A Simple 50-ohm Single-Band Balun

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1. Introduction

Before selecting a balun for your particular application, you shall consider the implications which the numerous approaches one can find in the literature yield in terms of e.g. bandwidth, construction simplicity, cost, weight, windload, waterproofing, impedance ratio, presence of radiating braids, etc.

The balun herein described is suitable for 50-ohm monoband antennas which can often represent a valid choice. Although so far I have seen no reference to this concept in magazines or books, it may well have been adopted by someone else before me; in all cases it seems worthwhile to me to briefly review a solution which is not addressed in common technical references.

2. The Proposed Concept

The descibed solution may be regarded as a modification of the well-known balun shown in fig. 1, which is however only suitable for 200-ohm antennas (refer to the ARRL Radio Amateur's Handbook for calculating the physical length of the delay coaxial cable section).

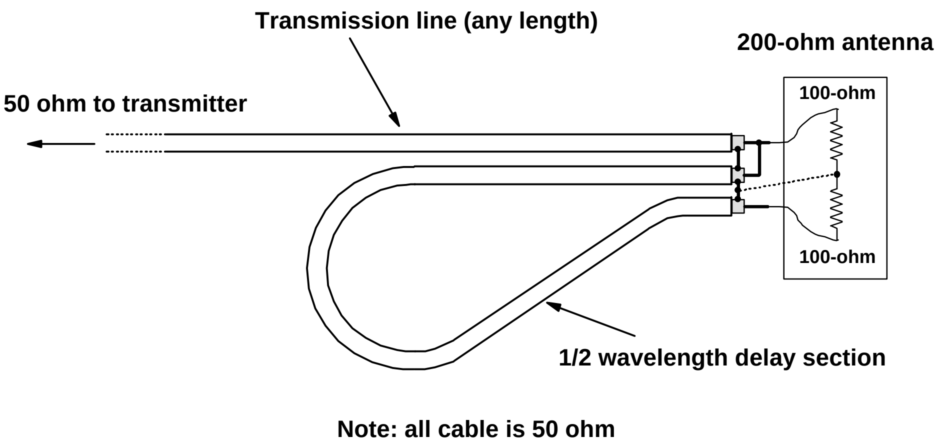

Fig. 1 The Well Known 200-Ohm Balun

An ideal and symmetrical 200-ohm antenna can be visualized as two 100-ohm resistors in series, their junction implicitly being at ground potential, i.e. the same potential of the coaxial cable braid. The λ/2 delay section, which provides for the necessary 180-degree phase shift, can so be viewed as terminated over 100 ohm (this causing an SWR 2:1 on that section); in virtue of its λ/2 length the impedance seen at its other extreme is still 100 ohm. The transmission line so results to be correctly terminated two 100-ohm resistors in parallel, that is 50 ohm.

Some authors recommend to physically connect the cable braid to the antenna structure (e.g. the boom), some others not; in theory, with a perfectly symmetrical antenna, this connection would not be required (for this reason it is shown with a dotted line in fig. 1).

Nevertheless, should the antenna result to be non-symmetrical for any reason (e.g. due to a non-flat ground reference), the above alternative could imply some small differences:

- If the braid is connected to the antenna structure, the load seen by the transmission line would somewhat change. For instance, should the two antenna feed points show 140 ohm and 60 ohm with respect to the ground potential (for a total of still 200 ohm), the total load seen by the transmission line would result to be 42 ohm. This example demonstrates that even a very strong imbalance would only cause a moderate SWR (about 1.19:1) on the transmission line.
- If the braid would instead be kept floating, impedance matching would remain ideal, but the cable braid in the proximity of the radiating element (for a length of about λ/4) would no more be “cold”, thus implying some reception from an heading usually orthogonal to the intended one (assuming that the transmission line runs along the boom), a fact which potentially lowers the antenna front-to-side ratio.

In my opinion, there are several reasons why connecting the coaxial cable braid to the antenna structure is the way to go.

Now let us consider the proposed balun which is pictorially sketched in fig. 2, where the 50-ohm antenna is again visualized as two 25-ohm resistors in series. The λ/4 and the 3λ/4 adapting sections result to be both terminated on 25 ohm (the SWR on those sections is then 2:1). As the length of both sections is an odd multiple of λ/4, the impedance seen at the other extremes is exactly 100 ohm, this causing the transmission line to be again correctly terminated on two 100-ohm resistors in parallel, i.e. 50 ohm. The length difference between the λ/4 and the 3λ/4 sections provides for the necessary 180-degree phase shift.

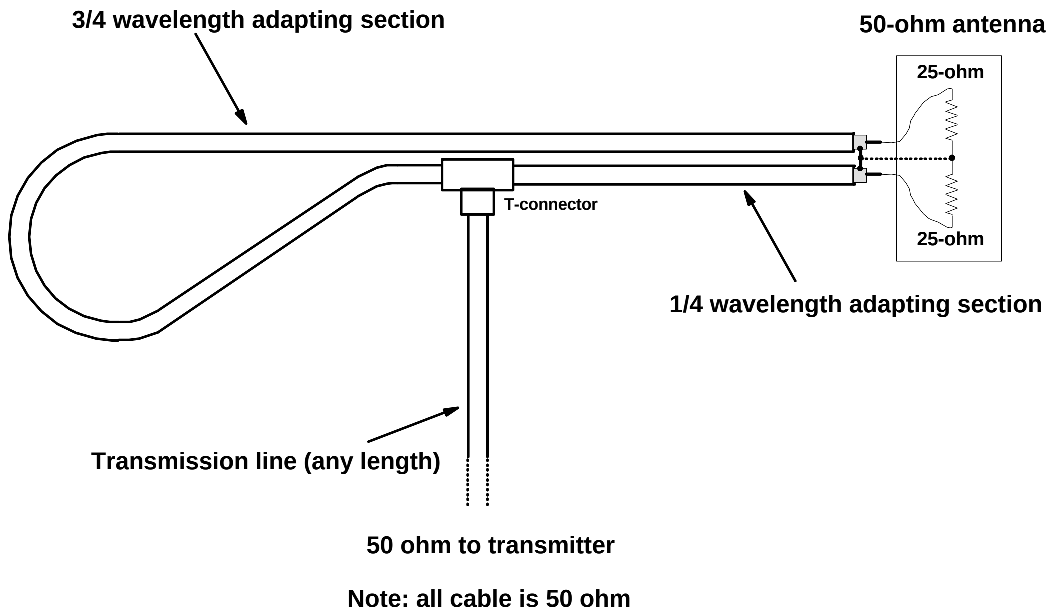

Fig. 2 The Proposed Balun

It is interesting to note that, differently from its 200-ohm counterpart (fig. 1), with this type of balun any impedance unbalance with respect to ground does not affect the load seen by the transmission line. For instance, with a 50 ohm antenna having impedance split of 35 ohm / 15 ohm, one adapting section would show about 71.43 ohm and the other one about 166.67 ohm, this two figures in parallel giving again 50 ohm. In the limit, with a fully asymmetrical antenna (50 ohm / 0 ohm), the impedance seen by the transmission line would still be 50 ohm. Thus, it would really make no sense not to physically connect the cable braid to the antenna structure.

3. Conclusions

The proposed solution, which is only applicable to monoband antennas, yields the following main advantages:

- easy to construct;
- easy to waterproof;
- easy to arrange (there is no section where the braid can be “hot”);
- it ideally matches any antenna imbalance with respect to ground;
- there is no need to specifically design the antenna for a 200-ohm impedance (this however may not always be regarded as a disadvantage).

The main drawback with respect to the well-known 200-ohm balun is the additional cost, weight and windload of the connectors and the extra coaxial cable. At this last regard:

- from the cost standpoint, one shall consider, in total, an extra $\lambda/2$ cable length;
- from the weight & windload standpoint, one may just account for an extra $\lambda/4$ cable length (the $\lambda/4$ adapting section, which runs along the boom, and possibly also along the mast, allows to correspondingly shorten the transmission line);

It can then be concluded that the proposed balun may result to be a convenient solution for the low-wavelength spectrum region, say above 15 or 20 MHz, as the extra cable runs can have a moderate length.