IDEAS FROM ABROAD

Eurotek

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Editor-in-Chief **Dick Rollema, PAoSE,** described in *Electron* (NL) his own 7-29MHz DJ4VM Cubical Quad. This is a well-known beam but Dick has simplified its feed and phasing system, replacing the customary open-wire feeders with coax circuitry. We quote him here on his universally useful **air-core baluns**.

USING ONE SIZE of quad loop for all bands (**Fig 1**), with a circumference ranging from approx λ/2 on 7MHz to 2λ on 29MHz, I expected a wide range of feed-point impedances. To get a feel for the problem, a single element was measured with the other element left non-resonant and therefore not affecting the measurements. My readings ranged from 33Ω on 7MHz to 560Ω on 29MHz, highly reactive and balanced. Mutual coupling between two active elements would probably make the situation worse. This rules out direct single-coax feed and also the use of ferrite or powdered iron in the baluns. Air core baluns were indicated. Units with a 4:1 impedance ratio promised a better match to my 17m of RG217/U to the shack than 1:1 baluns, especially on the highest frequencies, where coax losses due to mismatch were highest.

HOW THEY WORK

I MADE THE BALUNS of coaxial cable as shown in **Fig 2a**. Two equal lengths are connected in parallel at their unbalanced (left) ends and in series at the balanced right side. Assume that we could measure the instantaneous HF voltage on the centre pin of the left-end coax connector and find it to be +100V with respect to earth. That results, as is shown, in +100V and -100V respectively on the two output terminals, ie 200V between them, balanced with respect to earth. But that would be too simple. There would be a short-circuit between the +100V at point X and 0V at Y which must be eliminated. That is done by coiling the lower cable as shown in **Fig 2b**. Between X and Y there is now the reactance of that coil; if sufficiently high, point X no longer 'sees' point Y and there can be a voltage difference between them. For the top coax there is no such problem as both ends are at the same potential, but I did coil it up anyway, just for neatness.

This balun produces a 4:1 impedance transformation only if both cables are terminated in their characteristic impedance; I used 75Ω coax, so for 'flat' lines a purely resistive, balanced load of 2 x 75 = 150Ω would be required. Looking into the unbalanced end of the balun, an impedance of 75/2 = 37.5Ω would then be seen. As noted before, the DJ4VM loop is everything but 150Ω resistive. Unless the length of the cables in the balun is short with respect to the wavelength, the balun produces an additional impedance transformation which is largest when the cable lengths are near λ/4. This can add to or subtract from the 4:1 ratio. In the extreme, the impedance at the unbalanced end can even be higher than that of the balanced load! But that does no harm; the balancing action is valid over the whole intended frequency and impedance range.

CONSTRUCTION

THE BALUN ASSEMBLY is shown in **Fig 3**. None of the dimensions, materials or cable types are critical. However, if two baluns are to feed two equal elements in a reversible beam, the two baluns must be identical; also mark which of the balanced terminals is connected to the centre conductor at the unbalanced end, so you can get the phasing right. The formers are made of grey 110mm OD PVC waste pipe

I used matching end caps for the balanced ends; these are not cemented on, but made removable by securing them with three self-tapping screws which, like all hardware in this project, are stainless steel. An N-socket on a copper bracket is mounted inside the formers for connection to the RG213/U coax feeder. N-connectors are waterproof by design, though mine are sheltered by the formers - I thought that worthwhile. For the coax windings I used left-overs from cable TV installations (75Ω, specs similar to Uniradio M203 - *G4LQI*). Two equal lengths of 2.94m go into the two 8-turn coils. Short bare-wire jumpers from the outer ends of the coils pass through tight holes to the inside of the former, from where short lengths of the same coax connect to the N-socket. Note the '!' in Fig 3; the jumpers at that point, and only at that point, connect the core of the outside coax to the braid of the inside coax and vice versa.

The jumpers to the bolts in the end cap, which serve as terminals for the loop connections, are made of separated figure-8 flex. At the terminal end I used solder lugs; at their other end they are fed through small holes in the former and soldered to the inners of the coils. A similar jumper connects the N-socket flange to one of the self-tapping screws that hold the end cap to the 2in box-section boom of my beam. All coax ends, solder connections and feed-through holes were fixed and waterproofed with epoxy cement. Three coats of clear yacht varnish protect the completed assembly against ultra-violet light. After four years, the baluns are like new.

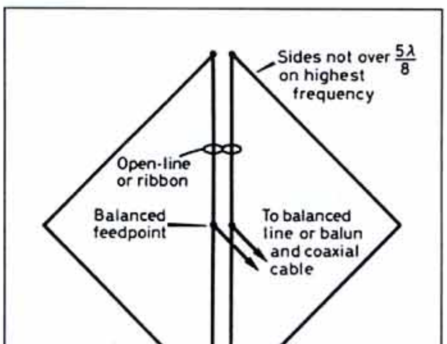

Fig 1: The DJ4VM quad loop. Normally, an open-wire feeder connects its feed-point to an ASTU in the shack. On bands where the loop circumference is larger than 1.0λ, extra gain is realized, which just about pays for the extra loss of using coax at high SWR. PA0SE considers this a fair trade-off for the convenience of coax and a much simpler ASTU.

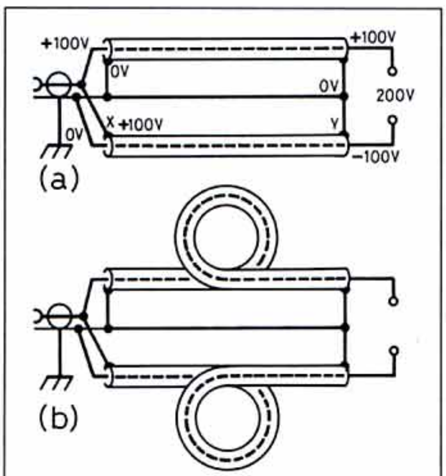

Fig 2: Principle of the 4:1 coax balun. Short-circuiting the voltage between X and Y in (a) is remedied by the self-inductance created by coiling the coax as in (b). The upper coax is coiled for neatness only.

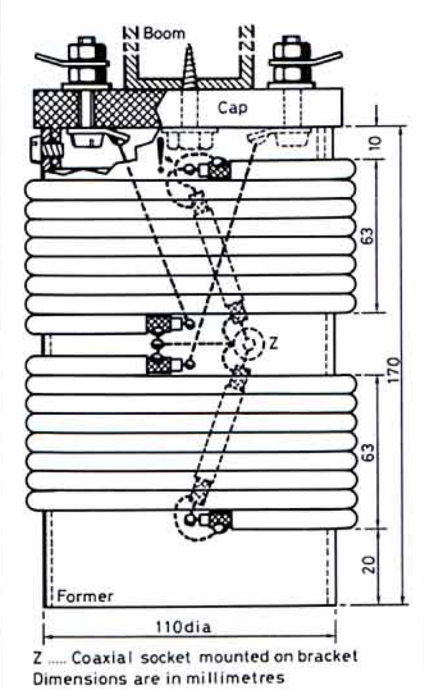

Fig 3: Construction of a 4:1 balun of 75Ω coax on a PVC former. The dashed connections are inside the former. The flange of the coax socket is earthed to the boom (wire not shown).