Wideband Small Receiving Loop Simplified

This is a small loop connected to an amplifier with very low input resistance e.g. 3 ohms. The small loop is injecting current into this amplifier. The loop works almost in short circuit mode (shunted with 3 ohms resistor). This current is induced by the electromagnetic field. The higher the current the better will be loop sensitivity.

The magnitude of this current ***I*** depends only from 2 factors: proportional to loop area ***S*** and inversely proportional to loop inductance ***L***. It does not depend from the frequency!. The shape of the loop is important only as factor which influences the loop inductance.

$$I_{(loop)} \sim S/L$$

This current does not depend from the loop loss resistance at frequencies where the inductive resistance X_L is much larger and usually this is fulfilled above 20-100KHz.

The wideband loop is almost a perfect magnetic field transducer if it is connected to a properly designed amplifier. The induced currents from the electric component of the field are very low so there is no need to use screened loop. This loop has the same radiation pattern as the well known resonance magnetic loop.

Conclusions:

1. ***S/L*** ratio is a merit of loop performance.

2. Use always 1 turn loop (more turns reduce ***S/L*** ratio!).

3. Increasing the loop linear size 2 times does increase ***S/L*** only 1.4 times (square root law).

4. Do not use screened loop (this will limit the loop bandwidth without any other benefits).

5. The loop loss resistance is not important so the material can be aluminum instead of copper.

6. Reduce the loop inductance as much as you can:
- use fat conductor e.g. tubes
- use parallel connected loops from thinner conductor.
- use **crossed parallel loops** (this is the most effective way to reduce the loop inductance).
- use circular shape when possible. The circumference has maximal ***S/L*** ratio compared to other geometric shapes.

7. The loop plane must be vertical if the loop is mounted near the ground (< wavelength/4). Low horizontal loop will have substantially reduced sensitivity.

Examples

Example 1: ***1 m diam. loop with 4 mm diam conductor.***

L *= 3.5 uH*

S *= 0.785* m^2

R_{loss} *= 3 ohms @ 10MHz*

X_L *= 220 ohms @ 10MHz*

I_1 *= 0.75 nA for 1uV/m field intensity*

Example 2: ***2 x 0.71 m diam. crossed parallel loops with 4 mm diam conductor with the same total area S.***

L *= 1.1 uH*

S *= 0.785* m^2

R_{loss} *= 1.5 ohms @ 10MHz*

X_L *= 69 ohms @ 10MHz*

I_2 *= 2.38 nA for 1uV/m field intensity*

I_2 is almost 3 times higher than I_1

For more details go to:

www.lz1aq.signacor.com/docs/wsml/wideband-active-sm-loop-antenna.htm

www. active-antenna.eu