The Radio Hotel Small Antennas – Mag Loops Part 1

by Rick Hiller–W5RH joined this month by JP Pritchard – K5JPP

A significant amount of Hams wish HF antennas were smaller. Small enough to fool the HOA, fool their spouse and their neighbors. But in spite of the antennas being smaller, Hams still want them to "get out" and work the contacts that they wish to work, on the bands and modes we all work. No small feat. As with any antenna, but especially a small loop, the radiation pattern and Feed Z /SWR are at the top of the list of antenna attributes to which we pay attention to and strive to maximize.

There has been an on and off affinity for small antennas for many decades now (Army Loop QST March 1968). Mag Loops in particular. Small in this case is 1/10th of a wavelength in length / circumference/perimeter; most are most are deployed in a circle. The current all around the loop is of similar amplitude, with little variation. Hence, the term Magnetic Loop. These small loops present a significant challenge to the implementing Ham due to two very important facts. One is that the feed impedance is very low; and two, being that the bandwidth of the antenna is very narrow. You have to get power to the antenna and we Hams like to move around and change frequencies, so most design attempts and discussion focus on feed Z and bandwidth. Not that efficiency is put off the table…it is not.

The interesting attributes of the small loops were first outlined in a 1982 book by Ted Hart, W4QJR. (Contact me if you want a PDF copy) They a can produce a low angle of radiation in line with the plane of the loop. A surprising characteristic from such a small antenna. Enhancing this pattern is possible with the addition of radials. A loop looks similar to a vertical antenna from these results. One beneficial or "comes with the house" property is low receive noise, as displayed by any smaller than full size antenna.

More recently, the ARRL publications QST and QEX have published a fair amount of articles about small loops. One design aspect that has, in my opinion, produced more relevant information is the fact that you can now successfully model these small loops with in the 4NEC2 NEC2 engine. The results are being put out into the Ham Radio knowledge base.

Physical construction is probably the biggest limitation to the average Ham. You cannot just measure and cut wire, as with a dipole. Small Loops take design time and planning. JP, K5JPP, has firsthand knowledge of building a few loops and he comments here:

"*With extensive and generous help of Elmers, Bill W5VOM and Rick W5RH, and after a lot of research, I can now claim ownership of two DIY mag loops. Yes, you can make a working loop with a bit of wire and an old variable capacitor, but if you want to build an antenna that will be useful for more than an experimental weekend, plan on getting your hands on the right parts, especially if you plan to transmit with your loop. First off, look for a true butterfly capacitor or a vacuum variable capacitor. No matter which you choose, make sure your cap spans an appropriate range of values, depending on the frequencies you hope to use. And make sure the cap is rated for a high enough voltage for whatever power you plan to transmit.*

Most of the loops you'll see in internet videos are supported by PVC pipe. Don't expect PVC to hold its shape in the hot Texas sun. Make sure you use heat resistant C-PVC pipe. Whatever you do, do not use wood as support structure for your loop. It turns out, wood apparently absorbs RF, especially when wet. If I were to construct a mag loop today, here's the website where I would look for guidance, built by Rich K8NDS, http://www.hlmagneticloopantennas.com. Visit his QRZ.com page as well, to see how he uses his "helical" magnetic loops. He also administers a group site for helical loop builders.

One final thought. Before you start, come to terms with the basic nature of mag loops. Tuning to resonance is an exercise in patience every time you change your operating frequency. As W5VOM puts it, finding the sweet spot for resonance is like tuning your capacitor on the edge of a razor." K5JPP

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To overcome the challenges of feed Z and bandwidth in the physical world, a few feed schemes have risen to the level of a universal solution. The Gamma Match and the secondary feed loop (acting like a transformer primary) The Gamma Match seems to have a bit more tuning issues to get the length, spacing and capacitive value correct, but works well once in place. The secondary loop is more easily implemented with a piece of coax making up the loop.

Bandwidth seems to be the most challenging of the physical worlds. It is usually done by a variable capacitor across a gap in the loop circumference. Not just any capacitor, mind you. A low loss, high voltage variable, leaning more toward a vacuum type, but not necessarily. The MFJ implementation used a butterfly capacitor where the fixed stators(2) were each welded to the loop's gap ends for keeping the resistance losses low. The variable stator (shaped like butterfly wings) would rotate 360 degrees around to cover a wide range of capacitance, thus tuning the loop to resonance over a fairly wide bandwidth. The tuning was performed by a geared down, slow speed DC motor or stepper motor, mechanically coupled to the butterfly plates.

Next time, in Part 2, we'll look into the theory of "why they work", "how they work" and just what does it take to build one of these. I'll give lots of online references too. Stay tune.

Talk to JP or Bill, W5VOM, or me if you have an interest in more information or you would actually like to attempt to build one.

Next time….

*The purpose of **The Radio Hotel** is to give you a practical kick start into exploring the workings of antenna systems Google the buzz words and find out what they mean. Read up on antenna system theory to see how it all works together. You will be glad you did.*

BVARC Awards Banquet – January 18, 2019

58 folks were in attendance at the Pappadeaux Seafood Restaurant a few Friday evenings ago. As typical, a loud and active social hour, before the meal serving started, was enjoyed by all. The food was typical Pappadeaux's excellent -- seafood and chicken entre's. Wait service was top notch as last year.

After the meal we were treated to JP giving away the door prizes. He actually gave away a door HI HI Scott, KD5FBA, provided 2 bottles of wine; Rick, W5RH, provided a set of his vacuum tube book ends and two stand-alone vacuum tube displays. The club provided 3 giftcards of $25, $25 and 50.

Tom Fontaine, our guest speaker was up next and he provided an enjoyable look into the life of a professional wrestler. Tom is on KNTH 1070 AM in the morning here in Houston. I would assume that radio work is much easier on the body than wrestling. HI

Awards followed a 2018 Slide show review and the South Texas Balloon Launch Team lead the awards line up with their Dr. Joe Taylor Award for their work in the VHF/UHF spectrum. Mark Janzer, K5MGJ, received the Loop and Zepp Award for is work with getting the HF bands happening with the Museum Ships activity. Donovan Bali, KG5BDZ, was not present for his reception of the club wide Order of the Key. If a club treasurer deserves the OotK, it is Donovan. 6 years Treasurer. Congratulations to all of the awardees.