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Small Loops For Low Frequency DX'ing

The small loop antenna has a lot of potential for low frequency (VLF through tropical bands) DX'ing. The loop is so useful because it possesses a bi-directional, roughly figure-8, response pattern (Fig. 1) with very sharp, very deep nulls. The nulls, or direction of minimum response, are found when the antenna is broadside to the arriving radio signal. The peak response, or main lobes, are found when the sides of the loop are facing the arriving signal. This is counter-intuitive to many people, for they assume that the max response occurs when the loop is broadside (as it is when the antenna is a ferrite loopstick). But on small loop antennas, the deep null is broadside to the loop.

The loop was originally used for radio direction finding and finding hidden transmitters. But for low-band DX'ers, there is another use: eliminating strong, local interfering signals to reveal hidden DX signals on the same, or adjacent, channels. I built one loop, and tried two commercials models (one a loopstick).

A loop antenna must have certain attributes. First, it must be small relative to the wavelength (λ) of the desired signals. The usual rule is a total wire length of <0.22λ, although most authorities argue for a wire length between 0.08λ and 1λ. At the frequencies where loops are best used, this requirement is not hard to meet because a wavelength is scores of dozens of feet. Another requirement is that the diameter (or edge length if not circular) be at least five times the width of the winding (if multiturn) or the diameter of the wire (if single turn). For most low frequency DX'ing a multiturn loop is needed.

A Homebrew Embroiderloop

Fashioning the loop is usually a bit of a chore, and winding even a dozen or so turns on a large form can be daunting—especially since the turns keep falling off the form. I hit upon an idea that allowed me to make a multiturn transformer loop (Fig. 2A) in which the outer loop (L1) was a 14-turn loop, and the receiver coupling loop (L2) was 2-turns. The loop is made of 16-conductor ribbon cable of the sort used by computerniks. Two wires in the center of the bundle (grey and white) are used for L2, while all the rest are used for L1. The form is a 14-inch embroidery or needlepoint hoop, which I bought from a craft store for $1.49. It consists of two concentric, close-fitting wooden hoops. The inner hoop is continuous, while the outer hoop is broken at one point. A screw and two tabs holds the ends together, and adjust for size. In embroidery, the fabric is placed between the two hoops and secured with the screw; in our loop antenna the 16-conductor ribbon cable is sandwiched into the space between inner and

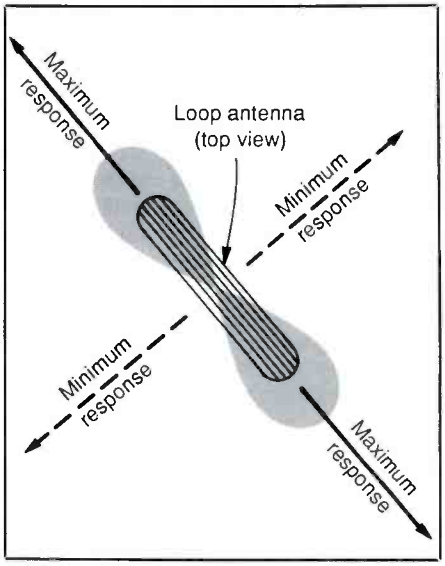

Figure 1 — Maximum and minimum response directions for a small wire loop antenna.

outer hoops. (Fig. 2B). The conductors of the cable are cross-connected in the manner shown in Fig. 2C to form one continuous coil.

The inner loop is connected to a length of coaxial cable, which carries signal to the radio receiver. The outer loop is connected to a variable tuning capacitor (C1 in Fig. 2A). I

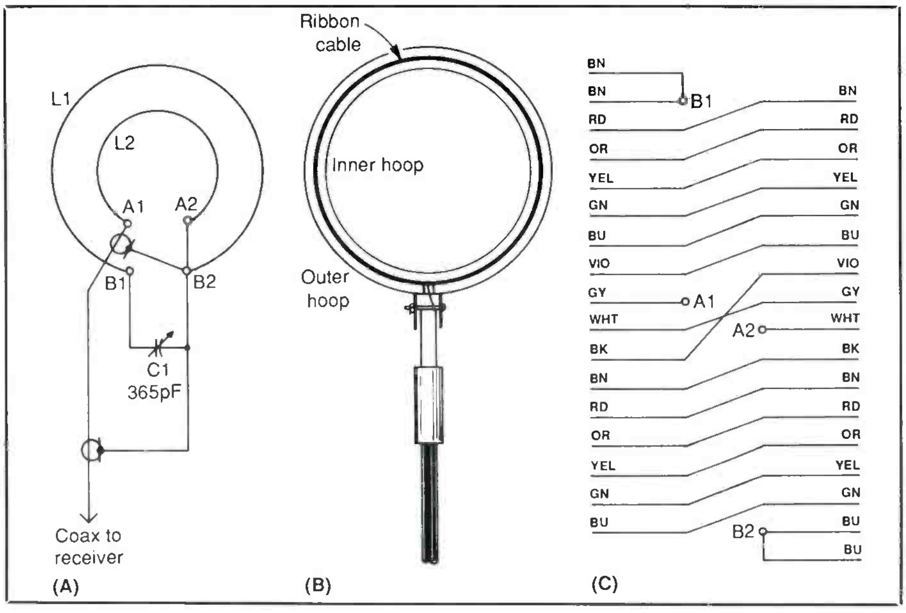

Figure 2—Homebrew loop antenna: A) Equivalent circuit, B) Construction using an embroidery hoop to hold 16-conductor ribbon cable; C) wiring connection for the 16-conductor ribbon cable.

Figure 3—Actual loop as constructed.

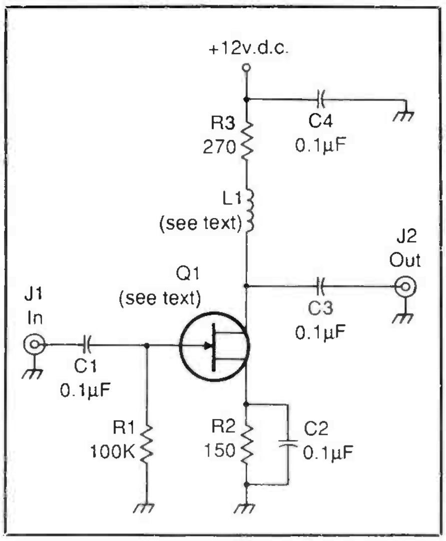

Figure 4 — JFET-based loop amplifier.

found that a 365-pF "broadcast band variable" capacitor was sufficient to tune the loop in all sections of the AM band. But some people tell me that two or three sections of 365 pF may be needed in some cases where fewer turns are used. Figure 3 shows the completed loop antenna.

Loop antennas don't pick up very much signal, even on good days. If the receiver lacks the sensitivity to make up for the difference, then a loop amplifier is needed. It should have a gain of 10 to 25 dB throughout the range of interest. For the AM broadcast band I found that the circuit of Fig.4 worked well. The circuit provided about 5 dB gain when L1 was removed and R3 connected directly to the drain of the JFET transistor. When L1 was used, the performance was best on the low end of the band when a 1 mH choke (*Digi-Key* part no. TK-4312) was used for L1. However, the performance was less, but more consistent across the band, when a 220 µH coil (*Digi-Key* part no. TK-1019) was used. The transistor used is an MPF-102 JFET, although either ECG-312 or NTE-312 will work as substitutes (and are generally available in local parts distributors).

Commercial Loop Antenna

Figure 5 shows two commercial loop antennas that I've used. Both are made by Palomar engineers (Box 455, Escondido, CA 92025; 619-747-3343). Both loops are connected to the Model LA-1 loop amplifier. The square loop in Fig. 5A is the Palomar Model HF-1, which is intended for high frequency shortwave use. It is made with a PVC housing, and plugs into the top of the loop amplifier. The loop in Fig. 5B is a loopstick antenna, Model BCB, that is designed for use in the AM broadcast band. Other models are available for other frequencies from VLF through HF. Both antennas are capable of being rotated in azimuth (as is proper for a loop), but the BCB antenna is also capable of being adjusted in elevation. This allows you to compensate for angle of arrival of sky wave signals. Both antennas performed well, and for those that don't want to mess with making one, may be the best solution for the cost.

Using a loop is simple, especially when the object is to reduce the signal strength of a co-channel of adjacent channel interfering signal. Loops work best in this manner on ground wave signals. You will be surprised at how much more "sensitive" your AM band DX receiver seems when the loud locals are cut down to size! Adjust the position of the loop to minimize the interfering signal, and be surprised what lays underneath, especially at night. ■

Figure 5 — A) Palomar Engineers HF-1 small loop; B) Palomar BCB loopstick. Both are connected to an LA-1 loop amplifier.