David Butler's

antenna workshop

David Butler G4ASR pauses from chasing v.h.f. DX and describes a 50MHz halo antenna made from water pipe!

Hello to you all – it's my turn in the *Antenna Workshop* again. This time around I'm pausing from chasing v.h.f. DX to describe how to construct a simple 50MHz antenna that can be built in a few hours using easy to obtain materials.

The antenna is really intended for stations that don't have the space to erect a directional beam antenna and yet want to participate in contacting DX stations during the summer Sporadic-E season.

Received signal strengths can be incredibly strong via Sp-E and although this antenna possesses unity gain, the results really will surprise constructors.

Popular Antenna

The halo antenna is a popular form of horizontally polarised radiator that has been around since the early 1940s. It's nothing more than a half wavelength dipole formed (normally) into an almost complete circle and end loaded by a capacitor to establish resonance. In the version I'm describing the halo is actually square in shape and fed to the 50Ω coaxial cable via a gamma match arrangement.

The antenna has an almost circular polar diagram, although there's a point of minimum signal in the direction of the side opposite to the gap. However, the antenna presents a relatively high angle of take-off when mounted low down which is great for single-hop Sp-E contacts around Europe and hopefully beyond.

The Design

Take a look at the layout and design of the 50MHz halo antenna shown in the diagram, **Fig. 1**. It's constructed from sections of 15mm water pipe joined at the corners by 90° elbow bends to produce a square shape with 710mm sides.

The photograph, **Fig. 2**, shows the completed halo antenna with a central support pipe. It's attached to a copper equal-T connector at the driven end and to a c.p.v.c. equal

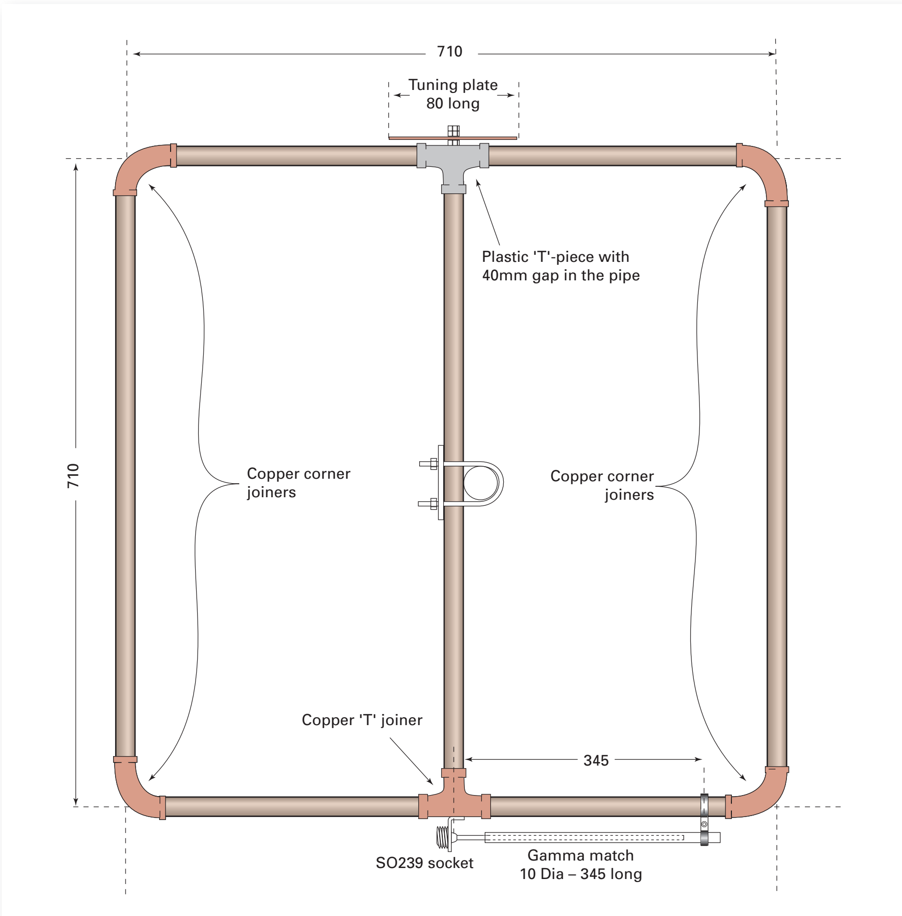

Fig. 1: Overall dimensions of the Halo antenna

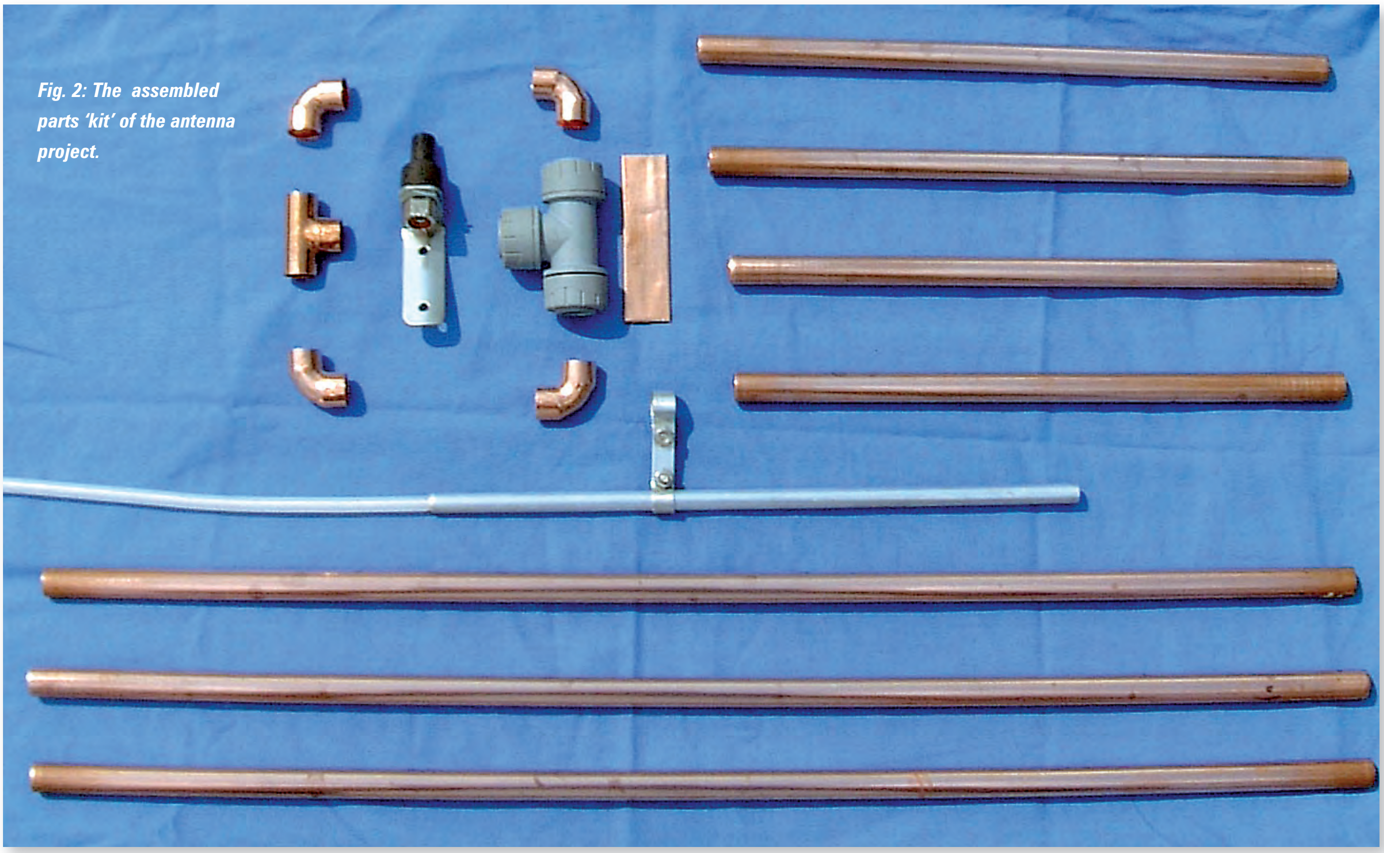

Fig. 2: The assembled parts 'kit' of the antenna project.

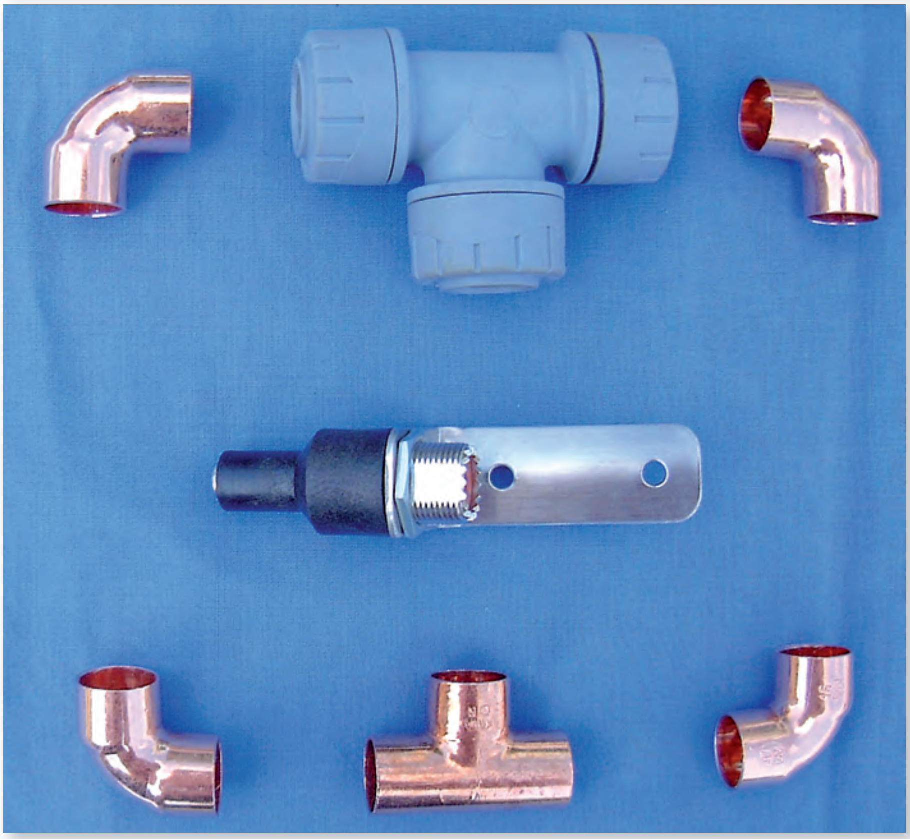

Fig. 3: A closer shot of the corners and joiners

T component at the open end. An r.f. connector of individual choice is fitted to a mounting bracket attached to the central copper T-connector.

At the opposite end of the support pipe the c.p.v.c. tee section acts as an insulator for the ends of the radiating element and provides a mounting point for a capacitive tuning vane. A gamma matching arm is attached to the square loop via a copper strap at one end and to the coaxial connector at the other.

The gamma match is effectively a capacitor that's constructed from an inner dielectric section of RG8 coaxial cable inserted into a copper or aluminium tube.

The Construction

Start the construction of the antenna by cutting the 15mm water pipe into seven pieces, three long pieces approximately 680mm long and four pieces approximately 340mm long. Note that the exact dimensions will depend on the size of the 90° elbow bends and the two equal T-pieces, shown in the photograph, **Fig. 3**.

The elbow bends can vary depending on manufacturer – but the important dimension to remember is that each side of the square must be 710mm centre-to-centre with all the components in place. **Note:** Make sure there's a 40mm gap at the open ends of the radiating element inside the c.p.v.c. tee connector.

The next step is to make the tuning vane and attach it to the c.p.v.c. T-piece as shown in the photograph, **Fig. 4**. (I used an 80mm length of 15mm diameter water pipe squashed flat in a vice). Then I drilled a suitable size hole centrally in both the end of the tee-piece and in the copper vane and attach together using a screw and lock nuts.

Next, I assembled all the component pieces on a flat surface. I suggest that constructors should re-check that each side of the square measures 710mm centre-to-centre and then permanently join them

Fig. 4: The tuning vane is a brass or copper plate 80x20mm.

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together, using a blow torch and solder.

Then I had to make the gamma match and coaxial connector assembly and constructors should take a look first at my layout shown in the photograph, **Fig. 5**. A 20mm wide brass plate is bent to form an 'L' shape measuring 50mm by 30mm. I used an SO-239 connector that had a threaded centre pin but this is a matter of choice, as any suitable coaxial connector can be used. Two small holes are drilled and the plate is attached to the copper T-piece with self-tapping screws.

The gamma arm is made from a 345mm length of 10mm diameter copper or aluminium tube. Then cut a 280mm section of RG8 coaxial cable discarding the shielding and outer covering. Slide 240mm of the centre wire and plastic dielectric into the tube leaving 40mm protruding.

The centre conductor is attached to the coaxial connector and then the copper tube is attached the radiating element 345mm from the centre of the SO-239 connector. The shorting bracket may conveniently be made by using reformed 15mm copper pipe clips. Note that I actually used a section of aluminium tubing because that's what I had available in my workshop at the time but ideally we should use copper or brass tubing.

Mounting & Adjustment

The central tube is used to provide a mounting point for a mast clamp as shown in the photograph, **Fig. 2**. Alternatively the antenna may be mounted on wooden slats using conventional plastic water pipe clips and then fixed indoors to wooden beams in the loft space or any other convenient mounting points.

Two parameters – the impedance match and the centre frequency of resonance – may be adjusted with this antenna design. Initially, the tuning vane should be set at right angles to the radiating element. If the measurements I've provided have been followed, this should set the halo to be resonant around 50.400MHz. Tuning is carried out by using a suitable transmitter and a standing wave ratio (s.w.r.) bridge. Adjust the transmitter so that it runs just a few watts output on 50.400MHz.

The s.w.r. should be under 2:1 but if it isn't then move the aluminium strap in or out to get an optimum match. Once the stub has been adjusted for the best match, re-check the s.w.r. between 50.000 - 51.000MHz to see where the s.w.r. curve lies within the band.

Note: If the centre frequency of resonance needs to be lowered, then simply rotate the tuning vane to be more parallel with the radiating element. Once it's set up to the chosen centre frequency, the lock nuts should be tightened up.

Typically, the 2:1 s.w.r. bandwidth curve will be around 500kHz or so. However, one point to note is that the circuit *Q* of the halo is relatively high and **very high voltages** can be developed across the ends of the loop! Therefore I recommend that the output power is restricted to no more than 100W.

That's all there is to it. Now get building and improve your plumbing skills at the same time – and I wish halo users 'good luck' with the next 50MHz Sp-E opening! ●

Material Shopping List

Materials needed to make the halo antenna include 3500mm x 15mm (1/2") copper water pipe (3 x 680mm, 4 x 340mm, 1 x 80mm sections) and 1 off brass plate 20mm x 80mm (to mount SO-239 connector). Also required are 1 off 345mm x 10mm copper tubing (Gamma match), 1 off copper strip 10mm x 100mm (Gamma match support bracket), 4 x copper 90° elbows, 1 x copper equal T-piece, 1 x 15mm c.p.v.c. equal T-piece, 1 x 280mm piece of RG8 coaxial cable (centre conductor and dielectric) and 1 x SO-239 coaxial connector (ideally with threaded centre pin).

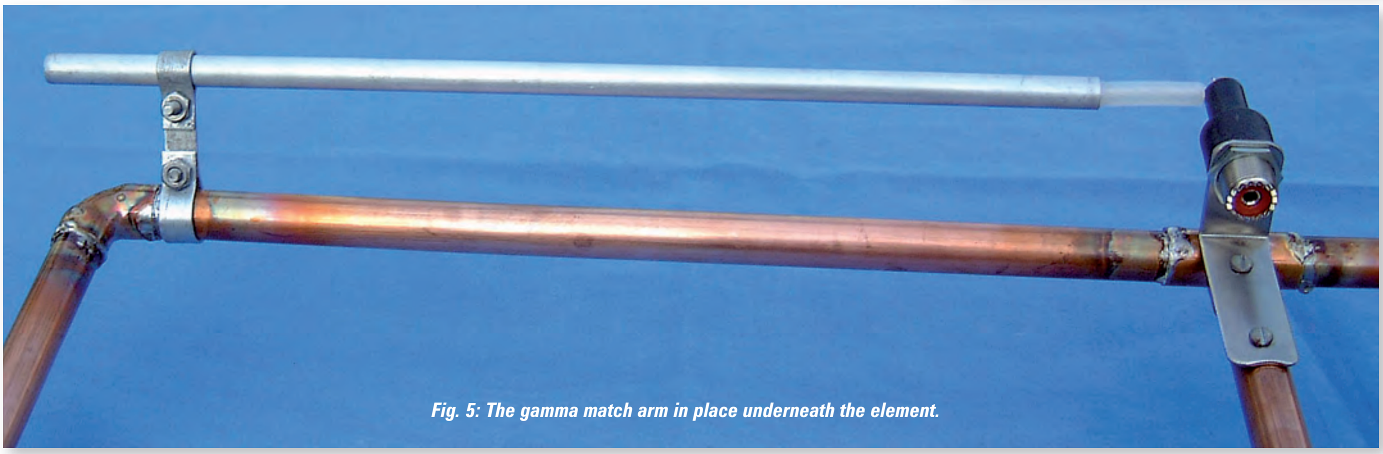

Fig. 5: The gamma match arm in place underneath the element.