Antenna Workshop

David Butler G4ASR comes to the Antenna Workshop with a two-element delta loop beam antenna for the 50MHz band. Now you've no excuse, so build one for yourself!

This time I'm going to describe a two-element delta loop antenna for the 50MHz band. To start, we'll look at the beam antenna shown in the diagram, **Fig. 1** consists of a driven element and a reflector element mounted on a short boom. The elements used in the delta loop beam are approximately one wavelength long, approximately λ/3 on each side.

As you know, loop antennas can take many shapes - so why not make it a triangle? The answer is, that this shape is ideal for a beam with full-wave elements. Additionally, it has all the features of a quad loop antenna as well as some significant advantages.

The first advantage is that the entire antenna is above the boom. Secondly, the antenna is often primarily constructed of aluminium tubing that provides extra strength compared with wire elements often used for quad loop antennas. For this antenna, I've used a 'plumbers delight' type of construction. **Note:** With this method of construction, all the elements are completely metal and are mounted directly onto a metal boom.

In this design, though the horizontal part of the loop is made from wire stretched between the two inclined vertical sections. The forward, or driven element, is then fed with 50Ω coaxial cable to allow a good match to the ubiquitous coaxial cable feeder.

To achieve a 50Ω impedance feedpoint, there is a gamma matching arm running along a loop arm.

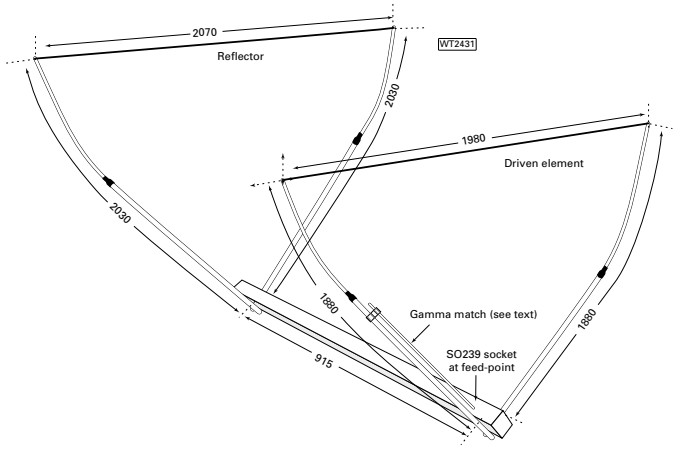

Fig. 1: Line drawing showing showing dimensions of elements and the overall shape.

The two-element beam described here has been dimensioned for 50.500MHz and has a very flat v.s.w.r. across the band. It has an estimated forward gain of about 7dBd, a gain figure that is equivalent to that of a three-element Yagi-Uda antenna array.

Two Hour Construction

Construction of the the delta loop is quite easy and took me less than two hours. First cut the 25mm (1in) square boom to the size shown in the diagram, Fig. 1. Then mark out and drill holes spaced 915mm apart for the four element to boom clamps. Note that each set of element clamps are in contact with each other but spaced 90° apart as shown in the photograph, **Fig. 2**. Next cut four lengths of 15mm (5/8in) tubing to 700mm long and drill a hole for the element mounting bolt in one end of each piece. Finally mount the 15mm element sections to the main boom using the element clamps.

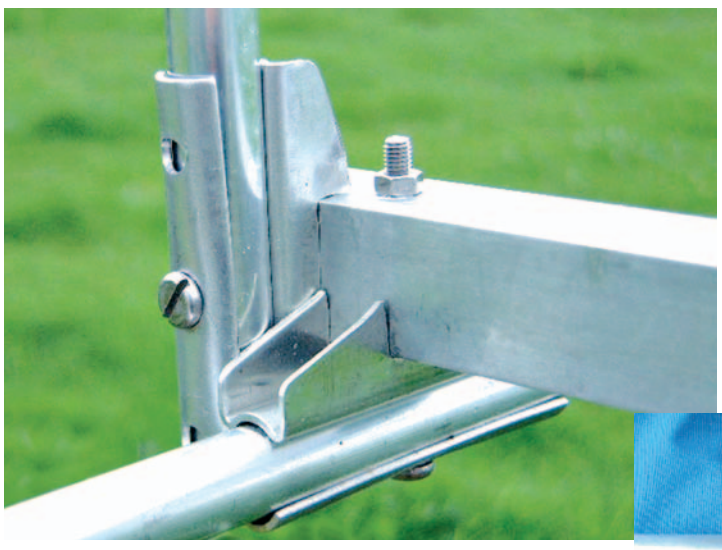

Fig. 2: (above) Element clamps hold the elements to the boom. See text for more detail.

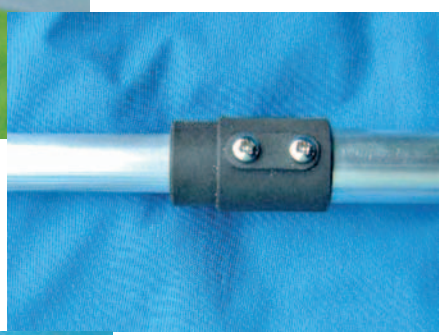

Fig. 3: (right) Element telescopic clamp makes a clean looking join that is easier to weatherproof.

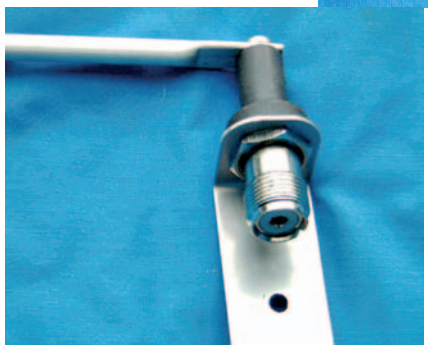

Fig. 4 (left): The Gamma match rod attaches to a moulded SO239 socket, making construction easier and no soldering is needed.

The next job is to cut four lengths of 12mm (1/2in) tubing to 1500mm long and then drill a hole in the end of each piece to enable the solder-tag and

wire to be fixed by a nut and bolt at the end of the elements. Insert these into the 15mm tubing, adjusting each element side to the length shown in the diagram Fig. 1. You can then fix the tubing with plastic adjustment pieces as shown in the photograph, **Fig. 3**.

Cut the wire to the dimensions shown in the diagram, Fig. 1 and solder the tags on each end. Include the length of the tag when cutting the wire to this dimension. Bolt the wire between the ends of the elements to close the loop. Both elements will bow inwards but this is intentional. **Note:** It will be prudent to recheck all dimensions now before fitting the gamma match.

The driven element is matched to the 50Ω coaxial cable by a gamma matching system shown in the photographs, **Fig. 4** and **Fig. 5**. The gamma element is in effect 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 (1/8in) diameter rod is partly telescoped inside a 6mm (1/4in) diameter tube. The tube is lined with ptfe sleeving which acts as a dielectric and provides a sliding fit. Insert 85mm of the gamma rod into the tube as shown in the diagram, **Fig. 6**. The end of the gamma rod is then clamped to the driven element 585mm from the centre line of the main boom.

Fig 5: Another look along the Gamma match and driven element arms.

The spacing between the rod and the driven element is set at 40mm both by the shorting clamp and the moulded SO239 antenna socket assembly. This is then fixed onto the main boom.

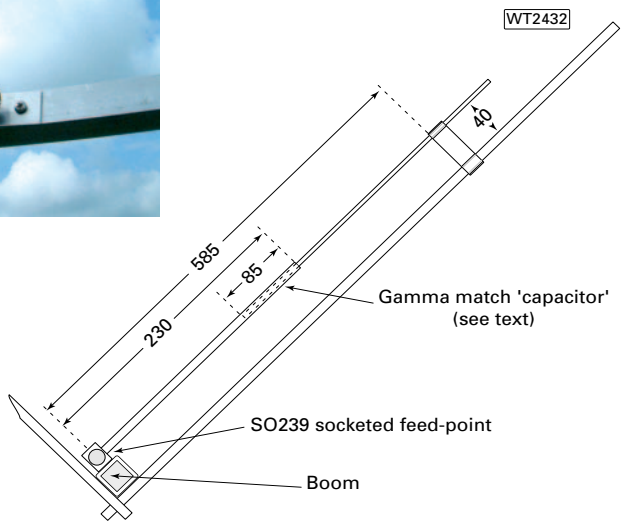

Fig 6: Details of the Gamma matching to achieve a 50Ω feed-point impedance. See text for more detail.

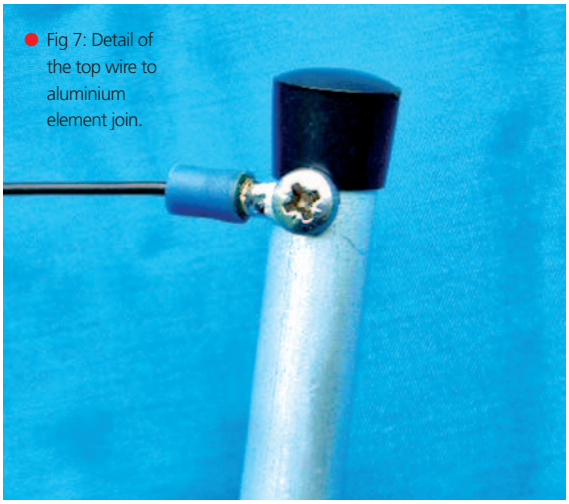

Fig 7: Detail of the top wire to aluminium element join.

Matching Errors

In order to avoid matching errors the gamma match should be adjusted with the s.w.r. bridge right at the antenna. Connect 50Ω coaxial cable from the bridge to the 50MHz transmitter and check that the v.s.w.r. is less than 1.2:1 across the band.

If the match is not sufficiently low, adjust the s.w.r. by sliding the 3mm rod in, or out, until a good setting is found. If one cannot be obtained slightly reposition the shorting clamp a short distance (one way or the other to suit) and repeat the procedure until the lowest reflected power is obtained.

Once the antenna is matched the coaxial cable can be attached to the feed point and the gamma match taped to prevent moisture getting into the tube. To complete the job fit plastic caps to the ends of the boom and the antenna elements.

With a suitable boom clamp attach the antenna to the main mast so that the triangular shaped loops are vertical. Being held vertically, ensures that the polarisation of radiation from this antenna is horizontally polarised.

If this is the first time you've used a beam antenna you may be in for a surprise. You have to point the antenna in the direction of the wanted station and as the antenna is very light a small TV type rotator can be used for this purpose. You can now turn on the transceiver and discover why 50MHz is called the 'Magic Band'. **PW**

Shopping List

Boom & Elements

1	Length (1m) of 25mm (1in) square aluminium tubing
4	Lengths (700mm) of 15mm (5/8in) aluminium tubing
4	Lengths (1.5m) of 12mm (1/2in) diameter aluminium tubing
4.1m	Plastic coated multi-strand wire

Gamma Match

1	230mm length of 6mm (1/4in) diameter aluminium tubing
1	450mm length of 3mm (1/8in) diameter rod
1	Moulded SO-239 socket and L-shaped fixing bracket

Clamps

1	Gamma shorting clamp
4	Element to boom clamps
1	Boom to mast clamp

A complete kit of parts for this antenna including the boom/mast clamp may be obtained from Sandpiper Aerial Technology, who can supply more bits for antennas than you will need for this particular project. The cost is £40 inclusive of postage and packing. Alternatively Sandpiper can supply element fixing clamps, aluminium tubing, gamma match assemblies and other antenna mechanical items.

Sandpiper Aerial Technology (www.sandpiperaerials.co.uk) of **Unit 5, Enterprise House, Cwmbach Industrial Estate, Aberdare CF44 0AE. Tel: (01685) 87042.** Please check with **Chris**, **Jane** or **Mark** for prices and availability of individual antenna items.