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High Performance One Foot Air Core Loop

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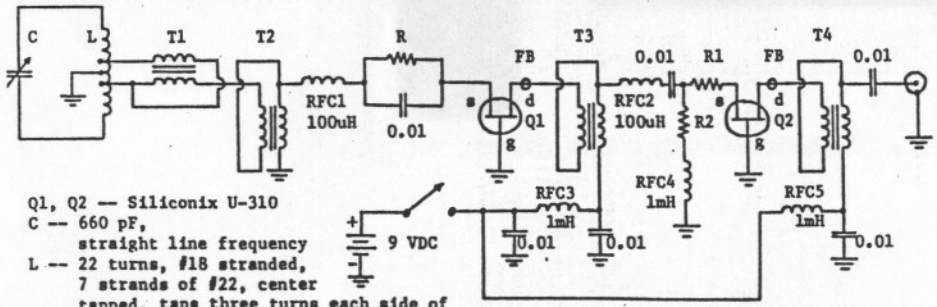
In my recent article "What's Wrong With Present Day Loop Antennas" I observed as others before me have observed that a 4 foot air core loop is too large for most DXers, and agreed with Russell Edmunds and Ralph Sanserino that a 2 foot air core loop is a reasonable starting point for a high performance loop antenna. And in my companion article "High Dynamic Range Balun Loops" I presented two unamplified and one amplified 2 foot air core loops. But a 2 foot air core loop is still quite large and not easy to move around. This motivated me to develop a 1 foot air core loop and companion amplifier which are not much larger than a ferrite rod loop, but which have demonstrably better performance -- a lower noise floor (better sensitivity), and much better strong signal handlind performance.

The main problem with developing a high performance 1 foot air core loop was the amp. The improved balanced differential amp (BDA) in the first article above, while adequate for ferrite rod loops, had detectable 2nd order IMD products when used with a 1 foot air core loop. Tapping the BDA input down on the 1 foot air core loop improved the IMD somewhat, but did not eliminate the spurious responses completely. The U-310 amp for the 2 foot loop was tried with the 1 foot loop, but the amp gain was slightly inadequate for the 1 foot loop. The solution was to add a second U-310 amp.

The dual U-310 amp in Fig. 1 below is identical to the amp for my 2 foot loop (in Fig. 5 of the second article above) up to T3. A different source bias circuit is required for Q2 to isolate the source of Q2 from +9 volts DC applied to the drain of Q1 through T3. The source bias resistor for Q2 is the combined resistance of R1 and R2. It is split into two parts because with the standard circuit (R1 = 0 and R2 = R) amp gain is not uniform throughout the MW band; gain at higher frequencies is higher. It might seem that inserting resistance (R1) in the signal path would lower gain uniformly, but that did not happen; gain at lower frequencies is unchanged, while gain at higher frequencies is reduced. By trial and error R1 = R2 = 220 ohms was found to give nearly uniform gain while coming close to the Q2 source bias design goal of 470 ohms. Output signal levels were somewhat higher than for the 2 foot air core loop with two turn taps, so three turn taps were used.



Q1, Q2 -- Siliconix U-310
C -- 660 pF, straight line frequency
L -- 22 turns, #18 stranded, 7 strands of #22, center tapped, taps three turns each side of center tap, 1 foot square frame, 1/4" spacing between turns, 1-3/4" spacing between 11 turn halves
T1, T2, T3, T4 -- 70 bifilar turns of #30 enameled copper wire on Amidon FT-82-61 ferrite toroid core
RFC1, RFC2 -- 100 uH choke, Mouser 43HH104
RFC3, RFC4, RFC5 -- 1 mH choke, Mouser ME 434-1120-103K
R -- 470 ohms
R1, R2 -- 220 ohms
FB -- ferrite bead, Amidon FB-64-101
Tuning Range -- about 500 KHz to 2000 KHz after adjusting the spacing of L
Current Drain -- about 8.5 mA

Figure 1

One Foot Air Core Loop

You can get a little more gain out of the 1 foot loop and amp of Fig. 1 by using taps at two turns each side of center tap, or taps at one turn each side of center tap. I don't recommend this because the higher signal levels are not necessary, and the increased Q seems to degrade audio quality when listening in wider receiver bandwidths. You can also get a little more gain at the high frequency end of the MW band and 160 meter ham band by reducing the value of R1 and increasing the value of R2 (keep R1 + R2 approximately equal to 470 ohms), but I don't recommend this either. The three turn taps and values of R1 and R2 have been carefully chosen for optimum signal levels and flat gain. The amp of Fig. 1 can be used with ferrite rod loops (preliminary tests suggest that a 2 or 3 turn tap each side of center tap is satisfactory), but I recommend against that. If you feel that you need better performance, use the amp as it was intended, with a 1 foot air core loop. Finally, the amp of Fig. 1 can be used with the 2 foot loop described in my previous article, but I recommend against that too unless you live far away from sources of man-made and power line noise, and the MW signal levels at your location are lower than normal. Perhaps someone in Hawaii, Alaska, or northern Canada could benefit by using the amp of Fig. 1 with a 2 foot air core loop.