About this Article

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apart for discrete wires. Some amateurs construct two-wire Beverages using "window" ladder-line, twisting the line about three twists per foot for mechanical and electrical stability in the wind.

The characteristic impedance Z_{ANT} of a Beverage made using two discrete wires with air insulation between them depends on the wire size, spacing and height and is given by:

$$Z_{ANT} = \frac{69}{\sqrt{\varepsilon}} \times \log\left[\frac{4h}{d}\sqrt{1+\left(\frac{2h}{S}\right)^2}\right] \quad \text{(Eq 4)}$$

where

Z_{ANT} = Beverage impedance = desired terminating resistance

S = wire spacing

h = height above ground

d = wire diameter (in same units as S and h)

ε = 2.71828

Beverages in Echelon

The pattern of a Beverage receiving antenna is dependent on the terminating resistance used for a particular antenna, as was demonstrated at the extremes by Figure 22.6. This compared the patterns for a terminated and an unterminated Beverage. The pattern of even a poorly terminated Beverage can be significantly improved by the addition of a second Beverage. The additional Beverage is installed so that it is operated *in echelon*, a word deriving from the fact that the two wires look like the parallel rungs on a ladder. For a practical 160 and 80 meter setup the second Beverage wire is parallel to the first Beverage, spaced from it by about 5 meters, and also staggered 30 meters ahead. See **Figure 22.9**.

The forward Beverage is fed with a phase difference of +125° such that the total phase, including that due to the forward staggering, is 180°. This forms the equivalent of an end-fire array fed out-of-phase, but it takes advantage of the natural directivity of each Beverage. **Figure 22.10** compares the pattern of a single 1-λ 160 meter Beverage that is sloppily terminated with two Beverages fed in echelon. The Beverages in echelon gives a modest additional gain of almost 2 dB. But where the two Beverages in echelon really shine is how they clean up the rearward pattern — from an average about 15 dB for the single Beverage to more than 25 dB for the two Beverages.

Even at a spacing of 5 meters, there is very little mutual coupling between the two Beverage wires because of their inherently small radiation resistance when they are mounted low above lossy ground. If you adjust for a low SWR (using proper transformers to match the feed line coaxes), the phase difference will depend solely on the difference in length of the two coaxes feeding the Beverage wires. **Figure 22.11** shows a wideband feed system designed by Tom Rauch, W8JI, as a "cross-fire" feed system. The 180° wideband phase-inverting transformer allows the system to work on two bands, say 160 and 80 meters. See the **Receiving Antennas** chapter in *ON4UN's Low-Band DXing* book for transformer details.

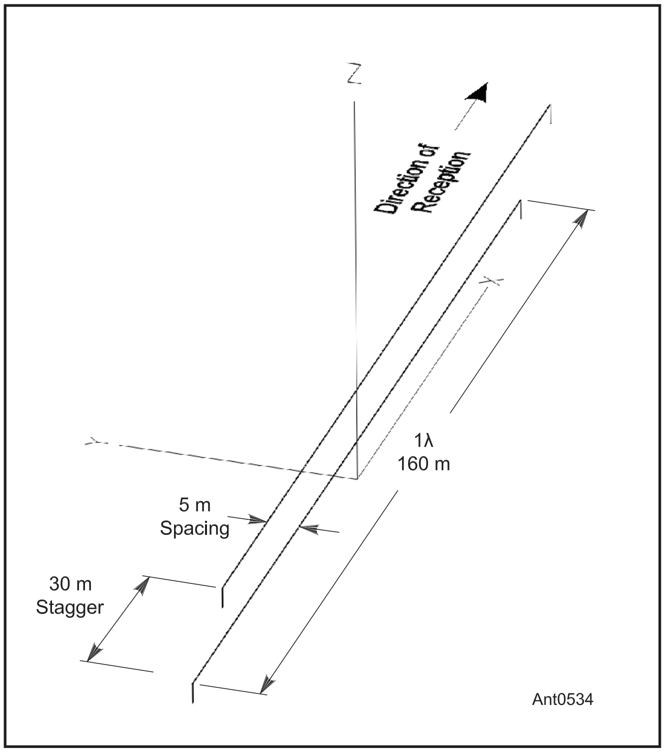

Figure 22.9 — Layout of two 160 meter 1-λ long Beverages in echelon, spaced 5 meters apart, with 30 meter forward stagger. The upper antenna has a 125° phase shift in its feed system.

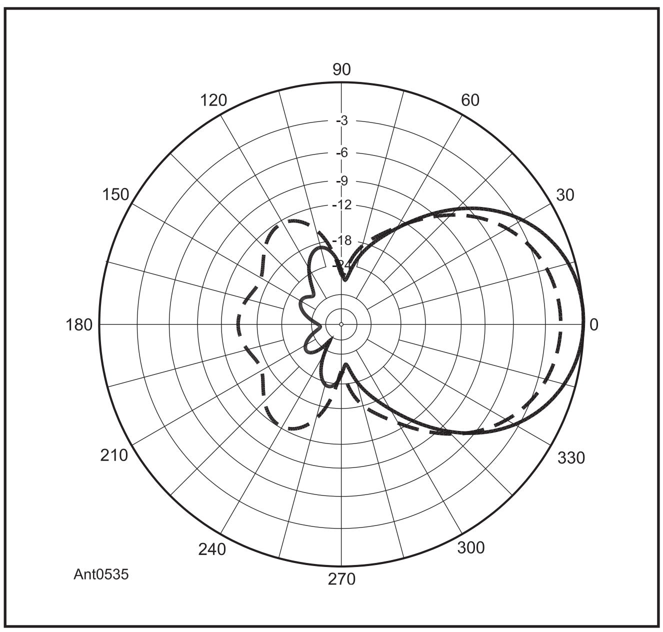

Figure 22.10 — Azimuth pattern at 10° takeoff angle for single Beverage (dashed line) and two Beverages in an echelon end-fire array. The rearward pattern is considerably cleaner on the echelon. Thus, two closely spaced, short Beverages can give considerable improvement over a single short Beverage.

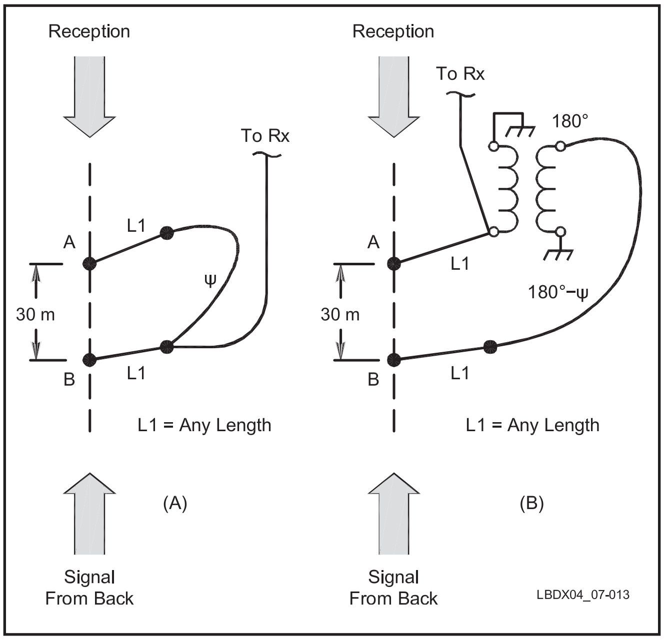

Figure 22.11 — Two ways of feeding the two-Beverage echelon array in Figure 22.9. On the left, a feed system good for one frequency; on the right, a "cross-fire" feed system good for 1.8 and 3.6 MHz. For this system we want a phase shift due to the coax length of +116° at the back Beverage A. The angle ϕ is thus 180° – 116° = 64° long on 160 meters. In the system on the right, a 64° length on 160 meters becomes 128° long on 80 meters. So with the phase-inverting transformer the net phase shift becomes 53° on 80 meters, a reasonable compromise. (*Courtesy W8JI and ON4UN)*

Beverage On Ground (BOG)

A number of low-band DXers have reported improved received signal-to-noise ratios using a Beverage On Ground (BOG). This consists of a wire placed directly on the ground, as if a regular Beverage antenna was simply installed on the ground. Results are mixed as discussed by Guy Olinger, K2AV, in the following excerpt from a discussion on the Topband reflector: "What is often called a BOG is really a ground-mounted low-velocity-factor receive antenna, which has its own set of rules. The technique of terminating the far end of a wire in what amounts to a characteristic impedance, to dissipate the standing wave on the wire, does not produce an optimum BOG.

"160 meter BOGs longer than 220 feet start to not model or perform well. One can easily model a BOG that has a pattern *reversal*. The various serious quirks of BOGs make them [difficult to use].

"Notching the BOG into the ground during installation prevents a large change in velocity factor as over seasons the wire gradually works itself through the grass and into the dirt. To get the BOG adjusted and with a somewhat constant behavior really requires that the BOG be in the actual ground, not laying on the grass where it can move vertically.

"The BOG's pattern will also vary with the ground's water content, which is in turn varying the velocity factor and the best termination strategy. This effect, along with the wire gradually growing down into the grass, can be responsible for the difficulty in obtaining repeatable and satisfactory results."

22.1.3 K6STI LOOP

The K6STI Loop (see Bibliography and this book's CD-ROM) in **Figure 22.12** is a horizontal loop that combines rejection of vertically polarized ground wave signals with a null in the vertical radiation pattern to reject high-angle local and regional noise. The sky wave response to lower-angle signals is approximately omnidirectional.

The 80 meter version of the antenna measures 25 feet on a side, is mounted horizontally 10 feet above ground, and made of #14 AWG wire. It's fed at opposite corners with phasing lines made of #14 AWG wire spaced 1.5 inches apart. A small ferrite transformer at the junction of the phasing lines matches the antenna to 50-Ω coax feed line and also functions as a balun. The trimmer capacitor (about 40 pF is required) in series with the antenna-side winding resonates the loop at 3.5 MHz.

The loop can be constructed as small as 10 feet on a side and still provide noise-rejecting benefits. The loop must be resonated with a variable capacitor and requires a preamplifier in most cases. (See the section on ferrite-loop antennas later in this chapter for a suitable design.) The design can be scaled to higher and lower bands by multiplying lengths, transformer turns, and capacitance values by $3.5 / f_{MHz}$.

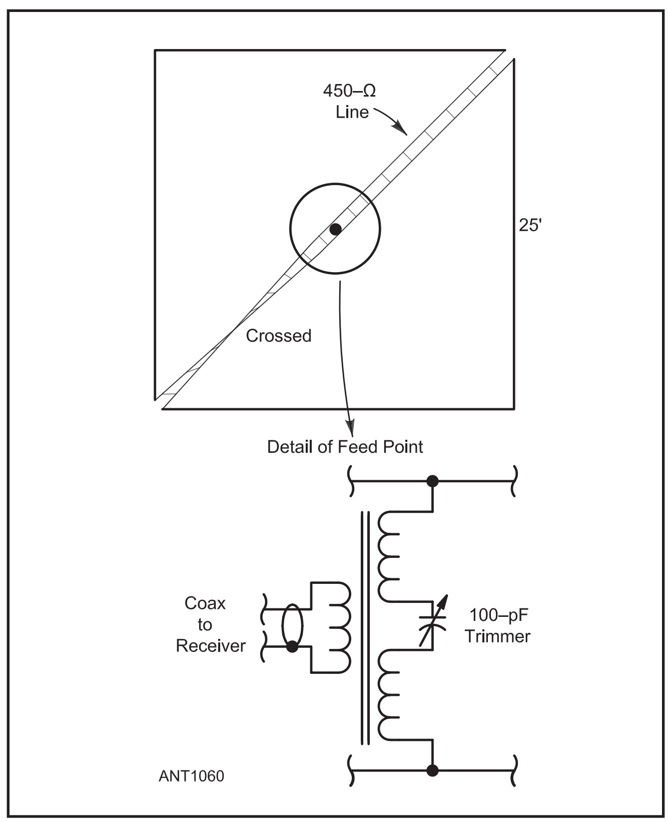

Figure 22.12 — Basic diagram of the 80 meter low-noise loop antenna showing detail of the feed point arrangement.