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the irca technical column

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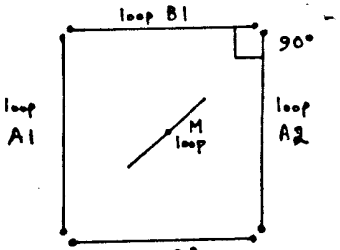
Four Wall Loops for Better Nulls

by Ben Peters

I have been experimenting with a number of loop antenna systems to find one which can solidly null pest signals troubled by "night" or "polarization" effect (mixture of sky-wave and groundwave reception), get good nulls on signals without needing to tilt a large loop, and get complex nulls and peaks which are unobtainable with a single unaided loop. Two of the systems I've tried are described in the Jan 14/84 DX Monitor ("Nulling with two wall mounted loops") and the May 19/84 DX Monitor ("The 3 parallel loop/Adcock system"). I feel the following system is an improvement on these previous ones, especially if you live in an area that rules out use of an amplified loop antenna.

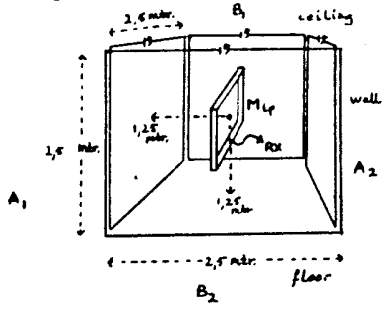
The system is comprised of four wall mounted loop antennas (mine are 2.5 meters on a side*), which are at 90° angles to each other---it is most convenient if these loops are wall mounted, but they can just as easily be hung from the ceiling, and weighted down towards the floor in the required square shape, as they are "floppy loops" made from 300 ohm twinlead. In the exact center of the cube formed by these loops is the rotatable loop antenna which normally feeds the receiver ("M loop" in figures 1 and 2). In figures 1 and 2, the vertical edge of each loop is separated by around 3 cm (a bit over an inch) from its neighbour.

Figure 1
View from above



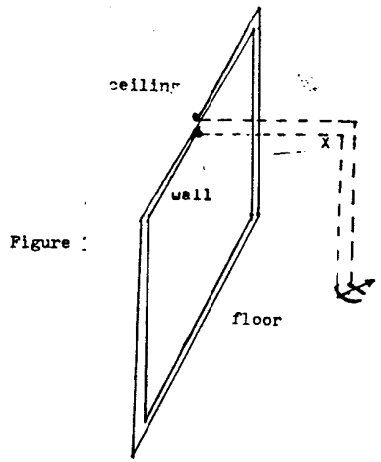
(loop tuning capacitors & windings eliminated for simplicity)

Figure 2 Side view



Each large loop is made up of a 10 meter length of twinlead (giving 2.5 meters on a side) wired up as in figure 3. Each loop is tuned by a variable capacitor (paralleled sections to equal about 1000 pF) located next to the receiver in the center of the four loops. The variable capacitor will tune the loop down to about 700 kHz. Below 700 kHz, first one, then another 470 pF fixed capacitor is switched in parallel with the variable cap to tune the loop to the bottom of the MW band. Each tuning capacitor is connected to its loop by a 3.25 meter length of twinlead (dashed lines in figure 3) which goes up to the ceiling (point "x") from the listening position, then across the ceiling to its respective loop. This tuning arrangement works well for me, but those eager for optimum results might make remotely tuneable capacitors--they have my blessing! I've noticed no hand capacity effects when nulling with this system.

Figure 3



* one meter equals about 39 inches

"M loop" in figures 1 and 2 is the "middle" loop antenna which feeds the receiver. It is rotatable, and its center should be in the exact center of the cube formed by the four wall loops. I've used a Martens loop here (even a 3 loop system, more on that later), but other loops should work just as well.

Nulling procedure:

Start with all the large loops' variable capacitors at minimum capacity. Then peak "M loop" for desired frequency and rotate this loop either to null the pest signal or in the direction of the desired signal. Generally the middle loop is set to null the dominant signal as best it can, but nulls using the entire system can usually be obtained with the middle loop in virtually any position. Then loop A1 is peaked on the undesired signal. Loop B1 is tuned for either a dip or peak in the undesired signal. If B1 peaks the signal, then A2 should be tuned for a dip; if B1 dips, then A2 should be tuned for a signal peak. Finally loop B2 is tuned for the null of the undesired signal/peak of the desired signal. Finally, slight rotation of "M loop" and/or readjustments of the tuning capacitors of the four big loops will finalize the null. Often, both a peak and a dip will be found when tuning each big loop. It sometimes pays to go back to the beginning and start the procedure over, but if you peaked loop B1 before, try tuning for a dip, then continue from there.

With all those tuning capacitors as well as the rotating loop in the center, a variety of nulling patterns may be established, from near cardioid to cloverleaf patterns, and often 3 or 4 subdominant stations can be separated out on a crowded channel. The more complex patterns require more practice of course. Luckily, for most DX situations, complicated adjustment is not required. Remember that the A1-A2-B1-B2 labelling of the loops is arbitrary, and simply tell you where the big loops are in relation to one another. Often a worthwhile null can be obtained by rotating the middle loop, then adjusting the capacitor of one of the two large loops most nearly parallel to the setting of the middle loop. This loop will be "A1", then loop "B1" (relative to "A1") is tuned as in the original procedure. Often adjusting these two loops for a null, then rerotating the middle loop slightly for the best null will be all that is needed. (The remaining large loops are left detuned to minimum capacity.)

Examples:

1. Daytime, 720 kHz. German dominant; BBC4 is DX target

R. West loop alone: DX is S9+20, reasonably readable, some noise/fading
4 big loops & 3 parallel loop system (middle loop is unamplified and feeds receiver. Similar results with single loop in center):
DX is at S9 and more readable, less noise, no fading.
If the center loop is amplified, then the DX is at S9+40, excellent readability. If feedback is used in the amplifier, signal level is greater yet, with very good readability.

When the 3 parallel loop system is used without the 4 big loops, the DX level is at S4, but it is a more stable and noise-free signal than the R. West loop delivers. This is with the center loop unamplified. When the center loop is amplified, then the DX is at S9+10/20 and readability is excellent.

(When strong locals rule out amplification, go for 4 big loops, with a large loop in the middle feeding the receiver.)

2. Nighttime, 873 kHz. AFN Germany dominant (ground & skywave)

R. West loop: Very hard work to get an unstable null when loop is rotated and tilted. Often nothing or weak AFN in that null. When there is DX in the null (depends on whether ground or sky-wave of AFN dominates) it's reasonably readable but unstable, and the loop frequently needs readjusting. Mostly the DX is the Soviet Union, but sometimes mixed with Spain and very rarely, traces of England.

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4 big loops & 3 parallel loop system: Always very easy nulling of AFN, always with strong & readable DX audio; only slight and easily performed adjustments needed from time to time. This null obtained when AFN is first nulled with the 3 parallel loop system, then improved with the 4 big loops (the 3 loop system alone also gives better nulls than the R. West loop). DX usually is the Soviet Union. However, when the receiver feeding loop is pointed in the direction of Spain and AFN is nulled using the sideloops and the 4 big loops, Spain can be logged with quite stable and readable audio later in the evening. When the same procedure is applied to England, there is considerably more fiddling, as England has a mixed skywave/groundwave signal, is weak, and both AFN and the Soviet Union are approximately 180° away. However, England can be heard mixed with Soviet audio, or, later at night, pretty well in the clear.

(Replacing the middle loop with the 3 parallel loop system described in the May 19/84 DX Monitor will give additional nulling power, but is advisable only for true "loop freaks" who care more about tiny differences and want to get the best null possible.)

Conclusions:

With the 4 big loops, it is possible at will (and not depending on conditions) to get at least one DX station with ease where the R. West loop for example gives nothing. This is because the 4 big loops, even when not used together with the 3 parallel loop system, but with just one small rotatable loop, is free of polarisation effect to a certain degree. Also, it is possible at will to pick out other co-channel DX stations from under a dominant regardless of their direction related to the dominant or other sub-dominant stations.

Compared with the 2 wall-corner loops (described in Jan 14/84 DX Monitor) the 4 big loops give: much higher DX strength, nulls easier to obtain and hold, much cleaner audio of dominant-free DX and nulls by pointing the receiver feeding loop in any desired direction. (The wall-corner loops allow nulls with only a few positions of the receiver feeding loop)

The relative signal strength produced by the system seems to be determined by the receiver feeding loop, so it would be wise to have as large a loop as possible as the middle loop, or have a good switchable amplifier on that loop if your location allows it.

Although my large loops are 2.5 meters on a side, the system may well be useable with smaller "large" loops (I hope to try such smaller loops myself and will report results--ed.). All experimentation was done with the receiver and loops ungrounded, but it may well be possible to ground the 4 large loops at the exact center of their windings, and ground the receiver chassis.

I find the 4-loop system more convenient to DX with than phasing two random wires, as nulls seem to be easier to find, and the system is quite free of polarisation-effect in the dominant station's signal. In general, the 4 loop system has greater DX capability than either the 2 wall corner loops or the 3 parallel loops, and definitely more than a single rotated and tilted loop antenna.