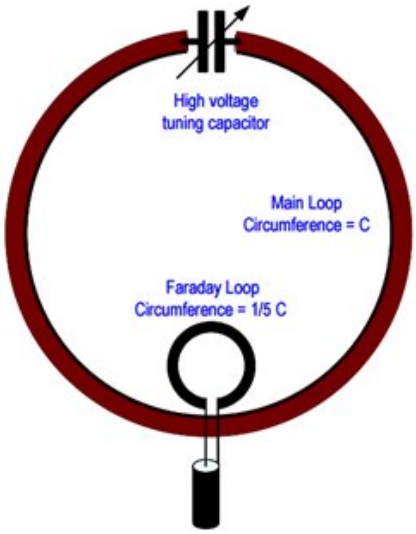
Coupling Loop Configurations
for Small Magnetic Loop Antennas

Frank Doerenberg - N4SPP

Two main types of inductive coupling are the unshielded coupling loop and the shielded coupling loop. No physical connection exists between the main loop and coupling loop. The shielded loop (Faraday loop) may result in a lower SWR.

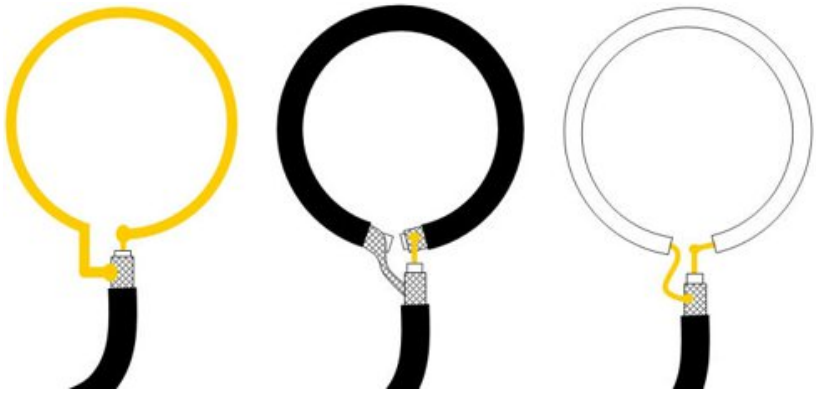


Unshielded Coupling Loop

One type of inductive coupling loop is the **unshielded loop**. The conductor has to be stiff and rigid enough to retain its shape.

Commonly used are:

- **Heavy gauge wire or small diameter copper tubing** - the conductor need not be heavier gauge than the center-conductor of the feed-line coax. However,heavier conductor will help retain shape of loop, and make it self-supporting. I have used "extra heavy" single-strand installation wire of 2.5 mm.
- **Braid of the coax** - center conductor is not used
- **Center conductor of coax, with outer insulation and braid removed** - Dielectric material of the coax is kept and provides rigidity.



Unshielded coupling loops
(1) Solid wire (2) braid of coax (3) center conductor of coax

The main loop and the coupling loop form a loosely coupled transformer. Turns ratio is fixed, but several coupling loop parameters affect the coupling:

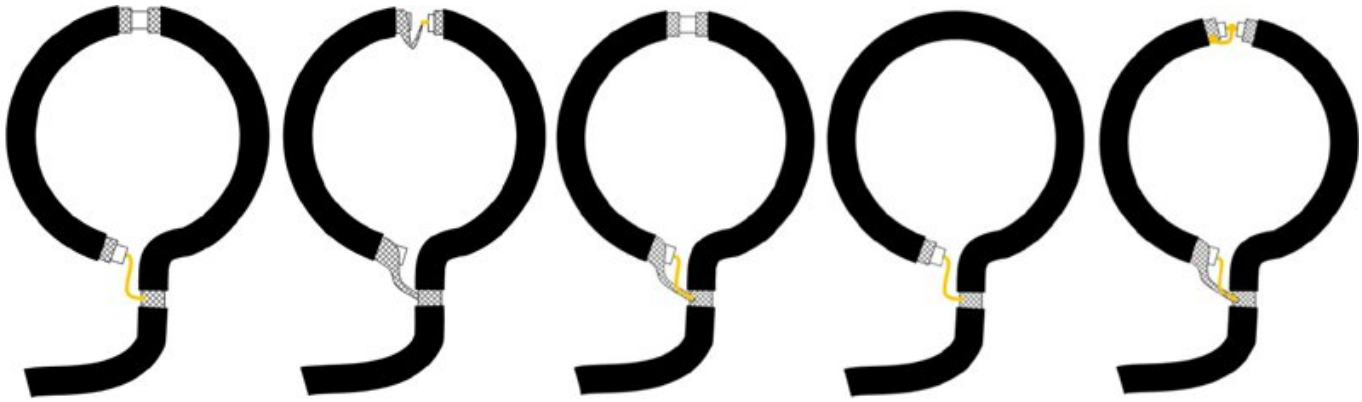
- **Size of the coupling loop** - standard diameter is 1/5 that of the main loop
- **Shape of the coupling loop** - standard shape is circular. Square and octagonal also used.
- **Placement along the main loop** - standard location is opposite tuning capacitor
- **Proximity to main loop** - coupling loop normally placed opposite tuning capacitor
- **Alignment to main loop**. Plane of coupling loop coincides with that of the main loop. The coupling with the main loop can be varied by turning the coupling loop about its vertical axis from where the coax is connected to the point at the top of the loop.
- **Gauge** of the conductor - coils - inductors

Shielded Coupling Loop

Another inductive coupling loop type is the **shielded loop**, often referred to as **Faraday Loop**. The typical diameter is 1/5 that of the main loop diameter, though some people have better results with a loop as small as 1/8 the size of the main loop. This coupling loop configuration is typically made of a section of coax cable for ease of construction.

There are a number of variations:

- **coax braid or shield** is interrupted at the point half way around the loop
- **center conductor** is interrupted at that same point
- **braid and center conductor** are connected at the starting point of the loop



Shielded coupling loops
Variations showing braid and center conductor connections

Some people feel claim that the "shielding" provides better screening from "electrostatic" noise. There is no convincing evidence that this makes any significant difference with respect to un-shielded coupling loops. If it *did* make a difference, the same principle could be applied to the main loop - which nobody does.

For the same diameter, the unshielded and the various shielded coupling loops all have a different self-resonance frequency. This is easily measured when not coupled to the main loop.

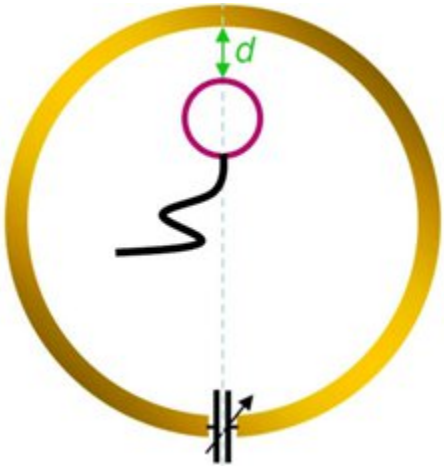
Comparative Measurements

Jochen Huebl (DG1SFJ) performed comparative measurements between unshielded loops and shielded loops.

- The coupling loop (diameter: 16.5 cm / 6.5") was placed in the same plane as the main loop, opposite the tuning capacitor
- Distance ***d*** between the two loops was varied:

  (1) starting with the coupling loop against the main loop with some insulation between them

  (2) then moving the coupling loop closer to the center of the main loop (max 10 cm / 4 inch)



- As induced magnetic field decreases with distance, coupling between the loops becomes weaker as distance is increased
- No difference exists as to coupling loop's placement - ***inside*** the main loop or ***outside*** the main loop

Conclusions

- SWR increased linearly with distance between coupling loop and main loop
- Lowest SWR was obtained with coupling loop closest to main loop
- Shielded coupling loop had slightly better SWR than unshielded coupling loop
- Return-loss increases rapidly when distance is increased to one inch, then becomes flat with further increase in distance
- Shielded coupling loops had about 6 dB better coupling