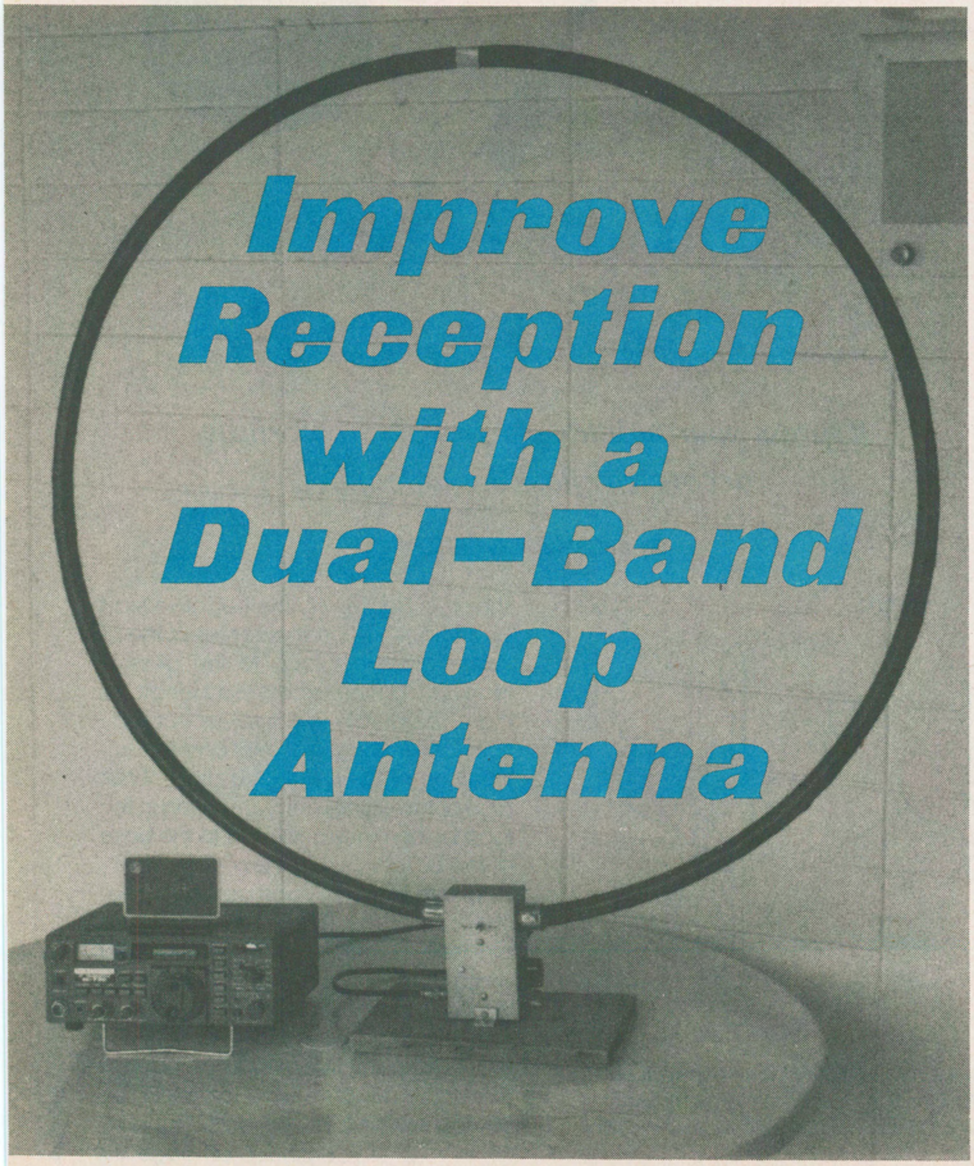
Improve your reception on the lower frequencies with this easy-to-build, amplified-antenna system

BY DAVE HOLLANDER, N7RK

One of the greatest problems encountered when DX'ing on the lower frequencies—such as 1.8 and 3.5/3.8 MHz—is weak signal reception. That problem is compounded when one lives in a noisy location. Power-line noise can be a real deterrent and, in many cases, may even give rise to second thoughts about DX'ing on the lower bands. But a recent move to a new location allowed me to return to my favorite DX band (80/75 meters).

I put up a pair of phased verticals (¼ wavelength or about 62 feet on 80/75 meters) and, despite having underground utilities, was quite shocked to find an almost constant S9 noise level on 80 meters. The noise was coming from power lines located a couple of blocks away. Although the power company has been cooperative, an alternate receiving antenna was necessary as it can sometimes take them weeks, even months, to fix the problems. Besides, you never know when the noise is going to re-occur (usually when a *DXpedition* is on from a country you have been trying to log for years).

There have been many schemes for receiving antennas. For instance, a "Beveridge" antenna (developed by and named for Harold Beveridge) would have been ideal. A Beveridge antenna is wire—a minimum of 1 wavelength long—stretched in the direction of the transmitting station, and generally erected only about 5–10 feet above ground. It has a bidirectional pattern if left unterminated. It is for receiving *only* and is useful for enhancing the signal-to-noise (S/N) ratio when listening to weak signals in high levels of atmospheric noise and interference. It is the most effective antenna for weak-signal reception on the 160- and 80/75-meter bands. But because of its size (approximately 260 feet for 80/75 meters, and 520 feet for 160 meters), it is not popular among city dwellers. Its size is crux of my problem; my backyard is a wee bit too small.



After studying antenna books, the *ARRL Radio Amateur's Handbook*, and various articles, I decided to build a receiving loop that could be placed inside my shack right next to the operating position. What follows is a very simple, easy-to-build, and inexpensive indoor receiving loop—the *Dual-Band Loop Antenna*—that covers both 80/75 and 160 meters. Changing bands is accomplished with the flip of a switch. If one is a good scrounger, it can probably be built for under thirty dollars.

About the Circuit. Figure 1 shows the schematic diagram of the Dual-Band Loop Antenna system. The receiving element consists of loops of wire threaded through a child's hula hoop. Switch S1 is used to select either 80/75- or 160-meter operation. When S1 is in the 80/75 position, only a single loop of wire, designated L2, is connected to the balance of the circuit. When S1 is placed in the 160 position, a double loop of wire, designated L1, is placed in series with L2, and all three loops are connected to the circuit. The receiving element is made resonant at the desired operating frequency using variable capacitor C1.

The received signal is passed to a very simple two-transistor preamp, consisting of Q1 (set up as a common-emitter amplifier) and Q2 (configured as a common-base amplifier). When S2 is

PARTS LIST FOR THE DUAL-BAND LOOP ANTENNA

CAPACITORS

C1—365-pF broadcast variable
C2—120-pF dipped-mica
C3—51-pF dipped-mica
C4, C5—.047-µF ceramic-disc

ADDITIONAL PARTS AND MATERIALS

Q1, Q2—3N3904, 2N4124, or similar general-purpose, NPN silicon transistor
R1, R2—150,000-ohm, ¼-watt, 5% resistor
R3—1000-ohm, ¼-watt, 5% resistor
L1, L2—See text
S1—SPDT toggle switch
S2—SPST toggle switch
B1—9-volt transistor-radio battery, or 6-12-volt power pack
J1—SO-239 or BNC chassis-mounted connector
Terminal strip or perfboard materials, metal enclosure, battery holder and connector, hula hoop, conduit fittings, antenna wire (see text), wooden base, solder, hardware, etc.

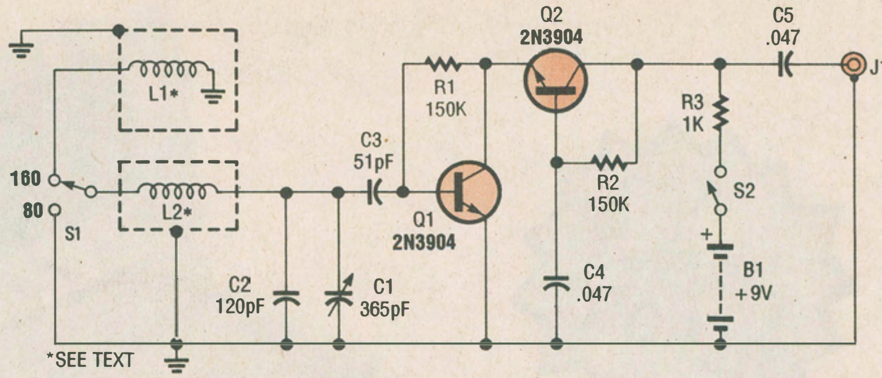


Fig. 1. The Dual-Band Loop Antenna consists of little more than three large loops of wire (L1 and L2), two transistors, and a few additional components.

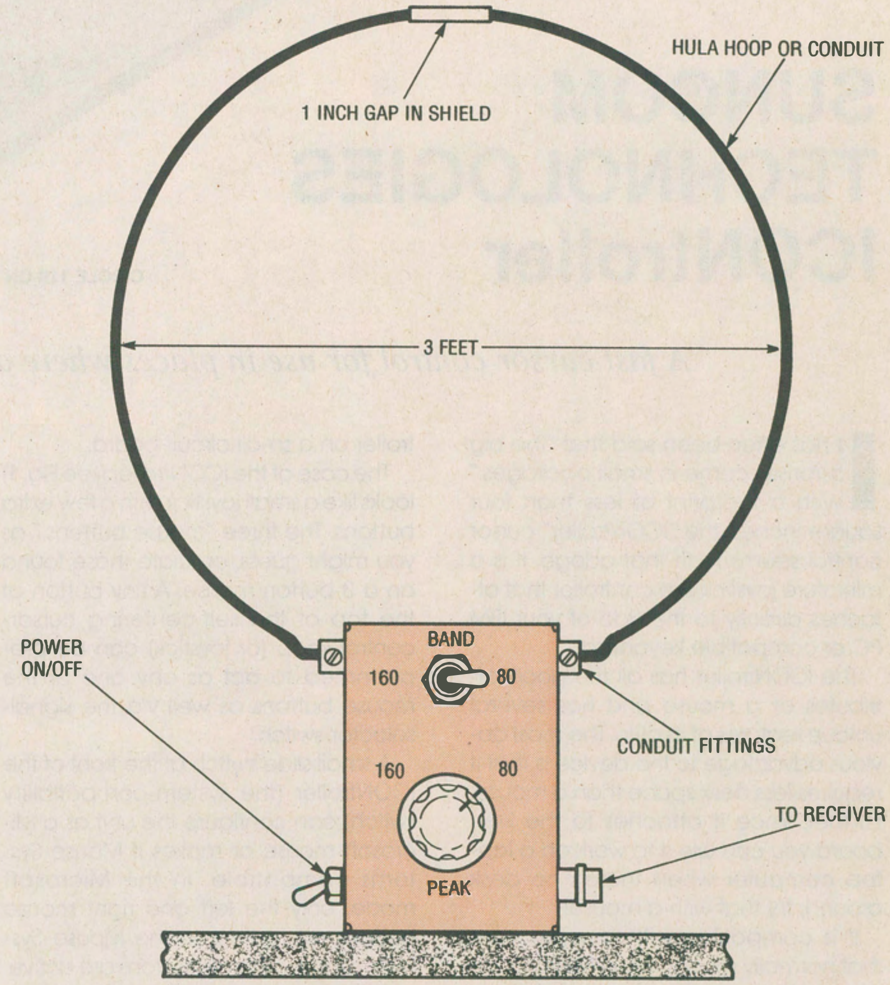


Fig. 2. The hula hoop is cut at the center of the exposed foil area and the ends brought into the metal enclosure through electrical-conduit fittings. The exposed foil is used to make electrical contact with the unit's metal enclosure.

turned on, a small voltage is applied to the base of Q2 through R3 and R2, turning that transistor on. With Q2 turned on, a small voltage is applied to the base of Q1 through R1, biasing it to just below turn on. The incoming signal, along with the bias voltage on Q1, is sufficient to cause Q1 to turn on and off as the incoming signal rises and falls. In that way, the incoming signal is used to modulate the DC voltage at the collector of Q2, producing an amplified version of the original signal at J1.

Power for the circuit is provided by a 9-volt battery, and because the circuit draws so little current, the battery should last at least a year if the circuit is turned off after an operating session. The circuit's operating voltage is not critical; in fact, the circuit could be powered from an inexpensive 6- to 12-volt plug-in power supply, if you wish.

Construction. The electronic portion of the author's prototype was built on a terminal strip, and housed in a metal enclosure (measuring about 2 × 3 × 5 inches), which was mounted to a wooden base to give the assembly stability. The antenna (loop) portion of the system was then mounted to the enclosure. That covers the overall construction of the antenna system, now let's take a more detailed look at the unit's construction.

The loops are housed in a child's hula hoop (which can be purchased at most toy stores). The hula hoop should be approximately three feet in diameter, although that dimension is not very critical.

The first step is to shield the hoop in order to eliminate electrostatic noise from power-lines and other sources. That's done by wrapping tin foil around the hoop and then covering the foil with electric tape, leaving about 2 inches of the foil exposed. Cut the hula hoop at the center of the exposed foil and then bring the ends of the insulated hula hoop into the metal enclosure through electrical-conduit fittings (see Fig. 2). The exposed foil will be used to make electrical contact with the circuit's metal enclosure.

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The hula hoop may be slightly undersized for the conduit fittings and may need to be shimmed. The author wrapped 10-mm copper strips around the tin foil to make up the difference.

After affixing the shielded hoop to the enclosure, it's time to wind the loops. To begin, pass one turn of wire through one end of the hoop, returning to the enclosure through the other end. That wire loop is for 80/75-meter operation. Note that neither the size nor type of wire that is used is critical. For example, I used 18-gauge speaker wire in my prototype.

Connect one end of the antenna wire to the junction of C1 and C2 and the other end to the center (wiper) contact of S1. Feed two more turns of antenna wire through the hoop. One end of that double loop of wire will be connected to ground and the other end goes to one of S1's contacts; the switch's remaining contact is tied to ground. The second loop is for 160-meter operation. Remove about 1-inch of the foil shielding from top dead center of the hoop to allow signal reception, while preventing the hoop shielding from acting as a shorted turn to the desired electromagnetic field.

Assemble the rest of the circuit using Fig. 1 as a guide. In the author's prototype, all of the other components—except S1, S2, B1, J1, and C1 (it's too big)—were placed on a terminal strip that was mounted (with one or two of its lugs grounded) to an inside wall of the enclosure. Point-to-point wiring was used to interconnect the components. You could also assemble the circuit on perfboard, if you prefer.

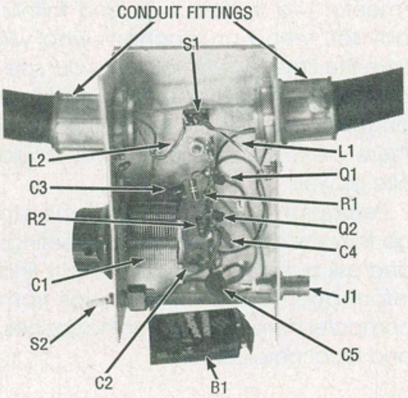
In any event, keep all lead connections as short as possible. Note that, although 2N3904 transistors are used in the schematic diagram and an alternate unit is listed along with the aforementioned transistor in the Parts List, the transistors are not critical; any general-purpose NPN transistor can be used in the circuit.

Once the circuit is complete, check your work for possible wiring errors; misconnected components, short circuits, etc. When that's done, mount the assembly to a piece of wood, which will serve as a stabilizing base. The author used a 1- × 12- × 12-inch piece of wood (which he just happened to have laying around).

Operation. The operation of the Dual-Band Loop Antenna is very simple. Connect it to the antenna jack of your receiver or to your transceiver's auxiliary-antenna jack. In the event that your transceiver does not have an auxiliary-antenna jack, you'll have to build some type of antenna-switching arrangement before using the project.

Warning: Whatever you do, *do not* transmit using this antenna; doing so will destroy the transistors in the preamp.

Apply power to the circuit by closing S2; then set S1 to 80 meters. Adjust C1 until the noise level peaks. You should



Here is an inside view of the Dual-Band Loop Antenna. Note that the entire circuit, except for S1, S2, C1, B1, and J1, was assembled on a terminal strip.

now be able to hear signals by tuning around the band. If you detect any power-line or other noise, rotate the loop until you find a null in the noise. Be sure to take your time as the null will be very sharp. In some cases, the noise can be reduced from an S9 to S0.

The loop can also be used to reduce the effects of extremely strong signals from local amateur installations. In addition, the loop can be used to lessen the high QRN from thunderstorms. By rotating it away from the direction of the storm, the QRN level is lowered several S-units, which may make the difference between a good copy and no copy at all.

The loop does have its limitations. If there is more than one source of noise, the loop will not be effective. When using the loop on 160 meters, you may have several false peaks when adjusting C1. The correct setting is determined experimentally. The correct peak will be obvious. But with incorrect settings, you will hear all kinds of broadcast garbage. ■