

# OLD RECEIVING MAGNETIC LOOP ANTENNAS

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Receiving magnetic loop antennas were widely used in the professional radio communication from the beginning of the 20 Century. Since 1906 magnetic loop antennas were used for direction finding purposes needed for navigation of ships and planes. Later, from 20s, magnetic loop antennas were used for broadcasting reception. In the USSR in 20- 40 years of the 20 Century when broadcasting was gone on LW and MW, huge loop antennas were used on Reception Broadcasting Centers (see pages 93- 94 about USSR's RBC). Magnetic loop antennas worldwide were used for reception service radio stations working in VLW, LW and MW. The article writes up several designs of such old receiving loop antennas.

## LW- MW Huge Receiving Loop Antennas for Broadcasting and Direction Finding

In old radio textbooks you can find description of old magnetic receiving loop antennas. As a rule, old magnetic receiving loop antennas had a triangle or square shape, a side of the triangle or square had length in 10-20 meters. The huge square was put on to a corner. The distance from the ground up to lower wires of the magnetic receiving loop usually was not less than 4 meters. Fig. 1A shows a triangular receiving loop antenna consisting of two perpendicular loops, used for direction finding at airports [1], Fig. 1B shows a square receiving loop antenna used on Broadcasting Radio Centers of the USSR at the end of 30s of the 20 Century [15]. Usually the receiving magnetic loop contained from one up to eight turns.

Fig. 2 shows a typical connection of the above mention huge magnetic receiving loop antennas designed for working on one fixing frequency to the receiver. To a resonance the loop A1 is tuned by lengthening coil L1 (sometimes two lengthening coils switched symmetrically to both side of the loop were used) and variable air-dielectric capacitor C1. T1 did connection with antenna feedline. L1, C1 and T1, as a rule, are placed directly near the antenna keeping minimum length for wires from the antenna to the parts. Certainly, there were others circuits for connection magnetic loops to a receiver, but the circuits were insignificantly distinguished from Fig. 2.

## Small- Sized Magnetic Loop of a Local Broadcasting Radio Center

Huge loop antennas were used for cities Broadcasting Radio Centers, for local Broadcasting Radio Centers a small- sized loops were used.

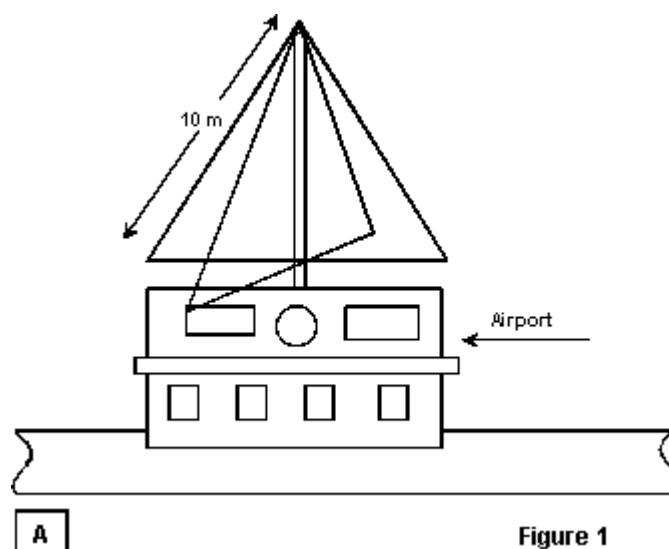


Figure 1

Figure 1 Old huge magnetic receiving loop antennas

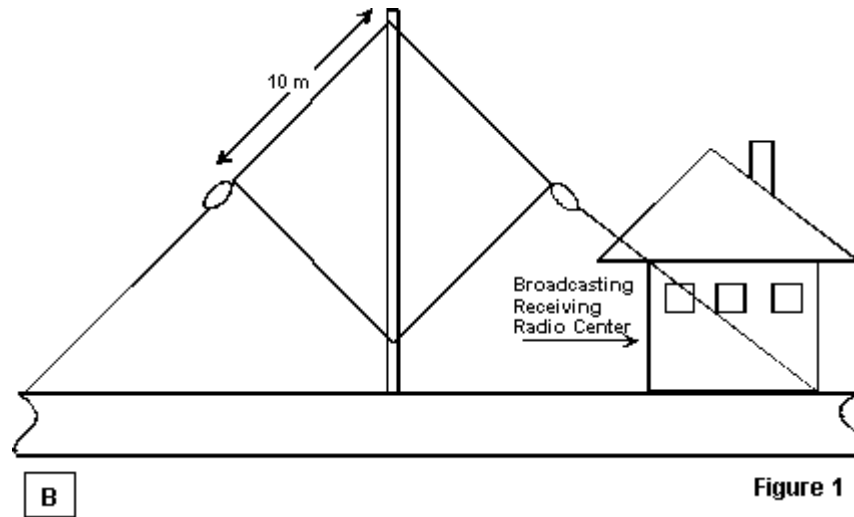


Figure 1 Old huge magnetic receiving loop antennas

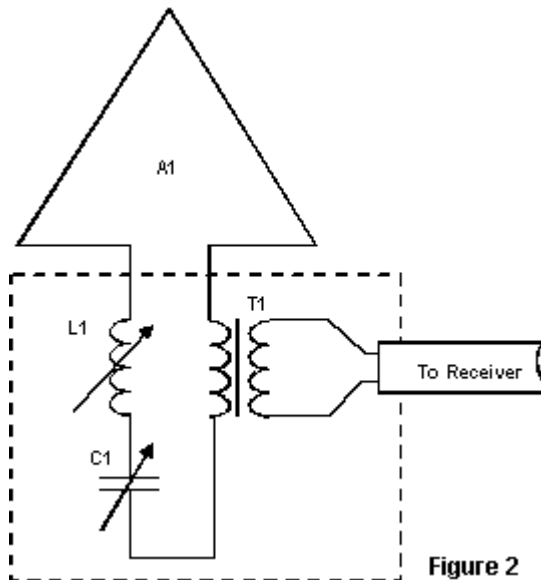


Figure 2 Connection of the reception magnetic loop to a radio receiver

main since the Broadcasting Center was in operation, so, the equipment were in continuous work already more than thirty years. Time to time the tubes of the receivers and amplifiers were changed, it was only that was done. Quality of work of the Broadcasting Center was great.

The most interesting part of this Broadcasting Center was a small-sized (certainly, small-sized in comparison with the antennas shown on Fig. 1) receiving magnetic loop antenna. By nameplate from the antenna I have known, that the antenna was made in 1949 on one of plants of Gorky (now Nizhniy Novgorod), Russia. Fig. 3A shows a design of the small-sized magnetic loop, and Fig. 3B shows the electric circuit of the antenna. Design and circuit, both, were pictured by me from the real loop.

The loop antenna (item 1) had diamond shape, sides had length in 105-cm (it was measured by a roulette), the loop was attached to a wooden cross (item 2), this one was covered by light lacquer. Overall height of the magnetic loop antenna was near to 2 meters. Antenna wires were more than 1-millimeter in diameter and were covered by thick black cotton isolation, a strong thin layer of light varnish covered the isolation.

Such small- sized receiving loop I have seen in an old village Broadcasting Radio Center in Central Russia, where I was occasionally in 80s of the 20 Century. The center was built in the beginning of 50 years of the 20 Century and till now was in work practically without changes. The broadcasting center settled down in a small room on a ground floor.

This rural Broadcasting Center contained a receiver PTS (see page 93- 94 about USSR's RBC) together with a small-sized loop antenna and an old tube audio amplifier, but I could not remember its type. All equipment was produced at the 50s. As I was told, the radio receiver and the audio amplifier of low frequency never were switched off from the

The loop contained about 20 turns of the wire. The turns were rigidly settled down in trenches of plates (item 3), the plates were probably made of an ebonite. The distance between turns on the plates was equal to the diameter of the wire. The loop antenna was coupled to a receiver through a coupling loop (item 4) that contained 4 turns. The coupling loop was connected to a receiver through a feedline (item 5). The feedline has length near 3 meters and looks like a main wire.

A small wooden box (item 6) was in the bottom of the loop. A big three-section (each section has 12-500-pF) variable capacitor with vernier intended for tuning the loop to a resonance was in the box. Also there were taps switch S1 and two trap (L1C2 and L2C3) tuning to hindered broadcasting radio stations. The trap is

switched to the feedline instead of crosspieces between clamping contacts K1K2 and K4K5. These contacts were established inside the box. Feedline contacts K3K6 were installed at a cheek of the box.

*However small-sized magnetic loop antennas were used not only to Broadcasting Radio Centers. Earlier, in 30-50 years of the 20 Century such antennas frequently installed inside broadcasting receivers. Some designs of the inner loop antennas are shown below.*

**Basket Magnetic Loop Antenna**

Receiving basket loop antennas were widely used for work with LW and MW receivers of direct amplification since of the end of 20s of the 20 Century. As a matter of fact, basket loop antennas are ones of the first types of magnetic loop antennas used by radio amateurs. Basket loop antennas were used both as to stationary receivers as to so called "suitcase receivers", i.e. tube receivers made inside a suitcase and intended to a movable work. Old radio magazines of 30- 50s of the last century contained hundreds designs of basket loop antennas.

Basket loop antennas were earlier so popular because, in the first, ever a radio amateur having a minimal experience of designing easily can make this one, in the second, a basket loop antenna can be made of any improvised material, and in the third, a basket loop antenna made even in home conditions works very effectively. The essence of the design of a basket loop antenna is that at its winding the step between turns is constant and equal to the diameter of the used wire (practically this step even bit more).

A coil, which has been reeled - up with such step, has rather small own parasitic capacity of turns to each other. It is possible to show, that the more parasitic own capacity of a coil is the less its Q is (see, for example, reference [3]). So, at a small own capacity a loop has high Q.

There are several basic points to pay attention at design of a basket loop antenna. A basket loop antenna can be reeled up on a plate from any dielectric stuff having small losses on frequencies where the antenna works. A basket loop antenna of LW- MW ranges can be made of a cardboard, wooden plate, PC- board, getinaks or ebonite. Pay attention, that some grey cardboard made of so-called "not washed" recycling paper (a paper

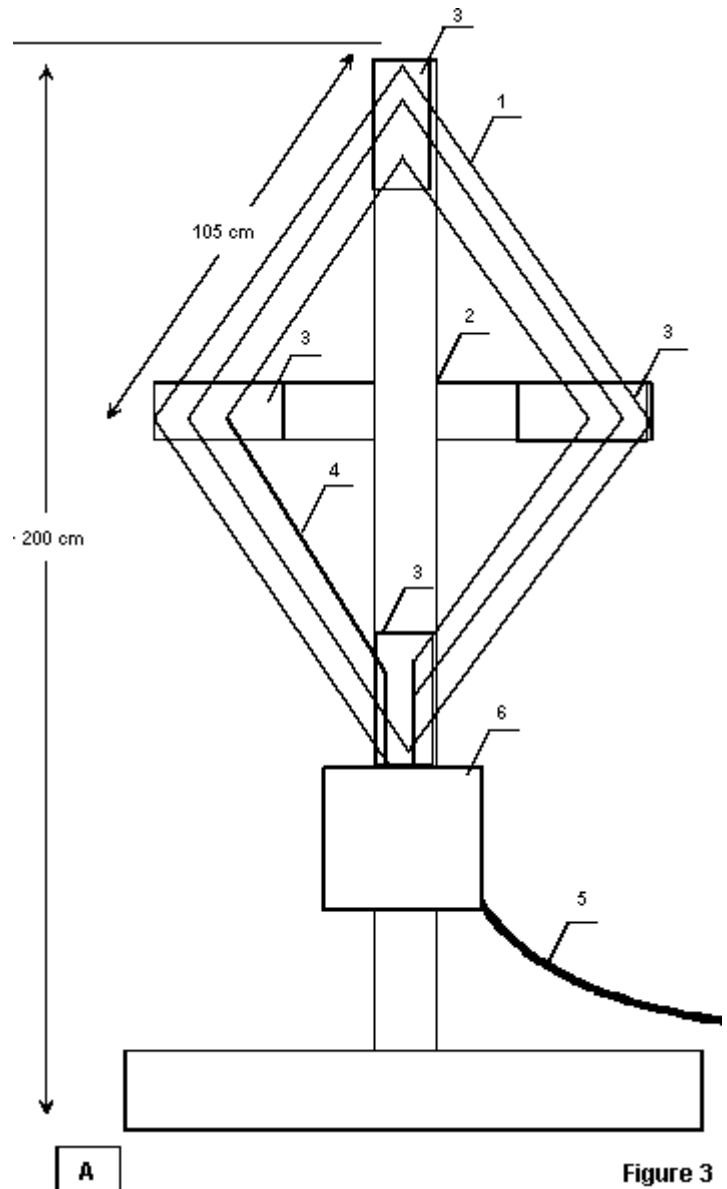


Figure 3

**Figure 3 Small-sized receiving loop of a rural Broadcasting Radio Center**

that is not washed off typographical paint) can have a big losses at LW- MW ranges, at least, in a microwave this cardboard is strongly heated up. Certainly, do not use the grey cardboard for a form of a basket loop antenna. Odd number slots are made in this dielectric plate, the more slots are done, the winding has more density Number of turns and sizes of an antenna form are depended on frequencies range used.

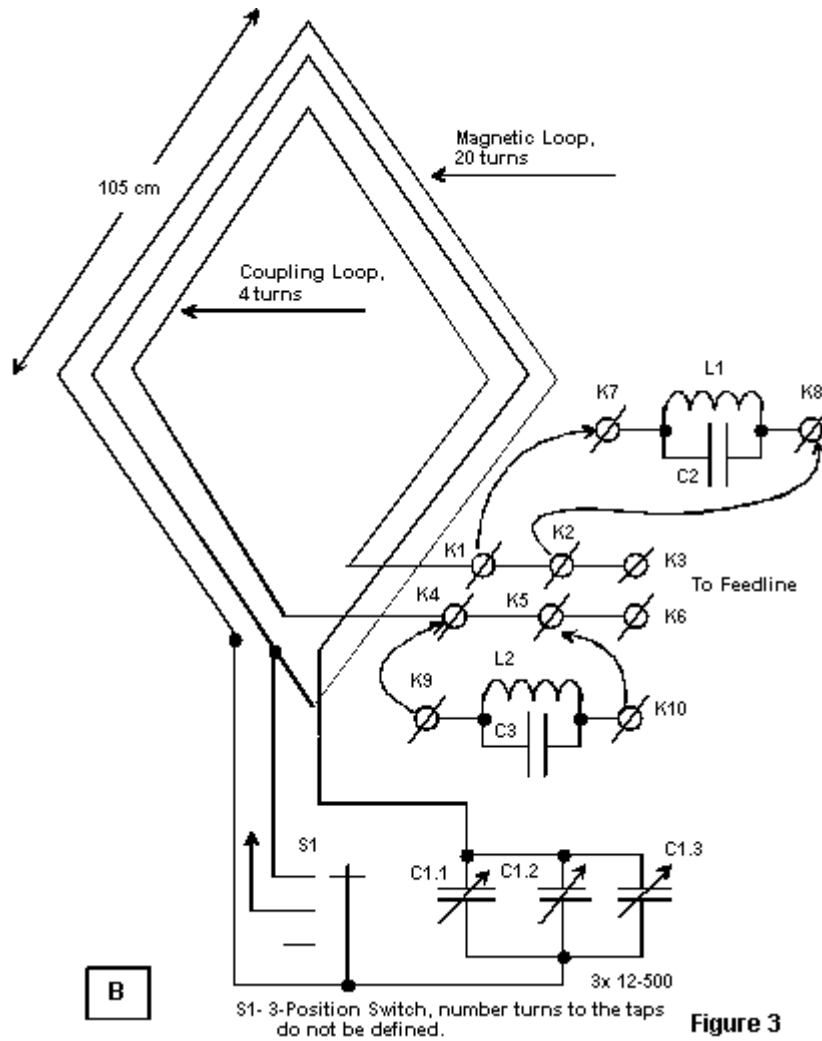


Figure 3 Small-sized receiving loop of a rural Broadcasting Radio Center

**Basket Loop Antenna of a Simple Tube Receiver of Direct Amplification**

Fig. 4 shows the circuit and design of a basket loop antenna intended for use in a simple three-tubes regenerative receiver for LW- MW. The receiver was described in the reference [5]. For design of the antenna a disk made of a cardboard or plywoods is used. The disk has diameter in 120 millimeters and the thickness in 3 millimeters. Five slots of 45 millimeters in the length of and 2-3 millimeters in width are done on the disk at equal distance one after the other. A special ledge for fastening the loop antenna is made on the disk. Magnetic loop antenna contained 250 turns of an insulated copper wire in diameter of 0,15-0,25 millimeters. Beginning of the reeling is up of the centre of the disk.

Taps are tapped from the loop for tuning the loop to a resonance. Taps are made from 50, 100, 150 and 200 turns. When you doing the taps, do not break off antenna wire, wind wire

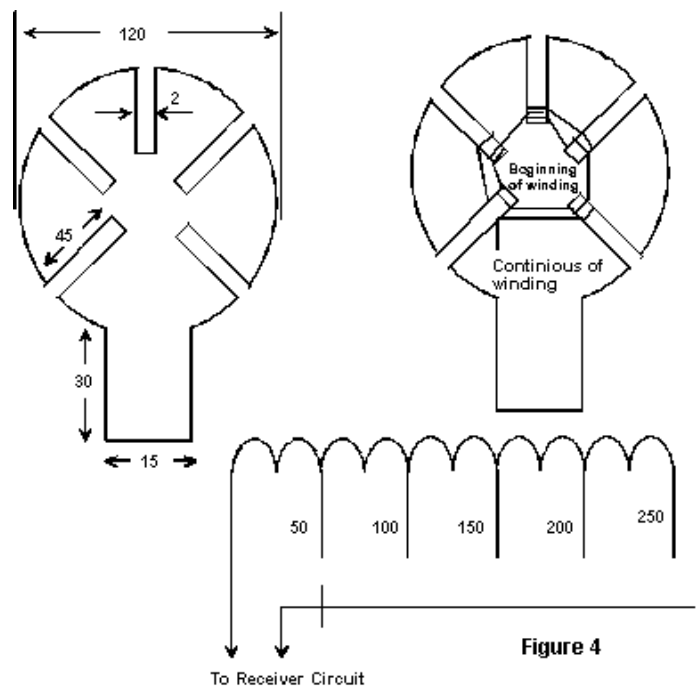


Figure 4 Magnetic basket loop antenna of a regenerative receiver of LW- MW

into a loop in length approximately 200 millimeters, then continue winding.

**Basket Loop Antenna of a Simple Suitcase Tube Superheterodyne**

Fig. 5 shows a basket loop antenna of a superheterodyne receiver of LW- MW made in a suitcase. The receiver was described in the reference [5]. The basket magnetic loop antenna is placed on a cover of a suitcase in which the receiver is placed. More slots - more density of winding of the loop.

The first section of the antenna contains 29 turns, it is wound by a Litz wire 10x0,07 (10 wire in diameter of 0,07 millimeters), as a last resort, this winding can be made by a wire of 0,4-0,5 millimeters in diameter. The first section starts to reel up from the internal part of the form. The second section of the antenna continues winding the first section, it is wound by a copper insulated wire of 0,2 millimeters in diameter and contains 70 coils. When the antenna works at MW the first section is shortened. At LW both section of the loop antenna are in work.

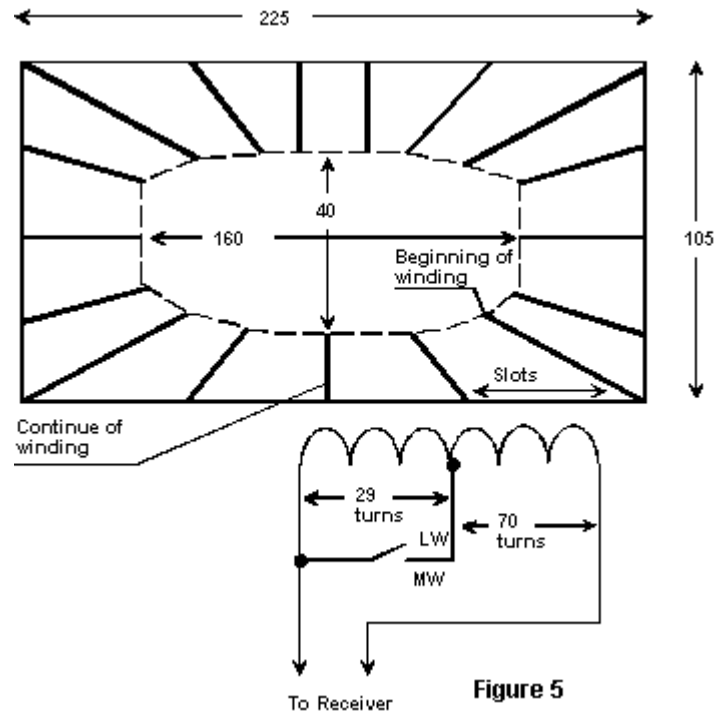


Figure 5 Magnetic basket loop antenna of a superheterodyne receiver of LW- MW

**Magnetic Loop Antenna of a Suitcase Tube Superheterodyne**

Certainly, not only basket loop antennas were used in old receivers. Simple loop antennas were widely used also. A simple superheterodyne LW- MW receiver made in

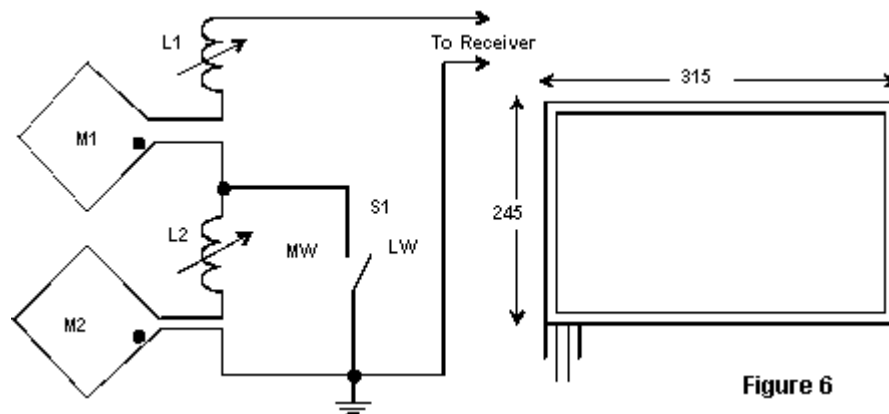


Figure 6 Magnetic loop antenna of a superheterodyne receiver of LW- MW

a suitcase and using a loop magnet antenna is described in the reference [5]. Fig. 6 shows the circuit and design of the loop antenna. It was used two magnetic loop antennas, M1 and M2. Lengthening coils are switched in serial with each loop antenna (L1 to M1 and L2 to M2), necessary for exact tuning of the loops to frequencies range needed. Both, M1 and M2 are used at LW. When the loop works at MW, M2 is shortened, and only M1 does receiving.

Magnetic antennas M1 and M2 have sizes 315x245 millimeters, M1 contains 14 turns of Litz wire 30x0,06, M2 contains 50 turns of Litz wire 15x0,05. As a last resort, instead of a Litz it is possible to use a copper insulated wire in diameter of 0,15 millimeters.

Lengthening inductor L1 contains 50 turns, lengthening inductor L2 contains 125 turns, the wire is Litz 15x0,05. These inductors are reeled on a form in diameter of 8 millimeters. The width of winding is 7 millimeters for both inductors.

### Short Wave Magnetic Loop Antenna

Magnetic loop antennas were used not only for LW and MW, also the antennas were used for SW. For example, in the reference [5] it was described a SW magnetic loop antenna which was used for 19-75 meters. The loop antenna was simultaneously the input circuit of the receiver. A variable capacitor 12x500-pF does tuning to a resonance of the loop. Fig. 7 shows design of the antenna.

The antenna is made of a copper strip 6x3 (width in 6 millimeters, thickness in 3 millimeters). Such strip is used for winding welding transformers. The loop antenna contains 2 turns, the distance between the turns is 10 millimeters, inductance of the magnetic loop is 3,1- $\mu$ H.

### Old Receiving Magnetic Loop Antennas

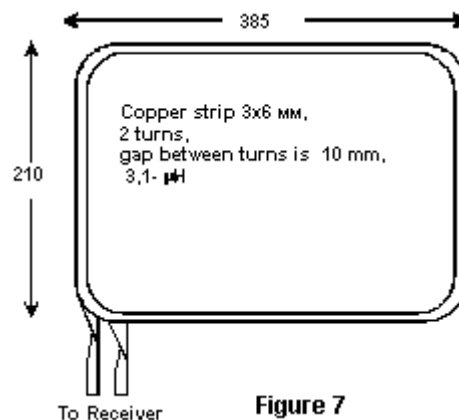


Figure 7 SW magnetic loop antenna

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