Antenna Workshop

David Butler G4ASR describes how to build a 4-element WA5VJB Yagi antenna for use on the 144MHz band.

Operating on the v.h.f. bands from a local hilltop is a great way to experience making contacts over reasonably long distances. There's even an exciting award scheme, **Summits on the Air** (SOTA), which encourages lightweight portable Amateur Radio operating in mountainous and wilderness areas.

All you need is a low power transceiver (it can be f.m. or s.s.b.) and a small antenna. You can use a small whip antenna, but this will only provide you with local v.h.f. contacts.

If you've spent a few hours trekking to the top of a hill you might as well get some reward for your effort by using a directional antenna with a bit of gain. The directional antenna I'm going to describe is a 4-element Yagi, originally designed by **Kent Britain WA5VJB** for use on the 144MHz band.

The basic antenna I shall describe is 1028mm long. But if that is too big I've also included details for a much smaller 3-element Yagi with a boom length of only 508mm.

This Yagi is very easy to build using inexpensive materials and simple hand-tools for its construction. So, if you need a directional Yagi for portable operation or general home station communications, this simple 144MHz antenna might just suit your requirements.

Yagi Configuration

The Yagi shown in the photograph, **Fig. 1**, is the 4-element version, comprising of a reflector, a driven element and two director elements mounted through a wooden boom. The driven element is slightly unconventional in that it uses a J-pole configuration. This arrangement raises the antenna feed-point impedance to 50Ω and allows the use of an unbalanced feeder cable.

Because you can use coaxial feeder, no baluns or gamma match methods are used in this design and the feed method is simplified by directly soldering the coaxial cable to the driven element.

Using the dimensions and spacings given in **Fig. 2** the Yagi will possess gain peak at around 144.2MHz, which is within the s.s.b. section of the band. However as the v.s.w.r. is substantially flat across the band, the performance is still better than fair within the f.m. section of the band above 145MHz.

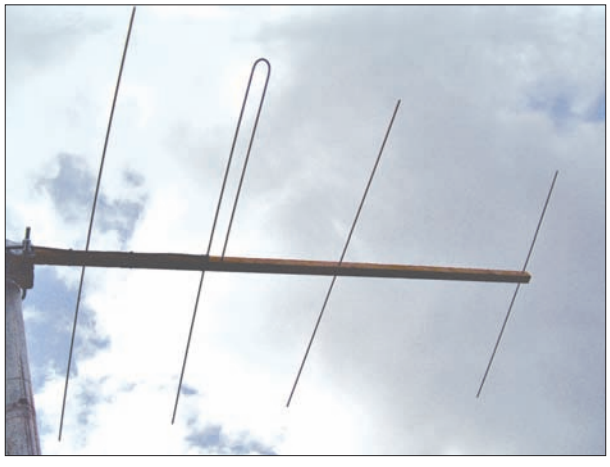

Fig. 1: The 4-element version of the WA5VJB Yagi antenna under a glowering sky. The three element version is quite a bit shorter if you need to conserve space in the turning circle.

Overall the Yagi is quite short, so it can be attached to the support mast with a clamp at the rear of the reflector element. The coaxial feed cable is also routed out towards the back of the antenna. This method ensures that neither the supporting mast nor cabling interferes with any of the Yagi elements thus maintaining the integrity of the antenna pattern.

Wooden Batten

I made the boom from a 1.5m length of 20mm (3/4in) square wooden batten. Select a suitable piece from a local d.i.y. store making sure that it is not warped or has knots in it. Paint or varnish should be applied to the boom to protect it from the weather if required. There is little reason why fibreglass or plastic tubing wouldn't work just as well.

The elements are made from 3mm (1/8in) silicon bronze welding rod, 'hobby' tubing, and solid grounding wire or aluminium tubing with no change in performance. However, as you must solder the coaxial cable directly to the J-pole it's best to use a material for the driven element that can be easily soldered.

By the way there's no performance loss if you use a different material for the J-pole and all the other elements - just use what you can get. Don't worry unduly if you cannot find any 3mm (0.125in) diameter rod, as 4mm rod can be used for the elements instead.

However, since this element diameter is slightly larger than the original WA5VJB design it may be necessary to reduce the lengths of the two director elements very slightly, a few millimetres at a time. The reflector and driven element and other inter-element spacing don't need changing though.

Construction

The antenna is surprisingly easy to build and I constructed mine within an hour using only a tape measure, a hacksaw, drill and hot glue gun. The dimensions in millimeters, shown in Fig. 2, should be read in conjunction with Fig. 1, which shows the general layout of the Yagi antenna.

The element spacing is referenced from the reflector position rather than giving individual inter-element dimensions. By referencing all dimensions to one starting position you reduce inaccuracies along the length of the boom. Measure, mark out and drill holes in the wooden boom to enable the elements to be secured as a push-fit through the boom.

The reflector and director elements are now cut to length and pushed through the holes in the wooden boom. A drop of glue or quick-set epoxy is used to hold the elements in place, having first made sure that the elements are centrally located about the boom.

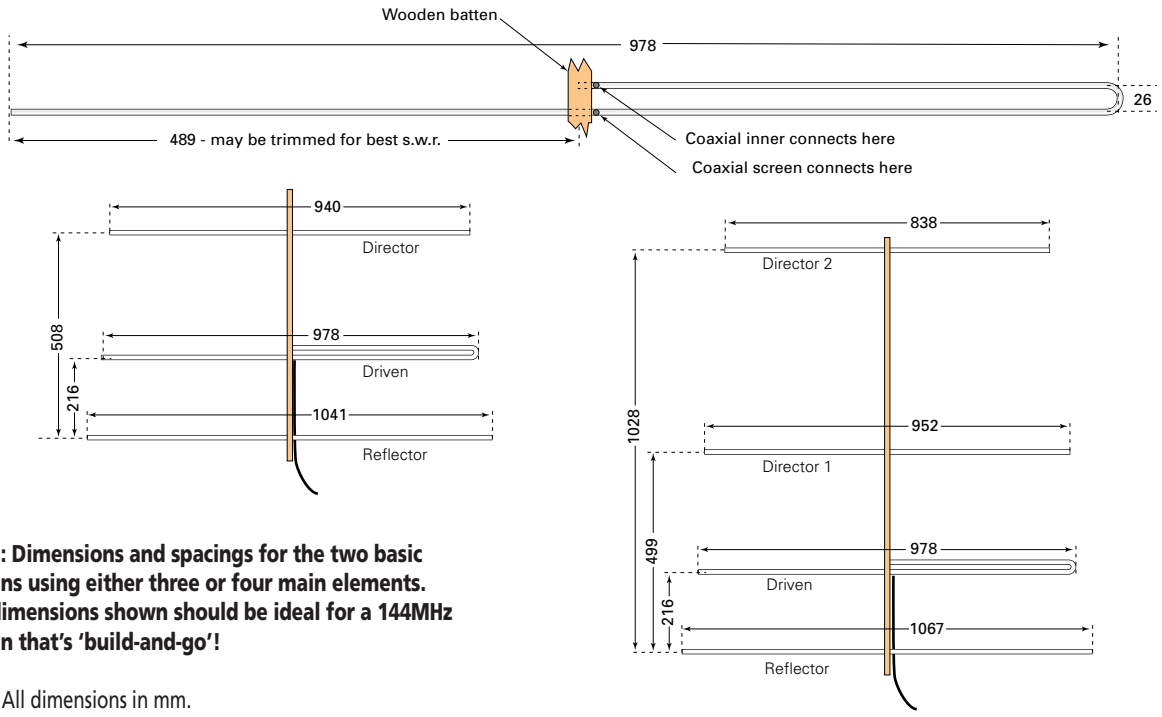

Fig. 2: Dimensions and spacings for the two basic designs using either three or four main elements. The dimensions shown should be ideal for a 144MHz design that's 'build-and-go'!

Note: All dimensions in mm.

The driven element is constructed as shown in the diagram, Fig. 2, and then pushed into the wooden boom. I used a 25mm (1") diameter broom handle as a former for the J-pole.

Before fixing it in place with glue, it's best solder the coaxial cable to the driven element. You may either want to connect a short piece of cable with an in-line coaxial connector (so that a longer main feeder may be connected to it) or attach a long piece of cable directly to the driven element.

The cable is soldered to the driven element, connecting the inner conductor to the open end of the J-pole and the outer screening to the middle of the element as shown in the photograph **Fig. 3**. The cable should be routed to the rear of the antenna fixing it to the wooden boom with tie-wraps or insulating tape. You could wind a small loop of the coaxial cable into an r.f. choke right at the feed-point to act as a balun but this is not absolutely necessary.

Check the v.s.w.r. of the antenna and then put a blob of glue over the end of the coaxial cable connection and around the element to fix it to the boom. You can adjust the v.s.w.r. by slightly trimming the open end of the J-pole but this shouldn't be necessary if you follow the dimensions given.

Results

The results of this project are that, for less than £10 you end up with a portable antenna that has a great performance for its price, size and weight. I hope that more Amateurs will discover the WA5VJB Yagi design and spend an evening making this cheap but very effective antenna.

PW

Fig. 3: Looking at the feed-point with more detail visible in the inset photograph.