An Unusual Two Band Magnetic Loop Antenna

(for 14 and 10 MHz)

1. INTRODUCTION

This article describes how to build a relatively small loop antenna which can be placed for instance at the balcony. My design is made for modest conditions, e.g. an antenna mounted on a balcony in a block house. It is especially suitable for a two band antenna covering two adjacent amateur radio bands (10/14 MHz, 14/18, etc.).

The antenna was practically tested on 10 MHz band.

The design was inspired by an article by DJ3RW about an unusual design of magnetic loop antenna for 50 MHz band, printed in Funkamateur 10/97.

More information on loop antennas is available in Links section below.

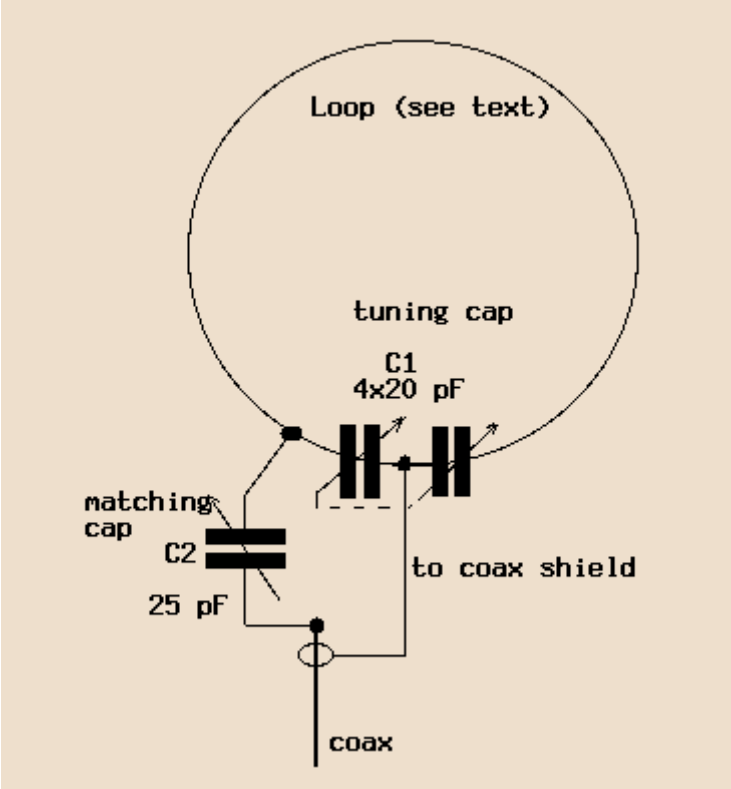
2. DESIGN HILIGHTS

The magloop antenna described here has a different feeding than the usual kind with a coupling loop. Also the tuning capacitor is not mounted at the "top" as usually, it is placed at the "bottom", fed part of the loop.

The loop is tuned by a symmetric, two-section variable capacitor with the common rotor connected to the coax cable shielding.

This antenna is "side-fed" directly from the coax center wire through a (variable) capacitor to one of the two "hot" ends of the tuning capacitor.

A picture will say much more:



3. INSTRUMENTS

You will need a GDO to check resonant frequency of the loop.

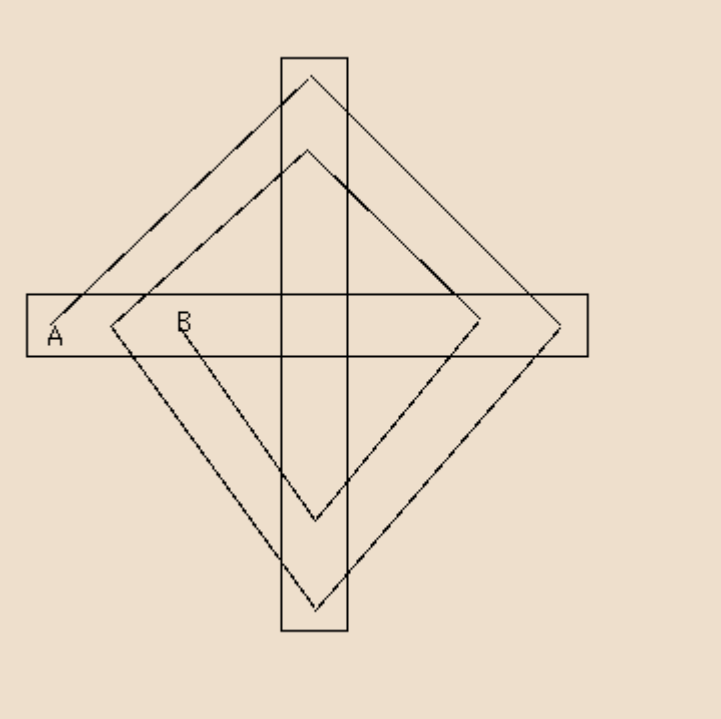
4. MATERIAL

Any data in the following list printed in *underlined italic* indicate measures or values I have tested on my 10/14 MHz loop.

A. Two wooden pales, *about 1 meter long*, or similar stuff to hold the loop.
B. A piece (about *3 meters*) of loudspeaker wicker cable. The thicker the better. You might perhaps use a copper tube, too. This is because of the high current in the loop (DJ3RW says 60 A at 100 W output - !!!).
C. A two-section symmetric variable capacitor *(I used 4x12.5 pF)*
D. A variable capacitor for coupling; or two fixed capacitors plus a switch (see below). I used *25 pF fixed capacitor for 10 MHz.*

5. CONSTRUCTION

1. First, make a symmetric cross of the two pales. The binding is up to you. I used nails.
2. Take the wicker cable and make two turns on the cross. Leave 5 cm (2 inch) space between the turns and leave a piece of free cable hanging at the end. See also picture:



3. Take the GDO and test resonant frequency of an open loop. The frequency should be slightly higher than the highest frequency you want to use.

Bands	Open loop resonant frequency MHz
10/14	16-17
14/18	21-22
18/21	24-25
21/24	26-28

4. The resonant frequency of your loop will decrease after you add the tuning capacitor and connect the feed!
5. Mount the tuning capacitor and connect both ends of the loop to its stators. Fix the coax feed and solder its shield to the rotor of the tuning capacitor.

   If you test the loop now, it should resonate slightly above the desired operating frequency. When I was testing my 10/14 MHz antenna at this point, it resonated between 11 and 16 MHz.

6. Mount the coupling capacitor. Connect one end the coax feed core and the other one to either end of the loop.

   Now there are two possibilities:

a. If you use a variable capacitor, you can do it as described above without further changes. Tuning the coupling capacitor is your problem. I did not test this, but it is almost obvious that a servo will be necessary.

   You can make it cheaper if you add a dial to the rotor and mark positions for each band.

b. You don't have to tune the coupling capacitor across one band (unless it's 10 meters). So you can put two fixed capacitors (let's call them C_L and C_H) in series. C_L will be used for the lower band (in my case it's 25 pF for 10 MHz) and should make a perfect match. While C_H combined in series with C_L has to match the antenna on the higher band. Put a switch or relay across $C_H$and don't forget that the switch is also a capacitor of its kind. When the switch is open or short, the higher or the lower band is coupled, respectively.
   (Sorry, no picture available)

Well done! :-)

6. SETUP

When the antenna is mounted, connect it and test its resonant frequency on your receiver. Loaded antenna will "drop" slightly - mine changed its resonant range from 11-16 MHz to approximately 10-15 MHz over the full variation of the tuning capacitor.

When tuning the antenna, first find the best position of the tuning capacitor by listening. After you have tuned a relatively sharp peak, tune the coupling capacitor (if you have a variable one) for best possible SWR.

My antenna has 1:1 SWR on 10 MHz band without an additional ATU. (In fact the loop itself with all the tuning and coupling circuits is an excellent ATU).

7. BANDWIDTH

My antenna has SWR 1:1 almost all over 10 MHz band. The SWR is getting slightly worse near band boundaries, but it is just enough to see the meter taking a very moderate move.

I didn't test 14 MHz because of a missing 2nd coupling capacitor. If it worked on 14 MHz the same way, you should be able to cover the whole CW sub-band with SWR 1:1 and most of the band with SWR better than 1:2 if not 1:1.5

8. THE TRUTH - Practical experience

I haven't heard much of a DX traffic. But my antenna is on the balcony on the third floor, surrounded by 30 meters high concrete buildings.

I have made QSO's mostly with Europe. Sometimes I get reports which are worse by 3S from stations with comparable output. Sometimes the other OM gives me even 1S more than I can hear him, again if the power is roughly the same.

Some examples (all QSO's were on 10 MHz):

- RA6WF 559/559
- LA6GIA 559/429
- G0NXA 559/419
- LZ1QK 579/589

9. Links

These links might be very useful if you intend to modify the design.

GW0TQM Small Transmitting (aka 'Magnetic') Loop Page
Here you can read more about theory as well as practical issues.
GW0TQM's Magnetic (Small Transmitting) Loop Computation.
If you prefer more than just estimation
80 METER FRAME ANTENNA by SM0VPO
This was the first one I built.
Loop antenna of 7N3WVM
Using PCB material!

I have received some questions regarding calculation, modification for lower bands, radiation pattern, etc. I am convinced that you can get the best answers from competent people who maintain the above mentioned pages. I actually work in a bank and have no measuring equipment at work or at home :) In fact, the above design was a very lucky experiment.

10. Feedback

Please let me know if you try to build this antenna, if you want to make any comments. I am very interested what you think about this article.

In fact, writing this article took me at least three times longer than the time to build the fly-swat. So at least three of you should make some use of it, don't you think so?

73 de Jindra, OK1FOU