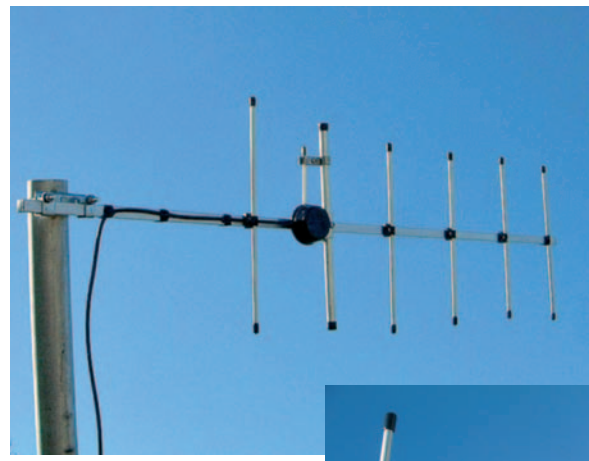
Antenna Workshop

A 6-Element Yagi Antenna For The 430MHz Band

David Butler G4ASR, a keen v.h.f. operator and VHF DXER columnist, describes a Yagi antenna for the popular 430MHz band.

An antenna should suit the job it's designed to do. So, if you are planning to build a moonbounce array, don't use this antenna! But if you need a directional Yagi for general communication modes, satellite operation or packet radio access then this 430MHz antenna might suit your requirements.

This antenna comprises of six elements mounted on a boom that is less than one metre long, yet it can provide a gain of around 10dBd. The Yagi antenna consists of the conventional reflector behind a gamma-matched driven element, with four director elements mounted on a boom about 1.2m long.



This antenna with its element and boom dimensions, is based on information contained in the American National Bureau of Standards (NBS) Technical Note 688. Written by **Peter Viezbicke** in 1976, this classic 30-page Yagi antenna design document can be viewed at **www.boulder.nist.gov/timefreq/general/pdf/451.pdf**

In this design all elements are directly fixed to the top surface of the boom by plastic clamps. Elements connected in this way possess a slight advantage in terms of noise and discharge of static build-up. As the Yagi is only 825mm long it can conveniently be attached to the support mast close to the reflector end of the boom, as you can see from the heading shot.

The coaxial cable, which should ideally be low-loss and have an impedance of 50Ω, is also routed out towards the back. This method ensures that neither the support mast or cabling interferes with any of the Yagi elements thus maintaining the integrity of the antenna pattern.

Number Of Sources

All materials for the antenna are available from a number of sources and I've found **Sandpiper Aerial Technology** one of the best suppliers for these specialised antenna components. The antenna, shown diagrammatically in **Fig. 1**, has a boom made from 15mm square aluminium tubing, parasitic elements from 6mm (1/4in) aluminium tubing and the driven element from 12mm (1/2in) aluminium tubing.

The gamma match assembly, **Fig. 2**, is constructed from 2mm brass rod and ptfe tube attached to a waterproof cable terminating box. Plastic clamps are used to fix the parasitic elements and a metal clamp to fix the driven element onto the square boom.

The easiest way to carry out s.w.r. adjustment is at ground level with the antenna pointing straight up and 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 may cause detuning. Check the s.w.r. with the shorting clip initially set at 100mm from the centre line of the main boom.

Fig. 2: The gamma match bar is covered in ptfe making a capacitive contact through the clamp to the driven element.

If the match is not sufficiently low, slightly reposition the shorting clip by a few millimetres until the lowest reflected power is obtained. A gamma match can induce currents on the shield of

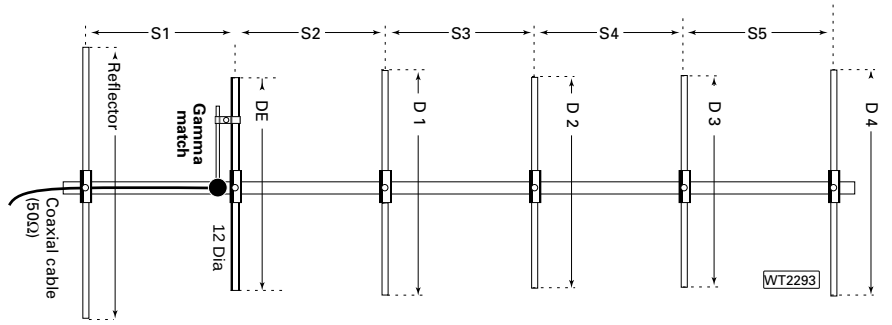


Fig. 1: The overall dimensions and layout of the 6-element Yagi antenna for 430MHz, dimensions are given in Table 1

the coaxial cable feed line (which can degrade the beam polar pattern) since it is an unbalanced system.

Pattern Distortion

The polar pattern distortion is more noticeable at u.h.f. but if an antenna is constructed with care there should be negligible effect to the polar pattern. This matching method however can be prone to moisture getting into the tubing so, it is necessary to seal the open end of the arm with heat-shrink sleeving.

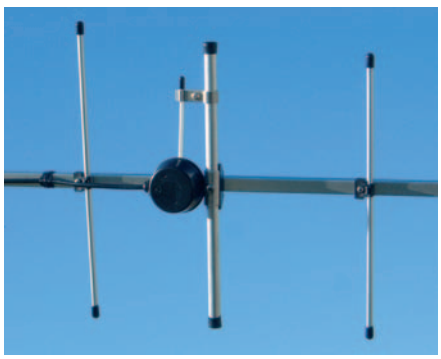


Fig. 3: A closer look at the rear three elements showing the gamma match system and coaxial cable run.

The table of dimensions, **Table 1**, should be read in conjunction with Fig. 1, which shows the general layout of the Yagi antenna. Start construction by cutting a one metre length of square aluminium tubing. Measure, mark out and drill holes to suit the element spacing as shown in Table 1. A tip here is to measure all spacing dimensions from the reflector position rather than marking out between each element.

An advantage of using only one reference point, is that by referring all dimensions to one starting position you reduce inaccuracies along the length of the boom. Now the reflector, directors and driven element are cut to length and attached to the main boom with the relevant clamps.

The driven element is matched to the 50Ω coaxial feeder cable by a gamma matching system shown in the photograph **Fig. 3**, where you can see the reflector, driven element and the first director. The gamma element is in effect a capacitor connected in series between the inner of the coaxial cable to a matching point on the driven element.

To provide the small amount of series capacitance (approximately 5pf) a 100mm length of 2mm diameter brass rod is covered with ptfe sleeve. The capacitor is formed between the brass rod, the ptfe dielectric and the stainless steel shorting clip. The end of the gamma rod is clamped to the driven element 100mm from the centre line of the main boom. The spacing between the rod and the driven element is set at 30mm by the stainless steel fixing clamp (see **Fig. 4** for more detail).

Table 1

Element	Ref	DE	D1	D2	D3	D4
Diameter	6	12	6	6	6	6
Length(mm)	330	302	305	298	298	305
Spacing(mm) (from rear)	0	152	309	481	653	825

Spacing(mm)	S1	S2	S3	S4	S5
	152	157	172	172	172

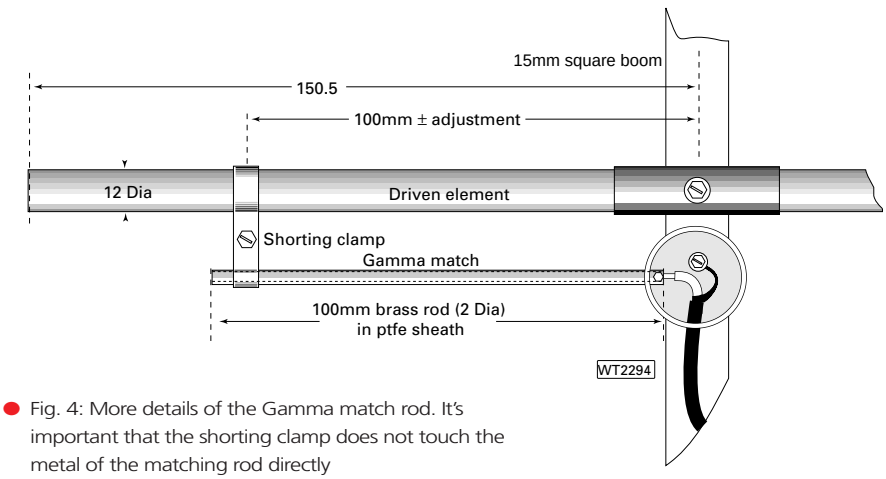


Fig. 4: More details of the Gamma match rod. It's important that the shorting clamp does not touch the metal of the matching rod directly

Coaxial Cable

This 6-element Yagi design is self-supporting from the rear and is fixed to the mast with a suitable clamp. The 50Ω coaxial cable is connected inside the waterproof junction box. The cable shielding is soldered to a tag and securely connected by a fixing screw to the centre line of the boom as close as possible to the driven element mounting.

The coaxial inner conductor is attached with a small solder tag to the gamma match brass terminal. The coaxial cable should be routed away from the driven element to the rear of the antenna boom. To complete the job fit rubberised caps to the ends of the boom and the antenna elements.

So, there you have it, a simple but effective antenna for the u.h.f. band. And you can claim to have built it yourself! PW

Sandpiper Aerial Technology 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 antenna items.
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