Antenna Workshop

FIVE YAGI ANTENNAS for the 50MHz band

Five On Fifty - David Butler G4ASR, a keen v.h.f. operator and our VHF DXer columnist, describes five antennas for the very popular 50MHz band.

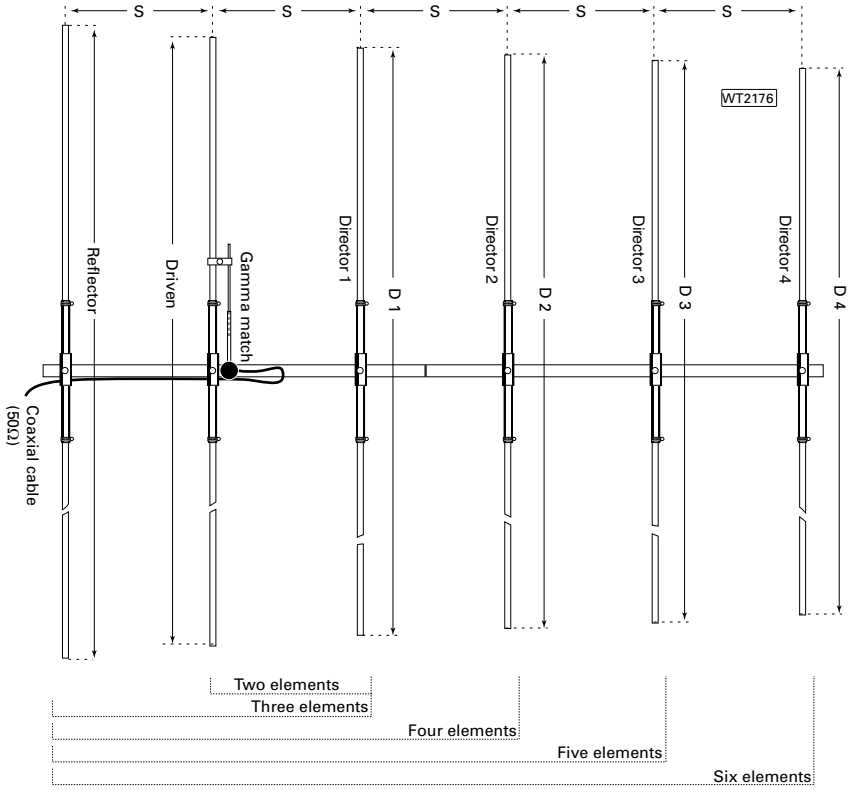


Fig. 1: Combined diagram of all the designs. Table 1 should be consulted for the actual dimensions for each design.

This time around I'm describing a set of five Yagi antennas for the 50MHz band varying in size from a small 2-element, to a larger 6-element whopper. If you have antenna size restrictions you might find that the 2-element beam on a 750mm boom will suit your needs as it looks very similar to an f.m. broadcast antenna.

Maybe you're a newcomer to the 50MHz band and don't know what antenna to start with. The 3-element Yagi with a 2.25m boom length is compact, yet provides good directivity and gain. Seasoned operators may wish to upgrade to a larger antenna with more gain and the performance of the 4-element or 5-element Yagis could be just what you're looking for.

If you really want to winkle out the DX stations, perhaps from a portable location, take a look at the the larger 6-element Yagi with a gain of 10dBd. The choice is yours. Whether you want to chat to local stations or are interested in DXing there will be a 50MHz antenna here to suit your requirements.

The design data for the five Yagi antennas shown here are very similar, the only difference between each model is the element length and element spacing. For each of these designs the element spacing remains constant and the elements reduce in length from back to front.

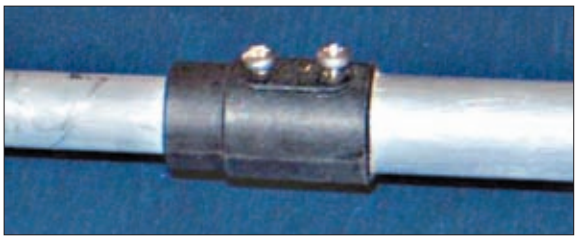
The diagram, **Fig. 1**, shows all the antenna designs combined into just one diagram. With the exception of the 2-element Yagi, all the antennas described here, consist of the conventional reflector, driven element, director arrangement. The smallest of these antennas doesn't use a reflector and consists only of a driven element and director. The table of dimensions, **Table 1**, should be read in conjunction with Fig. 1 which shows the general layout of the Yagi antennas.

Square Booms

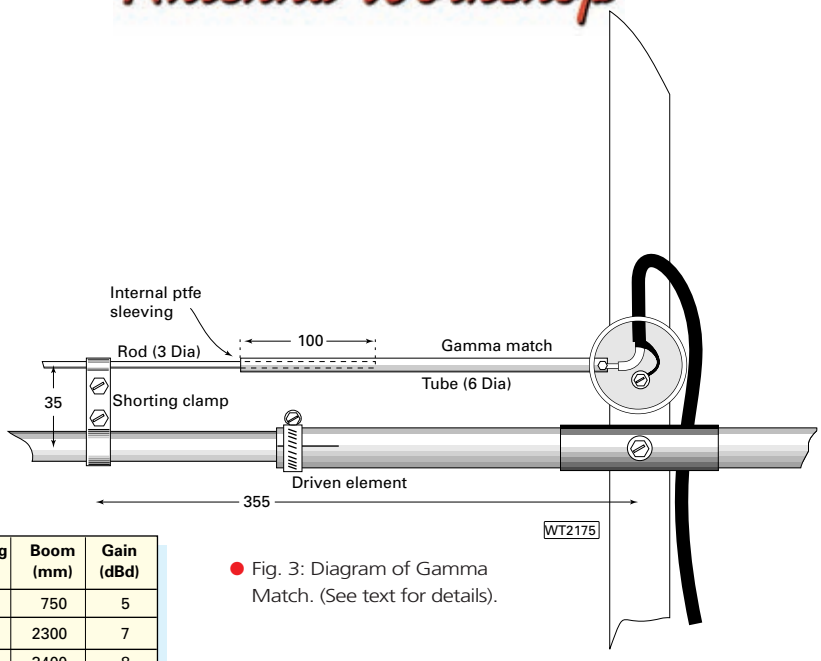
The antennas described here all use 25.4mm (1") square booms and 12.7mm (0.5in) diameter elements. These sizes form an excellent compromise, as I've found the materials are light enough for portable use, but they will also stand up to the rigours of winter in most of the UK.

Start construction with the boom which may need to be fabricated from one, two or even three pieces of square tube joined together. Cut to size a length of 25.4mm square aluminium tubing allowing a short overhang at each end of the boom. The 2- and 3-element Yagi designs use a single length of square boom. However, the designs for the four, five and six element versions will require two or three lengths of square tubing joined together with boom joints.

The joints consist of a 200mm length of 22mm (7/8in) square tubing inserted inside the 25mm boom and fixed with self-tapping screws. Measure, mark out and drill holes for the elements as shown



● Fig. 2: Photograph of moulded joining piece available from Sandpiper communications.



● Fig. 3: Diagram of Gamma Match. (See text for details).

Elements (No.)	Reflector (mm)	Driven (mm)	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	Spacing (mm)	Boom (mm)	Gain (dBd)
2		2819	2645				724	750	5
3	3073	2819	2654				1124	2300	7
4	3073	2819	2654	2616			1124	3400	8
5	3073	2819	2654	2641	2616		1130	4600	9
6	3061	2819	2629	2578	2527	2477	1092	5500	10

● Table 1: Table of dimension of the various designs covered in this article. Spacing (dimension S on Fig. 1) is fixed for each design.

in the tables. A tip here is to measure all spacing dimensions from the reflector position rather than marking out between each element. By referencing all dimensions to one starting position you greatly reduce inaccuracies along the length of the boom.

Now let's turn to making the various elements needed for the antenna. Each element is made from two lengths of 12.7mm (0.5in) outside diameter aluminium tubing telescoped into a 380mm (15in) centre section of 16mm (5/8in) tubing for strength. To set the element lengths I used moulded joining pieces with integral screws as shown in the photograph, **Fig. 2**.

Four Slits

Alternatively, cut four slits in the ends of the centre sections with a hacksaw and secure the joints with a small diameter hose clamp. Either method permits easy adjustment to frequency if required. Alternatively you can cut each element to length and fix through the centre section with self-tapping screws.

The dimensions given in Table 1 are for a design frequency of 50.5MHz. The 1.3:1 v.s.w.r. bandwidth curve is in excess of 1MHz so these measurements will fully cover the lower part of the band. If you only want to use the antenna above 51MHz reduce all the element sizes (not the spacing) by 50mm.

Shortening the elements by 50mm will optimise the antenna at around 51.5MHz. Clamps to join 12mm elements onto 25mm square booms are commercially available from a number of sources. I've found **Sandpiper Aerial Technology** one of the best suppliers for these specialised antenna components.

The driven element is matched to the 50Ω coaxial feeder cable by a gamma matching system shown in the diagram **Fig. 3**. In effect the arm is a variable capacitor (about 35pF) connected in series between the inner of the coaxial cable to a matching point on the driven element. To provide the necessary series capacitance a length of 3mm (1/8") diameter rod is partly telescoped inside a 6mm (1/4in) diameter tube about 200mm long. The tube is lined with p.t.f.e. sleeving which acts as a dielectric and provides a sliding fit.

The sleeving can be obtained from a model shop or commercially from Sandpiper. Alternatively you could carefully wrap plumbers p.t.f.e. tape around the rod until it is a snug fit inside the tube. Then insert 100mm of the gamma rod into the tube. The end of the gamma rod is clamped to the driven element 355mm from the centre line of the main boom. The spacing between the rod and the driven element is set at 35mm by the fixing clamp.

Coaxial cable is connected to the gamma rod in a waterproof junction box and the outer of the cable is securely connected to the centre line of the boom as close as possible to the driven element mounting. The position of the shorting clip is then adjusted for the lowest reflected power. If the match is not sufficiently low slightly adjust the length of rod inside the tube by a few millimetres and reposition the shorting clip.

Adjustment

The easiest way to carry out s.w.r. adjustment at ground level is with the antenna pointing straight up with the reflector element a metre or so above the ground. However for optimum performance you should always check the performance of the Yagi within your particular installation as it may also have other v.h.f. antennas within its capture area and these can cause detuning.

Using a gamma matching system can induce currents on the shield of the coaxial cable feed line (which can degrade the beam pattern) but if constructed with care there should be no noticeable distortion of the polar pattern. This matching method however can be prone to moisture incursion into the tubing so it is necessary to seal the open end of the arm with heat-shrink sleeving.

The smaller Yagi designs are self supporting and can be fixed to the mast with a suitable clamp located at the balance point. The four, five and six element Yagi antennas will require a support to prevent drooping of the main boom. An inexpensive yet effective method is to support the boom with nylon cord to a small clamp one metre or so above the main boom. To complete the job I suggest that rubberised caps are fitted to the ends of the boom and the antenna elements. *PW*

Now that you're ready to get going on the 'Magic Band' I suggest you take a look at the UK Six Metre Group web site at **http://www.uksmg.org**

Sandpiper Aerial Technology (**http://www.sandpiperaerials.co.uk**) of **Unit 5, Enterprise House, Cwmbach Industrial Estate, Aberdare, CF44 0AE. Tel: (01685) 870425** can supply element fixing clamps, aluminium tubing, gamma match assemblies and other antenna mechanical items. Please check with **Chris, Mark** or **Jane** for prices and availability of individual items for the antenna you'd like to make.