A New Look at Loop Antennas

Adding regeneration to ferrite-core and open-wire box loops.

by Ken Cornell W2IMB

Anyone who has used a properly operating regenerative preamplifier can appreciate the tremendous gain, sensitivity and selectivity that it provides their receiver for weak signal detection. Why not apply this principle to a loop antenna?

Due to years of experimental efforts, I had several types of ferrite core and open wire box type loops available. I decided to rework my favorite ferrite core loop to provide regeneration. I wired up a simple regenerative preamplifier on a small piece of perf board and wound some new coils to provide a source tap. The preamplifier circuit is shown in Figure 1. The loop assembly is shown in Figure 2 and it is offered as a suggested design.

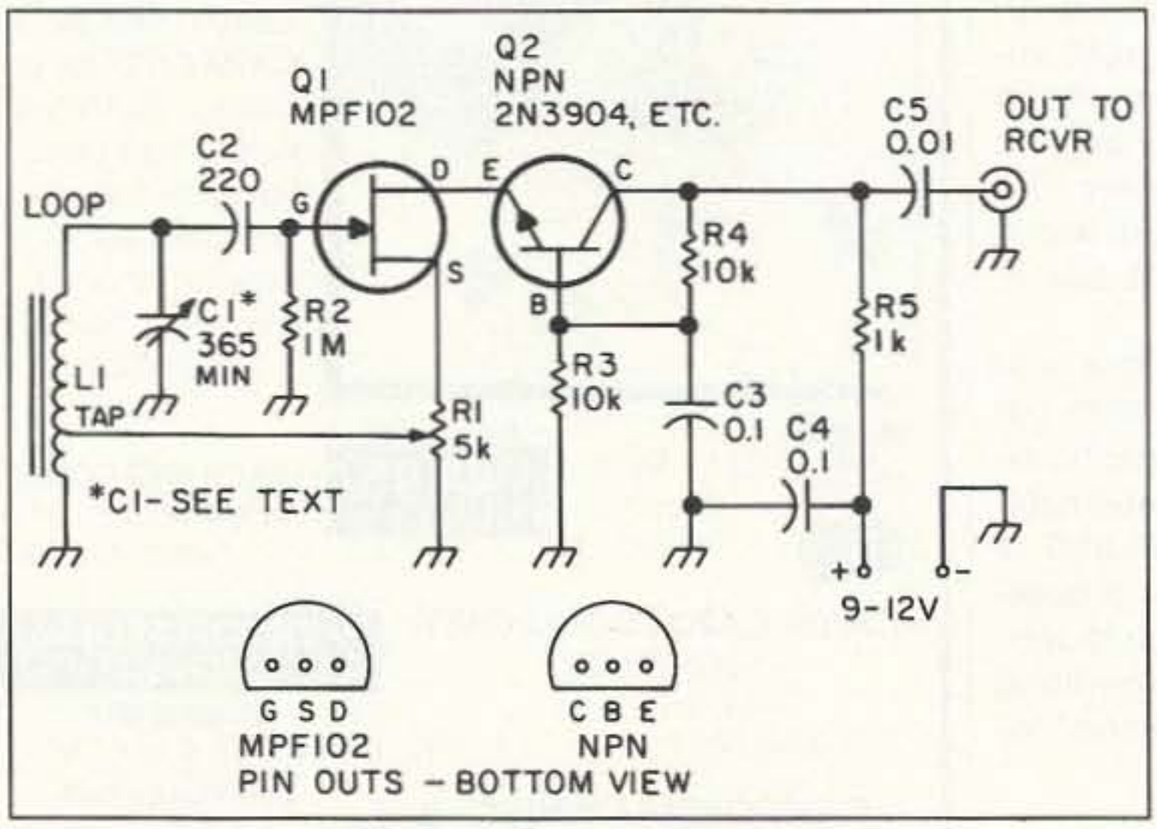

Figure 1. Preamplifier circuit.

I mounted the regeneration control potentiometer with the back shell pressed against the board, using double-sided tape (RS #64-2343). It is not practical to mount the tuning capacitor on the circuit board support so I mounted it on the base disc and connected it to the coil (L1) using a length of RG-59/U coax cable with the shield going to the ground end of the coil and the inner conductor to the gate end.

On the threshold of oscillation, the tuning is extremely sharp and a vernier dial should be used for C1. Another scheme would be to place a 10 to 15 pF variable capacitor across C1, set at half capacity, and use this for fine tuning as well.

Part values are as shown. Capacitors are disc type, 35V. Resistors are 1/8 or 1/4 watt. Potentiometer R1 should have a linear taper.

Of course, L1 and C1 should be a resonant circuit covering the desired frequency range. The number of turns required can be an experimental endeavor, depending on the ferrite core permeability and size. Most ferrite cores have a fairly high permeability (800 or more), therefore operation above 10 MHz is impractical since there would be too few turns on the coil to obtain a reasonable L/C ratio. Above 10 MHz a box wire loop antenna should be used instead of the ferrite rod/coil combination.

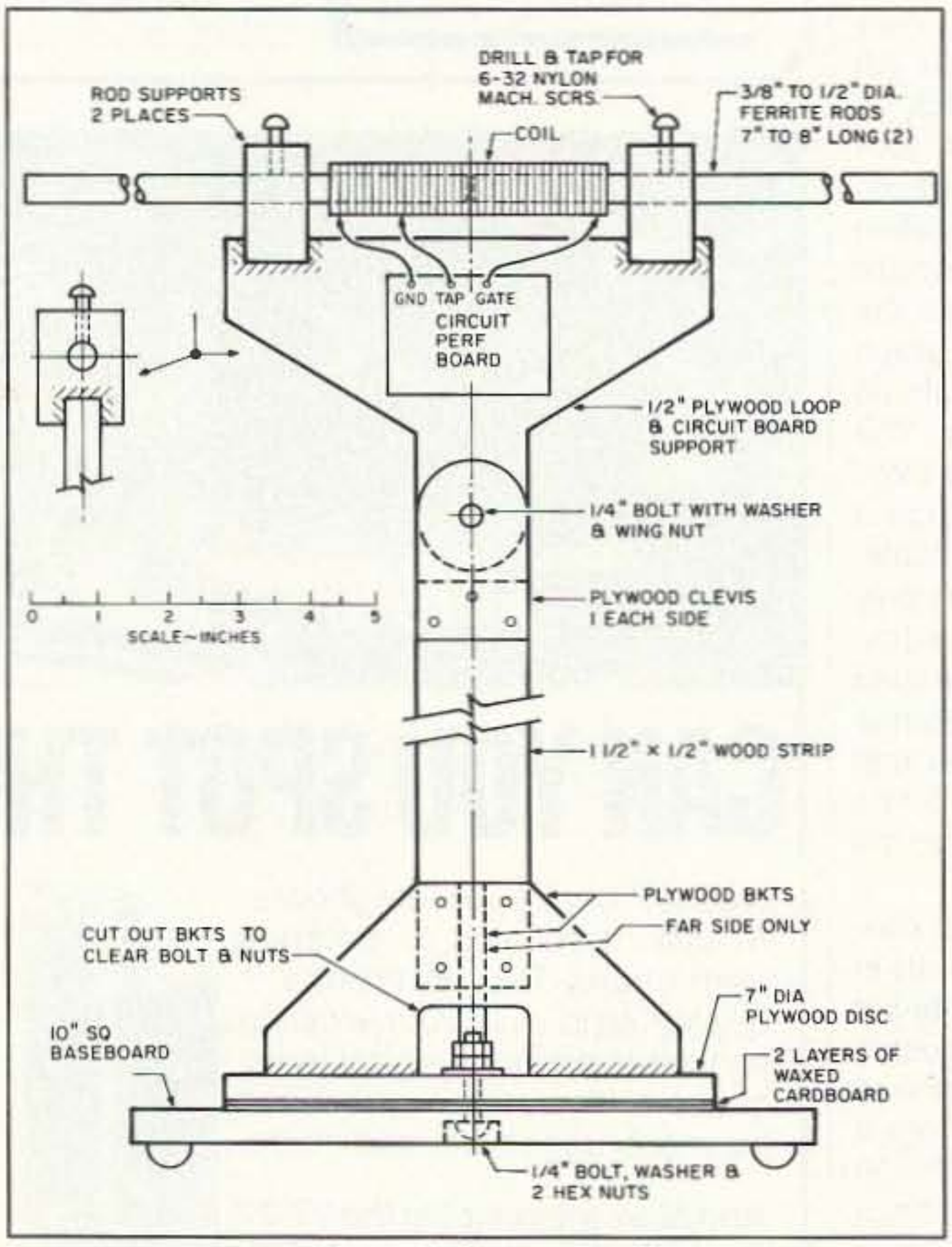

Figure 2. Loop assembly.

Construction

I used 1/2" diameter rods with a permeability of 2,000. I wound my coils on a 5/8" diameter form. Using a two-gang BC band variable capacitor for C1 with the stators in parallel for 160 meters, I wound 45 turns of #28 enameled magnet wire with the source tap at nine turns up from the ground end. The best tap for all coils is about 20% to 25% of the total number of turns: for 80 meters, 25 turns; and for 40 meters, 11 turns, with the wire space at 1/8" between turns.

If you follow the construction shown in Figure 2, I suggest that the two rod supports be clamped together and then drilled for the rods. Then place these on the rods and tape the junction of the two rods to insure proper alignment. Finally, cement the supports to the circuit board support.

The height of the rods over the base should permit swinging the rods to a vertical position without interfering with the base board.

The two layers of waxed cardboard sandwiched between the disc and the base board will allow smooth rotation. The center line bolt with its nuts should be just tight enough to allow for this.

To change coils, loosen the two nylon set screws and withdraw the rods. I used short lengths of flexible wire attached to mini-alligator clips to connect the coil to the circuit board.

In operation, it takes a little practice to become familiar with the features. Place your receiver and preamplifier in operational condition and advance the arm of R1 towards the source end. The circuit should go into oscillation. Turn back the arm and at some midpoint you should hear a weak "plop," then tune in the desired signal and slowly advance the arm back to the source end. Just before the circuit goes back into oscillation, the signal will peak up tremendously and at this point fine tuning is required.

Another much simpler design that I tried out with equal success is shown in Figure 3. In this case the rod is in a fixed position and the whole unit has to be rotated. The unit could be mounted on a camera tripod "pan head" to provide horizontal-to-vertical scanning.

Ferrite core loop antennas are not limited to the use of only one or two rods; in fact,

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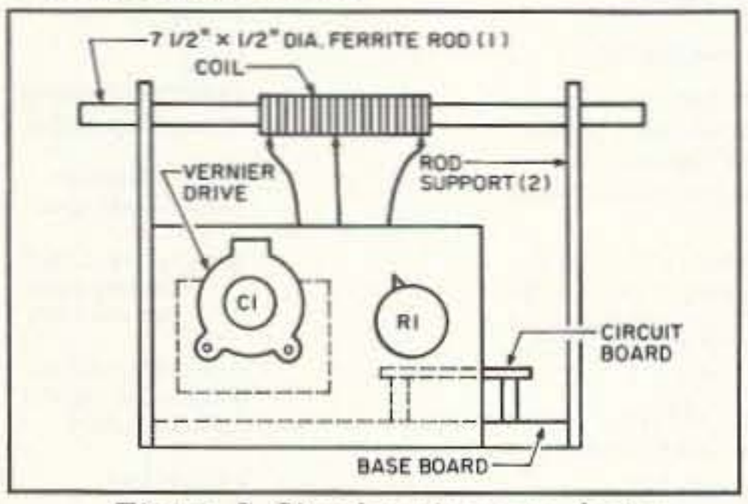

Figure 3. Simpler alternate design.

the longer the core the larger the capture area (aperture).

A friend gave me a dozen 1/4" diameter by 7-1/2" long ferrite rods with a permeability of 1800. I cemented seven of the rods together to form a core cluster 22-1/2" long. This scheme can be used with miscellaneous lengths and rod diameters. For best structural and electrical reasons, the joints in the rods should be staggered. See Figure 4.

WARNING: Ferrite rods are very brittle, like fine porcelain, and extreme care should be used in their handling. Dropping a rod is sure disaster!

I used the regenerative circuit on several of my open wire box loops, one low frequency and the other medium frequency, by adding a proper source tap. Again, the results were excellent. The source tap, for instance, on a 20-turn loop, would be at five turns.

I might mention that when the circuit is in oscillating condition, it can radiate a signal that could cause local interference (probably more so with a box type loop due to the larger aperture).

When a regenerative device such as the loop described here or a regenerative preamplifier is used with a conventional receiver it will be more effective to place the receiver in manual volume control. Turn the audio gain full up and use the RF gain control for comfortable listening. When the regenerative amplifier is in oscillating position, or near so, it can trigger the automatic gain control (or AVC) and it will deaden the receiver's response and may take several seconds to recover. This can be most annoying when you are tuning the amplifier circuit at its threshold.

In conclusion, the regenerative loop, compared with a straight preamplifier, far exceeded my expectations. While not providing the volume with the receiver using an outside longwire antenna, the loop does not have the susceptibility to local neighborhood electromagnetic interference that you would experience with a longwire, and the directional characteristics of the loop can be an important advantage.

If you like loops, try this scheme and you will be in for a big surprise.

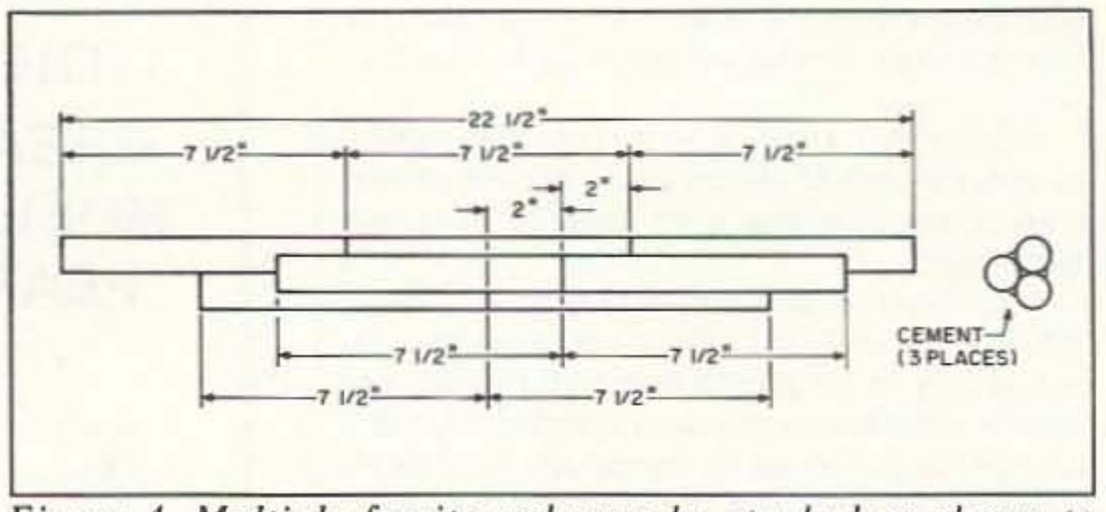

Figure 4. Multiple ferrite rods can be stacked as shown to increase the capture area (not to scale).

Parts List.

C1	365 pF variable (see text)
C2	220 pF disc ceramic
C3,C4	0.1 µF
C5	0.01 µF
R1	5k potentiometer
R2	1 MEG
R3,R4	10k
R5	1k
Q1	MPF102 FET
Q2	2N3904 NPN transistor
L1	#28 enameled wire (see text)
Misc.	Ferrite rods (3/8" to 1/2" dia., 7-8" long)

Ferrite rods can be obtained from Amidon Associates, P.O. Box 956, Torrance CA 90508. Phone: (310) 763-5770. An appropriate one for this antenna is their part number R33-050-750, a 1/2" diameter by 7.5" long rod with a permeability of 800; available for $18.