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A simple home-made 2m Yagi for portable operation

Hilton Willott describes an easy-to-build 2m Yagi suitable for portable use and in particular SOTA hilltop operation, where light weight and ease of physical transportation are prime considerations. It would be an ideal project for anyone contemplating operation in this year's RSGB 144MHz Backpackers events, which start in May.

I am an avid reader of the technical articles in *RadCom* and am constantly amazed by the high standard of technical ability of the authors. It is with some trepidation that I sat down to write this article. I did a year as an M3 and in December 2003 took and passed the RAE, but I consider myself very much a novice. I have no special electronic or mechanical skills but thought that if this project worked for me there was no reason that it should not benefit others in my situation. It needed the minimum of expertise, tools and cash. This is cheap, real 'Blue Peter' stuff, *but it works well.*

INSPIRATION

The motivation began whilst doing the September 2004 RSGB 144MHz Backpackers contest. I had just carted all of my gear up to the top of Hay Bluff and only just managed to set up prior to the start. The antenna that I use is a Tonna 9-element Yagi for 2 metres. It splits at the centre but is still very awkward to carry, with the elements protruding all over the rucksack and by the time I arrived I looked like a demented porcupine and the antenna needed serious straightening (see 'Down to Earth', *RadCom* February 2005, front cover and pages 40 – 41). This, together with four five-foot aluminium poles for a mast constituted a considerable load. I needed something smaller. During the contest I was fortunate to have QSOs with MW0YLS/P on SOTA summit NW016 and GW1INK/P on NW028 (thank you both). I made a mental note to find out more about SOTA.

I went back to the July 2004 *RadCom* and read the article by John Linford, G3WGV, and visited the excellent SOTA website (see 'Web search'). It seemed a great way to combine hill walking and amateur radio. All I needed was an antenna system that was easier to carry. By chance I found an article on the Internet by Kent Britain, WA5VJB, entitled 'Cheap Antennas for VHF/UHF'. He gives dimensions for 19 types of Yagi for VHF and UHF. I was impressed by the simplicity of the construction. Most great ideas are simple.

BUILDING THE BEAM

Kent used a piece of 1/2in x 3/4in wood as the boom for his antennas. I did not have any wood lying about but I did have some 1.5in plastic waste pipe. I then realised that if I used a pipe as the boom it would also act as a carrying tube for the elements whilst walking. The other thing I needed was some 1/8in silicon bronze welding rods. A friend had some 2m lengths of 3mm stainless steel welding rods; not ideal but I thought I would give it a go with this instead.

The tools that I used were: hacksaw, tape measure, vice, bench drill, file and a marker pen. The dimensions for 3, 4 and 6-element versions of the beam are given in **Table 1**. Note that all spacings are measured from the reflector, the rearmost element. Being American, all dimensions in Table 1 are in inches! See **Fig 1** for details of construction of the driven element. The distance H on the driven element is 1in.

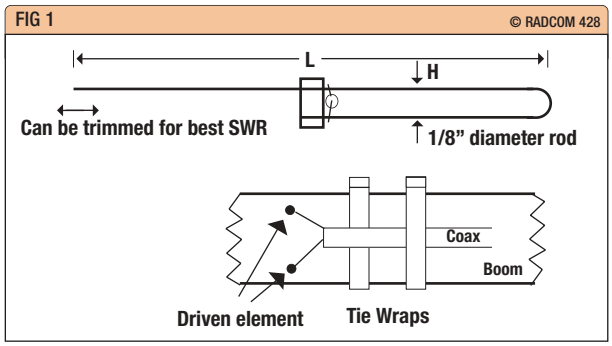

Fig 1: Detail of construction of the Yagi's driven element

The completed antenna under test in the author's garden.

The first thing to do is to note the length from the reflector to the last element and add a few inches, this is then used to cut a length of the plastic waste pipe. I then had the problem of making sure that the holes for the elements were all drilled as near to 90° to the axis of the pipe as possible. I noted that along the length of the pipe there was writing, printed in a continuous straight line by the manufacturer. I used this as a reference to mark out the places where the holes for the elements needed to be drilled. I suspect the engineers among you have a cunning method for all of this.

I drilled the first hole for the reflector about 1in from the end of the pipe and then carefully measured the correct length on the welding rod and cut it. This was to be my reference point both for the distances of the reflector and the angle at which the tube needed to be held to get the elements in line. I did not have a vice to clamp the pipe to the table of the drill so I used a couple of 'U' bolts I had in my box of bits. I inserted the reflector into the hole made in the pipe and used it to

Table 1

	144 MHz	REFLECTOR	DRIVEN ELEMENT	DIRECTOR 1	DIRECTOR 2	DIRECTOR 3	DIRECTOR 4
3 Element	Length	41.00in	38.50in	37.00in	-	-	-
	Spacing	0	8.50in	20.00in	-	-	-
4 Element	Length	42.00in	38.50in	37.50in	33.00in	-	-
	Spacing	0	8.50in	19.25in	40.50in	-	-
6 Element	Length	40.50in	38.50in	37.50in	36.50in	36.50in	32.75in
	Spacing	0	7.50in	16.50in	34.00in	52.00in	70.00in

Table 1: Element lengths and spacings for 3, 4 and 6-element versions of the Kent Britain, WA5VJB, portable 2m Yagi. The spacings are measured from the Reflector, the rear-most element of the antenna. The distance, H, on the driven element (see Fig 1) is 1.00in. Elements are 1/8in diameter.

Left: The completed 2m Yagi.

Above: Detail of driven element construction. Note the elastic band to provide just sufficient friction to stop the elements from sliding in and out.

Above left: Close-up showing the method of mounting on a telescopic fishing rod. The hole at right angles is to allow the antenna to be used with vertical polarisation.

sight along and get it in line vertically with the drill bit, chuck and shaft of the drill. Not very scientific but it worked OK. Having made another hole I made another element according to Kent's table and then placed that into the pipe and sighted along both of them. I then repeated the process until all of the holes were drilled. As I made the elements I made a light cut with the hacksaw half the diameter of the tube away from the centre of the element. This was to allow me to position the cut against the tube to get the elements centralised when assembling them. I also made a number of cuts in the end of each element according to its position number, again to ensure that I assembled it correctly in the field. The holes that I drilled were a gentle push fit but I was concerned that the elements did not move when they were in place as the holes gradually enlarged over a period of time. All I did was use a rubber band looped over the element, round the tube and then again over the element as it passed through on assembly. This provided good friction, yet by lifting the band the element could easily be slid out.

A problem that I had was how to attach the coax to the driven element as it was stainless steel. I do not have the kit to solder to stainless and the ability to easily attach and take off the coax seemed useful. I overcame this by filing a flat spot about 10mm long on the two points of attachment on the driven element and sliding the brass ferrule from a block connector on to the rod. This gave me one screw to locate the point of feed and the other to attach the coax.

I finished the construction (that is a very posh word for a process that took less than an hour and a half) and realised that I had failed to consider how I was going to mount the beast. I have a fibreglass fishing rod which I had bought from the local market for a fiver. It is a roach pole and extends to about 6m by sliding out the tapered sections. All I did was to select the sections that would give me about 4m in height and seemed stiff enough to cope with the antenna. I measured the diameter of the top section and drilled a hole in the waste pipe at the point of balance. In order to use the antenna for both SSB and FM [which on 2m are normally horizontally and vertically polarised, respectively – Ed] I drilled another at right angles to the first. As the fibreglass section is tapered the antenna slides down a couple of inches and becomes a nice firm fit – simple and easy.

TESTING, TESTING

Now for the moment of truth. I did not have high expectations as I am no antenna buff and no construction expert. I tied the pole to the washing line in the back garden and mounted the antenna. I fed it through my Avair AV 200 SWR meter to the trusty Icom IC-706MkII. I had an SWR of 5:1.

I pruned the driven element by half an inch. There was no science in this, just a guess. I got 2.5:1, by nibbling it down further by very small lengths I got it down to 1.4:1. I expect someone who knew what they were doing could get a better match but it was good enough for me to try it out.

On 4 October last year I went to a location near my Chepstow QTH at about 150m ASL and had a go. My first contact was with G3EDD using 10W on SSB with a report of 55. The second was with GW0PLN both on FM and SSB with reports of 57. The thing actually worked! Since then, my best DX with this antenna was from a location near my home at a height of 137m ASL, IO81PQ, on 16 December 2004 with F6KEQ in IN98 with a report of 55.

Kent notes that the antenna as designed is peaked for 144.2MHz but its performance is still good at 146MHz.

I have now also constructed one of Kent's 70cm antennas. It was as simple to construct as the one for 2m, and using the same methods and materials. I did have to spend a little more time playing with it to get the centre frequency right and to get the SWR down, but it was well worth it.

What next? Well, I was thinking that for SOTA it would be nice to pull the antenna out of the rucksack and have it self-assemble – rabbit out of a hat job. I am about to try to construct one of Kent's 2m antennas using pieces of metal from a tape measure. They seem stiff enough to retain their form yet bend easily when stuffed into a small space. We will see. ♦

WEB SEARCH

'Backpackers' contest (RSGB VHF Contest Committee):	www.blacksheep.org/vhfcc
SOTA:	www.sota.org.uk
'Cheap Antennas for VHF/UHF' (Kent Britain, WA5VJB):	www.clarc.org/Articles/uhf.htm