Pat Hawker's **Technical Topics**

ANOTHER COMPACT VK2ABQ 14MHZ ANTENNA

IT IS NOW ALMOST 20 years since *TT* presented the original VK2ABQ three-band (14/21/28MHz) wire beam antenna, first published as a short letter in *Electronics Australia*. Since then, Fred Caton, VK2ABQ (formerly G3ONC) has followed this with a number of other ideas, submitted directly to *TT*, including several modified forms of his original design which has become well-established (see *ART7*) and which has been endorsed by Les Moxon, G6XN in his book *HF Antennas for All Locations* (available from RSGB sales). I must admit that I sometimes wonder what professional antenna specialists such as VE2CV would make of the jottings which Fred sends along to explain his ideas.

A recent letter is no exception and I can only hope that I have understood at least the gist of this new design which dispenses with the open-wire phasing line used in the original VK2ABQ design, and has the driven element fed directly from a coax feed-line. The dimensions shown are for 14MHz, and should be divided by two for 28MHz. A 14MHz antenna can be used on 21MHz as an extended-element array, but the feedpoint impedance will rise and become reactive, so that an ATU will be necessary.

In effect, **Fig 1** shows a KISS recipe for a simple 14MHz two-element array. The unidirectional 135° phase shift is achieved using equal-length elements without a phasing line but with critical coupling.

Take a 71ft length of lightweight plastic-coated wire (bare/enamelled copper wire would need to be rather longer). First check for resonance with the wire fitted on the wooden frame, using a GDO. Then fold the 71ft wire into four, and touch the plastic with a hot soldering iron to identify where the sides are to be cut. The frame can be constructed from four 11ft 6in dowels ($^5/_8$in diameter) or garden canes, mounted on a square piece of board with about 15in sides (as in the original VK2ABQ designs). In placing the wire on the framework, make sure the two current-focus sections are placed an eighth-wave apart (2.5m on 14MHz) with the voltage-tips adjustable to 4in gaps in order to provide the quarter-cycle (90°) phase-shift between L1 and L2. The 90° critical coupling between L1 and L2 plus the 45° current loop spacing gives the required 135° phase-shift between the two elements resulting in an effective unidirectional two-element array with a satisfying front-to-back ratio, useful forward gain and sharp side nulls. VK2ABQ stresses that the gaps between the elements are critical in achieving critical coupling, in his case he found 3.75in optimum.

Fig 1(b) shows the piece of flat plastic material used as an insulator at the element feed point. The 0.25in coax cable is then routed down through the hole in the centre-board. Seal and 'gunk' the feedpoint, using for example *black* bitumen paint or similar. A nylon cord is loosely connected as a stabilizer between the feed-point insulator and the centre rear of the L2 current loop. VK2ABQ likens the array to an old-style critically-coupled IF transformer with lumped-components, but opened-up to tickle the ether and provide a simple, cheap, compact but effective two-element beam. To adjust the coupling, a simple current sampling gimmick can be used as in **Fig 2(a)**. Provided that the loop of the device is very small in terms of wavelength, it will not respond to the electric (voltage) field. **Fig 2(b)** shows a similar device but with a meter to increase sensitivity. With the antenna at shoulder height, and with the aid of a helper, the gaps at the voltage tips can be adjusted for equal current in both elements, indicating a 90° phase shift. Overcoupling will be indicated by more power in the reflector element, undercoupling by more power in the driven element. When power is shared equally, the coupling will be providing the correct 90° phase-shift. It should be appreciated that a VK2ABQ-type array is basically a form of driven array rather than a Yagi parasitic-reflector array.

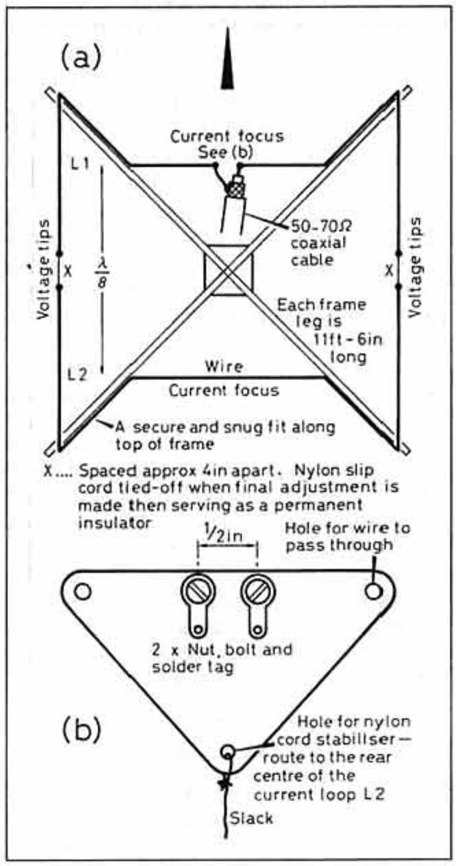

Fig 1(a): The VK2ABQ KISS 14MHz array. (b) Feed-point insulator with nylon cord stabiliser.

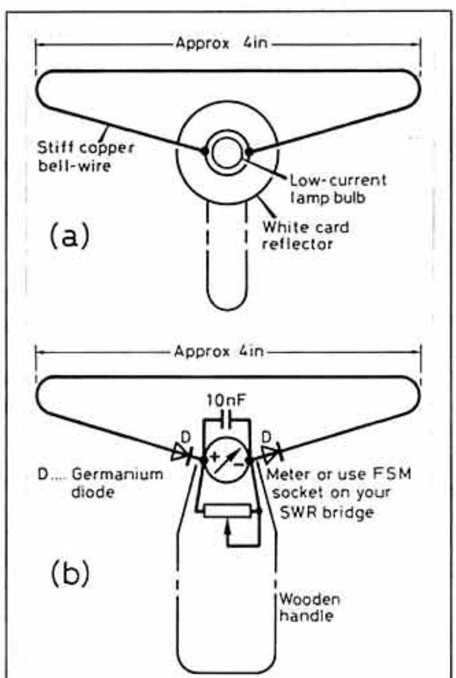

Fig 2(a): Simple current sampler. (b) More sensitive current sampler.

Adjustments may be carried out with one person standing in the middle of the shoulder-high array using the current sampler, and with a few watts of 14.05MHz RF fed to the antenna. The helper then adjusts the spacing at the voltage tips, but moves *well away* from the voltage tips after adjusting the spacing to instructions. Any large object near the voltage tips will nullify the adjustments.

Finally, VK2ABQ endorses the value of a tip that appeared many years ago in *TT* and elsewhere, and is applicable to all dipole-type antennas with low-impedance feeder. A 20KΩ carbon resistor soldered across the element feedpoint has no effect on the operation of the antenna but allows an ohmmeter check to be made in the shack as a warning against a broken feedline. VK2ABQ has used such a resistor (well covered in 'gunk') for some 25 years.

Incidentally, at the age of 74 years, Fred no longer feels able to correspond with readers seeking further advice on his antennas. He hopes that the information provided here will enable readers to achieve satisfactory results.

ANTENNA GAIN AND EFFICIENCY

JOHN BELROSE, VE2CV, as a professional antenna engineer, is clearly concerned at the looseness and inexactitude of much of the terminology and information that appears in the amateur radio periodicals (including, I must confess, those in *TT*). For example he was disturbed to read the suggestion by G4HOL (*TT*, December 1991) that "his horizontal loop at 3.5MHz has 9dB more gain than his quarter-wave sloper". VE2CV comments: "Great. Should he throw out his sloper? Maybe not? When on 3.5MHz I switch from my dipole to my half-delta loop, which has an overhead null, the signals received from stations a few hundred kilometres away decrease by up to three S-units (15dB); whereas the signals from DX stations a long way away, on the west coast of Canada, increase by up to three S-units, depending on propagation conditions (angle of arrival of the skywave signal). No wonder amateurs do not understand antennas. They read so much conflicting information."

In pleading *mea culpa* I would suggest that this is an age-old problem not made easier by the fact that the whole subject of antenna gains and losses offers enormous scope for sophistry, semantics and what is known in the trade as 'specmanship' - ie why say your antenna has a gain of 6dB when with some subtle redefinition you can say the gain is 12dB? For those of us who are not professional engineers, antennas are not easy to understand even in purely pragmatic terms! Think of the signal leaving the antenna and spraying out in many directions, possibly boosted by ground reflection according to polarization. Then consider the tiny percentage of the original power that actually tickles the receiving antenna, as found only by accurate ray-tracing of the signal over the specific path concerned and the actual height of the reflecting layers. It then becomes evident that the performance of an antenna may bear little relationship to a single definition of gain without reference to the lobe patterns of both horizontal and vertical radiation. The development of computer-modelling based on NEC codes has made it easier for professional-amateurs and some others to assess antenna performance without actually engaging in practical trials - but most of us still depend on subjective assessments.

Tony Henk, G4XVF, has shown clearly that the overall efficiency of small transmitting loop antennas in terms of the amount of power actually radiated compared with the output power of the transmitter is usually quite low with more energy being lost in the matching components including the capacitors than in the actual loop element.

Rightly, he warns against spending a lot of money on a remotely tuned loop if you have sufficient space to erect a more conventional transmitting antenna. But the small loop can be a useful addition to the amateur antenna armoury. I seem to be bombarded with enthusiastic letters and information from amateurs who have developed or used such loops (I will try to find space to include some of this information before too long). And for those who would wish to experiment with low-cost loops, a reminder that the idea can be tried out without remote tuning or expensive high-voltage capacitors using 'capacitors' formed from parallel rods (as in a *CQ* design from the Dec 1991 and Jan 1992 issues) or from lengths of coaxial cable etc. Certainly, many of those who have built small magnetic loop antennas have been pleasantly surprised how well they work, even though they tend to be inherently 'low-efficiency' antennas. They bestow a number of useful characteristics both for medium and long-distance operation.

John Brodzky, G3HQX, uses both a small loop and a full-wave (3.5MHz) more-or-less horizontal loop antenna formed by conversion from a long-wire antenna by continuing it back up his garden, across the house and back to where it started, fed at one corner with 300-ohm ribbon and through a 4:1 balun to his ATU. He considers the large loop is "the best wire antenna that I have ever used". It works well on all bands up to 28MHz. On 3.5MHz the low height means that it radiates at a high vertical angle primarily suitable for medium-distance contacts but able to get across the Atlantic at times. Above 14MHz he works anything he can hear. But he was not satisfied with the performance on 7MHz after hearing UK stations working JA and ZL stations that he could not even hear. He was attracted by the idea of introducing some further vertically polarized components into his signal and studied the F1CLI antenna but he decided that it would not suit his location. Instead he hit on the idea of bringing down near the ground a point that was removed from the feed-point by $3\lambda/4$. He felt that the two arms of a V (see **Fig 3**) formed by this alteration would now be at about 45° and carrying currents in phase, with a current maximum at the top of each arm. In making this change the overall length of the loop had to be increased by 12ft and the feed-point moved down one of the legs to get the bottom of the V to come to the bottom centre of his garden. The increased length has shifted the loop resonance to the CW end of 3.5MHz and at 7MHz it is also at the preferred frequency. The overall length of the loop is now 286ft.

I am not sure what computer-modelling (or VE2CV) would make of this arrangement - and one may have to discount the unusually good HF propagation conditions early this year - but G3HQX reports that since he made the changes he finds that on 7MHz most mornings he can work ZL, JA, VE (including VE7) and plenty of Ws (including West Coast W6s). He bases his operating times on 'gray-line' propagation as described in the book *Low-band DXing* by ON4UN (available from RSGB) using his computer to predict sunrise and sunset times at the home QTH and those of the areas of interest. It is unlikely that others will wish to duplicate an arrangement designed to fit a particular location, but it is interesting to note that good 7MHz DX is possible with a large loop having a height varying between 12ft and 24ft.

VE2CV'S COMMENTS ON THE F1LCI ANTENNA

IN *TT*, DECEMBER 1992, Jean Bourdereau, G1LCI, showed how he had effectively adapted an 84-metre horizontal loop antenna to provide 1.8MHz DX operation by grounding the far-end (centre-point) of the loop via a thick conductor (or grounded metal mast) and by connecting the open-wire loop feeders together at the attic transmitter end to form what was termed a top-fed grounded Marconi antenna on 1.8MHz. On other bands, by restoring the balanced feed, the operation of the antenna as a multiband horizontal loop was not affected: **Fig 4**.

The item has resulted in correspondence between Dr John Belrose, VE2CV (well-known as a professional antenna specialist who acts as an ARRL Technical Adviser) and F1LCI. VE2CV was intrigued by the idea of a single antenna that could be switched between: (1) a horizontal rectangular loop and (2) what is technically more accurately described as a form of vertical electromagnetic ground-plane loop (akin to the VE2CV half-delta loop as described in *QST* etc).

His own interests centre more on the 3.5MHz band than 1.8MHz. He writes: "Since both short and long distance communication is possible on this band, one would like to have more than one antenna with a switch to choose between antennas matched to the distance or azimuthal direction requirement. For near-vertical-incidence-skywave (NVIS) signals, out to several hundred kilometres, we want an antenna that favours high-angle skywaves, such as a dipole or horizontal loop at a height of about a quarter-wave (or less - *G3VA*). For distant stations, we want an antenna that has a vertical-plane pattern that favours low-angle skywaves; a null for NVIS signals is useful in order to reject nearby strong interfering signals, man-made radio noise and radio noise from nearby to medium-distance thunderstorms."

Consequently, VE2CV computer-modelled (ELNEC) the F1LCI antenna with reference to 3.5 and 7MHz as well as for its intended 1.8MHz. He comments as follows:

(1) The description of the antenna as (a) 'horizontal mode' and (b) 'vertical mode' is somewhat a misnomer. Both arrangements when used for the higher frequency bands are electrically large, and both polarizations (horizontal and vertical) are radiated by each arrangement. The change of pattern with frequency for the EMGP arrangement is particularly complicated.

(2) With the shorted-feed line, the antenna is *not* 'a top fed Marconi antenna' (the same applies to G3BDQ's 'steeple antenna'). It is a kind of electromagnetic ground plane (EMGP) loop; a rectangular half-loop top-corner-fed, excepting that there are two top wires, and this makes the difference between this EMGP loop and thin-wire half-loop. The grounded metal mast or

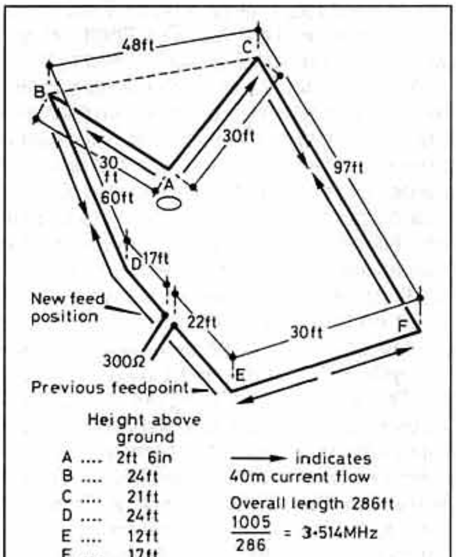

Fig 3: The large multiband loop antenna as modified by G3HQX to improve DX performance on 7MHz by adding the V-shaped section.

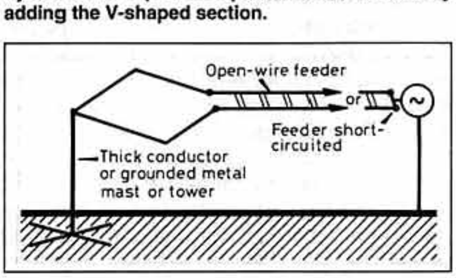

Fig 4: The F1LCI antenna as described in the December 1991 *TT* with option of a short-circuited feeder for 1.8MHz operation.