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Antennas

This month, G3LDO describes things to be aware of when feeding balanced antennas (particularly short ones) with coaxial cable.

For many years now I have used coaxial cable to feed a dipole antenna directly. The centre of the coax was connected to one leg of the dipole and the braid connected to the other. Antennas built this way seemed to work perfectly well, even though I was aware that connecting unbalanced feeder to a balanced antenna was, according to the text books, less than perfect.

In more recent years I have used a modified MQ-2 minibeam, the one shown on the front cover of [1]. This antenna is a small two-element beam antenna, which uses loading coils and capacitance 'spokes' to achieve multi-band operation. The driven element is split and fed directly with coax, as with the dipole described above. When SWR measurements were made on this antenna, it was found that, on some bands, the value of SWR changed if the length of the feeder was changed, or the shack end of the feeder was earthed. Common-mode currents, or antenna currents, were thought to be the problem.

In most previous discussions in this column regarding transmission lines, is has always been assumed that the two conductors carry equal and opposite currents (I1 and I2) throughout their length and consequently no radiation from the feeder takes place. In practice, this is very seldom the case. With coaxial cable, I1 flows on the inner conductor while I2 flows on the inside of the outer conductor. When this coax is connected to a balanced antenna all the I1 current flows on to its connected dipole element. The I2 on the inside of the inner conductor flows into the connected dipole element but part of I2 also flows down on to the outside of the coax outer conductor, which we can designate I3. Currents I1 and I3 are in phase and are the common-mode currents that can cause radiation from the coax.

Common-mode currents can also occur when the transmission line and the antenna arrangement is not symmetrical. In practice, most antenna arrangements are asymmetrical due to the number of electromagnetic obstructions to be found around an average suburban garden but, in most cases, they don't matter. In some cases, an antenna is designed so that the feeder is part of the radiating system as described in [2].

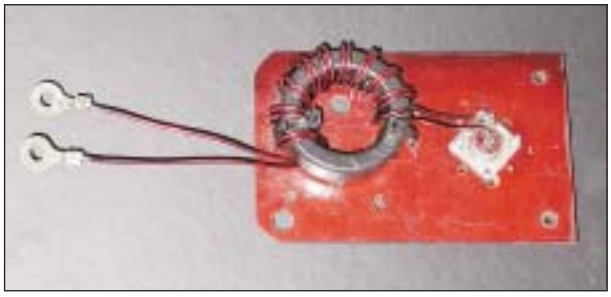
Common-mode currents seem worse on transmission line connected to small antennas, and this proved to be the case with my MQ-2. A current choke was originally made up a using a roll of RG-58 as a temporary stopgap. That was four years ago! and recently the antenna developed a high SWR, indicating trouble. The fault was found to be the 'temporary' current balun, which had succumbed to the ravages of years of coastal weather. I looked for a permanent solution that was in accord with the contents of my junk box.

MAGNETIC CORE CURRENT BALUN

Magnetic-cored baluns employ ferrite or iron powder material to provide a high common-mode impedance over a wide frequency range. The discovery of a T200 toroid core in the junk box inspired me to try the current choke balun from [3].

The balun is constructed simply by winding 10 bifilar turns of 14 or 16SWG (2mm) enamelled copper wire on the core, which had previously been given a layer of PVC tape. The construction is shown in the photograph. Plastic insulated electrical wire would probably give just as good results and provide better insulation for outdoor use. The balun was fixed to a piece of insulating material using tie wraps before being fixed to the antenna as shown in the photograph. The balun unit was then coated in grease for weather protection.

Information on the construction of the current choke balun in [3] recommends an Amidon FT240-43 ferrite ring. My T200 seems to work fine, the common-mode current effect described earlier is not present and the SWR readings are now stable.



The current balun with 10 bifilar turns of 14 or 16SWG (2mm) enamelled copper wire on a PVC tape layered T200 core.

FINALLY

In previous 'Antennas' columns, I described impedance measurement of an antenna. Because the impedance of a HF antenna varies with height, the only method of measuring the impedance of the antenna at its working height is to use a half-wavelength (or multiple) of feeder, which acts as a 1:1 transformer. However, a half-wavelength of feeder can have strong common-mode currents simply because it is resonant. This can have an adverse affect on the impedance measurements. The fix is to use the W2DU current balun comprising ferrite beads slipped over 300mm (1ft) of the feeder; described fully in [3]. ♦

REFERENCES

[1] *Backyard Antennas*. The modified MQ-2 is also described on pp103 – 05.
[2] 'Antennas', *RadCom* March 2004.
[3] *The ARRL Antenna Handbook*, 20th edition, pp26.21 – 26.25.

Seagull's eye view of the current balun fixed to the feed-point of the modified MQ-2, before the protective grease coating was applied.