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# A 5-FOOT ALTAZIMUTH LOOP FOR LONG OR MEDIUM WAVE RECEPTION

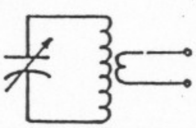
BY STEVE McDONALD VE7SL

Since the photograph of my large air-core loop first appeared on the front cover of the LOWDOWN (FEB/87), I have responded to over seventy requests for information regarding its construction. Today, over a year and a half later, hardly a week goes by without additional requests - evidently there is much interest in LW receiving antennas and loops in particular.

My initial interest in constructing the loop was necessitated by the purchase of an R71A receiver followed by the rather mediocre LW reception I was achieving using a long (150'), high (50') coaxial fed 'sloper' antenna. Living in a typical noisy (radio-wise) suburban city-sized lot, I found that all but the strongest of LW signals were obscured by power-line noise, TV birdies and nearby light-dimmer hash plus goodness knows what else! Reading everything I could find about loops and corresponding with loop users convinced me to try one for myself. It was fairly evident from my research that the loop had to be smoothly rotatable in both azimuth and altitude (tilt) if maximum benefit was to be realized. The ability to smoothly swing the loop in elevation as well as azimuth allows for a virtual complete "nulling" of any strong pest signals or, more importantly at this location, to null out offending noise sources. All the designs that I could find looked rather flimsy and shaky and most of these were for smaller size loops. A trip to the local hardware store convinced me that everything I needed for a smoothly operating design was readily available using PVC plumbing hardware.

The LW loop consists of 13 turns of #18-20 plastic covered stranded copper wire. This amounts to approximately 208' of wire. The 13 turn loop is resonated (tuned) with a 3-section miniature BCB variable capacitor (total range is 20-1000pF), removed from an old transistor radio. With a standard 2-section BCB variable (about 700pF), the LW loop tunes from approximately 200-700kHz; with the 3-section variable, tuning drops to approximately 170kHz. The MW (BCB) loop consists of 7 turns (approximately 115' of wire) and a single-section 365pF variable. This arrangement tunes from approximately 700-1700kHz. To cover the bottom end of the band, a small fixed capacitor (100-200pF) can be paralleled with the main tuning capacitor using an 'in-out' switching arrangement. Basically it is a 'cut and try' situation - try what you have for a tuning capacitor then add or remove turns.

The pick-up loop consists of 1 turn of the same type of wire used in the main loop; it is spaced 5" inside the main loop. The pick-up loop is fed with about 10' of 52ohm (RG58) coaxial cable at point "X" where the loop is terminated with 2 brass pins. Electrically, the loop looks like this:

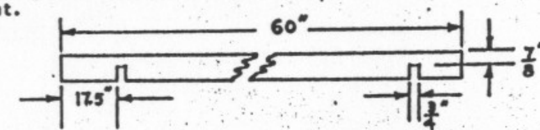


Loop purists might argue that this coaxial-fed link arrangement does not allow perfect electrical 'balancing' of the loop; I must say that I am unable to detect any 'skewing' of the loop pattern as both front and back-side nulls appear to be of equal depth. If you wanted to get real fussy, a balanced preamp using dual FETs or dual-gate MOSFETs at unity gain could be employed to obtain a perfect electrical balance.

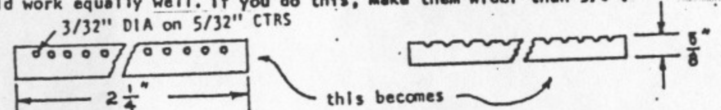
## FRAME CONSTRUCTION

Construction is straightforward and not difficult. If you are lacking the skills or the tools then perhaps you have a friend or neighbour that can lend a hand; another sure source of help is the local high school Woodworking shop. The 4 crossarms on the loop frame are made from 3/4" plywood, 1-3/4" wide by 60" in length. Any 3/4" stock such as Pine or Cedar will work equally well but it must be straight. Anything thicker than 3/4" will make the frame too heavy while anything thinner results in sag - 3/4" seems just right! The arms are joined by cutting 'half-lap' joints 17½" in from each end as shown in FIG. 1. These were cut on a table saw by clamping all 4 arms together and cutting 4 laps at a time. You can also cut these by hand using a small saw and a chisel. With careful layout they will be just as accurate as the table saw method. The arms are glued and screwed together with one #8 x 1½" wood screw at each lap joint.

FIG. 1




The plexi guides are short strips of 1/8" thick plexiglass that act as alignment guides for the main winding; these can also be made from thin wood such as a 'Popsickle' stick. There are probably dozens of things that could be readily used as guides but stay away from using metal. I originally drilled a series of holes (3/32" drill) on 5/32" centers as shown, then sanded (using a disc sander) the top portion of the holes away, leaving a series of grooves along which the wires can be guided. A file or electric hand sander will give you the same results only slower; 8 guides are required. These were fastened to the ends of the 4 crossarms by cutting a groove (same thickness as the guide) in the crossarm ends and gluing into place. Again a table saw was used but this could also be done carefully by hand. Another method is to simply fasten the guides with small screws and some glue to the side of the crossarm ends which should work equally well. If you do this, make them wider than 5/8".




## AZ/EL CONSTRUCTION

The main frame is tilted and rotated by an azimuth/elevation system constructed of standard 1¼" PVC pipe. This lightweight material allows everything to glide and tilt very smoothly and, if constructed properly, adjustments in azimuth or elevation of as little as ¼" are easily made.

Two 1¼" 'T' fittings along with their pipe adapters are required (part #3, #4) and 3 'end caps' are required (part #1, #2 and one for the floor stand). The end caps (#1, #2) are centered on the inside centers of the crossarms and are fastened with 2 short flat-head sheet metal screws in each end cap. The 1¼" tubing (#7, #8) is glued into the main 'T' (#3) using standard PVC cement but not glued into the end caps thus allowing the system to swing in elevation. Parts #7 and #8 are approximately 10" long but you should cut and size your own system; these should fit snuggly and press 'outwards' against the crossarms. Part #5 is a short piece of 1¼" tubing approximately 1½" long in order to extend the main loop frame forward of the floor stand frame and to keep the wires from rubbing against the stand when the loop is in an untilted (vertical) position. This should not be glued into the main 'T' (#3) thus allowing you to remove the loop frame for transport or to 'plug-in' a loop for another band. Part #6 is for swinging the loop in azimuth without having to grab hold of the frame. It is 22" long and glued into the 'T' (#4); do not glue part #6 if you desire to dismantle the loop for transport. Part #9, the main pivot pipe, is 35" long and is glued into the 'T' (#4); the bottom end of the pivot pipe sits inside another end cap fastened to the floor stand frame.

## FLOOR STAND

The floor stand is straightforward and its solid construction provides a very stable footing for the large loop. Standard 2x4 stock is used for parts 'A' and 'B', each 24" long. The center pieces (C) are 2 pieces of 2x4 glued and screwed together (each piece is 14½" long). These are fastened to 'A' and 'B' by gluing and screwing at point 'D' on both ends. The vertical wall pieces ('E' and 'F') are made of 3/4" Pine but any straight dry stock is fine. 'E' and 'F' are both 4" x 21" in size. The top 'bushing' is also 3/4" Pine or plywood; it is 4" x 4¼" but the latter measurement will depend on the final width of your 'C' pieces. Cut a hole (sabre saw, scroll saw, coping saw, hole saw etc) in the center of the bushing the same size as the pipe. The fit should be snug with no flop; wax the

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edges of the hole with an old candle and the entire loop will rotate like it has Teflon bearings! The bushing is glued and screwed to the top ends of 'E' and 'F'. The bottom end of the pivot pipe (#9) sits inside an end cap which has been centered and screwed to the top surface of 'C'. Rub some wax on the inside of the end cap before final assembly. Finish off the floor stand by screwing 4 large rubber equipment feet to the undersides of 'A' and 'B'.

USING THE LOOP

After reading and researching loop designs, I was rather skeptical about some of the claims made by loop users. This loop really opened my eyes! Initial trials on local groundwave powerhouses (CJOR-600kHz & CBU-690kHz) revealed that their very strong signals (s9+50db on the R71A S meter) could be COMPLETELY nulled so that no trace of carrier could be detected! Skywave propagated signals also showed deep nulls but not as pronounced as the groundwave signals; directional bearings can easily be obtained. European carriers on the BCB showed a pronounced null at 30 degrees; in short, the loop quickly made me a believer!

If your location is a quiet one, unlike my 33' wide urban lot, simply use the loop to peak weak signals or to null 'pests'. Maximum signal pickup is off the ends of the loop, just the opposite of a ferrite bar type loop. When a signal is nulled, the handle (part #6) will be aligned on the bearing to the station. This holds true only if the loop is not tilted; to get accurate bearings, keep the loop frame vertical. If noise is your problem, use the loop to null the noise source. You should find that almost all, if not all, local noise can be eliminated by carefully adjusting the position of the loop. Each few db of noise eliminated will reveal another layer of previously hidden signals. The first night I fired-up the loop the LW band sounded like 20m CW on a Saturday afternoon!

To null noise (or a signal), leave the loop untilted and rotate in azimuth slowly until the target is nulled. Slowly elevate the loop a few degrees and again slowly rotate to re-null. Repeat this procedure a few times, making very small adjustments each time; eventually you will reach the bottom of the null which will be very sharp and very deep. Further adjustments in the same pattern will result in 'passing through' the null. Try experimenting on local groundwave BCB carriers to get the feel of the loop's sharp nulling capability. Loop tuning is fairly sharp and the main tuning capacitor will require re-peaking every 20kHz or so.

RESULTS

The LW loop resulted in a dramatic increase in receive capabilities. The first eleven nights of listening provided 151 new beacons logged - most of them completely undetectable on my 50' sloper. Some of my first season catches were:

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|---|---|---|---|---|---|
| 417 | HHG | HUNTINGTON, IN | 367 | HA | HAO ATOLL, FR POL |
| 417 | EOG | GREENSBORO, AL | 353 | MPH | McGREGOR PT, HI |
| 407 | SWA | SWAN ISLAND, HONDURAS | 352 | RG | RARATONGA, COOK IS |
| 396 | ZBB | S BIMINI, BAHAMAS | 340 | VL | OSTROV SHUMSHU, SIBERIA |
| 396 | PH | INUKJUAK, QUEBEC | 323 | UT | CALCASIEU PASS, LA |
| 392 | ML | CHARLEVOIX, QUEBEC | 316 | MAJ | MAJURO, MARSHALL IS |
| 391 | DDP | SAN JUAN, PR | 315 | HO | HIHFO, WALLIS-FUTUNA |
| 387 | SPP | SAN ANDRES IS, COLOMBIA | 290 | NN | NANDI, FIJI |
| 378 | UX | HALL BEACH, NWT | 216 | CLB | WILMINGTON, NC |

One other thing I was told about loops is that they would not work inside my stucco house, supposedly because of the wire mesh screening beneath the stucco! I have built 3 loops and all have worked equally well. For curiosities sake, a smaller version (2' diameter) using scaled-down dimensions was constructed for the BCB; the deep nulling capabilities and directional characteristics were identical to the large loop. Signal pickup on the smaller loop was reduced by several db but was still deemed satisfactory; even using the small loop was a great improvement over the outside sloper. If you don't have the room for a large loop I can highly recommend a 2 or 3 footer for the band of your choice, scaled down from the large loop.