IRCA Technical Column

editor: Nick Hall-Patch
1538 Amphion St.
Victoria, B.C.
Canada V8R 4Z6

Is it a loop, or a random wire?

A look at outdoor directional antennas for a city lot

In the last couple of years, medium wave DXers have started to use the K9AY antenna, which looks like a large single turn outdoor loop antenna with pronounced directional characteristics. Although this is perhaps the best known, it is only one of a family of directional antennas with a broad null in one direction, and a broad peak in the other. Others are known as the “Ewe”, the “Flag”, and the “Pennant” antennas.

The Ewe antenna

We’ll start with the “Ewe” antenna, if only because it was the first to be described in the literature, in the February 1995 and January 1996 issues of QST, and, more importantly to us in this hobby, was empirically designed by **Patrick Martin** some years before those articles appeared. He has used it to log many trans-Pacific MW signals from Oregon.

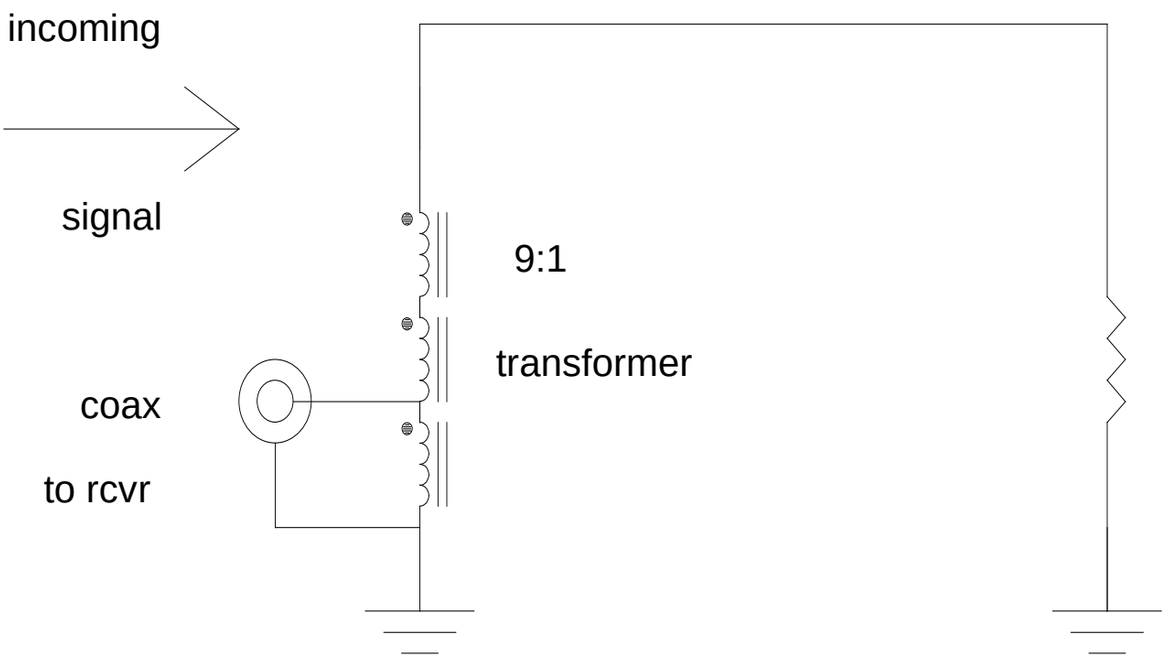

Figure 1 –the “Ewe” antenna

For the amateur bands, the “Ewe” is a length of wire about 10 feet high and up to 60 feet long. It has two downleads, one to the receiver through a 9:1 matching transformer to ground, and one at the opposite end which is terminated to ground through a resistor (see Figure 1) which is adjusted

for best front to back ratio. This antenna has a cardioid (heart-shaped) directional pattern in spite of its relatively small size, and, though it looks similar to a Beverage, it nulls signals off the terminating resistor end.

This antenna is essentially a pair of phased verticals with the horizontal wire between the downleads establishing the phase difference between the verticals. The QST article goes into some detail about the theoretical background, and presents various design approaches, which could be extrapolated to provide a useful antenna for other bands. Possible arrays are also discussed in the articles.

Patrick's version of the "Ewe" is somewhat larger than the above. He describes it as follows: "It runs about 200 feet long, running up a tree about 20 feet, over to the second tree and down that tree. It roughly runs to the northeast and is terminated by a 5 K ohm pot that can be adjusted (according) to how much water is in the ground. It runs over pretty swampy land. The antenna is run into the house through about 65 feet of RG59 and uses a home brew matching transformer of about 50 ohms to 500 ohms. The primary side (coax side) is floating and the secondary side (antenna) has one side to a Ground system of several 4 foot Radio Shack ground rods with a lot of #14 gauge bare copper wire buried in the ground."

The K9AY Terminated Loop

The K9AY Terminated Loop was described by Gary Breed, K9AY, in the September 1997 QST with additional information on page 73 of the May 1998 QST and uses about a quarter wavelength of wire at the highest frequency of interest. It is formed of a diamond or delta shaped loop of wire which, like the "Ewe" antenna, uses a 9:1 matching transformer and a terminating resistor in the leg(s) closest to the ground. The center of this leg (or the common point of the bottom two legs) is grounded at a point opposite to the loop's apex. (see Figure 2). This antenna uses its combined E-field and H-field response to generate a cardioid pattern.

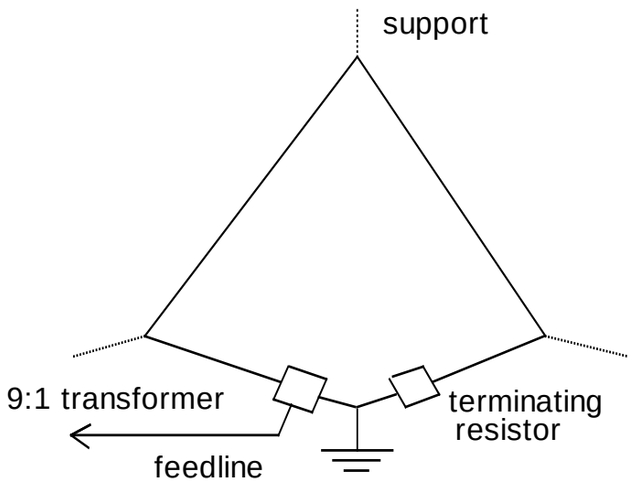

Figure 2 – the K9AY antenna

Guy Atkins (dxing@hotmail.com) recently used a commercial version of the K9AY loop antenna along with Beverage antennas in a winter DXpedition to Grayland, Washington. His comments are as follows:

I used a K9AY for the first time on this DXpedition. This particular K9AY is a commercial version from Wellbrook Communications in the UK. (http://www.wellbrook.uk.com) (Wellbrook House, Brookside Road, Bransgore, Christchurch BH23 8NA. Email sales@wellbrook.uk.com)

Wellbrook has only recently begun to sell their various antennas to USA and

Canadian customers. Their K9AY costs 140 GB Pounds, which was $230 US at time of purchase and they include shipping in the price. This version of the K9AY uses two loops to provide 360 degree coverage and to provide a reversible beam direction. Wellbrook supplies their control unit which sits at the DXer's operating position, the interface box (attached to the mast), about 100 feet of 2-conductor control wire for loop selection and clear, detailed instructions. The user needs to supply a regulated, “linear” ~12vdc power supply or battery feed (300ma draw), coax (50 or 75 ohm will work) between the interface and control boxes, loop wire, a supporting mast or other structure, and miscellaneous hardware as needed to complete the K9AY. The total loop circumference is determined by the user; I sized this K9AY as 86 ft. loops. The features that distinguish Wellbrook's K9AY from the basic K9AY described above are variable loop termination for optimized nulls and a "magnetic" matching transformer to help reduce noise pickup. Further information on the K9AY is found on Wellbrook's website.

For MW DX it performed admirably and equaled the performance of Beverage antennas at times. However, it was easy to miss a het or audio on a split frequency because the controls need critical adjustment (i.e. it's not a good antenna to use while scanning for hets between domestics). However, an email received from Andy Ikin of Wellbrook suggests that bandscanning with the K9AY on mediumwave can be improved by disconnecting the antenna from ground and turning the null control (pot) fully clockwise. Alternatively, a relay controlled jumper could be used to connect the ends of the loops, essentially turning the K9AY into a omnidirectional longwire. Once a split-frequency MW DX signal is noted, the controls would be adjusted for maximum S/N ratio and directivity as desired.

The Wellbrook K9AY's directionality--considering its size--is remarkable. Front-to-back ratio of 30-40db is typical, which is enough to completely eliminate many co-channel stations on mediumwave. There occasionally seems to be a slight reduction in domestic channel splatter when using the Wellbrook K9AY for trans-Pacific MW DX targets. On shortwave the K9AY is a low noise omni-directional antenna, filling in the gaps between the Beverages' coverage. For my afternoon/evening Indian and African loggings, the K9AY was consistently the best antenna (often the only antenna hearing the DX). "On target" Beverages, such as those we aimed due west for Papua New Guinea, always gave clearer signals on PNGs than the K9AY. It's tough to beat looking "down the barrel" with a Beverage antenna!

Of course, you'll need a way to get the apex of the loops in the air-- the DK9SQ mast is a nifty design that I bought for $99 US from http://www.bright.net/~kanga/kanga/dk9sq.htm It is a fiberglas telescoping mast and extends to approximately 33 feet, but I only used 26.5 ft of the height for the antenna. The Wellbrook website shows an alternative configuration of long, low rectangle-loops that works with shorter support poles.

I guess the advantage to Wellbrook's K9AY is the remote controlled variable termination circuit (Vactrol or similar) it employs for optimum directivity, and the use of an magnetic-type impedance matching transformer that helps reduce noise pickup (or so they say). For me, a big advantage was having a source for a K9AY with the electronics pre-built, since I'm so busy with college at this time in my life.

At http://www3.telus.net/7dxr/ k9ay/k9ayfoto.html, there are various pictures of the Wellbrook K9AY antenna as it was set up at Grayland. In addition, the site contains a RealAudio (k9aydemo.rm) file which compares directionality and sensitivity of the antenna to a 1000 ft. 290 degree Beverage in receiving 774 kHz JOUB, Akita, Japan at 1100 UTC Dec. 19, 1999. A file on the site, “k9_notes.txt”, describes when each antenna is used during the playback time of the file.

Dave Kenny in Britain also reviewed the Wellbrook K9AY antenna in the September 1999 edition of Communication, the monthly journal of the British DX Club; the review also appears at http://www.wellbrook.uk.com/reviews/BDXC.html He was very impressed with it, although most of the examples he used were of domestic DX. He points out that the Wellbrook K9AY’s control unit remotely varies the phase of the two loops by varying the termination resistance, allowing uni-directional null steering through 360 degrees without moving the antenna. Note that this variable direction null is not possible with the single K9AY loop seen in Figure 2.

The recent Newfoundland DXpedition also used K9AY antennas in the gaps between the Beverage beams, and Jean Burnell said that sometimes these provided quieter coverage than the Beverages. Al Merriman describes their use in some detail at Werner Funkenhauser’s excellent

MWDX web site, http://home.inforamp.net/~funk/termloop.html His findings were quite similar to Guy Atkins': "Nulls off the back of the loops ranged from 25 to approaching 40 db which is identical to the performance I get at home. The E-W loop performed so well compared to the Beverages that it was run through a splitter and used as the primary TA antenna. The N-S loop, although giving a good account of itself did not compare nearly as well against the 1 kilometer Brazil Beverage. Deep South Americans - Argentina, Uruguay, Brazil - were uniformly stronger and reception was cleaner on the Beverages. A lot of the stations were also heard on the loops but not as well. However when you moved away from the relatively narrow "beam" width of the Beverage - for instance the Venezuelans - were as good and occasionally stronger on the N-S loop than they were on the Beverage….Although the loops will knock signals arriving off the sides down an S-unit or so the Beverage did much better (in nulling stations off the side of the antenna)."

Note that Al also quickly progressed to a pair of K9AY's at 90 degrees to each other and phases them together to get nulls. He also found that the K9AY delivered about 8-10 dB less signal than his 135 foot slopers, so a preamplifier might be useful in some situations.

The Flag and the Pennant antennas

Both the Ewe and the K9AY antenna work best if they are placed over a good, uniformly conductive ground; a number of users of the K9AY have counterpoise wires helpful as an addition to the standard ground rod. The "Pennant" antenna (see http://www.angelfire.com/md/k3ky/page37.html for details) was initially developed by José Mata Garriga, EA3VY, to be independent of local ground when it was used on the low frequency amateur bands . It was developed further by Earl Cunningham, K6SE for use on the 160 meter amateur band; he also created another design called the "Flag" antenna (there is also a "Diamond" variant mentioned on the above web site). K6SE posted the following comments to the Topband Reflector:

"Both the Pennant and the Flag are 14 feet by 29 feet in size. The triangular Pennant was given its name by me because of its shape. The other configuration, being rectangular, I decided to call the "Flag". All modeling for these antennas was done with the tops of the antennas at 20 feet high and the bottoms at 6 feet high, with all wire #14 gauge.

The correct termination resistor for the Pennant is approximately 900 ohms, which can go either at the point of the Pennant or in the center of the vertical section. The feedpoint is at the opposite end. The correct termination value for the Flag is about 950 ohms, which goes in the center of either vertical section, with the feedpoint in the center of the other vertical section.

Both antennas are directional with a cardioid azimuth pattern with a deep null to the rear, just like the Ewe. They are useful on 160m, 80m and 40m as a receiving antenna."

Like the K9AY and the Ewe, the feedpoint of the Flag and Pennant incorporates a transformer. Peter Nesbit, VK3APN, suggests an FT140-43 toroid with 8 turns on the secondary, and 34 or 35 turns on the primary (for 900 or 950 ohms respectively).

Essentially, at low frequencies, the conductive ground a short distance below the K9AY and the Ewe tend to stop the horizontal portion of the antenna from efficiently receiving much signal. In the Flag and the Pennant, the return horizontal wire near to the ground has a similar effect on the upper horizontal wire. So the vertical portion of each of these antennas picks up the largest amount of signal, but the Flag and Pennant antennas are not supposed to be as dependent on a conductive ground to suppress the signal picked up from the horizontal portions of the antenna.

(parts of this article were taken from A DXer's Technical Guide , from the archives of the Topband Reflector (info at http://www.contesting.com/topband.html), with special input from Guy Atkins and Patrick Martin. A DXer's Technical Guide can be obtained from the IRCA Bookstore, 9705 Mary NW, Seattle WA 98117-2334 at $10.00 for IRCA/NRC/MWC members, $12.00 for non-members; overseas airmail add $2.50)

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For those who might like a look at the future of radio hardware, there is an overview of digital radio design (the ideal is to digitize the signal at the antenna; it's software from then on…) at http://www.ednmag.com/reg/1999/102899/22df2.htm In addition, a digital receiver handbook is available at http://www.pentek.com/digrecv/