Trafalgar. Input is on 433.575, output is on 438.575, CTCSS of 91.5 Hz.

Early in the project development it was realised that a decent antenna system was going to be an important part of this repeater. It needed to be very tough and withstand all weather for the next 10-20 years, it needed to be intrinsically grounded to improve lightning and static discharge immunity, it required a wide working bandwidth and it must have the capacity to tailor its radiation pattern to suit a specific service area. A simple co-linear vertical will not achieve those goals. Commercial dipole arrays that will do the job are expensive and, frankly, it felt too much like giving-in if we did not build our own. Accordingly, the essence of this article is a description of what we built, how we built it and how well it performed.

The dipole

Several designs were examined, but some of these were made from solid welded sections of aluminium, making it difficult to build and adjust. Other designs used 4:1 coax baluns at the feedpoint for matching, which sweep tests revealed to be quite narrow in working bandwidth.

After a series of experiments I settled on a half-wave dipole made entirely from standard copper fittings, with an interesting impedance matching technique.

Photo 1 shows the un-painted prototype. First reactions conjured up images of a device for distilling corn whisky by bare-footed mountain folk wearing straw hats, hence the name, but it does work surprisingly well as a UHF antenna.

This sample was cut from 12 mm and 50 mm copper pipe, elbows and end caps sourced from plumbing suppliers. Some stainless steel screws were added for support, then the whole lot was simply soldered together with a basic LPG gas torch. The soldered

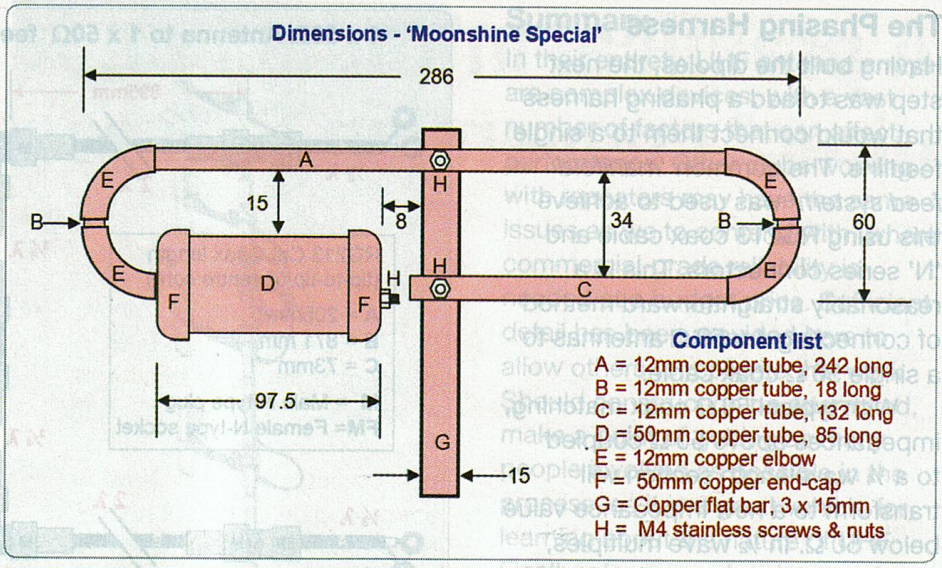

Photo 3: The dimensions of the 'Moonshine Special.

method was reasonably robust, but the final versions were bonded using silver-solder, which made the end result particularly tough.

You may well ask what is going on with this design, as the large copper cylinder looks a little out of place and the 50 Ω coax attaches directly to one side with no matching balun or stub.

The resonance of the antenna is established by the total length. That aspect is a conventional folded dipole, normally with a 300 Ω impedance requiring a balanced feed, except here one entire loop of the dipole is grounded. This allows the antenna to be a complete dead-short to DC and lets the dipole accept an unbalanced feedline of coax cable. The remaining dipole loop has a gap of a few mm and a termination point of the feedline centre-core. Normally this would still be a prohibitively high impedance, but we have added the copper cylinder to reduce the impedance to 50 Ω. There is nothing inside this cylinder. It is simply 50 mm tube with two 50 mm end caps soldered on. The ratio of the diameter of this cylinder to the adjacent 12 mm dipole leg provides a direct impedance transformation. The result is a wide bandwidth dipole, with a 50 Ω unbalanced feedpoint impedance, with an SWR of better than 1.2 :1 from 430 through to 440 MHz.

Rob VK3BRS provided some certainty here by conducting a series of spectral sweeps to confirm that we were dealing with a single resonance node covering our operating frequencies.

Building more dipoles

There was a lot of experimentation done using different lengths of copper of different diameters. The spacing between the cylinder and the adjacent dipole element was optimised, with the best symmetry achieved when the cylinder was bonded on its axis. The location of the screw for the coax centre core on the face of the cylinder (H) is not particularly critical, but it does need to be placed and fitted in the end cap before the cylinder is sealed. This is the only hole in the cylinder.

The assembly was bolted, then soldered to some 15 x 3 mm copper flat bar, which was in turn bolted to some 19 mm galvanised square tube suitable for mounting to the vertical mast with stainless steel U-bolts.

Four more dipoles were built and painted white before feedlines were attached to the 4 mm stainless mounting screws. Silicon rubber was then used to waterproof the connections. Each of the four antennas was tested and resulted in dead-needle SWR on the first measurements.