The Black Hole

ARRL SS Unlimited Team Champs 2000, 2001, 2002

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Comments on Small Receiving Loops

by Excerpted from PVRC Reflector

Ed. A member recently expressed an interest in seeing an article on small receiving antennas for the low bands. As luck would have it, while reviewing old issues for the "10 Years Ago …" box below, I came across K9MA's article on small shielded receiving loops, page 5. Just today, I picked up some additional comments from a discussion on the PVRC reflector.

(N4ZR) I built one *(K9AY Loop),* and have been pretty pleased -- I have a pretty steady S9 noise level on my transmit antenna (shunt fed tower) so an RX antenna is a must. Comparing on 160, there IS no comparison - noise is about S3 and stations off the nose are about the same strength as on the vertical (I use a 20 dB pre-amp.) On 80M, both noise and signal to noise are about on a par with my 4-element parasitic array, which has a fairly broad pattern, but good F/B.

I have modeled, and am collecting parts for, an array of AY loops, end-fire, spaced 135 feet, with 180 degree phasing. Modeling indicates a receiving directivity factor roughly comparable to a 500-foot beverage. You could probably use a similar approach with pennants or EWEs. The nice part about 180 degree phasing is that it apparently makes the matching at the antennas fairly non-critical, where otherwise mismatches can introduce some fairly major phasing errors (again according to ON4UN).

One thing that I am convinced is very important with K9AY loops is to use a real transformer to match the antenna, not an autotransformer. The reason for this is that I understand it is important to isolate the loop ground from the coax shield ground in order to minimize common-mode pickup on the feedline with these low-output antennas. I replicated the setup described several places in ON4UN's book, with two 50-bead chokes about 15 feet from the antenna, with the coax shield ground attached between the chokes. He makes some dramatic claims for reduction in common mode pickup using this technique, and friends who understand the theory say he's right.

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10 Years Ago in SMC

- Scott, K9MA, wrote a great article on matching and arraying small, shielded loops for receiving on the low bands. *(See page 5 of this issue.)*
- The Wisconsin section was buzzing over the news of KA9FOX's engagement.
- SMC welcomed K9VV and K8JP as new members.
- Yours truly (K9QQ) had just settled in for a 4 year stay in northern Japan as 7J7ABV.

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QSLing via the Bureau

By George Zurbuchen, K9CC

Please be very patient when using the bureau to QSL. Do not even think of sending a second request for at least two years. If the operator you are requesting a card from is using pre-printed labels, and he or she has already used your label on a QSL that is in transit, it wastes that operator's time searching to see if the request is legitimate.

To illustrate the point, I recently received about 75 cards for my operation in Bermuda that had taken place 22 months prior. So as you can see, that is just under two years, and the waiting process is only half over! Contained in those 75 cards were four cards from a German operator for a single contact that I had already sent out a card for. The four cards had ever increasing pleadings to "please QSL". I am assuming that he sent out those four cards to his bureau over a span of at least one year! If you use the bureau, be prepared for a very long wait, and probably a poor return rate. I do QSL bureau cards 100% myself however. If you QSL direct, please include a SASE, or a SAE and a green stamp. If to the USA, one green stamp is adequate, just about anywhere else in the world you need two. Yes, our postal rates in the USA are a bargain!

The VHF Column

By W9GKA, Kevin Kaufhold

Rules Revisions at the CAC. The Contest Advisory Committee is now considering the proposed rules revisions that survived last year's Special Advisory Committee process. The proposals being considered are: 1) The creation of a new SO limited category, evidently now with any four bands to choose from; 2) simplifying the power limit for the SOLP to 150 watts for the four lower VHF bands; 3) eliminating the rule on allowing multis to work their own ops on 2.3G and above; 4) generally strengthening the rules on minimizing grid circling and captive rovers; 5) sponsoring plaques for the January or September contests, this is fine. So far, comments from VHF operators appear to support the SO limited category. There is also support for a unified power limit level, but at the 200 watts level. The microwave and rover proposals are having a mixed response, and it is unknown how far the CAC can go on the rover proposal, as it is only conceptual in nature, lacking specific rules language. Stay tuned for more details.

2004 Sept VHF Results. The full results are now out, and the SMC finished 6th in the medium club category. In past years, we have finished anywhere from 4th through 8th. On an interesting note, Northern Lights RS was the first and only club ever to post 50+ club log entries for the September contest, putting it into the unlimited category.

On the individual SMC club member scores, Bob K2DRH, had another outstanding effort, placed 2nd in the nation in the SOLP. Other SMC members also did very well. Barry, N2BJ, placed 1st in the Central Division in the SO high power class. K9JK was 5th in the nation among the rovers, and won the Midwest Division for rovers. Zack, W9SZ, won the division in the QRP class; and Gene, N9TF, along with KC9ETU, won the division in the Multi-Limited. At the state level, WA1MKE won the SOLP in Indiana, and K9RN won the Multi-Unlimited in Illinois. Other SMC members participating included NT9E, K9IJ, W9GKA, and W9SE with SOLP entries. Marshall, W9RVG also ran the contest form deep Southern Illinois, but was out of the SMC circle. In all, SMC took 5 division leader positions spread across 2 divisions and 7 state-level top spots in 3 states. Congratulations to everyone!

Also of great note is that Pete, K9PW, ran SOHP from K3EAR and placed 2nd in the nation from out east, missing the top spot by only 2,000 points. Both Pete and the 1st place SOHP, K1TEO, broke the SO record in the process. Pete had a nice write-up and picture in QST, but I think what is most impressive about his effort is that he made contacts on 47G and 75G! I wonder what the equipment even looks like for those frequencies?

2005 Jan VHF SS. We had 19 operators submit log entries electronically, and the SMC aggregate to date stands at 289,000 points. This may be good enough for a 5th place finish in the medium competition, although that is based on only initial submissions. Bob, K2DRH, posted the highest national score in the SOLP, and several other of our operators are in a very good position in their respective classes, as well.

Onto June. The next VHF contest with a club flavor is the June VHF QSO Party. Last year, we scored 2nd in the medium class, with slightly under 30 entries. I believe that if we make an all-out effort, we can break the 50 op threshold, thereby pushing us into the unlimited class, in definite contention for an unlimited gavel. The June VHF event often experiences HF like conditions on 6 meters, so the SMC can be most competitive for this contest. Please plan on working this club competition.

(l) Pat, N9RV, and (r) Mike, W9RE operating KJ9D at the HDXCC Field Day 2004 station.

Jon, K9JS, at VE4VV for the 2004 ARRL SS SSB.

(Continued from page 1)

(W2DZO) Don't know about the "expert stuff", but I can fill you in on what worked on a very small lot. We tried several RX antennas at W4WS (my house) for several years- it was a small urban lot in a downtown area- space was an issue. While a K9AY loop sounded good, (but would benefit from more distance from the TX antennas), we found that the KC2TX split shield coax loops on 160 and 80 worked great- with less front end overload than the AY design; especially with a preamp and band pass filter combo- we used NQN filters and the Advanced Receiver Research P1-30/20VD preamp.

We had a switch circuit in place for switching the bands, and had a small TV rotator to turn the loop. If I had lots of room, I'd be all over the AY design, or even a short beverage (which we finally installed last October at KG4NEP and has made a HUGE! difference.) The loops are cheap and easy to make. I used rg-6 coax and a couple broom handles.

Remember, our low band TX antennas were 30' from the shack; anything too close will cause a dangerous voltage on the RX line. We popped one rig that way- be sure to put some opposing parallel diodes in there to save the front end.

(NI1N) I have a 4-way K9AY loop system. I bought the AYL-4 by K9AY sold by Array Solutions. I also have a 2-wire beverage using K1FZ transformers, switchable be-

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tween NE and SW.

For TX on 80m I have a 2-element full size vertical array with 240 radials each at least 1/2-wave on 80 meters. The radials on one of the verticals are closer to 4/10-wave on 160m, as I also switch in a loading coil to feed that vertical on 160.

I've found that there isn't a clear cut winner. There are times when either is better than the others.

When 80m is quiet, the verticals are superior. When there isn't much noise, its all signal.... that does wonders for the signal to noise ratio! When the band is noisier, it becomes a toss up. Either antenna may hear a given signal better, but in general the signal to noise ratio is best on the beverage followed closely by the K9AY loop. For those times, the beverage is usually best toward EU and the K9AY does a nice job of filling in the directions I can't cover with beverages.

On 160 the signal to noise ratio is always superior on the beverage and the K9AY loop compared to the vertical. But, at least at my QTH, 160 is a much noisier band than 80. On a half decent night here 80 is quiet enough that the signal to noise ratio is less of an issue and the forward gain outweighs it.

As far their directivity goes, judging only by the S-meter, the signals drop about 25db when I aim it 90 degrees away from the signal and even more when its aimed 180 degrees away.

My 2-element 80 meter array has nice front-to-back (seems to be 20 to 25db), but the front-to-side is much better on the K9AY. So, it does a better job of cutting down the stateside QRM.

Overall, I've found it to be a nice addition to the arsenal. It isn't the end-all-be-all of RX antennas, as there are times the others are better.

But, for $189 (the price of K9AY's AYL-4 control system from Array Solutions), it was well worth it.

I should also add the I have the K9AY setup in the side yard, somewhere between 160 and 180 feet away from the nearest TX vertical. That seems far enough to not cause problems.

From what I've read, if they are too close to the TX verticals, not only do you have to worry about RF on the RX line, but the loops will pick up signals re-radiated off the verticals and be less effective.

Small Shielded Loops for Receiving

By K9MA, Scott Ellington

An array of small loops can be a very attractive receiving antenna system for the low bands. Beverages are certainly a lot less trouble, but if you don't have the room, read on. First I'll describe a simple method of matching each loop which lends itself to easy band switching. Then I'll show how to use two or more loops in a directional array.

Even a single loop may be useful for eliminating noise or QRM from a particular direction. (Ref. 1) Shielded loops have very good broadside nulls and, most important for arrays, have little coupling to their feed lines or other nearby conductors. While such coupling can be minimized by carefully balancing unshielded loops, band switching is difficult. If each loop in an array is matched to 50 Ohms, the proper current phase can be achieved by simply inserting the appropriate lengths of transmission line. Because small loops are very inefficient, coupling between loops in an array is negligible, so each loop can be matched separately, and its impedance won't change when connected to the array.

As shown in Figure 1, the loop, as usual, has the shield broken at the midpoint. At one end, a small variable capacitor, C_2, is used to resonate the loop at the desired frequency. C_1, a much larger capacitor, makes the feed point impedance 50 Ohms at resonance. The principle is similar to that of the hairpin match often used for low impedance antennas. Resistor R_1 is optional, to increase the bandwidth at the expense of efficiency.

The value of C_2 is very critical, so an air variable, perhaps in parallel with a small mica capacitor, should be used. The value of C_1 is not very critical, though it should be a low-loss mica type. A mica compression trimmer could be used for C_1, but not for C_2. R_1, if used, must be non-inductive. Typical values are shown in Figure 1. Note that changing R_1 will significantly change C_1, but require only a small change in the value of C_2. Increasing R_1 will decrease C_1. The optimum value for R_1 is the largest value for which the atmospheric noise is above the receiver noise.

Using low capacitance RG-62 cable, the largest loop that will resonate at 3.5 MHz is about 5 feet on a side. A slightly smaller loop might be required for the 75 meter phone band. With a R_1=3.3 Ohms, the 2:1 bandwidth is about 50 kHz on both bands. With a receiver preamp, the efficiency is more than adequate, at least in an urban location.

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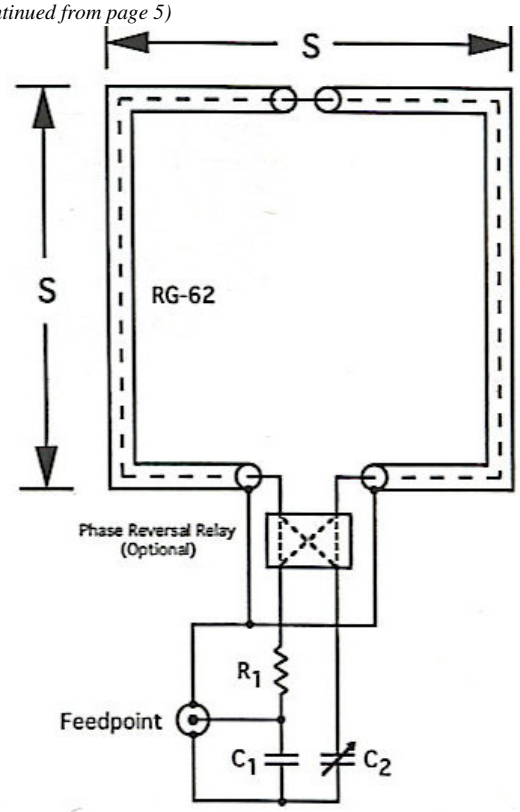

Typical Values

F	1.8 MHz	3.5 MHz
S	5 ft	5 ft
R_1	3.3 Ohms	3.3 Ohms
C_1	4970 pF	2950 pF
C_2	696 pF	83 pF

Figure 1
Loop Impedance Matching

The tuning procedure is simple. Install the initial capacitor in the C_1 position and carefully adjust C_2 for minimum SWR. Do not apply more than a couple watts. If the minimum SWR is greater than 1:1, change C_1 by about 10 percent and again adjust C_2 for minimum SWR. Repeat until the SWR is 1:1. If fixed capacitors are used for C_1, keep the leads short when installing them temporarily, or be prepared to increase the capacitance a bit when the leads are cut for permanent installation.

A DPDT relay can be used to switch between two sets of capacitors, one for 80 meters and one for 160. Be sure to bypass the relay control lines, or the tuning may change when the control cable is connected.

Arrays of loops are easily modeled with ELNEC, MN, etc.. (It is not necessary to try to include the effects of the shields in the model.) End-fire arrays using various numbers of loops can be used, as described in Ref. 2. Spacing of about 1/4 wavelength is optimum, but smaller spacings can be used with proper phasing. Keep in mind, though, that useful bandwidth goes down as spacing decreases. Modeling is by far the easiest way to determine the optimum phasing, particularly for two-band arrays, or those with spacing less than 1/4 wavelength. Because each loop in the array is matched to 50 Ohms, achieving the desired current magnitude and phase is straightforward.

The simple array at K9MA uses just two loops, spaced 21 meters apart. This spacing is about 1/4 wavelength on 80 meters and 1/8 wavelength on 160. Figure 2 shows the expected vertical pattern with phasing of 115 degrees on 80 meters, and 238 degrees on 160. This phasing results in a

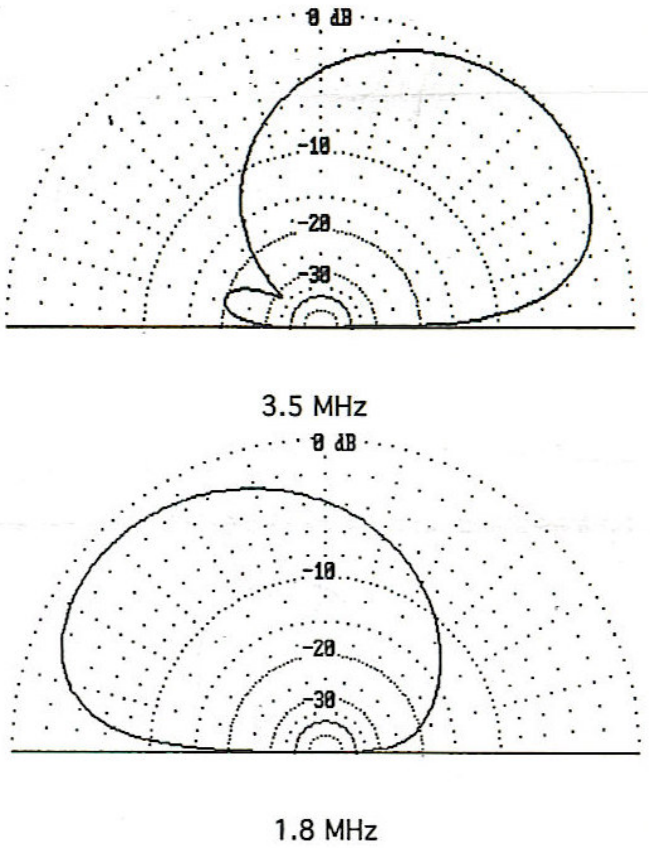

Figure 2
Elevation patterns for two-loop array

null off the back at a vertical angle of about 35 degrees on

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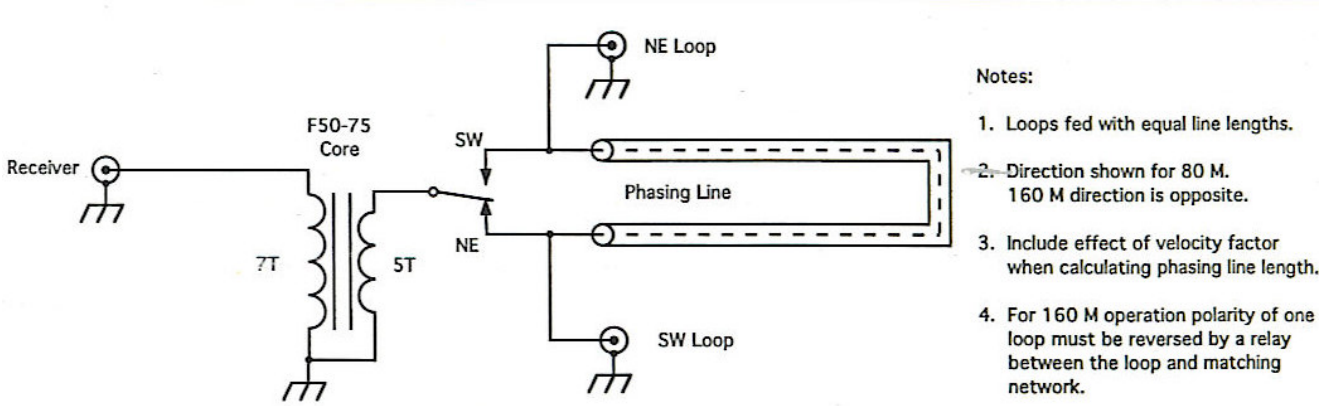

Figure 3
Loop Array Feed Circuit

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80 meters, which should provide better rejection of nearby stations. The 115 degree phase shift for 80 meters is obtained by inserting an extra length of RG-58 for one loop. The same phasing section provides a 238 degree phase shift on 160 if the polarity of one loop is reversed with a relay. The optimum phase shift for 160 is somewhat less than 238 degrees, but this value is a compromise which allows use of a single phasing section from one loop to the other, of course, reverses the direction. A small toroidal transformer with at1.4:1 turns ratio can be used to match the two parallel loops to 50 Ohms, though it's not essential. In any case, a receiver preamp will probably be necessary. Figure 3 is a simplified schematic of the feed system.

Two major factors may limit the performance of a loop array. As the SWR of each loop increases at frequencies other than resonance, the currents change from their ideal values, which reduces the front-to-back ratio. Using the largest possible value for R_1 maximizes the useful bandwidth. The second limiting factor is re-radiation from nearby objects, like towers and other antennas. Since each loop has a broadside null, that direction shouldn't be as critical.

The effects of a shunt-fed tower of other vertical antenna near the loops may sometimes be eliminated by proper termination of the vertical's feed line when receiving on the loops. A series LC seems to work well, but must be very carefully tuned. One way to determine the proper tuning is to listen on the loops, and adjust the vertical termination for minimum noise. Moving a loop close to the antenna may be necessary. The idea is to make the vertical "vanish" electrically at the receiving frequency. Another approach is to place a transmitter off the back of the loop array, and adjust the termination for the best null. (Be sure to check both directions, though.) Don't try to adjust the tuning by listening to signals with QSB. The termination tuning may be quite critical, so any change in feed line length or antenna tuning may require adjustment of the termination. Before adjusting the terminations, be sure the transmitting antennas are tuned the way they will be for normal operations. If termination proves successful, the termination networks can be switched in with relays on receive.

At K9MA, there's a 70 foot tower right between the two loops. The tower is shunt fed on 80 and 160. With the right shunt feed termination, the loops have about a 15 dB front-to-back ratio on 160, and consistently show a better signal-to-noise ratio than any other receiving antennas. However, if the shunt feed capacitor is detuned slightly, so the transmitting SWR goes above about 1.5:1, the loop front-to-back ratio vanishes. On 80, a good null can be achieved to the southwest, but to the northeast it seems impossible to achieve good performance. This may be due to proximity to buildings (or perhaps just the perversity of nature, since that's the important direction). Toward Europe, the loops seldom have a better signal-to-noise ratio on 870 than the other antennas, but they are useful in rejecting QRM from the southwest. A simple crystal oscillator, feeding a short vertical on the roof of my car, was very useful in adjusting the shunt feed terminations.

The performance limitations in a congested situation aren't surprising. The loops themselves seem to perform as expected. Even two loops in the clear should provide a good receiving pattern. A larger array should provide very good directivity, using a fraction of the space required for an equivalent Beverage.

References:

1. *F. Koontz, "A High-Directivity Receiving Antenna for 3.8 MHz", QST, August 1993, pages 31-34.*

2. *D. DeMaw, "A Receiving Loop for 1.8 MHz", ARRL Antenna Book, 17th Edition, pages 5-19 through 5-20.*

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By these presents *the American Radio Relay League certifies that* Marshall V. Pochay , *operator of Amateur Radio Station* W9RVG , *is the winner of this award in consideration of his accomplishment in making* 136 *contacts and a section multiplier of* 13 *for a score of* 2768 *points, during the period designated* June 11-12 19 60 *for this contest activity. This station in view of this outstanding radio work is hereby declared the winner for the* Illinois *Section.*

October 10, 1960

F. E. Handy.

PRINTED IN U. S. A.

Some VHF history from the blackhole. Marshall, W9RVG, won the Illinois Section in the 1960 running of the ARRL June VHF contest with 136 contacts and 13 mults.

Mike, KC9ETU, in the background and Gene, N9TF, in the foreground are looking a little beat towards the end of the 2005 January VHF SS contest.

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by NV5A

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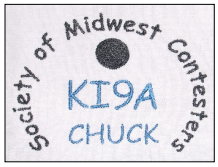

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