A Low Noise Loop That Works — Plus a Bonus 2 Meter Beam

Get an HF band receive antenna and a VHF log periodic, all on one boom.

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After subscribing to our local TV channels via direct broadcast satellite, I no longer had any use for my old TV antenna. I decided that rather than discard it, in typical Amateur Radio fashion, I would make it into a ham antenna project. I was more successful than I had hoped.

This is not meant to be a typical construction article. The antenna described is basically a 2 meter beam made from an old TV antenna and a rotatable receiving loop that is similar to one half of a K9AY array (see Figure 1) mounted above ground. It performs well on 2 meter FM and is very effective as a low noise receiving antenna. The cost is next to nothing and the whole thing has a fairly low profile.

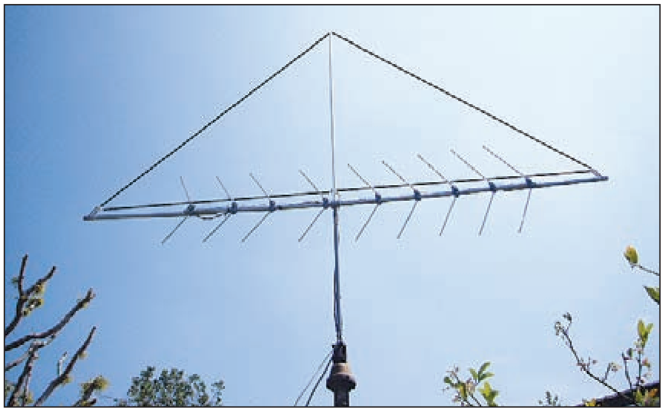

Figure 1 — Overall view of the completed 2 meter Yagi and rotatable receiving loop.

Start with What's at Hand

My TV antenna was a large RadioShack unit with VHF/UHF elements with a second support boom below the main boom. There were nine elements bent inward in typical TV antenna fashion. Other TV antennas could be modified and different mechanical arrangements could be devised to create a similar combination.

Using the log periodic design program from the 19th edition of *The ARRL Antenna Book*, the TV antenna boom length and number of elements were input as a starting point.[1] The program found the element lengths needed for a 144 to 148 MHz log periodic with an 111 inch long boom. The elements were trimmed to length (see Table 1) with an extra inch on each side for margin. I used an MFJ-259B antenna analyzer to plot the impedance of the antenna. I compared the measurements to the program results and found it was right on, so I trimmed off the extra inches.

The design program indicated a spacing for the target 2 meter antenna of about 15.7 inches between the two rear elements and 12.2 inches between the two front elements. Moving the TV antenna elements would be time consuming so I left the spacing as it was. The TV antenna generally has approximately 12.5 inches between elements 1 through 5, 17 inches between elements 5 and 6, 17 inches between elements 6 and 7 and 12.5 inches between elements 7 through 9.

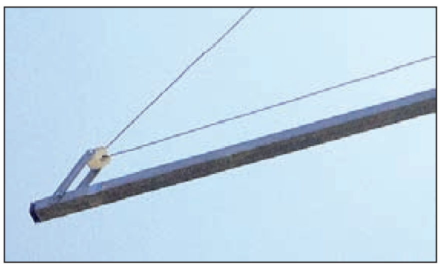

Figure 2 — Detailed view of loop end insulator.

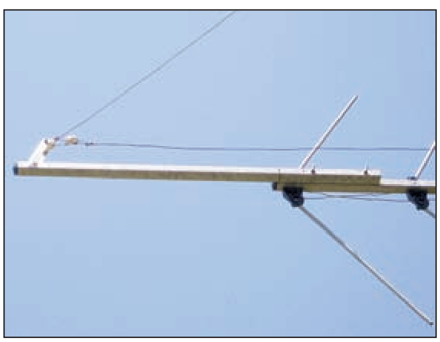

Figure 3 — Loop resistor and strain relief insulator at rear corner (see Figure 4).

Table 1

Results of *The ARRL Antenna Book* LPDA Design Program.

All dimensions in inches.

Element	*Length*	*Spacing*	*Cumulative Spacing*
1	40.180	0	0
2	38.751	15.696	15.696
3	37.372	15.138	30.834
4	36.043	14.599	45.433
5	34.761	14.080	59.513
6	33.524	13.579	73.093
7	32.332	13.096	86.189
8	31.182	12.630	98.819
9	30.072	12.181	111.000

The UHF elements and reflector screen were removed from the main boom, along with the lower support boom. The elements were turned to the vertical position for FM repeater use. There is no reason you could not leave the elements horizontal for 2 meter SSB and CW work. The front driven element of the 2 meter section is fed directly with 50 Ω RG-213 coaxial cable. No matching circuit is used and the coax is taped along the boom and back to the mast.

Adding the Loop Supports

The old lower support boom was cut in unequal parts and attached to the sides of the main boom so that there is about 87 inches from mast to tip on each side of the boom and about 86 inches for the bottom legs of the loop. The old support straps were turned up and an egg insulator was placed inside each support. See Figures 2 and 3. Mounting the extension

[1]R. D. Straw, Editor, *The ARRL Antenna Book*, 21st Edition. Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 9876. Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/sales/**; **pubsales@arrl.org**.

pieces on the side of the boom allowed for greater clearance of the receiving loop wires from the 2 meter elements.

Ten feet of ¾ inch PVC was driven two feet into the support mast to act as a vertical support for the receiving loop. A 6 foot piece of ½ inch electrical conduit was inserted to about half way down the PCV to keep it from flexing as shown in Figure 4. Just above the boom and on the mast, a small piece of clear polycarbonate is bolted through the mast to act as a center insulator. See Figure 5. The bolts also secure the mast, PVC and conduit together. Binding posts are used to secure the wires.

Installing the Loop

A piece of 10 gauge wire runs from the polycarbonate insulator on the mast, along the boom, through the boom support insulator, up through a hole in the end of the PVC, down to the other boom support insulator and back to the insulator. The wire is tensioned slightly to help support the boom.

The center of the loop base wire is fed with quad shield TV coax that was on hand, as shown in Figure 4. The best results were obtained with a 910 Ω resistor at the back corner near the 2 meter "reflector" end. The resultant pattern is nicely unidirectional, pointed the same direction as the 2 meter beam. The first configuration had the loop floating, without the coax shield grounded at the boom. With the coax grounded to the boom there was a slight improvement in the depth of the nulls and front to back ratio.

This loop is untuned and thus works on all bands without a matching transformer or tuning capacitors to foul or age. There was only a slight change in the 2 meter beam tuning after the loop was added.

Pulling it All Together

The TV antenna had a 5 foot long mast that was placed in a lightweight TV rotator mounted on a 10 foot pipe on the side of the house. It is only about 20 feet away from the Create 40 meter vertical, used as a 40, 80 and 160 meter inverted L ground plane.

The loop is just over a $\lambda/4$ wave on 40 meters. Using the receive antenna connection on my ICOM IC-756 PRO III with an Ameritron AL-80B, too much RF gets into the RX ANTENNA port on 40 meters and fouls the break-in circuit. A pair of signal diodes back to back across the RX antenna coax plug cured the problem.

2 Meter Performance

The ARRL antenna program gave an approximate gain of 8.35 dBd and front to back ratio of approximately 27 to 33 dB for a nine element log periodic on an 111 inch boom. Because of the TV antenna construction, no attempt was made to change the element spacing. The actual gain is likely

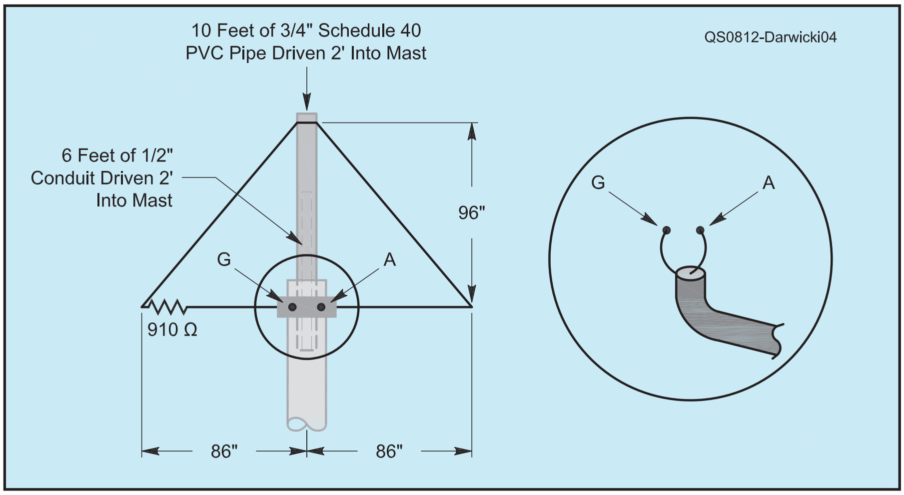

Figure 4 — Construction details of receiving loop. The resistor is adjacent to the corner insulator.

Figure 5 — Loop center insulator mounted on mast as described in text.

lower as the element spacing is 2 to 3 inches different in some sections than the program calculated. A test with a station about 20 miles away showed at least 25 dB difference as the beam was rotated 180°. No attempt was made to measure the 2 meter gain; however, several repeaters could be accessed with the beam that could not be accessed with a two stack ⅝ λ vertical at the same height. The measured SWR is about 1.2 to 1.4:1 at the band edges. Although it may not have optimal gain or F/B ratio, it is, in essence, a free 2 meter beam.

Loop Performance

There is about a 4 S unit improvement in S/N on 160 meters at this location and very noticeable directivity on local noise. The ICOM IC-756PROIII preamp is usually not needed. A small KD9SV preamp is kicked in at times on 160 meters if necessary.

The 2.5 MHz WWV signal is 4-5 S units down broadside to the loop and off the back. Noise is about 3 S units less than the ground plane. The 5 MHz WWV signal shows only about 1 S unit of directivity/null. With the same received strength, noise on the loop barely moves the meter and is S 4 on the main ground plane for 160/80/40.

There were several strange noise sources that were louder on the loop than on the ground plane, but the general ambient noise just off the noise source was louder on the ground plane. The noise source could be nulled out with the loop and overall noise is much lower.

The loop is an experimenter's dream. Using *EZNEC* antenna software, the loop pattern was shown to vary from endfire to broadside depending on the resistance value. The gain drops with added resistance, so you have to play with the value depending on how high it is mounted, frequency and other factors.

Conclusions

Generally, the loop appears to have good directivity and nulling capability on local noise and shows diminishing directivity on skywave signals as the frequency is increased. The 2 meter section has very usable gain and good front to back over the entire 2 meter band.

During the recent 9XØR operation there was an astonishing difference in signal to noise on 40 meters. The 9XØR SSB signal was barely readable on the main 40 meter ground plane, yet they were solid copy on the loop.

Rick Darwicki, N6PE, an ARRL Life Member, was first licensed in 1959 and holds an Amateur Extra class license. Rick is a Registered Mechanical Engineer. He spent most of his early career as a chief engineer designing heating, ventilating and air conditioning systems. He now specializes in due diligence for high rise buildings including fire protection, elevators and plumbing systems.

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