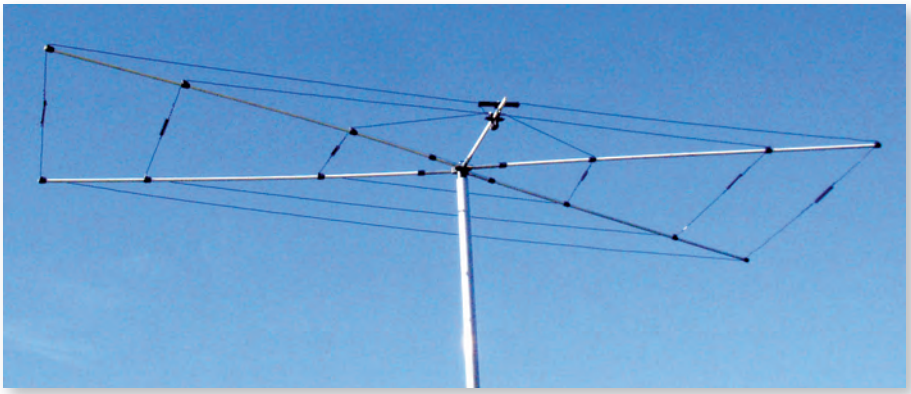
David Butler's

antenna workshop

David Butler G4ASR describes a Moxon Tri-Band Beam Antenna for the 50, 70 and 144MHz Bands.

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) that encourages lightweight portable operating in hilly and wilderness areas. All you need is a transceiver and a small antenna. Sometimes though, you may want the flexibility of operating on a number of different v.h.f. bands, especially as nowadays many transceivers cover a multitude of bands.

You could use a small whip antenna but this will only provide you with local v.h.f. contacts on one solitary band. If you've spent some time getting to the top of a hill you might as well get some reward for your effort by using a directional antenna that is lightweight, possesses a small amount of gain and covers a number of v.h.f. bands. A directional antenna that meets all these criteria is the Moxon beam.



The Moxon Beam

The Moxon beam antenna is fairly well known in Amateur Radio circles and is a derivative of the VK2ABQ square (a quad loop antenna, cut the loop at each side in the centre and then they're insulated from each other). Originally, VK2ABQ found that his beam antenna possessed some directivity and gain in the direction of the feed point. **Les Moxon G6XN** then looked at this design and made two very significant discoveries about the VK2ABQ square.

Les Moxon's experiments showed that a rectangular shape improved the forward gain and that the spacing between the ends of the wires had to be much greater than in the VK2ABQ. It became, a two-element beam but smaller than a 2-element Yagi. The version that I'm describing is essentially a set of wire beams with a common feed-point nested within each other to cover the 50, 70 and 144MHz bands.

Characteristics

No antenna does everything well but the Moxon design has a number of useful characteristics. It possesses a modest but useful gain of about 4dBd, it has a wide front lobe of around 100° beamwidth (between -3dB points) and none of the side-lobe notches associated with most other antennas. It has an excellent front/back ratio of up to -35dB and it requires little or no matching, connecting directly to a 50Ω feed line.

The antenna covers three popular v.h.f. bands, it's very lightweight and can be turned with a very small rotator if you're going to use it from a semi-permanent location. Finally, it's a compact and simple design that's inexpensive and easy to build with minimal tools and skills,

Tri-Band

Take a look at the layout of the tri-band Moxon antenna as shown in diagram **Fig. 1**. It consists of a centre aluminium spider, into which four fibreglass tubes are inserted. Plastic wire retainers, on the fibreglass spreaders allow the elements to be fixed. Wires form both driven and reflector elements for each of the three v.h.f. bands. The ends of the wire elements are kept apart by plastic insulator strips.

The centre spider also facilitates connection for another short length of fibreglass tube onto which is attached a coaxial connector **Fig. 2**, to form the common feed-point **Fig. 3**. The feed arrangement shown in the diagram, Fig. 1, was developed to provide isolation between the 50MHz and 144MHz elements.

A short section of aluminium tubing is also connected to the centre spider

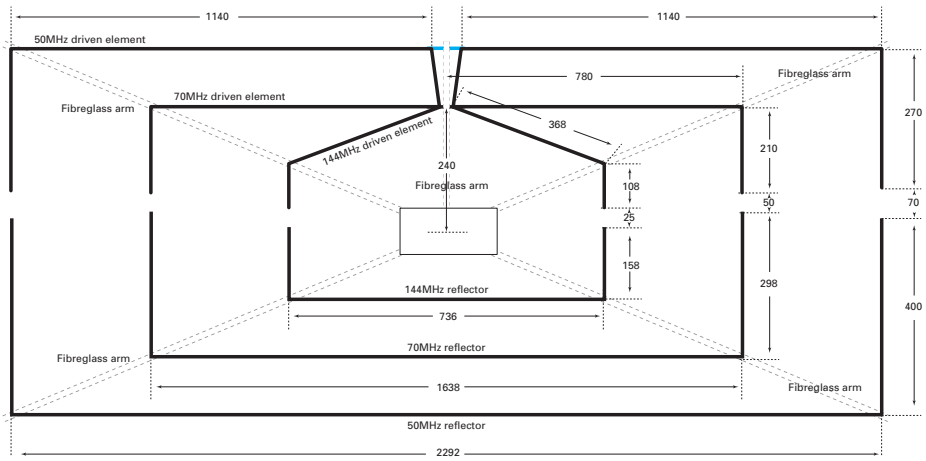


Fig. 1: An overall view of the triple-band Moxon rectangle for 50, 70 and 144MHz.

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Fig. 2: The 'spider' in the centre of the antenna is of simple design. The vertical running pole (vertical in the picture but horizontal in Fig. 1) goes out to become the support point for the common feed-point, as shown in Fig. 3.

to allow attachment to a main mast. Normally the antenna is mounted horizontally but it can be mounted vertically if you need to use it to access repeaters or other stations using vertical polarisation.

Materials & Construction

The materials for this antenna are easily obtained for construction, more so because I've arranged that you can get all the hardware such as the centre spider, plastic wire retainers, insulator strips and feed connection from **Sandpiper Antenna Technology** (see separate panel).

The beam elements are made from 2mm diameter 16-strand plastic coated wire. You should add an extra 80mm to each end of the elements for adjustment. The end 80mm of each wire element is passed through the plastic insulator and twisted back to secure it.

The layout of the 144MHz driven element is quite critical so follow the diagram exactly as shown. That's all there is to constructing the tri-band beam and now you're ready to check out the antenna.

Checking the Antenna

To start checking the antenna, temporarily connect a v.s.w.r. meter to the feed-point connector (use a 50Ω patch lead about a metre long) and then attach your 50Ω feed line to the other side of the v.s.w.r. meter back to the transceiver. The dimensions given should produce a minimum v.s.w.r. around the bottom of each band.

Check the v.s.w.r. on the 50MHz band first. It should be much less than 2:1. If not then shorten the driven element a small amount to move the v.s.w.r. curve up the band, or lengthen the wire to move it down.

Simply untwist the ends of the wire, adjust the length and then twisting the surplus back again. There is negligible interaction between the three bands so carry out the same procedure for the 70MHz band and finally the 144MHz band. If you've built the antenna to the dimensions given then normally any v.s.w.r. problems are associated with the proximity of the antenna to other objects and to a lesser extent the height of the antenna above ground.

Other Bands

Let's now look to making a Moxon rectangle for other bands. There's a program that calculates the dimensions of a Moxon rectangle. It's been written by **Dan Maguire AC6LA** and you can find this on his website at **www.ac6la.com**/ Just input the design frequency and diameter of the wire or tubing and the program will provide all the dimensions.

Note that if you want to build a Moxon rectangle with different size wire or tubing then altering the element diameter will result in slight changes for the required spacing of the element tips. Different size tubing changes the coupling between the tips.

To achieve the same coupling with larger tubing the tails will need to be further apart but without significantly changing the overall final design length of the reflector element. Anything more than small changes in element diameter may require juggling all of the dimensions to maintain performance and still have a near 50Ω feed-point impedance.

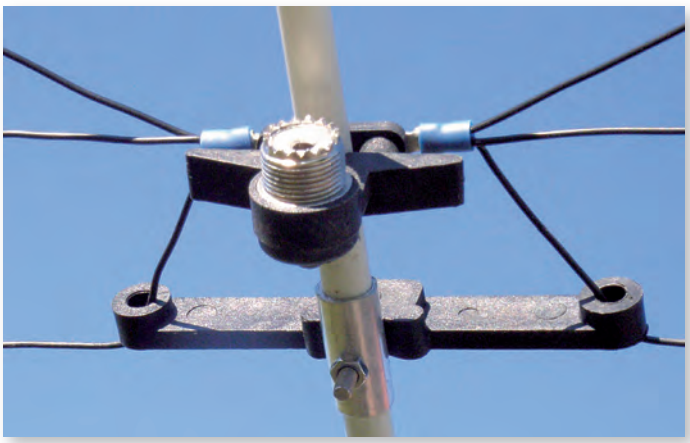

Fig. 3: The common feed-point. Note the tapering feed out to the 50MHz driven element.

A complete kit of parts to make this Moxon 50MHz, 70MHz, 144MHz tri-band beam antenna can be obtained from **Sandpiper Aerial Technology, Unit 5, Enterprise House, Cwmbach Industrial Estate, Aberdare, CF44 0AE** for an introductory price of £55. Postage & Packing is £10. Telephone Sandpiper for further details: **01685 870425** or via their website at: **www.sandpiperaerials.co.uk**