Two Element Lazy Looziana Loops for 15 or 20 Meters

An easy to make antenna, with good performance and the potential for a bonus (lagniappe) band.

Rick Rogers, K5RCR

My first ham radio station in 1968, as a 15 year old Novice. was set up for 15 meters. It was quite a rig, too: a 1953 vintage 50 W Elmac AF67 "Trans-citer" (transmitter-exciter) with a homebrew power supply, one crystal for 21.120 MHz and a Hammarlund HQ-150 receiver. The antenna, which my dad and I built one summer, was a "One-Element Rotary," a shortened dipole featured in the 1956 *ARRL Antenna Book*.[1] That *Antenna Book*, along with a magnificent pile of old *QST*s, came from a friend's periodic garage clean-out exercise.

My station occupied a none too comfy footprint of about 3 square feet of workbench space in our garage. It was snug, and with the summers in Los Angeles, sweltering. Yet, in the year or so that I kept this station on the air, I managed to work about 30 states and several countries. I have had a sentimental feeling toward 15 meters ever since. By the way, the antenna was still up 30 years later!

That was Then, This is Now

After many moves and many stations, I landed here in south Louisiana on rural property with few restrictions. Even so, the density of tree growth and the reptile population reduced my enthusiasm for wandering around in the woods stringing up large wire antenna arrays. I decided to go with a conventional rotator and tower arrangement. I wanted to try my hand at making a compact but effective 15 meter beam antenna to rekindle my interest in 15 meters. Even with the decline in the sunspot cycle, daytime openings on 15 are relatively common. The antenna had to be light enough to be turned by a modest rotator. However, the design should not be compromised in performance

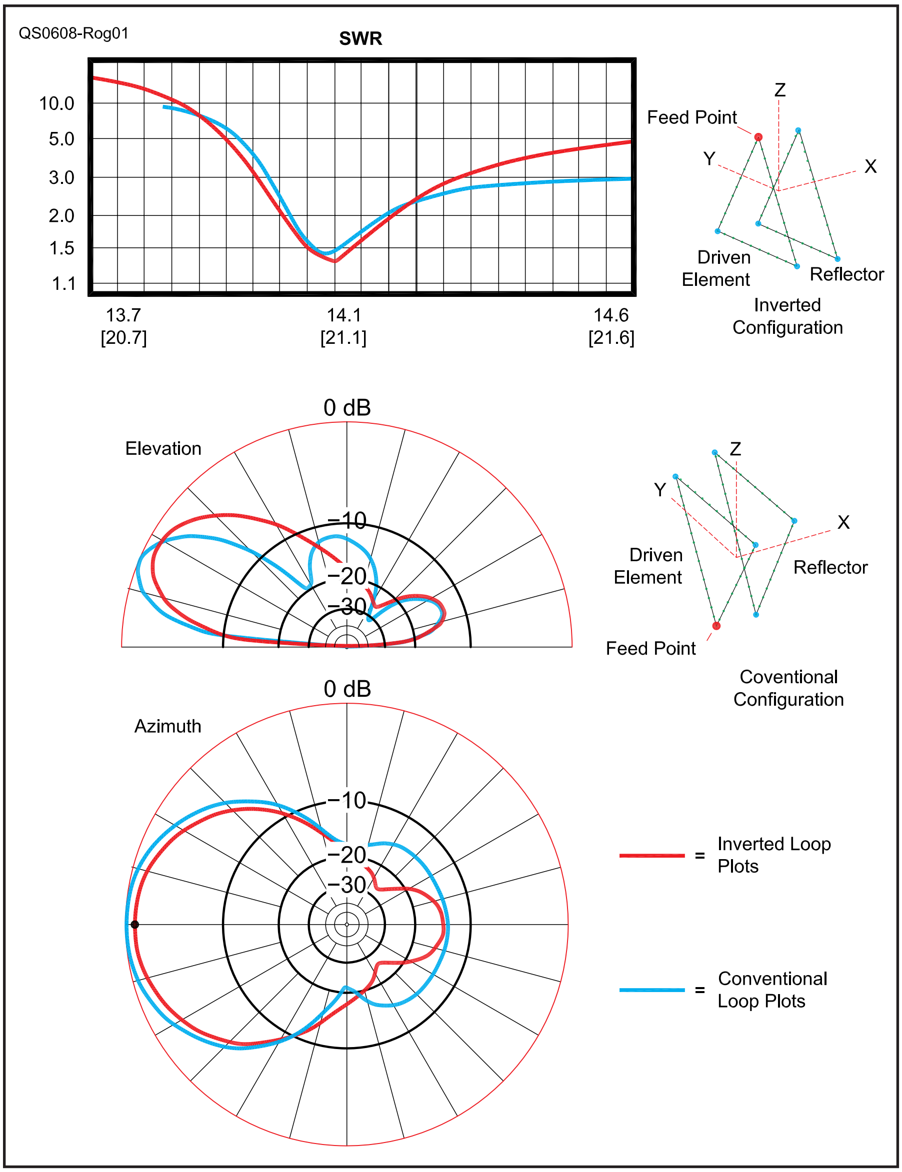

Figure 1 — Orientation, SWR and *EZNEC* model performance of two-element delta loop arrays in the conventional and inverted configuration. Both models are fed at the apex, 45 feet over "real MiniNEC" ground. SWR for either configuration [for 15 or 20 meters] are practically identical. Predicted antenna radiation patterns (20 meter version shown) are also very similar, with expected forward gains of around 10 dBi.

[1]Notes appear on page 34.

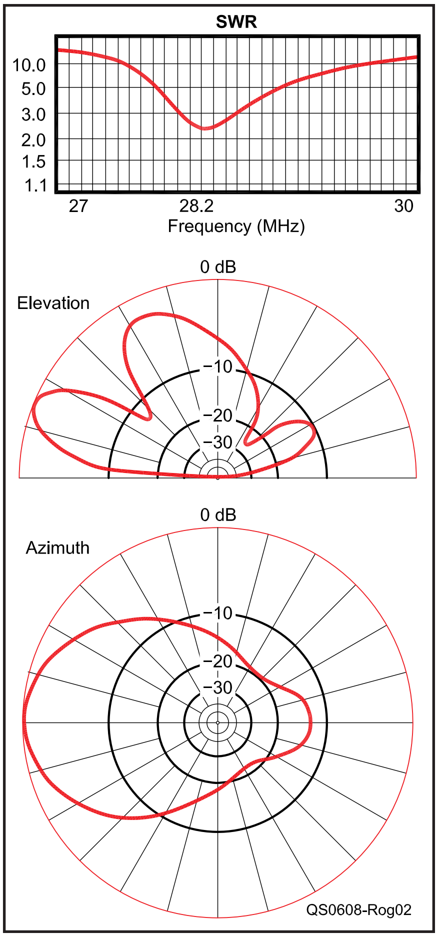

Figure 2 — *EZNEC* prediction of the performance of the 20 meter loop on 10 meters. The model predicts a forward gain of about 9 dBi with the array placed 45 feet over real ground. An antenna tuner easily allows this design to be useful on 10 meters in addition to 20.

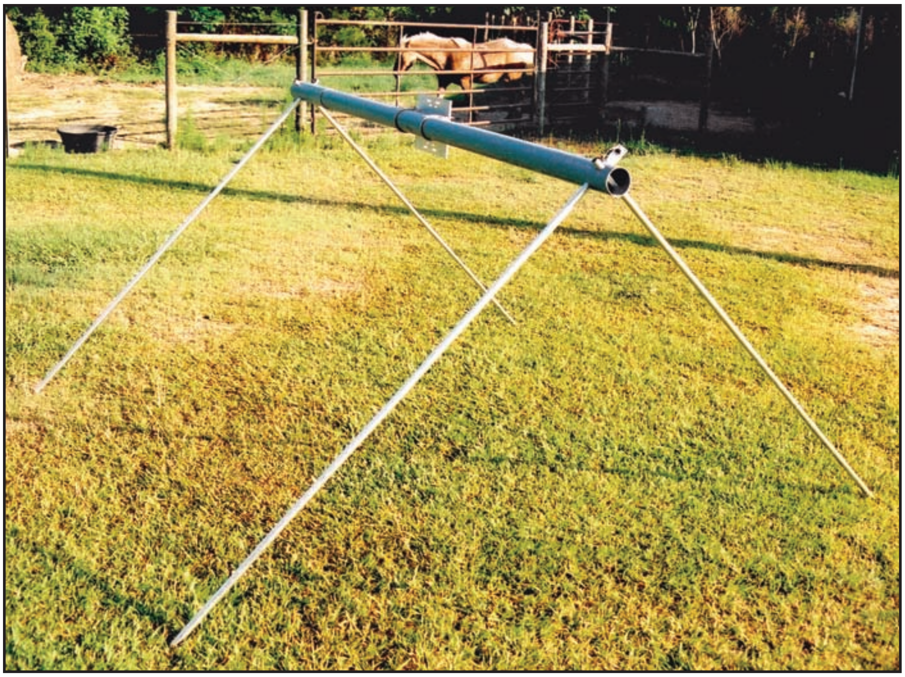

Figure 3 — V struts of aluminum tubing fixed to the boom. Buck, the wonder-pony, is indifferent. (At 40 years old, it's a wonder he's still around to be indifferent.)

by small dimensions and the power absorbing, bandwidth narrowing fixes necessary to make them resonate.

Modeling Normal and Droopy-Loops

I settled on a two element delta loop design.[2] This antenna, like the more traditional cubical quad loop with two elements, provides about the same performance as a full size, three element Yagi but with about one-half the boom length and three-quarters the "wingspan."[2,3] It is built with readily available materials. Assuming that everything must be bought new, the total cost will run about $100.

One problem with quads and delta loops in the conventional configuration, with the feed point at the apex and the base of the "delta" pointed up, is that they are awkward beasts to get onto the tower mast. So, I did an *EZNEC* study of two element delta loops in the conventional and the inverted configuration.[4] By inverted, I mean that the delta is still fed at the apex and with the feed point the same height above ground, but the base is now pointed down at the ground as shown in the title photo and in Figure 1.

The model assumed an element spacing of 0.12 λ, 6 feet at 15 meters, a driven loop length of 1.01 λ, 47 feet at 15 meters, a reflector of 1.07 λ, 49 feet at 15 meters, and a feed point 45 feet above "normal" ground. The model results of the conventional and inverted configurations were very similar. The conventional arrangement had about a 1 dB forward gain advantage and a few degrees lower take- off angle. The difference is probably not detectable with the typical ham receiver and ear. Both models presented 2:1 SWR bandwidths of around 250 kHz, as shown in Figure 1. Neither requires any special matching with the specified spacing of the reflector element.[3]

The inverted loop configuration is much easier to assemble and mount on the tower and offers a degree of inherent stability because the bulk of the antenna is *below* the rotator. This revelation convinced me that a full-size 20 meter version of the antenna would work just as well. Additionally, a 20 meter loop will be good to have around when 15 meter openings get chancier during the current sunspot cycle minimum. With a total circumference of around 70 feet, the 20 meter version would be a real challenge to assemble in the conventional way, but easy in the inverted configuration. An additional factor that would make the inverted loop a snap to install at this location is that the 35 foot Rohn tower at K5RCR has a Glen Martin Engineering Hazer trolley system. I can raise and lower experimental antennas at will without climbing the tower. I could essentially pull the inverted loop array up the tower as I built it. Of course, one could accomplish much the same thing by attaching a line to the array's boom and then pulling the antenna up the mast with a pulley attached to the top of the tower or to a ginpole.

In Louisiana, when you get something extra for nothing, the Cajuns call the bonus a *lagniappe* (pronounced *lan-yap*). There is some lagniappe in the 20 meter loop — it is also resonant on 10 meters, with an SWR of less than 3:1 between 28.0 and 28.5. This range is easy for a tuner to handle without much coax loss. According to *EZNEC*, the 20 meter loop should also produce respectable gain and directivity at 10 meters as shown in Figure 2.

Construction

Both the 15 and 20 meter antennas are built on a boom made from a piece of 3 × 10 foot lightweight PVC drain pipe (3000 pound crush rating). This pipe has one end expanded to receive another length of pipe. For either the 15 or 20 meter version, cut off 2 feet of the expanded end and save it. Cut the remaining section of pipe to a 5 foot length for the 15 meter boom, or to 7 feet for the 20 meter boom. Using a square, caliper or protractor, make four marks on the edge of each pipe-boom tube 90° apart. Extend a straight line back from the edge 4 inches from each mark. Make marks 2 and 4 inches back from the end of the boom on both sides of the tube. Drill a ⅞ inch hole for the V antenna struts centered on these marks so that the ⅞ inch aluminum tubing forms a V with the struts at the apex displaced 2 inches from each other as shown in Figure 2.

Insert the four ⅞ inch pieces of 6 foot long tubing into the holes and temporarily fit the two lengths of pipe boom together. Twist the shorter length tube until the V struts on either end of the boom line up with each other. Make some registration marks on the two pieces of pipe, pull them apart and liberally apply plastic pipe cement to the mating surfaces. Now stick the pipe boom sections together to make a big, spindly sawhorse-looking contraption as seen in Figure 3. The boom was assembled in two pieces because I found that it is almost impossible to drill holes at the ends of a 6 or 8 foot long piece of pipe that result in the V struts being parallel with one another. This way, drilling errors can be compensated for.

Drill ⅛ inch holes into the tubing on either side of the boom and put self-tapping screws in the holes to prevent the struts from creeping out of the boom. Now attach a coax feed line to the driven element Vs. There are two ways to attach coax to the array. The first is to flatten the terminal 2 inches of tubing forming the apex of the driven element at the boom. Drill a ⅝ inch hole in the middle of the flattened part and attach a coax bulkhead connector. Connect a 5 inch piece of 14 gauge wire between the center conductor of the bulkhead connector and attach it using a ring terminal and a self-tapping screw to the adjacent V strut as shown in Figure 4. Alternatively, strip 6 inches from one end of a length of RG-8 cable. Separate the shield from the center insulator and solder ring terminals to each conductor. To waterproof the cable end, cover the ring terminals with tape and then spray the assembly liberally with plastic "tool grip" such as Rustoleum "Grip and Guard." Attach a PL-259 to the other end and screw the ring terminals to the ends of one set of struts. Cut a 6 inch piece of 14 gauge wire and connect this between the ⅞ inch tubing sections at the apex of the reflector loop. Either feed line attachment method works well. Cover all connections with silicone sealant to prevent water entry and corrosion. Fit a 3 inch plastic pipe end cap over each end of the boom to give the apex of the antenna added strength as shown in Figure 5. At this point, attach the boom-to-mast plate and attach the boom to the rotator mast on the Hazer or to a cable on the gin pole.

For the 15 meter version, assemble the V struts for the driven element by adding telescoping 6 foot lengths of ¾ and ⅝ inch tubing. Total length of the driven element

Figure 4 — One method of attaching a feed line. Flattened tubing end is drilled for a coax bulkhead connector. Exposed connections are covered with silicone sealant to prevent exposure to water and corrosion.

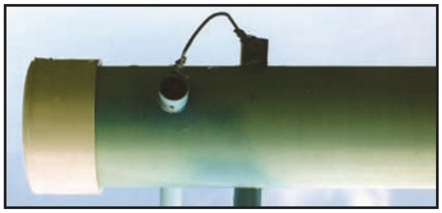

Figure 5 — Pipe cap (for 3 inch pipe) placed over the end of the boom end to stiffen the apex. Note also the tie wire between the reflector V struts.

struts are 16 feet 2 inches. For the reflector struts, the length is 16 feet 8 inches. Drill a ⅛ inch hole through the overlapping tubing sections and secure them with a self-tapping screw. To finish the loop, cut two pieces of 17 gauge aluminum fence wire 16 feet long for the driven element and 17 feet long for the reflector. Attach the wire between the ends of the V struts. The wire will be under modest, but easily manageable, tension. Assembly of the 20 meter version requires 23 foot, 4 inch struts for the driven element and 24 foot struts for the reflector. The base wire is 24 feet long for the driven and 26 feet long for the reflector. Resonant points for either antenna can be adjusted by changing the length of the base wires. It is easy to assemble this antenna by simply hoisting it up on the Hazer or the gin pole as each section is added to the struts.

Results

The 15 meter antenna showed an SWR of 1.2:1 at 21.1 MHz, almost exactly as modeled. The 20 meter version resonated at 14.085 MHz with a SWR = 1.1:1. The antennas appear to be superb performers. The antenna exhibits a front-to-back ratio of about 3 S-units and a front-to-side ratio of 5 S-units as measured on the meter of my Yaesu FT-847. The loops receive considerably better than a very good, 53 foot tall multiband vertical installed over a good ground. I have worked 33 countries in casual operating with the 15 meter antenna in just a few weekend afternoons, including VQ9LA on Chagos Island, about as far from my station as you can get without coming back around. On the first day I had the 20 meter version up, I worked all continents in about three hours. The stations included F6CTL/FO, ZF1PM, YV4GD, LZ2KV and 5Z4IA. Signal reports were uniformly excellent. I found that *lagniappe* was at work in the 20 meter loop as it loaded easily on 10 meters with a tuner and produced good contacts with South America during a brief mid-afternoon opening.

The inverted loop has proven tough in the face of some severe thunderstorms with wind gusts up to 75 miles per hour. The design is stable and easy to assemble. The approach could be extended to lower frequency bands as well. For example, a full-size 40 meter array would need a boom 17 feet long and loops with sides of about 47 feet.

Notes

[1] *The ARRL Antenna Book*, 8th Edition, Chapter 9, "Antennas for 14, 21 and 28 Mc," ARRL, 1956.

[2] R. Haviland, W4MB, *The Quad Antenna*, CQ Publications, 1993.

[3] *The ARRL Antenna Book*, 20th Edition, Chapter 12, "Quad Arrays," 2003. Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 9043. Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/shop/**; **pubsales@arrl.org**.

[4] Available from **www.eznec.com**.

Rick Rogers is a Professor of Neuroscience at the Louisiana State University, Pennington Biomedical Research Center, in Baton Rouge. He was first licensed in 1968 as WN6HGY, then WA6EZT, then N9COO, then N7GEF, then KI8GX and now K5RCR. He is well on his way to the not so coveted "licensed in all call areas" award. He can be reached at 9831 Bank St, Clinton, LA 70722 or **rogersrc@pbrc.edu**.

Feedback

◊ *Update:* Taka Shimazu, JA3KAB, has provided some updated information for those contemplating construction of his "Auto-bug Keyer with Message Memory" [May 2006, pp 36-38]. Printed circuit boards are now available from FAR Circuits at **www.farcircuits.net**. While the object file for the processor is still available by e-mail, those wishing to get a preprogrammed PIC may now obtain one directly from the author. Either send $10 and one IRC, or 10 IRCs to Taka K. Shimazu, 10-36 Kizuri 3-chome, Higashiosaka, Osaka 577-0827, Japan. A bank transfer will incur an additional $10 handling fee, while a check requires a $45 handling fee.

◊ Jim Kocsis, WA9PYH, author of "A Low-Cost Active Audio Filter for CW Reception [Jun 2006, pp 32-34], has a new e-mail address: **sadiekitty@sbcglobal.net**.

◊ Thanks to Bill, WD5IBY, for being the first to catch the Doctor's latest gaffe. In the July 2006 "Doctor" column, the radius of the Earth is about 4000 miles, not the 12,000 noted. With this correction, the car to horizon distance, with a λ/2 clearance, is 2.2 miles.