SMALL LOOP ANTENNA DESIGN & CONSTRUCTION

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A lot of the published articles for small loop antenna design & construction would have you believe that this is a complex process involving lots of mathematics and the use of rather exotic or hard-to-obtain materials. In reality, it is just not that complicated. Take a look at the diagrams below to see the basic forms of small (i.e. less than ¼ wavelength) loop antennas:

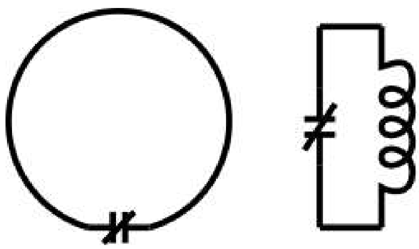

Figure-1a Figure-1b

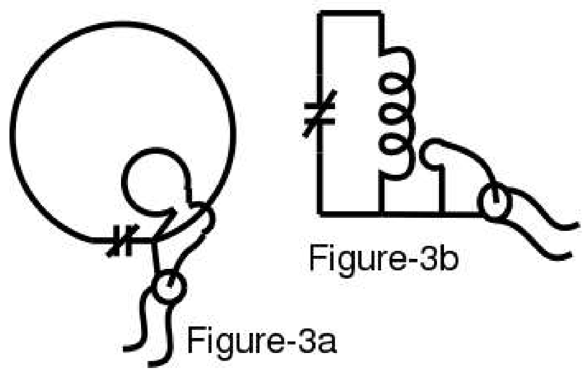

Figure-3b Figure-3a

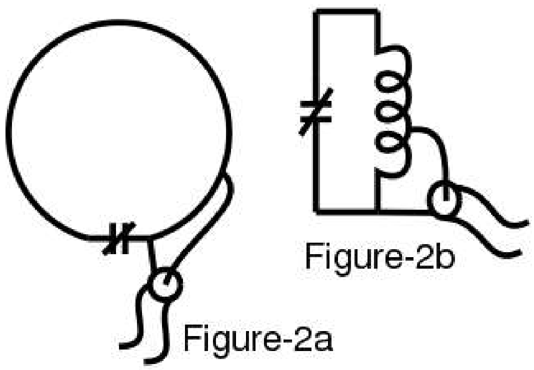

Figure-2b Figure-2a

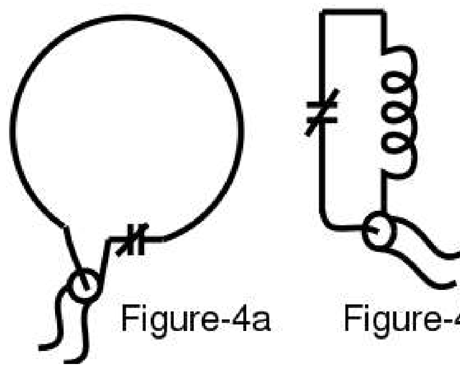

Figure-4a Figure-4b

Figure-1 shows the basic concept of a loop antenna. It is just the simple resonant circuit that you are already familiar with. If one increases the number or size of the turns then you have to reduce the amount of capacitance to maintain resonance, and if you decrease the size of the loop or reduce the number of turns you need to increase the capacitance to maintain resonance. You can simply pick the loop diameter that best fits your needs, then add enough capacitance to resonate it.

Materials used to build the loop are important, but you do not need to be fanatical about using the lowest possible resistance material. A fairly high Q-factor is desirable, but too high a Q will decrease the bandwidth, making it usable on only a very narrow portion of the band. For QRP power levels you might use AWG-20 hookup wire, and for 100 watts you can use the outside shield of an old section of coax (the stuff used for cable-TV leads works quite well). If you are running a kilowatt or so, then you might want to consider making your loop out of ½ inch copper pipe. In all cases you need to make sure that your connections are tight and have low-resistance characteristics (i.e. SOLDER ALL CONNECTIONS!).

There are several ways to feed your small loop antenna. Figure-2 shows a conventional tapped feed or ½ gamma match coupling. Figure-3 is link or transformer coupled. Figure-4 is an interesting feed method in that it inserts your 50 or so ohm feed impedance in series with the loop impedance. This has been shown experimentally to act similarly to adding a resistor in series to decrease the Q-factor. Using this method of feed will appreciably increase the apparent bandwidth of your antenna. Try this if you need to cover most or all of a particular band with one loop tuning setting.

There are all sorts of urban myths around about the need for low-resistance butterfly type capacitors for tuning your small loop. In actuality, you can use nearly any capacitor that will handle the RF voltage that will be experienced across the loop (NOTE: this can be quite high if your antenna Q is high). However, for receiving or QRP loops you may get by with a standard BC band variable or small transmitting variable cap.

For tuning your loop you will need a receiver for the band to be used and a variable capacitor that hopefully has a dial calibrated in picofarads. Connect the loop to your receiver and adjust the capacitor for most noise or for best received signal strength. Then read or measure the capacitance value that was required. Now cut a section of surplus coax to the length to have that same capacitance value. Attach this new coaxial fixed capacitor in place of your variable capacitor and you have a resonant small loop antenna.

For transmitting you may need to adjust your coupling connections (gamma tap point or coupling loop position and size) for best SWR.

Of course efficiency is related to loop diameter, but you can do make a surprising amount of contacts using HF band loops as small as 24 Inches in diameter.

A fairly attractive and adequately rigid support for the small loop can be made in various ways, but PVC pipe and even hula-hoops have been used successfully. Wooden frames work OK, and for low power one might just tape or tack the wire to the wall of a building.

Throughout this document I have used the term "loop",but squares, octagons, or triangles also work quite well. The bottom line is you must be able to resonate it at the desired operating frequency. Shape only affects the radiation pattern.

A horizontally mounted loop is usually omni-directional, while a vertical mounted one can be rotated to null or peak a particular signal.

It is just that simple! No math calculations, no exotic materials, and no complex assembly procedures are necessary to experiment with small (less than ¼ wavelength) loop antennas. Now you have no excuse for not trying a small loop antenna, if for no other reason than to allow you to speak with authority when comparing them with more conventional antenna systems.

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