MAGNETIC LOOP ANTENNAS

by KD8OUT Mike Kieffer

Disclaimer

- There is a LOT of controversy on exactly how these antennas work. The presentation is my opinion of all the articles and experimentation I have done.
- There are equations that are used to design these antennas, but the experimental results do not always agree.

What is a magnetic loop?

- Radio waves travel by a wave of electric and magnetic fields at 90 degrees to each other.

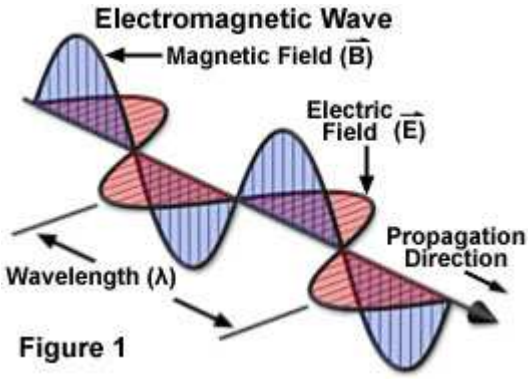
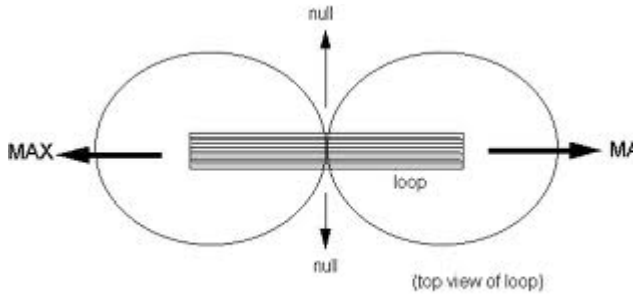


Figure 1

- Our regular antennas work by "recieving" the electric field portion of the radio wave. A small current is transduced on the antenna and the reciever amplifies it and converts it to audio.
- Magnetic loops work differently, they transduce the magnetic portion of the radio wave and are basically a LC tuned circuit.

- So, since magnetic loops operate on a different physical principle, what are the advantages and dissadvantages:
  - Magnetic loops are quiet because they are not affected by electrical interference.
  - Magnetic loops are small for a given wave length. They are 0.1 wave length or smaller circumference. 2 meters for 20 meters.
  - Magnetic loops can be mounted close to the ground. Typically 1 – 2 diameters off the ground.

– Magnetic loops are directional(beam).

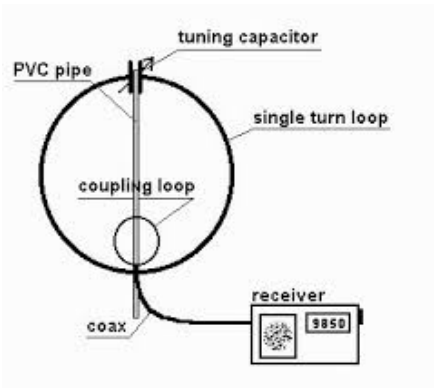


- Disadvantages:
  – Magnetic loops require high voltage and high current variable capacitors.

  – Magnetic loops have very low radiation resistance, so construction requires great care to minimize loss resistance.
  – Magnetic loops have a small band width.

OK, HOW DO I BUILD ONE?

- Traditional construction is copper tubing, at least 5/8" diameter. The larger the diameter, the larger the bandwidth and efficiency. From the equations, 2-3" diameter would be ideal, but how practical?

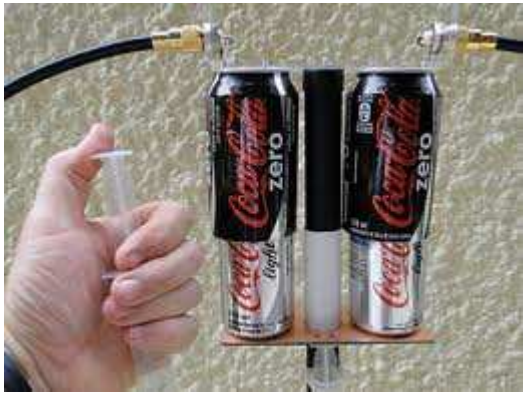


- You need some kind of a high voltage variable capacitor.

HIGH VOLTAGE CAPACITOR

- Need 10-150pf for most applications
- Transmitting leaf

- Home brew
- Plates



- Trombone

HIGH VOLTAGE CAPACITOR

– Coax

– Vacuum variable $80-120 on EBay, Russian surplus.

HOW DO I TUNE THE LOOP

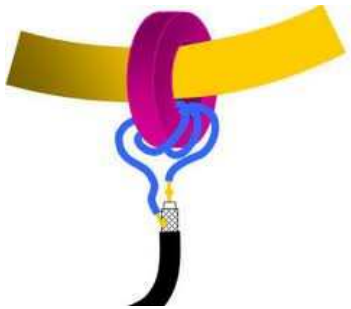
- The mag loop is bacically a tuned circuit consisting of the inductance of the loop and capacitor. It is a high Q circuit.
- Use an antenna analyzer and look for lowest SWR.
- Listen for peak volume on recieve.
- The reason for using a larger diameter loop conductor is to have a large bandwidth to avoid frequent retuning.

EQUATIONS

- The best calculator I have found.
- You can vary parameters and see the effects.
- NEC modeling software does not accurately model this antenna.
- The calculators give you theoretical values, your actual construction will also affect the antenna greatly.
- To be a magnetic loop, the loop circumfrence must be less than 0.1 wave length, more than that, the loop switches to electrical.

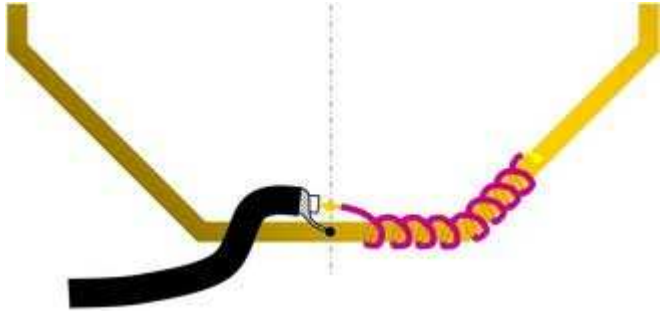
MY MAGNETIC LOOPS

- My first attempt was a 5/8 tube 4 foot diameter loop for 20 meters. I coupled it with a toroid and secondary winding.



- Results were marginal, small band width and high SWR.

- My next attempt was a 40 meter loop, 70" in diameter. I used 3" diameter pool noodles, spiral wrapped with 2 3/8 copper foil. I used a spiral gamma match and about 75pf of capacitance.



MY 40 meter loop

- That loop had good SWR on 40 meters for 7.18 to 7.225mhz. It was quiet and worked well.
- I found that you cannot “tightly” couple the feed to the loop.

20 Meter Loop

- My next attempt was a 2.86` diameter (9`circumfrence) loop for 20 meters with spiral wrapped 3" diameter pool noodles. I used a 50pf vacuum variable. Theory said this should work 10-20 meters.

20 Meter Loop

- The results are as expected. Good bandwidth and SWR on 20 to 10 Meters with my 3-50pf capacitor.