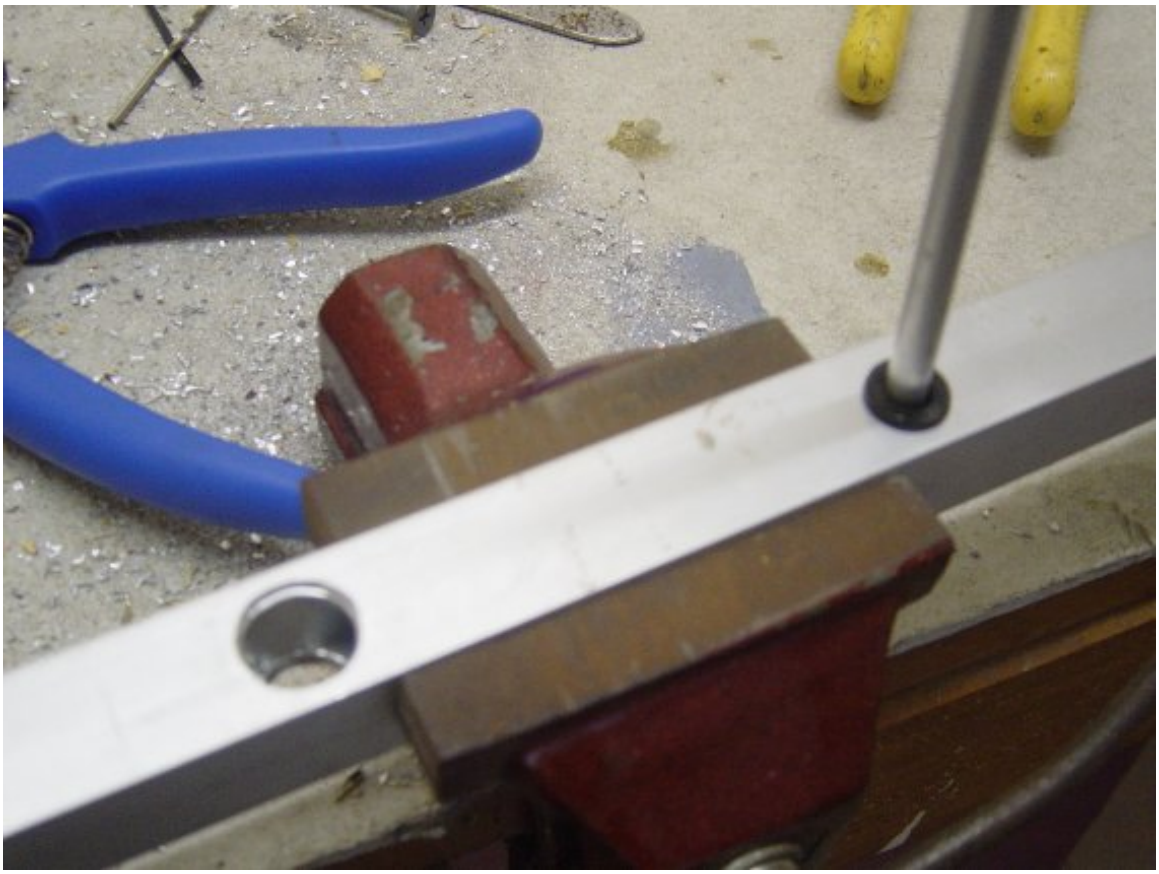
Both antennas would be fed using a pair of gamma match's, and a phasing harness. (more on that later). The material I chose to use was as follows:-

Boom:- 20mm aluminum box section, 3mm thickness (I had a choice here but later regretted this decision), the other alternative was 25 mm box section with 1.9mm thickness.

Driven element was 10mm solid aluminum rod, and all the parasitic elements were 6.35mm solid aluminum rod. Living here in North Queensland can be a pain as we are limited to what we can get, not what we want. I also chose to have all the elements insulated from the boom. This proved

a challenge at first, but after a bit of hunting I found two sizes of plastic LED inserts that fit perfectly. The LED insert for the 10mm rod had to be cut in order to fit into the 20mm box section. This was no problem at all. Below is a photo of the LED inserts, note the larger (10mm) which shows cut to size.

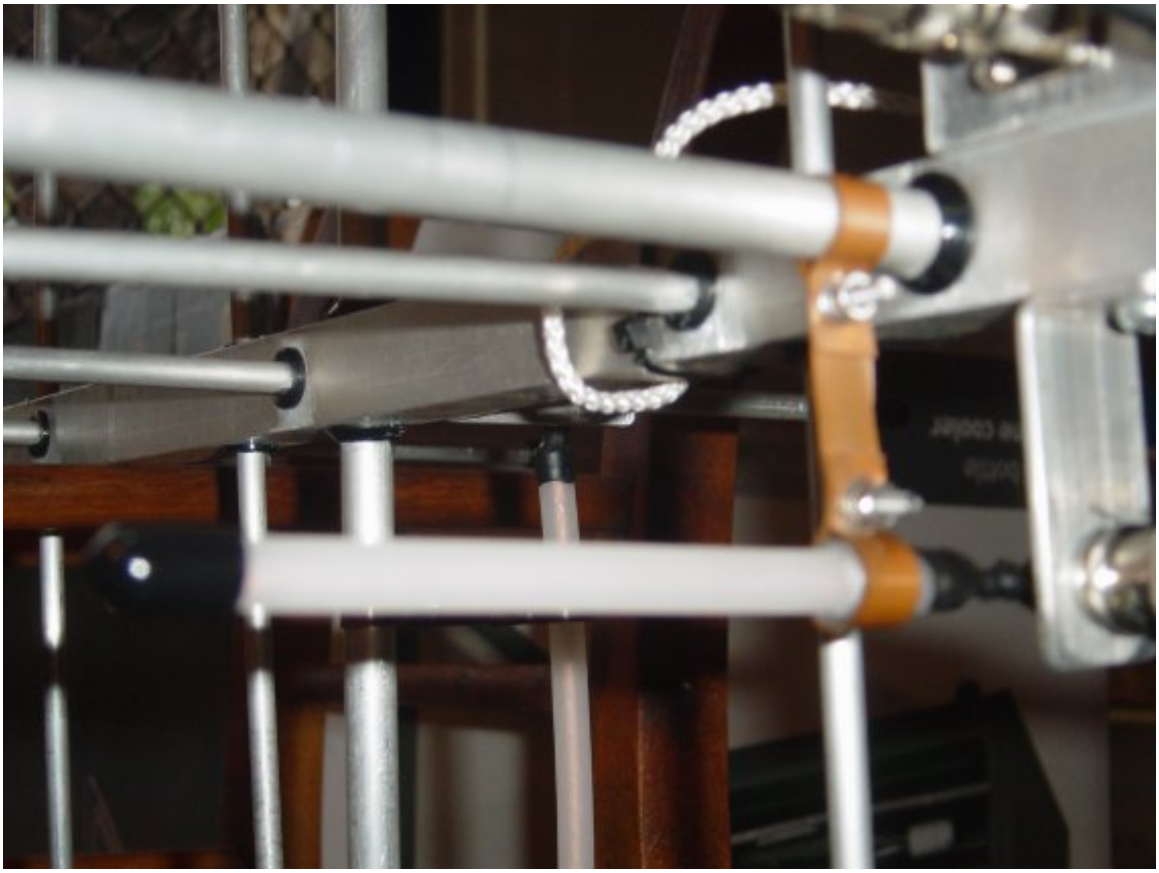
I started with a test piece of the boom as shown below in order to see if everything worked as planned.



The boom was drilled using a drill press for accurate ling ups, elements cut to size, and LED inserts trimmed. It was time to put it all together.

Gamma Match

This was made using striped 213 coax, 10mm aluminum tube (perfect fit with the coax), and copper strip cut to size to form the shorting bar. I made two brackets using 2mm aluminum flat bar, drilled and bent to hold the BNC connectors. I also used the same 10mm tube for the gamma tube. Hardware was 3mm stainless bolts to hold it together. See below:-

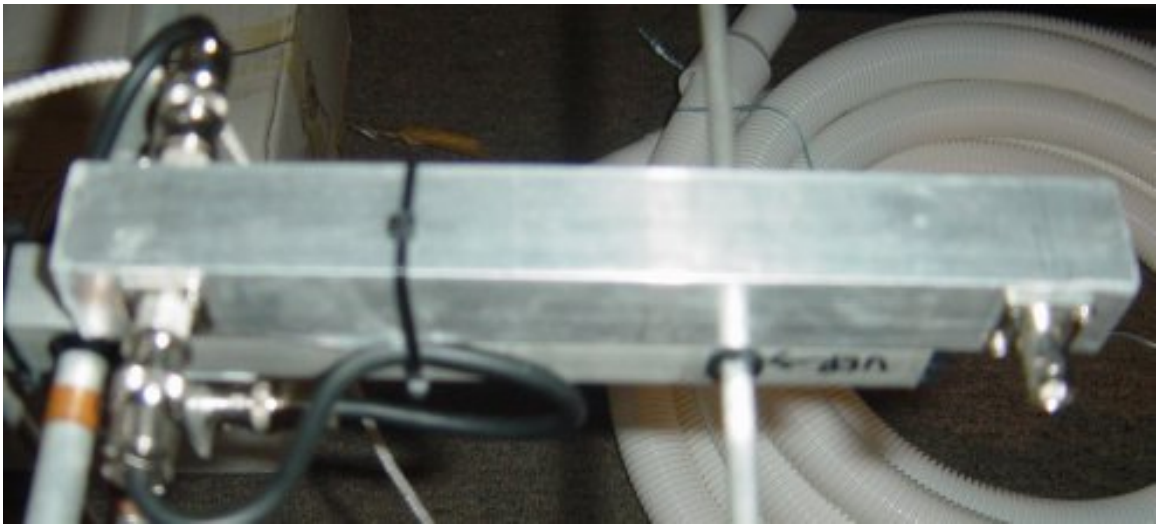


The phasing harness was made with quad shield RG6. Being the first one I have made, this took me some time to get it right. When the array was finished I found that the excess coax altered the VSWR a fair bit, depending where it was positioned. So I did some more research on the net, and found Chris's (G4WYA) website, which showed how to build a power divider/splitter using aluminum box section and copper pipe. He even had the formula, so you could make your own out of what ever size material you can get. This is where I should have used 25mm box section with 1.9mm wall thickness.

The Formula

138Log10(1.08*D/d)

Where "D" is the inside dimension of the box section, & "d" the outside diameter of the copper tube. After plotting it on a spreadsheet, I found that for my case the 25mm box section and the standard copper water pipe of 12.7mm would of given me approx 35.3 ohms, not bad from target of 35.35 Ohms. However I only had a small section of 25mm x 1mm box section & 12.7mm copper pipe. I did not want to send 40 dollars on a new length of box section just for this purpose. End result, the VSWR on the divider is 1:1.5, happy here. Below is an image of the completed divider.



Computer Software

As mentioned I used EZNEC to check the antennas before I did anything. I lost around 3db when crossing the antennas, final output was an estimated 11.25 Db. The radiation pattern is pretty good considering I want this array to be close and not pin point down a rifle barrel.

The final assembly showed good bandwidth and a VSWR of 1:1.5, once again happy here. I used an MFJ & AEA analyser for this. Big thanks for the use of these pieces of equipment from fellow hams in Townsville.

Last but not least, I purchased some 6 & 10mm plastic caps to put over the ends of the elements, just to finish it off. And here's the finished animal:-

We are currently in the monsoon season here, so when I finish the VHF antenna (and the bloddy rain stops) I can give it some on air tests.

I would appreciate any comments from the elmers, on what I could have done better, or different. As mentioned, this was my first at building a Yagi. I am always happy to learn from the experts.

All Best & 73'''s de…. Nick Soter VK4ZXX